

https://dspace.org/

# Factors associated with maternal dietary practices among pregnant women attending antenatal care services in the Southern Province of Rwanda

**Uwase, Aline**

**2025**
University of the Witwatersrand, Johannesburg
https://hdl.handle.net/10539/49943

Uwase, Aline. (2025). Factors associated with maternal dietary practices among pregnant women attending antenatal care services in the Southern Province of Rwanda [Master's dissertation, University of the Witwatersrand, Johannesburg]. WIReDSpace. https://hdl.handle.net/10539/49943

Downloaded from a DSpace repository. https://dspace.org/




# Factors associated with maternal dietary practices among pregnant women attending antenatal care services in the Southern Province of Rwanda

**Thesis Submitted to the Faculty of Health Sciences, University of the Witwatersrand, in fulfilment of the requirements for the degree of Doctor of Philosophy**

**Aline Uwase**

**Student Number 2477108**

---

**2025**

**School of Public Health**

**University of the Witwatersrand, South Africa**

**This work was supervised by:**

**Prof. Jonathan Levin**

Professor, Division of Epidemiology and Biostatistics, School of Public Health, Faculty of Health Sciences, University of the Witwatersrand, South Africa

**Dr Nirvana Pillay**

Senior Researcher, School of Public Health, Faculty of Health Sciences, University of the Witwatersrand, South Africa

and

**Associate Prof. Etienne Nsereko**

Associate professor, School of Health Sciences, College of Medicine and Health Sciences, University of Rwanda, Rwanda.

## Declaration

I, Aline Uwase, declare that this thesis is my own original, unaided work. It is being submitted for the Doctor of Philosophy degree at the University of the Witwatersrand, Johannesburg, South Africa. It has not been submitted before for any degree or examination at any other University or institution. I am aware that plagiarism is prohibited, and I understand that the University of the Witwatersrand may take disciplinary measures against me if it is known that this is not my original.

Name: Aline

Surname: Uwase

Date: 04/09/2025

Signature: 

## Dedication

This thesis is dedicated to the resilient and motivated women of Rwanda, particularly those in the Southern Province, whose strength and commitment in the face of adversity illuminate a path of optimism for future generations. To the pregnant women who graciously shared their experiences, challenges, and aspirations with me throughout this research journey, your invaluable dedication to the well-being of yourselves and your unborn children has been both humbling and enlightening. To my family, whose unwavering love, support, and encouragement have been the cornerstone of my academic journey. Your confidence in my capabilities has propelled me forward, even during the most challenging moments.

# Thesis material

## Original Papers for the Thesis

For all of the provided manuscripts, Aline Uwase contributed to the study design and conceptualisation, research management, training and supervision of field workers, data collection, data analysis, drafting the manuscripts, and first authorship:

**Aline Uwase,** Etienne Nsereko, Nirvana Pillay, Levin Jonathan, Gouge Jane. Factors contributing to the dietary practices of pregnant women in Sub-Saharan African countries: a scoping review (submitted to Pan African Medical Journal).

**Aline Uwase,** Etienne Nsereko, Henriette Usanzineza, Sara Jewett, Nirvana Pillay, Levin Jonathan. Factors associated with dietary practices among pregnant women in the southern province of Rwanda: a mixed method study. (Submitted to BMC pregnancy and childbirth)

**Aline Uwase,** Etienne Nsereko, Nirvana Pillay, Levin Jonathan. Dietary diversity and associated factors among pregnant women in the Southern Province of Rwanda: A facility-based cross-sectional study (Published in PLOS One: Aline Uwase, Etienne Nsereko, Nirvana Pillay, Jonathan Levin (2024), Dietary diversity and associated factors among pregnant women in the Southern Province of Rwanda: A facility-based cross-sectional study. PLoS ONE 19(2): e0297112. https://doi.org/ 10.1371/journal.pone.0297112)

**Aline Uwase,** Etienne Nsereko, Henriette Usanzineza, Sara Jewett, Levin Jonathan, Pillay Nirvana. Healthy mothers, healthy futures: exploring the influence of healthcare providers and male partners on pregnant women's dietary practices. (Submitted to BMC Public Health)

## Conference presentations

1. **Aline Uwase**, Etienne Nsereko, Nirvana Pillay, Jonathan Levin, and Jane Goudge. *Factors contributing to dietary practices of pregnant women in sub-Saharan African countries: a scoping review*. Oral presentation at the 9th Annual Scientific Conference of the Rwanda Society of Obstetricians and Gynaecologists in Kigali December 2023.

2. **Aline Uwase**, Etienne Nsereko, Nirvana Pillay, Jonathan Levin. *The status of dietary diversity and its associated factors among pregnant women in the Southern Province of Rwanda: A facility-based cross-sectional study*. Oral presentation at the 17th Joint Annual Scientific Health Conference 2023 (JASH)**,** Entebbe, Uganda, in September 2023.

3. **Aline Uwase**, Henriette Usanzineza, Etienne Nsereko, Sara Jewett, Nirvana Pillay, Jonathan Levin. *Factors associated with dietary practices among pregnant women in the southern province of Rwanda: a mixed method study*. Accepted for poster presentation at XXIV FIGO World Congress of Gynaecology and Obstetrics held in Paris, France, in October 2023.
4. **Aline Uwase,** Etienne Nsereko, Nirvana Pillay, Jonathan Levin**.** *Dietary diversity and associated factors among pregnant women in the Southern Province of Rwanda: A facility-based cross-sectional study.* Accepted for poster presentation at Wits SPH biennial research day held at Wits University in September 2023.

## Fellowship

Consortium for Advanced Research Training in Africa (CARTA) Fellowship for PhD valued at $100,000 (2020-2024).

**Training grants**

$9,500 –Internship Grant, awarded by CARTA to support the design of the intervention model at Duke University in North Carolina, USA (six weeks residential in 2023).

## Abstract

Maternal dietary practices during pregnancy are vital for maternal and foetal health. Poor dietary practices, common in developing countries, lead to complications such as low birth weight, preterm births, and maternal morbidity. These outcomes also increase healthcare costs and economic burdens. Despite the tragic history of Rwanda that led to a major loss of resources, Rwandan government interventions, including kitchen gardens, the Girinka program where the Government gives the cow to the poor family, and antenatal care (ANC) education, aim to address these issues. In addition, the journey to motherhood is influenced by healthcare professionals in ANC services as well as the male partners considering the Rwandan nuclear family structure. However, significant gaps remain, particularly in Rwanda's Southern Province, where maternal anaemia, underweight and associated neonatal complications are highly prevalent. This study assesses dietary practices, their determinants, and the role of male partners and healthcare providers in supporting pregnant women to inform targeted interventions. In this research, I used a two-phase approach. Phase one was a scoping review guided by Arksey and O'Malley's framework, exploring literature from Sub-Saharan Africa (SSA) published from 2012 to 2022 through databases such as PubMed and CINHAL. Phase two utilized a parallel convergent mixed method study design to explore dietary diversity and dietary practices among pregnant women, as well as factors associated with dietary diversity and dietary practices. In addition, the perspectives of male partners and healthcare providers in supporting the dietary practices of pregnant women and the challenges met when providing support were explored in this phase. The scoping review identified key drivers of dietary practices, including maternal education, male partner support, food insecurity, cultural beliefs, and health system dynamics. This review also highlights the research gap in SSA because the majority of included studies were conducted in one country (Ethiopia). Quantitative findings showed that 44.1% of pregnant women achieved good dietary diversity, 40% exhibited good dietary practices, but 23% were undernourished. Key positive factors included maternal education, kitchen gardens, and dietary knowledge, while food insecurity was a major barrier. Qualitative insights highlighted the role played by supportive male partners and healthcare providers, but showed how challenges like poverty, cultural norms, limited knowledge and inadequate healthcare resources hindered effective dietary support. More than half of pregnant women in the study exhibited poor dietary practices driven by complex socioeconomic, cultural, and systemic factors. Strengthening education, addressing food insecurity, promoting male involvement, and improving healthcare infrastructure are essential for enhancing maternal nutrition and achieving better pregnancy outcomes in Rwanda. Collaborative efforts

among stakeholders are critical to addressing these challenges and improving maternal and neonatal health.

**Keywords**: *Pregnant women, expectant mothers, Rwanda, Dietary practices, nutritional practices, dietary habits, dietary behaviours, nutritional behaviours*

## Acknowledgement

Completing this PhD thesis has been a journey filled with challenges, learning, and growth. I am deeply grateful to all those who have supported and guided me along the way. I express my deepest gratitude to the Almighty God for granting me strength, resilience, and guidance throughout this journey. You have been a source of solace and inspiration, guiding me through the challenges and triumphs of this academic pursuit.

I sincerely thank the Wits School of Public Health for admitting me into their esteemed institution. Your commitment to academic excellence and dedication to nurturing the next generation of public health leaders have shaped my academic journey. I am profoundly grateful to the University of Rwanda for granting me study leave and providing me with the opportunity to pursue further education. Your support and encouragement have been pivotal in enabling me to embark on this transformative journey.

I want to express my heartfelt gratitude to my primary supervisor, Prof Jonathan Levin; your expertise in statistical analysis, particularly in biostatistics and the STATA software, has been instrumental in shaping the quantitative aspect of this research. I am immensely grateful for your patience, dedication, and comprehensive guidance from importing data, cleaning, analysing, and exporting to interpreting results. Your meticulous attention to detail and comprehensive feedback on written pieces of information taught me the importance of honesty and integrity in research. Your mentorship has enriched my academic journey and inspired me to strive for excellence in all aspects of my work.

I want to extend my sincere appreciation to Dr Nirvana Pillay, whose expertise in qualitative research has been invaluable in navigating the complexities of data coding and analysis. Your guidance and support have been instrumental in developing my skills in scientific writing and critical thinking. I am grateful for your patience and encouragement, which remind me that qualitative research takes time and dedication. Your mentorship has been a beacon of light, guiding me through the challenges of this research journey.

I am also deeply indebted to Prof Etienne Nsereko, whose expertise in maternal health and valuable support have been a constant source of inspiration since my days as a bachelor's and master's student. Your guidance, encouragement, and invaluable insights have shaped the trajectory of my research and academic pursuits. I am grateful for your mentorship and the invaluable lessons you have imparted to me throughout this journey.

I extend my heartfelt gratitude to the Consortium for Advanced Research Training in Africa (CARTA) for sponsoring my PhD studies. Your generous support, mentorship, and invaluable resources have facilitated my academic and professional development. I deeply appreciate the opportunities afforded to me through CARTA, which have enriched my learning experience and broadened my horizons.

I want to acknowledge my fellow CARTA fellows. Your camaraderie, support, and shared experiences have been a source of encouragement and inspiration. I appreciate the friendships forged and the collective journey we have embarked upon together.

Mainly, I am especially grateful to Mrs Aneth Kalinjuma and Mrs Maureen Majamanda, whose constant check-ins and words of encouragement provided much-needed support during challenging times. Your kindness and friendship have been a source of strength and motivation throughout this journey. I want to acknowledge Mrs Alice Muhayimana and Mr Emmanuel Nzabonimana, with whom I shared the experience of travelling from Rwanda to South Africa to work on different aspects of PhD thesis and with whom I shared countless hours of planning and camaraderie. Your friendship and shared experiences have made this journey all the more memorable and rewarding.

My deepest gratitude goes to my husband, whose unwavering love, support, and understanding have sustained me through the ups and downs of this journey. Your presence, encouragement, and sacrifices have been the bedrock of my success. I am grateful for your unwavering support and for always ensuring that I did not miss anything, providing emotional support, and taking care of household responsibilities when I was engrossed in my studies.

I sincerely appreciate my parents and sisters for their unwavering love, support, and encouragement throughout this journey. Your belief in me has been a constant source of strength and inspiration, and I am forever grateful for your unwavering support.

Last but certainly not least, my sincere appreciation goes to the dedicated data collectors and study participants who generously contributed their time, insights, and experiences to this research endeavour. Your invaluable contributions have enriched the findings of this study and have the potential to impact maternal health outcomes positively.

# Table of Contents

**Declaration** ..... iii
**Dedication** ..... iv
**Thesis material** ..... v
Original Papers for the Thesis ..... v
Conference presentations ..... v
Fellowship ..... vi
**Abstract** ..... vii
**Acknowledgement** ..... ix
**Table of Contents** ..... xi
**List of tables** ..... xvi
**List of figures** ..... xvii
**List of abbreviations** ..... xviii
**The structure of the thesis** ..... xx
SECTION A ..... 1
**Chapter one: Introduction** ..... 1
1.1. Definition of Key Concepts ..... 1
1.2. Background ..... 3
1.3 . Trends of Maternal and Neonatal Health in Rwanda ..... 6
1.4. The Healthcare System in Rwanda ..... 7
1.5. Rwanda Family Structure ..... 10
1.6 Studying Maternal Dietary Practices within the Rwandan Food and Family Context ..... 11
1.7. Conceptual Framework ..... 12
1.8. Summary ..... 15
**Chapter two: Literature review** ..... 16
2.1 Importance of Maternal Dietary Practices During Pregnancy ..... 16
2.2 Good Dietary and Health Practices during Pregnancy ..... 18
2.2.1 Meal frequency ..... 18
2.2.2 Avoid skipping meals ..... 19
2.2.3 Avoid smoking and drinking alcohol. ..... 19
2.2.4 Adequate rest ..... 19
2.2.5 Dietary diversity ..... 20
2.3 Effects of Poor Dietary Practices on Maternal Health ..... 20

2.4 Effects of Inadequate Dietary Practices on the Foetus and Infant ..... 21
2.5 Factors Influencing Maternal Dietary Practices ..... 22
2.5.1 Intrapersonal level ..... 22
2.5.2 Interpersonal level ..... 24
2.5.3 Community level ..... 25
2.5.4 Organisation level ..... 26
2.5.5 Structural level ..... 27
2.6 . Evidence about Dietary Practices and Associated Factors ..... 29
2.7 Problem Statement ..... 31
2.8 Research Gap ..... 33
2.9 . Justification of the Study ..... 34
**2.10** Philosophical Foundation ..... 34
2.11 Primary Research Question ..... 36
2.12 Study Aim ..... 36
2.13 Specific Research Objectives ..... 36
2.14 Summary ..... 37
**Chapter three: Methods** ..... 38
3.1 Study Setting ..... 38
3.2. Study Design ..... 40
3.3. Study Participants ..... 43
3.3.1. Sample size ..... 44
3.3.2. Sampling method ..... 45
3.4. Data Collection and Tools ..... 45
3.5. Data Management and Analysis ..... 48
3.6. Quality Measures for Quantitative Survey ..... 49
3.7. The Research Team and Reflexivity ..... 49
3.8. Ethical consideration ..... 50
SECTION B: RESULTS ..... 51
**Chapter four: Factors contributing to the dietary practices of pregnant women in Sub-Saharan African countries: a scoping review.** ..... 53
4.1. Abstract ..... 53
4.2. Introduction ..... 53
4.3. Methods ..... 55
4.3.1. Identifying relevant studies ..... 55
4.3.2. Selection of relevant studies: Screening ..... 56
4.3.3. Charting the data ..... 56

4.3.4. Collating, summarising, and reporting the data ..... 57
4.4. Results ..... 57
4.4.1. Characteristics of the selected articles ..... 57
4.4.2. Key findings ..... 58
4.5. Discussion ..... 62
4.6. Policy and Practice Implications ..... 66
4.7. Conclusion ..... 67
**Chapter five: Factors associated with dietary practices among pregnant women in the southern province of Rwanda: a mixed method study** ..... 68
5.1. Abstract ..... 68
5.2. Introduction ..... 69
5.3. Conceptual framework ..... 70
5.4. Methods ..... 71
5.4.1. Study setting ..... 71
5.4.2. Study design and population ..... 71
5.4.3. Sampling procedure ..... 72
5.4.4. Sample size determination ..... 72
5.4.5. Data collection process and quality assurance ..... 72
5.5. Measurement of study variables ..... 73
5.5.1. Outcome variable ..... 73
5.5.2. Explanatory variables ..... 73
5.6. Data processing and analysis ..... 74
5.7. The qualitative research team and reflexivity ..... 75
5.8. Results ..... 76
5.8.1. Sociodemographic and obstetric profile of the study participants ..... 76
5.8.2. Distribution of dietary practice score ..... 79
5.8.3. Dietary and health practices among the study participants ..... 79
5.8.4. Factors associated with dietary practices of pregnant women ..... 81
5.9. Qualitative findings ..... 84
5.9.1. Characteristics of participants in the qualitative study ..... 84
5.9.2. Changes in dietary practices ..... 85
5.9.3. Barriers to good dietary practices ..... 85
5.9.4. Enablers of good dietary practices ..... 86
5.10 Enablers and barriers to Good Dietary Practices among Pregnant Women Using the Socio-Ecological Model ..... 88
5.11. Recommendations to improve dietary practices ..... 89

5.12. Discussion ..... 89
5.13. Strengths and limitations ..... 93
5.14. Conclusion ..... 93
5.15. Recommendations ..... 94
**Chapter six: Dietary diversity and associated factors among pregnant women in the Southern Province of Rwanda: A facility-based cross-sectional study** ..... 95
6.1. Abstract ..... 96
6.2. Introduction ..... 97
6.3. Methods and Materials ..... 98
6.3.1. Study design and setting ..... 98
6.3.2. Study population, sample size determination and sampling procedure ..... 99
6.3.3. Data collection process ..... 100
6.3.4. Measurement of study variables ..... 100
6.3.5. Data processing and analyses ..... 102
6.3.6. Ethics approval and consent to participate ..... 103
6.4. Results ..... 103
6.4.1. Sociodemographic, economic, and obstetric characteristics of participants ..... 103
6.4.2. Dietary diversity of pregnant women ..... 106
6.4.3. Nutritional status and dietary diversity of pregnant women in the Southern Province 107
6.4.4. Determinants of dietary diversity of pregnant women in the Southern Province of Rwanda 108
6.5. Discussion ..... 109
6.6. Policy and Practice Implications ..... 113
6.7. Limitations ..... 113
6.8. Conclusion ..... 113
**Chapter seven: Healthy mothers, healthy futures: Exploring the influence of healthcare providers and male partners on pregnant 'women's dietary practices** ..... 115
7.1. Abstract ..... 115
7.2 Introduction ..... 116
7.3 Methods and materials ..... 118
7.3.1. Study setting ..... 118
7.3.2. Study design and population ..... 118
7.3.3. Data collection process ..... 118
7.3.4. Data analysis ..... 119
7.4 Results ..... 119
7.4.1. Modalities of Support for Dietary Practices of Pregnant Women ..... 120

7.4.1.1. Emotional and educational supports ..... 120
7.4.1.2. Material support ..... 121
7.4.2. Barriers to effective support of dietary practices of pregnant women ..... 122
7.4.2.1. Limited Knowledge about good dietary practices ..... 122
7.4.2.2. Socioeconomic constraints to good dietary practices ..... 122
7.4.2.3. Gender, cultural norms and beliefs affect dietary practices ..... 123
7.4.2.4. Healthcare system challenges ..... 124
7.4.3 Strategies to improve maternal dietary practices ..... 125
7.4.3.1. Enhancing the health system ..... 125
7.4.3.2. Enhancing male partners' involvement ..... 125
7.4.3.3. Addressing Socioeconomic Barriers ..... 126
7.5. Discussion ..... 126
7.5.1. Household and community level ..... 126
7.5.2. Health System ..... 127
7.5.3. National policy and strategies ..... 129
7.6. Strengths and Limitations to the study ..... 129
7.7. Conclusion ..... 130
7.8. Implications for policy and practice ..... 130
**SECTION C** ..... 131
Chapter Eight: Integrated Discussion ..... 131
8.1. Introduction ..... 131
8.2. Prevalence and Implications of Poor Dietary Practices ..... 131
8.3. Implications of limited nutritional knowledge ..... 132
8.4. Implications of food insecurity ..... 134
8.5. Implications of owning a radio ..... 134
8.6. Socioecological Model SEM and factors associated with dietary practices ..... 135
8.7 Integration of Quantitative and qualitative findings ..... 136
8.8 Methodological Rigor and Contributions ..... 138
8.9 Knowledge contribution ..... 138
8.10 Strengths and limitations ..... 139
Chapter nine: Conclusion and Recommendations ..... 141
9.1. Conclusion ..... 141
9.2. Recommendations ..... 141
9.2.1. Recommendations for policy and practice ..... 141
9.2.2. Recommendations for research ..... 144
References ..... 146

Appendix 1. Declaration authors-co-authors agreement ..... 177
Appendix 2. Ethical clearances ..... 179
Appendix 3: Approval of the study by the Ministry of Health ..... 181
Appendix 4: Approval of the study by Rwanda Biomedical Centre ..... 182
Appendix 5: Approval of PhD thesis title ..... 183
Appendix 6: Approval of change of the PhD thesis title ..... 184
Appendix 7: Information sheets and consent forms (English version) ..... 185
Appendix 8: Information sheets and consent forms (Kinyarwanda version) ..... 196
Appendix 9 : Questionnaire for Quantitative Survey (English version) ..... 207
Appendix 10 : Questionnaire for Quantitative Survey (Kinyarwanda version) ..... 215
Appendix 11: Interview and Focus group discussion guides (English versions) ..... 227
Appendix 12: Interview and Focus group discussion guides (Kinyarwanda version) ..... 232
Appendix 13: Original paperPaper1 ..... 237
Appendix 14: Similarity report ..... 250
Appendix 15: Editing certificate ..... 252

## List of tables

Table 3.1: Summary of the 'study's phases and participants ..... 42
Table 3.2: Qualitative sample ..... 44
Table 5.1: Sociodemographic and obstetric characteristics of participants ..... 77
Table 5.2: Dietary and health practices among pregnant women ..... 80
Table 5.3: Factors associated with good dietary practices ..... 82
Table 5.4:Characteristics of the qualitative sample ..... 84
Table 5.5: Summary of enablers and barriers to good dietary practices ..... 89
Table 6.1: Sociodemographic, economic, and obstetric characteristics of participants ..... 104
Table 6.2:Dietary Diversity of pregnant Women ..... 106
Table 6.3: Nutritional Status and Dietary Diversity. ..... 107
Table 6.4: Determinants of Dietary Diversity of Pregnant Women in the Southern Province of Rwanda ..... 108
Table 8.1: Specific objectives and corresponding articles ..... 131

# List of figures

Figure 1.1: The healthcare system in Rwanda (adapted: The Ministry of Health) ..... 9
Figure 1.2: Socioecological model framework [Adapted: Mcleroy (1988)] ……. . 13
Figure 1.3: Integration of the socioecological model in study phases. (Created: author) ..... 15
Figure 3.1: Map of Rwanda (Source maps Rwanda)..... 38
Figure 3.2: Map of the southern Province of Rwanda. (Source: www.southernprovince.gov.rw)... 39
Figure 3.3: Overview of the study design (created by author) ……..41
Figure 4.1: PRISMA flow diagram of the study selection process. ..... 57
Figure 5.1: Socioecological framework adapted from McLeroy et al. (1988)..... 71
Figure 5.2: Distribution of dietary practice scores ..... 79
Figure 9.1:Suggested multilevel intervention (created by author)..... 144

## List of abbreviations

| | |
|---|---|
| **ANC** | Antenatal Care |
| **BMI** | Body Mass Index |
| **CHW**s | Community Health Workers |
| **DOHaD** | Developmental Origins of Health and Disease |
| **DRC** | Democratic Republic of the Congo |
| **EM** | Ecological Model |
| **FAO** | Food and Agriculture Organisation |
| **FGD** | Focus Group Discussions |
| **GWG** | Gestational Weight Gain |
| **HCP** | Health Care Providers |
| **HFIAS** | Household Food Insecurity Access Scale |
| **IDI** | In-Depth Interviews |
| **IFA** | Iron and Folic Acid |
| **IOM** | Institute of Medicine |
| **IUGR** | Intrauterine Growth Retardation |
| **KII** | Key Informants' Interviews |
| **LBW** | Low Birth Weight |
| **LGA** | Large-For-Gestational-Age |
| **LMIC** | Low- and Middle-Income Countries |
| **MDD-W** | Minimum Dietary Diversity for Women |
| **MDG** | Millennium Development Goal |
| **MMR** | Maternal Mortality Ratio |
| **MOH** | Ministry of Health |
| **MSSS** | Maternity Social Support Scale |
| **MUAC** | Mid-Upper Arm Circumference |
| **NCD** | Non-Communicable Disease |
| **NISR** | National Institute of Statistics of Rwanda |
| **PBF** | Performance-Based Funding |
| **PI** | Principal Investigator |
| **PCC** | Population Concept Context |
| **PICO** | Population, Intervention, Comparison, Outcome |

| | |
|---|---|
| **PTB** | Preterm births |
| **RDHS** | Rwanda Demographic and Health Survey |
| **SDG** | Sustainable Development Goals |
| **SGA** | Small-For-Gestational-Age |
| **SSA** | Sub-Saharan Africa |
| **WHO** | World Health Organization |

## The structure of the thesis

This doctoral thesis applied the divided block format and is organized into nine chapters divided into the following three sections:

### SECTION A

This section is made up of three chapters: Introduction, Literature Review, and Methods. The introduction includes definitions of key concepts used in the thesis, including maternal dietary practices, dietary diversity, nutritional knowledge and male partners. Following this, the chapter explores the Rwandan health system by detailing its structure and maternal health programs. It also examines the socio-cultural context by describing the structure of the Rwandan family, including gender roles and community influences that affect dietary practices. Additionally, it reviews trends in maternal health in Rwanda, highlighting key indicators such as maternal mortality rates, nutritional status, improvements in maternal health to date, and the gaps to bridge.

The second chapter which includes the literature review, discusses the concept and theoretical underpinnings of dietary practices, emphasizing their significance in shaping both maternal and foetal health outcomes. It also includes a critical examination of the global and regional prevalence of maternal malnutrition, thereby establishing a robust foundation for understanding the pressing need to investigate dietary practices among pregnant women within this specific geographical context. In addition, it explores the factors associated with dietary practices. The chapter outlines the general research question, general and specific objectives, problem statement, research gap, conceptual framework and justification of the study. The third chapter includes the research methods and describes the geographical context of the Southern Province of Rwanda, study design, data collection methods, research instruments, data analysis methods, and ethical considerations.

### SECTION B

The results section describes the study findings. They are presented in manuscript format from chapters four to seven and include published and unpublished manuscripts.

## SECTION C

This section has two chapters: Chapter eight presents the integrated discussion of the findings and analysis from this study, and Chapter nine includes the conclusion and recommendations from this study.

# SECTION A

## Chapter one: Introduction

This introduction chapter defines the key concepts utilized in the thesis. It then provides background information and an overview of the Rwandan health system and socio-cultural context, including the Rwandan family structure. Furthermore, it reviews maternal health trends in Rwanda.

### 1.1. Definition of Key Concepts

*Health practices:* Health practices during pregnancy go beyond diet and involve appropriate physical activity, sufficient rest, and avoiding harmful substances. Moderate physical exercises may improve circulation, relieve stress, and prepare the body for labour and delivery. Additionally, avoiding harmful substances such as tobacco is important for preventing adverse pregnancy and health outcomes. Adequate rest and sleep are essential to support the increased physical demands of pregnancy and to ensure the mother's general well-being. The implementation of comprehensive health practices is crucial for promoting a healthy pregnancy. To facilitate positive pregnancy experiences, the WHO advises healthcare providers to educate pregnant women regarding the significance of physical activity and the avoidance of smoking (1–3).

*Dietary diversity:* Dietary diversity is defined as the 'number of food types consumed through and within food groups during a specified period' (1). It is frequently reported as a proxy indicator of diet quality and can be summarized using the number of food groups consumed during the previous 24 hours (2). Dietary diversity promotes good health by preventing micronutrient deficiencies (3). The Food and Agriculture Organisation (FAO) has developed a guide to assess pregnant women's dietary diversity called "Minimum Dietary Diversity for Women" MDD-W (4). This MDD-W categorises the food a pregnant woman should consume into ten groups: 1) Grains, white roots and tubers, and plantains 2) Pulses (beans, peas and lentils) 3) Nuts and seeds 4) Dairy 5) Meat, poultry and fish 6) Eggs 7) Dark green leafy vegetables 8) Other vitamin A-rich fruits and vegetables 9) Other vegetables 10) Other fruits. The minimum acceptable dietary diversity for pregnant women is consuming at least five of the ten food groups. In this thesis, I use this MDD-W tool to evaluate the dietary diversity of pregnant women.

*Dietary practices:* Dietary practices are defined as the observable actions or behaviours of individuals or groups of people concerning food consumption, food choices and eating habits, which can be good or poor dietary practices (5). Sound dietary practices mean consuming the right types of food at the right time, quality, and quantity. The Institute of Medicine (IOM) recommends that pregnant women consume three main meals and two or more snacks per day to ensure continuous nutrient delivery to the foetus (6). In addition, the World Health Organization (WHO) recommends that pregnant women consume a variety of different food groups (7). Similarly, WHO recommends that healthcare providers educate pregnant women about consuming micronutrient supplements such as oral iron and folic acid (IFA), avoiding drinking alcohol and consuming too much coffee (more than 300mg of coffee per day) (8–10). Such recommendations are made because dietary practices directly influence the intake of essential nutrients necessary for maternal and foetal health. In this thesis, I assess dietary practices, which include dietary diversity, meal frequency, skipping meals, taking snacks, consuming IFA and drinking alcohol, and practices such as smoking and bed rest.

*Nutritional knowledge*: Maternal nutritional knowledge refers to the information, understanding and awareness of pregnant women concerning various aspects of nutrition relevant to maternal and child health (11). This knowledge may include dietary requirements during pregnancy, the role of consuming a diverse and balanced diet, nutrient needs for foetal and infant development and appropriate weight gain during pregnancy. This includes understanding the risks of poor nutrition during pregnancy, like micronutrient deficiencies. Adequate nutritional knowledge empowers pregnant women to make informed dietary decisions, facilitating the adoption of healthy dietary practices and lifestyle behaviours when other necessary conditions are met (12). The association between nutritional knowledge and dietary practices is mutual and synergistic. As individuals gain and apply nutritional knowledge to their daily food choices, they can better embrace and sustain healthy dietary practices. I used the knowledge and attitude assessment tool developed by FAO to assess the knowledge of pregnant women in this study.

*Maternal nutritional status*: Maternal nutritional status refers to the physiological condition of pregnant women concerning biochemical markers, nutrient stores, and anthropometric measurements (12). It involves body mass index (BMI), body weight, micronutrient levels, and overall health status. Undernutrition and overnutrition are critical aspects of nutritional status that affect health differently. Undernutrition is characterised by insufficient intake of calories, protein, and essential vitamins and minerals, leading to conditions such as low body weight,

anaemia, stunted growth and weakened immune function, which increases the susceptibility to infections (13). On the other hand, overnutrition includes a high intake of calories and nutrients, which is linked to obesity, metabolic syndrome, type 2 diabetes and cardiovascular disease (14). These extremes of nutritional status have severe consequences, highlighting the role of balanced nutrition in maintaining overall health.

The connection between dietary practices and nutritional status is bidirectional and dynamic. Dietary practices are essential in determining the nutritional status of pregnant women, as they directly impact the quality and quantity of nutrients available to affect maternal health and foetal development. On the other hand, maternal nutritional status can affect dietary practices by influencing appetite, food preferences, and nutrient requirements during pregnancy (15). Thus, encouraging good dietary practices, improving nutritional knowledge, and ensuring optimal maternal nutritional status are fundamental mechanisms that can be used by maternal and child health programs aiming to improve pregnancy outcomes and reduce maternal mortality and morbidity.

*Male partners:* Male partners, encompassing roles such as husbands, boyfriends, or long-term companions, are significant figures in women's lives. These relationships contribute to emotional and social well-being, offering companionship, support, and collaborative partnerships across various life domains (17). Their involvement can significantly influence a woman's well-being, affecting her mental, emotional, and physical health through their support, understanding, and shared responsibilities.

Male partners frequently assume significant roles in daily life's practicalities, which includes sharing household responsibilities, contributing to financial security, and participating in decision-making processes. In many cultural and social contexts, the dynamics of these partnerships can reflect broader societal norms and expectations regarding gender roles and equality (16). Effective communication, mutual respect, and shared values are essential for maintaining healthy and supportive relationships.

## 1.2. Background

Pregnancy is a critical period that requires optimal nutrition to meet maternal and infant physiological demands (17). Good dietary practices are the main pathway to meeting the nutritional demands of pregnant women and their foetuses (18). Conversely, suboptimal

maternal dietary intake during pregnancy can result in maternal malnutrition, a condition with a disproportionately high prevalence in low and middle income countries (19).

Maternal malnutrition includes women who suffer from anaemia, are underweight, and are overweight. Worldwide, around 170 million women (9.1%) are underweight, whereas an estimated 610 million (32.5%) are overweight (19). Globally, the average body mass index (BMI) in women is 24.4 kg/m², showing the trend of increasing overweight in women (20). However, in Sub-Saharan Africa and South Asia, maternal underweight is widespread, and women with limited incomes are the most affected (21). In this region, the prevalence of being underweight during pregnancy is 10.4% for rural and 6% for urban women. Women of reproductive age often enter pregnancy already undernourished and cannot cope with the additional nutrient demand caused by pregnancy, and then they fall into severe nutrition deficiency (22).

Multiple micronutrient deficiencies, including Vitamin A, Vitamin D, calcium, iodine, and zinc among pregnant women, are rising in African countries. A study that analysed micronutrient deficiency in some African countries reported that zinc deficiency was 56% for Ethiopia, 70% for Kenya, and 46% for Nigeria (23). In addition, in Côte d'Ivoire in West Africa, most women of reproductive age, including pregnant women, are deficient in folate (86%) (24).

Globally, an estimated 32 million (36.5%) pregnant women are anaemic, but regions of Africa and Southeast Asia still count for high prevalence of anaemia (24). Evidence from South Africa showed that the prevalence of anaemia in pregnancy ranged from 29.0 to 42.7 %: 76.7% in Pakistan, 71% in Guinea, 50.1% in Ethiopia and 53% in Sudan (25)(26). In Rwanda, anaemia, which is among nutrition indicators, increased from 17% in 2010 to 25% in 2020 among pregnant women. (National Institute of Statistics of Rwanda (NISR) [Rwanda], Ministry of Health (MOH) [Rwanda], 2020), and the Southern province has a high prevalence.

This situation must be addressed because undernutrition during pregnancy leads to low gestational weight gain (GWG) and poor pregnancy outcomes such as low birth weight (LBW) and preterm births (PTBs) (28). Most of the cases of both LBW and PTB occur in low- and middle-income countries, increasing the neonatal and infant mortality rate in this particular region (29). Therefore, it is necessary to identify its root causes to help prevent undernutrition during pregnancy and associated complications.

Determinants of undernutrition among pregnant women include poor dietary practices. Such practices include but are not limited to inadequate dietary diversity and unhealthy dietary behaviours such as skipping meals, eating less than three meals a day, drinking alcohol and non-consumption of micronutrient supplements like iron and folic acid (IFA) (30). However, most pregnant women in developing countries exhibit unhealthy dietary behaviours and do not comply with recommended dietary allowances (31). In particular, the diets of African and Asian pregnant women are mainly cereal-based, with less consumption of animal-source foods, vegetables, and fruits (32). Research conducted in Northwest Ethiopia revealed that a substantial proportion of pregnant women, estimated at 80.1%, exhibited poor dietary practices (32).

Dietary practices are influenced by multiple factors combining both the individual and her surroundings (33). Evidence from Ethiopia showed that the dietary practices of pregnant women were influenced by nutritional knowledge, maternal education level, and monthly income (34). A study conducted in Nigeria reported that maternal age, parity and husband support were associated with dietary practices (35). Moreover, a study conducted in Ghana revealed that cultural beliefs and food taboos were among the potential drivers of dietary practices (36). In Asia, the dietary practices of pregnant women are mainly influenced by traditional medical theories and cultural beliefs surrounding pregnancy (37).

Rwanda, an East African country, has significantly improved maternal and child health. However, underweight among pregnant women is persistent (9%), and the prevalence of anaemia steadily increased from 17% in 2010 to 25% in 2020 (38); the Southern Province accounts for the highest prevalence of anaemic and underweight pregnant women. Despite the persistence of poor nutrition among pregnant women in the south of the province, little is known about maternal dietary practices and their influencing factors.

Given the global and regional burden of maternal malnutrition discussed above, it is important to examine how maternal health indicators have evolved in Rwanda over time. Understanding these trends provides critical context for the current state of maternal nutrition and the urgency of addressing dietary practices during pregnancy.

## 1.3. Trends of Maternal and Neonatal Health in Rwanda

Rwanda is one of the countries where the implementation of several maternal interventions has improved significantly during the Millennium Development Goals (MDG) era (51). Even though the 1994 genocide devastated Rwanda's health system, efforts were made to rebuild it, which contributed to the country's achievement of MDG 5 of reducing the maternal mortality ratio by three-quarters (52,53). From 1990 to 2015, the country observed significant advances. The under-five mortality rate was decreased by more than half because of the expanded immunization programs, enhanced access to healthcare, and improved maternal care practices.

The maternal death rate has also decreased significantly because of increased numbers of competent birth attendants and greater access to emergency obstetric treatments. As the attention moved to the Sustainable Development Goals (SDG) in 2015, Rwanda progressed with SDG 3, which aims to ensure healthy lives and promote well-being for all ages. To achieve this, the interventions implemented include advanced care involving the management of severe complications related to the pregnancy, increasing the training and presence of specialists, strengthening the process and the training of midwives in providing timely and quality healthcare, improving infrastructure, enhancing interdisciplinary collaboration and access to a critical high dependency unit in the maternity ward (54,55). In addition, different policies and guidelines were set to improve maternal health. These involve antenatal care (ANC), which recommends that pregnant women attend at least four ANC visits, the first visit taking place within the first trimester (56).

Implementing a community-based health insurance system helped reduce the barriers to healthcare access while transforming health-seeking behaviours. The introduction of performance-based funding (PBF) programs enhanced the provision of high-quality health services. The utilization of community health workers significantly contributed to health care delivery, particularly in the short supply of health workers (57).

While Rwanda reduced its maternal mortality ratio (MMR) from 750 to 210 deaths per 100,000 live births between 2005 and 2015, the MMR remained stable in the following five-year period, falling from 210 to 203 deaths per 100,000 live births (59,60). This is still about three times higher than the global maternal mortality ratio (MMR) goal set out in the SDGs, which targets reducing maternal mortality to less than 70 deaths per 100,000 live births (58). The leading causes of maternal mortality include sepsis, haemorrhage, hypertensive preeclampsia and

unsafe abortion (59). In addition, anaemia among pregnant women increased from 17 to 25% in 2010-2020, and underweight by body mass index remained constant at 9% (60).

Dietary practices could indirectly contribute to the high maternal mortality rate in different ways. For example, poor dietary practices may lead to deficiencies in essential nutrients like vitamins and minerals, which are crucial for immune function. This increases the risk of infections during pregnancy, including those that can lead to sepsis if left untreated. Deficiencies in iron and vitamin K can increase the risk of excessive bleeding during childbirth. They can lead to weak blood clotting mechanisms, making pregnant women more vulnerable to postpartum haemorrhage. In addition, anaemia reduces the oxygen-carrying capacity of the blood, which can result in maternal fatigue, increased risk of infections, and complications during childbirth, such as haemorrhage. Constant levels of underweight among pregnant women, estimated at 9%, are critical because underweight women may have depleted nutrient stores, exposing them to obstetric complications such as haemorrhage and infections, thereby contributing to maternal mortality. Insufficient intake of nutrients like calcium, magnesium, and potassium may increase the risk of developing preeclampsia.

The observed progress in maternal health indicators is closely tied to the evolution of Rwanda's healthcare system. Therefore, it is essential to review the structure and capacity of the national health system, particularly in delivering maternal and nutritional services.

## 1.4. The Healthcare System in Rwanda

Rwanda, a mountainous country known as the land of a thousand hills, covers a total surface area of 26,338 square kilometres. Located in the Great Lakes Region of East-Central Africa, it shares borders with the Democratic Republic of the Congo (DRC) to the west, Tanzania to the east, Burundi to the south, and Uganda to the north. Rwandans primarily belong to a single cultural and linguistic group, and its population is predominantly young and rural, with the highest population density in Africa at 416 inhabitants per square kilometre. Rwanda has five provinces: North, South, East, and Western Province, as well as Kigali City. In 2022, Rwanda had a total population of 13,246,394. The Southern Province accounts for 22.7% of the total population (39). Since 2012, Rwanda has recognised a population growth rate of 2.3% (38).

The healthcare system in Rwanda was weak, with minimal access to medical services and reliance on traditional medicine during the colonial period. After independence in 1962, political instability and social inequalities blocked the development of a strong and stable

healthcare system (40). The 1994 genocide devastated the nation; over 800,000 people lost their lives, and many others were displaced (41). The genocide devastated Rwanda's economy, destroying agriculture, industries and infrastructure, including health infrastructure, leaving the population with limited services. Subsequently, Rwanda embarked on a remarkable trajectory of political stability and economic growth, leading to a significant reconstitution of its healthcare system (46). Rwanda's healthcare system is widely recognized for emphasising equity, innovation, and sustainability, serving as a beacon of resilience and transformation. Rwanda's healthcare system comprises both public and private institutions, which are categorized in a decentralized public sector augmented by private hospitals and clinics. The public healthcare system follows a pyramidal structure aligned within the five administrative divisions of the country: National, Province, District, Sector, Cell, and Village. This structure includes seven referral/university teaching hospitals at the apex, four provincial hospitals, 36 district hospitals, 499 health centres, and 476 health posts (42). The last two facilities are supported by 45,011 community health workers who engage in community outreach activities.

The Rwandan healthcare system has evolved significantly in recent years, improving healthcare outcomes for domestic and international patients. Health centres and posts provide primary healthcare services at the community level. District hospitals constitute the secondary level of care, while provincial and national referral and teaching hospitals represent the tertiary level (43). Rwanda introduced a cadre of trained community health workers (CHWs) in 2009 to enhance maternal and new-born care per WHO recommendations, serving at the household level and linking communities with the healthcare system. Each village has four CHWs, one of whom is exclusively responsible for maternal and new-born health, aiding in the early recognition of danger signs and referral of pregnant women (44).

Additionally, Rwanda implemented the Rapid SMS mobile health program in 2010 to enhance maternal and new-born care. This innovative technology establishes a digital link between community health workers and healthcare facilities, enabling remote monitoring of antenatal care and timely emergency referrals (45). Rapid SMS also enables reporting births and deaths, ensuring synchronization of health system data with community data.

At health centres, nurses and midwives provide antenatal care services, which include different services aimed at monitoring the health of the mother and the developing foetus, providing necessary treatments, and educating pregnant women on health practices. Their role extends beyond routine medical check-ups to encompass comprehensive support for maternal health,

including essential dietary guidance (46). They are tasked with promoting healthy eating habits by advising pregnant women on the consumption of a balanced diet, monitoring the nutritional status of pregnant women, identifying any deficiencies or risks, and providing tailored dietary recommendations to address specific needs (47).

Cases requiring advanced medical intervention are referred to district hospitals, where specialized equipment and services are accessible. In severe instances, medical practitioners provide additional support. Patients with critical conditions at the district hospital level are transferred to tertiary/referral hospitals, which are staffed with gynaecologists, paediatricians, and other specialised physicians. Figure 1.1 shows the structure of the health system in Rwanda.

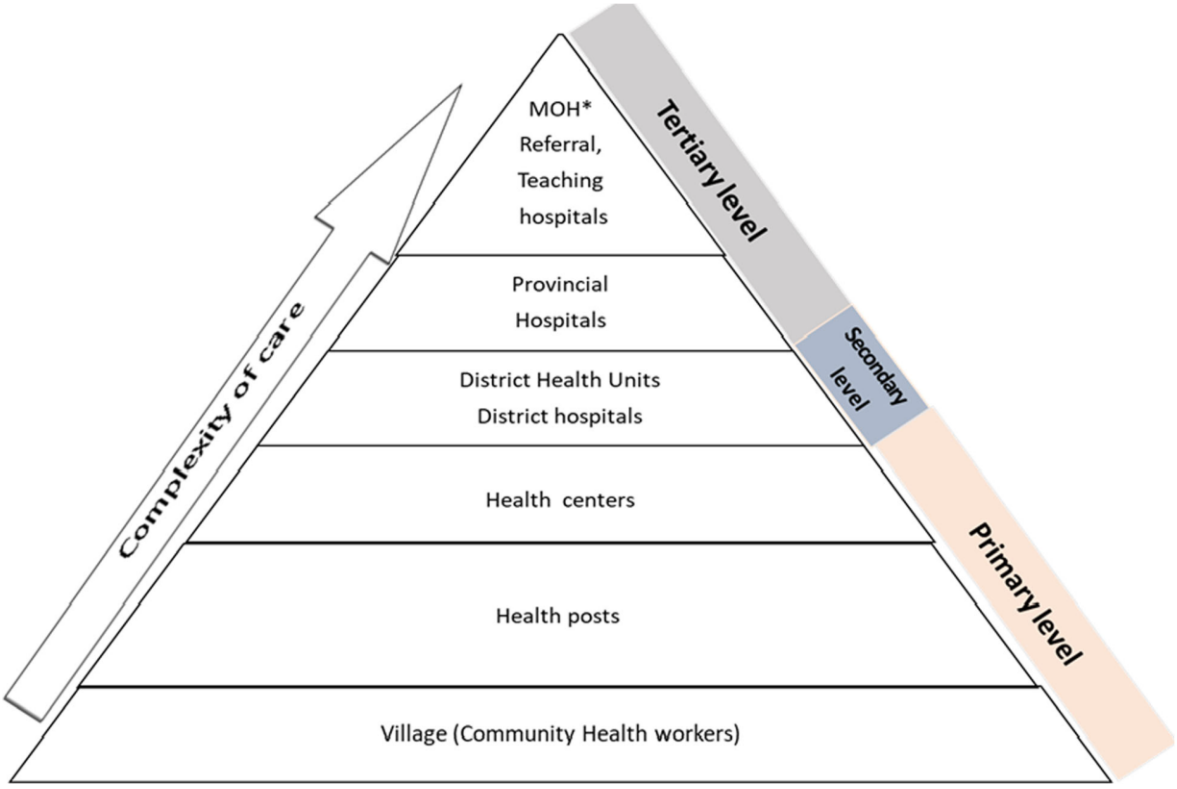



*Figure 0.1: The healthcare system in Rwanda (adapted: The Ministry of Health)*

The Rwandan Ministry of Health aims to provide all citizens equitable and affordable healthcare services. Therefore, a national policy established in 2004 made health insurance coverage compulsory by law in 2008, with annual subscription fees based on family income (48). Rwanda has made significant strides in health insurance coverage, with 91% of the population currently enrolled in the Rwanda Social Security Board's scheme. This provides subsidized access to healthcare services at 15% of the cost (54). Although private health

insurance options exist, the Ministry of Health's vision is to achieve 100% health insurance coverage.

Beyond the formal healthcare system, family structures also shape maternal health outcomes. In Rwanda, the family remains the primary unit of care and decision-making, especially regarding household food practices. The next section explores the Rwandan family structure and its implications for maternal dietary behaviours.

### 1.5. Rwanda Family Structure

In Rwanda, the family, or "umuryango," includes different relationships, extending from the immediate nuclear family to more extended ties. At its core, the Rwandan family mainly involves a husband, his wife (or wives), and their children (49). Only about 10% of Rwandan men possess more than one wife, and when they do, each wife typically has her own house (50). This structure underlines the nuclear family model, stressing the immediate connections between the father, mother, and children as the fundamental unit.

The Rwandan familial structure extends beyond the nuclear family to encompass secondary and tertiary relatives, including parents-in-law, siblings-in-law, uncles, and aunts (57). The family's third layer comprises the brothers and sisters-in-law and their offspring, as well as cousins, nephews, and nieces. Furthermore, Rwandan culture broadens the idea of family to encompass all members of one's original village, indicating a strong sense of communal responsibility (57). Regardless of their shared social and moral obligations, this extended family network increases each family member's support system, especially during life's major events such as pregnancy and birth. This complex family structure emphasizes the interdependence and shared accountability central to Rwandan society.

The structure of families in Rwanda further highlights the significance of the roles of male partners. In nuclear families, the direct relationships between fathers, mothers, and children are crucial, with men often holding the dominant decision-making power (49). This dynamic means that men’s attitudes, knowledge, and involvement directly impact the dietary practices of pregnant women. Furthermore, in circumstances where men have many wives, each wife keeping her household emphasises the importance of personalised support from the male partner to ensure that each woman receives proper nutritional recommendations.

While the primary family unit often centres around the nuclear family, secondary and tertiary relatives may also influence maternal dietary practices. As central figures within these extended networks, men may mobilize support or, conversely, create constraints for pregnant women.

This research aims to explore the nature of male involvement and its impact in order to generate actionable insights that foster a more enabling environment for healthy maternal nutrition.

Understanding family dynamics provides important context for maternal dietary practices. However, these practices are closely intertwined with maternal and neonatal health outcomes. The following section presents key trends in maternal and newborn health in Rwanda to further illustrate the urgency of addressing maternal nutrition

### 1.6 Studying Maternal Dietary Practices within the Rwandan Food and Family Context

In low- and middle-income countries like Rwanda, addressing maternal nutrition remains a public health priority due to the persistent burden of malnutrition, anaemia, and micronutrient deficiencies among pregnant women. Despite notable progress in maternal and child health, Rwanda continues to experience high rates of maternal undernutrition. According to the Rwanda Demographic and Health Survey (RDHS, 2020), 25% of pregnant women are anaemic, and 9% are underweight by BMI classification. These indicators are particularly concerning in regions such as the Southern Province, where the prevalence is highest. While health system interventions have expanded access to antenatal care and maternal education, less attention has been paid to understanding the lived dietary realities of pregnant women in the household context.

In Rwanda, the predominant nuclear family structure, composed of the mother, father, and children shapes household decision-making. Within this structure, the male partner often assumes the role of primary provider and financial decision-maker. As such, women's dietary choices are frequently influenced by the availability of household income, the level of support from their partners, and the prioritization of other family needs. This dynamic limits the woman’s autonomy in securing a diverse and nutritionally adequate diet during pregnancy, especially in settings where resources are scarce.

Moreover, household food patterns reflect broader socioeconomic and cultural contexts**.** In rural areas, subsistence farming and home gardens provide some access to fruits, vegetables, and staples like maize, beans, and cassava. However, food insecurity remains a reality for many households, especially during periods of drought or crop failure. In urban areas, reliance on purchased food presents a different set of challenges: high market prices, limited income, and reduced access to land for food production. These factors often force households to prioritize food quantity over quality.

Despite the critical role of nutrition in pregnancy, few studies in Rwanda have systematically examined the dietary practices of pregnant women in the context of their households and social environments. Existing data often focus on clinical outcomes rather than on the everyday realities of food access, preparation, and consumption during pregnancy. Furthermore, while male involvement in maternal care has gained attention in recent years, the role of male partners in influencing dietary practices of pregnant women is underexplored, especially in Rwanda a country having nuclear family systems.

This study therefore seeks to fill a critical gap by assessing not only the factors associated with maternal dietary practices, but also the challenges and enablers within the household setting, particularly in the Southern Province of Rwanda. By exploring both quantitative outcomes and qualitative experiences, this research aims to provide a nuanced understanding of how pregnant women navigate their nutritional needs within the constraints of household structure, cultural beliefs, gender roles, and economic realities.

## 1.7. Conceptual Framework

The ecological model (EM) is a theory-based framework developed by psychologist Urie Bronfenbrenner to identify the multilevel and interactive effects of personal factors and social, economic, cultural, and environmental factors (205). The literature considers EM as a valuable framework for investigating multilevel determinants of health behaviours/practices (206,207). This framework allows a comprehensive assessment of the factors influencing maternal dietary practices and identifies key areas for intervention at different levels. This study was guided by the EM, which recognizes that health behaviours/practices are affected by multiple levels of influence (208). Those levels are intrapersonal, interpersonal, organizational, community and policy levels.

In this study assessing the dietary practices, maternal characteristics, such as nutritional knowledge, perceptions, and beliefs on maternal nutrition, are included at the intrapersonal level of maternal dietary behaviours. Personal eating preferences and demographic factors, including age, education, and employment status, are also involved (209). The interpersonal level includes social assistance from friends, acquaintances, or family members like male partners but we emphasised on male partners considering the structure of family in Rwanda. The community level considers the social and cultural environment in which pregnant women live. They deal with cultural perceptions of maternal nutrition during pregnancy. Additionally,

included at this level are market accessibility, community food availability, and accessibility (210).

The medical care provided in a hospital occurs at the organizational level. The care provided in antenatal care services, including nutritional education and other nutritional support, is therefore included at the organizational level. Pregnant women's access to nutritional information and support may also be impacted by current policies and regulations in the healthcare setting (209).

The laws and rules that control the availability, accessibility, and price of food, as well as the laws and rules governing food production and marketing, may be included at the policy level (211). For the reason of available resources, this study assessed two government interventions implemented at the community level to improve dietary practices. The implementation of nutrition education during prenatal care services or the establishment of health and nutrition policies at the policy level may also be included. Figure 1.2 describes these different levels of socioecological model and specific variables assessed within this study.

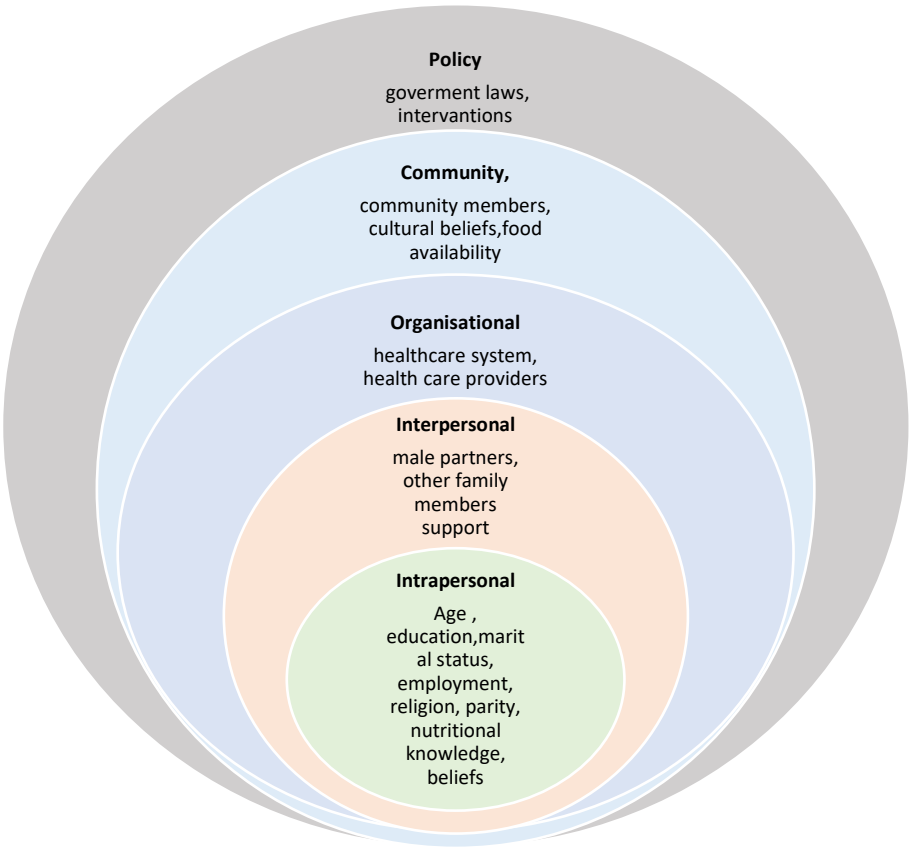



*Figure 1.2: Socioecological model framework [Adapted: Mcleroy (1988)]*

The ecological model is well suited to the analysis since it provides a thorough evaluation and comprehension of the numerous elements influencing the eating habits of pregnant women

from diverse socioeconomic backgrounds. We gained an understanding of the complex elements influencing the eating habits of pregnant women in the Southern Province of Rwanda through analysis of intrapersonal, interpersonal, community, organization, and policy levels. This paradigm makes it simpler to create interventions that influence people's behaviour, how community resources are distributed, and how healthcare is provided. Multi-layered interventions have a significant long-term effect and bring about long-lasting change (207). According to our predictions, the intervention model will greatly enhance mother and child health.

In conclusion, using a socioecological model for the study of maternal dietary practices has implications for comprehending the intricate interplay of components, creating targeted interventions, boosting collaboration, and directing the creation of policies and programs. In the Southern Province of Rwanda, this application of EM increases the likelihood of increasing maternal nutrition, which eventually benefits mother and child health.

This study employed a two-phase approach guided by the socioecological model. Phase one focused on Objective 1, and included a scoping review to lay the foundation for the subsequent phase. Phase two addressed Objectives 2, 3, and 4 involving quantitative and qualitative methodologies. Figure 1.3 illustrates the integration of the socioecological model into the study's phased design and objectives.

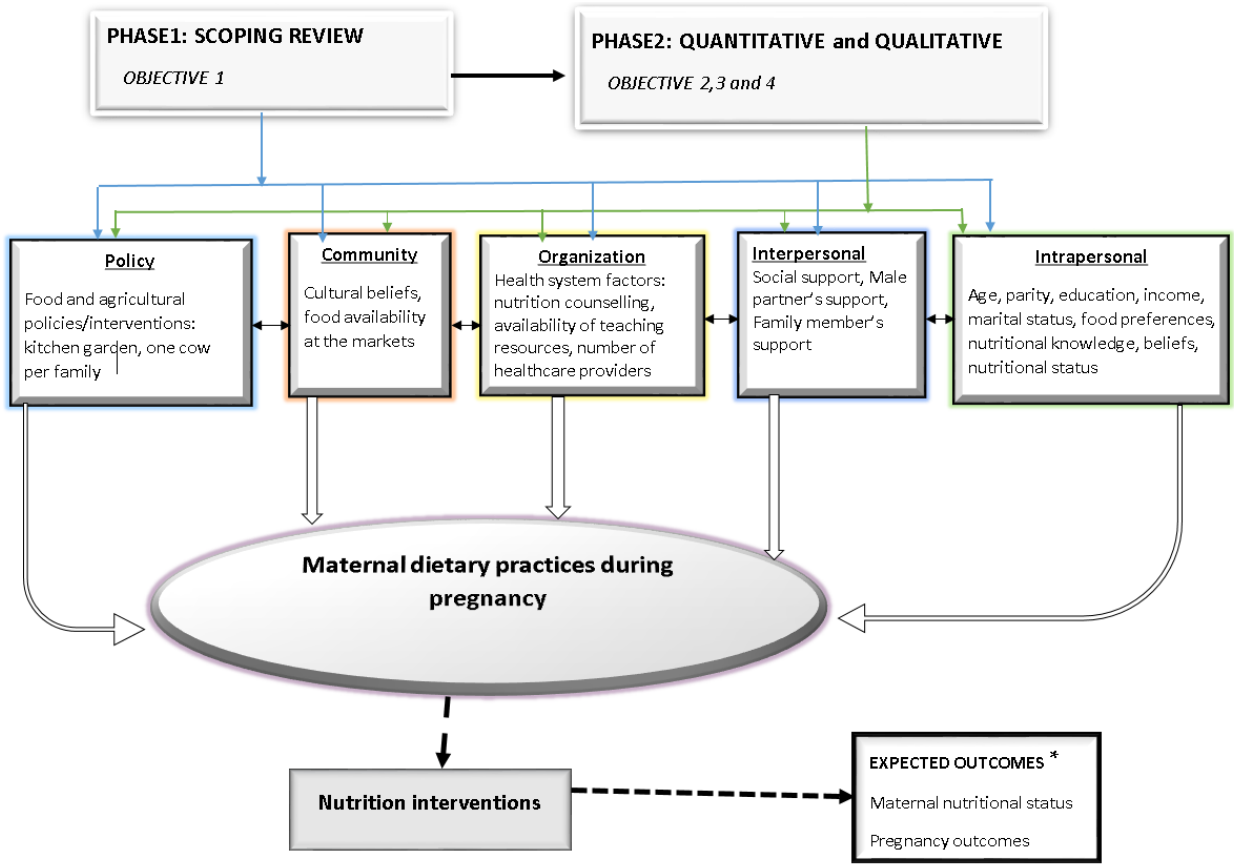



*Figure 1.2: Integration of the socioecological model in study phases. (Created: author)*

## 1.8. Summary

This introduction provides an in-depth exploration of maternal dietary and health practices during pregnancy. It points out the role of physical activity, balanced diets, micronutrient supplementation, and avoiding harmful substances to ensure positive pregnancy outcomes. Contextualized in Rwanda, the chapter describes the country's healthcare system, progress in maternal health outcomes, and persistent challenges, particularly in the Southern Province, where undernutrition and anaemia remain essential challenges. It identifies poor dietary practices as the key factor impacting maternal nutrition, setting the stage for research to address these gaps and improve maternal and neonatal health outcomes.

# Chapter two: Literature review

This chapter provides an overview of factors influencing the dietary practices of pregnant women. It discusses the significance and rationale for studying maternal dietary practices, the effect of dietary practices during pregnancy and factors influencing maternal dietary practices. This chapter reviews the existing literature on the status and the factors contributing to the dietary practices of pregnant women. In addition, I will provide the research questions, aims, and objectives that guided this research study.

Eligible articles were used to construct a literature review matrix to write this thesis. A broad methodological literature search was performed on the Web of Science, Google Scholar, PubMed, SC, and Research4 Life. An expanded "Population, Intervention, Comparison, Outcome" (PICO) model was used as the literature search strategy to create key terms for literature searching.

Several initiatives have been implemented to improve maternal dietary practices, which remain inadequate in developed and poor nations. Such treatments are unlikely to be effective unless they are based on detailed studies of the factors influencing pregnant women's dietary practices. However, studies were limited to assessing socioeconomic factors and knowledge of appropriate nutrition during pregnancy (34,61,62). At the same time, dietary practices are influenced by multilevel factors extending from individual to health system and policy levels. Therefore, this literature review focused on the primary purpose of the current study, which was to comprehensively assess the factors associated with the dietary practices of pregnant women attending antenatal care services in the Southern province of Rwanda.

## 2.1 Importance of Maternal Dietary Practices During Pregnancy

Adequate maternal dietary practices during pregnancy are essential because they substantially impact the health and well-being of both the mother and the developing foetus. Specifically, appropriate maternal dietary practices guarantee that the mother receives the nutrients needed to sustain her health while providing ideal conditions for the foetus's growth and development (63). Adequate dietary practices throughout pregnancy can minimize the incidence of gestational diabetes, pre-eclampsia, and anaemia, which are highly prevalent among pregnant women in Rwanda and are among the leading causes of maternal mortality in Rwanda (59). Understanding dietary practices can help identify potential concerns and address them as early as possible by encouraging healthier dietary practices, which lead to good pregnancy outcomes.

There is growing evidence that maternal poor dietary practices are associated with poor conditions such as gestational diabetes, preeclampsia, and anaemia, although the pathways are multifactorial and complex. Poor nutrition particularly excessive intake of energy-dense and nutrient-poor foods can contribute to excess weight gain and metabolic stress, which, when combined with other physiological changes during pregnancy, may increase the risk of insulin resistance and the development of gestational diabetes (64)(65).

Pre-eclampsia is a pregnancy-related illness characterized by high blood pressure and organ damage that usually occurs after the 20th week of pregnancy (66). Nutritional deficiencies caused by poor dietary practices, notably in calcium, magnesium, and antioxidants, can contribute to oxidative stress and inflammation in the placenta and blood vessels, which may result in compromised blood vessel function, decreased blood flow to the placenta, and development of pre-eclampsia (67).

Anaemia during pregnancy can be caused by a lack of essential nutrients such as iron and folate, which are required to synthesise haemoglobin. This protein transports oxygen in the blood. Inadequate iron consumption can result in decreased haemoglobin levels and oxygen-carrying ability, resulting in anaemia (68). Anaemia during pregnancy increases the risk of preterm birth, low birth weight and postpartum haemorrhage.

It is crucial to remember that various factors, including genetics, lifestyle, and overall health, determine the prevalence of these disorders. Inadequate dietary practices are only one of several variables that contribute to the development of these illnesses, which are frequently impacted by a mix of genetic predisposition and environmental circumstances. To avoid these issues, pregnant women must eat a well-balanced, nutrient-rich diet that fulfils their increased nutritional needs during pregnancy.

Moreover, emerging data suggests maternal dietary practices can influence the child's long-term health. Poor maternal practices may raise the risk of chronic diseases, including obesity and cardiovascular disease, in children later in life through metabolic programming (69,70). Metabolic programming, also known as the Developmental Origins of Health and Disease (DOHaD), refers to the process by which environmental factors during significant periods of early development can produce long-term effects on a person's metabolism and health outcomes later in life (71). This idea claims that unfavourable prenatal development settings, particularly in the case of low birth weight children, can increase the risk of developing chronic diseases like diabetes, obesity, and cardiovascular disease in adulthood (80). This is very

critical in Rwanda because the burden of non-communicable diseases (NCDs) is significant, contributing to increasing morbidity and mortality rates within the country. Key NCDs, such as cardiovascular diseases and diabetes, are becoming more prevalent, requiring expensive management that involves long-term healthcare resources, comprehensive treatment plans, and consistent follow-up, challenging the present healthcare infrastructure that is still growing to accommodate these needs.

## 2.2 Good Dietary and Health Practices during Pregnancy

Dietary and health practices include a range of dietary behaviours, including the intake of essential vitamins and minerals through different food groups and balanced meals. In Rwanda, where maternal and child health has been an essential focus of national health policies, understanding and enhancing dietary practices is paramount. Moreover, in a country where resources may be limited, ensuring that pregnant women have good dietary practices and access to proper nutrition is a fundamental component of public health strategy. Below, I discuss the various components of prenatal dietary and health practices and their importance in achieving optimal maternal and child health outcomes.

### 2.2.1 Meal frequency

Recommendations for meal frequency during pregnancy seek to offer a consistent and adequate supply of nutrients to meet the expectant mother's increased nutritional needs while also promoting healthy foetal growth and development (72). Factors like pre-pregnancy weight, activity level, and overall health influence meal frequency. It is essential for expecting mothers to consume at least three balanced main meals daily: breakfast, lunch, and dinner. Each main meal should contain a combination of carbohydrates, proteins, healthy fats, and fruits and vegetables. A well-balanced main meal gives the energy and nutrients needed to support the mother's health and the development of the baby (73). This is not always possible because of a variety of contextual and individual factors. The usual guideline is therefore to eat smaller, more frequent meals throughout the day (72).

In addition to the three main meals, pregnant women are advised to consume two to three nutrient-rich snacks in between to maintain a regular supply of energy and nutrients, reducing blood sugar fluctuations and ensuring the nutritional needs of the mother and baby are satisfied throughout the day (74). Furthermore, pregnant women should drink enough water throughout the day to aid digestion, keep amniotic fluid levels stable, and avoid dehydration (75).

### 2.2.2 Avoid skipping meals

Skipping meals during pregnancy is strongly discouraged as it can pose significant risks to both maternal and foetal health. Due to increased nutritional demands, a pregnant woman's diet is crucial for the proper development of the foetus. Skipping meals might result in an insufficient intake of vital nutrients required for foetal development and maternal health (76). In addition, skipping meals can cause blood sugar levels to fluctuate. Pregnant women may experience weakness, dizziness, and irritability when blood sugar levels drop. Unstable blood sugar levels might hurt the mother's energy and overall well-being. Prolonged fasting or irregular eating practices can affect the body's metabolism, resulting in inefficient energy consumption and increasing the risk of developing gestational diabetes (77). This can impact the mother's energy levels, leaving her tired and unable to cope with the physical demands of pregnancy, which could compromise foetal outcomes. Therefore, pregnant women should stick to a regular diet that includes balanced meals and nutritional snacks rather than missing meals.

### 2.2.3 Avoid smoking and drinking alcohol.

Tobacco use and alcohol consumption during pregnancy are harmful behaviours that can have severe, long-lasting consequences for both the mother and the developing foetus. As such, these practices are strongly discouraged throughout pregnancy. Smoking during pregnancy harms the pregnant woman and her unborn child through hazardous substances such as nicotine and carbon monoxide (78). These toxins can cross the placenta and reach the developing foetus, where they can have a variety of negative effects, including miscarriage and stillbirth, premature birth, low birth weight, and congenital abnormalities such as cleft lip and palate, heart issues, and respiratory problems (79–81).

Drinking alcohol during pregnancy can have serious implications since the alcohol crosses the placenta and interferes with the baby's development. Alcohol use during pregnancy is linked to an increased risk of miscarriage, stillbirth, preterm birth and low birth weight (82). In addition, alcohol usage during pregnancy may expose the children to learning difficulties, behavioural challenges, and a higher risk of mental health problems later in life (83,84).

### 2.2.4 Adequate rest

Rest is essential for maternal health and well-being during pregnancy. The expectant mother's body is subjected to tremendous physical and emotional demands, and appropriate rest is required to nourish the growing foetus, enhance maternal health, and prepare for childbirth (85). Resting helps the body to redirect energy and resources to support the growth and

development of the developing baby. Adequate rest helps ensure the foetus receives the nutrients and oxygen required for proper development. As the pregnancy advances, the mother's body changes to accommodate the growing baby, which can pressure many body areas, including the back, hips, and legs. Resting and taking breaks during the day can help relieve pain and lower the risk of musculoskeletal problems (85).

Chronic stress and a lack of sleep might affect blood pressure levels throughout pregnancy. Consistent rest can aid in blood pressure regulation, lowering the risk of pregnancy-related hypertension. Taking time to rest and relax can help to improve mental well-being and reduce stress and worry (86). According to some studies, lack of bed rest during pregnancy may be linked to an increased risk of preterm birth (87). This risk can be reduced by taking regular pauses and avoiding strenuous activity.

### 2.2.5 Dietary diversity

Dietary diversity during pregnancy refers to eating a wide variety of foods from various food groups to meet the increased nutritional needs of both the expecting mother and the developing foetus (88). A varied diet during pregnancy is important for supporting optimal mother and foetal health because it provides a wide range of essential nutrients. These nutrients include vitamins (e.g., vitamin C, vitamin A, folate), minerals (e.g., iron, calcium, zinc), critical fatty acids (e.g., omega-3 fatty acids), and protein (89), which are necessary for cell formation, immunological support, brain, heart and lung development, bone health, and overall growth (90). Pregnancy can cause a variety of discomforts, including nausea, food aversions, and cravings. A diversified diet allows pregnant women to alter their dietary choices to accommodate these symptoms while still obtaining the necessary nutrients (91)(88). In addition, pregnant women who consume a varied range of foods are less likely to have nutritional deficiencies, which can cause problems for both the mother and the baby, such as anaemia, preterm delivery, and poor foetal growth and development (92).

## 2.3 Effects of Poor Dietary Practices on Maternal Health

Poor dietary practices are linked with malnutrition, which during pregnancy leads to the failure of pregnant women to store the needed nutrients. In this case, the mother uses her store to produce the protein, energy, and micronutrients necessary for foetal growth and development (93). As such, maternal nutrition reserved for solely non-pregnant women's needs will be used

to respond to maternal and foetal physiological needs. Hence, the shared maternal nutrition use will negatively affect foetal growth and development and the mother's health.

In developing countries, anaemia is the primary adverse effect of inadequate dietary intake during pregnancy (94). Nutritional anaemia results from nutritional deficiencies, especially in iron and folic acid (IFA), compromising maternal and foetal health by increasing maternal vulnerability to postpartum haemorrhage, antepartum, and puerperal infection (95).

Second, inadequate access to food increases the risk of insufficient gestational weight gain (GWG) (96). Evidence suggests a strong correlation between maternal nutrient intake and gestational weight gain (GWG). In Vietnam, mothers experiencing 11-15 nutrient deficiencies exhibited significantly lower GWG than those with fewer deficiencies (106). Similarly, Indian research demonstrated a positive association between GWG and average calorie and fat intake (97). The American Institute of Medicine (IOM) guidelines recommend a weight gain of 12.5–18 kg for underweight women, 11.5–16 kg for normal-weight women, 7–11.5 kg for overweight women, and 5–9 kg for obese women (98)(99). Insufficient weight gain during pregnancy is linked to poor pregnancy outcomes, such as preterm delivery and small-for-gestational-age (SGA) babies (100). On the contrary, gaining too much weight during pregnancy increases the risk of gestational diabetes mellitus, a large-for-gestational-age (LGA)/ macrosomia baby, pregnancy-induced hypertension, and caesarean section (101). Those complications of insufficient/excess weight gain during pregnancy require close monitoring of weight gain.

Third, maternal nutritional deficiencies negatively affect the immune system's capacity to fight infection, increasing pregnant women's susceptibility to infection (102) deficiencies of zinc, iodine, and vitamin A compromise the health of the affected pregnant women. Zinc deficiency is linked to the risk of preterm delivery and complicated labour (103). Similarly, iodine deficiency increases the chances of miscarriage and prematurity (104). With the effects of maternal malnutrition during pregnancy mentioned above, it is believed that improving maternal nutrition leads to improved pregnancy outcomes and a better start to human life.

## 2.4 Effects of Inadequate Dietary Practices on the Foetus and Infant

Maternal nutrition, both pre-and post-conception, significantly impacts foetal growth and development. Poor dietary practices during pregnancy can lead to nutritional deficiencies, increasing the risk of intrauterine growth retardation (IUGR) and subsequent low birth weight

(LBW). Studies conducted in Nigeria and Ethiopia showed that mothers who received an inadequate diet during pregnancy gave birth to a higher percentage of LBW babies than those who were well-nourished (105,106). In addition, maternal nutritional deficiencies in vitamin D are linked to osteopenia in newborns, neonatal hypocalcaemia, cardiac failure, and childhood rickets (107–109).

Improving maternal nutrition during pregnancy is essential for foetal growth and development and the entire developmental stages up to adulthood. The foetal adverse health effects of poor maternal nutrition during pregnancy are the leading causes of neonatal and infant morbidity and mortality in developing countries (110). In addition, LBW is responsible for adulthood non-communicable diseases such as obesity and diabetes mellitus through "*Early metabolic programming of long-term health and disease"* (111).

## 2.5 Factors Influencing Maternal Dietary Practices

Maternal dietary practices are shaped by a complex interaction of individual, relational, community, and broader structural influences. This section presents the key determinants of dietary practices among pregnant women using an ecological framework. This approach facilitates a more holistic understanding of how various layers from personal knowledge to societal structures interact to influence dietary practices during pregnancy

### 2.5.1 Intrapersonal level

***Socio-demographic factors***

Dietary practices during pregnancy are influenced by several factors, encompassing age, educational attainment, income level, occupational status, ethnic background, cultural values, parity (referring to the number of times a woman has given birth to a fetus at 20 weeks or more, regardless of whether the infant was born alive or stillborn ), and gestational age (indicating the specific phase of pregnancy) (112,113). Each factor influences the dietary practices through different mechanisms as follows:

*Age:* There may be differences in dietary practices between younger and older pregnant women. For example, younger women may exhibit comparatively lower levels of experience and knowledge about appropriate nutritional practices during pregnancy. In contrast, older women may possess improved understanding and awareness due to their accumulated life experiences (113). On the other hand, older women may exhibit poor dietary practices as

compared to young women due to traditional norms and culture (114,115) or increased household responsibilities which hinders them from prioritising their own dietary practices.

*Education* has a significant role in shaping the knowledge and awareness of pregnant women regarding healthy dietary practices. Educated pregnant women will probably have an increased tendency to make healthy food choices that are well-informed and comply with dietary guidelines during pregnancy (30,116).

*Income* is a significant aspect of pregnant women's socioeconomic status, as it determines the affordability and accessibility of food. Increased socioeconomic level is connected with improved dietary variety, and pregnant women in wealthier families have access to more outstanding-quality meals than those with lower socioeconomic status (117). On the other hand, low socioeconomic status is connected to inadequate and monotonous meals, nutritional shortages, and a substantial risk of micronutrient deficiencies (118). Therefore, resources determine dietary intake and food sufficiency.

The type of *employment* a woman engages in can impact her ability to exhibit healthy dietary choices. Employed women have improved purchasing power, which increases the likelihood of accessing different food groups as compared to non-employed women (115,119).

The nutritional demands and preferences of women with higher *parity* who have experienced numerous pregnancies may differ from those of first-time mothers (120). Prior experiences with pregnancy can influence the awareness of dietary requirements and food choices.

***Maternal Nutritional Knowledge***

Adequate Maternal knowledge of proper nutrition is vital for adopting healthy dietary behaviours and subsequently improving pregnancy outcomes (121–123). Nutrition knowledge is critical in creating an understanding of the required nutrition intake among pregnant women (124). Nutritional knowledge allows pregnant women to have a better understanding of a balanced diet and their food sources, as well as the importance of good maternal nutrition during pregnancy (125). Lack of knowledge of adequate nutrition is a cause of malnutrition and would also cause worse dietary practices (126). Therefore, pregnant women must possess sufficient nutritional knowledge to meet their high nutritional demands. However, some pregnant women have inappropriate nutrition knowledge and incorrect opinions and perceptions about nutrition practices (127).

While knowledge is a necessary component of dietary practice, it is not sufficient on its own. Studies have shown that pregnant women may possess basic knowledge of nutrition but still engage in suboptimal dietary practices due to a range of structural and contextual factors, such as limited access to nutritious foods, economic constraints, cultural beliefs, and gender norms (126). Therefore, understanding the broader determinants of health behavior is essential in interpreting the link between knowledge and practice.

### 2.5.2 Interpersonal level

***Family influences***

The dietary practices of pregnant women are significantly influenced by the support received from family members, including their male partners. During pregnancy, the nutritional requirements increase, and the support provided by individuals close to the pregnant woman can significantly affect her capacity to maintain appropriate dietary practices (152). There exist several mechanisms via which familial support exerts an influence on the dietary practices of pregnant women:

***Emotional Support****:* The period of pregnancy is characterized by both physical and emotional challenges. The provision of emotional support by family members and male partners plays a critical role in decreasing the stress and anxiety experienced by pregnant women (153). This in turn promotes an improved ability to concentrate on demonstrating adequate eating practices to fulfil the increased nutritional needs (153). The experience of receiving affection and care has the potential to exert a positive impact on a pregnant woman's motivation to adhere to a nutritious dietary regimen.

***Meal preparation and planning*** can be crucial in ensuring pregnant women access a well-balanced and nutritious diet. Active involvement of family members and partners in this process can greatly contribute to achieving this goal (154). They can support the selection and preparation of meals that align with the unique nutritional requirements associated with pregnancy (153). Supportive family members and partners can actively promote healthy dietary choices among pregnant women, thereby encouraging them to consume nutritious foods.

It is recommended that pregnant women be accompanied by their family members or partners during grocery shopping outings to ensure the availability of a well-balanced and nourishing food supply for the household (155). Additionally, they can provide support in the process of choosing more nutritious food alternatives and avoiding potentially detrimental diet choices during the duration of pregnancy (153). The phenomenon of cravings and unhealthy habits

reduction is commonly observed in pregnant women, who often have a desire for specific food items that may not align with optimal nutritional choices. The presence of supportive family members can play a crucial role in moderating these desires and facilitating the shopping for healthier alternatives.

Family support, particularly from male partners plays a crucial role in facilitating pregnant women's adherence to good dietary practices. Male partners play a crucial role in ensuring food security, meal preparation, and emotional well-being. However, a shortage of such support often leads to suboptimal dietary practices increasing the risk of malnutrition and adverse birth outcomes.

### 2.5.3 Community level

***Cultural beliefs and food taboos during pregnancy***

Some cultural beliefs and traditions affect maternal nutrition during pregnancy. In this thesis, I focused specifically on food taboos or the cultural and social rules that prohibits the consumption of certain foods for religious, cultural, historical, or social reasons (128). Food taboos play a critical role in maternal undernutrition in SSA (129). Evidence shows that pregnant women from different parts of the world are required to avoid some nutritious foods due to their traditional beliefs, and these food taboos can lead to maternal and fetal malnutrition (128). In various cultures, the belief is that complying with the food taboos provides maternal and foetal protection (130,131). Breaking them may impair the foetus or threaten maternal health (132). These food restrictions are not usually based on medical science about the appropriate food types and quantity recommended for pregnant women and may influence women to disobey the dietary recommendations and guidelines provided by healthcare practitioners (133,134).

Some pregnant women in SSA restrict their food intake to avoid undergoing a difficult delivery and an obstructed and painful labour. The most prohibited foods are those rich in protein because of the belief that high-protein foods promote the body's growth, including the growth of a foetus, thereby complicating the birth process (135). Some pregnant women are discouraged from overeating and eating too often to avoid having a large baby and a difficult delivery, including a caesarean section or perineal tear (135,136). To ease delivery, some pregnant women reduce their quantity and frequency of food intake to avoid having big babies (137). Pregnant women may also avoid some food types because of their perceived harmful effects on the growing foetus, which include skin abnormalities, such as rashes and burns.

Women in the Eastern Cape, South Africa; the Afar region of Ethiopia; New Guinea; and the Gurage Zone in Ethiopia reported restricting their intake of roasted seeds, rice, semi-solid foods, fruits, vegetables, porridge, cereal soup, bananas, cabbage, milk, and yoghurt because they believed these foods would stick to the baby's skin (114,129,136,138,139).

However, many of these avoided foods are rich in protein-rich such as meat, fish, and eggs, which contain essential amino acids important for foetal growth and maternal tissue development (140). Similarly, the restriction of fruits, vegetables, and dairy products deprives women of essential vitamins and minerals such as vitamin C, folic acid, and calcium, necessary for foetal development and prevention of birth defects (140).

### 2.5.4 Organisation level

***Health system***

Several aspects of the health system may influence the dietary practices of pregnant women. These include healthcare infrastructure, regulations, services, and support systems that have an impact on the ability of pregnant women to obtain information, resources, and care (156). The accessibility of healthcare services is paramount in ensuring pregnant women receive adequate prenatal care, which in turn facilitates their education on good dietary practices during pregnancy (157). Regular prenatal visits allow healthcare practitioners to provide dietary counselling, evaluate nutritional status, and address any concerns or inquiries. The advice provided to pregnant women by healthcare providers is significantly influenced by their level of knowledge and training in prenatal nutrition. Healthcare professionals who possess extensive knowledge and remain current in their field can provide precise and pertinent nutritional advice (157).

The existence of nutrition education programs inside the healthcare system has the potential to exert a substantial impact on the dietary practices of pregnant women. Hospitals, clinics, and community health centres can provide educational opportunities such as classes, workshops, and counselling sessions focused on prenatal nutrition, thereby empowering women to make well-informed decisions regarding their dietary intake during pregnancy (156). The dissemination of accurate and evidence-based information regarding prenatal nutrition is a crucial function of health systems. Information can be disseminated through several channels, such as pamphlets, internet resources, social media platforms, and encounters with healthcare providers.

In addition, the presence of certified dieticians or nutritionists in the healthcare system can offer specialist counselling to pregnant women with special dietary requirements, such as women with gestational diabetes or other medical disorders (160). Health systems often provide or suggest prenatal supplements to pregnant women to address any vitamin shortages and ensure the intake of critical nutrients. These supplements commonly include folic acid and iron.

Thus several aspects of the health system influence the dietary practices of pregnant women. The implementation of a comprehensive healthcare system that is organized and provides adequate support can effectively improve the nutritional status of pregnant women (158). Providing educational resources and services and implementing policies that encourage good dietary practices can achieve favourable pregnancy outcomes.

### 2.5.5 Structural level

***Policy***

Policy influences the dietary practices of pregnant women through their impact on the presence, ease of access, price, and setting of the rules and regulations of nutritious food choices (159). Policies that may influence the dietary practices of pregnant women can be implemented at various levels, including local, regional, national, or international spheres (159). For example, the implementation of policies aimed at enhancing the availability and accessibility of fresh and nutritious food, such as the establishment of farmers' markets or community gardens, can effectively augment the accessibility of diverse dietary choices for pregnant women (160). On the other hand, the presence of "food deserts" in certain regions, characterized by restricted availability of fresh and nutritious food options, might adversely affect individuals' dietary decision-making.

Policies aimed at regulating the marketing and sale of dangerous substances, such as tobacco and alcohol, have the potential to deter their intake among pregnant individuals (161). The implementation of marketing and advertising regulations can exert an impact on dietary preferences, particularly on harmful food and beverage products aimed at children and pregnant women (161). Consequently, reducing exposure to marketing campaigns that promote sugary, high-fat, and low-nutrient foods can encourage healthy eating habits. Effectively crafted policies can enhance pregnant women's agency, enabling them to make more health-conscious decisions regarding their eating habits. This can improve health outcomes for both the mother and the developing foetus.

***Food insecurity***

Food insecurity is a global issue affecting low- and middle-income countries (LMIC), particularly SSA (141). The World Food Forum defines food insecurity as a state that arises "when all people at all times lack both physical and economic access to adequate food to satisfy their dietary needs for a productive and healthy life" (142). Different factors contribute to food security:

The first is ***food availability*** which includes not only the availability of food but also its accessibility, utilization, and stability. It requires a sufficient quantity and diversity of food for consumption to be accessible from the farm, the marketplace, or other options (143). Consequently, food availability is influenced by three primary factors: production, distribution, and exchange. It is intrinsically tied to agricultural output, distribution networks, and access to resources like transportation infrastructure and market integration within a specific community. (144). Limited food availability leads to poor dietary practices in pregnant women, which negatively affects pregnancy outcomes.

The second is ***food accessibility*** which consists of individuals and communities' ability to get the food they need for optimal dietary practices. It refers to the ability of the households to have the physical and financial means needed to purchase food and not be restricted from doing so owing to customs or traditions (145). When food prices exhibit a disproportionate increase compared to individuals' or families' earnings, it can challenge them to procure an adequate quantity and various food groups. In addition to physical and economic accessibility, socio-cultural access is another critical element of food accessibility, which ensures that the foods are culturally acceptable and that there are social protection networks to support the less fortunate (146). Therefore, the three dimensions of accessibility of food include affordability, allocation, and preference (147).

The third is ***food utilization*** which refers to the extent to which individuals efficiently use the resources available to them to meet their nutritional requirements (146). The utilisation involves a series of physiological events such as digestion, absorption, metabolism, and health outcomes for an individual's well-being (148). Pregnant women must have access to and digest sufficient quantities of high-quality food to support their health and the developing foetus. In addition, water and sanitation must be considered at this level. Therefore, food utilization involves nutritional value, social value, and food safety (146).

The fourth is the ***stability*** of the other three dimensions over time. If food intake is adequate today; pregnant women will still be considered food insecure if they have insufficient access to food periodically, exposing them to poor nutritional status (148). Stability denotes the ability of the nation/ community/(household) person to tolerate shocks to the food production chain caused by natural disasters (earthquakes) or artificial ones (economic crises) (144).

According to evidence, the majority of food-insecure households consume low-nutritional-value foods. Food price rises also reduce dietary diversity and are linked to poor nutritional outcomes (149). Food insecurity substantially influences nutritional practices at the household level among disadvantaged pregnant women (150). Women may cope with food insecurity in the home by eating fewer meals per day and lowering their consumption of higher-cost meats and eggs in favour of rice, thereby depriving themselves of critical nutrients. Similarly, inequitable food allocation due to gender discrepancies within the family may also occur, allowing men and boys to eat before women and girls (151).

## 2.6. Evidence about Dietary Practices and Associated Factors

Poor dietary practices are a public health challenge in developing countries, including Rwanda. Scholars in Northwest Ethiopia reported that most pregnant women, estimated at 80.1%, had poor dietary practices, and 66% of pregnant women in Addis Ababa demonstrated good dietary practices (162,163). In African and Asian countries, the diets of most pregnant women are low quality, mainly plant-based, with low consumption of animal-source foods, vegetables and fruits (164). For example, evidence from Nigeria showed that few pregnant women, estimated at 29.8%, consumed diversified food, whereas only 43.4% of respondents consumed fruits and vegetables daily (165). In Bangladesh, a study revealed that half of the pregnant women had acceptable dietary diversity, while 24% and 37% consumed vegetables and milk products (166). There is a shortage of studies assessing pregnant women's dietary practices in Rwanda. One study conducted in 2017 in Kigali City, Gasabo District, reported that half of the study participants (50%) did not achieve the minimum dietary diversity for women (MDD-W) (167).

Dietary practices are influenced by complex factors related to the pregnant women themselves and their surroundings. Several studies reported the socio-demographic characteristics of pregnant women to be among the drivers of their dietary practices. These characteristics include maternal age, education, employment and income (168–171).

Adequate maternal knowledge of proper nutrition was reported as an important factor in adopting healthy dietary practices (121,122). Furthermore, adequate nutrition knowledge

empowers pregnant women to discern between accurate and misleading dietary information, thereby mitigating the influence of unfounded beliefs or advice from social circles (182). Research conducted in Ethiopia and Iran has demonstrated a positive association between enhanced nutritional knowledge and adherence to dietary guidelines among expectant mothers (183, 184). However, a study conducted in Egypt reported that adequate nutritional knowledge did not translate into healthy dietary practices among pregnant women (172). This contradictory evidence means that nutritional knowledge is not a sufficient cause for improved dietary practices.

Several studies have reported that cultural beliefs, food taboos and traditional norms affect the dietary practices of pregnant women negatively. For example, in Ethiopia, a study reported that pregnant women avoided consuming dairy products such as cheese and yoghurt to prevent excessive weight gain and difficult delivery (173). In Tanzania, a study found that many women believe that eating meat, eggs, or fish while pregnant might transmit animal characters to the foetus (133). However, dairy products contain calcium, proteins, and vitamins A, B12, and D essential for foetal growth and development. Animal-sourced food consumption improves birth outcomes, such as birth weight (174,175). The evidence shows that moderate dairy product consumption may be linked to adequate birth weight and reduced risk of SGA (176).

Some pregnant women in Benin were fasting to prevent the growth of the foetus and the need for its extraction during labour (137). In Mikelle City, Ethiopia, beans and chickpeas were believed to exacerbate labour pains and cause abortions in pregnant women (177). Similarly, honey, mustard-containing foods and a soup prepared from linseed and chicken meat (yedoro shorba) were believed to relax the cervix and lead to abortions (139). Gastrointestinal problems were reported as the reason for food restrictions among pregnant women. In Ethiopia, pregnant women avoid cold meat, cold milk, yoghurt cheese, and cold water because they believed those foods caused bloody diarrhoea, vomiting, abdominal diseases, and typhoid (136).

Maternal and foetal protection from witchcraft was reported in some countries as the reason for food prohibition. Some women avoided foods they believed to be 'evil food' or food that was too dangerous to be consumed by a pregnant woman. In Kenyan cultural beliefs, the consumption of meat from animals that have died from complications like miscarriages, stillbirths, or retained placenta is considered taboo. It is believed that such meat, carrying an evil spirit, can be transferred to a pregnant woman, potentially leading to similar complications

(191, 192). Similarly, in Eastern Cape, South Africa, pregnant women are advised to eat horse wombs regularly and to drink baboon urine to protect the mother and baby from witchcraft and to ensure an easy delivery without complications (129).

This information clearly shows how pregnant women from SSA countries practice food taboos. It also highlights the importance of identifying the possible traditional beliefs and food taboos surrounding the food choices among pregnant women in Rwanda, which have not been explored. Exploring them will inform the development of a nutritional intervention that is culturally sensitive to redress possible misconceptions, hence improving dietary practices.

In addition, household food insecurity is associated with suboptimal dietary practices (150). The health system significantly affects the dietary practices of pregnant women. For example, studies revealed that pregnant women improved their dietary practices in some contexts due to the advice they received from healthcare providers (178,179). On the other hand, a study from Sweden revealed that pregnant women did not comply with the nutritional information from the health care providers because they were confusing (180). The support from family members, friends and neighbours improves the dietary practices of pregnant women. A study from Texas showed that family support, specifically from the husband, positively influenced the dietary practices of pregnant women (181). Conversely, family members can negatively influence dietary practices by discouraging pregnant women from complying with the appropriate dietary practices based on their inappropriate experiences (182). This evidence shows that adequate knowledge of effective nutrition during pregnancy and the involvement of healthcare providers and family members positively influence the dietary practices of pregnant women.

## 2.7 Problem Statement

Good dietary practices during pregnancy are the main pathway to meeting the nutritional demands of pregnant women and their foetuses (18). In Rwanda, some women of reproductive age, including pregnant and lactating women and adolescent girls, do not achieve minimum meal frequency and dietary diversity (183). Such practices are critical because they are the root causes of micronutrient deficiencies linked with poor pregnancy outcomes such as IUGR, PTBs, and LBW (184). For example, in Rwanda, the prevalence of PTB and LBW is estimated at 13.8 % and 7.9%, respectively (185).

The government of Rwanda has implemented interventions to improve dietary practices within the households. One intervention is kitchen gardens, whereby each household is encouraged to

grow different vegetables to improve vegetable consumption (186). Another is the "Girinka program," where vulnerable families are offered one cow to increase food availability (187). Another intervention occurs during ANC visits, where women with low income receive fortified flour known as “shisha kibondo” to make porridge; they also receive nutrition counselling and micronutrient supplements (IFA).

Despite such interventions, nutritional deficiencies among pregnant women are still on the rise, and poor dietary practices are among the potential risk factors that are yet to be fully addressed. This situation is significant because being underweight among pregnant women is persistent. Anaemia has steadily increased over the years, from 17% in 2010 to 25% in 2020. The Southern Province has the highest prevalence (38). In addition, in the Southern Province, according to the Rwanda Demographic and Health Survey (RDHS) of 2014/2015, the neonatal (25 per thousand) and infant (40 per thousand) mortality rates were higher than the national averages of 20 and 32 per thousand respectively (27).

Poor maternal dietary practices could be a factor explaining this high prevalence of anaemia among pregnant women and such poor neonatal and infant outcomes in the Southern Province. Dietary practices are influenced by multiple factors, combining both individual and environmental factors (33). Research studies show that factors that influence nutritional practices include inadequate nutritional knowledge, socio-economic factors, food insecurity, and incorrect cultural beliefs about food consumption during pregnancy (190, 191, 192). There is insufficient research in Rwanda on the factors that contribute to the dietary practices of pregnant women.

This research gap is significant because being underweight and having anaemia during pregnancy are linked with an increased risk of adverse pregnancy outcomes such as preterm deliveries, low birth weight, intrauterine growth retardation, and prenatal and child mortality. These pregnancy outcomes are essential public health concerns in Rwanda because they are among the leading causes of neonatal and infant mortality (188). Evidence from a rural hospital in Rwanda showed that only 54.4% of PTBs and LBW babies reached their third anniversary; of these, the majority (78.3%) became stunted, and more than half (64.3%) had abnormal child development (189).

In addition to maternal and child health outcomes, maternal undernutrition during pregnancy results in increased healthcare care costs, a negative economic impact due to premature births and LBW, which are associated with high risks of diseases (190). Moreover, malnutrition can

transfer from generation to generation when undernourished pregnant women give birth to undernourished daughters, who are at risk of turning into undernourished mothers, and the cycle continues (191). Therefore, there is a need for a comprehensive assessment of maternal dietary practices and their associated factors among pregnant women in the Southern Province of Rwanda to inform the design of an evidence-based nutritional intervention targeting these particular factors.

## 2.8 Research Gap

Good dietary practices during pregnancy are the main pathway to meeting the nutritional demands of pregnant women and their foetuses (18). Poor dietary practices and their complications are public health concerns in LMICs. Such dietary practices are influenced by multiple factors combining both the individual and her environment (33). Several studies conducted to evaluate the factors associated with the dietary practices of pregnant women used the quantitative approach (30,139,192). The quantitative approach allows for the collection and analysis of numerical data, finding patterns and averages, testing causal relationships, and generalizing results to broader populations (193).

Nevertheless, this approach does not offer insight into the thoughts, motivations, and drivers of the research question of interest (194). This drawback creates a need for an additional qualitative approach to explore the reasons behind the status of dietary practices. In addition, few studies have used a qualitative approach to explore the food taboos and perceptions towards nutrition during pregnancy. With a qualitative approach, a researcher deals with a small sample size, and it is impossible to accurately say that the gathered views represent the views of a wider population (195). Each approach has strengths and weaknesses. Therefore, combining the two boosts the quality and accuracy of the findings by adding both breadth and depth.

Few studies use a mixed-method approach to assess the factors influencing dietary practices. Scholars argue that the mixed-method research (MMR) approach works in answering complex research questions with qualitative data, enhancing the understanding of the survey, while quantitative data provides response patterns (196,197). Using the MMR approach benefits the study by covering the breadth and depth of issues, exploring diverse perspectives and uncovering relationships between the complex layers of the research questions (198). The MMR remains the best approach to answering the research questions on the factors associated with pregnant women's dietary practices.

There is limited evidence on the factors that influence the dietary practices of pregnant women in SSA, including Rwanda. Most of the available literature is from Ethiopia, as evidenced by the scoping review I conducted for this PhD (refer to Chapter 4). This knowledge gap is important because a comprehensive assessment of these factors informs the development of an evidence-based nutritional intervention. I therefore conducted this study to contribute to the existing knowledge.

## 2.9. Justification of the Study

Although it is known that poor dietary practices lead to micronutrient deficiencies and are linked to poor pregnancy outcomes, little is known about the factors influencing dietary practices among pregnant women in Rwanda. This study will contribute to the existing knowledge on maternal nutrition in Rwanda. The findings of this study will help identify the dietary practices and their associated factors among pregnant women in the Southern Province, which will highlight important areas for intervention and policy development. The findings from this study will help to inform policymakers and other relevant stakeholders about factors that need to be targeted to improve the dietary practices of pregnant women, hence improving pregnancy outcomes such as term deliveries and birth weight.

By improving the dietary practices of pregnant women, we expect to reduce the burden of maternal malnutrition and hence decrease maternal and child morbidity and mortality, hence contributing towards the achievement of the global nutrition target of 2030, which aims at reducing stunting and anaemia in women of reproductive age and low birth weight (199).

## **2.10** Philosophical Foundation

A philosophical approach is important in guiding the implementation and methodology of any research project. This research applied a convergent parallel mixed-methods approach to investigate maternal dietary practices during pregnancy in the Southern Province of Rwanda. The study involves the viewpoints of pregnant women, male partners, and healthcare providers working in antenatal care (ANC) services. The underlying philosophy of such a research approach is pragmatism (200).

Pragmatism is a philosophical tradition that was initiated in the late 19th century. Pragmatism is “a philosophy in which the meaning of actions and beliefs is found in their consequences” (201). In addition, pragmatism is described as a research paradigm that encourages the practice of mixed methods, the use of varied modes of analysis and a constant cycle of adductive

thinking while being directed by the researcher's hope to produce socially valuable knowledge (202). Creswell (2011) highlights that pragmatism is the primary philosophical worldview that offers a base for convergent parallel mixed-methods research since it is an actual philosophy based on ideas which use "what works" by various approaches and respecting both subjective and objective knowledge (200). Pragmatism supports the use of diverse research designs including formal and structured approaches as long as they are appropriate for addressing the research problem and understanding its practical consequences.

The fundamental principle of pragmatism is that research should be motivated by the practical problem (203). This study's central problem revolves around understanding the multiple factors associated with maternal dietary practices during pregnancy. These factors may involve individual beliefs, socio-cultural influences, economic conditions, and the role of healthcare providers in promoting healthy dietary practices. A problem-centred focus recommends that the researcher select methods that best suit the assessment of these diverse factors. Pragmatism recommends methodological pluralism, which states that no single method is superior or more valid. Instead, the choice of methods is determined by their convenience in responding to the research questions. Pragmatism encourages the flexible use of these methods, knowing that each offers valuable but diverse types of information. By mixing these approaches, the research achieves a more comprehensive understanding of the research problem (200). For example, in this study, qualitative methods (such as interviews and focus groups) allow for an in-depth exploration of the perceptions of pregnant women, male partners, and healthcare providers. This data is essential for understanding the socio-cultural dynamics that shape dietary decisions. On the other hand, quantitative methods (such as structured surveys) allow for measuring the prevalence of good dietary practices and factors across pregnant women.

One of the essential views of pragmatism is its focus on action and practical consequences (203). Pragmatist research is often motivated by the desire to solve real-world problems or inform practice and policy. In this study, the objective is to identify the factors influencing maternal dietary practices and use this information to improve maternal and child health outcomes. Pragmatism underscores that research should produce actionable outcomes. In this study, the practical consequences could directly inform household, community, and healthcare interventions to improve maternal dietary practices during pregnancy.

Pragmatism emphasizes context (204). The understanding that research findings are always located within specific social, cultural, and environmental contexts is pertinent to this study,

which was conducted in the Southern Province of Rwanda, a region with unique cultural norms, economic realities, and healthcare practices. Pragmatism encourages the exploration of these contextual factors, knowing that maternal dietary practices cannot be explored in isolation from the broader social, economic, and healthcare environments in which they occur.

Ontologically, this study assumes a pluralistic reality through realist and relativist positions, where the experiences of pregnant women, male partners, and healthcare providers reflect multiple, co-existing realities. Epistemologically, the study adopts a dual approach that embraces subjective and objective knowledge through positivist and constructivist assumptions.

Therefore, I argue that pragmatism provides a robust philosophical foundation for this research. Its emphasis on practical outcomes, flexibility, and real-world applicability aligns well with the research problem, which involves understanding complex socio-cultural, economic, and health risk-related factors. By integrating qualitative and quantitative approaches, the study can generate actionable insights that can inform interventions aimed at improving maternal dietary practices, ultimately contributing to better health outcomes for mothers and infants.

## 2.11 Primary Research Question

What factors influence pregnant women's dietary practices in the Southern Province of Rwanda?

## 2.12 Study Aim

This study aims to identify the different factors that affect the dietary practices of pregnant women in the Southern Province of Rwanda.

## 2.13 Specific Research Objectives

1. To describe the existing gaps in knowledge about the dietary practices of pregnant women and associated factors in Sub-Saharan Africa.
2. To identify the factors associated with the dietary practices of pregnant women in the Southern Province of Rwanda.
3. To assess dietary diversity and its determinants among pregnant women in the Southern Province of Rwanda.

4. To investigate the perspectives of healthcare providers and male partners regarding support for the dietary practices of pregnant women in the Southern Province of Rwanda.

## 2.14 Summary

This chapter highlights the need to comprehensively assess the factors associated with maternal dietary practices during pregnancy. The prevalence of poor nutritional status among pregnant women remains high in many low-resource settings, and adverse maternal and neonatal outcomes are well documented. Dietary practices during pregnancy are often suboptimal and influenced by a range of complex, context-specific factors. While existing research in sub-Saharan Africa (particularly in Ethiopia) has explored some of these influences, there is a lack of in-depth studies in other parts of the region, including Rwanda. Some studies from SSA have documented the role of cultural beliefs, food taboos, and misconceptions in shaping dietary behaviour during pregnancy, which may contribute to poor maternal dietary practices. However, more research is needed to understand these dynamics across diverse settings. The evidence gathered through this literature review helped refine the study's research questions and objectives, identify gaps in the literature, and inform the selection of an appropriate conceptual framework.

# Chapter three: Methods

This chapter presents the overall methodological approach to the PhD, tying together the different components of the study's sub-studies. It does not repeat the methods of the individual papers but rather elaborates on the overall study design.

## 3.1 Study Setting

The maternal mortality ratio in Rwanda reduced significantly from 750 deaths per 100,000 live births in 2005 to 210 deaths per 100,000 live births in 2015 but has subsequently remained roughly constant, being 203 per 100,000 live births in 2020 (59). The causes of maternal mortality in Rwanda include post-partum haemorrhage, post-caesarean wound infection, limited access to health facilities, poverty and anaemia (59). The nutritional status of pregnant women is indirectly linked to maternal mortality because it relates to some of the risk factors of maternal mortality. In Rwanda, anaemia among pregnant women has increased from 17% to 26% (2010-2020) (National Institute of Statistics of Rwanda (NISR) [Rwanda], Ministry of Health (MOH) [Rwanda], Rwanda Demographic and Health Survey 2019-20 Maryland, & ICF., 2021). The map of Rwanda is displayed in Figure 3.1.

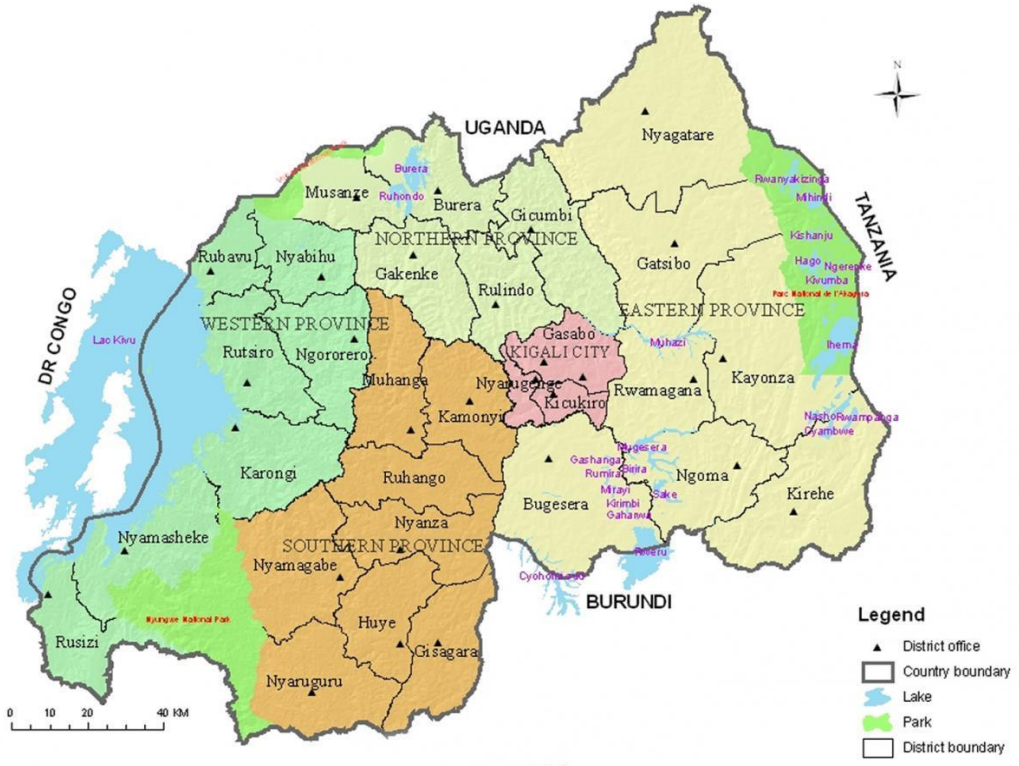



*Figure 0.1: Map of Rwanda (Source maps Rwanda)*

As described in the chapter 1, the Southern Province is situated in the south part of Rwanda and shares its borders with Kigali City and Northern Province to the North, Eastern Province to the East, Western Province to the West, and the Republic of Burundi to the South. The Southern Province covers 5701 km2 and has a population of more than two million, five hundred and eighty-nine thousand (2,589,000), with a population density of 429 per $km^2$ (National Institute of Statistics, 2022). In 2017, the Southern Province was ranked second among five provinces in household food insecurity (20.5%) and third in the poverty rate, which increased from 12.9 to 16.9% (73). According to RDHS 2014/2015 and preliminary results of 2019/2020, the Southern Province accounts for the highest prevalence of underweight and anaemic pregnant women (Rwanda Demographic Health Survey, 2014). The Southern Province has eight districts; Four of these districts were randomly selected as study sites: Kamonyi, Ruhango, Huye and Gisagara. Within each chosen district, two health centres (one rural and one urban) were randomly selected: Kamonyi (rural) and Gihara (urban) HCs from Kamonyi; Kibingo(urban) and Kinazi(rural) HCs from Ruhango; Rango(urban) and Mbazi (rural) HCs from Huye; Kibirizi(urban) and Kansi(rural) Hcs from Gisagara. A map of the Southern Province is given in Figure 3.2




*Figure 0.2: Map of the southern Province of Rwanda. (Source: [www.southernprovince.gov.rw](www.southernprovince.gov.rw))*

## 3.2. Study Design

This mixed-method study combined qualitative and quantitative approaches to achieve the study's objectives. I used a convergent parallel design that involved simultaneous quantitative and qualitative data collection. Convergent parallel mixed-methods research is an approach that combines both quantitative and qualitative methods in viewpoints, data collection and analysis with an equal reliance on both the quantitative and the qualitative techniques [161,163]. Convergent parallel mixed method research also adopts a pragmatic approach considering both scientific and interpretive paradigms with their ontological positions and epistemological assumptions. The qualitative study was undertaken to triangulate, expand, and complement the findings from the quantitative component of the research. (215).

The quantitative component, through structured interviews with 612 pregnant women, provided measurable data on dietary practices and their associations with socio-demographic and health-related variables. The qualitative component, comprising in-depth interviews with pregnant women and health care providers as well as focus group discussions with male partners, added contextual depth by exploring individual experiences, social dynamics, cultural beliefs, and systemic factors influencing dietary behaviors. Together, these complementary approaches enabled a more comprehensive understanding of the research problem, where the quantitative strand captured the 'what' and 'how much,' and the qualitative strand explored the 'why' and 'how' behind observed patterns. Integration of qualitative and quantitative findings was done during interpretation and reporting (216). Fig 3.3 summarises the overview of the study designs used within this research

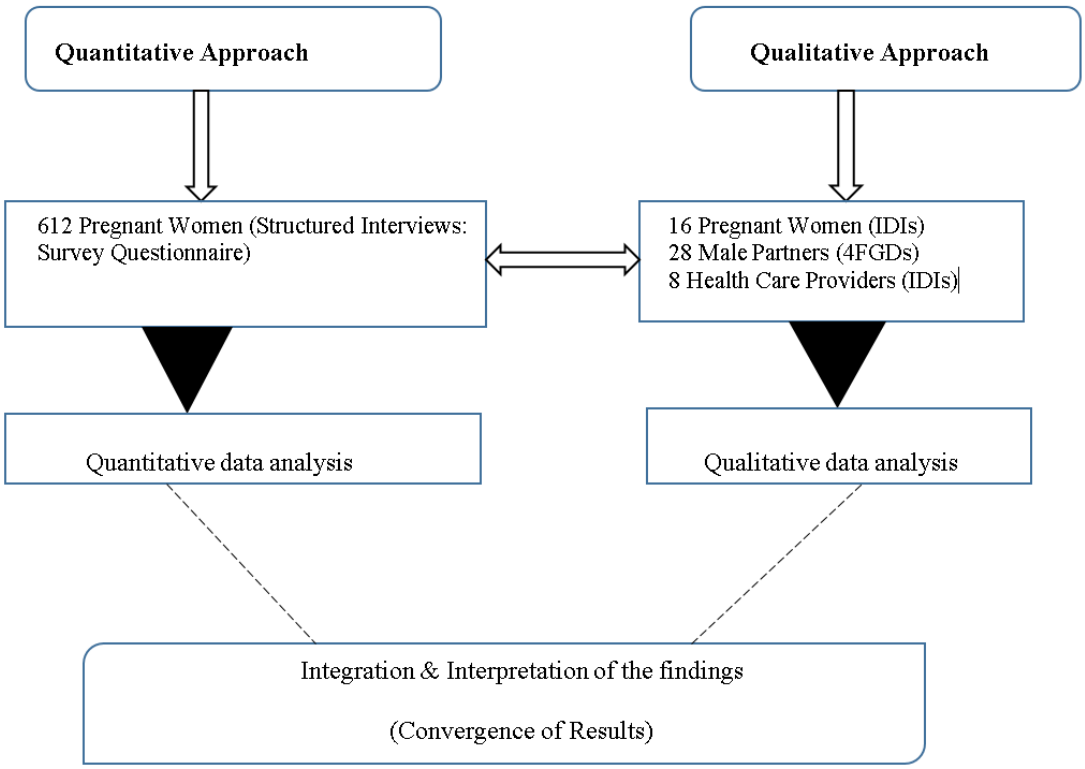



*Fig 3.3. Overview of the study design (created by author)*

Thus, this study was conducted within two distinct phases: phase one was a scoping review, followed by phase two, which involved a quantitative survey and qualitative study to comprehensively explore the factors associated with dietary practices of pregnant women. More details about the phases of the study are provided in Table 3.1.

*Table 0.1: Summary of the 'study's phases and participants*

| Phase | | Objective | Method | Data/Theme/Process | Participants |
|---|---|---|---|---|---|
| 1 | | 1 | Scoping review | Literature review: Concepts and gaps<br>Dietary practices<br>Influencing factors | **Research conducted in SSA involving pregnant women:**<br>Published in 2012- 2022,<br>in English using either qualitative, quantitative, or mixed methods approaches. |
| 2. | | 2, 3 | Quantitative | Structured interviews:<br>Dietary diversity<br>Dietary practices<br>Influencing factors | **Pregnant women:**<br>self-reported to be healthy<br>From the Second trimester and above |
| | | 4 | Qualitative | In-depth interviews (IDIs): Experiences and reasons for dietary practices | **Some Pregnant women** from the quantitative sample<br>self-reported to be healthy<br>From the Second trimester and above |
| | | | | Focus group discussions (FGDs): perceptions of their roles, support and challenges in supporting pregnant women | **Male partners** living with pregnant women |
| | | | | IDIs: perceptions of their roles, support and challenges in supporting pregnant women | **Healthcare providers** working in antenatal care services for at least 6 months. |

## 3.3. Study Participants

A detailed description of the study population is provided in each paper. Three different populations were recruited in phase two of this study. These include:

***Pregnant women***: I recruited 612 pregnant women in the quantitative survey to respond to the second and third study objectives. The pregnant women participating in the study reported being in good health and had resided in the study area for at least six months. This timeframe was chosen to account for the influence of local dietary norms on their eating habits. In addition, pregnant women from the second trimester and above were recruited because most of them are physiologically stable, and they can be easily found at the health centres. This selection helped to get a sufficient number of pregnant women who would represent 'others' views and get a rich picture of the similarities and differences in the factors associated with the dietary practices. I recruited an equal number of pregnant women from rural and urban areas to assess whether pregnant women from urban or rural areas experience the same challenges or to identify the opportunities to inform an inclusive intervention. Among the 612 pregnant women, 16 participated in the qualitative study, particularly for the third objective. This qualitative study aimed to get more insight into their experiences and reasons behind their dietary practices.

This assessment included input from male partners and healthcare providers, as well as information from pregnant women themselves, to gain a comprehensive understanding of dietary practices during pregnancy.

***Male partners***: To respond to the fourth objective, male partners living together with their pregnant female partners were recruited for focus group discussions (FGDs) because of the nature of the nuclear family in Rwanda. Male partners are the ones who spend most of the time with pregnant women and hence influence the dietary practices of pregnant women because they hold the decision-making power within the households. I sought to understand their role, experiences and challenges in supporting the dietary practices of pregnant women. Therefore, I conducted 4 FGDs (two in rural and two in urban locations); each FGD comprised seven participants.

***Health care providers***: Responding to the fourth objective, health care providers (HCPs) working in antenatal care services (ANC) were recruited for this study. ANC is considered a contact point between pregnant women and HCPs; pregnant women get most of the information related to the pregnancy, including nutrition, from HCPs working in ANC. I expected the HCPs to have important information about the dietary practices of pregnant women, and I wanted to

explore the support they deliver to pregnant women as well as the challenges they meet when supporting the dietary practices of pregnant women. I recruited eight HCPs (one per health centre) for key informant interviews (KIIs).

### 3.3.1. Sample size

A sample size of 612 pregnant women was chosen as the appropriate sample size to estimate the proportion of pregnant women to within 5%, using the formula [27]

$$n = \frac{Z^2 P(1-P)}{d^2}$$

Since there was no reliable estimate for the proportion with inadequate dietary diversity, we used a proportion of 50% to give a slightly larger sample size. A sample size of 385 would be sufficient to estimate the proportion to within ±5% (as measured by the 95% confidence interval for the proportion). However, considering the study's multi-stage cluster sampling design, where eight health centres were selected across four districts, with 73 participants recruited per health centre, we anticipated a degree of intra-cluster correlation among participants within the same health centre.

To account for this, a moderate design effect (deff) of 1.5 was used despite the large cluster (clinic) size, as it was felt that for measures such as dietary diversity the intra-cluster correlation would be low. This increased the required sample size to 578. Allowing for an estimated 6% loss due to refusal or ineligibility, the final target sample size was set at 612 pregnant women.

The qualitative sample included 16 pregnant women, eight healthcare providers and 28 male partners, to make a total of 52 participants. A summary of qualitative study participants is provided in Table 3.2

*Table 0.2: Qualitative sample*

| | **IDIs and KIIs** | | **4 FGDs** |
|---|---|---|---|
| **Health centres (HC)** | **Pregnant women** | **Health care providers** | **Male partners** |
| Rural: 4 | 8 | 4 | 14 |
| Urban: 4 | 8 | 4 | 14 |
| **Total: 8** | **16** | **8** | **28** |

### 3.3.2. Sampling method

Multistage cluster sampling was used in the Southern Province for the quantitative survey (Objectives 2 and 3). In the first stage, four of the eight districts were randomly selected, and after that, one rural health centre and one urban health centre were randomly sampled in each district, resulting in four rural health centres and four urban health centres for the study. Within the sampled health centres, a systematic sample of pregnant women was recruited, whereby the first participant was chosen randomly, and the next was the Kth number, which was considered by dividing the targeted population size by the anticipated sample size.

The qualitative study participants were sampled using purposive sampling methods, and pregnant women, male partners and healthcare providers meeting the inclusion criteria (section 3.3) were recruited for FGDs and IDIs. FGDs and IDIs were combined in the analysis to get richer data (217).

## 3.4. Data Collection and Tools

Quantitative data collection tools were adapted from the standardised tools and the literature (Appendix 9). The quantitative data collection tool consisted of seven sections assessing the outcome variables: dietary practices and dietary diversity. Dietary diversity was assessed using The Minimum Dietary Diversity for Women (MDD-W), which is a standardized data collection tool used to assess dietary diversity in women of reproductive age (15–49 years). It evaluates whether women have consumed foods from at least five out of ten predefined food groups in the past 24 hours. This threshold is considered an indicator of an adequate diet, as it suggests a higher likelihood of meeting daily micronutrient requirements, which is critical for women's health and well-being, especially during pregnancy and lactation (47).

I collected data through 24-hour dietary recall interviews. During these interviews, women were asked to recall all foods and drinks consumed in the past 24 hours. The responses were then categorized into ten food groups**,** which include: grains, white roots, tubers, and plantains; pulses; nuts and seeds; dairy; meat, poultry, and fish; eggs; dark green leafy vegetables; other vitamin A-rich fruits and vegetables; other vegetables; and other fruits. If a woman reported consuming foods from at least five of these groups, her diet was classified as meeting the minimum dietary diversity requirement. This approach provides a simple yet effective way to assess the diversity and quality of diets. Therefore, a list of 56 local foods was included in the questionnaire.

Dietary and health practices were assessed using 12 questions, including 7 to assess dietary practices adapted from the literature. The scores were calculated by summing the responses to each question. Each correct or favourable response was assigned one point, while incorrect or unfavourable responses received zero points.

Explanatory variables included demographic and obstetric characteristics, nutritional knowledge, socioeconomic, policy factors, maternal social support and household food insecurity. Sociodemographic characteristics included age, education, occupation, wealth category, and obstetric characteristics involved in the number of pregnancies and gestational age. The socioeconomic factors were assessed using an open-source questionnaire used in the Comprehensive Food Survey and Vulnerability Analysis and Nutrition Survey in Rwanda (73). I assessed nutritional knowledge using an open-source questionnaire adapted from FAO/WHO nutrition-related knowledge, attitudes, and practices (KAP) (82). This tool serves to collect data to comprehensively understand dietary behaviors, nutritional awareness, and dietary practice during pregnancy. The section assessing nutritional knowledge has been adapted to the local context and used to assess the knowledge of pregnant women included in this study. I assessed the participants' nutritional knowledge using 13-question focusing on their understanding of proper nutrition, ways to recognize and prevent anemia, and why nutrition matters during pregnancy. Scores ranged from 0 to 32, with higher numbers showing better knowledge. The total score was grouped into three categories: poor (score <16) moderate (score 16-23.9), and good (score ≥24).

Social support was assessed using the Maternity Social Support Scale (MSSS) designed by Webster and colleagues to assess the level and nature of social support available to women during pregnancy and postpartum (218). The MSSS establishes a systematic approach to evaluate this support, delivering valuable perspectives on the depth and nature of assistance available to expectant mothers through their social circles. It effectively measures distinct aspects of social support, including emotional support, informational support, and practical support. Emotional support encompasses gestures of caring, understanding, and comfort from loved ones and medical professionals. Informational support consists of recommendations, direction, or insights shared with mothers regarding pregnancy and child-rearing. Practical support entails concrete assistance, like help with childcare or domestic responsibilities.

I evaluated six key elements: support from family members, male partner’s assistance, social connections, marital conflicts, and the male partner’s control and affection. Participants rated

each component on a 5-point Likert scale with the following designations:"1=Never" represents a complete absence of support, "2=Rarely" indicates minimal or sporadic support, "3=Sometimes" denotes occasional or intermediate support, "4=Often" signifies, "5=Always" represents consistent and dependable support yielding total scores ranging from 6 to 30. The MSSS scores were classified into three categories: low (6-18), moderate (19-24), and high (25-30) social support.

I measured the 'household's food insecurity with a Household Food Insecurity Access Scale designed by Food and Nutrition Technical Assistance (219). The tool is designed to capture the experiences of households in terms of uncertainty, insufficient quality, and quantity of food due to lack of resources over a defined recall period, usually the past 30 days. It consists of nine questions that address three core domains of food insecurity including Anxiety and Uncertainty about Food Supply**,** Insufficient Quality and Insufficient Quantity**.** Each question is followed by a frequency response, where respondents indicate how often the experience occurred in the past 30 days as follow: Never (0), Rarely (1)**:** 1–2 times in the past 30 days, sometimes (2)**:** 3–10 times in the past 30 days and Often (3)**:** More than 10 times in the past 30 days. We recorded the responses for each question and calculated the total score to determine the level of food insecurity. The scores range from 0 to 27, with higher scores indicating greater severity of food insecurity while a score closer to zero indicates a household is food secure or has minimal concerns about food access. Based on the responses, participants were categorized in four groups including food secure (score <2), mild food insecurity (score 2-10), moderate food insecurity (score 11-17) and severe food insecurity (score >17).

Policy and health system factors questions were adapted from the existing policies to assess the availability of kitchen gardens and Girinka program (one cow per poor family), which are part of the Rwandan National Food and Nutrition Policy. Qualitative interview and focus group discussion guides were developed drawing from the literature and study objectives (Appendix 11). These guides underwent validity testing and pilot testing for clarity and completeness. Overall data collection was done for two months, from 15$^{th}$ May 2022 to 15$^{th}$ July 2022 in Kinyarwanda, a local language. Quantitative data collection, IDIs and KIIs lasted for 45-60 minutes, while FGDs lasted between one hour and one hour and a half. Quantitative data collection was conducted by eight research assistants trained in nursing, midwifery and human nutrition who have prior exposure to research data collection. One research assistant and I conducted the qualitative data collection. Data saturation, which refers to the “completion or

fullness" of the data (Padgett, 2008, p.171), was reached after approximately 12 first interviews. I continued interviewing to gain a broader understanding of the experiences of pregnant women in both rural and urban areas, delving deeper into their specific perspectives.

## 3.5. Data Management and Analysis

The data cleaning process was conducted using STATA Release 16, which was also employed for data analysis by calculating descriptive statistics, specifically frequencies and percentages for categorical variables and means with standard deviations (SD) for quantitative variables. I implemented a complete case analysis, excluding participants who had fasted the previous day. The study contained minimal missing values.

First, I fitted univariable logistic regression models to determine factors potentially linked to dietary practices, employing a liberal screening p-value of 0.20 to capture all possible confounding variables. I also incorporated design variables (district and rural/urban) and those previously recognized in the literature as correlates of dietary practices (age and wealth category) into the final model, regardless of their statistical significance. Quantitative explanatory variables were incorporated as continuous variables, with fractional polynomials utilized to examine any non-linear effects, as multiple researchers have highlighted the limitations of categorizing continuous exposure variables (220–222).

After identifying the pool of potential explanatory variables, I employed backward elimination with a nominal p-value of 0.05 for exclusion to select the final model, maintaining district, rural/urban, age, and wealth categories as fixed variables. While backward elimination and similar stepwise procedures have recognized limitations, this approach is advised for analyses without a primary exposure focus, offering the advantage that negatively confounded variable sets are less likely to be excluded since all significant explanatory variables are present in the initial model. This guidance is detailed in chapter 10 of *Regression Methods in Biostatistics: Linear, Logistic, Survival and Repeated Measures Models*, Second Edition by Vittinghoff E and colleagues in (2012).

Given the limited number of clusters (8 health centres) in our model, we opted to include terms for district and rural/urban rather than treating clusters as random effects. Factors impacting dietary practices were presented as odds ratios with 95% confidence intervals. We examined interactions involving key exposures (radio ownership, kitchen garden presence, food

insecurity, and nutritional knowledge), but none showed statistical significance. We assessed potential multicollinearity through variance inflation factors in the final model, finding no evidence. Additionally, we evaluated the final model's goodness of fit using the Hosmer-Lemeshow test, which revealed no lack of fit. We calculated Cronbach alpha values of 0.93 for food insecurity and 0.74 for maternal social support, indicating satisfactory reliability.

For qualitative data analysis, four research assistants transcribed recordings into Kinyarwanda using the true verbatim method, transcribing every spoken word exactly as they are heard to capture meanings and insights perfectly (20). Field notes were integrated into the written transcripts as supplementary data. Transcripts were then translated into English by a professional translator. Data were analysed using N-vivo version 12 conducting thematic analysis by combining deductive and inductive approaches in six steps: 1) familiarization with data; 2) identifying initial codes; 3) generating themes; 4) reviewing and defining themes; 5) coding the data; 6) organizing themes and write up (223). Then, themes and sub-themes were created, and quotes were used to report the findings.

## 3.6. Quality Measures for Quantitative Survey

The data collection tools were translated from English to a local language, Kinyarwanda, by professional translators and back-translated to English to ensure the originality and resemblance between both versions (224). Qualified data collectors were hired and trained on the current research. In addition, before starting data collection, a pilot study was conducted among 10 pregnant women to pre-test data collection tools. The pilot study helped assess the study's feasibility and refine the clarity of the data collection tools. Some questions were modified based on the pilot study feedback (225).

## 3.7. The Research Team and Reflexivity

I collected the qualitative data as part of my doctoral studies with the support of one research assistant. I am a Rwandan woman working in academia research the nutrition of pregnant women. I live in Kigali, the capital city of Rwanda, and have different living conditions and perceptions from the study participants. Upon my arrival at each health centre, the study participants thought I could be an external donor from a governmental agency or a renowned non-government organisation (NGO). This misconception persisted until I clarified my identity and the objective of my visit. These misconceptions could have influenced interview responses, potentially leading to over- or under-reporting information as participants anticipated potential donations. Given my prior involvement in studies with pregnant women, I know how to

approach these participants. Dressing simply, greeting them, explaining clearly the benefits and risks of participating, using simple language, and being a woman increased the 'participants' trust, and then they talked about their experiences towards dietary practices.

The research assistant is a Rwandan woman, aged 40 years old with a bachelor's degree in public health. She has been involved in research activities for eight years and works in a research institution where qualitative data collection is among her primary responsibilities. She is a woman from the Southern Province and has been involved in many studies conducted in the area. Being a woman and more familiar with the place facilitated engagement with the study participants, who freely provided the required information. The two co-authors who were part of the analysis stage are experienced South African qualitative researchers who have both worked on maternal health and were able to provide an external perspective on the analysis as well as quality assurance support.

## 3.8. Ethical consideration

Ethical approval was obtained from the Wits Human Research Ethics Committee (M211046) and the Institutional Review Board of the University of Rwanda (287/CMHS IRB/2021) (appendix 2). All required permissions were secured from relevant authorities (Ministry of Health and Rwanda Biomedical Centre (Appendix 3, 4). To ensure informed participation, all participants were provided with an information sheet detailing the study's objectives, potential risks and benefits, confidentiality procedures, and contact information for any questions or concerns. When the participants agreed to be part of the study, they signed an informed consent and tape-recording form allowing them to record the interviews (Appendix 7). Participants were assured that participating in this study does not cause physical harm, is voluntary, and can be stopped anytime without prejudice. A pregnant woman diagnosed with malnutrition (MUAC< 23cm) was given nutritional counselling and referred to nutritional services for further management. Data collection tools utilized unique codes instead of personal identifiers to ensure participant anonymity. The safety of all data was ensured by using password-protected computers. Qualified and trained enumerators were hired, and the confidentiality of the data was emphasised during the training about this research and data collection.

# SECTION B: RESULTS

This chapter includes the manuscripts produced from this PhD to comprehensively highlight the factors influencing the dietary practices of pregnant women that could be targeted in developing evidence-based interventions to improve maternal nutritional status. I made small changes, such as removing the acronyms mentioned in the introduction parts and some sections specific to particular journals, such as conflict of interest, acknowledgement, and funding resources sections. Apart from that, they are presented as published or submitted into scientific journals with the co-authors' permission to be submitted.

**Uwase, A.,** Nsereko, E., Pillay, N., Livin, J., Gaudge, J. Factors contributing to the dietary practices of pregnant women in Sub-Saharan African countries: a scoping review (submitted to Pan African Medical Journal).

This scoping review responds to the first objective of my PhD thesis, which is to identify the existing evidence about the factors associated with the dietary practices of pregnant women in sub-Saharan Africa. This review aimed to map the existing literature on the factors associated with dietary practices, identify gaps, and guide future research by informing the subsquent objectives of this study. The findings from this scoping review helped design the qualitative data collection tools and complemented the quantitative data collection tool as well. More details about the findings and methodology are provided in the entire manuscript.

**Uwase, A.,** Nsereko, E., Henriette, U., Sarah, N., Pillay, N., Levin, J.: Factors associated with dietary and health practices among pregnant women in the southern province of Rwanda: a mixed-method study (submitted to BMC pregnancy and childbirth).

Based on the findings from the first objective, I conducted this mixed-method study combining quantitative and qualitative approaches. Through these approaches, I assessed the factors associated with pregnant women's dietary practices and explored the reasons for their dietary practices in the Rwandan context, particularly in the Southern Province.

Aline Uwase, Etienne Nsereko, Nirvana Pillay, Jonathan Levin (2024), Dietary diversity and associated factors among pregnant women in the Southern Province of Rwanda: A facility-based cross-sectional study. PLoS ONE 19(2): e0297112. https://doi.org/10.1371/journal.pone.0297112

Dietary diversity is the main component of dietary practices that is used as a proxy indicator of dietary quality. In this quantitative study, I have assessed the status of dietary diversity and its determinants to predict the quality of diet consumed by the pregnant women in the Southern Province. Due to resource limitations, I could not measure their micronutrients status, so instead, I evaluated the nutritional status by considering Mid-upper arm circumferences.

**Uwase, A.,** Nsereko, E., Henriette, U., Sarah, N., Levin, J., Pillay, N Healthy mothers, healthy futures: Exploring the influence of healthcare providers and male partners on pregnant women's dietary practices (Submitted to BMC Public Health).

This qualitative study responded to the fourth objective, which was to explore how male partners and health care providers as the main supporting systems in Rwanda, support the dietary practices of pregnant women in the Southern Province of Rwanda. In addition to the support, I identified the challenges they meet when providing the support and their suggestions to improve the dietary practices of pregnant women.

# Chapter four: Factors contributing to the dietary practices of pregnant women in Sub-Saharan African countries: a scoping review.

## 4.1. Abstract

**Background:** The dietary practices of pregnant women in Sub-Saharan Africa have been reported to be consistently poor for a long time. Therefore, developing context-specific and timely interventions requires a comprehensive assessment and an understanding of the determinants of dietary practices during pregnancy. However, there is a dearth of reviews mapping the factors influencing the dietary practices of pregnant women in Sub-Saharan Africa. Thus, this scoping review aimed to describe the factors associated with the dietary practices of pregnant women living in Sub-Saharan African countries.

**Methods** We used the framework developed by Arksey and O'Malley, which, in this scoping study, included a five-step process and the Preferred Reporting Items for Systematic Reviews and Meta-Analyses for Scoping Reviews to guide this review. The Population, Concept, and Context framework was used to develop search syntax to guide the literature search, which was conducted using the PubMed and CINHAL databases. A manual search was also performed using Google and Google Scholar for studies published from June 2012 to June 2022.

**Results** This review included studies published in English or French during the past ten years. Thirty-six articles met the inclusion criteria and were included in the review. The review's findings revealed that factors contributing to the dietary practices of pregnant women are complex involving maternal and husband/partner's sociodemographic characteristics, household wealth index, family support and access to food and health facility services. In addition, food taboos and cultural beliefs surrounding nutrition during pregnancy affect the dietary practices of pregnant women. However, this review identified a shortage of studies identifying the effect of policy factors on the dietary practices of pregnant women.

**Conclusions:** A combination of nutrition-sensitive and nutrition-specific interventions, male partners' involvement, and women's empowerment would benefit SSA.

**Keywords**: *Expectant mothers, Pregnant women, Dietary practices, Nutritional practices, Food taboos, Sub-Saharan Africa*

## 4.2. Introduction

Maternal malnutrition is a serious global health concern contributing considerably to disease burden and mortality worldwide in mothers and children (226). Maternal malnutrition

disproportionately affects low and middle-income countries, particularly in Sub-Saharan Africa (SSA), where 23.5% of pregnant women are reported to be malnourished (227). A recent study showed that being underweight (with a body mass index (BMI) less than 18.5 kg/$m^2$) is common among women of reproductive age (15-49 years) in SSA, with a prevalence ranging from 10.4% in rural areas to 6% in urban areas, indicating that many women are malnourished by the time they start their pregnancies (228).

Pregnant women are especially prone to malnutrition because they require more nutrients to meet the physiological demands of being a mother and carrying a developing foetus (73). Maternal malnutrition is linked to an increased risk of pregnancy with complications and poor pregnancy outcomes, such as preterm membrane rupture, pregnancy-induced hypertension, intrauterine growth retardation, low birth weight, and congenital abnormalities, such as spina bifida (24). Malnutrition in women is frequently part of an intergenerational cycle of deprivation. Children exposed to malnutrition in utero are born with an increased risk of stunting (chronic malnutrition) and long-term deficits, such as impaired neurocognitive development, decreased educational performance, lower economic productivity in adulthood, and increased morbidity and mortality (229).

Studies have reported that dietary practices are among the core factors contributing to the nutritional status of pregnant women (116) (230). The dietary practices of pregnant women in SSA are reported to be poor. Recent evidence from Ethiopia and Benin shows that only 25.1% and 39.2% of pregnant women adhere to good dietary practices (231) (232). Similarly, in Ghana, the prevalence of good dietary practices among pregnant women is estimated at 19.1% (233). Therefore, it is crucial to improve pregnant women's maternal nutritional status caused by poor dietary practices. Studies show that the factors that negatively influence nutritional practices include inadequate nutritional knowledge, socioeconomic factors, food insecurity, and incorrect cultural beliefs about food consumption during pregnancy (119).

It is essential to review the factors associated with poor dietary practices during pregnancy in SSA to develop context-specific and appropriate interventions, which should help improve the dietary practices of pregnant women in SSA, as well as their nutritional status and delivery outcomes. However, there is a shortage of reviews describing the factors influencing the dietary practices of pregnant women in SSA. Therefore, a comprehensive review that examines the factors influencing the dietary practices of pregnant women in SSA is much needed. This

scoping review seeks to address this gap by describing the factors influencing pregnant women's nutritional practices in SSA countries.

## 4.3. Methods

The scoping review protocol of this review has been registered at open science framework with the following number https://doi.org/10.17605/OSF.IO/JSX24. This scoping review used the framework developed by Arksey and O'Malley that recommends a five-step process for scoping reviews: this includes 1) identifying the question(s), 2) identifying the relevant studies, 3) selecting the studies; 4) charting the data; and 5) collating, summarising, and reporting the data (234). We did not apply the sixth step, which is referred to by Arksey and O'Malley as an 'optional consultation exercise' to enlighten and validate the results of scoping reviews (235). We also used the Preferred Reporting Items for Systematic Reviews and Meta-Analyses Extension for Scoping Reviews (PRISMA-ScR) checklist and guidelines to ensure a comprehensive and replicable process (236).

### 4.3.1. Identifying relevant studies

#### 4.3.1.1. *Databases*

After developing the research questions, we searched for relevant studies published in the PubMed and CINAHL databases. While using all relevant databases reduces the chances that something will be missed, it considerably increases the number of hits (often by including articles that are not relevant). So the screening task can be enormous, reducing the review's feasibility. Given this inevitable trade-off and that the review is part of PhD study, we chose the two most relevant databases that are likely to include all relevant studies, i.e. PubMed and CINAHL. We also searched Google and Google Scholar to identify other appropriate sources within the grey literature. We conducted the literature search for two months between 1st May and 30th June 2022.

#### *4.3.1.2. Search*

The Population, Concept, and Context framework helped the study authors develop the search syntax whereby the population was pregnant women, the concept was dietary practices and beliefs or food taboos, and the context was countries in SSA. The key terms that were used to search for relevant studies were: [Pregnan* OR expectant mother], [Diet* OR nutrition* OR feeding OR eating], [food taboos OR food habits OR nutritional beliefs], and a list of countries in SSA. We used Boolean operators (AND, OR) to combine search terms and narrow the

results, and we conducted a manual search of relevant articles in Google Scholar to identify any additional publications or grey literature.

#### *4.3.1.2. Inclusion and exclusion criteria*

This review included studies that used qualitative, quantitative, or mixed methods approaches to assess the determinants of dietary practices among pregnant women. In addition, studies that explored cultural beliefs related to nutrition during pregnancy or food taboos among pregnant women in SSA were selected. Research published in the last ten years (June 2012 to June 2022) in English or French was also screened. The authors were limited to studies published in English or French due to resource constraints. Studies published in languages other than English or French would have required professional translators (additional human, time, and financial resources) along with the possibility of misinterpretations. However, we did not include review articles to ensure a thorough assessment of the primary data. Similarly, primary studies that recruited pregnant women having non-communicable diseases such as diabetes and HIV were not included in this review because these conditions expose pregnant women to particular dietary practices.

### 4.3.2. Selection of relevant studies: Screening

The principal investigator (AU) reviewed all primary articles by reviewing their titles and abstracts. During the primary screening, AU was unsure whether to include or exclude three articles. Thus, the articles were discussed with JG, and after reading the full text of all three studies, both authors agreed on their inclusion. Disagreement between authors about the inclusion of any studies based on reading the abstracts was resolved by including the studies in the next step of the process: reading the full text of the articles and reaching a consensus or seeking an opinion from a third author. The authors (EN, NP, and JL) read the final articles that were included and confirmed their eligibility.

### 4.3.3. Charting the data

We used Microsoft Excel 2016 to gather relevant information about the articles: author(s), year of publication, aim of the study, study population, study location, design, method, key findings, and conclusions. One researcher (AU) independently completed the data extraction process by reviewing all the full-text articles considered for inclusion to assess their coherence with the research questions, and the researcher concluded that all of the articles should be included in the study. The same researcher extracted the results section from each included article and pasted it into a Word document to highlight the relevant information. The second researcher

(JG) reviewed the extracted data to confirm their relevance to the research question, and the other authors (EN, NP, and JL) cross-checked the data extraction sheets and concluded that the extracted information addressed the research question.

### 4.3.4. Collating, summarising, and reporting the data

Relevant data, such as the aim, setting, research methods, and key findings of these studies, were analysed through a thematic analysis, whereby emerging themes related to our research question were identified.

## 4.4. Results

The initial search yielded 1303 records. We removed 13 duplicates and excluded 1248 records based on the screening of the titles and abstracts. Forty-two records were eligible for the full-text analysis, and six were excluded because they did not meet the inclusion criteria. Finally, 36 articles fulfilled the inclusion criteria in the review process (Figure 4.1).

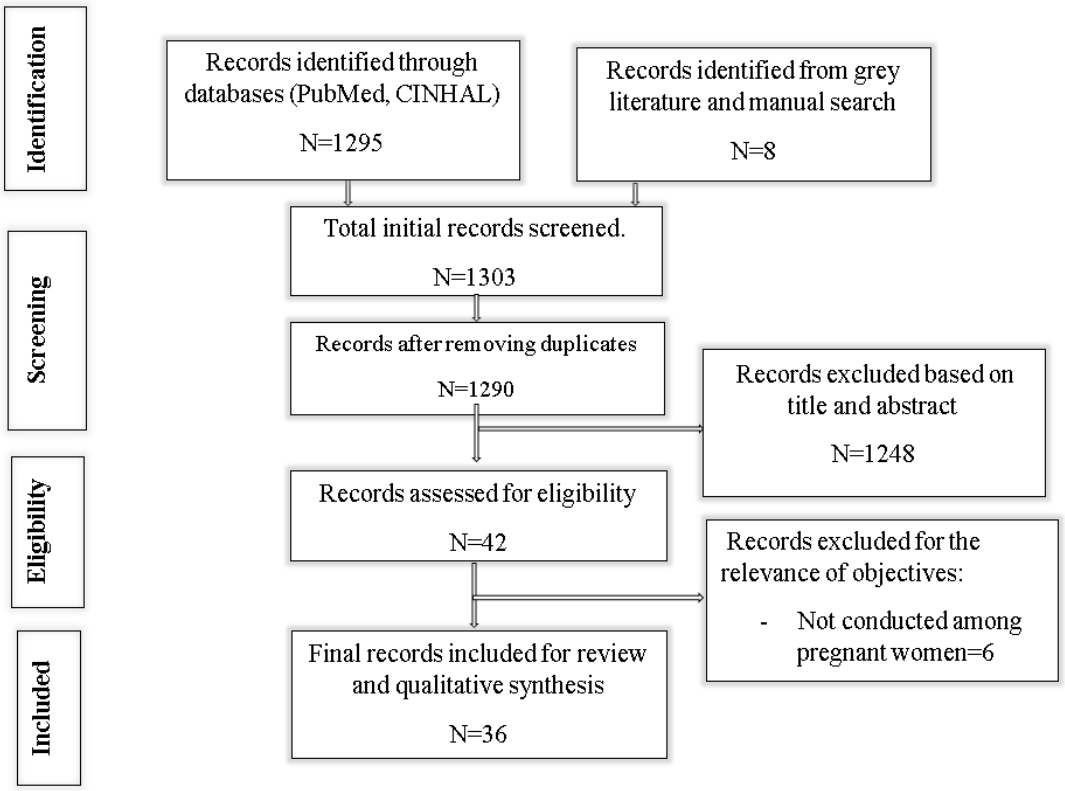



***Figure 0.1: PRISMA flow diagram of the study selection process.***

### 4.4.1. Characteristics of the selected articles

This scoping review included 36 studies conducted in SSA between 2013 and 2022 among pregnant women. Most studies (*n=20)* were published between 2013 and 2017, and 16 were

published between 2018 and 2022. Most of these studies *(n=21)* were conducted in different geographical regions of Ethiopia; four studies were from Nigeria, two studies each were from Niger and Kenya, and one study was conducted in each of the following countries: Benin, Ghana, New Guinea, South Africa, Sudan, Tanzania, and Zambia. Among the 36 studies, 23 used a quantitative approach, 10 used a qualitative approach, and three used mixed methods.

### 4.4.2. Key findings

The findings from the studies included in this scoping review were categorised into themes using a socio-ecological model developed by Urie Bronfenbrenner. This model classifies the factors influencing behaviour or practices at different levels, including intrapersonal, interpersonal, organisational, community, and policy levels (237). This model was helpful in structuring the findings of this scoping review because we found that reported factors occur at these different levels.

***Intrapersonal factors and dietary practices of pregnant women***

Intrapersonal factors relate to the pregnant woman, including age, education, marital status, nutritional knowledge, personal beliefs, and physiological changes. Among the included studies, 2/36 reported maternal age to affect dietary practices, where younger pregnant women followed good dietary practices compared to their older counterparts (115,238). Others (2/36) showed that single pregnant women practised better dietary habits than their married counterparts (19,20). Five out of 36 studies reported maternal educational as a potential factor associated with good eating habits during pregnancy. Pregnant women with a low level of education followed suboptimal dietary practices compared to their counterparts with a high or moderate level of education (119) (139,239–241). Higher education implies more profound knowledge, which is often translated into practice. Six out of 36 studies in this review reported that adequate knowledge of good nutrition during pregnancy influenced optimal dietary practices (119,231,239,241–243), whereas limited knowledge of nutrition during pregnancy leads to poor dietary practices (232). People with high levels of education are more likely to be offered employment opportunities and increase their income level. High-income level improves purchasing power, which leads to affordability and accessibility of different food groups as well as healthy dietary behaviors. Three studies among the 36 found that pregnant women employed by governments or merchants reported good dietary practices compared to their counterparts who were housewives (119,231,244). In addition, the monthly income of

pregnant women was found to influence good eating habits in four studies out of 36 (119,231,239,245).

Obstetric characteristics of pregnant women, such as gestational age and number of pregnancies, can affect their dietary practices. During the early stage of the pregnancy, pregnant women undergo different physiological changes, including gastrointestinal and immunologic, which impact dietary practices. One study included in this review revealed that the first trimester was linked with poor dietary practices, whereas late gestational age was related to improved dietary practices (116). Pregnant women who experienced chronic illness and pronounced physiological changes, such as nausea, vomiting, and food cravings, had poorer dietary practices compared to their healthier counterparts in 5/36 studies (116,119,165,246,247). Such conditions affect food preferences, and two authors in this review reported that pregnant women's food preferences influenced their dietary behaviour (116,248). Pregnant women who reported long inter-pregnancy intervals and had less than three children showed good dietary practices in two included studies (241,247).

***Interpersonal factors and dietary practices of pregnant women***

Interpersonal factors highlight the interaction between pregnant women and those who can provide nutritional support. They include household factors, such as family support, spousal support, household income, and household food security. 12 / 36 studies included in this review showed how the husbands/ male partners play an essential role in the dietary practices of pregnant women. Husbands' characteristics, such as age (89), educational level (232,245,249), income (246), occupation (115,245), attitude towards nutrition, and knowledge (232) were reported to influence the dietary practices of their pregnant wives. Husbands' emotional and financial support of their pregnant wives led to optimal dietary practices in three studies out of 36 (238,243,250). Pregnant women living with their husbands/male partners of advanced age, with a high education level and income and a paying job, exhibited good dietary practices compared to their counterparts. Two out of 36 studies (165,240) found that the dominant authority of husbands and the limited financial empowerment of wives led to poor dietary practices (165,240).

Among 36 studies, 14 (14/36) highlight the household's role in pregnant women's dietary practices. Eight studies included in this review reported that a higher socioeconomic status and household income affected the dietary practices of pregnant women

(114,115,232,240,247,250–253). In addition, two studies reported ownership of a radio or television (231,246), be linked with good nutritional practices of pregnant women while one study showed an association between livestock ownership, participation in the market exchange and dietary practices (250) . Household food security was reported to contribute to good dietary practices of pregnant women in three studies (231,240,254). In contrast, study participants in the included studies reported limited household food availability and finances to have a negative influence on their dietary practices in one study (255). Likewise, seasonal changes leading to limited edible crops and reduced vegetable production led to suboptimal nutritional practices among pregnant women in one study (135).

***Organisational factors and dietary practices***

Organisational factors relate to organisations and other structures pregnant women interact with; in this case, healthcare organisations or providers that deliver antenatal care (ANC), including nutritional education. Two studies included in this review reported that pregnant women who attended four or more ANC visits engaged in good nutritional practices compared to those with two or fewer visits (177,239). Similarly, pregnant women who received nutritional education or counselling from healthcare facilities exhibited adequate dietary intake compared to those who had not received this education in six studies (89,115,232,245,252,256). However, the limited nutritional knowledge of some healthcare providers was reported to be a barrier to good dietary practices among pregnant women in two studies (32,139).

***Community factors and dietary practices***

Community factors include cultural and health beliefs related to nutrition and food taboos during pregnancy. This scoping review found that pregnant women from different countries in SSA avoided certain foods or were encouraged to consume other types of food for various reasons, including personal, physiological, social, and cultural reasons, as well as traditional beliefs and misconceptions.

*Discouraged foods*

The studies in this review revealed that pregnant women in SSA restricted their intake of some types of food to avoid undergoing a difficult delivery and an obstructed and painful labour. The most prohibited foods were those rich in protein because of the belief that high-protein foods promote the body's growth, including the growth of a foetus, thereby complicating the birth process. Six studies out of 36 reported that many pregnant women restrict their intake of

unpasteurised milk, meat, eggs, sweet foods, butter, beans, oil, groundnuts and avocado to avoid having to deliver a large baby because tiny babies are easier to deliver and less likely to cause birth-related complications (114,135,138,177,257,258).

To ease delivery, some pregnant women reduced their quantity and frequency of food. Pregnant women in Benin practice fasting to prevent the growth of the foetus and the need for its extraction during labour (137). Similarly, in Tanzania and the Abala District of Ethiopia, pregnant women were discouraged from overeating and eating too often to avoid having a large baby and a difficult delivery, including a caesarean section or perineal tear (135,136).

Pregnant women avoided some food types because of their perceived harmful effects on the growing foetus, which included skin abnormalities, such as rashes and burns. Pregnant women from East Gojjam, Ethiopia, reported avoiding pimento, coffee, and tea because they believed these foods burn the foetus and cause skin abnormalities (258). Similarly, eight studies showed that women reported restricting their intake of roasted seeds, rice, semi-solid foods, fruits, vegetables, porridge, cereal soup, bananas, cabbage, milk, and yoghurt because they believed these foods would stick to the baby's skin and sugary food cause much salivation (36,114,129,136,138,139,257,259).

The pregnant women in the studies included in this review tabooed some foods because they feared pregnancy-related complications, such as miscarriage, abortion, and bleeding. Beans and chickpeas were believed to exacerbate labour pains and cause abortions in pregnant women in one study (177). Similarly, honey, mustard-containing foods and a soup prepared from linseed and chicken meat (yedoro shorba) were believed to relax the cervix and lead to abortions in one study as well (139). Solid foods and different types of bread were believed to cause severe bleeding during delivery in an other one study (36). Gastrointestinal problems were reported as the reason for food restrictions among pregnant women. In Ethiopia, pregnant women avoided cool meat, milk, yoghurt cheese, and cool water because they believed those foods caused bloody diarrhoea, vomiting, abdominal diseases, and typhoid (136).

Maternal and foetal protection from witchcraft was reported in some countries as the reason for food prohibition. Some women avoided foods they believed to be 'evil food' or food that was too dangerous to be consumed by a pregnant woman. In Kenya, some believe that the meat of animals that die from complications, such as miscarriages, stillbirths, or placenta retention, should not be eaten. Two studies reported beliefs that if a pregnant woman consumes such meat, a bad spirit in the animal's blood will be transferred to the pregnant woman, causing her

to have similar complications (257,260). Similarly, pregnant women are advised to eat horse womb regularly and to drink baboon urine to protect the mother and baby from witchcraft and to ensure an easy delivery without complications in one study (129).

*Encouraged foods*

Pregnant women were specifically encouraged to consume certain foods because of the perceived importance of these foods during pregnancy in two studies. In Kenya, pregnant women were advised to consume energy-giving foods, such as potatoes and ugali (maize bread), to prevent obstructed labour (Potatoes were believed to increase maternal strength) (260). Fruits, crab, and unripe plantain were encouraged with the belief that they could strengthen the unborn baby and the woman in labour (36). Women were also encouraged to eat meat and beans to stay healthy during pregnancy and to have sufficient blood (260).

## 4.5. Discussion

Dietary practices play a critical role in maternal and child health. This review described the factors associated with the dietary practices of pregnant women in SSA and found that these come from multiple levels of influence combining the individual and his environment.

Highly educated pregnant women had better dietary practices than their uneducated counterparts, which might be related to their greater access to different sources of nutritional information that improved their nutritional knowledge and, hence, their dietary practices. Less education, in particular, was closely related to worse dietary practices due to a lack of basic information, regardless of other circumstances. This finding is consistent with the results of studies conducted in Brazil (261).

Pregnant women with better nutritional knowledge exhibited optimal dietary practices. It is possible that their sufficient knowledge about the advantages and disadvantages of nutrition during pregnancy and the components of a balanced diet helped pregnant women follow standard dietary practices. However, these findings are inconsistent with a study conducted in Pakistan, in which only a few women applied their knowledge to dietary practices despite the high number of pregnant women with a high level of nutritional knowledge during pregnancy (262). This discrepancy in the findings may be attributed to the participants' sociodemographic characteristics and country-specific context.

High maternal income affected the optimal nutritional practices of pregnant women. This might be explained by increased income being linked to improved purchasing power, enhancing the

availability of diverse foods. As income increases, recommended foods and healthy nutrition practices are affordable. This finding is similar to a study conducted in Iran (263). Pregnant women employed reported good eating habits compared to homemakers. This difference might be because salaried pregnant women are financially empowered and can purchase different foods that might help them adhere to appropriate dietary practices. Moreover, these women could afford health care during delivery and were less worried about not receiving care during a complicated delivery. A similar finding was reported in a study conducted in Egypt (264).

The limited autonomy of women was identified as a factor hindering the dietary practices of pregnant women. Only a minority of women living in countries of SSA are allowed to make decisions about their health, including nutrition, which is a possible reason for this finding. Similarly, the culture of countries in SSA does not favour women, who are often the caregivers of entire families, providing food for all family members (despite limited food) and prioritising husbands and children. This situation forces a pregnant woman to eat only what is available, with limited options to acquire diverse foods. A similar finding has been reported in another study (265).

Such findings on individual characteristics highlight the need for women's empowerment in SSA. According to this review’s findings, the broad dimensions of women empowerment needed explicitly in SSA are cognitive, psychological, economic and sociocultural (266) . Cognitive empowerment involves improving pregnant women's understanding of the need to make healthy dietary choices during pregnancy. It also includes increasing the nutritional knowledge of a balanced diet and its advantages. Rising education level is one of the strategies that can be used to improve pregnant women's cognitive and psychological empowerment. Economic empowerment involves a woman's relative contribution to family support, access to employment, ownership of assets, land, and access to credit (267). Strategies to empower women economically include improving education, employment, income and initiating and implementing income-generating activities. The socio-cultural dimension captures gender norms, including norms regarding women's physical mobility, visibility in and access to social spaces (268).

This review found that the obstetric and gynaecological characteristics of the women, such as low parity, were related to good eating habits. Low parity 'goes hand in hand with small families, which decreases the nutritional burden and allows more time and money to be spent on the nutritional needs of family members, thereby improving their nutritional practices. First-

time mothers might want to do their best to comply with optimal dietary practices. However, a study in Pakistan reported parity as a non-predictor of dietary practices (269). High inter-pregnancy interval was reported to affect the dietary practices of pregnant women. It is possible that as the intervals between pregnancies increase, implementation of the required nutritional practices also increases because the nutritional advice received during the previous pregnancy will be resumed as the pregnant woman will not have very young children to care for.

Many studies included in this review reported the impact of male partners on the dietary practices of pregnant women. They showed how husbands' support during pregnancy could improve compliance with good eating habits because their support fosters shared responsibility for ensuring the availability of diverse foods. This warrants the involvement of husbands/male partners in the nutrition of pregnant women. In many developing countries, men dominate most life ranges from national to household. Men are commonly considered heads of households, control decision-making, and possess the most societal leadership. Men in developing countries possess the power to control financial household expenditure (270). This position of men in developing countries offers them the significant power to influence women's well-being, including nutritional health. However, male partners' involvement in maternal health is challenged by different barriers that still need to be overcome. Some barriers are associated with socio-cultural and traditional norms (271). Most men still believe that maternal health is a woman's field in which men are not expected to be actively involved (272). Other study conducted in Bangladesh have also highlighted the importance of male partners for women's health (273).

Household factors were reported by many studies included in this review to affect dietary practices. Household economic status and food security were reported as the dominant factors. Pregnant women from food-secure households followed optimal dietary practices compared to those from food-insecure households. The reason for this finding might be that SSA is the most food-insecure region in the world because of its rapid population growth rate, stagnant agriculture production, and dependency on cereal imports (274). This situation limits food availability and accessibility, not allowing pregnant women to adopt optimal eating habits; hence, they experience widespread hunger, leading to a high prevalence of nutritional deficiencies. This finding is consistent with another study conducted in Malaysia (275).

This review reported health system factors, such as attending ANC visits and receiving nutritional information from health facilities, that influenced the dietary practices of pregnant

women. The women with more frequent ANC visits where they received nutritional information were more likely to have better dietary practices than those with lower attendance rates. A probable explanation for this finding is that healthcare providers deliver nutritional education during ANC visits; thus, more frequent attendance increases the awareness of the benefits of adhering to sound nutritional practices. This finding is consistent with a study conducted in Malaysia (275). However, this review also showed that the limited nutritional knowledge of the health care providers working in ANC services was associated with the poor nutritional practices of pregnant women who attended these services. Healthcare providers are potential sources of nutritional information; therefore, if the source is limited, the information delivered to pregnant women will also be limited, negatively affecting their nutritional knowledge and practices.

This review found that community factors, such as cultural beliefs and traditions, affected maternal nutritional practices during pregnancy. The main reason for practicing food taboos was to avoid a large baby, foetal abnormalities and pregnancy complications. To avoid big babies, most pregnant women avoided consuming foods rich in nutrients such as animal sources, including meat, eggs, fish, and dairy products like cheese, milk and yoghurt. Animal-source foods contain quality protein and crucial micronutrients necessary for good pregnancy outcomes and infant development (276,277). Epidemiological studies reported that unusual animal-source food consumption contributes to maternal micronutrient deficiency, leading to under-nutrition in developing countries (278,279). This finding shows how pregnant women in SSA could be exposed to micronutrient deficiencies and their associated impact on pregnancy outcomes. Evidence shows that the adequate consumption of animal-sourced food during pregnancy improves birth outcomes by increasing birth weight (174). Similarly, dairy products contain calcium, proteins, and vitamins A, B12, and D, essential for foetal growth and development [63]. Other studies conducted in China, Thailand, and Indonesia have reported that cultural beliefs affect the consumption of animal sources of food (280–282).

In addition, some pregnant women in the included studies practice fasting to avoid a large foetus, which increases the likelihood of birthing complications leading to a caesarean section. The latter events are considered a malediction (curse) with expenses and serious complications, such as maternal and/or foetal death(s) and long-term back pain limiting one's functioning. Cases of medical emergencies require rapid intervention; however, the shortage of healthcare workers in most healthcare facilities in SSA increases the likelihood of adverse complications, such as the death of the mother and/or baby. However, fasting and reduced food intake expose

the mother and child to nutritional deficiencies, leading to poor nutritional status and associated complications.

Pregnant women in SSA avoided fruits and vegetables, such as pineapple, black grapes, papaya, and green leafy vegetables. However, fruits and vegetables are the primary sources of minerals and vitamins, including potassium, folate, magnesium, and vitamins A and C (283). In addition, vegetables and fruits also contain different bioactive substances important for maternal and foetal health (284). For example, vegetables and fruits contain the micronutrients essential for optimal immune and placental functions, which are important for foetal development (285,286). Similarly, studies have reported that eating green leafy vegetables, fruits, and dairy might help prevent poor pregnancy outcomes (287). Therefore, if not addressed, such community beliefs and practices could contribute to the high prevalence of low birth weight in SSA and the failure of intervention to meet the global nutrition target of 2030, which consists of reducing anaemia among pregnant women and low birth weight.

This review is comprehensive in that it summarises the factors associated with the dietary practices of pregnant women in SSA. Despite its strengths, the review has some limitations. The literature search was conducted in two databases. The databases that were not searched might have contained studies that would have complemented the findings of this review. However, we searched in Google and Google Scholar to anticipate this. Information about this topic might be missing because some studies have not been published online or in languages other than English or French. We did not control for the quality of the reviewed studies; therefore, the findings could be under or over-estimated due to methodological limitations.

## 4.6. Policy and Practice Implications

This scoping review highlights that the factors associated with eating habits are complex. This requires a multisector response that includes stakeholders from agriculture, health, education, social development and other sectors to prevent maternal malnutrition. Policymakers should establish programs that combine nutrition-sensitive interventions to improve food security, involve male partners in maternal nutrition, empower pregnant women, and address cultural misconceptions about nutrition during pregnancy. Nurses, midwives, gynaecologists, and other clinicians who deal with pregnant women should educate them and their male partners about optimal dietary practices during pregnancy and family planning strategies. The development of timely and affordable facilities for emergency obstetric care by the Ministries of Health and

Health Care Facilities in SSA is crucial for mothers' health and babies' next generation. Training materials and continuous development courses should be available to healthcare providers in ANC services to improve their nutritional knowledge.

## 4.7. Conclusion

The main drivers of nutritional practices reported in this scoping review were complex. They included maternal characteristics (occupation, educational level, and nutritional knowledge), husband and household characteristics (male partner support, household food insecurity), organisational factors (ANC services), and community characteristics (cultural beliefs and food taboos). This review also revealed a policy gap and the role that various sectors should play in supporting the dietary practices of pregnant women. The review found that most of the research in SSA had occurred in one country, highlighting the need for research in other SSA countries to understand the nutritional practices of pregnant women better and thus improve maternal and child health in the region. This research would support the design and development of combined and tailored nutrition-sensitive and nutrition-specific interventions to improve maternal nutrition. The review also highlighted that better access to emergency obstetric care should be a priority because many pregnant women avoid nutritious foods (associated with community beliefs) in fear of birthing larger babies and associated obstetric complications.

# Chapter five: Factors associated with dietary practices among pregnant women in the southern province of Rwanda: a mixed method study

A scoping review provided valuable insights into general trends and identified knowledge gaps across multiple countries in Sub-Saharan Africa (SSA). This enabled a comprehensive assessment of the unique factors influencing dietary practices, particularly in Rwanda. Conducting localized research ensures findings are relevant and actionable, increasing the likelihood of their integration into policy and practice. Additionally, research findings from Rwanda contribute to global knowledge on dietary practices during pregnancy, supporting international efforts to improve maternal nutrition. In Chapter Five, insights from the scoping review were used to guide the design and implementation of qualitative and quantitative studies to assess the factors associated with dietary practices among pregnant women in the Southern Province of Rwanda.

## 5.1. Abstract


**Background**

There is a need to improve the suboptimal dietary practices of pregnant women in low—and middle-income countries, including Rwanda. This is important because poor dietary practices lead to insufficient nutrient intake and poor nutritional status, which are constantly increasing in Rwanda. However, the factors associated with the dietary practices of pregnant women in Southern Province, Rwanda, remain unknown. Therefore, this study aimed to identify factors associated with the dietary practices of pregnant women in Southern Province, Rwanda.

**Methods**

In this mixed-method study, pregnant women who availed antenatal care services were included; 612 women participated in a quantitative survey, and of these, 16 participated in qualitative interviews. Interview data were collected using guides adapted from the literature. Survey results were analyzed with Stata 16, by using logistic regression models to identify factors associated with dietary practices. NVivo 12 was used to support thematic analysis, which was based on a hybrid coding (deductive and inductive) approach.

**Results:** Only 40% of the participants in the quantitative survey reported good dietary practices. The factors that were positively associated with good dietary practices included owning a radio (adjusted odds ratio [aOR] = 1.86 [1.23, 2.82]), having a high degree of

nutritional knowledge (aOR = 1.36 [1.14, 1.62]), and the education level of the head of the household (aOR = 1.65 [1.17, 2.32]). On the other hand, food insecurity was negatively associated with good dietary practices (aOR = 0.75 [0.67, 0.83]). Qualitative findings reinforced these results and were categorized into four themes: changes in dietary practices, barriers to dietary practices, enablers of dietary practices, and recommendations to improve dietary practices.

**Conclusion:** The dietary practices of pregnant women in Southern Province, Rwanda, are suboptimal and affected by different factors such as knowledge of dietary practices, owning a radio, food insecurity, support from their husbands, and government interventions. Educational initiatives involving male partners and other community members to improve knowledge of the issue and address related social norms could be beneficial. Media platforms, including radio, could be used to disseminate nutritional information, particularly in rural settings. Finally, agricultural interventions should be improved to reduce food insecurity.

## 5.2. Introduction

Good nutrition intake is necessary for an individual's health and well-being, specifically during pregnancy. During pregnancy, extra nutrients and energy are required to meet additional needs caused by physiological changes such as maternal tissue growth and foetal development (288). Good dietary practices help meet this extra demand and ensure sufficient and continuous intake of macronutrients and micronutrients (289). Dietary practices are observable actions, eating habits, and nutritional choices categorized as good or poor (34). Examples of such practices include meal frequency and quantity, snacking and its frequency, and micronutrient supplement use.

Poor dietary practices are a public health challenge in developing countries, including Rwanda. Several studies have reported the proportion of good dietary practices to be low among pregnant women in low- and middle-income countries, with the proportion being only 20% in Pakistan (278) versus 19.9% in Gojjam zone, Ethiopia (290) and 34.5% in Addis Ababa, Ethiopia (163). Many pregnant women in Sub-Saharan Africa consume inadequate diets that do not comply with the recommended dietary allowances (31). This is important because poor dietary practices lead to insufficient nutrient intake and poor nutritional status. These unhealthy conditions negatively affect a pregnant woman's life as well as that of her newborn infant, with effects persisting into adulthood (291). For example, a woman who develops iron deficiency

anaemia during pregnancy is at high risk of preterm delivery, giving birth to an infant with a low birth weight, hypoxia, infection, and maternal or infant mortality (292–294).

A set of complex factors influence the dietary practices of pregnant women. Various studies reported the following factors to be associated with dietary practices: nutritional knowledge; edible crop production (290); cultural beliefs, food taboos, and misconceptions (295); and maternal education level and age (296). In addition, household income and size and food security have been reported as predictors of dietary practices (241,290). Similarly, characteristics of the husband/male partner such as age, education, income, and support have been reported to be associated with dietary practices (249,297). Other studies reported obstetric factors such as availing antenatal care (ANC), number of pregnancies, and gestational week influence the dietary practices of pregnant women (34,298).

While research focusing on maternal health is common, there is little research investigating the factors associated with the dietary practices of pregnant women in Rwanda, particularly in the Southern Province. This research gap is important because the estimated prevalence of malnutrition as measured using the mid-upper arm circumference (MUAC) was 19.8% among pregnant women (299) and the prevalence of anaemia was 25% according to the recent Rwanda Demographic and Health Survey of 2020 (38). Southern Province has the highest proportion of pregnant women with anaemia (29%) and who are underweight (9%) (300). This study was therefore aimed at identifying factors associated with the dietary practices of pregnant women in Southern Province, Rwanda. We believe the findings from this study will support the development of an evidence-based intervention to improve dietary practices and nutritional status among pregnant women.

## 5.3. Conceptual framework

The implementation of this study was guided by the socioecological model of health behaviour developed by McLeroy et al. in 1988 (301). The socio-ecological model emphasizes that health behaviour is influenced by multiple factors originating from different levels of interaction among themselves. These levels include intrapersonal, interpersonal, organisational, community, and policy factors (302). According to McLeroy et al, (1988), intrapersonal factors are individual characteristics such as knowledge, attitude, skills, self-concept, and education. Interpersonal factors include social networks and social support systems, such as family and friends. Organisational factors include institutions with organisational rules and regulations for operation. Community factors involve the structures in which individuals live and their cultural

norms. Policy factors include laws and policies at the local, national, and international levels. Figure 5.1 shows these different levels, which all interact with each other.

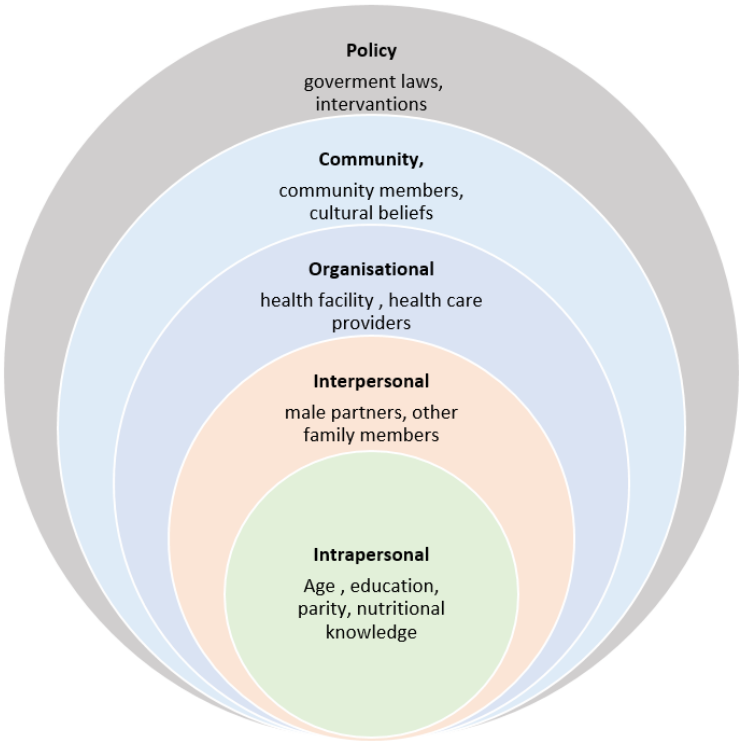



*Figure 0.1: Socioecological framework adapted from McLeroy et al. (1988)*

## 5.4. Methods

### 5.4.1. Study setting

This study was conducted in eight health centres in Southern Province, Rwanda. Four health centres were from a rural area and the remaining four were from an urban area. The Southern Province was selected because the Rwanda Demographic Health Surveys of 2014/2015 and 2019/2020 showed that it accounts for the highest prevalence of pregnant women who are underweight and with anaemia.

### 5.4.2. Study design and population

In this cross-sectional study, a mixed-method design was employed to collect data on pregnant women who availed ANC services. Adult (age: >18 years) pregnant women in their second or third trimester of pregnancy were included. Women in the first trimester of pregnancy were excluded because in the first trimester, women undergo physiological changes such as food cravings or aversion that negatively affect their dietary practices. In addition, pregnant women in the first trimester rarely avail of ANC services. Given that local norms and community beliefs influence dietary practices, only participants living in the study area for at least 6 months were recruited.

### 5.4.3. Sampling procedure

A multistage selection process was used to recruit pregnant women for the study. Four out of eight districts were randomly selected from the Southern Province in the first stage. In the second stage, one urban and one rural health centre were randomly selected from each of the chosen districts, totalling eight health centres. Anticipating 200 pregnant women per health centre monthly, a total sample size of 1600 women was estimated. To ensure a representative sample of 612, a sampling interval of 3 was established. In the selected health centres, a systematic sample of pregnant women was selected with a random start after which every third woman was sampled.

### 5.4.4. Sample size determination

This study is part of a larger body of work performed for the first author's doctoral work. The sample size of 612 pregnant women for the quantitative survey was calculated from a related study that evaluated dietary diversity and associated factors among pregnant women (303). In the related study, dietary diversity was defined using the Minimum Dietary Diversity for Women (MDD-W) indicator based on the number (out of a maximum of 10) of food groups from which at least one food item was consumed in the 24 h before the study interview. Adequate dietary diversity was defined as the consumption of at least one item from at least five of the food groups. A sample size of 612 pregnant women was chosen to estimate the proportion of pregnant women with adequate dietary diversity to ± 5%, assuming that the proportion of pregnant women with adequate dietary diversity would be approximately 50%, accounting for the clustering effects of women within a clinic by assuming a moderate design effect of 1.5 and allowing for a 6% refusal rate. Similar considerations allowed the proportion of pregnant women with good dietary practices to be estimated at ± 5%.

### 5.4.5. Data collection process and quality assurance

Before data collection, research assistants were trained and informed of the study's purpose, methods, and data collection tools. The data collection tools, namely the survey questionnaire and qualitative guide, were translated into Kinyarwanda, which is the local language, and pre-tested in non-study health centres. A few minor issues were raised after both tools were pre-tested, and the tools were modified to address these. The data collection methods were anonymous and involved the use of participant identification codes. For quantitative data collection, each district had two interviewers to collect data within the selected health centres. Every third woman was approached and requested to participate in the study. Those who

consented were interviewed face-to-face for approximately 45 minutes by using a structured questionnaire.

## 5.5. Measurement of study variables

### 5.5.1. Outcome variable

Dietary practices of the pregnant women enrolled were assessed using seven questions adapted from the literature (169,304). These questions were aimed at evaluating changes in meal frequency and quantity, snack habits, meal skipping, and reasons for meal skipping. The total score was obtained by awarding 1 point for each response reflecting a favourable practice and none if the response reflected an unfavourable practice. The overall dietary practice scores out of 7 was then classified as "good" if it was ≥5 out of 7 or "poor" if it was <5. The rationale for this is that several authors suggest a cut-off of 75% for good dietary practices (119,305,306) and a score of 5 out of 7 corresponds to 71% and is the closest to 75% for 7 items.

### 5.5.2. Explanatory variables

Sociodemographic data included maternal factors (occupation, age, education, and marital status), obstetric characteristics (gestational weeks, ANC visits, and parity), and household head characteristics (age, education, sex, and employment status). Socioeconomic variables included ownership of a radio, mobile phone, and livestock, as well as a self-reported 'ubudehe' category. Ubudehe is a Rwandan stratified social measure based on household income, whereby households are classified as rich, poor, and poorer (307).

The participants' nutritional knowledge was assessed using a 13-item questionnaire from the Food and Agriculture Organization's Knowledge, Attitude, and Practice Manual (308). The questions covered adequate nutrition, anaemia prevention, and the importance of nutrition during pregnancy. The responses were scored on a scale of 0 to 32, with higher scores indicating better knowledge. Nutritional knowledge was classified as poor, moderate, and good if the score was <16, 16-23.9, and ≥24, respectively, for the purpose of descriptive analysis. However, the actual nutrition knowledge score was used for logistic regression analysis. Social support was assessed using Webster et al.'s Maternity Social Support Scale (MSSS) (309) covering six items: family support, husband's help, friendship network, conflicts with the husband, and control and affection from the husband. Each item was rated on a 5-point Likert scale, and thus, scores between 6 and 30 were obtained. The actual score was used in the logistic regression analysis. However, for the purpose of the descriptive analysis, MSSS scores of 6-

18, 19-24, and 25-30 were defined as indicative of low, moderate, and high social support, respectively.

Household food insecurity was measured using the Household Food Insecurity Access Scale (HFIAS) developed by Food and Nutrition Technical Assistance [30]. The HFIAS consists of nine 'occurrence questions' and nine other questions related to the frequency of occurrence. Food insecurity was categorized into four levels: no insecurity (<2), mild (2-10), moderate (11-17), and severe (>17). However, actual scores were used in the logistic regression analysis.

## 5.6. Data processing and analysis

Quantitative data cleaning and analysis were conducted using Stata version 16. Descriptive statistics were calculated, providing means, standard deviations, frequencies, and percentages for respective variables. Univariable logistic regression models were fitted to identify the potential predictors of dietary practices with the use of a liberal p-value cut-off of 0.2 chosen to ensure the investigation of all potential confounders. Quantitative explanatory variables were fitted as such in the models and non-linearity in their effect on the logit scale was investigated using fractional polynomials (310). Categorization was avoided as recommended by several authors (222,311). District (as a 4-level categorical variable) and residence (urban/rural) were included in the model regardless of significance because they were design variables. Backward elimination with a nominal p-value of 0.05 for removal was used to achieve the final multivariable model. Owing to the small number of clusters (eight health centres) in our model, terms were fitted for district and rural/urban rather than adjusting for clusters as random effects. The impact of factors on dietary practices was expressed as odds ratios with 95% confidence limits. Interactions involving main exposure variables including food insecurity, ownership of radio, nutritional knowledge, and household head education level were examined but were found to be not statistically significant. Multicollinearity was assessed by considering the variance inflation factors, while the Hosmer-Lemeshow goodness-of-fit test with 10 groups was used to test for lack of fit in the final model.

**Qualitative data**

A qualitative explorative approach was used in the qualitative study. Participants were selected from the quantitative survey participants by using purposive sampling. Sixteen pregnant women were selected, i.e., two participants were chosen from each health centre such that one had a normal MUAC and the other had a low MUAC to gain insight into all categories.

Data collection was performed through in-depth interviews (IDIs) using an unstructured interview guide developed by the researchers by referring to the literature and based on the study objectives. The IDI guide consisted of three domains exploring the dietary practices during pregnancy, influencing factors, and suggestions to improve dietary practices. IDIs were conducted in the local language (Kinyarwanda) by the first author (AU) and one research assistant. These were audio-recorded, and the researchers also took field notes. Data were collected over 2 months, from June 16th to August 18th, 2022.

Two research assistants translated Kinyarwanda recordings into English. Transcripts were shared with the first author (AU), a Kinyarwanda native speaker, who used NVivo 12 to perform hybrid coding, which combines deductive and inductive coding (312). AU started with deductive coding, which consisted of starting with a predefined codebook based on the interview guide (313). Coding issues and mistranslations were identified in a meeting with co-authors (NP and SJ). AU corrected these errors after rechecking the original recordings and continued deductive coding. The codebook was shared with a co-author for co-coding, and this was followed by discussions and incorporation of inductive coding, which consisted of developing codes from the data (314). AU grouped the codes into themes and sub-themes, which were discussed and finalised with NP and SJ.

## 5.7. The qualitative research team and reflexivity

The qualitative data were collected by AU as part of her doctoral study. With expertise in nutrition research for pregnant women, AU's prior involvement in similar studies and her being a female researcher contributed to participant trust and open sharing. She was supported by a research assistant, also a Rwandan woman, originally from the Southern Province. The research assistant has expertise in the public health domain and extensive research experience, which facilitated engagement with the study participants. Both took field and reflexive notes after the interviews. These authors were supported in the analysis by co-authors NP and SJ, who are women living in South Africa and with expertise in child nutrition and maternal health. They were able to provide an outsider perspective on the analysis as well as quality assurance.

## 5.8. Results

### 5.8.1. Sociodemographic and obstetric profile of the study participants

This study included 612 pregnant women. The mean age of the pregnant women was 28 years (standard deviation: 6.5). Most of the participants were married (n = 503, 82.2%), in the third trimester (n = 387,63.2%), and were from households headed by men (n = 497, 81.2%). Among the married participants, many had poor dietary practice scores (n = 289, 57.5%), and a large proportion of pregnant women in their third trimester had poor dietary practices (n = 225, 58.1%). In addition, most pregnant women from households headed by men had poor dietary practices (n = 296, 59.6%). Further details are shown in Table 5.1.

## Table 0.1: Sociodemographic and obstetric characteristics of participants

| VARIABLE (N = 612, UNLESS OTHERWISE NOTED) | LEVELS | GOOD DIETARY PRACTICES (N%) | POOR DIETARY PRACTICES (N%) | TOTAL |
|---|---|---|---|---|
| **DISTRICT** | Gisagara | 69 (45.1) | 84 (54.9) | 153 |
| | Huye | 63 (41.2) | 90 (58.8) | 153 |
| | Kamonyi | 64 (41.6) | 90 (58.4) | 154 |
| | Ruhango | 46 (30.3) | 106 (69.7) | 152 |
| **RESIDENCE** | Rural | 120 (39.2) | 186 (60.8) | 306 |
| | Urban | 122 (39.9) | 184 (60.1) | 306 |
| **AGE (YEARS)** | Mean (SD) | 31 (7.1) | 29 (6.4) | 28 (6.5) |
| | 18-24 | 93 (41.5) | 131 (58.5) | 224 |
| | 25-34 | 111 (41.1) | 159 (58.9) | 270 |
| | ≥35 | 38 (32.2) | 80 (67.80) | 118 |
| **MATERNAL EDUCATION** | None | 10 (28.6) | 25 (71.4) | 35 |
| | Primary | 150 (36.9) | 257 (63.1) | 407 |
| | Secondary and above | 82 (48.2) | 88 (51.8) | 170 |
| **RELIGION** | Christian | 233 (40.0) | 351 (60.10) | 584 |
| | Others | 9 (32.1) | 19 (67.9) | 28 |
| **EMPLOYMENT** | Housewife | 193 (39.0) | 302 (61.0) | 495 |
| | Paying job | 49 (41.9) | 68 (58.1) | 117 |
| **MARITAL STATUS** | Married | 214 (42.5) | 289 (57.5) | 503 |
| | Single | 28 (25.7) | 81 (74.3) | 109 |
| **HOUSEHOLD HEAD AGE, YEARS, *(N = 574)*** | 20-29 | 86 (49.4) | 88 (50.6) | 174 |
| | 30-39 | 81 (36.6) | 140 (63.4) | 221 |
| | 40-49 | 35 (35.7) | 63 (64.3) | 98 |
| | ≥50 | 27 (33.3) | 54 (66.7) | 81 |
| **HOUSEHOLD HEAD SEX** | Male | 201 (40.4) | 296 (59.6) | 497 |
| | Female | 41 (35.6) | 74 (64.4) | 115 |
| **HOUSEHOLD HEAD EDUCATION LEVEL** | None | 35 (30.4) | 80 (69.4) | 115 |
| | Primary | 139 (36.6) | 241 (63.4) | 380 |
| | Secondary and above | 68 (58.1) | 49 (41.9) | 117 |

*[cont].* **Table 5.1. Sociodemographic and obstetric characteristics of participants**

| VARIABLE (N = 612, UNLESS OTHERWISE NOTED) | LEVELS | GOOD DIETARY PRACTICES (N%) | POOR DIETARY PRACTICES (N%) | TOTAL |
|---|---|---|---|---|
| **HOUSEHOLD HEAD EMPLOYMENT *(N = 610)*** | Not employed | 162 (36.6) | 281 (63.4) | 443 |
| | Employed | 80 (48.0) | 87 (52.0) | 167 |
| **HOUSEHOLD SIZE** | 1-3 | 139 (47.3) | 155 (52.7) | 294 |
| | 4-6 | 82 (32.9) | 167 (67.1) | 249 |
| | ≥7 | 21 (30.4) | 48 (69.6) | 69 |
| **WEALTH CATEGORY** | Poorer | 51 (39.2) | 79 (60.8) | 130 |
| | Poor | 102 (41.3) | 145 (58.7) | 247 |
| | Rich | 84 (37.7) | 139 (62.3) | 223 |
| | Unknown | 5 (41.7) | 7 (58.3) | 12 |
| **ESTIMATED GESTATIONAL WEEKS** | 13-27 | 80 (35.6) | 145 (64.4) | 225 |
| | 28-44 | 162 (41.9) | 225 (58.1) | 387 |
| **PARITY** | 0-1 | 148 (45.0) | 181 (55.0) | 329 |
| | 2-3 | 63 (31.0) | 140 (68.9) | 203 |
| | ≥4 | 31 (38.7) | 49 (61.3) | 80 |
| **ANC VISITS** | 0-1 | 51 (32.1) | 108 (67.9) | 159 |
| | 2-3 | 167 (41.9) | 231 (58.1) | 398 |
| | ≥4 | 24 (43.6) | 31 (56.4) | 55 |
| **FOOD INSECURITY** | Food security | 63 (75.0) | 21 (25.0) | 84 |
| | Mild food insecurity | 43 (46.7) | 49 (45.3) | 92 |
| | Moderate food insecurity | 53 (42.1) | 73 (57.9) | 126 |
| | Severe food insecurity | 83 (26.8) | 227 (73.2) | 310 |
| **NUTRITIONAL KNOWLEDGE** | Poor | 42 (23.9) | 134 (76.1) | 176 |
| | Moderate | 90 (43.3) | 118 (56.7) | 208 |
| | Good | 110 (48.3) | 118 (51.7) | 228 |
| **SOCIAL SUPPORT** | Low | 37 (28.2) | 94 (71.8) | 131 |
| | Moderate | 98 (39.0) | 153 (61.0) | 251 |
| | High | 107 (46.5) | 123 (53.5) | 230 |

### 5.8.2. Distribution of dietary practice score

The dietary practice scores ranged from 1 to 7. Many study participants had a score of 5 out of 7 (n = 181; 29.6%), and only four (0.6%) scored 7 out of 7. Further details are given in Figure 5.2.

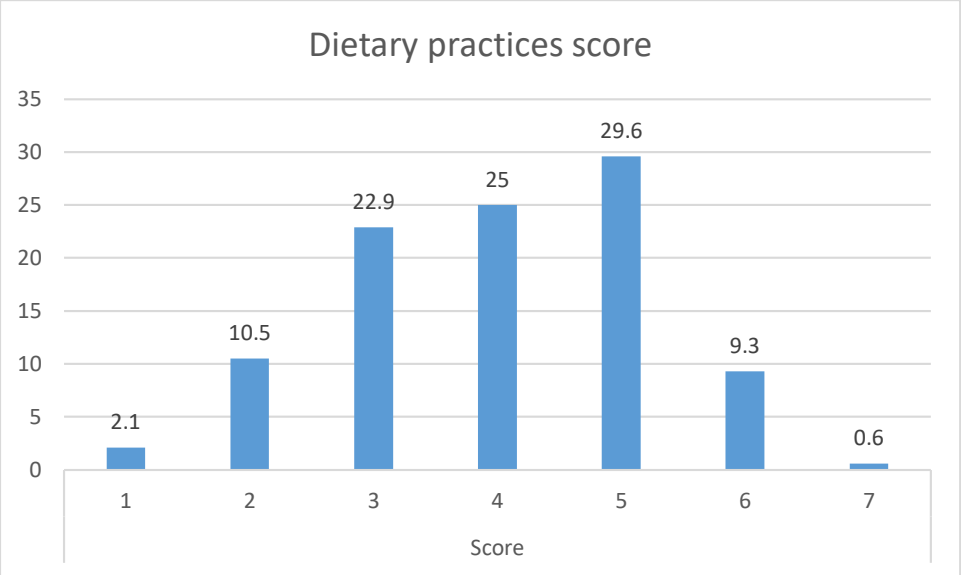



**Figure 0.2: Distribution of dietary practice scores**

### 5.8.3. Dietary and health practices among the study participants

As shown in Table 5.2, only 40% of participants had good dietary practices; many participants (n = 346, 56.5%) had three or more meals a day, and 64.0% (n = 391) did not skip a meal. The most common reason for skipping meals was not having enough food or money to buy food (n = 99, 45.0%). The majority of participants reported not smoking (n = 594, 97.2%) and not drinking alcohol (n = 490, 80.1%).

## Table 0.2: Dietary and health practices among pregnant women

| VARIABLE (N = 612, UNLESS OTHERWISE NOTED) | LEVELS | FREQUENCY | PERCENTAGE |
|---|---|---|---|
| **EATING MORE FREQUENTLY** | No | 252 | 41.2 |
| | Yes | 359 | 58.8 |
| **EATING MORE FOOD** | No | 464 | 75.9 |
| | Yes | 147 | 24.1 |
| **MEAL FREQUENCY** | <3 | 266 | 43.5 |
| | ≥3 | 346 | 56.5 |
| **SKIPPING MEALS** | No | 391 | 64.0 |
| | Yes | 220 | 36.0 |
| **REASONS FOR SKIPPING (N = 220)** | Not having enough food/money | 99 | 45.0 |
| | Fasting/prayer | 36 | 16.4 |
| | No appetite | 18 | 8.2 |
| | Not necessary | 57 | 25.9 |
| | Others | 10 | 4.5 |
| **SNACKING** | No | 270 | 44.2 |
| | Yes | 341 | 55.8 |
| **NUMBER OF SNACKS (N = 341)** | 1 | 132 | 38.7 |
| | ≥2 | 209 | 61.3 |
| **TAKING IRON AND FOLIC ACID SUPPLEMENTS (N = 610)** | No | 89 | 14.6 |
| | Yes | 521 | 85.4 |
| **TAKING A REST OF 2 HOURS** | No | 131 | 21.4 |
| | Yes | 480 | 78.6 |
| **SMOKING (N = 611)** | No | 594 | 97.2 |
| | Yes | 17 | 2.8 |
| **DRINKING ALCOHOL** | No | 490 | 80.1 |
| | Yes | 122 | 19.9 |
| **GOOD DIETARY PRACTICES** | Yes | 242 | 40.0 |
| | No | 370 | 60.0 |

### 5.8.4. Factors associated with dietary practices of pregnant women

Table 5.3 shows the results of fitting logistic regression models. Only the variables that remained statistically significant, as specified in the Methods section, were included in the adjusted (multivariable) model. As shown in the table, the factors that were positively associated with good dietary practices included owning a radio (adjusted odds ratio [aOR] = 1.86 [1.23, 2.82]), a high level of nutritional knowledge (aOR = 1.36 [1.13, 1.62]) and household head education level (aOR = 1.65 [1.17, 2.32]). On the other hand, food insecurity was negatively associated with good dietary practices (aOR = 0.75 [0.67, 0.83]).

## Table 0.3: Factors associated with good dietary practices

| FACTOR | CATEGORY | CRUDE OR [CI] | P-VALUE | ADJUSTED OR [CI] | P-VALUE |
|---|---|---|---|---|---|
| **DISTRICT** | Gisagara | 1 Reference | | **1** Reference | |
| | Huye | 0.85 [0.54, 1.34] | 0.489 | 1.62 [0.92, 2.86] | 0.448 |
| | Kamonyi | 0.86 [0.55 , 1.36] | 0.532 | 0.96 [0.55, 1.68] | |
| | Ruhango | 0.52 [0.33, 0.84] | 0.001 | 0.94 [0.51, 1.73] | |
| **RESIDENCE** | Rural | 1 Reference | | **1** Reference | |
| | Urban | 1.03 [0.74, 1.42] | 0.869 | 0.73 [0.49, 1.08] | 0.371 |
| **AGE** | Per 5-year increase | 0.91 [0.80, 1.03 ] | 0.134 | | |
| **EDUCATION** | Per 5-year increase | 1.34 [1.13, 1.58] | 0.001 | | |
| **RELIGION** | Christian | 1 Reference | | | |
| | Other religion | 1.02 [0.53, 1.96] | 0.930 | | |
| **OCCUPATION** | Housewife | 1 Reference | | | |
| | Paying job | 1.13 [0.74, 1.70] | 0.565 | | |
| **MARITAL STATUS** | Married | 1 Reference | | | |
| | Single | 0.46 [0.29, 0.74] | 0.001 | | |
| **RECEIVED NUTRITIONAL** | No | 1 Reference | | | |
| **INFORMATION** | Yes | 1.61 [0.75, 3.43] | 0.218 | | |
| **NUTRITIONAL KNOWLEDGE** | Per 5-unit increase | 1.51 [1.30, 1.74] | <0.001 | 1.36 [1.14, 1.62] | <0.001 |
| **ANC VISITS** | Per 1-visit increase | 1.18 [0.99, 1.39] | 0.056 | | |
| **PARITY** | Per 1-unit increase | 0.91 [0.82, 1.00] | 0.057 | | |
| **GESTATIONAL WEEKS** | Per 4-week increase | 1.08 [0.98, 1.19] | 0.105 | | |
| **HOUSEHOLD HEAD SEX** | Male | 1 Reference | | | |
| | Female | 0.71 [0.32, 1.60] | 0.414 | | |

**[cont]. Table 5.3 Factors associated with good dietary practice**

| FACTOR | CATEGORY | CRUDE OR [CI] | P-VALUE | ADJUSTED OR [CI] | P-VALUE |
|---|---|---|---|---|---|
| **HOUSEHOLD HEAD AGE** | Per 5 years increase | 0.90 [0.84, 0.97] | 0.006 | | |
| **HOUSEHOLD HEAD EDUCATION LEVEL** | Per 5 years increase | 1.82 [1.38, 2.39] | <0.001 | 1.65 [1.17, 2.32] | 0.033 |
| **HOUSEHOLD HEAD OCCUPATION** | Not employed | 1 Reference | | | |
| | Employed | 1.60 [1.11; 2.29] | 0.011 | | |
| **HOUSEHOLD SIZE** | Per 1-unit increase | 0.88 [0.80; 0.97] | 0.009 | | |
| **UBUDEHE CATEGORY** | Poorer | 1 Reference | | | |
| | Unknown | 1.18 [0.36, 3.84] | 0.781 | | |
| | Rich | 1.18 [0.80, 1.68] | 0.422 | | |
| **ACCESS TO AGRICULTURAL LAND** | No | 1 Reference | | | |
| | Yes | 1.16 [0.83, 1.62] | 0.370 | | |
| **OWNING LIVESTOCK** | No | 1 Reference | | | |
| | Yes | 1.56 [1.12, 2.16] | 0.008 | | |
| **OWNING A RADIO** | No | 1 Reference | | 1 Reference | |
| | Yes | 2.00 [1.60, 3.10] | <0.001 | 1.86 [1.23, 2.82] | 0.008 |
| **OWNING A TELEPHONE** | No | 1 Reference | | | |
| | Yes | 1.40 [0.93, 2.11] | 0.105 | | |
| **SOCIAL SUPPORT** | Per 5-unit increase | 1.50 [1.17, 1.83] | 0.001 | | |
| **FOOD INSECURITY** | Per 5-unit increase | 0.71 [0.65, 0.77] | <0.001 | 0.75 [0.67, 0.83] | <0.001 |
| **DEMONSTRATION OF BALANCED DIET PREPARATION** | No | 1 Reference | | | |
| | Yes | 1.65 [1.18; 2.28] | 0.003 | | |
| **KITCHEN GARDEN** | No | 1 Reference | | | |
| | Yes | 1.00 [0.71, 1.40] | 0.998 | | |
| **GIRINKA PROGRAM** | No | 1 Reference | | | |
| | Yes | 1.14 [0.59, 2.18] | 0.692 | | |

Gaps under the adjusted OR = variables not included in the final model

## 5.9. Qualitative findings

### 5.9.1. Characteristics of participants in the qualitative study

Table 5.4 describes the characteristics of the participants in the qualitative study. Sixteen pregnant women were involved in the qualitative study, eight of whom were from rural health centres. Many of them (n = 12, 75%) had one to four living children, and their highest level of education was primary school (n = 10, 62.5%). More details are provided in Table 2.

**Table 0.4:Characteristics of the qualitative sample**

| VARIABLE (N = 16) | LEVEL | FREQUENCY | PERCENTAGE |
|---|---|---|---|
| **AGE, YEARS** | 25-29 | 4 | 25 |
| | 30-34 | 6 | 37.5 |
| | 35-39 | 4 | 25 |
| | ≥40 | 2 | 12.5 |
| **EDUCATION** | No education | 1 | 6 |
| | Primary | 10 | 62.5 |
| | Secondary and above | 5 | 31.5 |
| **MARITAL STATUS** | Married | 11 | 68.7 |
| | single | 5 | 31.2 |
| **PARITY** | 0-1 | 5 | 31.3 |
| | 2-3 | 7 | 43.7 |
| | ≥4 | 4 | 25 |
| **RESIDENCE** | Urban | 8 | 50 |
| | Rural | 8 | 50 |

Qualitative findings were classified into four central themes, including changes in dietary practices, facilitators of dietary practices, barriers to dietary practices, and recommendations to improve dietary practices.

### 5.9.2. Changes in dietary practices

Some participants reported positive changes in their dietary practices after realising that they were pregnant and thus needed to improve their diet. The alterations included changes in food types, quantity, and frequency of consumption.

> *When I was not pregnant, I used to eat maize bread, beans, and eggplants and thought that was enough. I also used to have tea instead of porridge or have coffee, but now I include vegetables in each meal because I have a baby in the womb that I must feed. I eat frequently because I feel hungry more often.* (age: 29 years, rural resident, parity 2)

However, owing to different barriers, other participants were not able to change their usual dietary practices or change them negatively.

### 5.9.3. Barriers to good dietary practices

While not a significant factor in the survey, some pregnant women reported having limited nutrition information and expressed a desire for additional education during ANC visits.

> *Because not all pregnant women have information about adequate nutrition during pregnancy, it is necessary for the health centre to offer nutrition education to pregnant women when they visit for antenatal care and teach them how to ensure a balanced diet. I think it can help improve nutritional knowledge and practices.* (age: 30 years, urban resident, parity 2)

Although women in the first trimester of pregnancy were excluded from the study owing to anticipated physiologic changes such as food aversion and cravings, 8.2% of women who skipped meals noted having 'no appetite' in the first trimester. However, this changed in the later trimesters.

> *I was not able to eat because I constantly had a stomach ache and didn't have an appetite. I felt like I no longer wanted to eat rice and fried foods. I could only have a little bit of boiled foods. Otherwise, I mainly survived on black tea. In the last 3 months, I was able to eat.* (age: 45 years, rural resident, parity 5)

Poverty, insufficient finances, and unemployment made access to food difficult. In such cases, pregnant women prioritised food quantity over quality and ate less frequently.

> *Honestly, even getting food is very hard for me. For instance, I get food only after doing casual work and then I buy sweet potatoes or Irish potatoes, which are less expensive. I prefer them to get large quantities to serve my entire family. If I don't get a job, I eat once a day.* (age: 36 years, urban resident, parity 5)

Qualitative data showed that food unavailability at the markets or within the community hindered good dietary practices. Pregnant women from rural areas reported having more access to land and kitchen gardens, which increased food accessibility compared with those from urban areas. In addition, pregnant women in urban areas reported having limited access to land because of overcrowding or having a limited income. Therefore, they bought everything from the market, which hindered good dietary practices.

> *…As our region is developing, those from the lower socioeconomic class have difficulties in finding food since the land under cultivation has reduced because of construction activities. They can only buy sweet potatoes, beans, vegetables, … which is difficult since some are unemployed.* (age: 34 years, urban, parity 8)

Pregnant women reported that they were discouraged from consuming some types of food. The following quote provides an example of the rationale for avoiding certain foods; this was presented as 'common' knowledge within their families/communities.

> *It is said that babies are born with worms in their eyes or without eyebrows or hair if a pregnant woman eats* ***red pepper*** *or* ***alcohol****. I have also heard that having* ***sugarcane*** *can lead to the baby being born with skin cracks and joint lines like those on sugarcane. If you consume* ***avocados*** *during pregnancy, the baby is born with a lot of butter sticking on the skin all over the body, especially the forehead.* (age: 34 years, urban resident, parity 8)

### 5.9.4. Enablers of good dietary practices

Participants expressed that having adequate knowledge in selecting and preparing a balanced diet played a role in good dietary practices. For example, one participant stated the following:

> *Having knowledge regarding the dietary practices of pregnant women helps to know what kinds of food to prepare; you do your best to find the missing ones to have a balanced diet. If someone does not have such knowledge, she prepares what is available including unnecessary foods, but if you have knowledge, you prepare only what you need.* (age: 40 years, rural resident, parity 6)

Support from male partners was deemed critical by some participants in qualitative interviews. Male partners were described as being supportive in various ways: providing money, buying the required food, and preparing food.

> *My husband is responsible for looking for food. Right now I can't go to work because I am tired. Thus, he has to look for it, and once I feel less tired, I prepare what I want.*

*But if the weakness persists, he helps me when he comes back from work. He has more influence than anyone else.* (age: 34 years, rural resident, parity 4).

However, not all the male partners played a role in supporting the dietary practices of their pregnant partners. Some pregnant women were unhappy with the support they received from their male partners, as illustrated by the following interviewee: "*No, my husband does not shop for us. He is a smoker and a drunkard; therefore, it is difficult. Most of the time, I'm the one who works for my family."* (age: 36 years, rural resident, parity 5).

Although social support was not associated with good dietary practices in the final model, qualitative interviews revealed a different story. Interviewees reported that social support provided by their family and community members in the form of sharing food improved their dietary practices.

*You see, I don't have a banana plantation, and these days I am in love with cooking bananas. Sometimes, my mother-in-law tells me to cook fresh bananas or my neighbour provides some pumpkins*. (age: 34 years, rural resident, parity 4).

Owning a radio increased the odds of having good dietary practices in the final model. A potential mechanism for this association was described by an interviewee in the qualitative study:

*…. It is common in rural areas to have livestock, but their products are sold instead of being included in daily meals. From the radio, I got information about not selling all the products, but including them in meal, like eggs, which can help prevent sickness*. (age: 36 years, urban resident, parity 4).

Although participating in a demonstration by healthcare providers (HCPs) of how to prepare a balanced diet was not a significant factor affecting dietary practices in the final model, in the interviews, some pregnant women highlighted that HCPs and community health workers nevertheless helped them by improving their knowledge of good dietary practices.

*They play a role by informing and encouraging us to eat nutritious food. When you are going to prepare a meal at home, you remember what they have said and you prepare accordingly. It is like they remind you that you should cook nutritious food.* (age: 30 years, urban resident, parity 2).

However, some participants found the shared information and mode of delivery during ANC visits to be superficial. One participant reported as follows: *"Mostly healthcare providers don't state the importance of specific foods they encourage us to eat, and they rush, so there is no opportunity to ask for explanations."* (age: 45 years, rural resident, parity 5)

The insights gained from the responses of the participants of qualitative interviews further emphasized how government interventions such as the Girinka program and owning a kitchen garden can influence dietary practices, directly or indirectly. The following quote describes how owning a kitchen garden affects daily diet and economic status.

> *A kitchen garden is useful because I can't prepare a meal without vegetables ... Each day's meal contains vegetables. In addition, the garden saves me from buying vegetables and I use that money to buy other food.* (age: 32 years, urban resident, parity 2).

However, not all government interventions reach all beneficiaries in need. Despite their low wealth category and nutritional status, no participants in the qualitative study reported being part of the Shishakibondo program, a government intervention to supplement the dietary practices of vulnerable households by providing fortified porridge flour to pregnant and lactating women as well as young children aged 6−23 months.

### 5.10 Enablers and barriers to Good Dietary Practices among Pregnant Women Using the Socio-Ecological Model

To better understand the multi-dimensional factors influencing dietary practices during pregnancy, the key findings from both quantitative and qualitative data were organized using the Socio-Ecological Model. This framework allows for the classification of individual, interpersonal, community, organisational and policy level of influences. The table below summarizes the major Enablers and barriers identified across these levels.

**Table 5.5: Summary of enablers and barriers to good dietary practices**

| Level | Enablers | Barriers |
|---|---|---|
| *Individual* | Nutrition knowledge, motivation for healthy pregnancy | Low appetite and food aversion, cultural food beliefs |
| *Interpersonal* | Partner support, family food-sharing | Lack of partner involvement |
| *Community* | Radio messages, owning kitchen gardens, social support networks | Food taboos, reduced land for cultivation and market dependacy (urban areas) |
| *Organisational* | ANC counseling (when effective) | superficial nutrition education at ANC |
| *Government* | Girinka and kitchen gardens programs | Food insecurity, Inadequate reach of programs like Shishakibondo |

## 5.11. Recommendations to improve dietary practices

Recommendations from the participants in the qualitative study emphasized the need to address two main issues: improving knowledge about good dietary practices during pregnancy and addressing poverty, which impacts food availability and accessibility. The suggested recommendations included community sensitisation towards owning kitchen gardens and livestock, food supplements such as fortified flours to make porridge, enhanced nutrition education to improve knowledge of good dietary practices, initiation of income-generating activities, and provision of some start-up kits to improve household income.

## 5.12. Discussion

This study was aimed at determining the dietary practices and their associated factors among pregnant women in Southern Province, Rwanda**.** We found that 40% of participants had good dietary practices. The low compliance with good dietary practice may be explained by the characteristics of the participants included in the study: most of them had low levels of education, which has been reported in the literature to be associated with limited access to nutritional information and employment opportunities (249). This finding is important because poor dietary practices are linked to nutritional deficiencies, which lead to adverse pregnancy outcomes such as preterm delivery and infants with low birth weight (304). It could also explain the high prevalence of anaemia among pregnant women in the Southern Province and is suggestive of disturbances in nutritional markers, nutritional status, and pregnancy outcomes. The prevalence of good dietary practices in our study was higher than that reported in a study in South Gondar, Ethiopia (27.2%) (169), but lower than that in a study conducted in Dessie, a town in Ethiopia (45.2%) (315). This difference may be attributed to participants' characteristics and study settings.

**Factors associated with dietary practices**

The study findings illustrate an interaction of factors across different levels of the socioecological model, from intrapersonal to government interventions, in influencing dietary practices among pregnant women.

**Individual factors**

These are factors that relate directly to the pregnant woman. We found a positive relationship between a high level of knowledge and good dietary practices. This highlights the significance

of knowledge of dietary practices in making informed dietary choices. Individuals with limited knowledge of dietary practices are unable to make the correct choice of healthy dietary practices even when other necessary resources are available. A study conducted in South Ethiopia showed a positive association between a high level of dietary knowledge and good dietary practices (119). However, knowledge does not always translate into good practices. For example, physiological changes during pregnancy, such as food aversion and a decreased appetite, can markedly disrupt dietary patterns, even among those with good knowledge, as has been reported by the participants in this qualitative study. Food aversion or cravings increase or decrease food intake and meal frequency. When an pregnant woman is averse to eating highly nutritious foods, it can lead to poor nutritional status and poor pregnancy outcomes such as preterm birth and infants with low birth weight (316). The negative effects of food aversion on maternal dietary practices were reported in a study conducted in Ethiopia (119). Although food aversion often eases by the end of the first trimester, it is important to highlight that it can persist beyond that period, as was true for some of our study participants. Our study also found that beyond the individual level, other factors play a role in dietary practices such as the environment in which the pregnant woman lives.

**Household factors**

In addition to having adequate knowledge of dietary practices and being healthy during pregnancy, a supportive environment affects the dietary practices of pregnant women. Qualitative findings showed that receiving support from their families including husbands, children, and friends improves the dietary practices of pregnant women. This is consistent with the literature, which shows that social support helps to increase motivation and drive the adoption of healthy lifestyle changes (317). Supportive husbands may contribute financially to ensure that the household has access to nutritious foods. In addition, social support improves physical and mental health and reduces the risk of pregnancy and birth complications (318). Conversely, unsupportive partners or a lack of social support experienced by some study participants may lead to poor dietary practices and is linked to stress, anxiety, depression, and adverse pregnancy outcomes, such as preterm birth (319). Unsupportive husbands could potentially hinder good dietary practices in the Rwandan setting because men are the primary decision-makers and few women can decide about their health (320). This finding points to the need for interventions that include male partners or husbands.

The education level of the head of the household was positively associated with good dietary practices in this study. This finding is consistent with that of a study conducted in Somalia, which reported an association between household head education level and dietary practices (321). This may be because household heads with higher education levels may be employed and have higher household incomes, enabling them to access nutritious foods. In addition, highly educated household heads may be more informed about healthy dietary practices during pregnancy, allowing them to make informed nutritional choices and have improved societal norms. This finding shows the importance of education in empowering and promoting maternal dietary practices during pregnancy.

Quantitative results showed that pregnant women from households that owned a radio were more likely to have good dietary practices compared with those from households without radios. This could be a proxy for socioeconomic status but also highlights the potential impact of mass media in disseminating health messages, in this case about nutrition in pregnancy. Participants who underwent the qualitative interviews explained how radio broadcasts supported good dietary practices of pregnant women, particularly in rural areas. Similar findings were reported in another study conducted in Northwest Ethiopia (304).

Food insecurity decreased the odds of good dietary practices; this finding is consistent with that of a study conducted in Southwest Ethiopia (230). Qualitative data further revealed that food insecurity is a major barrier to good dietary practices and highlighted the importance of addressing economic factors. It is the most important issue to tackle because even when other factors such as knowledge, support, and education are addressed, food insecurity still compromises adherence to good dietary practices. Food insecurity often leads to restricted access to various food types and can be linked to pregnancy complications such as anaemia, gestational diabetes, pregnancy-induced hypertension (322), infants with low birth weight, and an increased risk of birth defects (323). In addition, food insecurity can cause stress during pregnancy (324) and is associated with psychosocial outcomes such as anxiety and depression (325). Given the implications of food insecurity during pregnancy, finding solutions to the issue must be a priority and should be addressed in ANC visits.

**Community factors**

Cultural beliefs towards nutrition for pregnant women were expressed by the participants in the qualitative IDIs. Cultural beliefs may affect the prescription of food and the importance given to dietary practices (326). While there were no specific foods that were culturally

prescribed to the pregnant women in the sample, there were foods that were prohibited such as eggplant, fermented milk, avocado, and chilli. This is important to note because the prohibited foods are rich in the nutrients required during pregnancy. Other studies have similarly reported food restrictions during pregnancy owing to cultural beliefs (36,242,327). These beliefs should therefore be addressed by improving education.

**Health system factors**

The study found that HCPs delivered practical guidance on how to prepare a balanced diet during ANC visits. Pregnant women reported that they attended these sessions but that their experiences varied between those where the sessions were helpful and others where the pregnant women perceived the information provided to be superficial. Therefore, pregnant women may be more likely to make positive dietary behaviour changes if told to do so by an HCP that they understand and perceive as knowledgeable on the topic (328). The report of the provision of superficial nutritional information in some ANC sessions may be due to a lack of time, teaching resources, and nutritional in-serving training (329). This was found in Ethiopia where a study reported a gap in nutritional knowledge among HCPs (290). These health system level constraints should be addressed to ensure comprehensive education because evidence suggests that effective nutrition counselling is associated with pregnant women making positive dietary changes.

**Government intervention**

Participants in the qualitative study reported that having a kitchen garden positively influenced dietary practices because it allowed them access to a variety of foods including fruits and vegetables. This is particularly important in rural areas where people have limited income-generating activities and poorer purchasing power than in urban areas. Kitchen gardens improve the dietary practices in general by increasing food availability and dietary intake of several nutrients; thereby preventing malnutrition among women. Studies conducted in Pakistan, Ethiopia, and Tanzania showed that kitchen gardens significantly improved food availability and accessibility (330)(331).

The Girinka program was reported to influence dietary practices because ownership of livestock helped improve access to and consumption of animal-source food. Our study found that even when households were not consuming livestock, but were selling it, it nevertheless increased purchasing power for other nutritiously important food, thereby positively affecting dietary practices. This finding is consistent with that of a study conducted in Tanzania that

showed that owning livestock affects dietary practices positively (332). However, the lack of statistical significance of these interventions in the quantitative study should not be overlooked and points to the need for further studies with appropriate study designs to fully explore this relationship.

The qualitative study also found that the shishakibondo government intervention did not reach all women interviewed. This program could positively affect pregnant women by improving their nutritional status and pregnancy outcomes. The failure to reach all pregnant women, particularly those who are malnourished or from low socioeconomic backgrounds, can perpetuate inequalities and have detrimental effects on unreached populations. It can also exacerbate existing health disparities, leading to higher rates of maternal and infant mortality as well as increased incidence of birth defects and developmental disorders among unreached populations. To maximize the effectiveness of such interventions, it is essential to ensure equitable access to fortified foods by extending the inclusion criteria and addressing the underlying socioeconomic determinants of malnutrition.

## 5.13. Strengths and limitations

The strength of this study is that it used mixed methods. Combining qualitative and quantitative methods allowed a comprehensive analysis and understanding of the dietary practices and associated factors. However, there is a lack of a standard quantitative tool to assess dietary practices. Social desirability and recall bias could have affected the study since the interviewees were asked to remember and report their personal dietary practices.

## 5.14. Conclusion

The study findings provide a nuanced understanding of the factors influencing the dietary practices of pregnant women in Southern Province, Rwanda. They highlight the role of food insecurity, knowledge of dietary practices, owning a radio, education level of the household head, healthcare and government interventions, social support, and cultural contexts in determining dietary practices during pregnancy. When considering how the findings from this study interconnect, it is apparent that they operate within a complex web of influences from different levels. For instance, nutrition education provided by HCPs and community health workers may equip pregnant women with enough knowledge to make healthier dietary choices. However, this knowledge may not lead to good dietary practices if women live in food-insecure households or lack support from their husbands or community members. Furthermore, male

partners may be unable to support the dietary practices of pregnant women because of cultural beliefs, insufficient knowledge, or food unavailability.

Government interventions, such as the Girinka program and kitchen gardens, offer opportunities for solutions to address food insecurity and promote good dietary practices. However, they may not improve dietary practices if households lack the necessary resources to persist with these initiatives (home gardens or domestic animals).

## 5.15. Recommendations

Based on the findings of this study, a multi-level approach is recommended to improve dietary practices among pregnant women. At the individual level, targeted nutrition education should be enhanced through antenatal care services, ensuring that pregnant women receive clear, specific, and actionable information about the importance of balanced diets and how to achieve them using locally available foods. Community health workers should be trained to provide ongoing support and follow-up. At the interpersonal and community levels, male partner involvement should be actively promoted through community outreach and health education sessions that emphasize their role in food provision and emotional support during pregnancy. Strengthening community-based initiatives such as kitchen gardening, local food demonstrations, and peer support groups can also empower women to adopt healthier practices despite financial limitations. At the structural level, interventions to improve food security must move beyond broad definitions and focus on increasing the availability, accessibility, and affordability of diverse and nutritious foods. This includes expanding the reach of government programs such as Girinka and Shishakibondo, with improved targeting to ensure inclusion of nutritionally vulnerable households. Finally, the use of mass media, especially radio, should be scaled up to disseminate culturally appropriate and evidence-based messages on maternal nutrition, given its positive association with dietary practices in this study. Collectively, these strategies should be integrated into maternal and child health programming to ensure sustainable improvements in maternal nutrition.

## Chapter six: Dietary diversity and associated factors among pregnant women in the Southern Province of Rwanda: A facility-based cross-sectional study

Dietary diversity is different yet complementary to dietary practices. While dietary practices include behaviors such as meal frequency, consumption of specific food items, skipping foods, dietary diversity emphases particularly on different food groups consumed during a given period. Assessment of dietary diversity helps to predict the micronutrient adequacy and have an overall insight about the diet quality, which cannot be fully captured by solely assessing the general dietary practices. While chapter five provides a general view, covering a varied range of dietary behaviors and socioecological factors, chapter six probes deeper into one important aspect of diet quality, both offering a comprehensive picture and in-depth analysis of dietary practices of pregnant women. In addition, the qualitative insights gathered in chapter seven about the support provided by healthcare providers and male partners will deepen the

understanding of the quantitative findings, helping to explain why some factors may enable or impede dietary diversity.

## 6.1. Abstract

The inadequate dietary diversity of pregnant women in low- and middle-income countries, including Rwanda, is rising and leading to macro and micronutrient deficiencies. The extent of dietary diversity and the factors contributing to it are unknown in Rwanda. This cross-sectional study, with 612 women who attended antenatal care services in Rwanda's Southern Province, identified determinants of dietary diversity among pregnant women. A multistage sampling scheme was used in which four districts were sampled, thereafter one urban and one rural health centre was sampled in each district and finally, a systematic sample of pregnant women was selected in each sampled health centre. Dietary diversity was measured using Minimum Dietary Diversity for Women (MDD-W), and multiple logistic regression models were fitted to identify factors associated with dietary diversity. Only 44.1% (95% confidence interval (CI) of [40.1%, 48.0%]) of participants had adequate dietary diversity. Approximately 95.4% of participants consumed grains, white roots, and tubers. The food groups that were the least consumed consisted of eggs (n = 99, 16.4%), as well as those consisting of milk and milk products (n = 112, 18.5%). The factors which were positively associated with dietary diversity were owning a radio (adjusted odds ratio [aOR] = 1.90 [95% CI 1.27, 2.85]), maternal education (aOR = 1.85 [95% CI 1.28, 2.65]), having a kitchen garden (aOR=1.69 [95% CI 1.11, 2.57]) and nutrition knowledge score (aOR =1.45 [95% CI 1.21, 1.74]) for a five-point increase in nutrition knowledge score. The factors negatively associated with dietary diversity include food insecurity, which reduced the odds of dietary diversity (aOR = 0.19 [0.07, 0.50]) per five-unit increase in food insecurity. Furthermore, the odds of adequate dietary diversity were lower among urban residents than rural residents (aOR = 0.69 [0.47, 1.03]). The household size was associated with dietary diversity with the odds of dietary diversity decreasing by 12% for a five-unit increase in household size (aOR=0.88 [0.79; 0.99]). 23% had poor nutritional status, indicated by their mid-upper arm circumference (MUAC; < 23 cm). Enhanced nutritional education is needed to improve the nutritional knowledge of this population with particular emphasis on the consumption of animal-source foods. Sensitisation activities promoting ownership of kitchen gardens and radios could improve dietary diversity among Rwanda's pregnant women.

## 6.2. Introduction

Pregnancy is a significant and nutritionally demanding period of a woman's life (333) because the physiological changes that ensure foetal growth and development lead to higher nutritional demands during pregnancy. The World Health Organization (WHO) recommends that pregnant women adopt healthy dietary practices by consuming adequate protein, carbohydrates, vitamins, and minerals (7). To comply with this recommendation, the National Food and Nutrition Policy of Rwanda recommends intervention packages that combine nutritional education about consuming nutritious and diverse foods and improved agricultural practices. These agricultural practices include 1) kitchen gardens to promote access to minerals and vitamins through vegetables; and 2) livestock ownership, mainly through the Girinka program (meaning "one cow-per-poor family") to promote access to proteins and other nutrients (334).

These National Food Nutrition Policy interventions were introduced because adherence to a diverse daily diet is the main strategy for complying with the WHO recommendation (335). Dietary diversity is defined as the 'number of food types consumed through and within food groups during a specified period' (1). It is frequently reported as a proxy indicator of diet quality and can be summarised using the number of food groups consumed during the previous 24 hours (2). Dietary diversity promotes good health by preventing micronutrient deficiencies (3). Inadequate dietary diversity, which is consuming fewer than five food groups in the previous 24 hours, is prevalent among pregnant women in low- and middle-income countries (23).

Studies report a high prevalence of poor dietary diversity during pregnancy in Oromia, Ethiopia (74.6%) (3), North East Ethiopia (68.6%) (252), and Tanzania (54%) (336). A study in Nigeria found that many women consumed vegetables, and among them, half practised food restrictions with regard to meat, eggs, and fish due to food taboos (337). Women in low- and middle-income countries have a starch-based diet that is largely deficient in animal-source foods and vegetables and fruit, which are rich in protein and minerals needed for the foetus (338).

When pregnant women do not diversify their diets, it leads to nutritional deficits, which is a public health concern in low- and middle-income countries. Maternal undernutrition varies between 10% and 19% in many countries of sub-Saharan Africa, as well as in south-eastern and south-central Asia (339). In developing countries, more than half of all pregnant women

have nutritional anaemia [14]: The prevalence of anaemia among reproductive women is 52.5% in the WHO South Asian region and 46% in the African region (340).

Poor nutritional status during pregnancy negatively affects the physiological growth of the foetus and increases the risk of preterm delivery, low birth weight, and maternal morbidity and mortality (24). The effect of deficient nutritional intake during pregnancy significantly shapes foetal health and exposure to some adulthood non-communicable diseases. However, high dietary diversity results in sufficient nutrients to ensure proper foetal growth (341).

Different factors contribute to dietary diversity during pregnancy. Studies report that factors associated with good dietary diversity during pregnancy include adequate knowledge of proper nutrition (342), middle to high income, and demographic characteristics, such as maternal age, education, occupation, and marital status (343). In addition, food security, including both accessibility and affordability, is associated with dietary diversity (344). Ownership of a radio, livestock, and a home garden positively affects dietary diversity (62). Furthermore, cultural beliefs and food taboos can negatively affect the dietary diversity of pregnant women because these taboos apply to green vegetables, cheese, yoghurt, green peppers, sugar cane, and other nutritious foods (345,346).

There is a shortage of studies on the factors associated with dietary diversity among pregnant women in Rwanda. A 2017 study conducted in Kigali City reported that 50% of study participants did not achieve the Minimum Dietary Diversity for Women (MDD-W) score (299); however, the study did not assess the factors contributing to this low score. Addressing this gap is critical because the 2019–2020 Demographic and Health Survey of Rwanda report that anaemia among pregnant women has increased from 17% in 2010 to 25% in 2020, and the Southern Province accounted for the highest prevalence of anaemia (38). Approximately 9% of the women in the Southern Province were underweight with a body mass index (BMI) < 18.5, compared to 6% of women nationally (60). Poor maternal dietary diversity could have contributed to this high prevalence of anaemia and low BMI among pregnant women. Therefore, this study assessed the status of dietary diversity, its determinants, and the nutritional status of pregnant women in the Southern Province of Rwanda.

## 6.3. Methods and Materials

### 6.3.1. Study design and setting

This cross-sectional study was conducted with pregnant women receiving antenatal care (ANC) services. It was conducted in the Southern Province of Rwanda, which shares its borders with Kigali City and the Northern Province to the North, the Republic of Burundi to the South, the Eastern Province to the East, and the Western Province to the West. In 2017, the Southern Province was ranked the second among five Provinces in having household food insecurity (20.5%) and the third in the poverty rate, which increased from 12.9 to 16.9% (347). According to the 2014–2015 Demographic and Health Survey of Rwanda and the 2019–2020 Demographic and Health Survey results, the Southern Province accounted for the highest prevalence of underweight and anaemic pregnant women. Data were collected within two months, from May 16$^{th}$ to July 18$^{th}$ 2022.

### 6.3.2. Study population, sample size determination and sampling procedure

Adult pregnant women (> 18 years) who self-reported being healthy in their second or third trimester were recruited to participate in the study. Women who were not healthy were excluded because some chronic diseases require special diets, which could affect dietary diversity. Pregnant women in their first trimester were excluded because most pregnant women are physiologically unstable and experience dietary disturbances, which could affect their dietary diversity.

A sample size of 612 pregnant women was chosen as the appropriate sample size to estimate the proportion of pregnant women with adequate dietary diversity to within 5%, using the formula(348) : $n = \frac{Z^2 P(1-P)}{d^2}$

We assumed that the proportion of women with adequate dietary diversity would be approximately 50%, which would make our sample size calculation slightly conservative. A sample size of 385 was considered sufficient to estimate the proportion to within ± 5% (as measured by the 95% CI for the proportion). This sample size assumed that a simple random sample of women was recruited; thus, allowances needed to be made for any clustering effects of women within a clinic. Assuming a moderate design effect of 1.5 increased the sample size to 578, and allowing for a 6% of refusal rate led to the final sample size of 612.

A multistage sampling scheme was used to sample 612 pregnant women. At the first stage four out of the eight districts in the Southern Province were selected using simple random sampling. At the second stage in each of the four sampled districts one urban health centre and one rural health centre were selected using stratified random sampling (with the strata being “rural” and “urban”). This gave a selected sample of eight health centres. Since each health centre was

expected to receive about 200 pregnant women monthly, this would give an expected total of approximately 1600 pregnant women. Since we required a sample of 612 women, the sampling interval was approximately 3. In each of the sampled health centres a systematic sample of pregnant women was selected with a random start after which every third woman was sampled.

### 6.3.3. Data collection process

Before data collection, eight interviewers (nurses and midwives) were trained for three days to collect quantitative data including anthropometric measurements. They were informed about the study's purpose, data collection process and data collection tools. Data collection tools were translated into the local language (Kinyarwanda), and they were pre-tested in health centres which were not part of the study to ensure that all questions were clear and interviewers had the same understanding of them. After the pre-test, a few questions were adjusted for clarity. In addition, data collection tools were anonymous, and Codes were used to identify the participants. Two interviewers were allocated to each district to collect data from the health centres located in that particular district. Interviewers approached the healthcare providers in the ANC service and requested the list of pregnant women registered for ANC consultations. They approached every third pregnant woman and briefly explained the study. Thereafter, the nutritional status of each pregnant woman was evaluated by measuring their MUAC using non-stretchable MUAC tape designed for adults. The literature reports that MUAC is the easiest anthropometric measurement of nutritional status in pregnant women, since it is easy to measure, does not require much training or resources and unlike BMI does not require calculations. Most importantly, MUAC is a better nutritional status indicator than BMI because it changes minimally during pregnancy (349). Two researchers independently assessed the MUAC value of the non-dominant arm to the nearest 0.1 cm without clothing on the arm (350). The MUAC of each pregnant woman was recorded, and in case of a difference in measurements between two researchers, the average MUAC was considered. The cut-off MUAC of 23 cm was used as it has been recommended by different authors, especially for Asian and African pregnant women (351). Pregnant women were assigned to one of two categories: poor nutritional status (MUAC < 23 cm) or good nutritional status (MUAC ≥ 23 cm) (351).

### 6.3.4. Measurement of study variables

**Outcome variable**

Dietary diversity was assessed using the MDD-W adapted from the Food and Agriculture Organisation guidelines (4) by creating a list of foods that are locally available. The MDD-W indicator consists of 10 food groups; participants receive a score of 1 for a given food group if she consumes at least one item in that food group; otherwise, the participant receives a score of zero for that food group. The assessment was conducted by asking participants to report all drinks and foods they had consumed the previous day (the last 24 hours), and a probing technique was used to help pregnant women recall all foods and drinks consumed. A list of 56 local foods was included in the questionnaire and sorted into 10 food groups. This list is provided as a supporting file in table S1. The total dietary diversity score was calculated and dichotomised as adequate dietary diversity (consumption of five or more food groups) or inadequate dietary diversity (consumption of less than five food groups) (4).

**Explanatory variables**

Data collected on sociodemographic characteristics included occupation, age, marital status, education, and religion, and data on obstetric characteristics included gestational weeks, parity, and the number of ANC visits. The socioeconomic section of the questionnaire assessed participants' ownership of a radio, a mobile phone, and livestock, and their 'ubudehe' category, which is a social stratification based on household income, ranging from the highest income of the richest households, to the lowest income of the poorest and most vulnerable households in society.

Nutritional knowledge was assessed using the questionnaire adapted from the Food and Agriculture Organisation's Knowledge, Attitude, and Practice Manual (308). It included 13 items, which assessed knowledge of adequate nutrition, recognition and prevention of anaemia during pregnancy, the importance of nutrition during pregnancy, and weight gain, resulting in a score between 0 and 32. Nutritional knowledge was classified as poor (< 50%), moderate (50%-74%), and good (≥ 75%). The items assessed are provided in supplement table S2.

We measured the household's food security using the Household Food Insecurity Access Scale designed by Food and Nutrition Technical Assistance (219). The scale consists of nine 'occurrence questions' and nine questions related to the frequency of occurrence. The occurrence questions characterise different dimensions of food insecurity, and the frequency of occurrence question is skipped if the participant reports that the corresponding occurrence has not occurred during the previous four weeks (30 days). For descriptive statistics, levels of food insecurity included in the Household Food Insecurity Access Scale ranged from no

insecurity (score < 2), mild insecurity (score 2–10), moderate insecurity (score 11–17), and severe insecurity (score > 17). The actual score was used for the multivariable analysis. Questions pertaining to the policy were adapted from the existing Rwandan program to assess the availability of kitchen gardens and being part of the Girinka program (i.e. the one cow per low-income family program).

Social support was assessed using the Maternity Social Support Scale designed by Webster et al. (309). It covers six items and assesses family support, such as the help from husband, friendship network, conflict with husband/male partner, feeling controlled by husband/male partner, and feeling loved by husband/male partner. Every item was assessed on a five-point Likert scale ranging from 1 to 5 points with a possible maximum score of 30. For descriptive purposes, Maternity Social Support Scale was categorised as low social support (0–18), moderate social support (19–24) and high social support (25–30). However, the actual score was used in data logistic regression.

### 6.3.5. Data processing and analyses

Data were cleaned using STATA Release 16, which was also used to analyse the data by computing descriptive statistics, namely frequencies and percentages for the categorical variables and means and standard deviations (SD) for quantitative variables. We did a complete case analysis; those who had fasted on the previous day were excluded from the analysis. In the whole study, there were very few missing values. The procedure explained below was used to select the final multiple logistic regression model for dietary diversity. Initially univariable logistic regression models were fitted to identify factors that were potentially associated with dietary diversity, using a liberal screening p-value of 0.20 to ensure that all potential confounders were investigated. In addition, variables that were part of the design (district and rural/urban) and variables previously identified in the literature as being associated with dietary diversity (age and wealth category) were included in the final model irrespective of statistical significance. The quantitative explanatory variables were included in the model as continuous variates, with fractional polynomials used to test for any non-linearity in their effect, as several authors have pointed out the disadvantage of categorising continuous exposure variables (220–222,310). Once the pool of potential explanatory variables had been identified, backward elimination with a nominal p-value for exclusion of 0.05 was used to select the final model, with district, rural/urban, age and wealth category fixed in the final model, While backward elimination and other stepwise procedures have a number of well-known disadvantages, it is

recommended for analyses such as this in which there is no primary exposure of interest, and it has the relative advantage that negatively confounded sets of variables are less likely to be omitted from the model since all important explanatory variables are included in the initial model. This recommendation can be found in Chapter 10 of Regression Methods in Biostatistics: Linear, Logistic, Survival and Repeated Measures Models. Second Edition by Vittinghoff E and colleagues in (2012). Due to the small number of clusters (8 health centres) in our model, we fitted terms for district and rural/urban rather than adjusting for clusters as random effects.

The impact of factors on dietary diversity was expressed as odds ratios with 95% confidence limits. Interactions involving the main exposures of interest (ownership of a radio, having a kitchen garden, food insecurity and nutritional knowledge) were investigated but none were found to be statistically significant. Potential multicollinearity was investigated through looking at the variance inflation factors for the final model, but no multicollinearity was found. In addition, we checked for goodness of fit of the final model using the Hosmer-Lemeshow goodness of fit test, which showed no evidence of lack of fit. We computed the Cronbach alpha for food insecurity which became 0.93 and maternal social support, which became 0.74 indicating acceptable reliability.

### 6.3.6. Ethics approval and consent to participate

The implementation of this study complied with the Declaration of Helsinki. This study was a part of a research project that has been approved by relevant authorities. Ethical clearances were secured from the Institutional Review Board of the University of Rwanda, where the study was conducted (287/CMHS IRB/2021), and the Human Research Ethics Committee (Medical) of the University of Witwatersrand, where the corresponding author is registered (M211046). Before the survey, participants provided written consent to be part of the study after receiving comprehensive details about the purpose, benefits, and risks of participation. Participants were also assured that their participation was voluntary and that the information they provided would remain confidential. They signed the consent form or provided fingerprints (for illiterate) as they were above 18 years old.

## 6.4. Results

### 6.4.1. Sociodemographic, economic, and obstetric characteristics of participants

Of the 612 pregnant women who participated in this study, six who reported that they had fasted 24 hrs before the interview date were excluded from the analysis because, in this case, the previous 24 hours were deemed not representative of their usual dietary diversity practices. Therefore, the data analysis included 606 participants. The mean age of the participants was (28 ± 6.5 SD) years. A large proportion of participants *(*n = 267) was between 25 and 34 years old, and 138 (51.7%) of them presented with inadequate dietary diversity. A total of 402 participants attended primary school; among them, 254 (63.2%) had inadequate dietary diversity. A total of 498 participants were married and more than half of them had inadequate dietary diversity (n = 265, 53.2%). Many participants (n = 243) reported being in the second wealth category (poor), and among them, 140 (57.6%) had inadequate dietary diversity; 306 women were classified as experiencing severe food insecurity, and the majority of these women had inadequate dietary diversity (n = 203, 66.3%). As for their clinical characteristics, most of the participants attended two to three ANC visits (n = 394) and 212 (53.8%) had inadequate dietary diversity (Table 6.1).

**Table 0.1: Sociodemographic, economic, and obstetric characteristics of participants**

| Factor | Category | Dietary Diversity | | Total (N=606) |
|---|---|---|---|---|
| | | Adequate n (%) | Inadequate n (%) | |
| **Overall** | | 267(44.1) | 339(55.9) | |
| **Age (years)** | **Mean (SD)** | 29(6.7) | 28(6.2) | 28(6.5) |
| | 18–24 | 91 (41.2) | 130 (58.8 ) | 221 |
| | 25–34 | 129(48.3) | 138 (51.7) | 267 |
| | ≥ 35 | 47(39.8) | 71(60.2) | 118 |
| **Education** | None | 12(35.3) | 22(64.7) | 34 |
| | Primary | 148(36.8) | 254(63.2) | 402 |

| | | | | |
|---|---|---|---|---|
| | Secondary and above | 107(62.9) | 63(37.1) | 170 |
| **Religion** | Christian | 251(43.4) | 327(56.6) | 578 |
| | Other | 16(57.1) | 12(48.9) | 28 |
| **Occupation** | Housewife | 204(41.5) | 287(58.5) | 491 |
| | Paying job | 63(54.8) | 52(45.2) | 115 |
| **Marital status** | Married | 233(46.8) | 265(53.2) | 498 |
| | Single | 34(31.5) | 74 (68.5) | 108 |
| **Household size** | 1–3 | 136(47.1) | 153(52.9) | 289 |
| | 4–6 | 105(42.3) | 143(57.7) | 248 |
| | ≥ 7 | 26(37.7) | 43(62.3) | 69 |
| **District** | Gisagara | 55(36.2) | 97(63.8) | 152 |
| | Huye | 57(38.3) | 92(61.7) | 149 |
| | Kamonyi | 103(67.3) | 50(32.7) | 153 |
| | Ruhango | 52(34.2) | 100(65.8) | 152 |
| **Residential area** | Rural | 142(47.0) | 160(53.0) | 302 |
| | Urban | 125(41.1) | 179(58.9) | 304 |
| **Gestational weeks** | 13–27 | 100(45.25) | 121(54.75) | 221 |
| | 28–44 | 167(43.4) | 218(56.6) | 385 |
| **Parity** | 0–1 | 155(47.8) | 169(51.2) | 324 |
| | 2–3 | 81(40.1) | 121(59.9) | 202 |
| | >=4 | 31(38.7) | 49(61.3) | 80 |
| **ANC visits** | 0–1 | 59(37.3) | 99(62.7) | 158 |
| | 2–3 | 182(46.2) | 212(53.8) | 394 |
| | >=4 | 26(48.2) | 28(51.8) | 54 |
| **Ubudehe category** | Poorer | 55(42.9) | 73(57.1) | 128 |
| | Poor | 103(42.4) | 140(57.6) | 243 |
| | Richer | 101(45.3) | 122(54.7) | 223 |
| | Unknown | 8 (66.67) | 4 (33.3) | 12 |
| **Radio** | No | 93(32.1) | 197(67.9) | 290 |
| | Yes | 174(55.1) | 142(44.9) | 316 |
| **Telephone** | No | 34(26.9) | 92(73.1) | 126 |
| | Yes | 233(48.5) | 247(51.5) | 480 |
| **Access to agricultural land** (n=605) | No | 114(47.9) | 124(52.1) | 238 |
| | Yes | 153(41.7) | 214(58.3) | 367 |
| **Kitchen garden** (n=605**)** | No | 74(34.9) | 138(65.1) | 212 |
| | Yes | 193(49.1) | 200(50.9) | 393 |
| **Food security** | Food security | 61 (73.5) | 22(26.5) | 83 |
| | Mild food insecurity | 54(58.7) | 38(41.3) | 92 |
| | Moderate food insecurity | 49(39.2) | 76 (60.8) | 125 |

| | | | | |
|---|---|---|---|---|
| | Severe food insecurity | 103(33.7) | 203(66.3) | 306 |
| **Nutritional knowledge** | Poor | 54(31.1) | 120(68.9) | 174 |
| | Moderate | 94(45.6) | 112(54.4) | 206 |
| | Good | 119(52.6) | 107(47.4) | 226 |
| **Social support** | Low | 36(27.7) | 94(72) | 130 |
| | Moderate | 123(49.6) | 125(50.4) | 248 |
| | High | 108(47.4) | 120(52.6) | 228 |

### 6.4.2. Dietary diversity of pregnant women

This study found that the mean dietary diversity score was 4.40 (SD = 2.14). Details about dietary diversity score are provided in supplement table S3. Less than half of the participants had adequate dietary diversity (n = 267, 44.1%), with a 95% CI of [40.1%, 48.0%]. The most consumed food group was that consisting of grains, white roots, tubers (n = 584, 96.4%), and pulses (n = 475, 78.4%). The food groups that were the least consumed consisted of eggs (n = 99, 16.4%), as well as those consisting of milk and milk products (n = 112, 18.5%). More details are provided in (Table 6.2).

**Table 0.2:Dietary Diversity of pregnant Women**

| **Food groups** | **Frequency** (n=606) | **%** |
|---|---|---|
| Grains, white roots and tubers, and plantains | 584 | 96.4 |

| | | |
|---|---|---|
| Pulses (beans, peas and lentils) | 475 | 78.4 |
| Nuts and seeds | 186 | 30.7 |
| Dairy | 112 | 18.5 |
| Meat, poultry and fish | 251 | 41.4 |
| Eggs | 99 | 16.3 |
| Dark green leafy vegetables | 365 | 60.2 |
| Other vitamin A-rich fruits and vegetables | 213 | 31.5 |
| Other vegetables | 201 | 33.2 |
| Other fruits | 207 | 34.12 |
| **Dietary diversity adequacy** | | |
| Adequate >=5 | 267 | 44.1 |
| Inadequate <5 | 339 | 55.9 |
| **Mean dietary diversity score** | **SD** | |
| 4.40 | 2.14 | |

SD: Standard Deviation

### 6.4.3. Nutritional status and dietary diversity of pregnant women in the Southern Province

In this study, 141 (23.1%) pregnant women had a MUAC < 23 cm, indicating poor nutritional status. The mean MUAC was 24.8 cm (SD = 2.64) and the proportion of participants with poor nutritional status was higher among those with inadequate dietary diversity (25.7% vs 19.1%), which was a marginally significant ($p$ = 0.053) difference (Table 6.3).

**Table 0.3: Nutritional Status and Dietary Diversity.**

| VARIABLE | CATEGORY | NUTRITIONAL STATUS | CHI-SQUARE | *P*-VALUE |
|---|---|---|---|---|

| | | Poor (MUAC < 23 cm) n (%) | Good (MUAC ≥ 23 cm) n (%) | | |
|---|---|---|---|---|---|
| **DIETARY DIVERSITY** | Inadequate | 87 (25.7%) | 251 (74.3%) | 3.7336 | 0.053 |
| | Adequate | 51 (19.1%) | 216 (80.9%) | | |

MUAC, mid-upper arm circumference

### 6.4.4. Determinants of dietary diversity of pregnant women in the Southern Province of Rwanda

The results of fitting multiple logistic regression models to find factors associated with adequate dietary diversity are summarized in Table 6.4. The adjusted odds ratio (aOR) for owning a radio was 1.90 with a 95% CI of [1.27, 2.85] and having a kitchen garden (aOR = 1.69[1.11, 2.57]) increased the likelihood of adequate dietary diversity. Food insecurity was associated with inadequate dietary diversity, as indicated by the aOR < 1 for adequate dietary diversity (aOR = 0.19[0.07, 0.50]). Other factors associated with dietary diversity were maternal education (aOR = 1.85[1.28, 2.65]) nutritional knowledge (aOR = 1.45 [1.21, 1.74]), household size (aOR=0.88[0.79;0.99]), and urban residence (aOR = 0.69[0.47, 1.03]) showing a significant difference in dietary diversity among the four districts ($p < 0.001$) with the odds of dietary diversity being highest in Kamonyi district (Table 6.4). The overall variance inflation factor was 1.43 and the highest was 2.65; the Hosmer-Lemeshow goodness of fit test showed no evidence of a lack of fit (P=0.469).

**Table 0.4: Determinants of Dietary Diversity of Pregnant Women in the Southern Province of Rwanda**

| Factor (n=612) | Category | Unadjusted OR [95% CI] | *p*-value | Adjusted OR [95% CI] | *p*-value |
|---|---|---|---|---|---|

| | | | | | |
|---|---|---|---|---|---|
| **District** | Gisagara | 1 | | 1 | <0.001 |
| | Huye | 1.09[0.68,1.74] | 0.710 | 1.43[0.81, 2.48] | |
| | Kamonyi | 3.63[2.26, 5.82] | <0.00 | 4.29[ 2.43, 7.56] | |
| | Ruhango | 0.91[0.57, 1.46] | 0.719 | 1.33[ 0.73, 2.42] | |
| **Residence** | Rural | 1 | | 1 | 0.005 |
| | Urban | 0.79[0.57, 1.09] | 0.144 | 0.59[0.40, 0.87] | |
| **Age** | Per one-year increase | .99[0.97, 1.02] | 0.526 | 1.01[0.98;1.04] | |
| **Ubudehe category** | | 0.97[0.79, 1.18] | 0.778 | 0.93[0.73;1.18] | |
| **Education-cubed** | | 1.03[1.01, 1.04] | <0.001 | 1.02[1.01, 1.03] | 0.003 |
| **Religion** | Christian | 1 | | | |
| | Others | 1.76[0.82, 3.80] | 0.004 | | |
| **Occupation** | Housewife | 1 | | | |
| | Paying Job | 1.66[1.10, 2.49] | 0.014 | | |
| **Marital status** | Married | 1 | | | |
| | Single | 0.52[0.33, 0.81] | 0.145 | | |
| **Household Size** | Per one member increase | 0.82[0.64, 1.04] | 0.115 | 0.88[0.79;0.99] | 0.03 |
| **Gestational week** | Per one unit increase | 0.99[0.97, 1.02] | 0.811 | | |
| **Parity** | Per one child increase | 0.80[0.63, 1.00] | 0.058 | | |
| **ANC visits** | Per one visit increase | 1.30[0.98, 1.74] | 0.065 | | |
| **Radio** | No | 1 | | 1 | < 0.001 |
| | Yes | 2.64[0.89, 3.67] | <0.001 | 1.85[1.25, 2.75] | |
| **Telephone** | No | 1 | | | |
| | Yes | 2.60[1.69, 4.00] | <0.001 | | |
| **Access to agricultural land** | No | | | | |
| | Yes | 0.78[0.56, 1.08] | 0.147 | | |
| **Kitchen garden(n=611)** | No | 1 | | 1 | 0.009 |
| | Yes | 1.81[1.28, 2.55] | 0.001 | 1.83[1.21, 2.76] | |
| **Food insecurity** | Per 5 units increase | .065[0.03, 0.14] | <0.001 | 0.16[0.06, 0.40] | <0.001 |
| **Nutritional knowledge** | Per 5 units' increase | 1.41[1.22, 1.62] | <0.001 | 1.51[1.27, 1.81] | <0.001 |
| **Social support** | Per 5 units increase | 5.7[1.91; 16.81] | 0.002 | | |

OR: Odd ratio

## 6.5. Discussion

This study assessed the dietary diversity of pregnant women who attended ANC services in the Southern Province of Rwanda and investigated the factors associated with adequate dietary diversity. Less than half of all the pregnant women (44.1%) met the minimum dietary diversity

criterion of consuming at least five food groups in the previous 24 hours. The determinants of dietary diversity among the study participants include owning a radio, having a kitchen garden, food insecurity, nutritional knowledge, maternal education, household size, and being urban residents.

The proportion of pregnant women who achieved adequate dietary diversity (44.1%) was lower than the proportions reported in studies conducted in Hosanna Town, Ethiopia (57.4%) (62), Southwest Ethiopia (48.3%) (352), Nepal (55%) (353), and the Gurage Zone, Ethiopia (57.9%) (343). However, the proportion was higher than those reported in studies conducted in North East Ethiopia (31.4%) (252) and Oromia Ethiopia (23.6%) (3). This discrepancy can be explained by differences in study periods and the geographical and sociocultural differences between the countries.

Grain, white root, and tuber foods were more consumed (96.4%) than other food groups. This finding is consistent with the literature that shows that the diet of pregnant women in low- and middle-income countries is mainly cereal-based and deficient in animal-source foods (354) It is also similar to the findings of a study conducted in Southwest Ethiopia that report that 99.8% of pregnant mothers consumed food consisting of white roots, grains, and tubers (355). Food groups that were less consumed by the participants in this study include eggs (16.3%) and milk and milk products (18.5%), which may be related to the higher price of animal-source foods. Thus, some pregnant women may have limited their consumption of animal products to holidays (Christmas and Easter) and ceremonies. However, these days were excluded from the data collection. Furthermore, some cultures restrict animal-source foods during pregnancy because these foods are considered taboo during pregnancy; for example, some pregnant women in Tanzania and South Africa restrict meat, milk, and eggs due to cultural norms (135,356). Similarly, a high consumption of cereal-based foods was reported in a study conducted in Tanzania, (336). However, this finding was different from the results of a study conducted in East Gojjam, Ethiopia, that report that legumes and seeds were the most frequently consumed food groups (85.5%) (357). This difference may be due to self-reporting differences, geographical location, and seasonal variation. This finding implies that pregnant women in the Southern Province of Rwanda are likely to have nutritional deficiencies and poor pregnancy outcomes because they do not consume a sufficient amount of animal-source foods containing higher quality protein and vital micronutrients essential for positive pregnancy outcomes and the growth and development of infants (358).

Maternal education was positively associated with optimal dietary diversity in this study, which may be related to participants' greater access to different sources of nutritional information that improved their nutritional knowledge, and hence, their dietary diversity. Education is a proxy measure of socioeconomic status, which could influence the ability to afford various types of food, and less education and a lower socioeconomic status could interfere with dietary diversity because of a lack of basic information on nutrition, regardless of other circumstances. This finding is similar to the results of a study conducted in Brazil that report that socioeconomic factors, including a high educational level, were associated with varied dietary patterns (261). According to this study conducted in Brazil, a varied dietary pattern consisted of various food items, such as 'grains, cereals and tubers', 'bread, cakes and cookies', and fruits and vegetables. Similarly, a study conducted in Ethiopia among pregnant women found that secondary and tertiary education of mothers were associated with adequate dietary diversity. [7]

Household size negatively affects the dietary diversity of pregnant women. Increased household size decreased the odds of adequate dietary diversity among pregnant women. It may be since a large household decreases the quantity and quality of food consumed per person because the food is shared among many people. Consequently, many families prioritise food quantity over quality, leading to poor diversification of consumed food. It is consistent with other studies conducted in South Africa and Nigeria (359,360).

Owning a radio was positively associated with the dietary diversity of pregnant women in this study. Pregnant women who owned a radio were two times more likely to vary their diet than those who did not own a radio. This finding may be because owning radio could expose pregnant women to nutritional information that can affect their dietary practices. The economic status of participants who owned a radio may have been higher than that of those who did not have a radio, which could have increased their access to information, and thereby, improved their dietary diversity. However, studies with appropriate design could help identify such association. This finding is similar to the results of a secondary analysis of data from three sub-Saharan African countries (Gambia, Liberia, and Rwanda) that report that mothers who had access to radios were more likely to diversify the diets of their children (361).

Having a kitchen garden was positively associated with dietary diversity. The odds of pregnant women who owned kitchen gardens having good dietary diversity were 1.59 times higher than for pregnant women who did not own a kitchen garden. This finding may be explained by the greater likelihood of a kitchen garden owner consuming different types of vegetables without

purchasing them, and using the money that might have been used to buy vegetables to purchase other food groups. Furthermore, kitchen garden owners can sell their excess vegetables and use their earnings to buy different varieties of food groups. A randomised controlled trial conducted in Tanzania to evaluate the effect of home gardens on dietary diversity among women observed that the women in the intervention group consumed more food groups than those in the comparison group (331). The consistency of these results between the two studies can be attributed to the similarity between the study participants and their geographical locations.

In the present study, it was found that food insecurity predicts adequate dietary diversity. This means a negative association where a decrease in food security was associated with a decrease in the odds of adequate dietary diversity, which was most likely because food insecurity decreases household food availability and accessibility, resulting in poor dietary diversity practices. Limited food availability affects intra-household food allocation because pregnant women often prioritise the nutrition of their family members over their own nutritional requirements. Studies conducted in Malawi and Ethiopia similarly found that women from households with moderate and severe levels of food insecurity had a low dietary diversity score and inadequate dietary diversity compared to women from households with low levels of food insecurity (219,362,363).

This study highlighted the positive relationship between nutritional knowledge and dietary diversity. Having nutritional knowledge increased participants' likelihood of exhibiting good dietary diversity. These results are consistent with those of studies conducted in Malawi (364), Bangladesh (365), and India (366), which found that having adequate knowledge of optimal nutrition during pregnancy translates to the practice of consuming food from different food groups. Interestingly, the urban residence was negatively associated with adequate dietary diversity. Pregnant women treated in urban health centres were less likely than those from rural health centres to achieve adequate dietary diversity. These results may be explained by the many opportunities for women in rural areas who are mainly farmers raising livestock to access a variety animal- and non-animal-source foods. On the other hand, pregnant women from urban health centres may have to purchase all of the food they consume due to limited space for farming, making it more difficult to access various food groups. These findings suggest that pregnant women in urban health centres with a low socioeconomic status require more attention and encouragement from staff to help them to improve their dietary diversity, which may be poor because of the high cost of living in urban areas. Although this finding is consistent with that of a study conducted in Nigeria (360), it differs from a study conducted in Ethiopia, in

which dietary diversity was found to be better among residents of an urban area (367). These cross-country differences may reflect the individual participants' characteristics and differences related to geographical locations.

## 6.6. Policy and Practice Implications

The findings of this study support the recommendations of the NFNP by calling for interventions to improve the dietary diversity of pregnant women in Rwanda. Different stakeholders should be involved in the implementation of nutrition-sensitive and nutrition-specific interventions. Agricultural interventions designed to foster kitchen garden ownership could help improve the dietary diversity of pregnant women, and nurses and midwives could enhance the nutrition education offered during ANC visits by emphasising the diversification of diets and the importance of consuming animal-source foods during pregnancy. Specific nutritional messages should be disseminated through different media, including radio.

## 6.7. Limitations

This study was based in health facilities; therefore, the findings are not generalizable to the entire population. Social desirability and recall bias could have occurred because we requested pregnant women to recall information and provide self-reports of what they consumed within the previous 24 hours. However, we used probing to mitigate this potential bias. In addition, the food consumed during the preceding 24 hours might not have been representative of the participants' routine diet. We excluded weekends and days with ceremonial major events to minimise such differences. The nutritional status of the participants was measured using the MUAC due to resource constraints; however, it would have been better to combine the MUAC results with the results of other biological indicators, such as haemoglobin level. The findings of this study should be triangulated with the qualitative study to explore whether there is a cultural influence on the dietary diversity of pregnant women in Rwanda.

## 6.8. Conclusion

More than half the participants in this study had inadequate dietary diversity. Many pregnant women consumed grains, white roots, and tubers, whereas few pregnant women consumed animal-source foods. Factors such as maternal education, food insecurity, ownership of a radio or kitchen garden, and having good nutritional knowledge were determinants of dietary diversity. Nutrition education is needed to emphasise the importance of animal-source foods and affordable alternatives to access them. Home visits for community sensitisation to raise awareness of the importance of owning a kitchen garden and radio could help improve the

dietary diversity of pregnant women. Furthermore, research studies measuring the micronutrient levels of pregnant women in Rwanda's Southern Province would be very important. There should be studies conducted to validate the MDD-W/Household Food Insecurity Access Scale tools in the Rwandan context.

# Chapter seven: Healthy mothers, healthy futures: Exploring the influence of healthcare providers and male partners on pregnant 'women's dietary practices

Male partners play an important role in the social support network of pregnant women and may affect their dietary practices in different ways. Exploring their perspectives on dietary practices of pregnant women allows one to get insight on how social support dynamics within the household affect dietary practices. Similarly, healthcare providers are important in providing dietary guidance, education, and support during pregnancy. Identifying healthcare providers' perspectives allows one to explore the extent to which healthcare providers support dietary practices of pregnant women, identify the status of healthcare delivery and areas for improvement in antenatal care services. Therefore, being informed by the findings from the previous chapter five and six, where I quantitatively assessed the level of social support provided to pregnant women, in chapter seven, I conducted a qualitative study to explore how male partners and healthcare providers working in ANC services support the dietary practices of pregnant women and the potential challenges they face when providing the nutritional support.

## 7.1. Abstract

**Background**

In Rwanda, particularly the Southern Province, maternal dietary practices during pregnancy are suboptimal. In this country, the path to motherhood is influenced by the support systems from healthcare providers who deliver antenatal care and male partners within the nuclear family structure. However, little is known about how healthcare providers and male partners support pregnant women in adopting healthy dietary practices. Hence, this study sought to provide more insight into how the dietary practices of pregnant women are supported.

**Methods**

This study used an exploratory qualitative research design. We collected data from study participants that included eight in-depth interviews with healthcare providers working in antenatal care services and four focus group discussions with male partners of pregnant women living in the Southern Province of Rwanda. We used thematic analysis that followed the hybrid coding of the data.

**Results**

The support provided to pregnant women regarding their dietary practices coalesced around three central themes. The first theme investigated the modalities of support for dietary practices. These encompassed emotional support, wherein male partners described the importance of emotional well-being as a fundamental component of good dietary habits; educational support, involving the provision of dietary information to pregnant women; and material support, which included the provision of food or financial resources. The second theme explored barriers to support, and this included limited knowledge of good dietary practices, genders and cultural beliefs, health system challenges as well as economic and food precarity. The third theme incorporated strategies for dietary improvement, focusing on male partner engagement, socioeconomic constraints, and healthcare system enhancements.

**Conclusion**

The study found that at the household, and community level, male partner support as well as gender and cultural norms affect the dietary practices of pregnant women. At the healthcare system level, ANC nurses and midwives are challenged with limited training, and shortage of resources. At the national level, economic and food precarity negatively affect dietary practices. Therefore, interventions aiming at enhancing the health system, actively engaging male partners, and preventing food and economic precarity could be beneficial for improving the dietary practices of pregnant women in this area.

*Keywords: pregnant women, dietary practices, male partners, healthcare providers*

## 7.2 Introduction

Healthy maternal dietary practices during pregnancy allow the mother to meet the increased nutritional demand necessary for foetal and maternal health and future breastfeeding practices. The most important recommendation during pregnancy is to adhere to a healthy, balanced diet (368). However, pregnant women are exposed to multiple factors that facilitate or inhibit them from making healthy dietary choices during pregnancy (369).

Midwives play a significant role as primary healthcare providers in providing prenatal care and have been identified as the primary and most commonly utilised resource for pregnant women seeking health information (370). Additionally, their involvement in delivering dietary guidance is explicitly outlined in the International Confederation of Midwives , which is a global organization that plays an important role in advancing the profession of midwifery and

ensuring good maternal and new-born health worldwide (371). Antenatal care service provides health professionals with the opportunity to engage in discussions and provide support about healthy dietary practices that are suggested for ensuring positive pregnancy experiences. A healthy diet includes increasing consumption of vegetables, fruits, and other key food groups, and abstaining from alcohol and tobacco (372). In addition, healthcare providers should also enhance understanding regarding significant nutritional considerations during pregnancy.

However, some healthcare providers are not able to positively influence the dietary practices of pregnant women due to numerous challenges. These include limited knowledge of basic nutrition guidelines for pregnant women (373). In addition, healthcare providers can be challenged by the limited guidelines that could be effectively used through dietary counselling practices (374). Sometimes, nutrition counselling is delivered within a limited time using inadequate documentation (375).

In addition to the healthcare providers, research has reported that where male partners are actively involved, they improve maternal and foetal health outcomes (376). Male partners are actively involved when they are present, available, understanding and willing to provide emotional, physical and financial support to pregnant women (377). The evidence shows a positive association between male partners' involvement and healthy maternal behaviours such as the utilisation of health services, preparation for childbirth, and adequate dietary diversity (378). However, male partners' involvement is hindered by several barriers, including limited knowledge about maternal health, gendered roles, socio-cultural norms and socioeconomic status (379–382).

In Rwanda, especially in the Southern Province, maternal dietary practices during pregnancy are suboptimal and poor nutritional status by MUAC is estimated at 23% (303). We lack understanding of how healthcare providers and male partners support healthy dietary practices in pregnant women, and the obstacles they may encounter are unclear. This study therefore explored the support provided by healthcare providers and male partners to pregnant women towards good dietary practices and the challenges they meet when trying to support the dietary practices.

## 7.3 Methods and materials

### 7.3.1. Study setting

This study was conducted in eight health centres located in the Southern Province of Rwanda; four were from a rural area, and the remaining four were from an urban area. The Rwanda Demographic Health Surveys of 2014/2015 and 2019/2020 show that the Southern Province accounts for the highest prevalence of underweight and anaemic pregnant women.

### 7.3.2. Study design and population

The study used an exploratory qualitative research design and approach to collect data among the study participants through in-depth interviews (IDIs) and focus group discussions (FGDs)(383). Participants consisted of male partners of pregnant women and healthcare providers working in antenatal care services. We collected data through four FGDs; two FGDs were from rural health centres, and two FGDs were from urban health centres. Each FGD included six to eight male partners making a total of 28 male partners participants. FGDs, compared to KIIs, offer efficient means to uncover shared experiences and cultural norms among study participants, fostering open discussion and providing deep insights into practices and challenges (384). Data was collected through IDIs, with one nurse or midwife from each health centre, making a total of eight healthcare providers.

We used purposive sampling within health centres to select the male partners of pregnant women who lived in the study area and were willing to participate. We also selected nurses or midwives in charge of antenatal care services who had worked for at least 6 months at the facility to ensure they were familiar with the practices of the health facility's population.

### 7.3.3. Data collection process

Prior to data collection, the research assistant was trained and informed on the study's purpose, methods, and data collection tools. Data were collected using unstructured interviews and focus group guides developed by the researchers. The tools used open-ended questions, allowing the participants to provide detailed information. They were translated to Kinyarwanda, locally spoken, and translated back into English to ensure accuracy and uniformity (385). The tools were then pre-tested in a focus group of four men and two interviews with healthcare providers from non-study health centres. After the pre-test, a few probes were added to improve clarity and depth. We collected data in October 2022. IDIs and FGDs were conducted in Kinyarwanda by the first author (AU) and one research assistant. These were audio-recorded, and the

researchers also took field notes. The first author facilitated the four FGDs with male partners and the eight IDIs with healthcare providers, which took place in a quiet room to avoid distractions. The research assistant took field notes and facilitated the audio recording. The FGDs took approximately one hour, while the IDIs were between 45 to 60 minutes. The discussions with male partners focused on their knowledge about foods encouraged or discouraged during pregnancy, how they support their pregnant wives to eat foods that optimise their health during pregnancy, the barriers that hinder their support of their wives and how they feel when they are unable to support their pregnant wives in the way they would like to. Interviews were conducted with nurses and midwives to investigate their roles in supporting the dietary practices of pregnant women. The interviews explored the integration of this support within their existing facility duties, the challenges encountered when promoting optimal nutrition among this population, and their management strategies for cases of maternal malnutrition.

### 7.3.4. Data analysis

Two research assistants transcribed recordings into Kinyarwanda using the true verbatim method, transcribing every spoken word exactly as they are heard to capture meanings and insights perfectly (20). Field notes were integrated into the written transcripts as supplementary data. Transcripts were translated into English by a professional translator. The first author (AU) and co-author (HU) checked the transcripts for clarity and completeness. Data were analysed using thematic analysis combining deductive and inductive approaches in six steps: 1) familiarization with data; 2) identifying initial codes; 3) generating themes; 4) reviewing and defining themes; 5) coding the data; 6) organizing themes and write up (223). The first author (AU) and co-author (EN) developed the initial codebook after reading all transcripts. AU and HU independently coded two FGDs and two IDIs; discrepancies were discussed and fixed to develop the final codebook. SJ validated the final codebook and suggested a few additional codes. AU and HU completed the coding of the remaining interviews and included in the analysis any new emerging codes not included in the initial codebook (386). Themes and sub-themes used for reporting the data were developed.

## 7.4 Results

The healthcare provider sample consisted exclusively of female personnel, specifically four nurses and four midwives. Their professional experience ranged from five to twelve years, and their ages spanned 36 to 50 years. The male partners of the pregnant women (n=27) were drawn

from both urban (n=14) and rural (n=13) locales. The women's parity ranged from one to five live births. Most male partners had attained a primary school education. Their ages ranged from 24 to 42 years. The analysis revealed three themes, namely (1) forms of support for dietary practices, (2) barriers to effective support, and (3) strategies for improvement of dietary practices. Each theme had associated sub-themes, and we include verbatim quotes to provide evidence to support the themes in the presentation of the findings.

### 7.4.1. Modalities of Support for Dietary Practices of Pregnant Women

This theme describes the support provided by healthcare providers and male partners to pregnant women to promote healthy dietary practices during pregnancy.

#### 7.4.1.1. Emotional and educational supports

While many men focused on their role in providing material resources, some men also stressed that their primary role was to provide a conducive household environment without any conflict. One male partner asserted that pregnant women must be emotionally supported and mentioned the impact this support could have:

> *"…when there is no peace at home even if you can provide everything it 'won't help. Because the first thing is peace and comfort, once you provide peace she gets time to feel safe, you take care of her and she behave like you have provided everything…. the positive impact is that she will take a balanced diet, get full security, which then positively affects the baby. " (*Man in FGD, rural)

Prenatal dietary support provided by healthcare providers primarily consisted of disseminating nutritional information and guidance regarding appropriate food choices during gestation, how to prepare a balanced diet, strategies to access inexpensive foods and the importance of micronutrient supplementation like Iron and Folic Acid (IFA). The midwife in this study described the information they provide during ANC visits:

> *" Firstly, we explain the pregnant women about a balanced diet and the proper way they should eat, and sometimes we show them how to prepare the meals because you may tell them the constituents of a balanced diet, but they may prepare them wrongly when they arrive at home. We give them some examples of foods that they may include in their meal that are not expensive to make a balanced diet. For instance, as the cultivating land is being reduced, we advise them to have a kitchen garden and some livestock like chickens so they have access to vegetables and eggs." (*Midwife, rural)

Healthcare providers address maternal malnutrition in different ways. Some refer patients to a nutritionist for specialized dietary management. In contrast, others conduct home visits to identify the underlying causes of malnutrition and develop appropriate interventions. A nurse explained the process:

> *"The first thing we do is a home visit. We evaluate what kind of support is needed. Do they need mental support? Do they have poor information? Why are they losing weight? Is it a family conflict with the husband? Then, we encourage the male partners to influence their wife's nutrition, by informing them of the importance of good dietary practices. In case of poor knowledge, we restart education in case. "(Nurse*, urban)

#### 7.4.1.2. Material support

The provision of food by male partners was seen as their significant contribution to supporting the dietary practices of their pregnant wives or partners. Some men felt immense responsibility to make available the necessary food or money for household food security and for the health of mother and baby. One man described how he saw his role in relation to providing resources for this:

> *"You see the first thing at home, when she needs for example these fruits, you have to provide money for her to obtain them. If she also needs eggs, that money can help her buying them. But as a male partner, I have to avail the foods to a pregnant woman so that she will give birth to a baby with appropriate weight. "(Man* in FGD, urban)

To assist malnourished pregnant women coming from the low-income families, the health care providers refer the pregnant women to a nutritional service within the health centre to get food supplements that consist of mixed flour to make fortified porridge or advocate for other food types from the local leaders. A nurse explained:

> *"When we find that malnutrition is caused by the lack of food, we sometime work with sector officers to see if they may have some food to help us, we also have some vocational foreigners who sometime bring foods here and we can also give some to the pregnant women. Another thing we do is to refer the women to the nutritional service to get the mixed-flour (Shishakibondo) to make the porridge. "(Nurse* rural)

### 7.4.2. Barriers to effective support of dietary practices of pregnant women

Male partners and healthcare providers experienced challenges which limited their ability to support the dietary practices of pregnant women.

#### 7.4.2.1. Limited Knowledge about good dietary practices

Healthcare providers talked about how they might miss information about dietary practices or how it can be superficial, especially when they are required to educate pregnant women. They are required to play multiple roles while their education focuses mainly on providing ANC in general. Some expressed concern about their skills in communicating about dietary practices, often feeling unprepared to offer comprehensive dietary counselling, *"We provide information as nurses/midwives but not nutritionist. You may listen to [a] nutritionist presenting and hear the difference. That means we miss some skills."* (Nurse, urban)

These limitations in knowledge negatively affect the daily practices of nurses and midwives aiming at supporting or taking care of pregnant women in terms of healthy dietary practices. A nurse explained how limited training in nutrition often hinders comprehensive dietary support:

> "…. *Otherwise there are some who don't educate the clients because they have no information of it, some don't want to take anthropometrics measures because they don't know how to interpret and intervene. "* (Midwife, rural)

Though nutrition education was delivered during ANC, male partners reported not being able to retain all the information, ignoring some or occasionally supplementing this with community beliefs, which are sometimes not correct. A male partner in an FGD explained:

> *"We are taught at the health centre, but not everybody keeps the lesson after leaving here. A nurse may keep teaching you, but finally, you do not take it all. 4 or 5 messages you can remain with, which means that the knowledge we have is not enough. That is why we usually use common knowledge, because we remember much less from what the nurses teach, or there is some information we do not consider."* (Man in FGD, rural)

#### 7.4.2.2. Socioeconomic constraints to good dietary practices

Male partners highlighted that the first challenge hindering their support of the dietary practices of their pregnant wives was the inability to get the required foods or other resources due to poverty. Healthcare providers corroborated this finding as well that insufficient

finance within household negatively affects dietary practices of pregnant women particularly in urban areas. A nurse explained the reactions of low-income families when they are educated about adequate dietary practices:

> *"The main challenge we face is poverty because there are some poor families who cannot afford what is needed. This is an urban area and there may be people migrated from rural who live with casual work paying one thousand FRW (1USD) or one thousand five hundred. They laugh at you when you tell them to find a balanced diet because they can buy sweet potatoes only to satisfy their children. Simply, the challenge is poverty." (Nurse*, urban)

Food availability was another challenge, with participants noting that even when they had money, some foods were unavailable locally. In addition, food unavailability sometimes involves extra transport costs, leading to the unaffordability of such food in case of insufficient finance. A man said:

> *"you may have money and your woman needs to eat fish but you can't find it in your region because fishes are not traded there. She may also need oranges but are not available at local market and you have to move to other region like Kigali where you need transport fees. You end up being unable to buy these foods because you only have money to cover 'food's price without additional transport fees." (*Man in FGD, rural)

#### 7.4.2.3. Gender, cultural norms and beliefs affect dietary practices

In Rwandan culture, food preparation is traditionally considered women's work, and men are not typically raised or educated in this area. Consequently, male partners in this study reported experiencing a lack of skills in food preparation as a limitation to the effective support. A male partner expressed how such norms challenge the support of pregnant women's dietary practices:

> *"The problem is not just poverty; We have food resources but are unable to prepare a balanced diet. Sometimes you find yourself trying sweet potatoes and mix with…., where you are not able to prepare an important diet. You have the food, but you do not know how to prepare that balanced diet." (*Man in FGD, rural)

All study participants mentioned that some men stick to gender roles and think that being involved in dietary-related practices of pregnant women negatively affects their masculinity rendering them the submissive and powerless men. A male partner in FGD described instances where men are not involved in caring for pregnant women who are in apparent need of support:

*"... There are many women who get pregnant but 'can't get support; this is very often and I have a lot of testimonies. Some men think that when you go into the kitchen to cook for the woman, she is absolutely dominant, and once the woman rules you, you are an undervalued and incapable man." (*Man in FGD, rural)

#### 7.4.2.4. Healthcare system challenges

Healthcare providers suggested that good teaching resources and standardized guidelines were important in supporting their role to inform and educate pregnant women on good dietary practices. However, they faced a shortage of materials in their work settings. A midwife described the role of education materials in delivering dietary counselling and their strategies to deal with this:

*"...Another is that teaching resources are not mostly available, and once you cannot access them, you then tell what you remember just because you have nothing else to remind you or to refer to. I think they are called image cards. We have some for pregnancy danger signs, but we 'don't have for nutrition. These image cards are very clear, having illustrating pictures containing key messages, which makes it easier for you when you are preparing the education session since you have information source."* (Midwife, rural)

Furthermore, healthcare system challenges included shortage of healthcare providers which hinders adequate dietary guidance because it involved an increase in workload in an already overburdened system. This affects the process of delivering key information to pregnant women, and does not allow for personalised counselling. It also decreases the frequency and depth of nutrition education delivered to pregnant women. A midwife explained how she manages such a situation:

*"... As the number of clients to receive increases, and I also have another service to deliver after ANC, I give a short summary and sometimes superficial information to ensure that they get back home early and I get the time for the clients in another service."* (Midwife, urban)

### 7.4.3 Strategies to improve maternal dietary practices

#### 7.4.3.1. Enhancing the health system

Healthcare providers sought additional training on nutritional management for pregnant women, specifically regarding the identification and treatment of malnutrition, to enhance their expertise in dietary practices. They suggested they need a formal guideline that will help them providing consistent management of malnourished women across different health centres. They also recommended the continuous training of community health workers (CHWs) to improve their skills and advance their knowledge of the dietary practices of pregnant women, so they continue working together.

> *"If there can be trainings to ensure that every health care provider is aware of adequate dietary practices during pregnancy, the clinical manifestation of malnutrition of a pregnant woman, what to do in the presence of these signs, like the way we know that a person with a low Hb level is managed in a given way like transfusion or others. We need to know what we can do for pregnant women having moderate, severe or mild malnutrition. This will ensure that me as nurse or midwife I am aware of this information and I can measure nutritional parameters, provide interpretation of the result and know how to intervene on the result..."* (Midwife, rural)

To facilitate effective dietary education sessions, healthcare providers suggested availing the teaching resources they can use when delivering nutrition education because people remember better what they have seen than what they have heard. A midwife explained that:

> *"I think that the more important priority is to have training material. It is hard to forget training materials like videos or pictures; they can implement the taught practices easily as they have been seen in videos and short films indicating how to prepare a balanced diet. This will benefit pregnant women and babies."* (Midwife, urban)

The nurses and midwives suggested the involvement of nutritionists in ANC services to delivering nutrition counselling to pregnant women because they possess advanced nutritional knowledge and skills which nurses or midwives do not have.

#### 7.4.3.2. Enhancing male partners' involvement

Because men rarely come to health centres to be educated about the nutrition of pregnant women due to traditional beliefs, some healthcare providers proposed home visits to meet the whole family and educate them about the dietary practices of pregnant women. Currently, there

is no formal programme for home visits; instead they are driven through the initiative of individual health centres. A nurse suggested:

> *"As many men 'can't come to the health centre, they can understand if we move toward their home to avoid shame. So we gather them and teach them as a whole family with children if they are elderly because some mother gets pregnant while having elderly children who can prepare food for their parent. We can observe direct improvement of dietary practices of pregnant women receiving daughters and male partners support."* (Nurse, urban)

Male partners suggested men's groups to allow them to share nutritional information and experiences of what happens in their households.

#### 7.4.3.3. Addressing Socioeconomic Barriers

Both participant groups argued that household economic status needed to be improved for better dietary practices and improved nutrition for pregnant women. Examples offered included donating small livestock like chickens to low-income families to access eggs, initiating saving groups, and assisting low-income families with starting activities that generate income. They also recommended extending food supplements delivered by the government to other wealth categories because some households are incorrectly classified, and hence not receiving government support even when they need it.

## 7.5. Discussion

This study explored the support healthcare providers and male partners provide to pregnant women to assist them in adhering to good dietary practices. We also explored the challenges met in their efforts to support pregnant women and their suggestions for improving their dietary practices.

### 7.5.1. Household and community level

Many male partners observed traditional gender roles, identifying dietary responsibilities such as food preparation as solely female duties. This reveals wider patriarchal social organisations recognized in Rwanda (7), where men's household roles are often restricted to financial provision, limiting their involvement in caregiving practices, including maternal dietary practices. This finding is consistent with findings from a study in Ghana, where gender roles significantly shape dietary support behaviors (387)

Emotional support plays a critical role in dietary adherence. Male partners highlighted that a stress-free household environment fosters better dietary habits, corroborating findings from Abrahams, who reported that emotional well-being enhances dietary adherence in pregnant women (388). Though male partners stated the willingness to offer emotional support and acknowledged the significance of household peace, cultural belief of masculinity mainly the stigma of appearing submissive or dominated hindered direct involvement, such as cooking or food preparation. This suggests for gender-transformative interventions meant to reshaping norms about male partners' engagement in maternal dietary practices beyond ordinary financial contribution.

The retention of dietary information among male partners appeared low, with some relying on community beliefs rather than scientific guidance. This is a general challenge in health education because people may forget essential information over time. Completing dietary information with their community knowledge reveals the effect of social and cultural factors. Community knowledge and practices can supplement or challenge evidence-based recommendations. Bridging the gap between clinical knowledge and community beliefs is important in Rwanda for promoting good dietary practices for pregnant women. Therefore, it is fundamental for nurses and midwives to know these dynamics and address the misconceptions.

Healthcare providers also described coming across the cultural beliefs that limited some dietary practices among pregnant women, such as restriction of consuming milk or meat. While prior studies revealed the influence of cultural food taboos (8), our findings highlight the adaptive tactics healthcare providers use by delivering alternatives to ensure dietary practices without directly confronting these beliefs. This balancing act warrants more formal incorporation into maternal education programming.

### 7.5.2. Health System

The fact that healthcare providers prioritize delivering education during ANC underscores the recognition of the critical role that good dietary practices play in maternal and foetal health. However, Nurses and midwives, while deeply dedicated, stated feeling ineffectively equipped to deliver thorough dietary education due to gaps in their nutrition education and the shortage of teaching resources, including illustrated materials or standardized guidelines. This shows general challenges within the Rwandan healthcare system, which, despite important advancement in maternal and child health indicators, still faces workforce scarcities and

capacity gaps (389). This is consistent with a study conducted in the Oromia region, Ethiopia, which reported that pregnant mothers' access to effective nutritional information is relatively low (390).

This result highlights a concerning disparity between the perceived importance of dietary education during ANC and the actual depth of education provided to pregnant women. The provision of superficial nutrition education suggests a missed opportunity to empower women with the knowledge and skills necessary to make informed decisions about their dietary practices during pregnancy, potentially increasing the risk of maternal malnutrition (391). Therefore, recognizing the gap between the perceived importance of nutrition education and its actual delivery in ANC presents an opportunity for healthcare systems to prioritize and improve the delivery of nutrition education to pregnant women.

Limited training in dietary practices of pregnant women is critical because usually, healthcare providers working in ANC are expected to have a comprehensive understanding of dietary practices. The lack of appropriate knowledge among healthcare providers might result in inadequate guidance and advice to pregnant women, leading to poor dietary practices and pregnancy outcomes (391). A similar finding was reported in a study conducted in Senegal, which showed that among the healthcare providers qualified to conduct ANC, only 20% were trained in maternal dietary practices (392). It is also consistent with the evidence that shows that medical students are not adequately exposed to fundamental nutrition courses as part of their educational curriculum, which consequently hinders their ability to deliver optimal nutrition education to patients (393)(394).This generates a need to deliver better nutritional training to healthcare providers working in ANC for improved care and health promotion.

A scarcity of teaching resources for the successful delivery of dietary practices education was consistent with a  Study conducted in Nigeria, which also reported inadequate resources to conduct nutrition education within health facilities (372). This is important because the use of educational materials as a reinforcement tool for verbal communication is recommended. In addition, the teaching material can have a positive impact on patient education and show potential for supporting patients in addressing doubts that may arise when they are not interacting with the health care provider (1).

Our results suggest that integration of nutritionists into ANC services and provision of consistent in-service training on maternal dietary practices could improve the quality of dietary guidance. Besides, the absence of structured and formal home visit programs further

compounds missed opportunities to involve male partners and family units, critical avenues for enhancing maternal dietary practices given the contextual challenges around men's attendance at health centres.

### 7.5.3. National policy and strategies

Echoing patterns of socio-economic precarity in Rwanda (395), male partners and healthcare providers constantly described poverty, food insecurity, and food unavailability as fundamental barriers to adequate maternal dietary practices. These obstacles were often more marked in urban settings where food prices and cost of living may be expensive, and among households reliant on informal or casual labour. This is consistent with evidence indicating that food insecurity disproportionately affects pregnant women in low-income settings, leading to suboptimal birth outcomes (333). These structural barriers should be considered carefully in ANC because even if other resources are met (knowledge, male partner involvement, healthcare providers support) healthy dietary practices could not be exhibited.

The unavailability of specific foods in local markets and transport costs were the particular challenges in rural or remote areas where access to various foods was restricted. This connection of economic destitution and geographic inequity reflects the findings from food security research in Rwanda (395) and underlines the need for joined social protection programs, like livelihood interventions and expanded food supplementation schemes. The lack of access to different food types lead to dietary inadequacies during pregnancy. In addition, the cost of transportation to access certain foods unavailable at the local market can add an extra layer of financial burden, preventing some families from making healthier food choices, exacerbating the problem of inadequate dietary practices during pregnancy (151). A study conducted in India showed the consistent results that food unavailability impedes good maternal dietary practices (396).

## 7.6. Strengths and Limitations to the study

The strength of this study relies on its inclusion of different perspectives from urban and rural settings, offering a deep understanding of how location and socioeconomic status affect dietary practices of pregnant women. In addition, the use of verbatim quotes enhances the contextual significance of our findings. However, the sample is not representative of the target population. For example, men and nurses or midwives who voluntarily participate in FGDs and IDIs may differ from those who were not involved. In addition, socio-desirability and recall bias may have occurred.

## 7.7. Conclusion

This study provides valuable insights into the multidimensional nature of support towards maternal dietary practices in Rwanda. These encompassed emotional support, wherein male partners described the importance of emotional well-being as a fundamental component of good dietary habits; educational support, involving the provision of dietary information to pregnant women by healthcare providers; and material support, which included the provision of food or financial resources by both male partners and healthcare providers. Barriers to the support, included limited knowledge of good dietary practices, genders and cultural beliefs, health system challenges as well as economic and food precarity. Therefore, tackling these interrelated factors involves holistic, context-sensitive interventions that engage not only pregnant women but also male partners, healthcare providers, and general community structures.

## 7.8. Implications for policy and practice

Implications of these findings include a need for, first, gender-transformative interventions that actively involve male partners through community dialogues, men's groups, or targeted home visits or outreach. These strategies could challenge rigid gender norms and improve male partners' engagement in maternal dietary practices.

Second, health system reinforcement should consider the incorporation of nutrition expertise within ANC services. This include delivering healthcare providers with continuous training on maternal dietary practices, equipping facilities with suitable teaching materials, standards guidelines and formalizing home visit programs to reach whole families in their settings. In addition, involving nutritionists in ANC services to provide specialized nutrition counselling to pregnant women and conducting formal home visits either by nurses, midwives or CHWs could be beneficial. Moreover, establishing free call-centres, or sending nutritional messages through a personal cell phone with reminders and information on good dietary practices.

Finally, implementing measures to address socioeconomic barriers among pregnant women and their families, such as providing small livestock, starting savings groups, and supporting income-generating activities for low-income families could help mitigate the economic precarity faced by pregnant women and their families.

# SECTION C

## Chapter Eight: Integrated Discussion

### 8.1. Introduction

In this chapter, I go back to the study objectives and compare them with the overall findings. I discuss the cross-cutting findings and revisit the conceptual framework that the socioecological model guided. Furthermore, I discuss the methodological rigor, the scholarly contribution of this PhD thesis as well as the strengths and limitations.

This study aimed to identify the different factors that affect the dietary practices of pregnant women in the Southern Province of Rwanda. The four specific objectives were achieved through four research manuscripts provided in Table 8.1.

**Table 0.1: Specific objectives and corresponding articles**

| Article | Objective |
|---|---|
| Factors contributing to the dietary practices of pregnant women in Sub-Saharan African countries: a scoping review. | I |
| Factors associated with dietary practices among pregnant women in the southern province of Rwanda: a mixed method study. | II |
| Dietary diversity and associated factors among pregnant women in the Southern Province of Rwanda: A facility-based cross-sectional study. | III |
| Healthy mothers, healthy futures: Exploring the influence of healthcare providers and male partners on pregnant women's dietary practices | IV |

### 8.2. Prevalence and Implications of Poor Dietary Practices

The findings of this study shed light on the critical issue of poor dietary practices among pregnant women in the Southern Province of Rwanda. The study found low rates of good dietary practices among pregnant women in the Southern Province, with only 40% demonstrating adequate practices. This finding aligns with existing literature indicating

pervasive challenges in ensuring sufficient nutrient intake during pregnancy, particularly in developing countries (397). Poor dietary practices have significant implications for maternal and foetal health, contributing to poor pregnancy outcomes such as low birth weight and preterm births. Low birth weight infants are more likely to experience stunted growth and development during childhood. Intrauterine growth restriction (IUGR), often caused by maternal malnutrition, can lead to infants being born small for gestational age (SGA), which is a risk factor for stunting as well (398). These poor practices could potentially contribute to the stunting rate among children in Rwanda, which is consistently high (33%) despite the different interventions implemented. In addition, this study revealed a low rate of good dietary diversity where only 44.1% had good dietary diversity. Poor dietary diversity during pregnancy can result in inadequate intake of essential nutrients needed for foetal growth and development. Nutrients such as protein, iron, zinc, calcium, vitamin D, and folate are crucial for the development of bones, muscles, organs, and overall growth. When these nutrients are lacking, the foetus may experience restricted growth, leading to stunted development. In addition to the possible synergistic effect of poor dietary practices and dietary diversity on the stunting rate, they could have contributed to the prevalence of poor nutritional status observed in this study, where 23% of study participants were malnourished, according to MUAC. Moreover, this high prevalence of poor dietary practices and diversity may have contributed to the high prevalence of anaemia and underweight among pregnant women in the Southern Province of Rwanda. The loss of maternal and child lives, coupled with the substantial economic burden of associated healthcare costs caused by poor pregnancy outcomes, underscores the critical need for effective interventions to address poor dietary practices among pregnant women in the Southern Province of Rwanda.

### 8.3. Implications of limited nutritional knowledge

This study revealed the association between good nutritional knowledge, good dietary practices and dietary diversity. However, pregnant women, male partners, and healthcare providers in the qualitative study reported having limited nutritional knowledge. This shortage of nutritional knowledge may critically affect maternal dietary practices during pregnancy, posing challenges to good pregnancy outcomes in different ways. For example, 1) Inadequate nutritional knowledge leads to poor dietary practices among pregnant women. Without the understanding of appropriate nutritional requirements during pregnancy, women may fail to prioritize essential nutrients, resulting in imbalanced diets deprived of essential vitamins, minerals, and macronutrients needed for maternal and foetal health. In addition, pregnant women with limited

nutritional knowledge may not efficiently use available resources or search for proper guidance from healthcare providers, which can result in missed opportunities for getting essential nutritional support such as personalized dietary counselling and supplementation guidance. With limited access to adequate nutritional information, women may unintentionally overlook significant aspects of maternal dietary practices, compromising pregnancy outcomes. 2) Male partners play an important role in influencing maternal dietary practices and providing nutritional support during pregnancy. However, when male partners have limited nutritional knowledge, their capacity to engage in promoting good dietary practices is reduced. This may be marked by inappropriate household food choices, limited involvement in meal preparation or purchasing, and a limited understanding of the nutritional requirements of pregnant women. Consequently, pregnant women may face additional barriers maintaining good dietary practices and may experience limited support from their male partners.

3) Healthcare providers are considered the main sources of nutritional information for pregnant women. However, a shortage of nutritional knowledge among healthcare providers can challenge the quality and efficacy of counselling sessions. Limited knowledge of adequate dietary requirements during pregnancy may result in providing inappropriate recommendations and overlooking individualized needs. In addition, healthcare providers may fail to address cultural/religious misconceptions or deliver evidence-based information, which could lead to confusion or uncertainty among pregnant women or male partners concerning dietary recommendations.

Eventually, the effect of limited nutritional knowledge goes beyond dietary practices to impact maternal and foetal health outcomes. Poor maternal dietary practices increase the risk of adverse pregnancy outcomes, such as gestational diabetes, low birth weight, and long-term health complications for the offspring, involving compromised cognitive development and high susceptibility to chronic diseases later in life. Therefore, controlling the impact of limited nutritional knowledge among pregnant women, male partners, and healthcare providers is paramount for enhancing maternal dietary practices and improving maternal and child health outcomes. By conducting interventions that prioritize education, engagement, and empowerment, stakeholders can jointly contribute to preventing the negative effects of malnutrition on pregnancy outcomes.

### 8.4. Implications of food insecurity

Both the quantitative and qualitative aspects of this study revealed a strong negative association between food insecurity and dietary practices, including dietary diversity. This finding aligns with existing research, which consistently demonstrates that food insecurity significantly hinders pregnant women's access to nutritious foods crucial for their health and the healthy development of their unborn child(219). Food-insecure pregnant women often depend on inexpensive, energy-dense foods that are limited in essential nutrients, which can lead to micronutrient deficiencies (e.g., iron, folate, calcium) important for good pregnancy outcomes. In addition, food-insecure households usually have a shortage of food variety due to financial limitations. As a result, pregnant women may consume monotonous diets lacking fresh fruits, vegetables, lean proteins, and dairy products. A lack of dietary diversity diminishes the intake of necessary nutrients and antioxidants essential for maternal and foetal health, increasing the risk of nutrient deficiencies and pregnancy complications. Moreover, pregnant women facing food insecurity may be involved in meal skipping or irregular eating due to food unavailability. Inconsistent access to meals can disturb maternal metabolism, such as blood sugar levels and hormonal balance, which may lead to gestational diabetes, inadequate weight gain, and poor pregnancy outcomes.

Consequently, living with food insecurity may induce chronic stress and anxiety due to the fears around food availability and the incapability to get adequate nutrition (399). Stress can interrupt appetite regulation, change food preferences, and negatively affect eating behaviours, worsening poor dietary practices during pregnancy. This information creates a pressing need to address food insecurity during pregnancy, which involves multidimensional approaches such as social, economic, and policy interventions. Improving access to affordable and nutritious foods, increasing household income, expanding food assistance programs, and providing comprehensive prenatal care and support services are important to mitigate the negative impact of food insecurity on maternal dietary practices of pregnant women in the Southern province of Rwanda.

### 8.5. Implications of owning a radio

Ownership of a radio was positively associated with dietary practices and dietary diversity in the quantitative survey, and pregnant women in the qualitative study discussed potential mechanisms for this association. However, it is important to acknowledge that radio ownership may serve as a proxy for higher socio-economic status or household food security, and the observed association may not reflect a direct causal link. Households with radios may already

have better access to food, education, and health services, which could explain their more diverse dietary practices.

Nonetheless, radio remains a widely used and potentially powerful platform for disseminating nutritional information in Southern Province. To ensure equitable access to such messages, especially for women who do not own radios, alternative approaches such as community listening clubs or shared listening points could be explored. These strategies may help extend the reach of health communication to the most nutritionally vulnerable groups, who may otherwise be missed by conventional media-based interventions. A more nuanced and inclusive approach to radio-based education may therefore be necessary to support improved dietary practices during pregnancy across diverse socio-economic settings (400).

### 8.6. Socioecological Model SEM and factors associated with dietary practices

The findings of this PhD show that determinants of maternal dietary practices among pregnant women in the Southern province of Rwanda align with the Socioecological Model (SEM), which suggests that health behaviors are influenced by different, interacting levels of influence, covering intrapersonal, interpersonal, organizational, community and policy levels.

At the intrapersonal level, factors such as maternal education and nutritional knowledge emerged as substantial predictors of dietary practices, supporting the SEM's premise that personal knowledge and attitudes shape health behaviors. In addition, physiological changes such as food cravings or aversion negatively influenced the dietary practices. At the interpersonal level, this study underlined the importance of social support from male partners, friends and community members. However, some male partners are not involved in maternal dietary practices though they are among the potential influencers. Social support is a key component of the SEM, as interpersonal relationships influence health behaviors. The lack of male partner involvement due to knowledge gaps, cultural norms, poverty, and family conflicts indicates structural barriers to shared nutritional responsibility.

Organizational factors, particularly nutrition education provided by healthcare providers, were reported to facilitate the implementation of good dietary practices, stressing the facilitating role of healthcare providers in promoting healthy dietary practices. However, barriers to dietary practices support from healthcare providers included limited training in maternal nutrition, inconsistent guidelines, teaching resource shortages, and high workloads linked with the shortage of working staff. The findings at this level validate the SEM's organizational level**,** as institutional support is critical for improving maternal nutrition. Community-level factors, such

as cultural and religious beliefs, were found to influence food choices, confirming the SEM's recognition of community norms and values as determinants of health behaviors. In addition, food insecurity in the form of food unavailability at the nearest markets was a barrier to good dietary practices.

Government interventions, such as the Girinka program and kitchen gardens, were reported to positively contribute to maternal nutrition, underscoring the impact of policy initiatives in promoting good dietary practices. Though I assessed two agricultural practices of one policy (National Food Nutrition Policy (334), (kitchen garden, girinka program), there are many other policies that can affect dietary practices through various levels. For example, policies related to healthcare infrastructure, insurance coverage, and availability of prenatal care services can significantly impact pregnant women's access to healthcare and, consequently, their dietary practices. Food insecurity and the unavailability of food at markets are indicators of broader societal and policy-level issues related to food distribution, agricultural policies, and economic disparities. The negative impact of residing in urban areas on dietary practices reflects broader urbanization trends and associated policy considerations such as urban planning and transportation infrastructure. Policies promoting access to educational media content, including nutrition information and health messaging, can contribute to improving dietary practices among pregnant women.

The study findings strongly support the SEM as an appropriate framework for understanding maternal dietary practices. Each level of the SEM is relevant to the identified challenges and facilitators. However, while the SEM is useful for conceptualizing multi-level influences, its application must be complemented by policy-driven interventions, including health system strengthening, gender-sensitive nutrition programs, and economic empowerment initiatives.

### 8.7 Integration of Quantitative and qualitative findings

While the quantitative findings provided measurable patterns and associations, the qualitative data offered rich, contextual narratives that explained the **"**why" and "how" behind the numbers. Integrating both strands of evidence yields a more comprehensive understanding of maternal dietary practices and their associated factors.

For example, the quantitative data revealed that only 44.1% of pregnant women achieved good dietary diversity, and 23% were undernourished, despite 40% reporting good dietary practices**.** Factors significantly associated with good dietary practices included maternal education,

kitchen gardens, and dietary knowledge**,** while food insecurity emerged as a major barrier. The qualitative findings elaborated on these trends by showing how poverty, unemployment, and limited food availability, particularly in urban settings, made it difficult for women to access a variety of nutritious foods. Women in rural areas described having better access to food through access to land, kitchen gardens and livestock**,** while urban women faced higher vulnerability due to lack of land and market dependency. This aligns with the quantitative link between kitchen gardens and improved dietary outcomes.

Although food taboos were not assessed in the quantitative survey, qualitative findings brought to light culturally driven dietary restrictions (e.g., avoidance of avocado, red pepper, eggplant, and sugarcane). These taboos, when layered with economic limitations**,** had a compounding effect especially for women who had limited food options to begin with. This is particularly evident among urban dwellers who relied entirely on markets and had few or no alternatives when certain foods were unavailable or culturally discouraged. This suggests a complex interaction between belief systems and food access**,** which has important implications for nutrition education and program design

The mixed-methods approach also uncovered discordance between statistical associations and lived experiences**.** While social support was not significantly associated with good dietary practices in the final quantitative model, qualitative narratives emphasized the critical role of male partners, family members, and community support in shaping food choices. Some women described receiving money or food from their husbands, while others lamented the lack of support. Similarly, Kitchen demonstrations by healthcare providers did not show a quantitative impact but were described in interviews as valuable though sometimes superficial sources of nutritional information.

Both data sets pointed to the importance of government programs like Girinka (One Cow per Poor Family) and access to kitchen gardens. While these were associated with better dietary practices, the qualitative findings also highlighted inequities in access none of the women interviewed reported benefiting from the Shishakibondo program**,** despite qualifying by wealth indicators. This disconnect between eligibility and access illustrates the importance of monitoring program implementation alongside assessing outcomes.

One unexpected finding was that 8.2% of participants who skipped meals attributed it to first-trimester loss of appetite, despite first-trimester women being excluded from the study due to

concerns over food aversions and cravings. This highlights how pregnancy-related symptoms may persist or fluctuate beyond the first trimester and may not be fully captured by gestational age categories. The integration of both data types allowed for a deeper understanding of such nuances.

### 8.8 Methodological Rigor and Contributions

The study employed a mixed-methods approach, integrating quantitative surveys, qualitative interviews, and a scoping review to explore maternal dietary practices during pregnancy comprehensively. The scoping review served to map out the existing literature on the factors associated with the dietary practice of pregnant women using the socio-ecological model. By systematically reviewing a wide range of studies conducted in SSA and published in both English and French, the study revealed gaps and trends in the literature, informing the following phases.

Using parallel convergent mixed-methods design in phase two served to triangulate the findings from quantitative and qualitative approaches, allowing a deep exploration of maternal dietary practices during pregnancy. The mixing of quantitative data and qualitative insights provided a complete understanding of dietary practices, dietary diversity, and associated factors among pregnant women. By investigating both objective indicators and subjective experiences, the study captured the complexities of factors influencing the dietary practices of pregnant women within the socio-ecological context.

By combining theoretical frameworks and empirical evidence, this study advanced my understanding of maternal dietary practices within a wide socio-ecological context. It offered practical solutions for improving maternal dietary practices during pregnancy and pregnancy outcomes. In addition, the inclusion of diverse stakeholders, including pregnant women, male partners, and healthcare providers, enriched the findings by capturing multiple perspectives.

### 8.9 Knowledge contribution

The findings of this study conducted in the Southern Province of Rwanda make several scholarly contributions to the field of maternal and child health, mostly in the context of maternal dietary practices during pregnancy. The study sheds light on the prevalence of dietary practices among pregnant women in the Southern Province of Rwanda, where only 40% reported good dietary practices and 44.1% demonstrated good dietary diversity. In addition, the thesis provides insights into the nutritional status of pregnant women, with 23% having poor nutrition status referring to MUAC highlighting the need for targeted interventions.

Through the socioecological model, the thesis widely examines the factors influencing maternal dietary practices during pregnancy. It identifies intrapersonal, interpersonal, organizational, and community-level factors, including maternal education, spousal support, antenatal care attendance, cultural beliefs, and government interventions. This comprehensive approach expands the understanding of the complex interplay between individual, interpersonal, and environmental factors shaping maternal dietary practices. This thesis highlights the influence of cultural/religious beliefs and socioeconomic factors on maternal dietary practices. It recognises barriers such as limited nutritional knowledge among pregnant women, male partners, and healthcare providers due to cultural beliefs and inadequate exposure to nutritional information. Moreover, poverty and food insecurity emerge as important barriers to exhibiting good dietary practices. On the other hand, it suggests evidence supporting the effectiveness of government programs like the Girinka program and kitchen gardens in improving maternal dietary practices. The findings from this study inform policy and programmatic interventions expected to improve maternal dietary practices during pregnancy.

## 8.10 Strengths and limitations

The strengths and limitations are discussed in the individual manuscripts and I summarise them here ease of reference. A study strength was the use of mixed methods which allowed me to incorporate diverse perspectives, and provided a nuanced understanding of pregnant women's dietary practices. By using a parallel convergent mixed-methods design, the study was able to triangulate data from various sources, improving the validity and reliability of the findings.

The study involved rigorous methodologies in each phase, such as using well-known frameworks for the literature review, using standardized data collection tools, and applying appropriate statistical and qualitative analysis techniques. The use of these methodologies boosts the credibility and trustworthiness of the study findings. The study included various stakeholders, including pregnant women, healthcare providers, and male partners, in data collection through surveys, interviews, and focus group discussions. This inclusion ensures that different perspectives are considered, increasing the relevance and applicability of the recommendations.

Study limitations included limited generalizability due to the particular context and population sampled. For example, the sampling strategy focuses on pregnant women attending antenatal care services, which may not represent the general population of pregnant women. A potential source of bias in the qualitative data collection process lies in the use of purposive sampling.

This method may inadvertently select participants who are more readily available, possess stronger opinions, or are more inclined to participate, potentially leading to biased and unrepresentative findings. Furthermore, the literature search was limited to studies published in French and English, which may introduce language bias and overlook relevant studies published in other languages, potentially limiting the comprehensiveness of the literature review. Morever, due to resources constraints, nutritional status was only assessed using MUAC, while, I should have measured Hb and micronutrients. Another limitation of this study is the exclusion of partner violence as a variable, which may influence pregnant women's dietary practices; future research should consider exploring this factor to provide a more comprehensive understanding of interpersonal determinants of maternal dietary practices.

# Chapter nine: Conclusion and Recommendations

## 9.1. Conclusion

This PhD thesis delivers a significant understanding of the dietary practices of pregnant women in the Southern Province of Rwanda, shedding light on both barriers and opportunities for promoting good dietary practices and pregnancy outcomes. The findings show a concerning trend, with only less than half of pregnant women demonstrating good dietary practices and an important proportion (23%) facing malnutrition, as shown by mid-Upper Arm Circumference measurements. Furthermore, the study reveals the complex interaction of factors influencing dietary practices during pregnancy, as explained using the socio-ecological model.

However, the study identified gaps in socio-economic status, male partners' engagement due to knowledge, gender roles, cultural beliefs, poverty, food insecurity and family conflicts. In addition, Healthcare system constraints, limited nutritional knowledge among pregnant women, male partners, and healthcare providers was identified, emphasising the need for improved education and awareness campaigns.

By controlling these complex factors and implementing targeted interventions at levels of the socio-ecological model, substantial improvement can be made in promoting good maternal dietary practices and improving pregnancy outcomes. This thesis contributes valuable knowledge to the field of maternal nutrition and highlights the significance of holistic approaches to maternal health and nutrition interventions.

## 9.2. Recommendations

The findings of this study highlight the urgent need for comprehensive interventions to control the multiple challenges facing pregnant women in Rwanda regarding dietary practices. Based on the insights gained from the study participants, to improve maternal dietary practices, a collaborative effort from different sectors is needed particularly from health, education, finance, agriculture and gender sectors. I have framed these recommendations in relation to policy and practice as well as research.

### 9.2.1.Recommendations for policy and practice

The findings of this study create a need for action for different policymakers, such as:

**Enhance the healthcare system to ensure the effective support.** Healthcare providers reported challenges in supporting the dietary practices of pregnant women, such as limited

nutritional knowledge, shortage of teaching resources, and delivery of superficial nutritional education due to the shortage of working staff and heavy workload. To enhance the efficacy of antenatal care (ANC) in addressing maternal malnutrition, policymakers could prioritise the professional development of healthcare providers, such as nurses and midwives, and develop a revised training curriculum that equips them with in-depth knowledge and practical skills in nutritional science. Such training should emphasize the provision of evidence-based, individualized dietary guidance and counselling to pregnant women. Furthermore, the curriculum should incorporate modules on the identification, assessment, and appropriate management of malnutrition in pregnant women.

Furthermore, there should be investment in the development and dissemination of teaching resources, such as educational materials and visual aids, to support healthcare providers in delivering effective nutrition education. Utilising digital tools can be an effective way to reach a broad audience and ensure that pregnant women and their family members receive and remember important nutrition information. This is particularly beneficial since male partners have reported forgetting some of the information delivered to them. As such, these resources should be culturally sensitive, linguistically accessible, and designed to strengthen key messages about the role of a balanced diet and good dietary practices during pregnancy.

Moreover, nutritionists and community health workers should be actively involved in supporting dietary counselling for pregnant women and their families to decrease the burden of the heavy workload of healthcare providers working in ANC. Nutritionists are assumed to have more advanced nutritional knowledge than nurses or midwives; they could assist in effectively delivering tailored nutritional counselling, while CHWs could help reach a wide audience in the community through home visits and assist with education sessions. Cooking demonstrations focused on improving dietary practices and nutritional outcomes should be initiated as well.

**Enhance male partners' engagement in maternal dietary practices of pregnant women**

Pregnant women, their male partners and healthcare providers reported the lack of male partners' involvement in maternal nutrition, though they are the primary decision-makers. Therefore, policymakers should develop targeted nutrition education programs that actively involve male partners in supporting maternal dietary practices. Men should be engaged via home visits, community health workers' education sessions, and men's groups, as suggested by participants in this study. This involvement will strengthen the promotion of shared

responsibility, improve the understanding of gender roles, uproot cultural misconceptions and foster a supportive environment for healthy dietary practices.

**Addressing poverty and food insecurity**

The study participants reported food insecurity and poverty as challenges to good dietary practices. Recognizing the interconnectedness of food security and socioeconomic well-being, policymakers should prioritize a multi-sectoral approach to improve the lives of pregnant women and their households. This could include implementing income-generating programs and diverse microfinance initiatives, including savings groups. Agriculture interventions such as the Girinka program and kitchen gardens positively influenced the dietary practices of pregnant women, highlighting the importance of constant investment in such programs. Therefore, policymakers should consider scaling up these initiatives and maintaining their sustainability to improve food availability hence good dietary practices.

I also recommend a multilevel intervention involving male partners. Multilevel interventions address more than one level of influence simultaneously or in close succession (401). In the suggested intervention, these levels will include household level (pregnant women and male partners), community (mothers' groups, husbands' clubs and village kitchens) and organisational (health care providers). Multilevel interventions can generate synergistic effects, where the combined impact of interventions surpasses the sum of their individual effects. This synergy can arise when interventions at different levels support and reinforce each other. (402). Many researchers are focused on maximizing the design, implementation, and evaluation of multilevel interventions due to the fact that they are most likely to achieve considerable and continuous change (403), which suggests a multilevel intervention depicted in Figure 9.1.

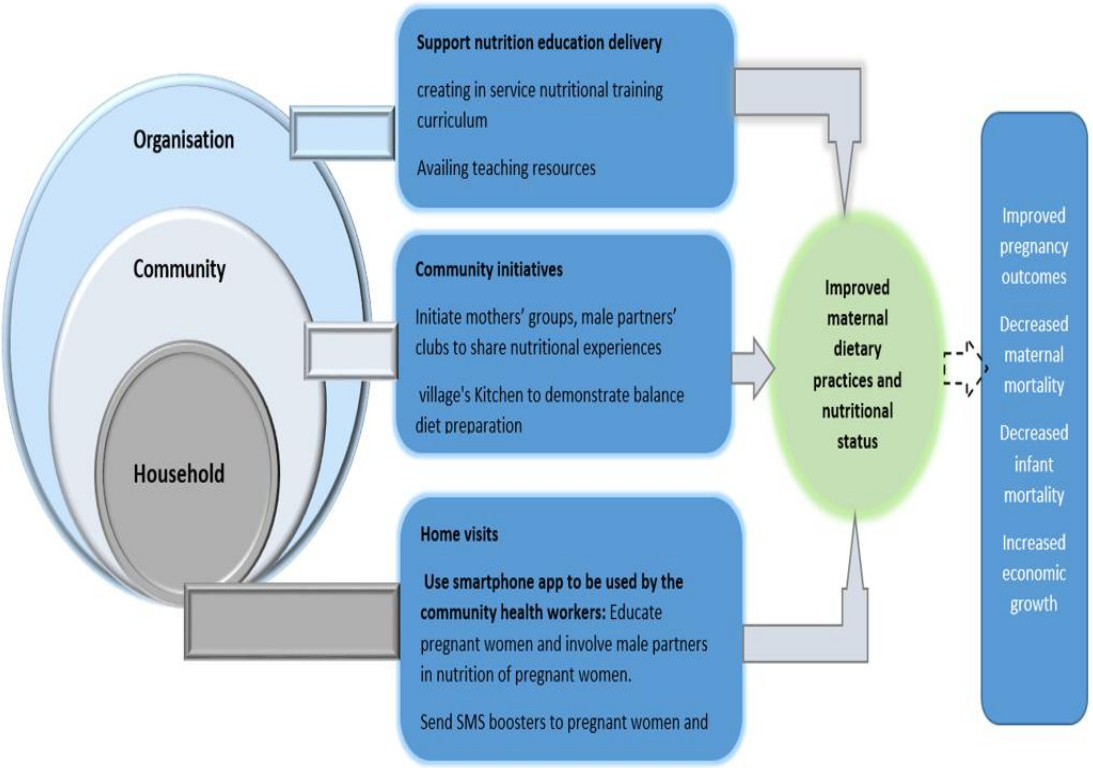



**Figure 0.1:Suggested multilevel intervention (created by author)**

### 9.2.2.Recommendations for research

The recommendations for future research informed by the findings of this thesis include:

1) Conducting community-based research that involves all pregnant women (attending and non-attending ANC services). By including both groups, researchers can make sure that the findings represent the entire population. Non-attending pregnant women may demonstrate different dietary practices and face barriers that attending women do not meet. Therefore, involving them in the study ensures a more complete understanding of the factors affecting dietary practices.
2) Conducting a follow-up study that involves different seasons (at least 12 months) because the dietary practices and diversity may depend on the season. Conducting a follow-up study over multiple seasons helps capture the dynamic nature of dietary practices and identify seasonal trends because dietary practices may depend on factors such as harvest cycles, climate conditions, and cultural practices related to seasonal foods.
3) Conducting clinical research that aims to explore the nutritional status of pregnant women by analyzing the micronutrient profiles since their dietary practices and diversity suggest

poor nutritional status, will inform the evidence-based micronutrient supplement intervention.

Emerging from this PhD thesis, I plan to continue with the following research activities:

- Apply for funds to fully develop the nutritional intervention model I have recommended drawing on the thesis findings.
- Conduct a pilot study to assess the feasibility, acceptability and scalability of the designed intervention model on maternal dietary practices, maternal weight gains and birth weight. By conducting a pilot study, I will test the designed intervention model in a specific setting, identify any potential challenges or limitations, and refine the intervention protocols based on the findings. In addition, I will be able to determine whether the intervention is achieving its intended outcomes and identify areas for improvement.
- Validate the intervention model and recommend its implementation on a large sample size.

# References


1. Arsenault JE, Nikiema L, Allemand P, Ayassou KA, Lanou H, Moursi M, et al. Seasonal differences in food and nutrient intakes among young children and their mothers in rural Burkina Faso. J Nutr Sci [Internet]. 2014 [cited 2022 Jul 18];3(e55):1–9.

2. Rathnayake KM, Madushani P, Silva K. Use of dietary diversity score as a proxy indicator of nutrient adequacy of rural elderly people in Sri Lanka. BMC Res Notes [Internet]. 2012 Dec 29;5(1):469.

3. Desta M, Akibu M, Tadese M, Tesfaye M. Dietary Diversity and Associated Factors among Pregnant Women Attending Antenatal Clinic in Shashemane, Oromia, Central Ethiopia: A Cross-Sectional Study. J Nutr Metab [Internet]. 2019 Mar 12;2019:1–7.

4. FAO F. Minimum Dietary Diversity for Women A Guide to Measurement. 2016. 1–82 p.

5. Nana A, Zema T. Dietary practices and associated factors during pregnancy in northwestern Ethiopia. BMC Pregnancy. 2018;18(83):1–8.

6. Siega-riz AM, Herrmann TS, Savitz DA, Thorp JM. Frequency of Eating During Pregnancy and Its Effect on Preterm Delivery. Am J Epidemiol. 2001;153(7):647–52.

7. WHO. WHO Recommendations on Antenatal Care for a Positive Pregnancy Experience. Ultrasound Obstet Gynecol. 2013;41(1):102–13.

8. WHO. Prevention of harm caused by alcohol exposure in pregnancy. 2016. 53 p.

9. WHO/NMH/PND/14.3. WHO recommendations on prevention and management of tobacco use and second-hand smoke exposure in pregnancy. 2014;

10. Jahanfar S, Sh J. Effects of restricted caffeine intake by mother on fetal , neonatal and pregnancy outcomes.Cochrane Database of Systematic Review. Cochrane Database Syst Rev. 2015;(6).

11. Miller LMS, Cassady DL. The effects of nutrition knowledge on food label use. A review of the literature. Appetite [Internet]. 2015;92:207–16.

12. Tyagi MS, Singh Toteja G, Bhatia N. Maternal Nutritional Status and Its Relation with Birth Weight. Int J Heal Sci Res [Internet]. 2017;7(8):422.

13. Leocádio PCL, Lopes SC, Dias RP, Alvarez-Leite JI, Guerrant RL, Malva JO, et al. The Transition From Undernutrition to Overnutrition Under Adverse Environments and Poverty: The Risk for Chronic Diseases. Front Nutr. 2021;8(April):1–5.

14. Res M, Ruts C, Hospital CR, Sciences M, Committee IE, Crh-smims S. Prevalence Rtms. 2018;(May):517–20.

15. Acosta P, Rojas-Humpire R, Newball-Noriega EE, Morales-García WC, Saintila J, Ruiz Mamani PG, et al. Dietary practices and nutritional status of children served in a social program for surrogate mothers in Colombia. BMC Nutr [Internet]. 2023;9(1):1–9.

16. Triulzi I, Somerville C, Sangwani S, Palla I, Orlando S, Mamary HS, et al. Understanding the meanings of male partner support in the adherence to therapy among HIV-positive women: a gender analysis. Glob Health Action [Internet]. 2022;15(1).

17. Franca, Cetin I, Verduci E, Canzone G, Giovannini M, Scollo P, et al. Maternal Diet and Nutrient Requirements in Pregnancy and Breastfeeding. An Italian Consensus Document. Nutrients. 2016;1–17.

18. Supplements D, Hailu S, Woldemichael B. Dietary diversity and associated factors among pregnant women attending antenatal care at public health facilities in Bale Zone , Southeast Ethiopia. Dovepress Nutr Diet Suppl. 2019;11:1–8.

19. UNICEF. UNICEF Programming Guidance. Prevention of malnutrition in women before and during pregnancy and while breastfeeding. Caring Child Born Small Gestation Age [Internet]. 2021;64. Available from: https://www.unicef.org/media/115361/file/Maternal

20. UNICEF. Fed to Fail: The crisis of children's diets in early life. Unicef [Internet]. 2021;2021 Child Nutrition Report. Available from: https://data.unicef.org/resources/fed-to-fail-2021-child-nutrition-report/

21. Victora CG, Christian P, Vidaletti LP, Gatica-Domínguez G, Menon P, Black RE. Revisiting maternal and child undernutrition in low-income and middle-income countries: variable progress towards an unfinished agenda. Lancet. 2021;397(10282):1388–99.

22. Black RE, Victora CG, Walker SP, Bhutta ZA, Christian P, Onis M De, et al. Maternal and Child Nutrition 1 Maternal and child undernutrition and overweight in low-income and middle-income countries. 2011;

23. Harika R, Faber M, Samuel F, Kimiywe J, Mulugeta A, Eilander A. Micronutrient Status and Dietary Intake of Iron, Vitamin A, Iodine, Folate and Zinc in Women of Reproductive Age and Pregnant Women in Ethiopia, Kenya, Nigeria and South Africa: A Systematic Review of Data from 2005 to 2015. Nutrients [Internet]. 2017 Oct 5;9(10):1096.

24. Gernand AD, Schulze KJ, Stewart CP, West KP, Christian P. Micronutrient deficiencies in pregnancy worldwide: health effects and prevention. Nat Rev Endorinol. 2016;12(5):274–89.

25. Balcha WF, Eteffa T, Tesfu AA, Alemayehu BA, Chekole FA, Ayenew AA, et al. Factors associated with anemia among pregnant women attended antenatal care: A health facility-based cross-sectional study. Ann Med Surg. 2023;Publish Ah:7–8.

26. Fite MB, Assefa N, Mengiste B. Prevalence and determinants of Anemia among pregnant women in sub-Saharan Africa: a systematic review and Meta-analysis. Arch Public Heal [Internet]. 2021;79:1–11.

27. National Institute of Statistics of Rwanda (NISR) [Rwanda], Ministry of Health (MOH) [Rwanda] and II. Rwanda Demographic and Health Survey 2014-15. 2015.

28. Mitao M, Philemon R, Obure J, Mmbaga BT, Msuya S, Mahande MJ. Risk factors and adverse perinatal outcome associated with low birth weight in Northern Tanzania: A registry-based retrospective cohort study. Asian Pacific J Reprod [Internet]. 2016;5(1):75–9.

29. Harrison MS, Goldenberg RL. Global burden of prematurity. Semin Fetal Neonatal Med [Internet]. 2016;21(2):74–9. Available from: http://dx.doi.org/10.1016/j.siny.2015.12.007

30. Abute L, Beyamo A, Erchafo B, Tadesse T, Sulamo D. Dietary Practice and Associated Factors among Pregnant Women in Misha Woreda , South Ethiopia : A Community-Based Cross-Sectional Study. Hindawi J Nutr Metab. 2020;2020:8.

31. Othoo DA WJ and EK. Dietary assessment of vitamin a and iron among pregnant. African journalof food ,Agriculture,nutrition Dev. 2014;14(3):2114–28.

32. Demilew YM, Alene GD, Belachew T. Dietary practices and associated factors among pregnant women in West Gojjam Zone, Northwest Ethiopia. BMC Pregnancy Childbirth [Internet]. 2020 Dec 6;20(1):18.

33. Abubakari A, Jahn A. Maternal Dietary Patterns and Practices and Birth Weight in Northern

Ghana. PLoS One. 2016;1–17.

34. Yalewdeg M, Birhane M, Adissu Y. Dietary Practices and Their Determinants Among Pregnant Women in Gedeo Zone, Southern Ethiopia: A Community-Based Cross-Sectional Study. Nutr Diet Suppl [Internet]. 2020 Dec;Volume 12:267–75.

35. EA U. Nutritional Practices and Taboos Among Pregnant Women Attending Antenatal Care at General Hospital in Kano, Northwest Nigeria. Ann Med Health Sci Res [Internet]. 2016;6(2):109.

36. Otoo P, Habib H, Ankomah A. Food Prohibitions and Other Traditional Practices in Pregnancy: A Qualitative Study in Western Region of Ghana. Adv Reprod Sci [Internet]. 2015;03(03):41–9.

37. Chen LW, Low YL, Fok D, Han WM, Chong YS, Gluckman P, et al. Dietary changes during pregnancy and the postpartum period in Singaporean Chinese, Malay and Indian women: The GUSTO birth cohort study. Public Health Nutr. 2014;17(9):1930–8.

38. Rwanda NI of S of R, Ministry of Health(MOH) and I 202. Rwanda Demographic and Health Survey: Key Indicators report. Kigali, and Rockville, Maryland, USA: NISR and ICF. 2020. 55 p.

39. Rwanda NI of S of. Fifth Rwanda Population and Housing Census, 2022. Vol. 6, Population and Housing Census. 2022. 1–176 p.

40. Aly A, Avila E, Cram AE. ENDOSCOPIC PLASTIC SURGERY. Surg Clin North Am [Internet]. 2000 Oct;80(5):1373–82.

41. Research: Strong Health System Key to Growth in Post-Genocide Rwanda | Partners In Health [Internet]. Available from: https://www.pih.org/article/research-strong-health-system-key-growth-post-genocide-rwanda

42. Rwanda MOH. Ministry of Health Fourth Health Sector Strategic Plan. Minist Heal [Internet]. 2018;(July):1–104. Available from: http://moh.gov.rw/fileadmin/templates/Docs/FINALH_2-1.pdf

43. Rwanda Ministry of Health. Health Sector Policy. 2015;41. Available from: http://www.moh.gov.rw/fileadmin/templates/policies/Health_Sector_Policy___19th_January_2015.pdf

44. Condo J, Mugeni C, Naughton B, Hall K, Tuazon MA, Omwega A, et al. Rwanda's evolving community health worker system: A qualitative assessment of client and provider perspectives. Hum Resour Health. 2014;12(1):1–7.

45. Ngabo F, Nguimfack J, Nwaigwe F, Mugeni C, Muhoza D, Wilson DR, et al. Designing and implementing an innovative SMS-based alert system (RapidSMS-MCH) to monitor pregnancy and reduce maternal and child deaths in Rwanda. Pan Afr Med J. 2012;13:1–15.

46. Lundeen T, Musange S, Azman H, Nzeyimana D, Murindahabi N, Butrick E, et al. Nurses' and midwives' experiences of providing group antenatal and postnatal care at 18 health centers in Rwanda: A mixed methods study. PLoS One. 2019;14(7):1–16.

47. Rurangirwa AA, Mogren I, Ntaganira J, Govender K, Krantz G. Quality of antenatal care services in Rwanda: Assessing practices of health care providers. BMC Health Serv Res. 2018;18(1):1–11.

48. Hong R, Ayad M, Ngabo F. Being insured improves safe delivery practices in Rwanda. J Community Health. 2011;36(5):779–84.

49. Adekunle JO. Culture and Customs of Rwanda. Cult Cust Rwanda. 2007;

50. Ndushabandi EN, Kagaba M, Gasafari W. Intra-family conflicts in Rwanda: A constant challenge to sustainable peace in Rwanda. 2016;1–87.

51. Bucagu M, Kagubare JM, Basinga P, Ngabo F, Timmons BK, Lee AC. Impact of health systems strengthening on coverage of maternal health services in Rwanda, 2000-2010: A systematic review. Reprod Health Matters [Internet]. 2012;20(39):50–61.

52. Magge H, Chilengi R, Jackson EF, Wagenaar BH, Kante AM, Hingora A, et al. Tackling the hard problems: Implementation experience and lessons learned in newborn health from the African Health Initiative. BMC Health Serv Res. 2017;17(Suppl 3).

53. Waage J, Banerji R, Campbell O, Chirwa E, Collender G, Dieltiens V, et al. The Millennium Development Goals: a cross-sectoral analysis and principles for goal setting after 2015. Lancet. 2010;376(9745):991–1023.

54. WHO RM of H. Success Factors for Women ' s and Children ' s Health Rwanda. 2014;28.

55. UNFPA. Maternal Mortality Reduction Programme in Rwanda. 2008; Available from: http://rwanda.unfpa.org/drive/MaternalMortalityReductioninRwanda%28VLR%29.pdf

56. Uwimana G, Elhoumed M, Gebremedhin MA, Nan L, Zeng L. Determinants of timing, adequacy and quality of antenatal care in Rwanda: a cross-sectional study using demographic and health surveys data. BMC Health Serv Res [Internet]. 2023;23(1):1–12.

57. MOH 2013. Maternal, Neonatal and Child Health National Strategy. Structure. 2013;(June):1150–1150.

58. Sserwanja Q, Gatasi G, Musaba MW. Evaluating continuum of maternal and newborn healthcare in Rwanda: evidence from the 2019–2020 Rwanda demographic health survey. BMC Pregnancy Childbirth. 2022;22(1):1–11.

59. Rulisa S, Ntihinyurwa P, Ntirushwa D, Wong A, Olufolabi A. Causes of Maternal Mortality in Rwanda, 2017-2019. Obstet Gynecol. 2021;138(4):552–6.

60. Ministry of health N institute of statistics of R. Rwanda Demographic and Health Survey 2019-20 District Pro le North Province. 2019. 1–79 p.

61. Tsegaye D, Tamiru D, Belachew T. Factors Associated with Dietary Practice and Nutritional Status of Pregnant Women in Rural Communities of Illu Aba Bor Zone , Southwest. Dovepress Nutr Diet Suppl. 2020;83(155):103–12.

62. Delil R, Zinab B, Mosa H, Ahmed R, Hassen H. Determinants of dietary diversity practice among pregnant women attending antenatal clinic at Wachemo University Nigist Eleni Mohammed memorial referral hospital, Southern Ethiopia. PLoS One. 2021 Apr 1;16(4 April):1–10.

63. Supplements D. Dietary Practices and Their Determinants Among Pregnant Women in Gedeo Zone , Southern Ethiopia : A Community-Based Cross-Sectional Study. Nutr Diet Suppl. 2020;266–75.

64. Durnwald C. Gestational diabetes: Linking epidemiology, excessive gestational weight gain, adverse pregnancy outcomes, and future metabolic syndrome. Semin Perinatol [Internet]. 2015;39(4):254–8.

65. Plows JF, Stanley JL, Baker PN, Reynolds CM, Vickers MH. The pathophysiology of gestational diabetes mellitus. Int J Mol Sci. 2018;19(11):1–21.

66. Gathiram P, Moodley J. Pre-eclampsia: Its pathogenesis and pathophysiolgy. Cardiovasc J Afr. 2016;27(2):71–8.

67. Perry A, Stephanou A, Rayman MP. Dietary factors that affect the risk of pre-eclampsia. BMJ Nutr Prev Heal. 2022;5(1):118–33.

68. Ali Khalaf M, Khider DM, Kamal BJ. Anemia in Pregnant Women in Kirkuk Governorate. Kirkuk J Med Sci. 2020;8(1):78–85.

69. Barker DJP, Hales CN, Fall CHD, Osmond C, Phipps K, Clark PMS. Type 2 (non-insulin-dependent) diabetes mellitus, hypertension and hyperlipidaemia (syndrome X): relation to reduced fetal growth. Diabetologia. 1993;36(1):62–7.

70. Fall CHD, Osmond C, Barker DJP, Clark PMS, Hales CN, Stirling Y, et al. Fetal and infant growth and cardiovascular risk factors in women. Bmj. 1995;310(6977):428.

71. Nakano Y. Adult-onset diseases in low birth weight infants: Association with adipose tissue maldevelopment. J Atheroscler Thromb. 2020;27(5):397–405.

72. Diana R, Chistianti DF, Anwar F, Kusuma R, Rachmayanti RD, Khomsan A. Food suggestions, meal frequency, and dietary diversity among pregnant women: A quantitative study in Madura. Futur Food J Food, Agric Soc. 2020;8(3):1–12.

73. Lartey A. Maternal and child nutrition in Sub-Saharan Africa: challenges and interventions. Proc Nutr Soc [Internet]. 2008 Feb;67(1):105–8.

74. Paver K. Healthy Snacking During Pregnancy. 2015;1–3.

75. Zhang N, Zhang F, Chen S, Han F, Lin G, Zhai Y, et al. Associations between hydration state and pregnancy complications, maternal-infant outcomes: Protocol of a prospective observational cohort study. BMC Pregnancy Childbirth. 2020;20(1):1–11.

76. Shiraishi M, Haruna M, Matsuzaki M. Effects of Skipping Breakfast on Dietary Intake and Circulating and Urinary Nutrients During Pregnancy. Asia Pac J Clin Nutr. 2019;28(1):99–105.

77. Ballon A, Neuenschwander M, Schlesinger S. Breakfast Skipping Is Associated with Increased Risk of Type 2 Diabetes among Adults: A Systematic Review and Meta-Analysis of Prospective Cohort Studies. J Nutr [Internet]. 2019;149(1):106–13.

78. Tarasi B, Cornuz J, Clair C, Baud D. Cigarette smoking during pregnancy and adverse perinatal outcomes: a cross-sectional study over 10 years. BMC Public Health [Internet]. 2022;22(1):1–8.

79. McDonnell BP, Regan C. Smoking in pregnancy: pathophysiology of harm and current evidence for monitoring and cessation. Obstet Gynaecol. 2019;21(3):169–75.

80. Wehby GL, Assistant PD. The Impact of Maternal Smoking during Pregnancy on Early Child Neurodevelopment. 2012;5(2):1–42.

81. Cornelius MD, Day NL. The effects of tobacco use during and after pregnancy on exposed children. Alcohol Res Health [Internet]. 2000;24(4):242–9.

82. Dejong K, Olyaei A, Lo JO. Alcohol Use in Pregnancy. Clin Obstet Gynecol. 2019;62(1):142–55.

83. Addila AE, Azale T, Gete YK, Yitayal M. The effects of maternal alcohol consumption during pregnancy on adverse fetal outcomes among pregnant women attending antenatal care at

public health facilities in Gondar town, Northwest Ethiopia: a prospective cohort study. Subst Abus Treat Prev Policy. 2021;16(1):1–15.

84. Gomez KU, Goodwin L, Chisholm A, Rose AK. Alcohol use during pregnancy and motherhood: Attitudes and experiences of pregnant women, mothers, and healthcare professionals. PLoS One [Internet]. 2022;17(12 December):1–20.

85. Meher S, Duley L. Rest during pregnancy for preventing pre-eclampsia and its complications in women with normal blood pressure. Cochrane Database Syst Rev. 2006;2010(2).

86. Ahuja M. Bed rest in pregnancy and its related complications: Is it needed? J SAFOG. 2012;4(3):147–50.

87. Matenchuk B, Khurana R, Cai C, Boulé NG, Slater L, Davenport MH. Prenatal bed rest in developed and developing regions: a systematic review and meta-analysis. C open. 2019;7(3):E435–45.

88. Kebede AN, Sahile AT, Kelile BC. Dietary Diversity and Associated Factors Among Pregnant Women in Addis Ababa, Ethiopia, 2021. Int J Public Health. 2022;67(November):1–7.

89. Tilahun AG, Kebede AM. Maternal minimum dietary diversity and associated factors among pregnant women, Southwest Ethiopia, 2021. BMC Nutr [Internet]. 2021 Oct 28 [cited 2022 Jul 18];7(1):66.

90. Saaka M, Rauf AA. Role of dietary diversity in ensuring adequate haematological status during pregnancy. Int J Med Res Heal Sci. 2015;4(4):749.

91. Zhu S, Zhao A, Lan H, Li P, Mao S, Szeto IM, et al. Nausea and Vomiting during Early Pregnancy among Chinese. 2023;1–11.

92. Zerfu TA, Umeta M, Baye K. Dietary diversity during pregnancy is associated with reduced risk of maternal anemia, preterm delivery, and low birth weight in a prospective cohort study in rural Ethiopia. Am J Clin Nutr [Internet]. 2016;103(6):1482–8.

93. King JC. Physiology of pregnancy and nutrient metabolism 1 – 3. 2000;71:1218–25.

94. Ayensu J, Annan R, Lutterodt H, Edusei A, Peng LS. Prevalence of anaemia and low intake of dietary nutrients in pregnant women living in rural and urban areas in the Ashanti region of Ghana. PLoS One [Internet]. 2020;15(1):1–15.

95. Abu-Ouf NM, Jan MM. The impact of maternal iron deficiency and iron deficiency anemia on child's health. Saudi Med J. 2015;36(2):146–9.

96. Rasmussen KM, Yaktine AL. WEIGHT GAIN DURING PREGNANCY. 2009.

97. Mishra KG, Bhatia V, Nayak R. Maternal Nutrition and Inadequate Gestational Weight Gain in Relation to Birth Weight : Results from a Prospective Cohort Study in India. 2020;9(3):213–22.

98. Rasmussen KM, Yaktine AL. Weight Gain During Pregnancy : Reexamining the Guidelines. 2009. 324 p.

99. Pregnancy ND, Gain W, Ii P, Committee NS, Status N, Pregnancy D, et al. Nutrition During Pregnancy. 1990.

100. Sunsaneevithayakul P, Titapant V, Ruangvutilert P, Sutantawibul A, Phatihattakorn C, Wataganara T. Relation between gestational weight gain and pregnancy outcomes. 2014;40(4):995–1001.

101. Siega-riz AM, Viswanathan M, Moos M, Deierlein A, Mumford S, Knaack J, et al. A systematic review of outcomes of maternal weight gain according to the Institute of Medicine recommendations : birthweight , fetal growth , and postpartum weight retention. YMOB [Internet]. 2009;201(4):339.e1-339.e14.

102. Katona P, Katona-apte J. The Interaction between Nutrition and Infection. Clin Pract. 2008;90024(6):1582–8.

103. Shah D, Sachdev HPS. Zinc Deficiency in Pregnancy and Fetal Outcome. 2006;(January):15–30.

104. Pearce EN, Lazarus JH, Moreno-reyes R, Zimmermann MB. Consequences of iodine deficiency and excess in pregnant women : an overview of current knowns and unknowns 1 , 2. Am J Clin Nutr. 2016;104:918–23.

105. Amosu AM, Degun AM. Impact of maternal nutrition on birth weight of babies . Biomed Res. 2014;25(1):75–8.

106. Woldeamanuel GG, Geta TG, Mohammed TP, Shuba MB, Bafa TA. Effect of nutritional status of pregnant women on birth weight of newborns at Butajira Referral Hospital ,. Sage Open Med. 2019;7:1–7.

107. Koletzko B, Godfrey KM. Nutrition During Pregnancy , Lactation and Early Childhood and its Implications for Maternal and Long-Term Child Health : The Early Nutrition Project Recommendations. 2019;93–106.

108. Leffelaar ER, Vrijkotte TGM, Eijsden M Van. Maternal early pregnancy vitamin D status in relation to fetal and neonatal growth : results of the multi-ethnic Amsterdam Born Children and their Development cohort. 2010;25:108–17.

109. Bischoff-ferrari HA. Vitamin D – Role in Pregnancy and Early Childhood. 2011;17–21.

110. Purandare CN. Maternal Nutritional Deficiencies and Interventions. 2013;62(December 2012):621–3.

111. Koletzko B, Brands B, Poston L, Godfrey K, Demmelmair H, Children VH. Symposium on ‘ Metabolic flexibility in animal and human nutrition ’ Session I : Early nutrition programming , life performance and cognitive function. In: NS Proceedings of the Nutrition Society. 2012. p. 371–8.

112. Tsegaye D, Tamiru D, Belachew T. Factors Associated with Dietary Practice and Nutritional Status of Pregnant Women in Rural Communities of Illu Aba Bor Zone, Southwest Ethiopia. Nutr Diet Suppl. 2020;12:103–12.

113. Demilew YM, Alene GD, Belachew T. Dietary practices and associated factors among pregnant women in West Gojjam Zone, Northwest Ethiopia. BMC Pregnancy Childbirth. 2020 Jan 6;20(1).

114. Ramulondi M, de Wet H, Ntuli NR. Traditional food taboos and practices during pregnancy, postpartum recovery, and infant care of Zulu women in northern KwaZulu-Natal. J Ethnobiol Ethnomed. 2021;17(1):1–19.

115. Mideksa S, Dida N. Assessment of Dietary Practice and Associated Factors Among Pregnant Mother in Ambo District , West Shoa , Results : Conclusion : EjrhOrg [Internet]. 2018;10(4):43–51.

116. Diddana TZ. Factors associated with dietary practice and nutritional status of pregnant women in Dessie town, northeastern Ethiopia: a community-based cross-sectional study. BMC

Pregnancy Childbirth [Internet]. 2019 Dec 23 [cited 2022 Jul 18];19(1):517. Available from: https://bmcpregnancychildbirth.biomedcentral.com/articles/10.1186/s12884-019-2649-0

117. Martikainen P, Brunner E, Marmot M. Socioeconomic differences in dietary patterns among middle-aged men and women. Soc Sci Med. 2003;56:1397–410.

118. Darmon N, Drewnowski A. Does social class predict diet quality ? 1 – 3. Am J Clin Nutr. 2008;87:1107–17.

119. Abute L, Beyamo A, Erchafo B, Tadesse T, Sulamo D, Sadoro T. Dietary Practice and Associated Factors among Pregnant Women in Misha Woreda, South Ethiopia: A Community-Based Cross-Sectional Study. J Nutr Metab [Internet]. 2020 Sep 25 [cited 2022 Jul 18];2020:1–8.

120. Fernández E, Luque T, Moya P, López M, Gallardo M, Enrique C. Factores que influyen en los patrones dietéticos durante el embarazo en una sociedad culturalmente diversa. Nutrients [Internet]. 2020;12(11):1–20.

121. Wong JL, Tunku U, Rahman A, Xin LZ, Keng SL. Knowledge of nutrition during pregnancy and associated factors among antenatal mothers. 2018;(March).

122. Mirsanjari M, Abdul W, Wan M, Ahmad A, Othman MS. Does Nutritional Knowledge Have Relationship With Healthy Dietary Attitude and Practices during Pregnancy ? 2012;(May 2016):2–7.

123. Zerfu TA, Biadgilign S. Pregnant mothers have limited knowledge and poor dietary diversity practices, but favorable attitude towards nutritional recommendations in rural Ethiopia: evidence from community-based study. BMC Nutr [Internet]. 2018 Dec 27;4(1):43.

124. O'Brien G, Davies M. Nutrition knowledge and body mass index. Health Educ Res. 2007;22(4):571–5.

125. Suh NchangMugyia A, Nguti Kien Tanya A, Nana Njotang P, Koki Ndombo P. Knowledge and attitudes of pregnant mothers towards maternal dietary practices during pregnancy at the Etoug-Ebe Baptist Hospital, Yaounde. Heal Sci Dis [Internet]. 2016;17(2):24–9.

126. Gezimu W, Bekele F, Habte G. Pregnant mothers' knowledge, attitude, practice and its predictors towards nutrition in public hospitals of Southern Ethiopia: A multicenter cross-sectional study. SAGE open Med [Internet]. 2022 Jan;10:20503121221085844.

127. Guggino A, Barbero S, Ponzo V, Viora E, Durazzo M, Bo S. Myths about nutrition in pregnancy. J Obstet Gynaecol (Lahore). 2016;36(7):964–5.

128. Meyer-Rochow VB. Food taboos: Their origins and purposes. J Ethnobiol Ethnomed. 2009;5:1–10.

129. Chakona G, Shackleton C. Food Taboos and Cultural Beliefs Influence Food Choice and Dietary Preferences among Pregnant Women in the Eastern Cape, South Africa. Nutrients [Internet]. 2019 Nov 5;11(11):2668.

130. Oluleke MO, Ogunwale AO, Arulogun OS, Adelekan AL. Dietary intake knowledge and reasons for food restriction during pregnancy among pregnant women attending primary health care centers in Ile-Ife, Nigeria. Int J Popul Stud. 2016;2(1):103–16.

131. Maduforo AN, Nwosu OIC, Ndiokwelu CI, Obiakor-Okeke PN. Food superstition, feeding practices and nutritional anthropometry of pregnant women. Jorind [Internet]. 2013;11(1):12–28.

132. Tahir HMH. Food Taboos among Pregnant Women in Health Centers , Khartoum State-. Int J Sci Heal Res. 2018;3(March):13–25.

133. Arzoaquoi SK, Essuman EE, Gbagbo FY, Tenkorang EY, Soyiri I, Laar AK. Motivations for food prohibitions during pregnancy and their enforcement mechanisms in a rural Ghanaian district. J Ethnobiol Ethnomed [Internet]. 2015;1–9.

134. Maimbolwa M, Ahmed Y, Diwan V, Arvidson ABR. Safe motherhood perspectives and social support for primigravidae women in Lusaka, Zambia. Afr J Reprod Health. 2003;7(3):29–40.

135. Lennox J, Petrucka P, Bassendowski S. Eating practices during pregnancy: perceptions of select Maasai women in Northern Tanzania. Glob Heal Res Policy [Internet]. 2017 Dec 13;2(1):9.

136. Hadush Z, Birhanu Z, Chaka M, Gebreyesus H. Foods tabooed for pregnant women in Abala district of Afar region, Ethiopia: an inductive qualitative study. BMC Nutr [Internet]. 2017 Dec 22 [cited 2022 Jul 18];3(1):40.

137. Tefera W, Brhanie TW, Dereje M. Dietary diversity practice and associated factors among pregnant women attending ANC in Kolfe Keranyo sub city health centers, Addis Ababa, Ethiopia. medRxiv [Internet]. 2020;1–30.

138. Wondmeneh TG. Dietary diversity practice and its influencing factors among pregnant women in Afar region of Ethiopia: mixed method study. BMC Pregnancy Childbirth [Internet]. 2022 Dec 6 [cited 2022 Jul 18];22(1):291.

139. Geta TG, Gebremedhin S, Omigbodun AO. Dietary Diversity Among Pregnant Women in Gurage Zone, South Central Ethiopia: Assessment Based on Longitudinal Repeated Measurement. Int J Womens Health [Internet]. 2022 Apr [cited 2022 Jul 18];Volume 14:599–615.

140. Marshall NE, Abrams B, Barbour LA, Christian P, Friedman JE, Jr WWH, et al. The importance of nutrition in pregnancy and lactation: lifelong consequences. Am J Obs Gynecol. 2022;226(5):607–32.

141. Nsabimana A, Swain RB, Surry Y, Ngabitsinze JC. Income and food Engel curves in Rwanda : a household microdata analysis. Agric food Econ. 2020;4:1–20.

142. Gibson M. Food Security—A Commentary: What Is It and Why Is It So Complicated. Foods. 2012;18–27.

143. Assistance F technical. Food Security Indicators and Framework for Use in the Monitoring and Evaluation of Food Aid Programs. 1999;(January).

144. Swaminathan MS, Bhavani R V. Food production & availability - Essential prerequisites for sustainable food security. Indian J Med Res. 2013;138(SEP):383–91.

145. Haeften R Van, Caudill H, Kilmartin E. Second Food Aid and Food Security Assessment ( FAFSA-2 ) Summary.Washington,DC:FHI360/FANTA. 2013;(February).

146. Peng W, Berry EM. The concept of food security. Encycl Food Secur Sustain. 2018;(January):1–7.

147. Capone R, El Bilali H, Debs P, Cardone G, Driouech N. Food Economic Accessibility and Affordability in the Mediterranean Region: an Exploratory Assessment at Micro and Macro Levels. J Food Secur. 2014;2(1):1–12.

148. Government of The Bahamas. The national food & nutrition security policy and agenda for

action for the Commonwealth of the Bahamas. 2017;66.

149. Darmon N, Drewnowski A. Contribution of food prices and diet cost to socioeconomic disparities in diet quality and health: A systematic review and analysis. Nutr Rev. 2015;73(10):643–60.

150. Raj D, Id S, Ghimire S, Upadhayay SR, Singh S. Food insecurity and dietary diversity among lactating mothers in the urban municipality in the mountains of Nepal. PLoS One. 2020;1–17.

151. Ramachandran N. Women and Food Security in South Asia Current Issues and Emerging Concerns Nira Ramachandran *. 2006;7.

152. Muzaffar DU. Role of family in general management and care during and after pregnancy. Int J Clin Obstet Gynaecol. 2021;5(2):150–2.

153. Pike V, Kaplan Ramage A, Bhardwaj A, Busch-Hallen J, Roche ML. Family influences on health and nutrition practices of pregnant adolescents in Bangladesh. Matern Child Nutr. 2021;17(S1):1–12.

154. Wiradnyani LAA, Khusun H, Achadi EL, Ocviyanti D, Shankar AH. Role of family support and women's knowledge on pregnancy-related risks in adherence to maternal iron-folic acid supplementation in Indonesia. Public Health Nutr. 2016;19(15):2818–28.

155. Hutchinson AD, Charters M, Prichard I, Fletcher C, Wilson C. Understanding maternal dietary choices during pregnancy: The role of social norms and mindful eating. Appetite [Internet]. 2017;112:227–34. Available from: http://dx.doi.org/10.1016/j.appet.2017.02.004

156. Shudura E, Yoseph A, Tamiso A. Utilization and Predictors of Maternal Health Care Services among Women of Reproductive Age in Hawassa University Health and Demographic Surveillance System Site, South Ethiopia: A Cross-Sectional Study. Adv Public Heal. 2020;2020.

157. Dusingizimana T, Ramilan T, Weber JL, Iversen PO, Mugabowindekwe M, Ahishakiye J, et al. Predictors for achieving adequate antenatal care visits during pregnancy: a cross-sectional study in rural Northwest Rwanda. BMC Pregnancy Childbirth [Internet]. 2023;23(1):1–9. Available from: https://doi.org/10.1186/s12884-023-05384-0

158. Rizk J, Andreou E, Hileti D, Ghaddar A, Zampelas A. Assessing Health Care Providers' Knowledge and Practices of Nutrition during Pregnancy in Lebanon: A Cross-Sectional Study. Medicina (Kaunas). 2023;59(8):1–12.

159. Fao. Major issues for nutrition strategies Summary 1992 FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS WORLD HEALTH ORGANIZATION. 1992;1–32.

160. Government of Nepal National Planning Commission. Multi-sector Nutrition Plan for accelerating the reduction of Maternal and Child Under-nutrition in Nepal. 2013;2017(September 2012):1–163.

161. Reifsnider E. Effective nutritional practices and policies for childbearing and childrearing women. Encycl Early Child Dev. 2006;(January):24–9.

162. Demilew YM, Alene GD, Belachew T. Dietary practices and associated factors among pregnant women in West Gojjam Zone , Northwest Ethiopia. BMC Pregnancy Childbirth. 2020;20(18):1–11.

163. Tenaw Z, Arega M, Tachbele E. Nutritional knowledge , attitude and practices among pregnant women who attend antenatal care at public hospitals of Addis Ababa , Ethiopia. Int J

Nurs Midwifery. 2018;10(7):81–9.

164. Chakona G. Minimum Dietary Diversity Scores for Women Indicate Micronutrient Adequacy and Food Insecurity Status in South African Towns. Nutrients. 2017;9:812.

165. Rosen JG, Clermont A, Kodish SR, Matar Seck A, Salifou A, Grais RF, et al. Determinants of dietary practices during pregnancy: A longitudinal qualitative study in Niger. Matern Child Nutr [Internet]. 2018 Oct 28;14(4):e12629. Available from: https://onlinelibrary.wiley.com/doi/10.1111/mcn.12629

166. Nguyen PH, Sanghvi T, Kim SS, Tran LM, Afsana K, Mahmud Z, et al. Factors influencing maternal nutrition practices in a large scale maternal , newborn and child health program in Bangladesh. PLoS One. 2017;1–17.

167. Nsereko E, Uwase A, Mukabutera A, Muvunyi CM, Rulisa S, Ntirushwa D, et al. Maternal genitourinary infections and poor nutritional status increase risk of preterm birth in Gasabo District , Rwanda : a prospective , longitudinal , cohort study. BMC Pregnancy Childbirth. 2020;345(20):1–13.

168. Rosen JG, Clermont A, Kodish SR, Matar Seck A, Salifou A, Grais RF, et al. Determinants of dietary practices during pregnancy: A longitudinal qualitative study in <scp>N</scp> iger. Matern Child Nutr [Internet]. 2018 Oct 28;14(4):e12629. Available from: https://onlinelibrary.wiley.com/doi/10.1111/mcn.12629

169. Belay WS, Cherkos EA, Taye EB. Dietary practice during pregnancy and associated factors among pregnant women in Farta district, South Gondar Zone, Northwest Ethiopia, 2021. Clin Epidemiol Glob Heal [Internet]. 2022;14(August 2021):100968. Available from: https://doi.org/10.1016/j.cegh.2022.100968

170. Fite MB, Tura AK, Yadeta TA, Oljira L, Roba KT. Prevalence and determinants of dietary practices among pregnant women in eastern Ethiopia. BMC Nutr [Internet]. 2022 Dec 11 [cited 2022 Jul 18];8(3):1–10. Available from: http://www.ncbi.nlm.nih.gov/pubmed/35012664

171. Mo A. Dietary Practices and Food Preferences of Pregnant Women in Port Harcourt Metropolis , Nigeria. Acta Sci Nutr Heal. 2020;4(3):45–8.

172. Girard AW, Olude O. Nutrition Education and Counselling Provided during Pregnancy : Effects on Maternal , Neonatal and Child Health Outcomes. Paediatr Perinat Epidemiol. 2012;26:191–204.

173. Iradukunda F. Food taboos during pregnancy. Health Care Women Int [Internet]. 2019;0(0):1–10. Available from: https://doi.org/10.1080/07399332.2019.1574799

174. Pimpin L, Kranz S, Liu E, Shulkin M, Karageorgou D, Miller V, et al. Effects of animal protein supplementation of mothers , preterm infants , and term infants on growth outcomes in childhood : a systematic review and meta-analysis of randomized trials. Am J Clin Nutr. 2019;410–29.

175. Zerfu TA, Umeta M, Baye K. Dietary habits , food taboos , and perceptions towards weight gain during pregnancy in Arsi , rural central Ethiopia : a qualitative cross-sectional study. J Heal Popul Nutr [Internet]. 2016;35(22):1–7. Available from: http://dx.doi.org/10.1186/s41043-016-0059-8

176. Abreu S, Santos PC, Montenegro N, Mota J. Relationship between dairy product intake during pregnancy and neonatal and maternal outcomes among Portuguese women. Obes Res Clin Pract [Internet]. 2016; Available from: http://dx.doi.org/10.1016/j.orcp.2016.07.001

177. Gebrearegay F, Id T, Gebremariam LW. Food taboos and related misperceptions during pregnancy in Mekelle city , Tigray ,. 2020;1–14. Available from: http://dx.doi.org/10.1371/journal.pone.0239451

178. Evenson KR, Carrier KS. A qualitative study of women's perceptions of provider advice about diet and physical activity during pregnancy. PMC. 2014;91(3):372–7.

179. Lewallen LP. Healthy Behaviors and Sources of Health Information Among Low-Income Pregnant Women. 1994;21(3):200–6.

180. Wennberg AL, Lundqvist A, Ulf H, Sandstr H, Hamberg K. Women ' s experiences of dietary advice and dietary changes during pregnancy. 2013;29:1027–34.

181. Eileen R. Fiowles, Miranda Bryant, SungHun Kim, Lorraine o RJR. Predictors of dietary quality in low-income pregnant women: A path analysis. Nurs Res. 2012;60(5):286–94.

182. Malek L, Jia S. Understanding Drivers of Dietary Behavior before and during Pregnancy in Industrialized Countries. Heal Nutr Adolesc yound Women. 2015;80:117–40.

183. Rwanda Biomedical center N. National social and behavior change communication strategy for intergrated early childhood development, nutrition and WASH (2018-2024). 2018;

184. Gernand AD, Schulze KJ, Stewart CP, Jr KPW. Micronutrient deficiencies in pregnancy worldwide : health effects and prevention. Nat Publ Gr. 2016;12(May).

185. (WHO) U and WHO. Low birth weight estimates. 2015;3–9.

186. Paul Sommers LS. Kitchen Garden Guidelines. 2017;(June).

187. MUDINGU J. Girinka Programme transforms livelihoods , reconciles communities. 2016;1–4.

188. Khurmi MS, Sayinzoga F, Berhe A. Newborn Survival Case Study in Rwanda - Bottleneck Analysis and Projections in Key Maternal and Child Mortality Rates Using Lives Saved Tool ( LiST ). 2017;6(2):93–108.

189. Kirk CM, Uwamungu JC, Wilson K, Hedt-gauthier BL, Tapela N, Niyigena P, et al. Health , nutrition , and development of children born preterm and low birth weight in rural Rwanda : a cross-sectional study. BMC Pediatr. 2017;1–9.

190. Tesfaye A, Sisay G, Kabthymer RH, Tesfaye T. Under-nutrition and associated factors among pregnant women in public health care hospitals of Gedeo Zone, southern Ethiopia: A cross-sectional study. Heliyon [Internet]. 2022;8(5):e09511. Available from: https://doi.org/10.1016/j.heliyon.2022.e09511

191. Symington EA, Baumgartner J, Malan L, Zandberg L, Ricci C, Smuts CM. Nutrition during pregnancy and early development (NuPED) in urban South Africa: A study protocol for a prospective cohort. BMC Pregnancy Childbirth. 2018 Jul 24;18(1).

192. Tefera W, Brhanie TW, Dereje M. Dietary diversity practice and associated factors among pregnant women attending ANC in Kolfe Keranyo sub city health centers, Addis Ababa, Ethiopia. medRxiv [Internet]. 2020 May 3 [cited 2022 Jul 20];2020.04.27.20081596. Available from: https://www.medrxiv.org/content/10.1101/2020.04.27.20081596v1

193. Apuke OD. Quantitative Research Methods : A Synopsis Approach. Kuwait Chapter Arab J Bus Manag Rev. 2017;6(11):40–7.

194. Pradeilles R, Holdsworth M, Olaitan O, Irache A, Osei-Kwasi HA, Ngandu CB, et al. Body size preferences for women and adolescent girls living in Africa: a mixed-methods systematic

review. Public Health Nutr [Internet]. 2022 Mar;25(3):738–59. Available from: https://www.proquest.com/scholarly-journals/body-size-preferences-women-adolescent-girls/docview/2638863816/se-2

195. MOHAJAN HK. Qualitative Research Methodology in Social Sciences and Related Subjects. J Econ Dev Environ People. 2018;7(1):23.

196. Schifferdecker KE, Reed VA. methods of exploration Using mixed methods research in medical education : basic guidelines for researchers. 2009;637–44.

197. Mccusker K, Gunaydin S. Research using qualitative , quantitative or mixed methods and choice based on the research. 2015;

198. Johnson RB, Onwuegbuzie AJ, Turner LA. Journal of Mixed Methods Research. J Mix Res Methods. 2007;1(2):112–33.

199. World Health Organization, UNICEF. The extension of the 2025 Maternal, Infant and Young Child nutrition targets to 2030. WHO Press [Internet]. 2019;1–12. Available from: https://www.who.int/nutrition/global-target-2025/discussion-paper-extension-targets-2030.pdf?ua=1

200. Meissner H, Creswell J, Klassen AC, Plano V, Smith KC. Best Practices for Mixed Methods Research in the Health Sciences. Methods [Internet]. 2011;29:1–39. Available from: http://scholar.google.com/scholar?hl=en&btnG=Search&q=intitle:Best+Practices+for+Mixed+Methods+Research+in+the+Health+Sciences#0

201. Kaushik V, Walsh CA. Pragmatism as a researcKaushik, V. and Walsh, C. A. (2019) 'Pragmatism as a research paradigm and its implications for Social Work research', Social Sciences, 8(9). doi: 10.3390/socsci8090255.h paradigm and its implications for Social Work research. Soc Sci. 2019;8(9):1–17.

202. Feilzer MY. Doing mixed methods research pragmatically: Implications for the rediscovery of pragmatism as a research paradigm. J Mix Methods Res. 2010;4(1):6–16.

203. Morgan DL. Pragmatism as a Paradigm for Social Research. Qual Inq. 2014;20(8):1045–53.

204. Kaushik V, Walsh CA. Pragmatism as a research paradigm and its implications for Social Work research. Soc Sci. 2019;8(9).

205. Kilanowski JF. Breadth of the Socio-Ecological Model. J Agromedicine [Internet]. 2017;22(4):295–7. Available from: https://doi.org/10.1080/1059924X.2017.1358971

206. Smedley BD, Syme SL. Promoting Health : Intervention Strategies Social and Behavioral Research from. 2001;15(3):149–67.

207. Owen N, Heart B, Fisher EB. ECOLOGICAL MODEL OF HEALTH BEHAVIOR. 2008.

208. Cisse N, Ariun E, Mckyer IELJ, Mkuu R. Examining Nutritional Adequacy and Dietary Diversity Among Women in Niger. Matern Child Health J. 2017;21(6):1408–16.

209. Golden SD, Earp JAL. Social Ecological Approaches to Individuals and Their Contexts: Twenty Years of Health Education & Behavior Health Promotion Interventions. Heal Educ Behav. 2012;39(3):364–72.

210. Nagel B, Partelow S. A methodological guide for applying the social-ecological system (SES) framework: a review of quantitative approaches. Ecol Soc. 2022;27(4).

211. Walker HM, Calkins C, Wehmeyer ML, Walker L, Bacon A, Palmer SB, et al. A social-

ecological approach to promote self-determination. Exceptionality. 2011;19(1):6–18.

212. National Institute of Statistics of Rwanda (NISR) [Rwanda], Ministry of Health (MOH) [Rwanda] and I 2021., Rwanda Demographic and Health Survey 2019-20 Final Report. Kigali, Rwanda, and Rockville, Maryland U, ICF. N and. Rwanda Demographic Health Survey, 2019-20. 2021. 1–586 p.

213. Republic THE. Population and Housing Census 2012. Natl Inst Stat rwanda. 2020;

214. Rwanda N institute of statistics of. R demographic and health survey 2014-2015. 2014.

215. Östlund U, Kidd L, Wengström Y, Rowa-Dewar N. Combining qualitative and quantitative research within mixed method research designs: A methodological review. Int J Nurs Stud. 2011;48(3):369–83.

216. Guetterman TC, Fetters MD, Creswell JW. Integrating quantitative and qualitative results in health science mixed methods research through joint displays. Ann Fam Med. 2015;13(6):554–61.

217. Wu Y, Ma X, Fraser WD, Li M, Wang W, Huang H, et al. Caregivers' perceptions, challenges and service needs related to tackling childhood overweight and obesity: a qualitative study in three districts of Shanghai, China. BMC Public Health. 2021;21(1):1–10.

218. Webster J, Linnane JWJ, Dibley LM, Hinson JK, Starrenburg SE, Roberts JA. Measuring social support in pregnancy: Can it be simple and meaningful? Birth. 2000;27(2):97–101.

219. Kang Y, Hurley KM, Ruel-Bergeron J, Monclus AB, Oemcke R, Wu LSF, et al. Household food insecurity is associated with low dietary diversity among pregnant and lactating women in rural Malawi. Public Health Nutr. 2019 Mar 1;22(4):697–705.

220. Greenland S. Dose Response and Trend Analysis in Epidemiology: Alternative to Categorical Analysis. Journal of epidemiology; 1995. p. 356–65.

221. Greenland S. Avoiding Power Loss With Categorization and Ordinal Score in Dose-Response and Trend Analysis. Journal of epidemiology; 1994. p. 450–4.

222. Royston P, Altman DG, Sauerbrei W. Dichotomizing continuous predictors in multiple regression: A bad idea. Stat Med. 2006;25(1):127–41.

223. Braun V, Clarke V. Using thematic analysis in psychology. Qual Res Psychol. 2006;3(2):77–101.

224. Tyupa S. A theoretical framework for back-translation as a quality assessment tool. New Voices Transl Stud. 2011;7(1):35–46.

225. In J. Introduction of a pilot study. Korean J Anesthesiol. 2017;70(6):601–5.

226. Ahmed T, Hossain M, Sanin KI. Global Burden of Maternal and Child Undernutrition and Micronutrient Deficiencies. Ann Nutr Metab [Internet]. 2012;61(Suppl. 1):8–17. Available from: https://pubmed.ncbi.nlm.nih.gov/23343943/

227. Desyibelew HD, Dadi AF. Burden and determinants of malnutrition among pregnant women in Africa: A systematic review and meta-analysis. PLoS One. 2019;14(9):1–19.

228. Kedir H, Berhane Y, Worku A. Magnitude and determinants of malnutrition among pregnant women in eastern Ethiopia: Evidence from rural, community-based setting. Matern Child Nutr. 2016;12(1):51–63.

229. Soliman A, Sanctis V De, Alaaraj N, Ahmed S, Alyafei F, Hamed N, et al. Early and Long-term Consequences of Nutritional Stunting : From Childhood to Adulthood. J Nutr Sci. 2021;92(4):1–12.

230. Shemsu S, Argaw A, Zinab B. Dietary Practice and Nutritional Status Among Pregnant Women Attending Antenatal Care at Mettu Karl Referral Hospital, Southwest Ethiopia. Open Public Health J. 2020;13(1):538–46.

231. Girma Tilahun A, Molla Kebede A, Ejigu AG. Dietary Practice and Associated Factors Among Pregnant Women at Public Health Institution in Mizan-Aman Town, Southwest Ethiopia. Nutr Metab Insights [Internet]. 2021 Jan 20 [cited 2022 Jul 18];14:1–10. Available from: http://www.ncbi.nlm.nih.gov/pubmed/34819735

232. Ehwarieme AT, Amiegheme EF, Enosekhafoh B. Knowledge and practice of healthy nutrition among pregnant women attending antenatal clinic at selected private hospitals in Benin City. Int J Nurs Midwifery. 2019;11(7):75–86.

233. Appiah PK, Naa Korklu AR, Bonchel DA, Fenu GA, Wadga-Mieza Yankey F. Nutritional Knowledge and Dietary Intake Habits among Pregnant Adolescents Attending Antenatal Care Clinics in Urban Community in Ghana. Silveyra MX, editor. J Nutr Metab [Internet]. 2021 Feb 13;2021:1–9. Available from: https://www.hindawi.com/journals/jnme/2021/8835704/

234. Levac D, Colquhoun H, O'Brien KK. Scoping studies: Advancing the methodology. Implement Sci. 2010;5(1):1–9.

235. Arksey H, Malley LO, Arksey H, Malley LO. Scoping studies : towards a methodological framework Scoping Studies : Towards a Methodological Framework. Int J socil Res Methodol. 2017;5579(October):1–15.

236. Peterson J, Pearce PF, Ferguson LA, Langford CA. Understanding scoping reviews. J Am Assoc Nurse Pract [Internet]. 2017 Jan;29(1):12–6. Available from: https://journals.lww.com/01741002-201701000-00005

237. Dresler-Hawke E, Whitehead D. The Behavioral Ecological Model as a Framework for School-Based Anti-Bullying Health Promotion Interventions. J Sch Nurs [Internet]. 2009 Jun 10;25(3):195–204. Available from: http://journals.sagepub.com/doi/10.1177/1059840509334364

238. Ugwa E. Nutritional practices and taboos among pregnant women attending antenatal care at general hospital in Kano, Northwest Nigeria. Ann Med Health Sci Res [Internet]. 2016;6(2):109. Available from: http://www.amhsr.org/text.asp?2016/6/2/109/181846

239. Yalewdeg M, Birhane M, Adissu Y. Dietary Practices and Their Determinants Among Pregnant Women in Gedeo Zone, Southern Ethiopia: A Community-Based Cross-Sectional Study. Nutr Diet Suppl [Internet]. 2020 Dec 18 [cited 2022 Jul 20];Volume 12:267–75. Available from: https://www.dovepress.com/dietary-practices-and-their-determinants-among-pregnant-women-in-gedeo-peer-reviewed-fulltext-article-NDS

240. Gudeta TG, Terefe AB, Mengistu GT, Sori SA. Determinants of Dietary Diversity Practice among Pregnant Women in the Gurage Zone, Southern Ethiopia, 2021: Community-Based Cross-Sectional Study. Chigusa Y, editor. Obstet Gynecol Int [Internet]. 2022 May 9 [cited 2022 Jul 18];2022:1–11. Available from: http://www.ncbi.nlm.nih.gov/pubmed/35586393

241. Yismaw WS, Teklu TS. Nutritional practice of pregnant women in Buno Bedele zone, Ethiopia: a community based cross-sectional study. Reprod Health [Internet]. 2022 Dec 31;19(1):84. Available from: https://search.ebscohost.com/login.aspx?direct=true&db=cin20&AN=156111076&site=ehost-

live

242. Tsegaye D, Tamiru D, Belachew T. Food-related taboos and misconceptions during pregnancy among rural communities of Illu Aba Bor zone, Southwest Ethiopia. A community based qualitative cross-sectional study. BMC Pregnancy Childbirth [Internet]. 2021 Dec 17 [cited 2022 Jul 18];21(1):309. Available from: https://bmcpregnancychildbirth.biomedcentral.com/articles/10.1186/s12884-021-03778-6

243. Ogechi AC, Hamdalat OO. Factors Influencing the Nutritional Practice of Pregnant Women Living in a Semi-Urban Region of Ogun State , Nigeria. Saudi J Med. 2017;3389:114–20.

244. Olatona FA, Olowu OJ, Goodman OO, Amu EO. Dietary habits , diversity , and predictors among pregnant women attending primary health care centers for antenatal care in Lagos , Nigeria. Fam Med Prim care. 2021;10:3076–83.

245. Delil R, Zinab B, Mosa H, Ahmed R, Hassen H. Determinants of dietary diversity practice among pregnant women attending antenatal clinic at Wachemo University Nigist Eleni Mohammed memorial referral hospital, Southern Ethiopia. Erbil N, editor. PLoS One [Internet]. 2021 Apr 9;16(4):e0250037. Available from: http://dx.doi.org/10.1371/journal.pone.0250037

246. Nana A, Zema T. Dietary practices and associated factors during pregnancy in northwestern Ethiopia. BMC Pregnancy Childbirth [Internet]. 2018 Dec 25;18(1):183. Available from: https://search.ebscohost.com/login.aspx?direct=true&db=cin20&AN=129785766&site=ehost-live

247. Djossinou DRA, Savy M, Fanou-Fogny N, Landais E, Accrombessi M, Briand V, et al. Changes in women's dietary diversity before and during pregnancy in Southern Benin. Matern Child Nutr [Internet]. 2020 Apr;16(2):1–12. Available from: https://search.ebscohost.com/login.aspx?direct=true&db=cin20&AN=142357104&site=ehost-live

248. Goodluck A, Patience A, Harcourt P. Predictors of Nutritional Practices among Pregnant Women Attendinag Ante-Natal Clinic in Health Centres in Akpor Kingdom of Obio / Akpor Local Government Area of Rivers State , Niger Delta. Asian J pregnancy childbirth. 2020;3(2):69–74.

249. Fite MB, Tura AK, Yadeta TA, Oljira L, Roba KT. Prevalence and determinants of dietary practices among pregnant women in eastern Ethiopia. BMC Nutr [Internet]. 2022 Dec 11;8(1):3. Available from: https://doi.org/10.1186/s40795-021-00494-4

250. Desta M, Akibu M, Tadese M, Tesfaye M. Dietary Diversity and Associated Factors among Pregnant Women Attending Antenatal Clinic in Shashemane, Oromia, Central Ethiopia: A Cross-Sectional Study. J Nutr Metab [Internet]. 2019 Mar 12 [cited 2022 Jul 20];2019:1–7. Available from: https://www.hindawi.com/journals/jnme/2019/3916864/

251. Workneh F, Eglovitch M, Shiferaw T, Shiferie F, Amanuel H, Tadesse AW, et al. Dietary Practices Among Pregnant Women in Rural Amhara, Ethiopia. Curr Dev Nutr [Internet]. 2021 Jun 7;5(Supplement_2):698–698. Available from: https://academic.oup.com/cdn/article/5/Supplement_2/698/6293109

252. Aliwo S, Fentie M, Awoke T, Gizaw Z. Dietary diversity practice and associated factors among pregnant women in North East Ethiopia. BMC Res Notes [Internet]. 2019 Dec 7;12(1):123. Available from: https://doi.org/10.1186/s13104-019-4159-6

253. Tefera W, Brhanie TW, Dereje M. Dietary diversity practice and associated factors among pregnant women attending ANC in Kolfe Keranyo sub city health centers, Addis Ababa,

Ethiopia. medRxiv [Internet]. 2020;2020.04.27.20081596. Available from: https://www.medrxiv.org/content/10.1101/2020.04.27.20081596v1%0Ahttps://www.medrxiv.org/content/10.1101/2020.04.27.20081596v1.abstract

254. Jemal K, Awol M. Minimum Dietary Diversity Score and Associated Factors among Pregnant Women at Alamata General Hospital, Raya Azebo Zone, Tigray Region, Ethiopia. J Nutr Metab [Internet]. 2019 May 2 [cited 2022 Jul 18];2019:1–6. Available from: http://www.ncbi.nlm.nih.gov/pubmed/31192011

255. Rosen JG, Clermont A, Kodish SR, Matar Seck A, Salifou A, Grais RF, et al. Determinants of dietary practices during pregnancy: A longitudinal qualitative study in Niger. Matern Child Nutr. 2018 Oct 1;14(4).

256. Oumer A, Abraham M, Nuri A. Predictors of Major Dietary Patterns Among Pregnant Women Attending Public Health Facilities in Eastern Ethiopia: A New Epidemiological Approach. Front Nutr [Internet]. 2022 Apr 25 [cited 2022 Jul 18];9(1):855149. Available from: http://www.ncbi.nlm.nih.gov/pubmed/35548559

257. Riang'a RM, Broerse J, Nangulu AK. Food beliefs and practices among the Kalenjin pregnant women in rural Uasin Gishu County, Kenya. J Ethnobiol Ethnomed [Internet]. 2017 Dec 25;13(1):29. Available from: http://ethnobiomed.biomedcentral.com/articles/10.1186/s13002-017-0157-8

258. Getnet W, Aycheh W, Tessema T. Determinants of Food Taboos in the Pregnant Women of the Awabel District, East Gojjam Zone, Amhara Regional State in Ethiopia. Adv Public Heal [Internet]. 2018 Oct;1–6. Available from: https://search.ebscohost.com/login.aspx?direct=true&db=cin20&AN=132067981&site=ehost-live

259. M'soka NC, Mabuza LH, Pretorius D. Cultural and health beliefs of pregnant women in Zambia regarding pregnancy and child birth. Curationis [Internet]. 2015 Feb 27 [cited 2022 Jul 18];38(1). Available from: http://curationis.org.za/index.php/curationis/article/view/1232

260. Riang'a RM, Nangulu AK, Broerse JEW. "When a woman is pregnant, her grave is open": health beliefs concerning dietary practices among pregnant Kalenjin women in rural Uasin Gishu County, Kenya. J Heal Popul Nutr [Internet]. 2017 Dec 16;36(1):1–12. Available from: https://jhpn.biomedcentral.com/articles/10.1186/s41043-017-0130-0

261. Hoffmann JF, Angélica M, Nunes A, Giselle S, Ozcariz I, Buss C. Dietary patterns during pregnancy and the association with sociodemographic characteristics among women attending general practices in southern Brazil : the ECCAGe Study. cad Saude publica. 2013;29(5):970–80.

262. Mahrnood S, Atif MF, Mujeeb SSA, Bano N. Assessment of Nutritional Beliefs and Practices in Pregnant and Lactating Mothers in an Urban and Rural Area of Pakistan.

263. Vakili M, Abedi P, Sharifi M, Hosseini M. Dietary diversity and its related factors among adolescents: a survey in Ahvaz-Iran. Glob J Health Sci. 2013;5(2):181–6.

264. Alkalash SH, Elnady RT, Khalil NA, Hegazy NN. Dietary Practice and Nutritional Status Among Pregnant Women Attending Antenatal Care of Egyptian , Rural Family Health Unit Dietary Practice and Nutritional Status Among Pregnant Women Attending Antenatal Care of Egyptian , Rural Family Health Unit. Egypptian J Hosp Med. 2021;83(April):1030–7.

265. Forbes F, Wynter K, Zeleke BM, Fisher J. Male partner involvement in birth preparedness , complication readiness and obstetric emergencies in Sub-Saharan Africa : a scoping review. BMC Pregnancy Child. 2021;21(128):1–20.

266. Mainuddin A, Ara Begum H, Rawal LB, Islam A, Shariful Islam SM. Women Empowerment and Its Relation with Health Seeking Behavior in Bangladesh. J Fam Reprod Heal [Internet]. 2015;9(2):65–73. Available from: http://www.ncbi.nlm.nih.gov/pubmed/26175761%0Ahttp://www.pubmedcentral.nih.gov/articlerender.fcgi?artid=PMC4500817

267. Medel-anonuevo C. Women -- education and empowerment. JOICFP News [Internet]. 1997 Jan;7(271):1–67. Available from: http://www.ncbi.nlm.nih.gov/pubmed/12292052

268. Afulani PA, Altman M, Musana J, Sudhinaraset M. Conceptualizing pathways linking women's empowerment and prematurity in developing countries. BMC Pregnancy Childbirth [Internet]. 2017 Nov 8;17(S2):338. Available from: https://bmcpregnancychildbirth.biomedcentral.com/articles/10.1186/s12884-017-1502-6

269. Ali F, Thaver I, Khan SA. ORIGINAL ARTICLE ASSESSMENT OF DIETARY DIVERSITY AND NUTRITIONAL STATUS OF PREGNANT WOMEN IN ISLAMABAD , PAKISTAN Fatima Ali , Inayat Thaver , Shahzad Ali Khan. J Ayub Med Coll Abbottabad. 2014;26(4):506–9.

270. Kunene B. Involving men in maternity care : South Africa. 2004;

271. Gibore NS, Bali TAL, Kibusi SM. Factors influencing men ' s involvement in antenatal care services : a cross-sectional study in a low resource setting , Central Tanzania. Reprod Health. 2019;1–10.

272. Natoli L, Holmes W, Chanlivong N, Chan G, Toole MJ. Promoting safer sexual practices among expectant fathers in the Lao People's Democratic Republic. Glob Public Health [Internet]. 2012 Mar;7(3):299–311. Available from: http://www.tandfonline.com/doi/abs/10.1080/17441692.2011.641987

273. Nguyen PH, Frongillo EA, Sanghvi T, Wable G, Mahmud Z, Tran LM, et al. Engagement of husbands in a maternal nutrition program substantially contributed to greater intake of micronutrient supplements and dietary diversity during pregnancy: Results of a cluster-randomized program evaluation in Bangladesh. J Nutr. 2018;148(8):1352–63.

274. Giller KE. The Food Security Conundrum of sub-Saharan Africa. Glob Food Sec [Internet]. 2020 Sep;26(1):100431. Available from: https://doi.org/10.1016/j.gfs.2020.100431

275. Mohamadpour M, Mohd Sharif Z, Avakh Keysami M. Food Insecurity, Health and nutritional status among sample of Palm-Plantation households in Malaysia. J Heal Popul Nutr. 2012;30(3):291–302.

276. Fite MB, Tura AK, Yadeta TA, Oljira L, Roba KT. Consumption of animal source food and associated factors among pregnant women in eastern Ethiopia: A community-based study. Desta M, editor. PLoS One [Internet]. 2022 Jun 17;17(6):e0270250. Available from: https://www.proquest.com/scholarly-journals/consumption-animal-source-food-associated-factors/docview/2687699208/se-2

277. Krebs NF, Westcott JE, Butler N, Robinson C, Bell M, Hambidge KM. Meat as a First Complementary Food for Breastfed Infants: Feasibility and Impact on Zinc Intake and Status. J Pediatr Gastroenterol Nutr [Internet]. 2006 Feb;42(2):207–14. Available from: https://journals.lww.com/00005176-200602000-00018

278. Lee SE, Talegawkar SA, Merialdi M, Caulfield LE. Dietary intakes of women during pregnancy in low- and middle-income countries. Public Health Nutr. 2013;16(8):1340–53.

279. Torheim LE, Barikmo I, Parr CL, Hatløy A, Ouattara F, Oshaug A. Validation of food variety

as an indicator of diet quality assessed with a food frequency questionnaire for Western Mali. Eur J Clin Nutr. 2003;57(10):1283–91.

280. Liu N, Mao L, Sun X, Liu L, Chen B, Ding Q. Postpartum practices of puerperal women and their influencing factors in three regions of Hubei, China. BMC Public Health [Internet]. 2006 Dec 7;6(1):274. Available from: https://bmcpublichealth.biomedcentral.com/articles/10.1186/1471-2458-6-274

281. Turner C, Pol S, Suon K, Neou L, Day NPJ, Parker M, et al. Beliefs and practices during pregnancy, post-partum and in the first days of an infant's life in rural Cambodia. BMC Pregnancy Childbirth. 2017;17(1):1–8.

282. Hartini TNS, Padmawati RS, Lindholm L, Surjono A, Winkvist A. The importance of eating rice: Changing food habits among pregnant Indonesian women during the economic crisis. Soc Sci Med. 2005;61(1):199–210.

283. Murphy M, Stettler N, Reiss R, Smith K. Associations of consumption of fruits and vegetables during pregnancy with infant birth weight or small for gestational age births: a systematic review of the literature. Int J Womens Health [Internet]. 2014 Oct;6:899–912. Available from: http://www.dovepress.com/associations-of-consumption-of-fruits-and-vegetables-during-pregnancy--peer-reviewed-article-IJWH

284. Liu RH. Health-Promoting Components of Fruits and Vegetables in the Diet. Adv Nutr [Internet]. 2013 May 1;4(3):384S-392S. Available from: https://academic.oup.com/advances/article/4/3/384S/4591619

285. Ahn YM, Kim YJ, Park H, Park B, Lee H. Prenatal Vitamin C Status is Associated with Placental Apoptosis in Normal-term Human Pregnancies. Placenta. 2007;28(1):31–8.

286. Bergen NE, Jaddoe VWV, Timmermans S, Hofman A, Lindemans J, Russcher H, et al. Homocysteine and folate concentrations in early pregnancy and the risk of adverse pregnancy outcomes: The generation R study. BJOG An Int J Obstet Gynaecol. 2012;119(6):739–51.

287. Zerfu TA, Pinto E, Baye K. Consumption of dairy, fruits and dark green leafy vegetables is associated with lower risk of adverse pregnancy outcomes (APO): a prospective cohort study in rural Ethiopia. Nutr Diabetes [Internet]. 2018 Dec 20;8(1):52. Available from: http://dx.doi.org/10.1038/s41387-018-0060-y

288. Barker DJP, Godfrey KM, Gluckman PD, Harding JE, Owens JA, Robinson JS. Fetal nutrition and cardiovascular disease in adult life. Lancet. 1993;341(8850):938–41.

289. Sahoo S, Panda B. A Study of Nutritional Status of Pregnant Women of Some Villages in Balasore District, Orissa. J Hum Ecol. 2006;20(3):227–32.

290. Demilew YM, Alene GD, Belachew T. Dietary practices and associated factors among pregnant women in West Gojjam Zone, Northwest Ethiopia. BMC Pregnancy Childbirth [Internet]. 2020 Jan 6;20(1):1–11. Available from: https://search.ebscohost.com/login.aspx?direct=true&db=cin20&AN=141077735&site=ehost-live

291. Adikari AMNT, Sivakanesan R, Wijesinghe DGNG, Liyanage C. Assessment of nutritional status of pregnant women in a rural area in Sri Lanka. Trop Agric Res. 2016;27(2):203.

292. Scholl TO, Johnson WG. Folic acid: Influence on the outcome of pregnancy. Am J Clin Nutr. 2000;71(5 SUPPL.).

293. Gambling L, Danzeisen R, Fosset C, Andersen HS, Dunford S, Srai SKS, et al. Iron and copper interactions in development and the effect on pregnancy outcome. J Nutr [Internet].

2003;133(5 SUPPL. 2):1554S-1556S. Available from: https://doi.org/10.1093/jn/133.5.1554S

294. Bhutta ZA, Darmstadt GL, Hasan BS, Haws RA. Community-based interventions for improving perinatal and neonatal health outcomes in developing countries: A review of the evidence. Pediatrics. 2005;115(2):519–617.

295. Sisay Alemayehu M. Dietary Practice and Associated Factors among Pregnant Women in Gondar Town North West, Ethiopia, 2014. Int J Nutr Food Sci [Internet]. 2015;4(6):707. Available from: http://www.sciencepublishinggroup.com/journal/paperinfo?journalid=153&doi=10.11648/j.ijnfs.20150406.27

296. Kennedy G, Fanou-Fogny N, Seghieri C, Arimond M, Koreissi Y, Dossa R, et al. Food groups associated with a composite measure of probability of adequate intake of 11 micronutrients in the diets of women in urban Mali. J Nutr [Internet]. 2010;140(11):S2070–8. Available from: https://doi.org/10.3945/jn.110.123612

297. Anyasor Chiamaka Ogechi. [PDF] Factors Influencing the Nutritional Practice of Pregnant Women Living in a Semi-Urban Region of Ogun State , Nigeria | Semantic Scholar. Saudi J Med [Internet]. 2017 [cited 2022 Jul 20];2(5):114–20. Available from: https://www.semanticscholar.org/paper/Factors-Influencing-the-Nutritional-Practice-of-in-Ogechi-Hamdalat/ab7ca6202325d5a76cc2e8ab94175d9ba81316a6

298. Ea U. Nutritional Practices and Taboos Among Pregnant Women Attending Antenatal Care at General Hospital in Kano , Northwest Nigeria. 2016;109–14.

299. Nsereko E, Uwase A, Mukabutera A, Muvunyi CM, Rulisa S, Ntirushwa D, et al. Maternal genitourinary infections and poor nutritional status increase risk of preterm birth in Gasabo District, Rwanda: a prospective, longitudinal, cohort study. BMC Pregnancy Childbirth [Internet]. 2020 Jun 3 [cited 2022 Jul 18];20(1):345. Available from: https://bmcpregnancychildbirth.biomedcentral.com/articles/10.1186/s12884-020-03037-0

300. National Institute of Statistics of Rwanda, Ministry of Health, ICF International. Rwanda| 2014-15 Demographic and Health Survey. Key Findings. In: Rwanda| 2014-15 Demographic and Health Survey Key Findings [Internet]. 2015. p. 24. Available from: http://www.dhsprogram.com/pubs/pdf/SR229/SR229.pdf

301. Mcleroy KR, Bibeau D, Steckler A, Glanz K. An Ecological Perspective on Health Promotion Programs. Heal Educ Behav. 1988;15(4):351–77.

302. Scarneo SE, Kerr ZY, Kroshus E, Register-Mihalik JK, Hosokawa Y, Stearns RL, et al. The socioecological framework: A multifaceted approach to preventing sport-related deaths in high school sports. J Athl Train. 2019;54(4):356–60.

303. Uwase A, Nsereko E, Pillay N, Levin J. Dietary diversity and associated factors among pregnant women in the Southern Province of Rwanda: A facility-based cross-sectional study. PLoS One [Internet]. 2024;19(2):e0297112. Available from: http://dx.doi.org/10.1371/journal.pone.0297112

304. Nana A, Zema T. Dietary practices and associated factors during pregnancy in northwestern Ethiopia. BMC Pregnancy Childbirth. 2018 May 25;18(1).

305. Girma Tilahun A, Molla Kebede A, Ejigu AG. Dietary Practice and Associated Factors Among Pregnant Women at Public Health Institution in Mizan-Aman Town, Southwest Ethiopia. Nutr Metab Insights [Internet]. 2021 Jan 20;14:117863882110577. Available from: http://journals.sagepub.com/doi/10.1177/11786388211057796

306. Diddana TZ. Factors associated with dietary practice and nutritional status of pregnant women in Dessie town , northeastern Ethiopia : a community-based cross-sectional study. 2019;1–10.

307. Alexis H. The Challenges and Examination of New Programme Ubudehe 2020 in Rwanda. Am J Ind Bus Manag. 2023;13(05):287–311.

308. Nations F and AO for Un. Guidelines for assessing nutrition-related K nowledge , A ttitudes and P ractices manual Guidelines for assessing nutrition-related K nowledge , A ttitudes and P ractices manual. 2014.

309. Webster J, Linnane JWJ, Dibley LM, Hinson JK, Starrenburg SE, Roberts JA. Measuring Social Support in Pregnancy: Can It Be Simple and Meaningful? Birth [Internet]. 2000 Jun 1 [cited 2022 Dec 1];27(2):97–101. Available from: https://onlinelibrary.wiley.com/doi/full/10.1046/j.1523-536x.2000.00097.x

310. Royston P, Ambler G, Sauerbrei W. The use of fractional polynomials to model continuous risk variables in epidemiology. Int J Epidemiol. 1999;28(5):964–74.

311. Soper ME. What you see may not be what you get: Errors in online bibliographic records for serials. Ref Libr. 1990;12(27–28):185–213.

312. Swain J. A Hybrid Approach to Thematic Analysis in Qualitative Research: Using a Practical Example. A Hybrid Approach to Themat Anal Qual Res Using a Pract Ex. 2018;(January 2018).

313. Skjott Linneberg M, Korsgaard S. Coding qualitative data: a synthesis guiding the novice. Qual Res J. 2019;19(3):259–70.

314. Tzeng W-C, Lipson JG. A general inductive approach for qualitative data analysis. Fam Community Health [Internet]. 2007 Jan;30(1):74–83. Available from: http://journals.lww.com/00003727-200701000-00009

315. Diddana TZ, Kelkay GN, Dola AN, Sadore AA. Effect of Nutrition Education Based on Health Belief Model on Nutritional Knowledge and Dietary Practice of Pregnant Women in Dessie Town, Northeast Ethiopia: A Cluster Randomized Control Trial. J Nutr Metab [Internet]. 2018 Jun 21;2018:1–10. Available from: https://www.hindawi.com/journals/jnme/2018/6731815/

316. Yalew A, Tekle Silasie W, Anato A, Fikrie A. Food aversion during pregnancy and its association with nutritional status of pregnant women in Boricha Woreda, Sidama Regional State, Southern Ethiopia, 2019. A community based mixed crossectional study design. Reprod Health [Internet]. 2021 Dec 18 [cited 2022 Jul 18];18(1):208. Available from: https://reproductive-health-journal.biomedcentral.com/articles/10.1186/s12978-021-01258-w

317. Fernández-Teijeiro Álvarez A. The Protective Effect of Prenatal Social Support on Infant Adiposity in the First 18 Months of Life. An Pediatr. 2020;93(6):355–7.

318. Abdou CM, Hobel CJ. Familialism, Social Support, and Stress: Positive Implications for Pregnant Latinas. NIH Public Access. 2008;14(2):155–62.

319. Woldetensay YK, Belachew T, Biesalski HK, Ghosh S, Lacruz ME, Scherbaum V, et al. The role of nutrition, intimate partner violence and social support in prenatal depressive symptoms in rural Ethiopia: Community based birth cohort study. BMC Pregnancy Childbirth. 2018;18(1):1–10.

320. Påfs J, Musafili A, Binder-Finnema P, Klingberg-Allvin M, Rulisa S, Essén B. “They would never receive you without a husband”: Paradoxical barriers to antenatal care scale-up in Rwanda. Midwifery. 2015;31(12):1149–56.

321. Mohammed F, Abdirizak N, Jibril A, Oumer A. Correlates of minimum dietary diversity among pregnant women on antenatal care follow up at public health facility in Puntland, Somalia. Sci Rep [Internet]. 2023;13(1):1–11. Available from: https://doi.org/10.1038/s41598-023-48983-9

322. Barbara A AMS-R and CG. Household food insecurity is associated with self-reported pregravid weight status, gestational weight gain and pregnancy complications. NIH Public Access [Internet]. 210AD;110(5):692–701. Available from: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3624763/pdf/nihms412728.pdf

323. Defects CB, Carmichael SL, Yang W, Herring A, Abrams B, Shaw GM. Maternal Food Insecurity is associated with increased risk of certain birth defects. 2007;137(9):2087–92.

324. McKay FH, Spiteri S, Zinga J, Sulemani K, Jacobs SE, Ranjan N, et al. Systematic Review of Interventions Addressing Food Insecurity in Pregnant Women and New Mothers. Curr Nutr Rep [Internet]. 2022;11(3):486–99. Available from: https://doi.org/10.1007/s13668-022-00418-z

325. Augusto ALP, De Abreu Rodrigues AV, Domingos TB, Salles-Costa R. Household food insecurity associated with gestacional and neonatal outcomes: A systematic review. BMC Pregnancy Childbirth. 2020;20(1):1–11.

326. de Diego-Cordero R, Rivilla-Garcia E, Diaz-Jimenez D, Lucchetti G, Badanta B. The role of cultural beliefs on eating patterns and food practices among pregnant women: a systematic review. Nutr Rev. 2021;79(9):945–63.

327. Zerfu TA, Umeta M, Baye K. Dietary habits, food taboos, and perceptions towards weight gain during pregnancy in Arsi, rural central Ethiopia: a qualitative cross-sectional study. J Health Popul Nutr. 2016 Jul 25;35(1):22.

328. May L, Suminski R, Berry A, Linklater E, Jahnke S. Diet and Pregnancy: Health-Care Providers and Patient Behaviors. J Perinat Educ. 2014;23(1):50–6.

329. Boyle M, Lawrence S, Schwarte L, Samuels S, McCarthy WJ. Health care providers' perceived role in changing environments to promote healthy eating and physical activity: Baseline findings from health care providers participating in the healthy eating, active communities program. Pediatrics. 2009;123(SUPPL. 5):293–300.

330. Rauf R, Aamir M. Kitchen gardening : A strategy for improving nutritional status of rural households in Sindh province of Pakistan. 2021;10(6):249–63.

331. Blakstad MM, Mosha D, Bellows AL, Canavan CR, Chen JT, Mlalama K, et al. Home gardening improves dietary diversity, a cluster-randomized controlled trial among Tanzanian women. Matern Child Nutr. 2021;17(2):1–12.

332. Bundala N, Kinabo J, Jumbe T, Rybak C, Sieber S. Does homestead livestock production and ownership contribute to consumption of animal source foods? A pre-intervention assessment of rural farming communities in Tanzania. Sci African [Internet]. 2020;7:e00252. Available from: https://doi.org/10.1016/j.sciaf.2019.e00252

333. Bhutta ZA, Das JK, Rizvi A, Gaffey MF, Walker N, Horton S, et al. Evidence-based interventions for improvement of maternal and child nutrition: What can be done and at what cost? Lancet. 2013;382(9890):452–77.

334. Http://www.moh.gov.rw/ M of LG http://www. minaloc. gov. rw. M of H, Http://www.minagri.gov.rw/ M of A and AR. Rwanda National Food and Nutrition Policy. 2014;(January):1–65.

335. Biradar KB, Sravani V, K PS, Lakshmi C, Shivlila H, Nagabushan G, et al. Assessment of Nutritional Supplements Prescribed in Pregnant Women and Pediatric Patients in Basaveshwara Teaching and General Hospital. J food Nutr [Internet]. 2015 Dec 2;2(102):1–9. Available from: http://www.jscholaronline.org/full-text/JFN/2_102/Assessment-of-Nutritional-Supplements-Prescribed-in-Pregnant-Women-and-Pediatric.php

336. Ochieng J, Afari-Sefa V, Lukumay PJ, Dubois T. Determinants of dietary diversity and the potential role of men in improving household nutrition in Tanzania. van Wouwe JP, editor. PLoS One [Internet]. 2017 Dec 12;12(12):e0189022. Available from: https://dx.plos.org/10.1371/journal.pone.0189022

337. Olatona FA, Olowu OJ, Goodman OO, Amu EO. Dietary habits, diversity, and predictors among pregnant women attending primary health care centers for antenatal care in Lagos, Nigeria. J Fam Med Prim care [Internet]. 2021 Aug [cited 2022 Jul 18];10(8):3076–83. Available from: http://www.ncbi.nlm.nih.gov/pubmed/34660450

338. Fasola O, Abosede O, Fasola FA. Knowledge , attitude and practice of good nutrition among women of childbearing age in Somolu Local Government , Lagos State. J Public Health Africa. 2018;9(793):42–6.

339. Abera SF, Kantelhardt EJ, Bezabih AM, Tsadik M, Lauvai J, Ejeta G, et al. What factors are associated with maternal undernutrition in eastern zone of Tigray, Ethiopia? Evidence for nutritional well-being of lactating mothers. BMC Public Health. 2020;20(1):1–12.

340. WHO. WHO antenatal care recommendations for a positive pregnancy experience Nutritional interventions update: Multiple micronutrient supplements during pregnancy. Geneva: World Health Organisation;2020.Liscence: CC BY-NC-SA 3.0 IGO. 2020. 1–68 p.

341. Asayehu TT, Lachat C, Henauw S De, Gebreyesus SH. Dietary behaviour, food and nutrient intake of women do not change during pregnancy in Southern Ethiopia. Matern Child Nutr [Internet]. 2017 Apr;13(2):e12343. Available from: https://onlinelibrary.wiley.com/doi/10.1111/mcn.12343

342. Zerfu TA, Biadgilign S. Pregnant mothers have limited knowledge and poor dietary diversity practices , but favorable attitude towards nutritional recommendations in rural Ethiopia : evidence from community-based study. BMC Nutr. 2018;43(4):1–9.

343. Gudeta TG, Terefe AB, Mengistu GT, Sori SA. Determinants of Dietary Diversity Practice among Pregnant Women in the Gurage Zone, Southern Ethiopia, 2021: Community-Based Cross-Sectional Study. Chigusa Y, editor. Obstet Gynecol Int [Internet]. 2022 May 9;2022:1–11. Available from: https://www.hindawi.com/journals/ogi/2022/8086793/

344. Saaka M, Mutaru S, Osman SM. Determinants of dietary diversity and its relationship with the nutritional status of pregnant women. J Nutr Sci [Internet]. 2021 Mar 2;10(e14):1–8. Available from: https://www.cambridge.org/core/product/identifier/S2048679021000069/type/journal_article

345. Taruvinga A, Muchenje V, Mushunje A. Determinants of rural household dietary diversity: The case of Amatole and Nyandeni districts, South Africa \n. Int J Dev Sustain [Internet]. 2013;2(4):2233–47. Available from: http://isdsnet.com/ijds-v2n4-4.pdf

346. Zerfu TA, Umeta M, Baye K. Dietary habits, food taboos, and perceptions towards weight gain during pregnancy in Arsi, rural central Ethiopia: a qualitative cross-sectional study. J Heal Popul Nutr [Internet]. 2016 Dec 25;35(1):22. Available from: https://search.ebscohost.com/login.aspx?direct=true&db=cin20&AN=117242453&site=ehost-live

347. MINAGRI N institute of statistics/World FP. Comprehensive food security& vulnerability analysis. Rwanda. 2018;(April).

348. Naing L, Winn T, Rusli BN. Practical Issues in Calculating the Sample Size for Prevalence Studies. 2006;(Ci):9–14.

349. Miele MJ, Souza RT, Calderon IMP, Feitosa F, Leite DF, Rocha Filho E, et al. Proposal of MUAC as a fast tool to monitor pregnancy nutritional status: Results from a cohort study in Brazil. BMJ Open. 2021;11(5):1–11.

350. Mehrotra R, Sinha A, Yallamraju S, Gattumeedhi S, Gupta A, Khadse S. Use of mid upper arm circumference for evaluation of nutritional status of OSMF patients. J Int Soc Prev Community Dent [Internet]. 2014;4(5):122. Available from: http://www.jispcd.org/text.asp?2014/4/5/122/146217

351. Ververs M tesse, Antierens A, Sackl A, Staderini N, Captier V. Which Anthropometric Indicators Identify a Pregnant Woman as Acutely Malnourished and Predict Adverse Birth Outcomes in the Humanitarian Context? PLoS Curr [Internet]. 2013;5(JUNE). Available from: file:///pmc/articles/PMC3682760/

352. Kuma MN, Tamiru D, Belachew T. Level and predictors of dietary diversity among pregnant women in rural South-West Ethiopia: a community-based cross-sectional study. BMJ Open [Internet]. 2021 Oct 25 [cited 2022 Jul 18];11(10):e055125. Available from: https://bmjopen.bmj.com/lookup/doi/10.1136/bmjopen-2021-055125

353. Shrestha V, Paudel R, Sunuwar DR, Lyman ALT, Manohar S, Amatya A. Factors associated with dietary diversity among pregnant women in the western hill region of Nepal: A community based cross-sectional study. Hussain A, editor. PLoS One [Internet]. 2021 Apr 8;16(4):e0247085. Available from: http://dx.doi.org/10.1371/journal.pone.0247085

354. Erokhin V, Diao L, Gao T, Andrei JV, Ivolga A, Zong Y. The supply of calories, proteins, and fats in low-income countries: A four-decade retrospective study. Int J Environ Res Public Health. 2021;18(14):1–30.

355. Tsegaye D. Factors Associated with Dietary Practice and Nutritional Status of Pregnant Women in Rural Communities of Illu A ... Factors Associated with Dietary Practice and Nutritional Status of Pregnant Women in Rural Communities of Illu Aba Bor Zone , Southwest.

356. Ramulondi M, de Wet H, Ntuli NR. Traditional food taboos and practices during pregnancy, postpartum recovery, and infant care of Zulu women in northern KwaZulu-Natal. J Ethnobiol Ethnomed [Internet]. 2021 Dec 20;17(1):15. Available from: https://doi.org/10.1186/s13002-021-00451-2

357. Yeneabat T, Adugna H, Asmamaw T, Wubetu M, Admas M, Hailu G, et al. Maternal dietary diversity and micronutrient adequacy during pregnancy and related factors in East Gojjam Zone, Northwest Ethiopia, 2016. BMC Pregnancy Childbirth [Internet]. 2019 Dec 15;19(1):173. Available from: https://search.ebscohost.com/login.aspx?direct=true&db=cin20&AN=136461826&site=ehost-live

358. Fite MB, Tura AK, Yadeta TA, Oljira L, Roba KT. Consumption of animal source food and associated factors among pregnant women in eastern Ethiopia: A community-based study. PLoS One [Internet]. 2022;17(6 June):1–13. Available from: http://dx.doi.org/10.1371/journal.pone.0270250

359. Sambo TA, Oguttu JW, Mbombo-Dweba TP. Analysis of the dietary diversity status of

agricultural households in the Nkomazi Local Municipality, South Africa. Agric Food Secur [Internet]. 2022 Aug 25;11(1):46. Available from: https://doi.org/10.1186/s40066-022-00387-0

360. Obayelu OA, Osho FR. How diverse are the diets of low-income urban households in Nigeria? J Agric Food Res [Internet]. 2020;2(December 2019):100018. Available from: https://doi.org/10.1016/j.jafr.2019.100018

361. Ba DM, Ssentongo P, Gao X, Chinchilli VM, Richie JP, Maiga M, et al. Prevalence and determinants of meeting minimum dietary diversity among children aged 6–23 months in three sub-Saharan African Countries: The Demographic and Health Surveys, 2019–2020. Front Public Heal [Internet]. 2022 Aug 23;10. Available from: https://www.frontiersin.org/articles/10.3389/fpubh.2022.846049/full

362. Harrigan J. Food insecurity, poverty and the Malawian Starter Pack: Fresh start or false start? Food Policy. 2008;33(3):237–49.

363. Hidru HD, Berwo Mengesha M, Hailesilassie Y, Tekulu Welay F. Burden and Determinant of Inadequate Dietary Diversity among Pregnant Women in Ethiopia: A Systematic Review and Meta-Analysis. J Nutr Metab [Internet]. 2020 Aug 14 [cited 2022 Jul 18];2020:1–10. Available from: http://www.ncbi.nlm.nih.gov/pubmed/32855822

364. Katenga-Kaunda LZ, Kamudoni PR, Holmboe-Ottesen G, Fjeld HE, Mdala I, Shi Z, et al. Enhancing nutrition knowledge and dietary diversity among rural pregnant women in Malawi: a randomized controlled trial. BMC Pregnancy Childbirth [Internet]. 2021 Dec 22 [cited 2022 Jul 18];21(1):644. Available from: https://bmcpregnancychildbirth.biomedcentral.com/articles/10.1186/s12884-021-04117-5

365. Nguyen PH, Sanghvi T, Kim SS, Tran LM, Afsana K, Mahmud Z, et al. Factors influencing maternal nutrition practices in a large scale maternal, newborn and child health program in Bangladesh. de Souza RJ, editor. PLoS One [Internet]. 2017 Jul 10;12(7):e0179873. Available from: https://dx.plos.org/10.1371/journal.pone.0179873

366. Nguyen PH, Kachwaha S, Avula R, Young M, Tran LM, Ghosh S, et al. Maternal nutrition practices in Uttar Pradesh, India: Role of key influential demand and supply factors. Matern Child Nutr. 2019;15(4):1–15.

367. Hirvonen K. Rural–urban differences in children's dietary diversity in Ethiopia: A Poisson decomposition analysis. Econ Lett [Internet]. 2016 Oct;147:12–5. Available from: https://linkinghub.elsevier.com/retrieve/pii/S0165176516302981

368. Daba G, Beyene F, Garoma W, Fekadu H. Assessment of Nutritional Practices of Pregnant Mothers on Maternal. Sci Technol Arts Res J. 2013;2(3):105–13.

369. Aaronson LS, Mural CM, Pfoutz SK. Seeking Information: Where Do Pregnant Women Go? Heal Educ Behav. 1988;15(3):335–45.

370. Grimes HA, Forster DA, Newton MS. Sources of information used by women during pregnancy to meet their information needs. Midwifery [Internet]. 2014;30(1):e26–33. Available from: http://dx.doi.org/10.1016/j.midw.2013.10.007

371. ICM. Essential Competencies for Midwifery Practice 2018 Update. Int Confed Midwives [Internet]. 2018;32(2):13. Available from: http://w3.bgu.ac.il/lib/customproxy.php?url=http://search.ebscohost.com/login.aspx?direct=true&db=bth&AN=43594828&site=eds-live&authtype=ip,uid&custid=s4309548&groupid=main&profile=eds

372. Ibikunle HA, Okafor IP, Adejimi AA. Pre-natal nutrition education: Health care providers' knowledge and quality of services in primary health care centres in Lagos, Nigeria. PLoS One. 2021 Nov 1;16(11 November):1–14.

373. Arrish J, Yeatman H, Williamson M. Midwives and nutrition education during pregnancy: A literature review. Women and Birth [Internet]. 2014;27(1):2–8. Available from: http://dx.doi.org/10.1016/j.wombi.2013.02.003

374. Grenier LN, Atkinson SA, Mottola MF, Wahoush O, Thabane L, Xie F, et al. Be Healthy in Pregnancy: Exploring factors that impact pregnant women's nutrition and exercise behaviours. Matern Child Nutr. 2021;17(1):1–9.

375. Nankumbi J, Ngabirano TD, Nalwadda G. Maternal Nutrition Education Provided by Midwives: A Qualitative Study in an Antenatal Clinic, Uganda. J Nutr Metab. 2018;2018:1–7.

376. Gopal P, Fisher D, Seruwagi G, Taddese HB. Male involvement in reproductive, maternal, newborn, and child health: Evaluating gaps between policy and practice in Uganda. Reprod Health. 2020;17(1):1–9.

377. Alio AP, Lewis CA, Scarborough K, Harris K, Fiscella K. A community perspective on the role of fathers during pregnancy: A qualitative study. BMC Pregnancy Childbirth. 2013;13.

378. Tokhi M, Comrie-Thomson L, Davis J, Portela A, Chersich M, Luchters S. Involving men to improve maternal and newborn health: A systematic review of the effectiveness of interventions. PLoS One. 2018;13(1):1–16.

379. Id NSG, Bali TAL. Community perspectives : An exploration of potential barriers to men ' s involvement in maternity care in a central Tanzanian community. PLoS One [Internet]. 2020;1–27. Available from: http://dx.doi.org/10.1371/journal.pone.0232939

380. Bagenda F, Batwala V, Orach CG, Nabiwemba E, Atuyambe L. Benefits of and Barriers to Male Involvement in Maternal Health Care in Ibanda District, Southwestern, Uganda. Open J Prev Med. 2021;11(12):411–24.

381. Babirye JN, Rutebemberwa E, Kiguli J, Wamani H, Nuwaha F. More support for mothers : a qualitative study on factors affecting immunisation behaviour in Kampala , Uganda. 2011;1–11.

382. Kabagenyi A, Jennings L, Reid A, Nalwadda G, Ntozi J, Atuyambe L. Barriers to male involvement in contraceptive uptake and reproductive health services: A qualitative study of men and women's perceptions in two rural districts in Uganda. Reprod Health [Internet]. 2014;11(1):1–9. Available from: Reproductive Health

383. O.Nyumba T, Wilson K, Derrick CJ, Mukherjee N. The use of focus group discussion methodology: Insights from two decades of application in conservation. Methods Ecol Evol. 2018;9(1):20–32.

384. TCI. Activities and Considerations in Conducting FGDs and KIIs (Qualitative Study). 2020; Available from: https://tciurbanhealth.org/wp-content/uploads/2020/12/A-Qualitative-Study.pdf

385. Regmi K, Naidoo J, Pilkington P. Understanding the Processes of Translation and Transliteration in Qualitative Research. Int J Qual Methods. 2010;9(1):16–26.

386. Keenan KF, Van Teijlingen E. The quality of qualitative research in family planning and reproductive health care. J Fam Plan Reprod Heal Care. 2004;30(4):257–9.

387. Amugsi DA, Lartey A, Kimani E, Mberu BU. Women's participation in household decision-

making and higher dietary diversity: findings from nationally representative data from Ghana. J Health Popul Nutr [Internet]. 2016;35(1):16. Available from: http://dx.doi.org/10.1186/s41043-016-0053-1

388. Abrahams Z, McHiza Z, Steyn NP. Diet and mortality rates in Sub-Saharan Africa: Stages in the nutrition transition. BMC Public Health [Internet]. 2011;11(1):801. Available from: http://www.biomedcentral.com/1471-2458/11/801

389. Oleribe OO, Momoh J, Uzochukwu BSC, Mbofana F, Adebiyi A, Barbera T, et al. Identifying key challenges facing healthcare systems in Africa and potential solutions. Int J Gen Med. 2019;12:395–403.

390. Alehegn MA, Fanta TK, Ayalew AF. Exploring maternal nutrition counseling provided by health professionals during antenatal care follow-up: a qualitative study in Addis Ababa, Ethiopia-2019. BMC Nutr [Internet]. 2021;7(1):20. Available from: http://www.ncbi.nlm.nih.gov/pubmed/34092250

391. Teweldemedhin LG, Amanuel HG, Berhe SA, Gebreyohans G, Tsige Z, Habte E. Effect of nutrition education by health professionals on pregnancy-specific nutrition knowledge and healthy dietary practice among pregnant women in Asmara, Eritrea: A quasi-experimental study. BMJ Nutr Prev Heal. 2021;4(1):181–94.

392. Ningue EAB, Galibois I, Blaney S. Nutrition services by health providers during antenatal consultations in Senegal: A comparison of observed versus self-reported practices. J Glob Heal Reports. 2021;5.

393. Khullar D, Mullangi S, Yu J, Weems K, Shipman SA, Caulfield M, et al. The state of telehealth education at U.S. medical schools. Healthcare. 2021;9(2).

394. Kelly M. Adams, Martin Kohlmeier SHZ. Nutrition in Medicine: Nutrition Education for Medical Students and Residents. In: Nutr Clinical Practice [Internet]. University of Hawaii Press; 2010. p. 471–80. Available from: https://www.degruyter.com/document/doi/10.1515/9780824843816-005/html

395. Sly BC, Weir TL, Cunningham-sabo L, Leisz SJ, Stull VJ, Melby CL. Agriculture : A Community-Engaged Proof-of-Concept Study. 2023;

396. Nguyen PH, Kachwaha S, Tran LM, Sanghvi T, Ghosh S, Kulkarni B, et al. Maternal Diets in India: Gaps, Barriers, and Opportunities. Nutrients [Internet]. 2021 Oct 9;13(10):3534. Available from: https://doi.org/10.3390/nu13103534

397. Kavle JA, Landry M. Addressing barriers to maternal nutrition in low- and middle-income countries: A review of the evidence and programme implications. Matern Child Nutr. 2018;14(1):1–13.

398. Ashorn P, Alho L, Ashorn U, Cheung YB, Dewey KG, Gondwe A, et al. Supplementation of maternal diets during pregnancy and for 6 months postpartum and infant diets thereafter with small-quantity lipid-based nutrient supplements does not promote child growth by 18 months of age in rural malawi: A randomized controlled tria. J Nutr. 2015;145(6):435.

399. Terfa ZG, Nantanda R, Lesosky M, Devereux G, Obasi A, Mortimer K, et al. Household food insecurity, maternal nutrition, environmental risks and infants' health outcomes: Protocol of the IMPALA birth cohort study in Uganda. BMJ Open. 2022;12(3):1–8.

400. Kabir R. How do traditional media access and mobile phone use affect maternal healthcare service use in Bangladesh? Moderated mediation effects of socioeconomic factors. PLoS One [Internet]. 2022 Apr;17(4). Available from: https://www.proquest.com/scholarly-journals/how-

do-traditional-media-access-mobile-phone-use/docview/2656181120/se-2

401. Frank, Matthew G. annis, Watkins M. Multilevel Interventions To Address Health Disparities Show Promise In Improving Population Health Electra. Physiol Behav. 2019;35(80):678–87.

402. Agurs-Collins T, Persky S, Paskett ED, Barkin SL, Meissner HI, Nansel TR, et al. Designing and Assessing Multilevel Interventions to Improve Minority Health and Reduce Health Disparities. Am J Public Health. 2019;109:S86–93.

403. Cleary PD, Gross CP, Zaslavsky AM, Taplin SH. Multilevel interventions: Study design and analysis issues. J Natl Cancer Inst - Monogr. 2012;(44):49–55.

# Appendices

## Appendix 1. Declaration authors-co-authors agreement

**Co-Author(s) Agreement**

**Declaration: Student's contribution to article(s) and agreement of co-author(s)**

I, Aline Uwase, student number 2477108, declare that this Thesis/Dissertation/Research Report is my own work and that I contributed adequately towards research findings published in this article(s) stated below which are included in my Thesis/Dissertation/Research Report.

Signature of student: Date 23/03/2025

Name of Primary Supervisor: Prof Jonathan Levin

Signature of Primary Supervisor Date 24/03/2025

**Agreement by co-authors:** By signing this declaration, the co-authors listed below agree to the use of the article by the student as part of his/her Thesis/Dissertation/Research Report. In cases where the student is not the 1st author of a published article, the primary supervisor must explain (under comments) why the student is entitles to use the paper for his/her degree purposes.

**Article 1: Title:** Dietary diversity and associated factors among pregnant women in the Southern Province of Rwanda: A facility-based cross-sectional study

**name of journal, volume number and page numbers**: PLoS ONE 19(2): e0297112 (Status: Published)

| Author | Name | Signature | Date |
|---|---|---|---|
| 1st author | Aline Uwase | | 23rd March,2025 |
| 2nd author | Etienne Nsereko | Etienne NSEREKO | 24/03/2025 |
| 3rd author | Nirvana Pillay | | 25/03/2025 |
| 4th Author | Jonathan Levin | | 24/03/2025 |

**Article 2: Title:** Factors contributing to the dietary practices of pregnant women in Sub-Saharan African countries: a scoping review.

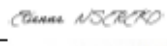
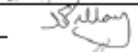
**name of journal, volume number and page numbers:** Panafrican Medical journal,2023 (Status: under review)

| Author | Name | Signature | Date |
|---|---|---|---|
| 1st author | Aline Uwase | | 23rd March,2025 |
| 2nd author | Etienne Nsereko | Etienne NSEREKO | 24/03/2025 |

| | | | |
|---|---|---|---|
| 3rd author | Nirvana Pillay |  | 25/03/2025 |
| 4th author | Jonathan Levin | | 24/03/2025 |
| 5th author | Jane Goudge |  | 24th March 2025 |

**Article 3: Title:** Factors associated with dietary practices among pregnant women in the southern province of Rwanda: a mixed- method study.

**name of journal, volume number and page numbers:** BMC pregnancy and childbirth,2024 (Status: under review)

| Author | Name | Signature | Date |
|---|---|---|---|
| 1st author | Aline Uwase |  | 23rd March,2025 |
| 2nd author | Etienne Nsereko |  | 24/03/2025 |
| 3rd author | Henriette Usanzineza |  | 24/03/2025 |
| 4th author | Sara Jewett |  | 24/03/2025 |
| 5th author | Nirvana Pillay |  | 25/03/2025 |
| 6th author | Jonathan Levin |  | 24/03/2025 |

**Article 4: Title:** Healthy mothers, healthy futures: exploring the influence of healthcare providers and male partners on pregnant women's dietary practices.

**name of journal, volume number and page numbers:** BMC Public Health, 2025 (Status: under review)

| Author | Name | Signature | Date |
|---|---|---|---|
| 1st author | Aline Uwase |  | 23rd March, 2025 |
| 2nd author | Etienne Nsereko |  | 24/03/2025 |
| 3rd author | Henriette Usanzineza |  | 24/03/2025 |
| 4th author | Sara Jewett |  | 24/03/2025 |
| 5th author | Jonathan Levin |  | 24/03/2025 |
| 6th author | Nirvana Pillay |  | 25/03/2025 |

## Appendix 2. Ethical clearances

UNIVERSITY of RWANDA

COLLEGE OF MEDICINE AND HEALTH SCIENCES

DIRECTORATE OF RESEARCH & INNOVATION

*CMHS INSTITUTIONAL REVIEW BOARD (IRB)*

Kigali, 27th /August /2021

**UWASE Aline**
**School of Health Sciences, CMHS, UR**

**Approval Notice: No 287/CMHS IRB/2021**

Your Project Title ***"Maternal Dietary Practices and their Influencing Factors among Pregnant Women Attending Antenatal Care Services in the Southern Province of Rwanda"*** has been evaluated by CMHS Institutional Review Board.

| | | **Involved in the decision** | | |
|---|---|---|---|---|
| | | | No (Reason) | |
| **Name of Members** | **Institute** | Yes | **Absent** | **Withdrawn from the proceeding** |
| Prof Kato J. Njunwa | UR-CMHS | X | | |
| Dr Stefan Jansen | UR-CMHS | X | | |
| Dr Brenda Asiimwe-Kateera | UR-CMHS | X | | |
| Prof Ntaganira Joseph | UR-CMHS | X | | |
| Dr Tumusiime K. David | UR-CMHS | X | | |
| Dr Kayonga N. Egide | UR-CMHS | X | | |
| Mr Kanyoni Maurice | UR-CMHS | | X | |
| Prof Munyanshongore Cyprien | UR-CMHS | X | | |
| Mrs Ruzindana Landrine | Kicukiro district | | X | |
| Dr Gishoma Darius | UR-CMHS | X | | |
| Dr Donatilla Mukamana | UR-CMHS | X | | |
| Prof Kyamanywa Patrick | UR-CMHS | | X | |
| Prof Condo Umutesi Jeannine | UR-CMHS | | X | |
| Dr Nyirazinyoye Laetitia | UR-CMHS | X | | |
| Dr Nkeramihigo Emmanuel | UR-CMHS | | X | |
| Sr Maliboli Marie Josee | CHUK | X | | |
| Dr Mudenge Charles | Centre Psycho-Social | X | | |

After reviewing your protocol during the IRB meeting of where quorum was met and revisions made on the advice of the CMHS IRB submitted on 27th August 2021, **Approval has been granted to your study.**
Please note that approval of the protocol and consent form is valid for **12 months**.

Email: researchcenter@ur.ac.rw P.O Box 3286 Kigali, Rwanda www.ur.ac.rw

UNIVERSITY OF THE
WITWATERSRAND
JOHANNESBURG

R49 Ms A Uwase, Dr N Pillay and Mr E Nsereko

# HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)
## CLEARANCE CERTIFICATE NO. M211046

| | |
|---|---|
| **NAME:** (Principal Investigator) | Ms A Uwase, Dr N Pillay and Mr E Nsereko |
| **DEPARTMENT:** | School of Public Health<br>Medical School<br>University |
| **PROJECT TITLE:** | *Maternal dietary practices and their influencing factors amonst pregnant women attending antenatal care services in the Southern Province of Rwanda* |
| **DATE CONSIDERED:** | 2021/10/29 |
| **DECISION:** | Approved unconditionally |
| **CONDITIONS:** | |
| **NOTE:** | If contact information regarding student study participants is required, please contact the Registrar's office - <Nicoleen.Potgieter@wits.ac.za> |
| **SUPERVISOR:** | Professor J Levin |
| **APPROVED BY:** | Dr CB Penny, Chairperson, HREC (Medical) |
| **DATE OF APPROVAL:** | 2022/01/18 |

**This Clearance Certificate is valid for 5 years from the date of approval. An extension may be applied for.**

---

**DECLARATION OF INVESTIGATORS**

To be completed in duplicate and **ONE COPY** returned to the Research Office secretariat on the 3rd floor, Phillip Tobias Building, Parktown, University of the Witwatersrand, Johannesburg.

I/we fully understand the conditions under which I am/we are authorized to carry out the above-mentioned research and I/we undertake to ensure compliance with these conditions. Should any departure be contemplated from the research protocol as approved, I/we undertake to submit details to the Committee. **I agree to submit a yearly progress report**. When a funder requires annual re-certification, the application date will be one year after the date when the study was initially reviewed. In this case, the study was initially reviewed in **October** and therefore reports and re-certification will be due in the month of **October** each year. Unreported changes to the study may invalidate the clearance given by the HREC (Medical).

Uwase Aline
Signature of Principal Investigator

19/01/2022
Date

## Appendix 3: Approval of the study by the Ministry of Health

Republic of Rwanda

MINISTRY OF HEALTH

**National Health Research Committee**
**Ref: NHRC/2021/PROT/050**

To: **Mrs. UWASE Aline**
**Principal Investigator**

**Scientific Review Approval Notice**

With reference to your request for approval of the Research Protocol entitled; **"Maternal dietary practices and their influencing factors among pregnant women attending antenatal care services in the Southern Province of Rwanda.;**

We are pleased to inform you that, following a thorough review and critical analysis of your proposal **(NHRC/2021/PROT/050)**, National Health Research Committee has approved your Research Protocol.

However,

1) Changes amendments on approach and methodology must be submitted to the NHRC for review and approval to validate the changes.
2) Submission to NHRC of final results using the attached template is mandatory
3) Failure to fulfill the above requirements will result in termination of study

Once again National Health Research Committee appreciates your interest in research.

Your final approval reference number is **NHRC/2021/PROT/050.**

Sincerely,

**Dr. Parfait UWALIRAYE**
**Chairperson of NHRC**

Date: 21/10/2021

## Appendix 4: Approval of the study by Rwanda Biomedical Centre

RWANDA BIOMEDICAL CENTER

A Healthy People, A Wealthy Nation

Kigali, ...4.../..10../ 2021
Ref: No ..1520/RBC/2021

*Maternal,Child and Community Health Division*

**To the chair of National Health Research Committee**
**KIGALI**

**Re: Approval of Research study "Maternal dietary practices and their influencing factors among pregnant women attending antenatal care services in the Southern Province of Rwanda"**

This is to confirm that the Division of Maternal, Child and Community Health under RBC has approved the research study **"Maternal dietary practices and their influencing factors among pregnant women attending antenatal care services in the Southern Province of Rwanda"** that will be submitted to both RNEC and NHRC in the coming days.

This project has the potential to offer substantial benefit to the Rwandan population especially the component on nutrition of pregnant women.

Sincerely,

**Dr. Felix SAYINZOGA**
**MCCH Division Manager**

**Cc:**
- **Aline UWASE**

## Appendix 5: Approval of PhD thesis title

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

Private Bag 3 Wits, 2050
Fax: 027117172119
Tel: 02711 7172076

Reference: Mrs Sandra Benn
E-mail: sandra.benn@wits.ac.za

30 January 2024
Person No: 2477108
PAG

Mrs A Uwase
College of Medicine and Health Sciences
University of Rwanda
KG 11 Ave
Kimironko/ Gasabo District
3286 KIGALI
Rwanda

Dear Mrs Aline Uwase

**Doctor of Philosophy: Approval of Title**

We have pleasure in advising that your proposal entitled *Maternal dietary practices and their influencing factors among pregnant women attending antenatal care services in the Southern Province of Rwanda* has been approved. Please note that any amendments to this title have to be endorsed by the Faculty's higher degrees committee and formally approved.

Yours sincerely

Mrs Sandra Benn
Faculty Registrar
Faculty of Health Sciences

## Appendix 6: Approval of change of the PhD thesis title

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

Private Bag 3 Wits, 2050
Fax: 027117172119
Tel: 02711 7172076

Reference: Mrs Sandra Benn
E-mail: sandra.benn@wits.ac.za

21 June 2024
Person No: 2477108
TAA

Mrs A Uwase
College of Medicine and Health Sciences
University of Rwanda
KG 11 Ave
Kimironko/ Gasabo District
3286 KIGALI
Rwanda

Dear Mrs Aline Uwase

**Doctor of Philosophy: Change of title of research**

I am pleased to inform you that the following change in the title of your Thesis for the degree of **Doctor of Philosophy** has been approved:

| | |
|---|---|
| From: | **Maternal dietary practices and their influencing factors among pregnant women attending antenatal care services in the Southern Province of Rwanda** |
| To: | **Factors associated with maternal dietary practices among pregnant women attending antenatal care services in the Southern province of Rwanda** |

Yours sincerely

Mrs Sandra Benn
Faculty Registrar
Faculty of Health Sciences

## Appendix 7: Information sheets and consent forms (English version)

### 1. Study Information sheet for pregnant women

**Introduction**

**Greetings,**

My name is Aline UWASE, a Ph.D. student at the University of Witwatersrand (Johannesburg) in the school of Public Health. I'm doing research to understand the factors influencing the dietary practices of pregnant women and this research study will be supervised by Prof Jonathan Levin, Dr Nirvana Pillay and Dr Etienne Nsereko. This information sheet helps you understand the study and decide whether you would like to participate. If you agree to take part in this study, you will confirm that you understand this study and voluntarily decide to participate by signing this document. A copy of the signed document will be given to you to keep. This interview will be recorded and we request you to sign a consent for recording if you agree with it. For further information, feel free to contact me.

**Purpose of the study**

We are interested in identifying the factors influencing the dietary practices among pregnant women. We think that dietary practices govern the nutritional status of the pregnant woman and are linked with pregnancy outcomes. Therefore, we want to assess the actual dietary practices and their associated factors to see how the findings from this study could help designing a nutritional intervention model that will contribute to prevent malnutrition among pregnant women. In addition, the findings from this study will help to inform the policy formulation in terms of nutrition of pregnant women.

**Invitation to consent**

We are inviting you to take part in a research study. However, participating in a research study is a personal choice. Please read or listen carefully all the information about this study and decide to participate or not. You can seek advice from your family or friends if you want. In addition, you can request clarifications from the researchers.

**Why am I chosen to be part of this research?**

You are invited to be part of this study because you are pregnant in second trimester or above, healthy (self-reported) and have lived in this community for at least 12 months.

**What am I expected to do if I take part in this research study?**

The following procedures will occur: Two interviewers will approach you in antenatal care services section of health center. They will provide you all the information about this study and request you to sign a consent form for participating in the study and to be tape recorded. After that, the same interviewers will take anthropometric measurements including mid-upper arm circumference (MUAC) from you. Then, you will participate in the interview that focuses on your dietary practices and their enabling factors such as socioeconomic, cultural, health system, policy

and nutritional knowledge. These interviews will take at most one hour and will be carried out in a quiet place at the health centre. If you are diagnosed with malnutrition, you will be provided with nutritional counselling by one of the trained research team member and will be directly refered to the Antenatal care services line manager of your respective health center for further management and care. In case you report any kind of physical abuse or gender-based violence (GBV) you will be advised to call the anti-GBV service on 3512 for support.

**What are the risks of participating in this research?**

Participating in this study has no risks. However, during interview, you may feel uncomfortable with some questions and do not want to talk about them. In this event, you are not forced to provide information and you are free to not respond.

**What are the benefits of participating in this study?**

Participating in this study will not benefit you directly. But, the information you give could help health policy makers learn more about appropriate interventions for improving dietary practices of pregnant women.

**Voluntary consent**

Participation is entirely voluntary. If you do not opt for being part of this study, there will be no consequence to you or your unborn baby. You will have your consistent benefits, and you can still get your care from health facilities as usual.

**Privacy and anonymity**

The collected information will be kept private and confidential. If the findings from this study are published or presented at scientific conferences, your name andother personal means of identifications will not be mentioned. In addition, the data collection tools will use codes for identification instead of names.

**Confidentiality**

The confidentiality of the information you provide will be ensured as much as possible. Interviews will take place in a quiet and secured room containing only the researcher and the participant. Your consent form and your information will be kept in a research record created for you and they will be only accessible for the researchers.

**Will I be paid?**

There will be no payment for participating in the study. However, refreshments will be provided during the interview.

**Who can respond to my questions about this research?**

You can contact the researchers about any questions you should have about this study**. contact Mrs. Aline UWASE, School of health sciences,** University of Rwanda College of Medicine and Health Sciences, telephone: +250 788 642 136, email: alinemunyaneza1@gmail.com or auwase38@ur.ac.rw.

You can also contact my supervisors, Prof Jonathan Levin, First Floor Room 151, Division of Epidemiology and Biostatistics, School of Public Health Johannesburg, South Africa, email: Jonathan.Levin@wits.ac.za.

**Outputs of the research**

The results of this research will be communicated to you at health centers. In addition, the findings will be shared with different policy makers in Rwanda. Furthermore, the results will help the principal investigator to develop a nutrition interventional model to prevent malnutrition among pregnant women. Moreover, the results will be published as academic work in scientific journals. Finally, the results will be presented in a thesis that will be submitted to the University of the Witwatersrand, Johannesburg, South Africa for assessment. As per HPCSA guidelines, we will preserve the records of the data for a minimum of two years after the study results have been published or six years if there is no publication.

**Contact details of the Research Ethics Committees**

This research study was approved by the Institutional Review Board (IRB) of the University of Rwanda, College of Medicine and Health Sciences and University of the Witwatersrand HREC (Human Research Ethics Committee. For IRB, you can contact the chairperson Professor Jonas Njunwa Kato at njunwakato@gmail.com or call him at +250 788490522. For HREC which is an independent committee established to help protect the rights of research participants, please contact the Chairperson of this Committee who is Professor Clement Penny, who may be contacted on telephone number 011 717 2301, or by e-mail on Clement.Penny@wits.ac.za. The telephone numbers for the Committee secretariat are 011 717 2700/1234 and the e-mail addresses are Zanele.Ndlovu@wits.ac.za and Rhulani.Mukansi@wits.ac.za.

**What will happen if the participant does not stay up to the end of the study?**

If the participant does not carry on with the study, all information collected with him/her will be destroyed and will not be used for final reporting of results.

**Sponsor of the research**

This research will be supported by the Consortium for Advanced Research Training in Africa (CARTA). CARTA is jointly led by the African Population and Health Research Center and the University of the Witwatersrand and funded by the Carnegie Corporation of New York (Grant No--B 8606.R02), Sida (Grant No:54100029), the DELTAS Africa Initiative (Grant No: 107768/Z/15/Z). The DELTAS Africa Initiative is an independent funding scheme of the African Academy of Sciences (AAS)'s Alliance for Accelerating Excellence in Science in Africa (AESA) and supported by the New Partnership for Africa's Development Planning and Coordinating Agency (NEPAD Agency) with funding from the Wellcome Trust (UK) (Grant No: 107768/Z/15/Z) and the UK government.

## 2. Study information sheet for male partners

**Introduction**

**Greetings,**

My name is Aline UWASE, a Ph.D. student at the University of Witwatersrand (Johannesburg) in the school of Public Health. I'm doing research to understand the factors influencing the dietary practices of pregnant women and this research study will be supervised by Prof Jonathan Levin, Dr Nirvana Pillay and Dr Etienne Nsereko. This information sheet helps you understand the study and decide whether you would like to participate. If you agree to take part in this study, you will confirm that you understand this study and voluntarily decide to participate by signing this document. A copy of the signed document will be given to you to keep. This interview will be recorded and we request you to sign a consent for the interview to be recorded if you are in agreement with this. For further information, feel free to contact me.

**Purpose of the study**

We are interested in identifying the factors influencing the dietary practices among pregnant women. We think that dietary practices govern nutritional status of the pregnant woman and are linked with pregnancy outcomes. Therefore, we want to assess the actual dietary practices and their associated factors to see how the findings from this study could help me to design a nutrition intervention model that will contribute to prevent malnutrition among pregnant women. In addition, the findings from this study will help to inform the policy formulation in terms of nutrition of pregnant women.

**Invitation to consent**

We are inviting you to take part in a research study. However, participating in a research study is a personal choice. Please read or listen carefully all the information about this study and decide to participate or not. You can seek advice from your family or friends if you want. In addition, you can request clarifications from the researchers.

**Why am I chosen to be part of this research?**

You are invited to take part in this study because your female partner is pregnant. As a household head, you can potentially influence the dietary practices of your pregnant woman and know more about other enabling factors and challenges of maternal dietary practices during pregnancy.

**What am I expected to do if I take part in this research study?**

The following procedures will occur: Either at the health centre or some other community centre, depending on your preference, you will meet two interviewers who will provide you all the information concerning this study and you will be requested to sign a consent form to be part of the study and to be tape recorded. After that you will participate in the focus group

discussions (FGDs) with the interviewers and other male partners that focuses on dietary practices of pregnant women and your involvement in supporting them. In addition, you will be required to keep the information shared by group members confidential. These FGDs will take at most one hour and will be audio recorded.

**What are the risks of participating in this research?**

Participating in this study has no risks. However, during interview, you may feel uncomfortable with some questions and may not want to talk about them. In this event, you are not forced to provide information and you are free to not respond.

**What are the benefits of participating in this study?**

Participating in this study will not benefit you directly. But, the information you give could help health policy makers learn more about appropriate interventions for improving dietary practices of pregnant women.

**Voluntary consent**

Participation is entirely voluntary. If you do not choose to be part of this study, there will be no consequence to you or your pregnant wife. You will have your consistent benefits, and you can still get your care from health facilities as usual.

**Privacy and anonymity**

The collected information will be kept private and confidential. If the findings from this study are published or presented at scientific conferences, your name and other personal identifications will not be mentioned. Besides, the data collection tools will use codes for identification instead of names.

**Confidentiality**

The confidentiality of the information you provide will be ensured as much as possible. Interviews will take place in a quiet and secured room containing only the researcher and the participant. Your consent form and your information will be kept in a research record created for you and they will be only accessible for the researchers.

**Will I be paid?**

There will be no payment for participating in the study. However, refreshments will be provided to you during interview.

**Who can respond to my questions about this research?**

You can contact the researchers about any questions you should have about this study**. contact Mrs. Aline UWASE, School of health sciences,** University of Rwanda College of Medicine and Health Sciences, telephone: +250 788 642 136, email: alinemunyaneza1@gmail.com or auwase38@ur.ac.rw. You can also contact my supervisors, Prof Jonathan Levin, First Floor Room 151, Division of Epidemiology and Biostatistics, School of Public Health Johannesburg, South Africa, email: Jonathan.Levin@wits.ac.za.

**Outputs of the research**

The results of this research will be communicated to you at health centers. In addition, the findings will be shared with different policy makers in Rwanda. Furthermore, the results will help the principal investigator to develop a nutrition interventional model to prevent malnutrition among pregnant women. Moreover, the results will be published as academic work in scientific journals. Finally, the results will be presented in a thesis that will be submitted to the University of the Witwatersrand, Johannesburg, South Africa for assessment. As per HPCSA guidelines, we will preserve the audio records for a minimum of two years after the study results have been published or six years if there is no publication.

**Contact details of the Research Ethics Committees**

This research study was approved by the Institutional Review Board (IRB) of the University of Rwanda, College of Medicine and Health Sciences and university of the Witwatersrand HREC (Human Research Ethics Committee. For IRB, you can contact the chairperson Professor Jonas Njunwa Kato at njunwakato@gmail.com or call him at +250 788490522; or Professor Stefan Johnson. For HREC which is an independent committee established to help protect the rights of research participants; please contact the Chairperson of this Committee who is Professor Clement Penny, who may be contacted on telephone number 011 717 2301, or by e-mail on Clement.Penny@wits.ac.za. The telephone numbers for the Committee secretariat are 011 717 2700/1234 and the e-mail addresses are Zanele.Ndlovu@wits.ac.za and Rhulani.Mukansi@wits.ac.za.

**What will happen if the participant does not stay up to the end of the study?**

If the participant does not carry on with the study, all information collected concerning him/her will be destroyed and will not be used for final reporting of results.

**Sponsor of the research**

This research will be supported by the Consortium for Advanced Research Training in Africa (CARTA). CARTA is jointly led by the African Population and Health Research Center and the University of the Witwatersrand and funded by the Carnegie Corporation of New York (Grant No--B 8606.R02), Sida (Grant No:54100029), the DELTAS Africa Initiative (Grant No: 107768/Z/15/Z). The DELTAS Africa Initiative is an independent funding scheme of the African Academy of Sciences (AAS)'s Alliance for Accelerating Excellence in Science in Africa (AESA) and supported by the New Partnership for Africa's Development Planning and Coordinating Agency (NEPAD Agency) with funding from the Wellcome Trust (UK) (Grant No: 107768/Z/15/Z) and the UK government.

### 3. Study Information sheet for health care providers

**Introduction**

**Greetings,**

My name is Aline UWASE, a Ph.D. student at the University of Witwatersrand (Johannesburg) in the school of Public Health. I'm doing research to understand the factors influencing the dietary practices

of pregnant women and this research study will be supervised by Prof Jonathan Levin, Dr Nirvana Pillay and Dr Etienne Nsereko. This information sheet helps you understand the study and decide whether you would like to participate. If you agree to take part in this study, you will confirm that you understand this study and voluntary decide to participate by signing on this document and a copy to keep will be given to you. This interview will be recorded and we request you to sign a consent for recording if you agree with it. For further information, feel free to contact me.

**Purpose of the study**

We are interested in identifying the factors influencing the dietary practices among pregnant women. We think that dietary practices govern the nutritional status of the pregnant woman and are linked with pregnancy outcomes. Therefore, we want to assess the actual dietary practices and their associated factors to see how the findings from this study could help designing a nutritional intervention model that will contribute to prevent malnutrition among pregnant women. In addition, the findings from this study will help to inform the policy formulation in terms of nutrition of pregnant women.

**Invitation to consent**

We are inviting you to take part in a research study. However, participating in a research study is a personal choice. Please read carefully all the information about this study and decide to participate or not. You can seek advice from your family or friends if you want. In addition, you can request clarifications from the researchers.

**Why am I chosen to be part of this research?**

You are invited to take part in this study because you work in ANC services. As a health care provider who is always with the pregnant women, you could know some information about their nutrition and some challenges you meet when providing them nutritional support

**What am I expected to do if I take part in this research study?**

If you agree, you will sign a consent for participating in the study and being tape recorded. Then you will sit for an In-Depth Interview with our interviewers in a quiet room. This interview will take at most one hour

**What are the risks of participating in this research?**

Participating in this study has no risks. However, during interview, you may feel uncomfortable with some questions and do not want to talk about them. In this event, you are not forced to provide information and you are free to not respond.

**What are the benefits of participating in this study?**

Participating in this study will not benefit you directly. But, the information you give could help health policy makers learn more about appropriate interventions for improving dietary practices of pregnant women.

**Voluntary consent**

Participation is entirely voluntary. If you do not opt for being part of this study, there will be no consequence to you. You will have your consistent benefits, and you will not lose your job.

**Privacy and anonymity**

The collected information will be kept private and confidential. If the findings from this study are published or presented at scientific conferences, your name and other personal identifications will not be mentioned. In addition, the data collection tools will use codes for identification instead of names.

**Confidentiality**

The confidentiality of the information you provide will be ensured as much as possible. Interviews will take place in a quiet and secured room containing only the researcher and the participant. Your consent form and your information will be kept in a research record created for you and they will be only accessible for the researchers.

**Will I be paid?**

There will be no payment for participating in the study. However, refreshments will be provided during interview.

**Who can respond to my questions about this research?**

You can contact the researchers about any questions you should have about this study**. contact Mrs. Aline UWASE, School of health sciences,** University of Rwanda College of Medicine and Health Sciences, telephone: +250 788 642 136, email: alinemunyaneza1@gmail.com or auwase38@ur.ac.rw. You can also contact my supervisors, Prof Jonathan Levin, First Floor Room 151, Division of Epidemiology and Biostatistics, School of Public Health Johannesburg, South Africa, email: Jonathan.Levin@wits.ac.za.

**Outputs of the research**

The results of this research will be communicated to you at health centers. In addition, the findings will be shared with different policy makers in Rwanda. Furthermore, the results will help the principal investigator to develop a nutritional interventional model to prevent malnutrition among pregnant women. Moreover, the results will be published as academic work in scientific journals. Finally, the results will be presented in a thesis that will be submitted to the University of the Witwatersrand, Johannesburg, South Africa for assessment. As per HPCSA guidelines, we will preserve the audio records for a minimum of two years after the study results have been published or six years if there is no publication.

**Contact details of the Research Ethics Committees**

This research study was approved by the Institutional Review Board (IRB) of the University of Rwanda, College of Medicine and Health Sciences and university of the Witwatersrand HREC (Human Research Ethics Committee. For IRB, you can contact the chairperson Professor Jonas Njunwa Kato at njunwakato@gmail.com or call him at +250 788490522; or Professor Stefan Johnson. For HREC which is an independent committee established to help protect the rights of research participants; please contact the Chairperson of this Committee who is Professor Clement Penny, who may be contacted on telephone number 011 717 2301, or by e-mail on Clement.Penny@wits.ac.za. The telephone numbers

for the Committee secretariat are 011 717 2700/1234 and the e-mail addresses are Zanele.Ndlovu@wits.ac.za and Rhulani.Mukansi@wits.ac.za.

**What will happen if the participant does not stay up to the end of the study?**

If the participant does not carry on with the study, all information collected with him/her will be destroyed and will not be used for final reporting of results.

**Sponsor of the research**

This research will be supported by the Consortium for Advanced Research Training in Africa (CARTA). CARTA is jointly led by the African Population and Health Research Center and the University of the Witwatersrand and funded by the Carnegie Corporation of New York (Grant No--B 8606.R02), Sida (Grant No:54100029), the DELTAS Africa Initiative (Grant No: 107768/Z/15/Z). The DELTAS Africa Initiative is an independent funding scheme of the African Academy of Sciences (AAS)'s Alliance for Accelerating Excellence in Science in Africa (AESA) and supported by the New Partnership for Africa's Development Planning and Coordinating Agency (NEPAD Agency) with funding from the Wellcome Trust (UK) (Grant No: 107768/Z/15/Z) and the UK government

## 4. Informed consent form to be part of the study for all participants

**Factors associated with maternal dietary practices among pregnant women attending antenatal care services in the Southern Province of Rwanda**

Author: Aline UWASE

Position: Ph.D. candidate

Tel: +250 788 642 136

I, ……., agree to participate in this research project. The research has been explained to me and I understand what my participation will involve. I agree to the following:

(Please circle the relevant options below).

| | | |
|---|---|---|
| I have read/listen information on the research that I am going to participate in. | YES | NO |

| | | |
|---|---|---|
| I have had the time to ask clarifications to some questions and the responses given to me were satisfactory. | YES | NO |
| I decide voluntarily to participate in this study | YES | NO |
| I agree that my participation will remain anonymous | YES | NO |
| I agree that the researcher may use anonymous quotes in his / her research report. | Yes | NO |
| I agree that the interview may be tape recorded | YES | NO |
| I agree that the information I provide may be used anonymously after this project has ended, for academic purposes by other researchers, subject to their own ethics clearance being obtained. | YES | NO |

…… signature/Fingerprint

…… name of participant

…… date

…… signature

…… name of person seeking consent

…… date

5. **Informed consent for tape recording (all participants)**

**Factors associated with maternal dietary practices among pregnant women attending antenatal care services in the Southern Province of Rwanda**

Author: Aline UWASE

Position: Ph.D. candidate

Tel: +250 788 642 136

I would like to seek your permission to record the process of the interview/FGD on tape. The recording is to ensure that all that the discussion during the interview/FGD session is captured. The tape will be kept rigorously confidential and will be destroyed after two years in case of publication or six years in the absence of publication. Do you agree to be tape recorded during the course of the interview/FGD?

Yes……... No…….

Interviewer's statement

I…… Date: …….

Hereby confirm that I have provided clear information about the objective of tape recording and I have got participant's consent to record.

Interviewee's Declaration

I hereby agree to be tape recorded during the course of the interview/ FGD.

Name of Respondent: …….....

Signature /Finger print of Respondent: …… Date: .....

Name of Interviewer: …….....

Signature of Interviewer: ……...Date: ……...

6. **Confidentiality agreement for Focus-group discussion**

**Factors associated with maternal dietary practices among pregnant women attending antenatal care services in the Southern Province of Rwanda**

**Author: Aline UWASE**

**Position: Ph.D. candidate**

**Tel: +250 788 642 136**

By signing this statement, I am indicating my understanding of my responsibilities to guard the confidentiality of this focus group discussion.

Names of the participant:

Signature of the participant:

Date:

## Appendix 8: Information sheets and consent forms (Kinyarwanda version)

**1.ABAGORE BATWITE**

**Gusesengura imirire y'abagore batwite n'impamvu nyamukuru mubabyeyi baje kwimisha inda mu bigonderabuzima by'intara y'amagepfo mu Rwanda.**

**Igice cya mbere: Amakuru**

Nitwa Aline Uwase, umunyeshuri muri kaminuza ya Witwatersrand Johannesburg/ Afurika y'epfo mu ishuri ryubuzima rusange. Ndigukora ubu bushakashatsi kugira ngo nzabone impamyabumenyi yikirenga mu buzima rusange bw'umwana n'umugore utwite. Buzaba buhagarariwe na Prof Jonathan Levin, Dr Nirvana PILLAY bo muri Afurika y'epfo na Bwana Etienne Nsereko wo mu Rwanda. Uru rupapuro rwamakuru rugufasha gufata umwanzuro wo kuba wagira uruhare muri ubu bushakashatsi. Nuhitamo kugira uruhare muri ubu bushakashatsi, urasabwa gushyira umukono kuriyi nyandiko kugirango wemeze ko wumva ubushakashatsi kandi wemeye kwitabira kandi Uzahabwa kopi yo kubika. Iki kiganiro kizatwa amajwi, turagusaba gusinya uruhushya rwo gufata amajwi niba ubyemera. Niba ufite ikibazo, ntutinye kumbaza.

**Intego yubushakashatsi**

Dushishikajwe no kumenya ibintu bigira uruhare ku mirire y'abagore batwite. Twibwira ko imirire y’umugore utwite ifitanye isano n’ubuzima bwumubyeyi ndetse n’umwana atwite. Turashaka rero gusuzuma imiterere yimirire y’abagore batwite n’ibintu bifitanye isano nayo kugirango tumenyeshe ishyirwaho rya politiki mubijyanye nimirire yabagore batwite.

**Ubutumire bwo kugira uruhare mubushakashatsi**

Ubushakashatsi burimo abantu bahitamo kubigiramo uruhare. Nyamuneka fata umwanya wawe wo gusoma / kumva amakuru yose yerekeye ubu bushakashatsi hanyuma ufate icyemezo cyo kwitabira. Ushobora kuganira ku cyemezo cyawe n'umuryango wawe cyangwa inshuti niba ubishaka. Niba ufite ikibazo, ushobora kandi kubaza abashakashatsi.

**Kuki natoranijwe kugirango mbe muri ubu bushakashatsi?**

Urasabwa kugira uruhare muri ubu bushakashatsi kuko utwite/ umugore wawe atwite/ Wita kubagore batwite.

**Bizagenda bite ndamutse nemeye kugira uruhare muri ubu bushakashatsi?**

Niba wemeye, ibi bikurikira bizabaho: Mugihe uri ku kigo nderabuzima uzasabwa kwitabira ikiganiro cyibanda kumirire yumugore utwite, ibiyigiramo uruhare ndetse nuruhare rwawe bwite. Iki kiganiro kiratwara byibuze isaha imwe kandi turagikorera ku kigo nderabuzima ahantu hacecetse.

**Ni izihe ngaruka nshobora kwitega kuba mu bushakashatsi?**

Kwitabira ubu bushakashatsi nta ngaruka. Ariko, mugihe cy’ibazwa, ushobora kumva utishimiye ibibazo bimwe na bimwe kandi ntushake kubiganiraho. Muriicyo gihe, ntabwo uhatirwa gutanga amakuru kandi ufite uburenganzira bwo kudasubiza.

**Hari inyungu zo kugira uruhare muri ubu bushakashatsi?**

Nta nyungu zako kanya kuri wowe mu kwitabira ubu bushakashatsi. Nyamara, amakuru utanga ashobora gufasha abashinzwe politiki yubuzima kumenya byinshi kubijyanye nuburyo bukwiye bwo kunoza imikorere yimirire yabagore batwite.

**Kwemera kubushake**

Ufite uburenganzira busesuye bwo guhitamo niba witabira cg utitabira ubu bushakashatsi. Kubugiramo uruhare ni ubushake rwose. Niba uhisemo kutaba muri ubu bushakashatsi, nta gihano kizafatirwa wowe cyangwa umwana wawe utwite. Ntabwo uzatakaza inyungu zawe zisanzwe, kandi ushobora kubona ubuvuzi bwawe mu kigo nderabuzima nkuko bisanzwe.

**Amabanga no kutamenyekanisha amazina**

Tuzakora ibishoboka byose kugirango amakuru yihariye yakusanyirijwe muri ubu bushakashatsi agirwe ibanga. Niba amakuru avuye muri ubu bushakashatsi yatangajwe cyangwa yatanzwe mu nama

zubumenyi, amazina yawe bwite ntabwo azakoreshwa. Byongeye kandi, ibikoresho byo gukusanya amakuru bizakoresha kode aho gukoresha amazina.

**Ibanga**

Uruhare mu bushakashatsi rushobora kubamo gutakaza ubuzima bwite, ariko amakuru akwerekeye azabikwa mu ibanga bishoboka. Ibiganiro bizabera mucyumba gituje kandi gifite umutekano kirimo abashakashatsi gusa nabitabiriye. Ububiko bw'Ubushakashatsi buzashyirwaho kubera wowe. Urupapuro rwuko wemeye kugira uruhare mubushakashatsi hamwe namakuru yawe azashyirwa muri ubwo bubiko kandi abashakashatsi bonyine ni bo bazabugeraho.

**Nzahembwa kuba naragize uruhare muri ubu bushakashatsi?**

Ntabwo hazishyurwa amafaranga yo kwitabira ubu bushakashatsi. Ariko uzahabwa icupa ry'amazi cg umutobe igihe uzaba uri mu kiganiro

**Ninde ushobora gusubiza ibibazo byanjye kubyerekeye ubu bushakashatsi?**

Ushobora kuvugana nabashakashatsi kubibazo byose, impungenge, cyangwa ibibazo ufite kuri ubu bushakashatsi hamagara Madamu Aline UWASE ukora mu Ishuri Rikuru ry'Ubuvuzi n'ubumenyi bw'ubuzima, Rwanda, telefone: +250 788 642 136, imeri: alinemunyaneza1@gmail.com. Ushobora kandi kwandikira n'abayobozi banjye, Prof Jonathan Levin, uri muri Afrika yepfo, imeri: Jonathan.Levin@wits.ac.za.

**Ibizava mu bushakashatsi**

Ibizava mu bushakashatsi bizabimenyeshwa ku bigo nderabuzima. Byongeye kandi, ibizavamo bizasangizwa n'abafata ibyemezo batandukanye mu Rwanda. Nanone, ibisubizo bizafasha ushinzwe ubushakashatsi nyamukuru, guhanga ibikorwa bizafasha gukumira imirire mibi ku bagore batwite. Byongeye kandi, ibisubizo bizatangazwa nkibikorwa byamasomo mubinyamakuru bya siyansi. Hanyuma, ibisubizo bizahuzwa mugitabo kizashyikirizwa kaminuza ya Witwatersrand, Johannesburg, Afurika yepfo kugira ngo gisuzumwe.

**Aho wabariza uramutse ukeneye amakuru kubareberera imyitwarire yubushakashatsi**

Wahamagara uhagarariye ikigo gishinzwe gusuzuma (IRB) cya kaminuza y'u Rwanda, Ishuri Rikuru ry'Ubuvuzi n'ubumenyi bw'ubuzima Professor Jonas Njunwa Kato kuri njunwakato@gmail.com cyangwa ukamuhamagara kuri +250 788490522; cyangwa umwungirije kuri **0783 340 040**. Ushobora kandi guhamagara uhagarariye Komite ishinzwe imyitwarire y'ubushakashatsi bw'abantu muri Afurika y'epfo kuri Tel: (011) 717 2229.

**Bizagenda bite mugihe uwitabiriye ubushakashatsi adakomeje?**

Niba uwitabiriye adakomeje ubushakashatsi, amakuru yose yakusanyirijwe hamwe azasenywa kandi ntazakoreshwa mu gutanga raporo yanyuma.

**Igice cya II: Icyemezo cyo kubyemera**

Nasomye / numvise amakuru yubushakashatsi ngiye kwitabira. Nagize amahirwe yo kubaza ibibazo kandi ibibazo byose nabajije byashubijwe ndanyurwa. Nemeye kubushake kugira uruhare muri ubu bushakashatsi

Izina ryuwitabiriye_____

Umukono w'uwitabiriye _____

Itariki _____

Umunsi / ukwezi / umwaka

***Umutangabuhamya (Niba uwitabiriye atazi gusoma no kwandika)***

Niboneye gusoma neza urupapuro rwabemera kugira uruhare mubushakashatsi, kandi umuntu ndeberera yagize amahirwe yo kubaza ibibazo. Ndemeza ko ku giti cye yatanze uburenganzira ntagahato.

izina ry'umutangabuhamya_____

Isinya y'umutangabuhamya…….

Igikumwe cyuwitabiriye

**ABAGABO BAFITE ABAGORE BATWITE**

**Gusesengura imirire y'abagore batwite n'impamvu nyamukuru mubabyeyi baje kwimisha inda mu bigonderabuzima by'intara y'amagepfo mu Rwanda.**

**Igice cya mbere: Amakuru**

Nitwa Aline Uwase, umunyeshuri muri kaminuza ya Witwatersrand Johannesburg/ Afurika y'epfo mu ishuri ryubuzima rusange. Ndigukora ubu bushakashatsi kugira ngo nzabone impamyabumenyi yikirenga mu buzima rusange bw'umwana n'umugore utwite. Buzaba buhagarariwe na Prof Jonathan Levin, Dr Nirvana PILLAY bo muri Afurika y'epfo na Bwana Etienne Nsereko wo mu Rwanda. Uru rupapuro rwamakuru rugufasha gufata umwanzuro wo kuba wagira uruhare muri ubu bushakashatsi. Nuhitamo kugira uruhare muri ubu bushakashatsi, urasabwa gushyira umukono kuriyi nyandiko kugirango wemeze ko wumva ubushakashatsi kandi wemeye kwitabira kandi Uzahabwa kopi yo kubika. Iki kiganiro kizatwa amajwi, turagusaba gusinya uruhushya rwo gufata amajwi niba ubyemera. Niba ufite ikibazo, ntutinye kumbaza.

**Intego yubushakashatsi**

Dushishikajwe no kumenya ibintu bigira uruhare ku mirire y'abagore batwite. Twibwira ko imirire y'umugore utwite ifitanye isano n'ubuzima bwumubyeyi ndetse n'umwana atwite. Turashaka rero gusuzuma imiterere yimirire y'abagore batwite n'ibintu bifitanye isano nayo kugirango tumenyeshe ishyirwaho rya politiki mubijyanye nimirire yabagore batwite.

**Ubutumire bwo kugira uruhare mubushakashatsi**

Ubushakashatsi burimo abantu bahitamo kubigiramo uruhare. Nyamuneka fata umwanya wawe wo gusoma / kumva amakuru yose yerekeye ubu bushakashatsi hanyuma ufate icyemezo cyo kwitabira. Ushobora kuganira ku cyemezo cyawe n'umuryango wawe cyangwa inshuti niba ubishaka. Niba ufite ikibazo, ushobora kandi kubaza abashakashatsi.

**Kuki natoranijwe kugirango mbe muri ubu bushakashatsi?**

Urasabwa kugira uruhare muri ubu bushakashatsi kuko umugore wawe atwite ukaba waduha amakuru ajyanye n'imirire ye nuko ubimufashamo.

**Bizagenda bite ndamutse nemeye kugira uruhare muri ubu bushakashatsi?**

Niba wemeye, ibi bikurikira bizabaho: Mugihe uri ku kigo nderabuzima cg mugace kiwanyu uzasabwa kwitabiro ikiganiro hamwe nabandi bagabo bagenzi bawe bafite abagore batwite. Tuzaganira ku mirire yabagore batwite nicyo mubafasha ngo imere neza. Ikindi tuzagusaba kugira ibanga amakuru azatangwa na bagenzi bawe. Iki kiganiro bizatwara byibuze isaha imwe kandi kizabera ahantu hacecetse.

**Ni izihe ngaruka nshobora kwitega kuba mu bushakashatsi?**

Kwitabira ubu bushakashatsi nta ngaruka bizakugiraho. Ariko, mugihe cy'ibazwa, ushobora kumva utishimiye ibibazo bimwe na bimwe kandi ntushake kubiganiraho. Muriicyo gihe, ntabwo uhatirwa gutanga amakuru kandi ufite uburenganzira bwo kudasubiza.

**Hari inyungu zo kugira uruhare muri ubu bushakashatsi?**

Nta nyungu zako kanya kuri wowe mu kwitabira ubu bushakashatsi. Nyamara, amakuru utanga ashobora gufasha abashinzwe politiki yubuzima kumenya byinshi kubijyanye nuburyo bukwiye bwo kunoza imikorere yimirire yabagore batwite.

**Kwemera kubushake**

Ufite umudendezo wo guhitamo niba utitabira ubu bushakashatsi. Kubugiramo uruhare ni ubushake rwose. Niba uhisemo kutaba muri ubu bushakashatsi, nta gihano kuri wowe cyangwa umugore wawe ndetse n'umwana wawe utaravuka. Ntabwo uzatakaza inyungu zawe zisanzwe, kandi ushobora kubona ubuvuzi bwawe mu bigo nderabuzima nkuko bisanzwe.

**Amabanga no kutamenyekanisha amazina**

Tuzakora ibishoboka byose kugirango amakuru yihariye yakusanyirijwe muri ubu bushakashatsi agirwe ibanga. Niba amakuru avuye muri ubu bushakashatsi yatangajwe cyangwa yatanzwe mu nama zubumenyi, amazina yawe bwite ntabwo azakoreshwa. Byongeye kandi, ibikoresho byo gukusanya amakuru bizakoresha kode aho gukoresha amazina.

**Ibanga**

Uruhare mu bushakashatsi rushobora kubamo gutakaza ubuzima bwite, ariko amakuru akwerekeye azabikwa mu ibanga bishoboka. Ibiganiro bizabera mucyumba gituje kandi gifite umutekano kirimo abashakashatsi gusa nabitabiriye. Ububiko bw'Ubushakashatsi buzashyirwaho kubera wowe. Urupapuro rwuko wemeye kugira uruhare mubushakashatsi hamwe namakuru yawe azashyirwa muri ubwo bubiko kandi abashakashatsi bonyine ni bo bazabugeraho.

**Nzahembwa kuba naragize uruhare muri ubu bushakashatsi?**

Ntabwo hazishyurwa amafaranga yo kwitabira ubu bushakashatsi.

**Ninde ushobora gusubiza ibibazo byanjye kubyerekeye ubu bushakashatsi?**

Ushobora kuvugana nabashakashatsi kubibazo byose, impungenge, cyangwa ibibazo ufite kuri ubu bushakashatsi hamagara Madamu Aline UWASE ukora mu Ishuri Rikuru ry'Ubuvuzi n'ubumenyi bw'ubuzima, Rwanda, telefone: +250 788 642 136, imeri: alinemunyaneza1@gmail.com cyangwa auwase38@ur.ac.rw. Ushobora kandi kuvugana nabayobozi banjye, Prof Jonathan Levin, Icyumba cya

mbere cya 151, Ishami rya Epidemiologiya na Biostatistics, Ishuri ryubuzima rusange Johannesburg, Afrika yepfo, imeri: Jonathan.Levin@wits.ac.za.

**Ibizava mu bushakashatsi**

Ibizava mu bushakashatsi bizabimenyeshwa ku bigo nderabuzima. Byongeye kandi, ibizavamo bizasangizwa n'abafata ibyemezo batandukanye mu Rwanda. Nanone, ibisubizo bizafasha ushinzwe ubushakashatsi nyamukuru, guhanga ibikorwa byibanda kumirire yabagore batwite bizafasha gukumira imirire mibi ku bagore batwite. Byongeye kandi, ibisubizo bizatangazwa nkibikorwa byamasomo mubinyamakuru bya siyansi. Hanyuma, ibisubizo bizahuzwa mugitabo kizashyikirizwa kaminuza ya Witwatersrand, Johannesburg, Afurika yepfo kugira ngo gisuzumwe.

**Aho wabariza uramutse ukeneye amakuru kubareberera imyitwarire yubushakashatsi**

Ubu bushakashatsi buzemezwa n'ikigo gishinzwe gusuzuma (IRB) cya kaminuza y'u Rwanda, Ishuri Rikuru ry'Ubuvuzi n'ubumenyi bw'ubuzima na kaminuza ya Witwatersrand HREC (Komite ishinzwe imyitwarire y'ubushakashatsi bw'abantu. Kuri IRB, ushobora kuvugana na perezida Professor Jonas Njunwa Kato kuri njunwakato@gmail.com cyangwa ukamuhamagara kuri +250 788490522; cyangwa umwungirije kuri **0783 340 040**. Ku HREC ari komite yigenga yashyizweho kugirango ifashe kurengera uburenganzira bwabitabiriye ubushakashatsi; ushobora guhamagara umuyobozi kuri Tel: (011) 717 2229.

**Bizagenda bite mugihe uwitabiriye ubushakashatsi adakomeje?**

Niba uwitabiriye adakomeje ubushakashatsi, amakuru yose yakusanyirijwe hamwe azasenywa kandi ntazakoreshwa mu gutanga raporo yanyuma.

**Igice cya II: Icyemezo cyo kubyemera**

Nasomye / numvise amakuru yubushakashatsi ngiye kwitabira. Nagize amahirwe yo kubaza ibibazo kandi ibibazo byose nabajije byashubijwe ndanyurwa. Nemeye kubushake kugira uruhare muri ubu bushakashatsi

Izina ryuwitabiriye_____

Umukono w'uwitabiriye _____

Itariki _____

Umunsi / ukwezi / umwaka

***Umutangabuhamya (Niba uwitabiriye atazi gusoma no kwandika)***

Niboneye gusoma neza urupapuro rwabemera kugira uruhare mubushakashatsi, kandi umuntu ndeberera yagize amahirwe yo kubaza ibibazo. Ndemeza ko ku giti cye yatanze uburenganzira ntagahato.

izina ry’umutangabuhamya_____

Isinya y’umutangabuhamya…….

Igikumwe cyuwitabiriye

**Umushakashatsi ufasha abitabiriye ubushakashatsi gusobanukirwa**

Nasomye neza urupapuro rw’amakuru uko nshoboye kugira ngo abazitabira bumve ko hazakorwa ibi bikurikira: Gukora ikiganiro, gufatwa amajwi n’ibipimo. Ndemeza ko uwitabiriye yahawe umwanya wo kubaza ibibazo bijyanye n’ubushakashatsi, kandi ibibazo byose byabajijwe nuwitabiriye byashubijwe neza. Ndemeza ko uwitabiriye atigeze ahatirwa gutanga uruhushya, ko uruhushya rwatanzwe ku bushake.

Izina ry’umushakashatsi _____

Umukono wumushakashatsi……...

**ABAGANGA BITA KUBAGORE BATWITE**

**Gusesengura imirire y’abagore batwite n’impamvu nyamukuru mubabyeyi baje kwimisha inda mu bigonderabuzima by’intara y’amagepfo mu Rwanda.**

**Igice cya mbere: Amakuru**

Nitwa Aline Uwase, umunyeshuri muri kaminuza ya Witwatersrand Johannesburg/ Afurika y’epfo mu ishuri ryubuzima rusange. Ndigukora ubu bushakashatsi kugira ngo nzabone impamyabumenyi yikirenga mu buzima rusange bw’umwana n’umugore utwite. Buzaba buhagarariwe na Prof Jonathan Levin, Dr Nirvana PILLAY bo muri Afurika y’epfo na Bwana Etienne Nsereko wo mu Rwanda. Uru rupapuro rwamakuru rugufasha gufata umwanzuro wo kuba wagira uruhare muri ubu bushakashatsi. Nuhitamo kugira uruhare muri ubu bushakashatsi, urasabwa gushyira umukono kuriyi nyandiko kugirango wemeze ko wumva ubushakashatsi kandi wemeye kwitabira kandi Uzahabwa kopi yo kubika. Iki kiganiro kizatwa amajwi, turagusaba gusinya uruhushya rwo gufata amajwi niba ubyemera. Niba ufite ikibazo, ntutinye kumbaza.

**Intego yubushakashatsi**

Dushishikajwe no kumenya ibintu bigira uruhare ku mirire y'abagore batwite. Twibwira ko imirire y’umugore utwite ifitanye isano n’ubuzima bwumubyeyi ndetse n’umwana atwite. Turashaka rero gusuzuma imiterere yimirire y’abagore batwite n’ibintu bifitanye isano nayo kugirango tumenyeshe ishyirwaho rya politiki mubijyanye nimirire yabagore batwite.

**Ubutumire bwo kugira uruhare mubushakashatsi**

Ubushakashatsi burimo abantu bahitamo kubigiramo uruhare. Nyamuneka fata umwanya wawe wo gusoma / kumva amakuru yose yerekeye ubu bushakashatsi hanyuma ufate icyemezo cyo kwitabira. Ushobora kuganira ku cyemezo cyawe n'umuryango wawe cyangwa inshuti niba ubishaka. Niba ufite ikibazo, ushobora kandi kubaza abashakashatsi.

**Kuki natoranijwe kugirango mbe muri ubu bushakashatsi?**

Urasabwa kugira uruhare muri ubu bushakashatsi kuko ukora kwa muganga muri servisi zita kubagore batwite. Ushobora kumenya neza amakuru ajyanye n'imirire yabo, amakuru mubaha yerekeranye n'imirire ndets n'imbogamizi muhura nazo mukubaha ayo makuru.

**Bizagenda bite ndamutse nemeye kugira uruhare muri ubu bushakashatsi?**

Niba wemeye, ibi bikurikira bizabaho: Mugihe uri ku kigo nderabuzima uzasabwa kwitabiro ikiganiro hamwe numwe mubashakashatsi. Muzaganira ku ruhare rwawe mu mirire y'abagore batwite. Iki kiganiro bizatwara byibuze isaha imwe kandi kizabera ahantu hacecetse.

**Ni izihe ngaruka nshobora kwitega kuba mu bushakashatsi?**

Kwitabira ubu bushakashatsi nta ngaruka bizakugiraho. Ariko, mugihe cy'ibazwa, ushobora kumva utishimiye ibibazo bimwe na bimwe kandi ntushake kubiganiraho. Muriicyo gihe, ntabwo uhatirwa gutanga amakuru kandi ufite uburenganzira bwo kudasubiza.

**Hari inyungu zo kugira uruhare muri ubu bushakashatsi?**

Nta nyungu zako kanya kuri wowe mu kwitabira ubu bushakashatsi. Nyamara, amakuru utanga ashobora gufasha abashinzwe politiki yubuzima kumenya byinshi kubijyanye nuburyo bukwiye bwo kunoza imikorere yimirire yabagore batwite.

**Kwemera kubushake**

Ufite umudendezo wo guhitamo niba utitabira ubu bushakashatsi. Kubugiramo uruhare ni ubushake rwose. Niba uhisemo kutaba muri ubu bushakashatsi, nta gihano kuri wowe ntanubwo uzatakaza inyungu zawe zisanzwe mu kazi.

**Amabanga no kutamenyekanisha amazina**

Tuzakora ibishoboka byose kugirango amakuru yihariye yakusanyirijwe muri ubu bushakashatsi agirwe ibanga. Niba amakuru avuye muri ubu bushakashatsi yatangajwe cyangwa yatanzwe mu nama zubumenyi, amazina yawe bwite ntabwo azakoreshwa. Byongeye kandi, ibikoresho byo gukusanya amakuru bizakoresha kode aho gukoresha amazina.

**Ibanga**

Uruhare mu bushakashatsi rushobora kubamo gutakaza ubuzima bwite, ariko amakuru akwerekeye azabikwa mu ibanga bishoboka. Ibiganiro bizabera mucyumba gituje kandi gifite umutekano kirimo abashakashatsi gusa nabitabiriye. Ububiko bw'Ubushakashatsi buzashyirwaho kubera wowe.

Urupapuro rwuko wemeye kugira uruhare mubushakashatsi hamwe namakuru yawe azashyirwa muri ubwo bubiko kandi abashakashatsi bonyine ni bo bazabugeraho.

**Nzahembwa kuba naragize uruhare muri ubu bushakashatsi?**

Ntabwo hazishyurwa amafaranga yo kwitabira ubu bushakashatsi.

**Ninde ushobora gusubiza ibibazo byanjye kubyerekeye ubu bushakashatsi?**

Ushobora kuvugana nabashakashatsi kubibazo byose, impungenge, cyangwa ibibazo ufite kuri ubu bushakashatsi hamagara Madamu Aline UWASE ukora mu Ishuri Rikuru ry'Ubuvuzi n'ubumenyi bw'ubuzima, Rwanda, telefone: +250 788 642 136, imeri: alinemunyaneza1@gmail.com cyangwa auwase38@ur.ac.rw. Ushobora kandi kuvugana nabayobozi banjye, Prof Jonathan Levin, Icyumba cya mbere cya 151, Ishami rya Epidemiologiya na Biostatistics, Ishuri ryubuzima rusange Johannesburg, Afrika yepfo, imeri: Jonathan.Levin@wits.ac.za.

**Ibizava mu bushakashatsi**

Ibizava mu bushakashatsi bizabimenyeshwa ku bigo nderabuzima. Byongeye kandi, ibizavamo bizasangizwa n'abafata ibyemezo batandukanye mu Rwanda. Nanone, ibisubizo bizafasha ushinzwe ubushakashatsi nyamukuru, guhanga ibikorwa byibanda kumirire yabagore batwite bizafasha gukumira imirire mibi ku bagore batwite. Byongeye kandi, ibisubizo bizatangazwa nkibikorwa byamasomo mubinyamakuru bya siyansi. Hanyuma, ibisubizo bizahuzwa mugitabo kizashyikirizwa kaminuza ya Witwatersrand, Johannesburg, Afurika yepfo kugira ngo gisuzumwe.

**Aho wabariza uramutse ukeneye amakuru kubareberera imyitwarire yubushakashatsi**

Ubu bushakashatsi buzemezwa n'ikigo gishinzwe gusuzuma (IRB) cya kaminuza y'u Rwanda, Ishuri Rikuru ry'Ubuvuzi n'ubumenyi bw'ubuzima na kaminuza ya Witwatersrand HREC (Komite ishinzwe imyitwarire y'ubushakashatsi bw'abantu. Kuri IRB, ushobora kuvugana na perezida Professor Jonas Njunwa Kato kuri njunwakato@gmail.com cyangwa ukamuhamagara kuri +250 788490522; cyangwa umwungirije kuri **0783 340 040**. Ku HREC ari komite yigenga yashyizweho kugirango ifashe kurengera uburenganzira bwabitabiriye ubushakashatsi; ushobora guhamagara umuyobozi kuri Tel: (011) 717 2229.

**Bizagenda bite mugihe uwitabiriye ubushakashatsi adakomeje?**

Niba uwitabiriye adakomeje ubushakashatsi, amakuru yose yakusanyirijwe hamwe azasenywa kandi ntazakoreshwa mu gutanga raporo yanyuma.

**Igice cya II: Icyemezo cyo kubyemera**

Nasomye / numvise amakuru yubushakashatsi ngiye kwitabira. Nagize amahirwe yo kubaza ibibazo kandi ibibazo byose nabajije byashubijwe ndanyurwa. Nemeye kubushake kugira uruhare muri ubu bushakashatsi

Izina ryuwitabiriye_____

Umukono w'uwitabiriye _____

Itariki _____

Umunsi / ukwezi / umwaka

**Umushakashatsi ufasha abitabiriye ubushakashatsi gusobanukirwa**

Nasomye neza urupapuro rw'amakuru uko nshoboye kugira ngo abazitabira bumve ko hazakorwa ibi bikurikira: Gukora ikiganiro, gufatwa amajwi n'ibipimo. Ndemeza ko uwitabiriye yahawe umwanya wo kubaza ibibazo bijyanye n'ubushakashatsi, kandi ibibazo byose byabajijwe nuwitabiriye byashubijwe neza. Ndemeza ko uwitabiriye atigeze ahatirwa gutanga uruhushya, ko uruhushya rwatanzwe ku bushake.

Izina ry'umushakashatsi _____

Umukono wumushakashatsi……...

**KUMENYESHWA NO KWEMERA GUFATA AMAJWI**

**Gusesengura imirire y'abagore batwite n'impamvu nyamukuru mubabyeyi baje kwimisha inda mu bigonderabuzima by'intara y'amagepfo mu Rwanda**

Ndashaka gusaba uruhushya rwo gufata amajwi y'ikiganiro turi bugirane. Gufata amajwi ni ukugira ngo mu byo twaganiriye byose hatagira ikiducika. Ikiganiro cyafashwe kizabikwa mu ibanga kandi kizasenywa ako kanya nyuma yo kwandukura. Uremera gufatwa amajwi mugihe cy'ikiganiro?

Yego …… ... Oya

**Ufata amajwi**

Ndemeza ko nasobanuye neza intego yo gufata amajwi kandi nahawe uruhushya nuwitabiriye ubushakashatsi.

**Ufatwa amajwi**

Nemeye ko bamfata amajwi mugihe cy'ibazwa / ikiganiro.

Izina ry'ubazwa …… ..... ...

Umukono / igikumwe cyubazwa: …… Itariki: ..... .....

Izina ryuwabajije…….. Itariki……

## Appendix 9 : Questionnaire for Quantitative Survey (English version)

| ***Section 1: Identification of the household(HH) information*** | |
|---|---|
| ***This section is to be completed by enumerator before interview*** | |
| Date of interview: \|___\|___\|/ \|___\|___\|/ \|___\|___\|___\|___\| (Day, Month, Year) | |
| Enumerator's name: | Enumerator ID: \|___\|____\|____\| |
| District Name: | District code: \|___\|____\| |
| Health centre name: | Health centre code: \|___\|____\| |
| Participant ID: \|___\|____\|_____\|_____\| | |
| Has the pregnant woman signed the informed consent? (Please make sure that she agrees to be interviewed). | 1=Yes, 0=No (if no interview ends here) |

| ***Section 2: sociodemographic &HH characteristics (Pregnant woman answers this section)*** | | |
|---|---|---|
| **Question** | **Response code** | **code** |
| 1. Pregnant Woman's MUAC | Record the number in cm<br>1>23cm, 0<23cm | |
| 2. Pregnant Woman's HG | Record the number<br>If not available, note N/A | |
| 3. How old are you? | Write the P W's age:<br>Record the age (completed years) ---------- | |
| 4. Did you ever attend school? | 1 = Yes 0= No (skip to 6) | \|_____\| |
| 5. If yes, what was the highest school level that you attained? | 1= incomplete primary 2= complete primary<br>3= incomplete secondary, 4= complete secondary or higher | \|____\| |
| 6. What is your religion? | 1 = Christian 2= Islam 3= Traditionalist 4= Jehovah witness<br>5= does not belong to any religion | |
| 7. What is your main occupation ? | 1= Farming 2= raising livestock 3=Artisans and trade , 4=Casual labour (cash or food), 5=Salaried 6=Others (Specify)_____ | \|____\| |
| 8. What is the P W's marital status? | 1= married 2= living with the partner<br>3= widowed 4= divorced 5= separated, 6= Single | \|____\| |
| 9. Who is the Household head/ | 1= myself, 2= my husband/partner 3= my parents 4= my guardians | |
| 10. What is the age of the HH head/? | Record the age in years | \|_____\| |

| | | |
|---|---|---|
| 11. What is the gender of the HH head? | 1= male 2= female | \|_____\| |
| 12. Has the Head of the HH attended school? | 1=Yes 0=No If the answer is 0 skip to Q14 | \|_____\| |
| 13. If yes, what was the highest school level that the head of the household attained? | 1= incomplete Primary 2= complete Primary<br>3= incomplete Secondary, 4= complete secondary or higher | \|_____\| |
| 14. What is the main occupation of the HH head? (Mark only the main one ) | 1= Farming and 2=Raising livestock) 3=Business (artisan/trade, etc.) 4=Casual labour (cash or food) 5=Salaried/pension, 6=Others (Specify) _____ | \|_____\| |
| 15. Does your partner/husband have another household? (another wife **make sure the mother is married or cohabiting**) | 1 = Yes 0 = No | \|____\| |
| 16. How many people live in this household | Record number | \|____\| |
| ***Section 3: I'd like to ask you a few questions about obstetrical history*** | | |
| 17. When was your last Menstrual Period | Record the date | Estimated gestational weeks |
| 18. How many live children have you given birth to | Record number | \|_____\| |
| 19. How many ANC Visits did you attend during the current pregnancy? | Record the number | |
| ***Section 4: Let us now talk about income, employment, ownership of assets and living conditions of your household*** | | |
| 20. What is the wealth category (ubudehe) of your household? | 1=Richest 2= Richer<br>3= Poor 4=Poorer<br>9= Don't know | \|_____\| |
| 21. Does the household have access to agricultural land? | 1=Yes 0=No (skip to question 22) | \|_____\| |
| a. If yes, what is the ownership status | 1=Self-owned<br>2=Hired<br>3=Public land,<br>4=Any other specify:_____ | \|_____\| |
| 22. Does your household belong to land consolidation program | 1=Yes 0=No<br>If No (skip to question 24) | \|_____\| |
| 23. If yes ,what types of food do you mainly cultivate? | 1= Rice<br>2= Cassava<br>3= Soya beans<br>4= Beans<br>5= Maize<br>6=vegetables | \|_____\| |

| | | |
|---|---|---|
| | 7= Others (specify) | |
| 24. Does your HH own a kitchen garden? | | |
| 25. Does your HH belong to Girinka program? | | |
| 26. Does the household own any livestock | 1=Yes 0=No (Skip to Q27) | \|_____\| |
| a. If yes, what is the number of livestock owned in the household? | **Livestock** | **Number** |
| | 1= Cows | \|_____\| |
| | 2=Goats | \|_____\| |
| | 3=Sheep | \|_____\| |
| | 4=Rabbits | \|_____\| |
| | 5= ibishuhe | \|_____\| |
| | 6= sumbirigi | \|_____\| |
| | 7=Chicken | \|_____\| |
| | 8=Pigs | \|_____\| |
| | **9= others (specify)** | \|_____\| |
| 27. Does the household own Radio or TV or telephone? | Radio 1 = Yes 0 = No<br>Television<br>Telephone | \|_____\|<br><br>\|_____\| |
| 28. Does any household member earn/get money from the following? *(record 1=Yes and 0=No against each activity).* | | |
| Agricultural farm produce | \|_____\| | Sale of livestock and livestock products including fish and honey \|_____\| |
| Formal employment<br>Business (specify): | \|_____\| | Casual labour \|_____\|<br>Donations/gifts/remittance |

| ***Section 5: Food security*** | | |
|---|---|---|
| 29. In the past [four weeks/30 days] did you worry that your household would not have enough food? | 1 = Yes 0 = No<br>If no (Skip to Q30) | \|_____\| |
| a. How often did this happen in the past [4 weeks/30 days]? | 1=Rarely (1 to 2 times)<br>2=Sometimes (3 to 10 times)<br>3=Often (more than 10 times) | \|_____\| |
| 30. In the past [four weeks/30 days] were you or any household member not able to eat the kinds of foods you preferred because of a lack of resources? | 1 = Yes 0 = No<br>If no (Skip to Q31) | \|_____\| |
| a. How often did this happen in the past [4 weeks/30 days]? | 1=Rarely (1 to 2 times)<br>2=Sometimes (3 to 10 times)<br>3=Often (more than 10 times) | \|_____\| |
| 31. In the past [four weeks/30 days], did you or any household member have to eat a limited variety of foods due to a lack of resources? | 1 = Yes 0 = No<br>If no (Skip to Q32) | \|_____\| |
| a. How often did this happen in the past [4 weeks/30 days]? | 1=Rarely (1 to 2 times)<br>2=Sometimes (3 to 10 times)<br>3=Often (more than 10 times) | \|_____\| |

| | | |
|---|---|---|
| 32. In the past [4 weeks/30 days], was there ever no food to eat of any kind in your house because of lack of resources to get food? | 1 = Yes 0 = No<br>If no (Skip to Q33) | \|_____\| |
| a. How often did this happen in the past [4 weeks/30 days]? | 1=Rarely (1 to 2 times)<br>2=Sometimes (3 to 10 times)<br>3=Often (more than 10 times) | \|_____\| |
| 33. In the past [4 weeks/30 days], did you or any household member go to sleep at night hungry because there was not enough food? | 1 = Yes 0 = No<br>(if no skip to Q34) | \|_____\| |
| a. How often did this happen in the past [4 weeks/30 days]? | 1=Rarely (1 to 2 times)<br>2=Sometimes (3 to 10 times)<br>3=Often (more than 10 times) | \|_____\| |
| 34. In the past [4 weeks/30 days], did you or any household member go a whole day and a whole night without eating anything at all because there was not enough food? | 1 = Yes 0 = No<br>If no (Skip to Q35) | \|_____\| |
| a. How often did this happen in the past [4 weeks/30 days]? | 1=Rarely (1 to 2 times)<br>2=Sometimes (3 to 10 times)<br>3=Often (more than 10 times) | \|_____\| |
| 35. In the past four weeks, did you or any household member have to eat some foods that you really did not want to eat because of a lack of resources to obtain other types of food? | 1 = Yes 0 = No<br>If no (Skip to Q36) | \|_____\| |
| a. How often did this happen in the past [4 weeks/30 days? | 1=Rarely (1 to 2 times)<br>2=Sometimes (3 to 10 times)<br>3=Often (more than 10 times) | \|_____\| |
| 36. In the past four weeks, did you or any household member have to eat a smaller meal than you felt you needed because there was not enough food? | 1 = Yes 0 = No<br>If no (Skip to Q37) | \|_____\| |
| a. How often did this happen in the past [4 weeks/30 days? | 1=Rarely (1 to 2 times)<br>2=Sometimes (3 to 10 times)<br>3=Often (more than 10 times) | \|_____\| |
| 37. In the past four weeks, did you or any other household member have to eat fewer meals in a day because there was not enough food? | 1 = Yes 0 = No<br>If no (Skip to Q38) | \|_____\| |
| a. How often did this happen in the past [4 weeks/30 days? | 1=Rarely (1 to 2 times)<br>2=Sometimes (3 to 10 times)<br>3=Often (more than 10 times) | \|_____\| |

| | |
|---|---|
| ***Section 6: Maternal dietary diversity (24h recall to be asked to pregnant women)*** | |
| 38. *Now I'd like to ask you to describe everything that you ate or drank yesterday during the day or night, whether you ate it at home or anywhere else. Please include all foods and drinks, any snacks or small meals, as well as any main meals Please also include food you ate even if it was eaten elsewhere, away from your home. Let start with what you consumed yesterday* | |
| | **From the time you got up yesterday morning to the time you got up today -24hrs. Yes= 1, No= 0** |

| | |
|---|---|
| ***Food Item*** | \|_____\| |
| corn/maize | \|_____\| |
| Sorghum | \|_____\| |
| Other cereals *(Rice, wheat, cereal products)* | \|_____\| |
| Cereal products (breads, sorghum and maize paps,) | \|_____\| |
| Cassava | \|_____\| |
| White sweet potato | \|_____\| |
| Other White Roots and tubers *(Irish potatoes, yams, colocasia, ….)* | \|_____ |
| Carrot, orange sweet potato, or other tubers that are orange inside | \|_____\| |
| Cooking banana | \|_____\| |
| Beans, Peas and other pulses soya | \|_____\| |
| Dark green leafy vegetables (e.g. cassava leaves, dodo, spinach ) | \|_____\| |
| Pumpkin, squash and other orange vegetables | \|_____\| |
| Other Vegetables (cabbages, eggplant) | \|_____\| |
| Ground nuts and seeds | \|_____\| |
| Orange colored fruits (e.g. ripe mango, ripe papaya,) | \|_____\| |
| Other Fresh fruits (apple, pineapple , watermelon) | \|_____\| |
| Fish /small silver fish | \|_____\| |
| Organ Meat (liver kidney, heart, blood based food.) | \|_____\| |
| Flesh meat (beef goat lamb rabbit, chicken and other poultry etc.…) | \|_____\| |
| Eggs | \|_____\| |
| Oil, fat, butter, ghee (including palm oil) avocados | \|_____\| |
| Sugar and sweets | \|_____\| |
| Milk and milk products (yogurts, chees ) | \|_____\| |
| Condiments (salt, pepper, other spices, fish powder, or other items used to give flavor to the food: pili pili, onions….) | \|_____\| \|_____\| |

***Section 7: Knowledge of pregnant women on maternal nutrition during pregnancy***

*I am going to ask you some questions about nutrition of pregnant women. Please let me know if you need me to clarify any of my questions. Feel free to ask any question you may have*

| | | |
|---|---|---|
| 39. Have you personally received any information about nutrition during pregnancy | 1 = Yes 0= No | \|_____\| |
| 40. From where did you get this information? | 1 = Health centre worker,<br>2 = CHW,<br>3 = Other mothers<br>4 = Radio,<br>5 = Evening parent's meeting<br>6= others (specify) | \|_____\| |
| 41. How should a pregnant woman eat in comparison with a non-pregnant woman? | 1 = Yes<br>0= No<br><br>*Eat more at each meal (eat more food each day)* | \|_____\|<br><br>\|_____\| |

| | | |
|---|---|---|
| | *Eat more frequently (eat more times each day)*<br>*Eat more protein-rich foods*<br>*Eat more iron-rich foods*<br>*Use iodized salt when preparing meals*<br>*Eat more fibre-rich foods*<br>*Eat more calcium -rich foods* | \|_____\|<br>\|_____\|<br>\|_____\|<br>\|_____\|<br>\|_____\| |
| 42. How many food group should a pregnant woman consume? | Record the number<br>99= does not know | |
| 43. Are these food groups the following? | 1= yes 0= N0<br>1. Grains, white roots and tubers, and plantains.<br>2. Pulses (beans, peas and lentils)<br>3. Nuts and seeds<br>4. Dairy<br>5. Meat, poultry and fish<br>6. Eggs<br>7. Dark green leafy vegetables<br>8. Other vitamin A rich fruits and vegetables<br>9. Other vegetables<br>10. Other fruits<br>99=Don't know | \|_____\|<br>\|_____\|<br>\|_____\|<br>\|_____\|<br>\|_____\|<br>\|_____\|<br>\|_____\| |
| 44. How many meals should a pregnant woman take? | Record the number<br>99= Don't know | \|_____\| |
| 45. It is beneficial to consume snacks to avoid going hungry for a long time in pregnancy? | 1 = Yes 0= No | \|_____\| |
| 46. Most women would benefit from the types of micronutrient supplements ? | 1 = Yes 0= No if no skip to Q 48<br>99= Don't know | _____\|\| |
| 47. If yes, What are they? | 1 = Yes 0= No<br>99= Don't know<br>Iron and folic acid | \|_____\| |
| 48. What is the health benefit for taking folic acid supplements/tablets? | 1 = Yes 0= No<br>0= Don't know<br>a. For normal development of the nervous system of the unborn baby (brain, spine and skull)<br>b. To prevent birth defects/abnormalities the nervous system of the unborn baby (brain, spine and skull)<br>c. Other (specify) | \|_____\|<br>\|_____\| |

| | | |
|---|---|---|
| 49. Have you heard about iron-deficiency anaemia? | 1 = Yes 0= No if no skip to Q 52 | \|_____\| |
| 50. If Yes: Can you tell me how you can recognize someone who has anaemia? | 1 = Yes<br>0= No<br>0= Don't know<br>1. Less energy/weakness<br>2. Paleness/pallor<br>3. Spoon nails/bent nails (koilonychias)<br>4. More likely to become sick (less immunity to infections)<br>5. Losing weight<br>6. Having dizziness | \|_____\|<br>\|_____\|<br>\|_____\|<br>\|_____\| |
| 51. How can anaemia be prevented? | 1 = Yes<br>0= No<br>0= Don't know<br>1. Eat/feed iron-rich foods/having a diet rich in iron<br>2. Eat/give Vitamin-C-rich foods during or right after meals<br>3. Take/give iron supplements if prescribed<br>4. Treat other causes of anaemia (diseases and infections) – seek health-care assistance.,<br>5. Other (specify) | \|_____\|<br>\|_____\|<br>\|_____\|<br>\|_____\| |
| 52. Can you list examples of foods rich in iron? | Record the name of food<br>99= Don't know | |
| 53. Appropriate weight gain during pregnancy indicates adequate and balanced nutrition | 1 = Yes 0= No<br>99= Don't know | \|_____\| |
| 54. Nutrients deficiency during pregnancy could affect health status of mothers and baby | 1 = Yes 0= No<br>99= Don't know | \|_____\| |
| 55. Underweight mother can affect foetal well-being and growth | 1 = Yes 0= No<br>99= Don't know | \|_____\| |
| 56. If woman was a normal weight before pregnancy, she should gain weight between 11.5 kg and 16.0 kg during pregnancy | 1 = Yes 0= No<br>9= Don't know | \|_____\| |
| **Section 8: Practices of antenatal mothers on maternal nutrition during pregnancy** | | |
| 57. Do you smoke? | 1 = Yes 0= No | \|_____\| |
| 58. Does any household member smoke? | 1 = Yes 0= No | |

| | | |
|---|---|---|
| 59. Do you drink alcohol? | 1 = Yes 0= No | |
| 60. How do you usually eat now that you are pregnant? | 1 = Yes<br>0= No<br>1.More frequently?<br>2. Less frequently?<br>3. More food<br>4.Fewer food? | \|_____\|<br>\|_____\| |
| 61. How many meals do you have per day? | Record the number | |
| 62. Do you usually take snacks between the main meals? | 1 = Yes 0= No<br>If no, go to Q64 | \|_____\| |
| 63. If yes, How many per day? | Record the number | |
| 64. If no, what are the reasons? | Record down the reason<br>_____ | |
| 65. Do you usually skip meals? | 1 = Yes 0= No | \|_____\| |
| 66. If yes, why? | Record the reasons | |
| 67. During pregnancy, do you take ≥2h of rest every afternoon? | 1 = Yes 0= No | \|_____\| |
| 68. Why do you take such rest? | Record the reasons | |
| 69. If not, why don't you take such rest? | Record the reasons | |
| 70. Do you usually receive IFA during pregnancy from health facility? | 1 = Yes 0= No | \|_____\| |
| 71. If you receive them, do you take all? | 1 = Yes 0= No | |
| 72. If not what could be the reasons? | Record the reasons | |
| 73. Do health care providers demonstrate how to prepare a balanced diet? | 1 = Yes 0= No | \|_____\| |
| 74. Do you usually participate in Village's Kitchen? | 1 = Yes 0= No | |
| 75. Are you in the category of these receiving shishakibondo? (fortified flour) | 1 = Yes 0= No | \|_____\| |
| 76. Have you receive deworming drugs? | 1 = Yes 0= No | \|_____\| |
| 77. Have you received free mosquito net? | 1 = Yes 0= No | \|_____\| |
| 78. What do you think can be done to improve nutrition of pregnant women | Record the response<br>_____ | |

*Section 9:* **MATERNITY SOCIAL SUPPORT**

| *These are about your relationships with your family and community* | | | | | | |
|---|---|---|---|---|---|---|
| *How do you feel about the support you have right now?* | | *Always* | *Most of the time* | *Some of the time* | *Rarely* | *Never* |
| 1 | I have good friends who support me | 5 | 4 | 3 | 2 | 1 |
| 2 | I have neighbors who support me | 5 | 4 | 3 | 2 | 1 |
| 3 | I have people in the community who support me | 5 | 4 | 3 | 2 | 1 |
| 4 | I have conflict with members of my community | 5 | 4 | 3 | 2 | 1 |
| 5 | My family is always there for me | 5 | 4 | 3 | 2 | 1 |
| 6 | There is conflict with my nuclear family | 5 | 4 | 3 | 2 | 1 |
| 7 | There is conflict with my extended family | 5 | 4 | 3 | 2 | 1 |
| 8 | My husband helps me a lot | 5 | 4 | 3 | 2 | 1 |
| 9 | There is conflict with my husband | 5 | 4 | 3 | 2 | 1 |
| 10 | I have conflict with my husband's family | 5 | 4 | 3 | 2 | 1 |
| 11 | I feel controlled by my husband | 5 | 4 | 3 | 2 | 1 |
| 12 | I feel loved by my husband | 5 | 4 | 3 | 2 | 1 |
| Any comment | | | | | | |

## Appendix 10 : Questionnaire for Quantitative Survey (Kinyarwanda version)

| **IGICE *1: Umwirondoro wçuwitabiriye ubushakashatsi*** | |
|---|---|
| ***iki gice kigomba kuzuzwa nubaza mbere yo gutangira ikiganiro*** | |
| Itariki y'ikiganiro : \|___\|___\|/ \|___\|___\|/ \|___\|___\|___\|___\| umunsi,ukwezi, umwaka | |
| amazina y'ubaza : | Nimero y'ubaza : \|___\|____\|____\| |
| izina ry'akarere : | Nimero y'akarere : \|___\|____\| |
| Izina ry'ikigonderabuzima : | nimero y'ikigonderabuzima : \|___\|____\| |
| Nimero y'uwitabiriye ubushakashatsi \|___\|____\|_____\|_____\| | |

| | |
|---|---|
| Umubyeyi yasinye urupapuro rwo kwemera kugira uruhare mubushakashatsi? Banza urebe ko yabyemeye | 1= yego , 0= oya ( niba ari oya ikiganiro kirangirire aha) |_____| |

**IGICE *2: Imiterere n'imibereho y'urugo ( umugore utwite yasubiza iki gice)***

| **Ikibazo** | **igisubizo** | **Kode** |
|---|---|---|
| 1. umuzenguruko w'ikizigira cy'akaboko ( MUAC) | Andika umubare 1 >23cm , 0< 23cm | |__ |
| 2. Hemoglobine (HB) | Andika umubare/ Niba ntayo andika N/A | |_____| |
| 3. Ufite imyaka ingahe? | Andika umubare w'imyaka | |_____| |
| 4. Wigeze ugera mu ishuri? | 1 = Yego 0 = oya (niba ari oya jya kukibazo cya 6) | |_____| |
| 5. wagarukiye ku ruhe rwego? | 1= ntabwo narangije abanza 2= narangije abanza<br>3=ntabwo narangije ayisumbuye 4=narangije ayisumbuye no kuzamura | |_____| |
| 6. Idini ryawe ni irihe? | 1 = umukirisitu 2= umwislam 3= Gakondo 4= Umuhamya wa yehova 5= Nta dini ngira | |_____| |
| 7. Ni uwuhe mwuga nyamukuru ukora ? | 1= umuhinzi 2= umworozi 3= umucuruzi 4=umunyakiraka 5= Nkorera Umushahara 6= ibindi bisobanure | |_____| |
| 8. Ni irihe rangamimerere ryawe? | 1= narashyingiwe 2= Mbana n'umugabo<br>3= umupfakazi 4= baratandukanye byemewe n'amategeko 5= twaratandukanye 6= ndi ingaragu | |
| 9. Ni nde Umukuru wumuryango? | Andika umukuru w'umuryango?<br>1=Njjyewe 2=Umugabo 3=Ababyeyi 4=abandera 5=ikindi | |_____| |
| 10. Umukuru wumuryango afite imyaka ingahe? | Andika umubare w'imyaka / niba atabizi 99 | |_____| |
| 11. Igitsina? | Gabo/Gore | |_____| |

| | | |
|---|---|---|
| 12. Umukuru wumuryango yageze mu ishuri? | 1= yego , 0= oya niba ari oya, jya ku kibazo cya 5 | \|_____\| |
| 13. Niba ari yego yagarukiye ku yahe mashuri? | 1= ntabwo yarangije abanza 2= yarangije abanza<br>3=ntabwo yarangije ayisumbuye 4=yarangije ayisumbuye no kuzamura | \|_____\| |
| 14. Ni uwuhe mwuga nyamukuru umukuru wumuryango akora | 1= umuhinzi and 2= umworozi 3= aracuruza 4=umunyakiraka 5=akorera Umushahara /ari mukiruhuko cy<br>'izabukuru, 6= ibindi bisobanure _____ | \|_____\| |
| 15. Umugabo wawe yaba afite undi mugore? | 1 = Yego 0 = oya | \|_____\| |
| 16. Muri uru rugo haba abantu bangahe? | andika umubare | \|_____\| |
| **IGICE** *cya 3:* Ndifuza kukubaza ibibazo byerekeranye n'urubyaro | | |
| 17. Uheruka mumihango yanyuma ryari? Andika itariki cg simbizi | Gereranya ibyumweru inda ifite | |
| 18. Wabyaye abana bangahe baba bariho cg batariho? | Andika umubare | \|_____\| |
| 19. Wipimishije kangahe kuri iyi nda utwite? | Andika umubare | |
| **IGICE** ***4: Reka noneho tuvuge ku rugo rwanyu: ibyo mwinjiza, akazi, umutungo n'imibereho y'urugo rwawe*** | | |
| 20. Uri mu cyiciro cya kangahe cy'ubudehe? | 1= 1, 2= 2, 3=3, 4=4 99 = Ntabwo nkizi | \|_____\| |
| 21. Urugo rwanyu rufite ubutaka bwo guhinga? | 1 = Yego 0 = oya (niba ari oya jya kukibazo cya 21) | \|_____\| |
| a. Niba ari yego, ni uruhe ruhare mubufiteho? | 1= ni ubwacu bwite 2=turabukodesha 3=ni ubwa leta<br>4=ikindi gisobanure:_____ | \|_____\| |
| 22. Urugo rwanyu ruba muri gahunda yo guhuza ubutaka? | 1 = Yego 0 = oya (niba ari oya jya kukibazo cya 22) | \|_____\| |
| 23. Niba ari yego, ni ibihe bihingwa mukunda guhinda ? | Hitamo ibishoboka byose<br>1. Umuceri<br>2. Imyumbati<br>3. Soya<br>4. Ibishyimbo<br>5. ibigori<br>6. imboga<br>7. Ibindi (bivuge) | |

| | | |
|---|---|---|
| 24. Mufite akarima k'igikoni? | 1 = Yego 0 = oya | \|_____\| |
| 25. Muba muri gahunda ya girinka munyarwanda? | 1 = Yego 0 = oya | |
| 26. Hari amatungo mworoye? | 1 = Yego 0 = oya (niba ari oya jya kukibazo cya 26) | \|_____\| |
| a. Niba ari yego, ni ayahe kandi ni angahe? | **Amatungo** | **Umubare** |
| | 1= inka | \|_____\| |
| | 2=ihene | \|_____\| |
| | 3=intama | \|_____\| |
| | 4=inkwavu | \|_____\| |
| | 5=ibishuhe | \|_____\| |
| | 6=Isumbirigi/imbega z'inzungu | \|_____\| |
| | 7=inkoko | \|_____\| |
| | 8=ingurube | \|_____\| |
| | 9= irindi tungo (rivuge) | \|_____\| |
| 27. Urugo rwanyu rufite radio cg telephone cg television? | Radio: 1 = Yego 0 = Oya<br>Televisiyoo: 1 = Yego 0 = Oya<br>Telefoni: : 1 = Yego 0 = Oya | \|_____\|<br>\|_____\|<br>\|_____\| |
| 28. Umuntu wo muri uru rugo yaba abona amafaranga aturutse aha hakurikira? *(andika 1= niba ari yego na 0= niba ari oya* | | |
| Mu bihingwa yejeje byacurujwe | \|_____\| | Kugurisha amatungo cg ibirikomokaho nk'ubuki, amagi, amata n'ibindi \|_____\| |
| Akazi ka reta<br>Ubucuruzi (busobanure) | \|_____\| | Ikiraka<br>Inkunga/impano \|_____\| |

| **IGICE cya 5: Kwihaza mubiribwa** | | |
|---|---|---|
| 29. Muminsi 30 ishize wigeze uhangayikishwa nuko ibiribwa bidahagije | 1 = Yego 0 = oya (niba ari oya jya kukibazo cya 29) | \|_____\| |
| b. Byabayeho kangahe mu minsi 30 ishize? | 1= gake cyane (inshuro 1 cg 2) 2= rimwe na rimwe (inshuro 3 kugera 10) 3= kenshi (inshuro zirenze 10) | \|_____\| |

| | | |
|---|---|---|
| 30. Mu minsi 30 ishize, waba cg undi wo mu rugo rwanyu utarashoboye kurya ibyo washakaga kubera kubura ubushobozi? | 1 = Yego 0 = oya (niba ari oya jya kukibazo cya 30) | \|_____\| |
| a. Byabayeho kangahe mu minsi 30 ishize? | 1= gake cyane (inshuro 1 cg 2) 2= rimwe na rimwe (inshuro 3 kugera 10)<br>3= kenshi (inshuro zirenze 10) | \|_____\| |
| 31. Mumninsi 30 ishize, waba cg undi wo mu rugo rwanyu mutarashoboye guhinduranya indyo bitewe no kubura ubushobozi? | 1 = Yego 0 = oya (niba ari oya jya kukibazo cya 31) | \|_____\| |
| a. Byabayeho kangahe mu minsi 30 ishize? | 1= gake cyane (inshuro 1 cg 2) 2= rimwe na rimwe (inshuro 3 kugera 10)<br>3= kenshi (inshuro zirenze 10) | \|_____\| |
| 32. Mu minsi 30 ishize, byigeze bibaho ko mubuririza ntacyo kurya gihari kubera kubura ubushobozi ? | 1 = Yego 0 = oya (niba ari oya jya kukibazo cya 32) | \|_____\| |
| a. Byabayeho kangahe mu minsi 30 ishize? | 1= gake cyane (inshuro 1 cg 2) 2= rimwe na rimwe (inshuro 3 kugera 10)<br>3= kenshi (inshuro zirenze 10) | \|_____\| |
| 33. Mu minsi 30 ishize ibyo kurya byaba byarigeze bibabana bike ku buryo hagira abaharira bamwe abandi bakaburara? | 1 = Yego 0 = oya (niba ari oya jya kukibazo cya 33) | \|_____\| |
| a. Byabayeho kangahe mu minsi 30 ishize? | 1= gake cyane (inshuro 1 cg 2) 2= rimwe na rimwe (inshuro 3 kugera 10) 3= kenshi (inshuro zirenze 10) | \|_____\| |
| 34. Mu minsi 30 ishize waba cg undi wo mu muryango abwirirwa akanaburara ;kubera ko ibiryo bidahagije? | 1 = Yego 0 = oya (niba ari oya jya kukibazo cya 34) | \|_____\| |
| a. Byabayeho kangahe mu minsi 30 ishize? | 1= gake cyane (inshuro 1 cg 2) 2= rimwe na rimwe (inshuro 3 kugera 10) 3= kenshi (inshuro zirenze 10) | \|_____\| |
| 35. Mu minsi 30 ishize mwaba mwarariye ibiryo mutashakaga kurya kubera kubura ubushobozi bwo kugura ibindi? | 1 = Yego 0 = oya (niba ari oya jya kukibazo cya 35) | \|_____\| |
| a. Byabayeho kangahe mu minsi 30 ishize? | 1= gake cyane (inshuro 1 cg 2) 2= rimwe na rimwe (inshuro 3 kugera 10) 3= kenshi (inshuro zirenze 10) | \|_____\| |

| | | |
|---|---|---|
| 36. Mu minsi 30 ishize wowe cg undi wo mu rugo rwanyu yariye ibiryo bike ugereranyije nibyo washakaga kuberako ibiribwa bitari bihagije? | 1 = Yego 0 = oya (niba ari oya jya kukibazo cya 36) | \|_____\| |
| a. Byabayeho kangahe mu minsi 30 ishize? | 1= gake cyane (inshuro 1 cg 2) 2= rimwe na rimwe (inshuro 3 kugera 10) 3= kenshi (inshuro zirenze 10) | \|_____\| |
| 37. Mu minsi 30 ishize wowe cg undi wo mu rugo rwanyu yariye inshuro nke ku munsi kubera ko ibiryo bitari bihagije? | 1 = Yego 0 = oya (niba ari oya jya kukibazo cya 37) | \|_____\| |
| a. Byabayeho kangahe mu minsi 30 ishize? | 1= gake cyane (inshuro 1 cg 2) 2= rimwe na rimwe (inshuro 3 kugera 10) 3= kenshi (inshuro zirenze 10) | \|_____\| |

**IGICE** ***cya 6: Imirire itandukanye y'abagore batwite***

38. . *Tugiye kuganira ku byo kurya wariye ejo umunsi wose kuva mu gitondo ubyutse kugeza nijoro uryama. Urambwira ibyo wariye iwawe mu rugo cg ahandi hatari mu rugo yewe unashyiremo ibyo wariye igihe warimo utegura amafunguro abandi bari bufungure. Ndagirango umbwire niba ejo hashize waba warariye ibiribwa ngiye kukubwira:*

| ***Ibiribwa*** | **Yego= 1, oya= 0** \|_____\| |
|---|---|
| *Ibigori* | \|_____\| |
| *Amasaka* | \|_____\| |
| *Ibindi binyampeke (Umuceri, ingano, …….)* | \|_____\| |
| *Ibikomoka ku binyampeke (Umugati, umutsima w' Amasaka, w' ibigori, w' ingano, igikoma, ....)* | \|_____\| |
| *Imyumbati* | \|_____\| |
| *ibijumba by'umweru* | \|_____\| |
| *Ibindi binyabijumba by'umweru (ibirayi, ibikoro, amateke…)* | \|_____ |
| *karoti, ibijumba bya orange* | \|_____\| |
| *Ibitoki bitekwa ( inyamunyu)* | \|_____\| |
| *Ibishyimbo, Amashaza, n' ibindi binyamisogwe* | \|_____\| |
| *Imboga Rwatsi (e.g. isombe, dodo, epinari, imbwija, isogi, isogereza, umushogoro, ibisusa)* | \|_____\| |
| *Ibihaza bisa na karoti mo imbere* | \|_____\| |
| *Izindi mboga* | \|_____\| |
| *Ubunyobwa n' ibisa nabwo (utubuto tw' ibihwagari, sesame, inzuzi, ubunyobwa)* | \|_____\| |

| | |
|---|---|
| *Imbuto zifite ibara rya karoti mo imbere (e.g. umwembe , ipapayi,)* | \|_____\| |
| *Izindi mbuto* | \|_____\| |
| *Ifi/ isambaza/ indagara* | \|_____\| |
| *Inyama zo munda (umwijima,impyiko,umutima, ikiremve)* | \|_____\| |
| *Inyama z'inka, z'ihene, z'intama, z'urukwavu, z'inkoko, z'ingurumbe…)* | \|_____\| |
| *Amagi* | \|_____\| |
| *Ubuto , amavuta y'inka, amamesa, marigarine, avoka, ....* | \|_____\| |
| *Isukari n'ibindi biryohera (keke, bombo, shokora, konfiture, igishehe, .....)* | \|_____\| |
| *Amata n'ibiyakomokaho* | \|_____\| |
| *Ibihumyo/ibyobo/ibinyamigina, imegeli* | \|_____\| |
| *Ibirungo ( umunyu, urusenda, n'ibindi bikoreshwa kugirango ibiryo bigire icyanga: pilipili, ibitunguru,….)* | \|_____\| |
| *Ibindi/ bivuge* | \|_____\| |
| | |

**IGICE CYA 7. Ubumenyi bwabagore batwite ku mirire yumugore utwite:** ***Ngiye kukubaza ibibazo byerekeranye nimirire yumugore utwite Umbwire niba hari ikibazo utumva neza ngusobanurire. Ntugire impungenge, wisanzure ubaze aho utumva*****.**

| | | |
|---|---|---|
| 39. Wigeze wumva amakuru yerekeranye n'imirire y'umugore utwite? | 1 = Yego 0= Oya<br>(niba ari OYA jya ku kibazo cya 40) | \|_____\| |
| 40. Wayakuye he? | 1 = Ku kigonderabuzima, 2 = Abajyanama b'ubuzima, 3 = abandi bagore 4 = Radio, 5 = Akagoroba k'ababyeyi 6= ahandi havuge---------- | \|_____\| |
| 41. Umugore utwite agomba kurya ate ugereranyije na mbere yo gutwita? | 1 = Yego 0= Oya<br>*Kurya byinshi?*<br>*Kurya inshuro nyinshi?*<br>*Kurya ibyubaka umubiri byinshi (protein)?*<br>*Kurya ibiryo byinshi bikungahaye kubutare/feri?* | \|_____\|<br>\|_____\|<br>\|_____\|<br>\|_____\|<br>\|_____\| |

| | | |
|---|---|---|
| | *Kurya ibiryo birimo umunyu wo guteka?*<br><br>*Kurya ibiryo byinshi bifasha mu igorora (bikungahaye kuri fibre)?*<br><br>*Kurya ibiryo byinshi bikungahaye kuri kalisiyumu ?* | \|_____\|<br><br>\|_____\| |
| 42. Umugore utwite agomba kurya ubwoko bungahe bwibiryo? | Andika umubare<br><br>99= ntabwo mbizi | |
| 43. Ubwo bwoko bw'ibiribwa umugore utwite agomba kurya bwaba ari ubu? | 1 = Yego 0= Oya<br>11. Ibinyampeke, ibinyabijumba n'ibitoki<br>12. Ibinyamisogwe (ibishyimbo, amashaza soya)<br>13. Ubunyobwa, ibihwagari, inzuzi, sezame<br>14. Ibikomoka ku mata<br>15. Inyama, inkoko n'amafi<br>16. Amagi<br>17. Imboga rwatsi<br>18. Imboga n'imbuto zikungahaye kuri vitamin A<br>19. Izindi mboga<br>20. Izindi mbuto<br>99=Ntabwo mbizi | \|_____\|<br>\|_____\|<br>\|_____\|<br>\|_____\|<br>\|_____\|<br>\|_____\|<br>\|_____\|<br>\|_____\|<br>\|_____\|<br>\|_____\| |
| 44. Umugore utwite agomba kurya kangahe ku munsi? | Andika inshuro<br><br>99= Ntabwo mbizi | \|_____\| |
| 45. Ni byiza ko umugore utwite afata ifunguro rito hagati y'amafunguro Manini ? | 1 = Yego 0= Oya<br><br>99= Ntabwo mbizi | \|_____\| |
| 46. Abagore benshi bafashwa n'ubwoko bwinyunganira mirire? | 1 = Yego 0= Oya | \|_____ |
| 47. Ni ari YEGO ni ubuhe? | 1 = Yego 0= Oya<br><br>99= Ntabwo mbizi<br><br>Fer na acide folique | |

| | | |
|---|---|---|
| 48. Ni akahe kamaro ko gufata fer? | a. Kugira ngo imitsi ye ikure neza (mu bwonko, urutirigongo, umutwe)<br><br>b. Kugira ngo hirindwe ko yazavukana ubumuga (mu bwonko, nurutirigongo, umutwe)<br><br>c.Ibindi (bivuge)----------<br>---------- | \|_____\|<br><br>\|_____\| |
| 49. Wigeze wumva indwara yo kubura amaraso itewe nuko ubutare(feri) bwabaye buke mu mubiri? | 1 = Yego 0= Oya<br><br>(niba ari oya jya ku kibazo cya 50) | \|_____\| |
| 50. Niba ari yego, mbwira uko wamenya umuntu ufite icyo kibazo? | 1 = Yego 0= Oya<br><br>99= Ntabwo mbizi<br><br>1. Acika intege<br>2. Aba umweru mu biganza no mu maso<br>3. Inzara zireba hasi/zihengamye<br>4. Ararwaragurika<br>5. Arananuka<br>6. Agira isereri | \|_____\|<br>\|_____\|<br>\|_____\|<br>\|_____\|<br>\|_____\|<br>\|_____\| |
| 51. Ni gute iyo ndwara yakwirindwa? | 1 = Yego 0= Oya<br><br>99= Ntabwo mbizi<br><br>1. Kurya ibiribwa bikungahaye ku butare/feri<br>2. Gufatanya ibiribwa bikungahaye kuri kalisiyumu nirindi funguro cg kubifata ukimara kurya<br>3. Gufata inyunganira mirire igihe uyandikiwe<br>4. Kwivuza izindi ndwara zishobora guteza amaraso make. | \|_____\|<br><br>\|_____\|<br><br>\|_____\|<br><br>\|_____\| |
| 52. Ushobora kumbwira ibiribwa bikungahaye ku butare waba uzi? | Andika izina ry'ibiribwa, niba atabizi andika 99 | |

| | | |
|---|---|---|
| 53. Kwiyongera ibiro bikwiye ku mubyeyi byerekanana ko yariye indyo yuzuye igihe yari atwite? | 1 = Yego 0= Oya<br>99= Ntabwo mbizi | \|_____\| |
| 54. Kubura intungamubiri zihagije bishobora kugira ingaruka ku buzima bw'umubyeyi n'umwana atwite? | 1 = Yego 0= Oya<br>99= Ntabwo mbizi | \|_____\| |
| 55. Umubyeyi ufite imirire mibi igihe atwite, ashobora guteza ingaruka ku gukura k'umwana ukiri munda? | 1 = Yego 0= Oya<br>99= Ntabwo mbizi | \|_____\| |
| 56. Umubyeyi ufite ibiro bikwiye mbere yo gutwita, agomba kwiyongeraho byibura ibiro bingahe mu gihe atwite? | Andika umubare w'ibiro, niba atabazi andika 99 | \|_____\| |
| **IGICE cya 8: Imyitwarire yabagore batwite ku mirire yabo** | | |
| 57. Unywa itabi cg ukarijundi? | 1 = Yego 0= Oya | \|_____\| |
| 58. Ese uwo mubana yaba anywa itabi cg akarijundika? | 1 = Yego 0= Oya | \|_____\| |
| 59. Ujya unywa ibinyobwa bisembuye? | 1 = Yego 0= Oya | \|_____\| |
| 60. Ubu utwite ni gute ukunda kurya ugereranyije na mbere yo gutwita?<br>1 = Yego 0= Oya | 1. Urya inshuro nyinshi?<br>2. Urya inshuro nke?<br>3. Urya ibiryo byinshi?<br>4.Urya ibiryo bike? | \|_____\|<br>\|_____\| |
| 61. Urya inshuro zingahe ku munsi? | Andika umubare | \|_____\| |
| Ukunda gufata ifunguro rito hagati yamafunguro manini? | 1 = Yego 0= Oya | \|_____\| |
| 62. Niba ari yego, kandgahe ku munsi? | Andika umubare | \|_____\| |
| 63. Niba ari oya, kubera iki? | Andika impamvu<br>_____ | |
| 64. Ujya usimbuka ifunguro/ wiyiriza? | 1 = Yes 0= No | \|_____\| |

| | | |
|---|---|---|
| 65. Niba ari yego, kubera iki? | Andika impamvu | \|_____\| |
| 66. Iyo utwite ujya ufata ikiruhuko cya nyuma ya saa sita nibura amasaha 2 ? | 1 = Yego 0= Oya (niba ari oya jya ku kibazo cya 67) | \|_____\| |
| 67. Kubera iki ufata icyo kiruhuko? | Andika impamvu---------- | |
| 68. Niba ari oya kubera iki utagifata? | Andika impamvu---------- | |
| 69. Ku kigonderabuzima bakunda kubaha inyunganira mirire? | 1 = Yego 0= Oya | \|_____\| |
| 70. Niba ari yego, iyo baziguhaye ukunda kuzifata buri gihe? | 1 = Yego 0= Oya<br>(niba ari YEGO simbuka ikibazo cya 71) | \|_____\| |
| 71. Niba ari oya, kubera iki? | Andika impamvu<br>_____ | \|_____\| |
| 72. Abaganga bajya babereka uko umugore utwite ategura indyo yuzuye? | 1 = Yego 0= Oya | \|_____\| |
| 73. Ujya witabira gahunda y'igikoni cy'umudugudu? | 1 = Yego 0= Oya | \|_____\| |
| 74. Uri mu cyiciro cy'ababahabwa ifu ya shishakibondo? | 1 = Yego 0= Oya | \|_____\| |
| 75. Ujya uhabwa ibinini by'inzoka iyo utwite? | 1 = Yego 0= Oya | \|_____\| |
| 76. Ubusanzwe Umugore utwite bamuha inzitiramibu y'ubuntu? | 1 = Yego 0= Oya | \|_____\| |
| 77. Mwumva ari iki cyakorwa kugira ngo imirire yumugore utwite irusheho kumera neza? | Andika igisubizo<br>_____ | |

**Igice cya 9: Ubufasha/gushyigikirwa igihe umubyeyi atwite**

78. Mu magambo akurikira toranyamo iryo wumva rihuye n'urugero ushyigikiweho

| Soma aya magambo | Buri gihe | Kenshi | Rimwe na rimwe | Gake | Nta na rimwe |
|---|---|---|---|---|---|

| | | | | | | |
|---|---|---|---|---|---|---|
| 1 | Mfite inshuti nziza zinyitaho | 5 | 4 | 3 | 2 | 1 |
| 2 | Mfite abaturanyi bo hafi banyitaho | 5 | 4 | 3 | 2 | 1 |
| 3 | Mfite abantu mu gace ntuyemo banyitaho | 5 | 4 | 3 | 2 | 1 |
| 4 | Mfitanye amakimbirane n ‘abaturanyi | 5 | 4 | 3 | 2 | 1 |
| 5 | Umuryango wanjye umba hafi igihe cyose | 5 | 4 | 3 | 2 | 1 |
| 6 | Hari amakimbirane mu muryango wanjye mvukamo/mbamo | 5 | 4 | 3 | 2 | 1 |
| 7 | Mfite amakimbirane n’umuryango wanjye mugali | 5 | 4 | 3 | 2 | 1 |
| 8 | Umugabo wanjye aramfasha cyane | 5 | 4 | 3 | 2 | 1 |
| 9 | Umugabo wanjye dufitanye amakimbirane | 5 | 4 | 3 | 2 | 1 |
| 10 | Mfitanye amakimbirane no kwa data bukwe | 5 | 4 | 3 | 2 | 1 |
| 11 | Umugabo wanjye ampozaho ijisho (arankontorora bikabije) | 5 | 4 | 3 | 2 | 1 |
| 12 | Umugabo wanjye mbona ankunda | 5 | 4 | 3 | 2 | 1 |

| Ikindi warenzaho |
| --- |
| |

## Appendix 11: Interview and Focus group discussion guides (English versions)

**Interview guide for Pregnant women**

**Factors associates with maternal dietary practices among pregnant women attending antenatal care services in the Southern Province of Rwanda**

**Health center: ……... Date…….**

**Participant ID……**

Welcome to this interview and thank you for responding to our invitation. I'm Aline UWASE, an assistant lecturer at the University of Rwanda and a Ph.D. student at Wits University, Johannesburg. I am interested in learning more about the dietary practices of pregnant women and to better understand the factors that influence this. Today we will be talking about your nutrition/diet as a pregnant woman. This discussion will last between 45-60 minutes. Do you have another question before we start the interview?

1. **When you realised/discovered you were pregnant, did you change your diet/what you ate in any way? If yes, why and how?**

Probes: What kinds of food do you eat? How is this different from before?

- How Often? Why?
- What don't you eat? Why?
- What foods do you think are healthy for you and your baby?

2. **How is it easy to obtain healthy foods?**

Probes: Are there any foods that are culturally encouraged for pregnant women?

  - If any, could you please tell me why such foods are encouraged?

- What are the culturally avoided foods/drinks for pregnant women?
  - If any, could you please tell me why such foods are avoided?

3. **Where do you get information about nutrition and diet from?**

Probes: Family members? Neighbours (other women)? Social media? CHWs? HCPs?

- What nutritional information do you get from that source?

- Which source of information do you trust more and why?

4. **Is there anyone that plays a role in influencing what you eat during your pregnancy?**

Probes: Male partners? Mother in law? Mother? Other family members? Neighbours? Health care providers?

- How/ why that particular person influences what you eat?

5. **What other factors/things influence what you have been eating during this pregnancy?**

Probes: Availability of food? Economic status? Social support? Knowledge? Owning the kitchen garden? Being part of Girinka program? Please tell me more about this**?**

6. **How do you feel when you know you are not eating enough or the right foods?**

Probes: fears of food insecurity, how do you manage that?

7. **How do you think what you eat influences your health and the health of your baby?** Baby growth. How?
   Maternal health? How?

Thank you very much for your time and effort. Your responses will be useful to our research. Do you have anything else to say?

---

## Interview guide for Health care providers

**Factors associates with maternal dietary practices among pregnant women attending antenatal care services in the Southern Province of Rwanda**

**Health center: ……... Date…….**

**Participant ID……**

Welcome to this interview and thank you for responding to our invitation. I'm Aline UWASE, an assistant lecturer at the University of Rwanda and a Ph.D. student at Wits University, Johannesburg. Today we will be talking about the nutrition of pregnant women. In this study, we are trying to better understand the perceptions and experiences of people from this community, including yours, towards the dietary practices of pregnant women. This discussion will last between 45-60 minutes. Do you have another question before we start the interview?

1. **What do you think influences what pregnant women in this community eat?**

Probes: culture? Nutritional knowledge?

- why do you say that? Tell us more about how it influences what pregnant women eat?

2. **In this facility, what support is given to pregnant women to ensure they, and their babies are getting the best nutrition?**
3. **What kinds of nutrition information do you and other HCPs discuss with pregnant women during ANC visits?**

Probes:

- Eating habits? Tell us more rather than why throughout. Or vary it a little.
- Dietary diversity? Why?
- Iron and Folic Acid consumption? Why?
- Weight gain? Why?

4. **is nutrition information discussion with pregnant women integrated into each ANC session? Every visit?**
    - where did you get the nutritional information you provide to pregnant women from? Schools? in service training? Social media? CPD?
5. **Do you experience any challenges when delivering nutritional information to pregnant women? Please tell us more**

Probes:

- Shortage of guideline sources? How?
- Lack of nutritional training? How?
- Shortage of human resources? How?
- A lot of work? How?
- Cultural beliefs? How?

6. **How do you offer support to women who tell you that they are not eating the right foods or enough of the right foods?**

    What do you do when a woman is underweight and/or there is evidence that the baby is not thriving? Are there other NGOs/government departments/others that you can refer to? Where would a woman go to for help and support.
7. **What do you think could be done to help improving nutritional counseling to pregnant women?**

Thank you very much for your time and effort. Your responses will be useful to our research. Do you have anything else to say

---

## Focus Group Discussion Guide for Male partners

**Factors associates with maternal dietary practices among pregnant women attending antenatal care services in the Southern Province of Rwanda**

**Health center ID: ……... Date…….**

Welcome to this focus group discussion and thank you for responding to our invitation. I'm Aline UWASE, an assistant lecturer at the University of Rwanda and a P.H.D student at Wits University, Johannesburg. Today we will be talking about the nutrition of pregnant women. We are concerned with the perceptions and experiences of people from this community including yours towards the dietary practices of pregnant women. This discussion will last between 45-60 minutes. Do you have another question before we start the interview?

1. **How do you support your wife/partner remain healthy through their pregnancy so that they and the babies are well and healthy?**
2. **Do you offer any support to make sure she is eating well? What do you do? How do you do this?**

Probes:

- Giving her money? How does it affect their nutrition?
- Buying food? How does it affect their nutrition?
- Take her to ANC? How does it affect their nutrition?
- Reminding her taking micronutrient supplement? How does it affect their nutrition?
- Allowing her a time to rest? How does it affect their nutrition?
- Check her weight gain? How does it affect their nutrition?

3. **What do you think a pregnant woman should eat?**

Probes:

- Food types? Why? How often?
- How do you know this? where did you learn this information?
- Which source do you trust more and why?

4. **Could you please tell me what a pregnant woman should not eat?**

Probes:

- Food types? Why?

- How do you know this? where did you learn this?

5. **What do you think is the effect of dietary practices on maternal and child health?**

- Baby growth. How?
- Maternal weight gain. How?
- Term delivery. How?
- Prevent anaemia and its complication. How?
- How did you know this information?

6. **What are the barriers that hinder you providing a nutritional support to your pregnant women partners?**

Probes:

- Cultural factors? How?
- Economic factors? How?
- lack of nutritional knowledge? How?
- Food insecurity? How?

7. **How do you feel when you are unable to ensure good nutrition to your pregnant women?**

Thank you very much for your time and effort. Your responses will be useful to our research. Do you have anything else to say?

---

## Appendix 12: Interview and Focus group discussion guides (Kinyarwanda version)

### INYOBORAKIGANIRO N'ABAGORE BATWITE

**Imirire yabagore batwite nimpamvu nyamukuru ziyitera, mubagore batwite baza ku bigonderabuzima byintara yamagepfo mu Rwanda**

**Ikigonderabuzima……. Itariki……**

**Numero iranga uwitabiriye ikiganiro ……**

Ndagushimira ko witabiriye ubutumire bwacu, nkwifurije ikaze muri iki kiganiro. Nge mugiye kuganira nitwa…….
nkaba ndi umwe mubagize iyi kipe yubushakashatsi. Uyu munsi turaganira ku bibazo bimwe na bimwe bifitiye akamaro abagore n'abana mu gace utuyemo aribyo imirire y'umugore utwite. Dushishikajwe no kumenya ibitekerezo n'imikorere y'abantu bo mugace utuyemo harimo ibyawe kimwe nuburyo amakuru yerekeye imirire y'ababyeyi batwite yigwa. Iki kiganiro kiramara hagati yiminota 45-60 kandi turakoresha akuma gafata amajwi nkuko twabigusobanuriye mbere ukanabisinyira. Hari ikindi kibazo ufite mbere yuko dutangira ikiganiro?

1. **Igihe wamenyaga ko utwite wigeze uhindura uburyo bwo kurya? Niba ari yego gute kandi kubera iki?**
   - ***Ibibazo:*** Nibihe biribwa nyamukuru urya? bitandukaniye he nka mbere yo gutwita? Kubera iki?
   - Urya inshuro zingahe? Kubera iki?
   - Ni ibiki utarya? Kubera iki?
   - Ni ibihe biribwa utekereza ko bifite akamaro ku buzima bw'umubyeyi utwite numwana atwite?
2. **Bikorohera gute kubona indyo yuzuye?**
   - Ni ibihe biryo / ibinyobwa umuco ushishikariza abagore batwite gufata?
   - Niba bihari, ushobora kumbwira impamvu ibiryo nkibi babashishikariza kubifata?
   - Ni ibihe biryo / ibinyobwa umuco ushishikariza abagore batwite kudafata?
   - Niba bihari, ushobora kumbwira impamvu babasaba kubyirinda?
3. **Nihe ukura amakuru yimirire y'umugore utwite?**

- ***Ibibazo:*** Abagize umuryango? Abaturanyi (abandi bagore/babyeyi)? Imbuga nkoranyambaga? Abajyanama bubuzima? abaganga?
- Ni ayahe makuru yimirire wakuye muri buri hantu?
- wizera cyane amakuru wakuye he? kandi kuki?

4. **Ninde ugira uruhare mubyo urya igihe utwite?**

   ***Ibibazo***: umugabo wawe? Nyokobukwe? Abandi bagize umuryango? Abaturanyi? Abaganga?

   • Nigute / kuki agira uruhare mubyo umugore utwite arya?

5. **Ni ibihe bintu bindi nyamukuru bigira uruhare mubyo urya nuburyo urya igihe utwite?**
   - ***Ibibazo:*** Kuboneka kw'ibiryo? Imiterere y'ubukungu? Ubufasha bw'abo mu muryango cg abaturanyi? Ubumenyi bw'imirire? Kugira akarima kigikoni? Kuba muri girinka munyarwanda?
   - Nigute buri cyiciro kibigiramo uruhare? Gira icyo ubimbwiraho.

6. **Wumva umeze ute iyo utekereje ko uri kurya indyo ituzuye itanahagije?**
   - Ubikoraho iki?

7. **Utekereza ko imiririe yumugore utwite hari icyo imara ku buzima bw'umubyeyi n'umwana?** Gute? Bisobanure neza?

Urakoze cyane kubisubizo byawe. Bizaba ingirakamaro rwose kur'ubu bushakashatsi. Hari ikintu ntigeze mbaza, wifuza kongeraho?

---

## INYOBORAKIGANIRO N'ABAGANGA

## Imirire yabagore batwite nimpamvu nyamukuru ziyitera, mubagore batwite baza ku bigonderabuzima byintara yamagepfo mu Rwanda

**Ikigonderabuzima……. Itariki……**

**Numero iranga uwitabiriye ikiganiro ……**

Ndagushimira ko witabiriye ubutumire bwacu, nkwifurije ikaze muri iki kiganiro. Nge mugiye kuganira nitwa……nkaba ndi umwe mubagize iyi kipe yubushakashatsi. Uyu munsi turaganira ku bibazo bimwe na bimwe bifitiye akamaro abagore n'abana mu gace utuyemo

aribyo imirire y’umugore utwite. Dushishikajwe no kumenya ibitekerezo n'imikorere y’abantu bo mugace utuyemo harimo ibyawe kimwe nuburyo amakuru yerekeye imirire y'ababyeyi batwite yigwa. Iki kiganiro kiramara hagati yiminota 45-60 kandi turakoresha akuma gafata amajwi nkuko twabigusobanuriye mbere ukanabisinyira. Hari ikindi kibazo ufite mbere yuko dutangira ikiganiro?

8. **Utekereza ko ari iki kigira uruhare mubyo abagore batwite barya muri aka gace?**

Probes:

- Umuco? Ubumenyi bw’imirire? Kuboneka kw’ibyo kurya?

9. Kubera iki uvuze ibyo? Nsobanurira neza
10. **Muri iki kigonderabuzima, ni ubuhe bufasha muha abagore batwite kugira ngo bo n’abo batwite bagire imirire myiza?**
11. **Ni ayahe makuru ajyanye nimirire, wowe cg bagenzi bawe muha abagore batwite iyo baje kwipimisha inda?**
    - Eating habits
    - Guhinduranya indyo
    - Gufata ibinini bya fer
    - Kwiyongera ibiro
    - Kubera iki buri makuru? Nsobanurira neza
12. **Buri munsi uko ababyeyi baje kwipimisha mubaganiriza kubyerekeranye nimirire yumugore utwite?**
    Amakuru mubaha muyakura he? Ku ishuri? amahugurwa? imbuga nkoranyambaga? Nsobanurira neza.
13. **Ni izihe mbogamizi uhura nazo cg bagenzi bawe mugihe mutanga amakuru yimirire kubagore batwite?**
    - Ibura ry'imfashanyigisho ngenderwaho? sobanura?
    - Kubura amahugurwa yimirire? gute?
    - Ibura ry'abakozi? gute?
    - Akazi kenshi? Umuco? Nsobanurira neza
14. Ni ubuhe bufasha muha umubyeyi mubona ko afite imirire mibi? Cg iyo bigaragara ko umwana adakura neza? Hari indi miryango itegamiye kur leta mumwoherezamo ngo bamufashe? Cg hari ahandi hantu mumwohereza ngo ahabwe ubufasha kubijyanye nimirire?
15. Utekereza ko hakorwa iki ngo ubujyanama muha abagore batwite burusheho gukorwa neza?

Urakoze cyane kubisubizo byawe. Bizaba ingirakamaro rwose kur'ubu bushakashatsi. Hari ikintu ntigeze mbaza, wifuza kongeraho ?

---

## IKIGANIRO MW'ITSINDA RY'ABAGABO

**Imirire yabagore batwite nimpamvu nyamukuru ziyitera, mubagore batwite baza kwipimisha mu bigonderabuzima by'intara yamagepfo mu Rwanda**

**Ikigonderabuzima……. Itariki……**

Ndabashimira ko mwitabiriye ubutumire bwacu, mbifurije ikaze muri iki kiganiro. Nge mugiye kuganira nitwa……mfatanyije na ……. Tukaba turi mubagize iyi kipe yubushakashatsi. Uyu munsi turaganira ku bibazo bimwe na bimwe bifitiye akamaro abagore n'abana mu gace dutuyemo aribyo imirire y'umugore utwite. Dushishikajwe no kumenya ibitekerezo n'imikorere y'abantu bo mugace mutuyemo harimo ibyanyu kimwe n'uruhare rwanyu mugutuma abagore batwite bagira imirire myiza. Iki kiganiro kiramara hagati yiminota 45-60 kandi turakoresha akuma gafata amajwi nkuko twabibasobanuriye mbere mukanabisinyira. Hari ikindi kibazo mufite mbere yuko dutangira ikiganiro?

8. **Ese mwambwira icyo umugore utwite agomba kurya?**

*Sobanuza:* Ubwoko bwibiryo? Kubera iki? Kangahe ku munsi? Kubera iki?

- Ibyo wabimenya ute? ibi wabyize he?
- Ni he wakuye amakuru wizera cyane kurusha ahandi? Kubera iki?

2. **Noneho se mwambwira icyo umugore utwite atagomba kurya?**

- *Sobanuza:* Ubwoko bwibiryo? Kubera iki?
- Ibyo wabimenya ute? ibi wabyize he?
- Ni he mwakuye amakuru mwizera kurusha ahandi? Kubera iki?

3. **Mutekereza ko akamaro kimirire myiza mugihe umugor atwite ari akahe?**

*Sobanuza:* Ku mikurire yumwana? Sobanura neza

- Kongera ibiro byumubyeyi? Sobanura neza
- Kubyarira igihe? Sobanura neza
- Birinda kubura amaraso kumubyeyi? Sobanura neza
- Ayo makuru mwayamenye mute?

4. **Ni ubuhe bufasha muha abagore banyu igihe batwite kugira ngo bagire imirire myiza? Mukora iki? Mubigenza mute?**

*Sobanuza:* Kumuha amafaranga? Ni gute bigira ingaruka ku mirire yabo?

- Kugura ibiryo? Ni gute bigira ingaruka ku mirire yabo?
- Kumujyana kwipimisha? Ni gute bigira ingaruka ku mirire yabo?
- Kumwibutsa gufata inyunganiramirire? Ni gute bigira ingaruka ku mirire yabo?
- Kumwemerera umwanya wo kuruhuka? Ni gute bigira ingaruka ku mirire yabo?
- kureba uko yiyongereye ibiro? Ni gute bigira ingaruka ku mirire yabo?

5. **Ni izihe nzitizi muhura nazo igihe mufasha abagore banyu kugira imirire myiza iyo batwite?**

*Sobanuza:* Impamvu z'umuco? Sobanura neza

- Impamvu zubukungu? Sobanura neza
- kubura ubumenyi bwimirire? Sobanura neza
- Kubura kwibiribwa Sobanura neza

6. **Wumva umeze ute iyo udashoboye kubonera umugore wawe indyo iboneye igihe atwite? Sobanura neza**

Murakoze cyane kubisubizo byanyu. Bizaba ingirakamaro rwose kur'ubu bushakashatsi. Hari ikintu ntigeze mbaza, mwifuza kongeraho ?

---

# Appendix 13: Original paperPaper1

PLOS ONE

RESEARCH ARTICLE

## Dietary diversity and associated factors among pregnant women in the Southern Province of Rwanda: A facility-based cross-sectional study

**Aline Uwase**[1]*, **Etienne Nsereko**[1], **Nirvana Pillay**[2], **Jonathan Levin**[3]

1 University of Rwanda College of Medicine and Health Sciences, Kigali, Rwanda, 2 University of Witwatersrand School of Public Health, Johannesburg, South Africa, 3 University of Witwatersrand School of Public Health, Pretoria, South Africa

* aliuwase@yahoo.fr

Check for updates

OPEN ACCESS

**Citation:** Uwase A, Nsereko E, Pillay N, Levin J (2024) Dietary diversity and associated factors among pregnant women in the Southern Province of Rwanda: A facility-based cross-sectional study. PLoS ONE 19(2): e0297112. https://doi.org/10.1371/journal.pone.0297112

**Editor:** Zakari Ali, MRC Unit The Gambia at LSHTM, GAMBIA

**Received:** April 25, 2023

**Accepted:** December 28, 2023

**Published:** February 23, 2024

**Copyright:** © 2024 Uwase et al. This is an open access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

**Data Availability Statement:** All relevant data are within the paper and its Supporting Information files.

**Funding:** This study has been supported by the Consortium for Advanced Research Training in Africa (CARTA). CARTA is jointly led by the African Population and Health Research Centre and the University of the Witwatersrand It is funded by the Carnegie Corporation of New York (Grant No. G-19-57145), Sida (Grant No. 54100113), the Uppsala Monitoring Centre, the Norwegian Agency for Development Cooperation (Norad), the Wellcome Trust [reference no. 107768/Z/15/Z], and the UK Foreign, Commonwealth & Development Office, with support from the Developing Excellence in Leadership, Training, and Science in Africa (DELTAS Africa) programme. The statements made, and views expressed are solely the responsibility of the Fellow. The funders had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript.

**Competing interests:** The authors have declared that no competing interests exist.

### Abstract

The inadequate dietary diversity of pregnant women in low- and middle-income countries, including Rwanda, is rising and leading to macro and micronutrient deficiencies. The extent of dietary diversity and the factors contributing to it are unknown in Rwanda. This cross-sectional study, with 612 women who attended antenatal care services in Rwanda's Southern Province, identified determinants of dietary diversity among pregnant women. A multistage sampling scheme was used in which four districts were sampled, thereafter one urban and one rural health centre was sampled in each district and finally, a systematic sample of pregnant women was selected in each sampled health centre. Dietary diversity was measured using Minimum Dietary Diversity for Women (MDD-W), and multiple logistic regression models were fitted to identify factors associated with dietary diversity. Only 44.1% (95% confidence interval (CI) of [40.1%, 48.0%]) of participants had adequate dietary diversity. Approximately 95.4% of participants consumed grains, white roots, and tubers. The food groups that were the least consumed consisted of eggs (n = 99, 16.4%), as well as those consisting of milk and milk products (n = 112, 18.5%). The factors which were positively associated with dietary diversity were owning a radio (adjusted odds ratio [aOR] = 1.90 [95% CI 1.27, 2.85]), maternal education (aOR = 1.85 [95% CI 1.28, 2.65]), having a kitchen garden (aOR = 1.69 [95% CI 1.11, 2.57]) and nutrition knowledge score (aOR = 1.45 [95% CI 1.21, 1.74]) for a five-point increase in nutrition knowledge score. The factors negatively associated with dietary diversity include food insecurity, which reduced the odds of dietary diversity (aOR = 0.19 [0.07, 0.50]) per five-unit increase in food insecurity. Furthermore, the odds of adequate dietary diversity were lower among urban residents than rural residents (aOR = 0.69 [0.47, 1.03]). The household size was associated with dietary diversity with the odds of dietary diversity decreasing by 12% for a five-unit increase in household size (aOR = 0.88 [0.79; 0.99]) . 23% had poor nutritional status, indicated by their mid-upper arm circumference (MUAC; < 23 cm). Enhanced nutritional education is needed to improve the nutritional knowledge of this population with particular emphasis on the consumption of animal-source foods. Sensitisation activities promoting ownership of kitchen gardens and radios could improve dietary diversity among Rwanda's pregnant women.





### Introduction

Pregnancy is a significant and nutritionally demanding period of a woman's life [1] because the physiological changes that ensure foetal growth and development lead to higher nutritional demands during pregnancy. The World Health Organization (WHO) recommends that pregnant women adopt healthy dietary practices by consuming adequate protein, carbohydrates, vitamins, and minerals [2]. To comply with this recommendation, the National Food and Nutrition Policy of Rwanda recommends intervention packages that combine nutritional education about consuming nutritious and diverse foods and improved agricultural practices. These agricultural practices include 1) kitchen gardens to promote access to minerals and vitamins through vegetables; and 2) livestock ownership, mainly through the Girinka program (meaning "one cow-per-poor family") to promote access to proteins and other nutrients [3].

These National Food Nutrition Policy interventions were introduced because adherence to a diverse daily diet is the main strategy for complying with the WHO recommendation [4]. Dietary diversity is defined as the 'number of food types consumed through and within food groups during a specified period' [5]. It is frequently reported as a proxy indicator of diet quality and can be summarised using the number of food groups consumed during the previous 24 hours [6]. Dietary diversity promotes good health by preventing micronutrient deficiencies [7]. Inadequate dietary diversity, which is consuming fewer than five food groups in the previous 24 hours, is prevalent among pregnant women in low- and middle-income countries [8].

Studies report a high prevalence of poor dietary diversity during pregnancy in Oromia, Ethiopia (74.6%) [7], North East Ethiopia (68.6%) [9], and Tanzania (54%) [10]. A study in Nigeria found that many women consumed vegetables, and among them, half practised food restrictions with regard to meat, eggs, and fish due to food taboos [11]. Women in low- and middle-income countries have a starch-based diet that is largely deficient in animal-source foods and vegetables and fruit, which are rich in protein and minerals needed for the foetus [12].

When pregnant women do not diversify their diets, it leads to nutritional deficits, which is a public health concern in low- and middle-income countries. Maternal undernutrition varies between 10% and 19% in many countries of sub-Saharan Africa, as well as in south-eastern and south-central Asia [13]. In developing countries, more than half of all pregnant women have nutritional anaemia [14]; The prevalence of anaemia among reproductive women is 52.5% in the WHO South Asian region and 46% in the African region [14].

Poor nutritional status during pregnancy negatively affects the physiological growth of the foetus and increases the risk of preterm delivery, low birth weight, and maternal morbidity and mortality [15]. The effect of deficient nutritional intake during pregnancy significantly shapes foetal health and exposure to some adulthood non-communicable diseases. However, high dietary diversity results in sufficient nutrients to ensure proper foetal growth [16].

Different factors contribute to dietary diversity during pregnancy. Studies report that factors associated with good dietary diversity during pregnancy include adequate knowledge of proper nutrition [17], middle to high income, and demographic characteristics, such as maternal age, education, occupation, and marital status [18]. In addition, food security, including both accessibility and affordability, is associated with dietary diversity [19]. Ownership of a radio, livestock, and a home garden positively affects dietary diversity [20]. Furthermore, cultural beliefs and food taboos can negatively affect the dietary diversity of pregnant women

because these taboos apply to green vegetables, cheese, yoghurt, green peppers, sugar cane, and other nutritious foods [21, 22].

There is a shortage of studies on the factors associated with dietary diversity among pregnant women in Rwanda. A 2017 study conducted in Kigali City reported that 50% of study participants did not achieve the Minimum Dietary Diversity for Women (MDD-W) score [23]; however, the study did not assess the factors contributing to this low score. Addressing this gap is critical because the 2019–2020 Demographic and Health Survey of Rwanda report that anaemia among pregnant women has increased from 17% in 2010 to 25% in 2020, and the Southern Province accounted for the highest prevalence of anaemia [24]. Approximately 9% of the women in the Southern Province were underweight with a body mass index (BMI) < 18.5, compared to 6% of women nationally [25]. Poor maternal dietary diversity could have contributed to this high prevalence of anaemia and low BMI among pregnant women. Therefore, this study assessed the status of dietary diversity, its determinants, and the nutritional status of pregnant women in the Southern Province of Rwanda.

## Methods and materials

### Study design and setting

This cross-sectional study was conducted with pregnant women receiving antenatal care (ANC) services. It was conducted in the Southern Province of Rwanda, which shares its borders with Kigali City and the Northern Province to the North, the Republic of Burundi to the South, the Eastern Province to the East, and the Western Province to the West. In 2017, the Southern Province was ranked the second among five Provinces in having household food insecurity (20.5%) and the third in the poverty rate, which increased from 12.9 to 16.9% [26]. According to the 2014–2015 Demographic and Health Survey of Rwanda and the 2019–2020 Demographic and Health Survey results, the Southern Province accounted for the highest prevalence of underweight and anaemic pregnant women. Data were collected within two months, from May 16$^{th}$ to July 18$^{th}$ 2022.

### Study population, sample size determination and sampling procedure

Adult pregnant women (> 18 years) who self-reported being healthy in their second or third trimester were recruited to participate in the study. Women who were not healthy were excluded because some chronic diseases require special diets, which could affect dietary diversity. Pregnant women in their first trimester were excluded because most pregnant women are physiologically unstable and experience dietary disturbances, which could affect their dietary diversity.

A sample size of 612 pregnant women was chosen as the appropriate sample size to estimate the proportion of pregnant women with adequate dietary diversity to within 5%, using the formula [27]: $n = \frac{Z^2 p(1-p)}{d^2}$.

We assumed that the proportion of women with adequate dietary diversity would be approximately 50%, which would make our sample size calculation slightly conservative. A sample size of 385 was considered sufficient to estimate the proportion to within ± 5% (as measured by the 95% CI for the proportion). This sample size assumed that a simple random sample of women was recruited; thus, allowances needed to be made for any clustering effects of women within a clinic. Assuming a moderate design effect of 1.5 increased the sample size to 578, and allowing for a 6% of refusal rate led to the final sample size of 612.

A multistage sampling scheme was used to sample 612 pregnant women. At the first stage four out of the eight districts in the Southern Province were selected using simple random

sampling. At the second stage in each of the four sampled districts one urban health centre and one rural health centre were selected using stratified random sampling (with the strata being "rural" and "urban"). This gave a selected sample of eight health centres. Since each health centre was expected to receive about 200 pregnant women monthly, this would give an expected total of approximately 1600 pregnant women. Since we required a sample of 612 women, the sampling interval was approximately 3. In each of the sampled health centres a systematic sample of pregnant women was selected with a random start after which every third woman was sampled.

### Data collection process

Before data collection, eight interviewers (nurses and midwives) were trained for three days to collect quantitative data including anthropometric measurements. They were informed about the study's purpose, data collection process and data collection tools. Data collection tools were translated into the local language (Kinyarwanda), and they were pre-tested in health centres which were not part of the study to ensure that all questions were clear and interviewers had the same understanding of them. After the pre-test, a few questions were adjusted for clarity. In addition, data collection tools were anonymous and Codes were used to identify the participants. Two interviewers were allocated to each district to collect data from the health centres located in that particular district. Interviewers approached the healthcare providers in the ANC service and requested the list of pregnant women registered for ANC consultations. They approached every third pregnant woman and briefly explained the study. Thereafter, the nutritional status of each pregnant woman was evaluated by measuring their MUAC using non-stretchable MUAC tape designed for adults. The literature reports that MUAC is the easiest anthropometric measurement of nutritional status in pregnant women, since it is easy to measure, does not require much training or resources and unlike BMI does not require calculations. Most importantly, MUAC is a better nutritional status indicator than BMI because it changes minimally during pregnancy [28]. Two researchers independently assessed the MUAC value of the non-dominant arm to the nearest 0.1 cm without clothing on the arm [29]. The MUAC of each pregnant woman was recorded, and in case of a difference in measurements between two researchers, the average MUAC was considered. The cut-off MUAC of 23 cm was used as it has been recommended by different authors, especially for Asian and African pregnant women [30]. Pregnant women were assigned to one of two categories: poor nutritional status (MUAC $< 23$ cm) or good nutritional status (MUAC $\geq 23$ cm) [30].

## Measurement of study variables

### Outcome variable

Dietary diversity was assessed using the MDD-W adapted from the Food and Agriculture Organisation guidelines [31] by creating a list of foods that are locally available. The MDD-W indicator consists of 10 food groups; participants receive a score of 1 for a given food group if she consumes at least one item in that food group; otherwise, the participant receives a score of zero for that food group. The assessment was conducted by asking participants to report all drinks and foods they had consumed the previous day (the last 24 hours), and a probing technique was used to help pregnant women recall all foods and drinks consumed. A list of 56 local foods was included in the questionnaire and sorted into 10 food groups. This list is provided as a supporting file in S1 Table. The total dietary diversity score was calculated and dichotomised as adequate dietary diversity (consumption of five or more food groups) or inadequate dietary diversity (consumption of less than five food groups) [31].





### Explanatory variables

Data collected on sociodemographic characteristics included occupation, age, marital status, education, and religion, and data on obstetric characteristics included gestational weeks, parity, and the number of ANC visits. The socioeconomic section of the questionnaire assessed participants' ownership of a radio, a mobile phone, and livestock, and their 'ubudehe' category, which is a social stratification based on household income, ranging from the highest income of the richest households, to the lowest income of the poorest and most vulnerable households in society.

Nutritional knowledge was assessed using the questionnaire adapted from the Food and Agriculture Organisation's Knowledge, Attitude, and Practice Manual [32]. It included 13 items, which assessed knowledge of adequate nutrition, recognition and prevention of anaemia during pregnancy, the importance of nutrition during pregnancy, and weight gain, resulting in a score between 0 and 32. Nutritional knowledge was classified as poor ($< 50\%$), moderate (50%-74%), and good ($\geq 75\%$). The items assessed are provided in S2 Table.

We measured the household's food security using the Household Food Insecurity Access Scale designed by Food and Nutrition Technical Assistance [33]. The scale consists of nine 'occurrence questions' and nine questions related to the frequency of occurrence. The occurrence questions characterise different dimensions of food insecurity, and the frequency of occurrence question is skipped if the participant reports that the corresponding occurrence has not occurred during the previous four weeks (30 days). For descriptive statistics, levels of food insecurity included in the Household Food Insecurity Access Scale ranged from no insecurity (score $< 2$), mild insecurity (score 2–10), moderate insecurity (score 11–17), and severe insecurity (score $> 17$). The actual score was used for the multivariable analysis. Questions pertaining to the policy were adapted from the existing Rwandan program to assess the availability of kitchen gardens and being part of the Girinka program (i.e. the one cow per low-income family program).

Social support was assessed using the Maternity Social Support Scale designed by Webster et al. [34]. It covers six items and assesses family support, such as the help from husband, friendship network, conflict with husband/male partner, feeling controlled by husband/male partner, and feeling loved by husband/male partner. Every item was assessed on a five-point Likert scale ranging from 1 to 5 points with a possible maximum score of 30. For descriptive purposes, Maternity Social Support Scale was categorised as low social support (0–18), moderate social support (19–24) and high social support (25–30). However, the actual score was used in data logistic regression.

### Data processing and analyses

Data were cleaned using STATA Release 16, which was also used to analyse the data by computing descriptive statistics, namely frequencies and percentages for the categorical variables and means and standard deviations (SD) for quantitative variables. We did a complete case analysis; those who had fasted on the previous day were excluded from the analysis. In the whole study, there were very few missing values. The procedure explained below was used to select the final multiple logistic regression model for dietary diversity. Initially univariable logistic regression models were fitted to identify factors that were potentially associated with dietary diversity, using a liberal screening p-value of 0.20 to ensure that all potential confounders were investigated. In addition, variables that were part of the design (district and rural/urban) and variables previously identified in the literature as being associated with dietary diversity (age and wealth category) were included in the final model irrespective of statistical significance. The quantitative explanatory variables were included in the model as continuous

variates, with fractional polynomials used to test for any non-linearity in their effect, as several authors have pointed out the disadvantage of categorising continuous exposure variables [35–38]. Once the pool of potential explanatory variables had been identified, backward elimination with a nominal p-value for exclusion of 0.05 was used to select the final model, with district, rural/urban, age and wealth category fixed in the final model, While backward elimination and other stepwise procedures have a number of well-known disadvantages, it is recommended for analyses such as this in which there is no primary exposure of interest, and it has the relative advantage that negatively confounded sets of variables are less likely to be omitted from the model since all important explanatory variables are included in the initial model. This recommendation can be found in chapter 10 of Regression Methods in Biostatistics: Linear, Logistic, Survival and Repeated Measures Models. Second Edition by Vittinghoff E and colleagues in (2012). Due to the small number of clusters (8 health centres) in our model, we fitted terms for district and rural/urban rather than adjusting for clusters as random effects. The impact of factors on dietary diversity was expressed as odds ratios with 95% confidence limits. Interactions involving the main exposures of interest (ownership of a radio, having a kitchen garden, food insecurity and nutritional knowledge) were investigated but none were found to be statistically significant. Potential multicollinearity was investigated through looking at the variance inflation factors for the final model, but no multicollinearity was found. In addition, we checked for goodness of fit of the final model using the Hosmer-Lemeshow goodness of fit test, which showed no evidence of lack of fit. We computed the Cronbach alpha for food insecurity which became 0.93 and maternal social support, which became 0.74 indicating acceptable reliability.

### Ethics approval and consent to participate

The implementation of this study complied with the Declaration of Helsinki. This study was a part of a research project that has been approved by relevant authorities. Ethical clearances were secured from the Institutional Review Board of the University of Rwanda, where the study was conducted (287/CMHS IRB/2021), and the Human Research Ethics Committee (Medical) of the University of Witwatersrand, where the corresponding author is registered (M211046). Before the survey, participants provided written consent to be part of the study after receiving comprehensive details about the purpose, benefits, and risks of participation. Participants were also assured that their participation was voluntary and that the information they provided would remain confidential. They signed the consent form or provided fingerprints (for illiterate) as they were above18 years old.

## Results

### Sociodemographic, economic, and obstetric characteristics of participants

Of the 612 pregnant women who participated in this study, six who reported that they had fasted 24 hrs before the interview date were excluded from the analysis because, in this case, the previous 24 hours were deemed not representative of their usual dietary diversity practices. Therefore, the data analysis included 606 participants. The mean age of the participants was (28 ± 6.5 SD) years. A large proportion of participants (n = 267) was between 25 and 34 years old, and 138 (51.7%) of them presented with inadequate dietary diversity. A total of 402 participants attended primary school; among them, 254 (63.2%) had inadequate dietary diversity. A total of 498 participants were married and more than half of them had inadequate dietary diversity (n = 265, 53.2%). Many participants (n = 243) reported being in the second wealth category (poor), and among them, 140 (57.6%) had inadequate dietary diversity; 306 women were classified as experiencing severe food insecurity, and the majority of these women had





inadequate dietary diversity (n = 203, 66.3%). As for their clinical characteristics, most of the participants attended two to three ANC visits (n = 394) and 212 (53.8%) had inadequate dietary diversity (Table 1).

### Dietary diversity of pregnant women

This study found that the mean dietary diversity score was 4.40 (SD = 2.14). Details about dietary diversity score are provided in S3 Table. Less than half of the participants had adequate dietary diversity (n = 267, 44.1%), with a 95% CI of [40.1%, 48.0%]. The most consumed food group was that consisting of grains, white roots, tubers (n = 584, 96.4%), and pulses (n = 475, 78.4%). The food groups that were the least consumed consisted of eggs (n = 99, 16.4%), as well as those consisting of milk and milk products (n = 112, 18.5%). More details are provided in (Table 2).

### Nutritional status and dietary diversity of pregnant women in the Southern Province

In this study, 141 (23.1%) pregnant women had a MUAC < 23 cm, indicating poor nutritional status. The mean MUAC was 24.8 cm (SD = 2.64) and the proportion of participants with poor nutritional status was higher among those with inadequate dietary diversity (25.7% vs 19.1%), which was a marginally significant ($p = 0.053$) difference (Table 3).

### Determinants of dietary diversity of pregnant women in the Southern Province of Rwanda

The results of fitting multiple logistic regression models to find factors associated with adequate dietary diversity are summarised in Table 4. The adjusted odds ratio (aOR) for owning a radio was 1.90 with a 95% CI of [1.27, 2.85] and having a kitchen garden (aOR = 1.69 [1.11, 2.57]) increased the likelihood of adequate dietary diversity. Food insecurity was associated with inadequate dietary diversity, as indicated by the aOR < 1 for adequate dietary diversity (aOR = 0.19 [0.07, 0.50]). Other factors associated with dietary diversity were maternal education (aOR = 1.85 [1.28, 2.65]) nutritional knowledge (aOR = 1.45 [1.21, 1.74]), household size (aOR = 0.88 [0.79,0.99]), and urban residence (aOR = 0.69 [0.47, 1.03]) showing a significant difference in dietary diversity among the four districts ($p < 0.001$) with the odds of dietary diversity being highest in Kamonyi district (Table 4). The overall variance inflation factor was 1.43 and the highest was 2.65; the Hosmer-Lemeshow goodness of fit test showed no evidence of a lack of fit (P = 0.469).

## Discussion

This study assessed the dietary diversity of pregnant women who attended ANC services in the Southern Province of Rwanda and investigated the factors associated with adequate dietary diversity. Less than half of all the pregnant women (44.1%) met the minimum dietary diversity criterion of consuming at least five food groups in the previous 24 hours. The determinants of dietary diversity among the study participants include owning a radio, having a kitchen garden, food insecurity, nutritional knowledge, maternal education, household size, and being urban residents.

The proportion of pregnant women who achieved adequate dietary diversity (44.1%) was lower than the proportions reported in studies conducted in Hosanna Town, Ethiopia (57.4%) [20], Southwest Ethiopia (48.3%) [39], Nepal (55%) [40], and the Gurage Zone, Ethiopia (57.9%) [18]. However, the proportion was higher than those reported in studies conducted in

Table 1. Sociodemographic, economic, and obstetric characteristics of participants.

| Factor | Category | Dietary Diversity | | Total (N = 606) |
|---|---|---|---|---|
| | | Adequate n (%) | Inadequate n (%) | |
| **Overall** | | 267(44.1) | 339(55.9) | |
| **Age (years)** | **Mean (SD)** | 29(6.7) | 28(6.2) | 28(6.5) |
| | 18–24 | 91 (41.2) | 130 (58.8) | 221 |
| | 25–34 | 129(48.3) | 138 (51.7) | 267 |
| | ≥ 35 | 47(39.8) | 71(60.2) | 118 |
| **Education** | None | 12(35.3) | 22(64.7) | 34 |
| | Primary | 148(36.8) | 254(63.2) | 402 |
| | Secondary and above | 107(62.9) | 63(37.1) | 170 |
| **Religion** | Christian | 251(43.4) | 327(56.6) | 578 |
| | Other | 16(57.1) | 12(48.9) | 28 |
| **Occupation** | Housewife | 204(41.5) | 287(58.5) | 491 |
| | Paying job | 63(54.8) | 52(45.2) | 115 |
| **Marital status** | Married | 233(46.8) | 265(53.2) | 498 |
| | Single | 34(31.5) | 74 (68.5) | 108 |
| **Household size** | 1–3 | 136(47.1) | 153(52.9) | 289 |
| | 4–6 | 105(42.3) | 143(57.7) | 248 |
| | ≥ 7 | 26(37.7) | 43(62.3) | 69 |
| **District** | Gisagara | 55(36.2) | 97(63.8) | 152 |
| | Huye | 57(38.3) | 92(61.7) | 149 |
| | Kamonyi | 103(67.3) | 50(32.7) | 153 |
| | Ruhango | 52(34.2) | 100(65.8) | 152 |
| **Residential area** | Rural | 142(47.0) | 160(53.0) | 302 |
| | Urban | 125(41.1) | 179(58.9) | 304 |
| **Gestational weeks** | 13–27 | 100(45.25) | 121(54.75) | 221 |
| | 28–44 | 167(43.4) | 218(56.6) | 385 |
| **Parity** | 0–1 | 155(47.8) | 169(51.2) | 324 |
| | 2–3 | 81(40.1) | 121(59.9) | 202 |
| | > = 4 | 31(38.7) | 49(61.3) | 80 |
| **ANC visits** | 0–1 | 59(37.3) | 99(62.7) | 158 |
| | 2–3 | 182(46.2) | 212(53.8) | 394 |
| | > = 4 | 26(48.2) | 28(51.8) | 54 |
| **Ubudehe category** | Poorer | 55(42.9) | 73(57.1) | 128 |
| | Poor | 103(42.4) | 140(57.6) | 243 |
| | Richer | 101(45.3) | 122(54.7) | 223 |
| | Unknown | 8 (66.67) | 4 (33.3) | 12 |
| **Radio** | No | 93(32.1) | 197(67.9) | 290 |
| | Yes | 174(55.1) | 142(44.9) | 316 |
| **Telephone** | No | 34(26.9) | 92(73.1) | 126 |
| | Yes | 233(48.5) | 247(51.5) | 480 |
| **Access to agricultural land** (n = 605) | No | 114(47.9) | 124(52.1) | 238 |
| | Yes | 153(41.7) | 214(58.3) | 367 |
| **Kitchen garden** (n = 605) | No | 74(34.9) | 138(65.1) | 212 |
| | Yes | 193(49.1) | 200(50.9) | 393 |

(*Continued*)

**Table 1.** (Continued)

| | | Dietary Diversity | | |
|---|---|---|---|---|
| **Factor** | **Category** | **Adequate n (%)** | **Inadequate n (%)** | **Total (N = 606)** |
| **Food security** | Food security | 61 (73.5) | 22(26.5) | 83 |
| | Mild food insecurity | 54(58.7) | 38(41.3) | 92 |
| | Moderate food insecurity | 49(39.2) | 76 (60.8) | 125 |
| | Severe food insecurity | 103(33.7) | 203(66.3) | 306 |
| **Nutritional knowledge** | Poor | 54(31.1) | 120(68.9) | 174 |
| | Moderate | 94(45.6) | 112(54.4) | 206 |
| | Good | 119(52.6) | 107(47.4) | 226 |
| **Social support** | Low | 36(27.7) | 94(72) | 130 |
| | Moderate | 123(49.6) | 125(50.4) | 248 |
| | High | 108(47.4) | 120(52.6) | 228 |

https://doi.org/10.1371/journal.pone.0297112.t001

North East Ethiopia (31.4%) [9] and Oromia Ethiopia (23.6%) [7]. This discrepancy can be explained by differences in study periods and the geographical and sociocultural differences between the countries.

Grain, white root, and tuber foods were more consumed (96.4%) than other food groups. This finding is consistent with the literature that shows that the diet of pregnant women in low- and middle-income countries is mainly cereal-based and deficient in animal-source foods [41] It is also similar to the findings of a study conducted in Southwest Ethiopia that report that 99.8% of pregnant mothers consumed food consisting of white roots, grains, and tubers [42]. Food groups that were less consumed by the participants in this study include eggs (16.3%) and milk and milk products (18.5%), which may be related to the higher price of animal-source foods. Thus, some pregnant women may have limited their consumption of animal products to holidays (Christmas and Easter) and ceremonies. However, these days were excluded from the data collection. Furthermore, some cultures restrict animal-source foods

**Table 2. Dietary diversity of pregnant women.**

| Food groups | Frequency (n = 606) | % |
|---|---|---|
| Grains, white roots and tubers, and plantains | 584 | 96.4 |
| Pulses (beans, peas and lentils) | 475 | 78.4 |
| Nuts and seeds | 186 | 30.7 |
| Dairy | 112 | 18.5 |
| Meat, poultry and fish | 251 | 41.4 |
| Eggs | 99 | 16.3 |
| Dark green leafy vegetables | 365 | 60.2 |
| Other vitamin A-rich fruits and vegetables | 213 | 31.5 |
| Other vegetables | 201 | 33.2 |
| Other fruits | 207 | 34.12 |
| **Dietary diversity adequacy** | | |
| Adequate > = 5 | 267 | 44.1 |
| Inadequate <5 | 339 | 55.9 |
| **Mean dietary diversity score** | **SD** | |
| 4.40 | 2.14 | |

SD: Standard Deviation

https://doi.org/10.1371/journal.pone.0297112.t002

**Table 3. Nutritional status and dietary diversity.**

| Variable | Category | Nutritional status | | Chi-square | *p*-value |
|---|---|---|---|---|---|
| | | Poor (MUAC < 23 cm) n (%) | Good (MUAC ≥ 23 cm) n (%) | | |
| Dietary diversity | Inadequate | 87 (25.7%) | 251 (74.3%) | 3.7336 | 0.053 |
| | Adequate | 51 (19.1%) | 216 (80.9%) | | |

MUAC, mid-upper arm circumference

https://doi.org/10.1371/journal.pone.0297112.t003

during pregnancy because these foods are considered taboo during pregnancy; for example, some pregnant women in Tanzania and South Africa restrict meat, milk, and eggs due to cultural norms [43, 44]. Similarly, a high consumption of cereal-based foods was reported in a study conducted in Tanzania [10]. However, this finding was different from the results of a study conducted in East Gojjam, Ethiopia, that report that legumes and seeds were the most frequently consumed food groups (85.5%) [45]. This difference may be due to self-reporting

**Table 4. Determinants of dietary diversity of pregnant women in the Southern Province of Rwanda.**

| Factor (n = 612) | Category | Unadjusted OR [95% CI] | *p*-value | Adjusted OR [95% CI] | *p*-value |
|---|---|---|---|---|---|
| **District** | Gisagara | 1 | | 1 | <0.001 |
| | Huye | 1.09 [0.68,1.74] | 0.710 | 1.43[0.81, 2.48] | |
| | Kamonyi | 3.63 [2.26, 5.82] | <0.00 | 4.29[2.43, 7.56] | |
| | Ruhango | 0.91 [0.57, 1.46] | 0.719 | 1.33[0.73, 2.42] | |
| **Residence** | Rural | 1 | | 1 | 0.005 |
| | Urban | 0.79 [0.57, 1.09] | 0.144 | 0.59[0.40, 0.87] | |
| **Age** | Per one-year increase | .99 [0.97, 1.02] | 0.526 | 1.01[0.98,1.04] | |
| **Ubudehe category** | | 0.97 [0.79, 1.18] | 0.778 | 0.93[0.73;1.18] | |
| **Education-cubed** | | 1.03 [1.01, 1.04] | <0.001 | 1.02[1.01, 1.03] | 0.003 |
| **Religion** | Christian | 1 | | | |
| | Others | 1.76 [0.82, 3.80] | 0.004 | | |
| **Occupation** | Housewife | 1 | | | |
| | Paying Job | 1.66 [1.10, 2.49] | 0.014 | | |
| **Marital status** | Married | 1 | | | |
| | Single | 0.52 [0.33, 0.81] | 0.145 | | |
| **Household Size** | Per one member increase | 0.82 [0.64, 1.04] | 0.115 | 0.88[0.79;0.99] | 0.03 |
| **Gestational week** | Per one unit increase | 0.99 [0.97, 1.02] | 0.811 | | |
| **Parity** | Per one child increase | 0.80 [0.63, 1.00] | 0.058 | | |
| **ANC visits** | Per one visit increase | 1.30 [0.98, 1.74] | 0.065 | | |
| **Radio** | No | 1 | | 1 | < 0.001 |
| | Yes | 2.64 [0.89, 3.67] | <0.001 | 1.85[1.25, 2.75] | |
| **Telephone** | No | 1 | | | |
| | Yes | 2.60 [1.69, 4.00] | <0.001 | | |
| **Access to agricultural land** | No | | | | |
| | Yes | 0.78 [0.56, 1.08] | 0.147 | | |
| **Kitchen garden(n = 611)** | No | 1 | | 1 | 0.009 |
| | Yes | 1.81 [1.28, 2.55] | 0.001 | 1.83[1.21, 2.76] | |
| **Food insecurity** | Per 5 units increase | .065 [0.03, 0.14] | <0.001 | 0.16[0.06, 0.40] | <0.001 |
| **Nutritional knowledge** | Per 5 units'increase | 1.41 [1.22, 1.62] | <0.001 | 1.51[1.27, 1.81] | <0.001 |
| **Social support** | Per 5 units increase | 5.7[1.91; 16.81] | 0.002 | | |

OR: Odd ratio

https://doi.org/10.1371/journal.pone.0297112.t004

differences, geographical location, and seasonal variation. This finding implies that pregnant women in the Southern Province of Rwanda are likely to have nutritional deficiencies and poor pregnancy outcomes because they do not consume a sufficient amount of animal-source foods containing higher quality protein and vital micronutrients essential for positive pregnancy outcomes and the growth and development of infants [46].

Maternal education was positively associated with optimal dietary diversity in this study, which may be related to participants' greater access to different sources of nutritional information that improved their nutritional knowledge, and hence, their dietary diversity. Education is a proxy measure of socioeconomic status, which could influence the ability to afford various types of food, and less education and a lower socioeconomic status could interfere with dietary diversity because of a lack of basic information on nutrition, regardless of other circumstances. This finding is similar to the results of a study conducted in Brazil that report that socioeconomic factors, including a high educational level, were associated with varied dietary patterns [47]. According to this study conducted in Brazil, a varied dietary pattern consisted of various food items, such as 'grains, cereals and tubers', 'bread, cakes and cookies', and fruits and vegetables. Similarly, a study conducted in Ethiopia among pregnant women found that secondary and tertiary education of mothers were associated with adequate dietary diversity [7].

Household size negatively affects the dietary diversity of pregnant women. Increased household size decreased the odds of adequate dietary diversity among pregnant women. It may be due to the fact that a large household decreases the quantity and quality of food consumed per person because the food is shared among many people. Consequently, many families prioritise food quantity over quality, leading to poor diversification of consumed food. It is consistent with other studies conducted in South Africa and Nigeria [48, 49].

Owning a radio was positively associated with the dietary diversity of pregnant women in this study. Pregnant women who owned a radio were two times more likely to vary their diet than those who did not own a radio. This finding may be because owning radio could expose pregnant women to nutritional information that can affect their dietary practices. The economic status of participants who owned a radio may have been higher than that of those who did not have a radio, which could have increased their access to information, and thereby, improved their dietary diversity. However, studies with appropriate design could help identify such association. This finding is similar to the results of a secondary analysis of data from three sub-Saharan African countries (Gambia, Liberia, and Rwanda) that report that mothers who had access to radios were more likely to diversify the diets of their children [50].

Having a kitchen garden was positively associated with dietary diversity. The odds of pregnant women who owned kitchen gardens having good dietary diversity were 1.59 times higher than for pregnant women who did not own a kitchen garden. This finding may be explained by the greater likelihood of a kitchen garden owner consuming different types of vegetables without purchasing them, and using the money that might have been used to buy vegetables to purchase other food groups. Furthermore, kitchen garden owners can sell their excess vegetables and use their earnings to buy different varieties of food groups. A randomised controlled trial conducted in Tanzania to evaluate the effect of home gardens on dietary diversity among women observed that the women in the intervention group consumed more food groups than those in the comparison group [51]. The consistency of these results between the two studies can be attributed to the similarity between the study participants and their geographical locations.

In the present study, it was found that food insecurity predicts adequate dietary diversity. This means a negative association where a decrease in food security was associated with a decrease in the odds of adequate dietary diversity, which was most likely because food insecurity decreases household food availability and accessibility, resulting in poor dietary diversity

practices. Limited food availability affects intra-household food allocation because pregnant women often prioritise the nutrition of their family members over their own nutritional requirements. Studies conducted in Malawi and Ethiopia similarly found that women from households with moderate and severe levels of food insecurity had a low dietary diversity score and inadequate dietary diversity compared to women from households with low levels of food insecurity [33, 52, 53].

This study highlighted the positive relationship between nutritional knowledge and dietary diversity. Having nutritional knowledge increased participants' likelihood of exhibiting good dietary diversity. These results are consistent with those of studies conducted in Malawi [54], Bangladesh [55], and India [56], which found that having adequate knowledge of optimal nutrition during pregnancy translates to the practice of consuming food from different food groups. Interestingly, the urban residence was negatively associated with adequate dietary diversity. Pregnant women treated in urban health centres were less likely than those from rural health centres to achieve adequate dietary diversity. These results may be explained by the many opportunities for women in rural areas who are mainly farmers raising livestock to access a variety animal- and non-animal-source foods. On the other hand, pregnant women from urban health centres may have to purchase all of the food they consume due to limited space for farming, making it more difficult to access various food groups. These findings suggest that pregnant women in urban health centres with a low socioeconomic status require more attention and encouragement from staff to help them to improve their dietary diversity, which may be poor because of the high cost of living in urban areas. Although this finding is consistent with that of a study conducted in Nigeria [49], it differs from a study conducted in Ethiopia, in which dietary diversity was found to be better among residents of an urban area [57]. These cross-country differences may reflect the individual participants' characteristics and differences related to geographical locations.

## Policy and practice implications

The findings of this study supports the recommendations of the NFNP by calling for interventions to improve the dietary diversity of pregnant women in Rwanda. Different stakeholders should be involved in the implementation of nutrition-sensitive and nutrition-specific interventions. Agricultural interventions designed to foster kitchen garden ownership could help improve the dietary diversity of pregnant women, and nurses and midwives could enhance the nutrition education offered during ANC visits by emphasising the diversification of diets and the importance of consuming animal-source foods during pregnancy. Specific nutritional messages should be disseminated through different media, including radio.

## Limitations

This study was based in health facilities; therefore, the findings are not generalisable to the entire population. Social desirability and recall bias could have occurred because we requested pregnant women to recall information and provide self-reports of what they consumed within the previous 24 hours. However, we used probing to mitigate this potential bias. In addition, the food consumed during the preceding 24 hours might not have been representative of the participants' routine diet. We excluded weekends and days with ceremonial major events to minimise such differences. The nutritional status of the participants was measured using the MUAC due to resource constraints; however, it would have been better to combine the MUAC results with the results of other biological indicators, such as haemoglobin level. The findings of this study should be triangulated with the qualitative study to explore whether there is a cultural influence on the dietary diversity of pregnant women in Rwanda.

## Conclusion

More than half the participants in this study had inadequate dietary diversity. Many pregnant women consumed grains, white roots, and tubers, whereas few pregnant women consumed animal-source foods. Factors such as maternal education, food insecurity, ownership of a radio or kitchen garden, and having good nutritional knowledge were determinants of dietary diversity. Nutrition education is needed to emphasise the importance of animal-source foods and affordable alternatives to access them. Home visits for community sensitisation to raise awareness of the importance of owning a kitchen garden and radio could help improve the dietary diversity of pregnant women. Furthermore, research studies measuring the micronutrient levels of pregnant women in Rwanda's Southern Province would be very important. There should be studies conducted to validate the MDD-W/Household Food Insecurity Access Scale tools in the Rwandan context.

## Supporting information

**S1 Table. Description of local foods included in the dietary diversity questionnaire.**
(PDF)

**S2 Table. Description of questions used to assess the nutritional knowledge.**
(PDF)

**S3 Table. Detailed dietary diversity scores.**
(PDF)

## Author Contributions

**Conceptualization:** Aline Uwase, Etienne Nsereko, Nirvana Pillay, Jonathan Levin.

**Data curation:** Aline Uwase, Jonathan Levin.

**Formal analysis:** Aline Uwase, Jonathan Levin.

**Funding acquisition:** Aline Uwase.

**Investigation:** Aline Uwase.

**Methodology:** Aline Uwase, Etienne Nsereko, Nirvana Pillay, Jonathan Levin.

**Project administration:** Aline Uwase, Etienne Nsereko, Nirvana Pillay, Jonathan Levin.

**Resources:** Aline Uwase.

**Software:** Aline Uwase, Jonathan Levin.

**Supervision:** Aline Uwase, Etienne Nsereko, Nirvana Pillay, Jonathan Levin.

**Validation:** Aline Uwase, Etienne Nsereko, Nirvana Pillay, Jonathan Levin.

**Visualization:** Aline Uwase, Etienne Nsereko, Nirvana Pillay, Jonathan Levin.

**Writing – original draft:** Aline Uwase, Etienne Nsereko, Nirvana Pillay, Jonathan Levin.

**Writing – review & editing:** Aline Uwase, Etienne Nsereko, Nirvana Pillay, Jonathan Levin.

## References

1. Bhutta ZA, Das JK, Rizvi A, Gaffey MF, Walker N, Horton S, et al. Evidence-based interventions for improvement of maternal and child nutrition: what can be done and at what cost? Lancet. 2013; 382 (9890):452–477. https://doi.org/10.1016/S0140-6736(13)60996-4 PMID: 23746776

2. World Health Organization. WHO recommendations on antenatal care for a positive pregnancy experience. 2016 Nov 28. Available from: https://www.who.int/publications/i/item/9789241549912
3. Republick of Rwanda. Rwanda National Food and Nutrition Policy. 2014, Jan. Available from:https://www.moh.gov.rw/fileadmin/user_upload/policies/National_Food_and_Nutrition_Policy_.pdf
4. Sravani V, Lakshmi C, Shivlila H, Nagabushan G, Vinay Kumar G, Kalyani B, et al., Assessment of nutritional supplements prescribed in pregnant women and pediatric patients in Basaveshwara Teaching and General Hospital. J. Food Nutr. 2015; 2(102): 1–9. https://doi.org/10.17303/jfn.2015.2.102
5. Arsenault JE, Nikiema L, Allemand P, Ayassou KA, Lanou H, Moursi M, et al. Seasonal differences in food and nutrient intakes among young children and their mothers in rural Burkina Faso. J Nutr Sci. 2014; 3: e55. https://doi.org/10.1017/jns.2014.53 PMID: 26101623
6. Rathnayake KM, Madushani P, Silva K. Use of dietary diversity score as a proxy indicator of nutrient adequacy of rural elderly people in Sri Lanka. BMC Res Notes. 2012; 5: 469. https://doi.org/10.1186/1756-0500-5-469 PMID: 22931957
7. Desta M, Akibu M, Tadese M, Tesfaye M. Dietary diversity and associated factors among pregnant women attending antenatal clinic in Shashemane, Oromia, Central Ethiopia: A cross-sectional study. J Nutr Metab. 2019; 2019: 3916864. https://doi.org/10.1155/2019/3916864 PMID: 30993019
8. Harika R, Faber M, Samuel F, Kimiywe J, Mulugeta A, Eilander A. Micronutrient status and dietary intake of iron, vitamin a, iodine, folate and zinc in women of reproductive age and pregnant women in Ethiopia, Kenya, Nigeria and South Africa: A systematic review of data from 2005 to 2015. Nutrients. 2017; 9(10): 1096. https://doi.org/10.3390/nu9101096 PMID: 28981457
9. Aliwo S, Fentie M, Awoke T, Gizaw Z. Dietary diversity practice and associated factors among pregnant women in North East Ethiopia. BMC Res Notes. 2019; 12(1): 123. https://doi.org/10.1186/s13104-019-4159-6 PMID: 30845950
10. Ochieng J, Afari-Sefa V, Lukumay PJ, Dubois T. Determinants of dietary diversity and the potential role of men in improving household nutrition in Tanzania. PLoS One. 2017; 12(12): e0189022. https://doi.org/10.1371/journal.pone.0189022 PMID: 29232413
11. Olatona FA, Olowu OJ, Goodman OO, Amu EO. Dietary habits, diversity, and predictors among pregnant women attending primary health care centers for antenatal care in Lagos, Nigeria. J Family Med Prim Care. 2021; 10(8): 3076–3083. https://doi.org/10.4103/jfmpc.jfmpc_397_21 PMID: 34660450
12. Fasola O, Abosede O, Fasola FA. Knowledge, attitude and practice of good nutrition among women of childbearing age in Somolu Local Government, Lagos State. J Public Health Afr. 2018; 9(1): 793. https://doi.org/10.4081/jphia.2018.793 PMID: 30079171
13. Abera SF, Kantelhardt EJ, Bezabih AM, Tsadik M, Lauvai J, et al. What factors are associated with maternal undernutrition in eastern zone of Tigray, Ethiopia? Evidence for nutritional well-being of lactating mothers. BMC Public Health. 2020; 20(1): 1214. https://doi.org/10.1186/s12889-020-09313-0 PMID: 32770979
14. World Health Organization. WHO antenatal care recommendations for a positive pregnancy experience. Nutritional interventions update: Multiple micronutrient supplements during pregnancy. Geneva: World Health Organization; 2020.
15. Gernand AD, Schulze KJ, Stewart CP, West KP Jr, Christian P. Micronutrient deficiencies in pregnancy worldwide: health effects and prevention. Nat Rev Endocrinol. 2016; 12(5): 274–89. https://doi.org/10.1038/nrendo.2016.37 PMID: 27032981
16. Asayehu TT, Lachat C, Henauw S, Gebreyesus SH. Dietary behaviour, food and nutrient intake of women do not change during pregnancy in Southern Ethiopia. Matern Child Nutr. 2017; 13(2): e12343. https://doi.org/10.1111/mcn.12343 PMID: 27373896
17. Zerfu TA, Baadgiligin S. Pregnant mothers have limited knowledge and poor dietary diversity practices, but favorable attitude towards nutritional recommendations in rural Ethiopia: evidence from community-based study. BMC Nutr. 2018; 4: 43. https://doi.org/10.1186/s40795-018-0251-x PMID: 32153904
18. Gudeta TG, Terefe AB, Mengistu GT, Sori SA. Determinants of dietary diversity practice among pregnant women in the Gurage Zone, Southern Ethiopia, 2021: Community-based cross-sectional study. Obstet Gynecol Int. 2022; 2022: 8086793. https://doi.org/10.1155/2022/8086793 PMID: 35586393
19. Saaka M, Mutaru S, Osman SM. Determinants of dietary diversity and its relationship with the nutritional status of pregnant women. J Nutr Sci. 2021; 10: e14. https://doi.org/10.1017/jns.2021.6 PMID: 33889397
20. Delil R, Zinab B, Mosa H, Ahmed R, Hassen H. Determinants of dietary diversity practice among pregnant women attending antenatal clinic at Wachemo University Nigist Eleni Mohammed memorial referral hospital, Southern Ethiopia. PLoS One. 2021; 16(4): e0250037. https://doi.org/10.1371/journal.pone.0250037 PMID: 33836030

21. Taruvinga A, Muchenje V, Mushunje A. Determinants of rural household dietary diversity: The case of Amatole and Nyandeni districts, South Africa. Int. J. Dev. Sustain. 2013; 2(4): 2233–2247.

22. Zerfu TA, Umeta M, Baye K. Dietary habits, food taboos, and perceptions towards weight gain during pregnancy in Arsi, rural central Ethiopia: a qualitative cross-sectional study. J Health Popul Nutr. 2016; 35(1): 22. https://doi.org/10.1186/s41043-016-0059-8 PMID: 27456151

23. Nsereko E, Uwase A, Mukabutera A, Muvunyi CM, Rulisa S, Ntirushwa D, et al. Maternal genitourinary infections and poor nutritional status increase risk of preterm birth in Gasabo District, Rwanda: a prospective, longitudinal, cohort study. BMC Pregnancy Childbirth. 2020; 20(1): 345. https://doi.org/10.1186/s12884-020-03037-0 PMID: 32493304

24. Republic of Rwanda. Rwanda demographic and health survey 2019–20: key indicators report. Kigali: NISR and ICF; 2020.

25. National Institute of Statistics of Rwanda, Ministry of Health. Rwanda demographic and health survey 2019–20: District Pro le North Province. 2019.

26. National Institute of Statistics. Comprehensive food security & vulnerability analysis. Rwanda. 2018.

27. Naing L., Winn T., and Rusli B. N., "Practical Issues in Calculating the Sample Size for Prevalence Studies," no. Ci, pp. 9–14, 2006.

28. Miele MJ, Souza RT, Calderon I, Feitosa F, Leite DF, Rocha Filho E, et al. Proposal of MUAC as a fast tool to monitor pregnancy nutritional status: results from a cohort study in Brazil. BMJ Open. 2021; 11 (5): e047463. https://doi.org/10.1136/bmjopen-2020-047463 PMID: 34031116

29. Yallamraju SR, Mehrotra R, Sinha A, Gattumeedhi SR, Gupta A, Khadse SV. Use of mid upper arm circumference for evaluation of nutritional status of OSMF patients. J Int Soc Prev Community Dent. 2014; 4(Suppl 2): S122–5. https://doi.org/10.4103/2231-0762.146217 PMID: 25558452

30. Ververs MT, Antierens A, Sackl A, Staderini N, Captier V. Which anthropometric indicators identify a pregnant woman as acutely malnourished and predict adverse birth outcomes in the humanitarian context? PLoS Curr. 2013;5: ecurrents.dis.54a8b618c1bc031ea140e3f2934599c8. https://doi.org/10.1371/currents.dis.54a8b618c1bc031ea140e3f2934599c8 PMID: 23787989

31. Food and Agriculture Organization for the United Nations. Minimum dietary diversity for women. A guide to measurement. 2016.

32. Food and Agriculture Organization for the United Nations. Guidelines for assessing nutrition-related knowledge, attitudes and practices. 2014.

33. Kang Y, Hurley KM, Ruel-Bergeron J, Monclus AB, Oemcke R, Wu LSF, et al. Household food insecurity is associated with low dietary diversity among pregnant and lactating women in rural Malawi. Public Health Nutr. 2019; 22(4): 697–705. https://doi.org/10.1017/S1368980018002719 PMID: 30378520

34. Webster J, Linnane JW, Dibley LM, Hinson JK, Starrenburg SE, Roberts JA. Measuring social support in pregnancy: can it be simple and meaningful? Birth. 2000; 27(2): 97–101. https://doi.org/10.1046/j.1523-536x.2000.00097.x PMID: 11251486

35. Greenland S. Avoiding power loss associated with categorization and ordinal scores in dose-response and trend analysis. Epidemiology. 1995; 6(4): 450–4. https://doi.org/10.1097/00001648-199507000-00025 PMID: 7548361

36. Greenland S. Dose-response and trend analysis in epidemiology: alternatives to categorical analysis. Epidemiology. 1995; 6(4): 356–65. https://doi.org/10.1097/00001648-199507000-00005 PMID: 7548341

37. Royston P, Altman DG, Sauerbrei W. Dichotomizing continuous predictors in multiple regression: a bad idea. Stat Med. 2006; 25(1): 127–41. https://doi.org/10.1002/sim.2331 PMID: 16217841

38. Royston P, Ambler G, Sauerbrei W. The use of fractional polynomials to model continuous risk variables in epidemiology. Int J Epidemiol. 1999; 28(5): 964–74. https://doi.org/10.1093/ije/28.5.964 PMID: 10597998

39. Kuma MN, Tamiru D, Belachew T. Level and predictors of dietary diversity among pregnant women in rural South-West Ethiopia: a community-based cross-sectional study. BMJ Open. 2021; 11(10): e055125. https://doi.org/10.1136/bmjopen-2021-055125 PMID: 34697127

40. Shrestha V, Paudel R, Sunuwar DR, Lyman ALT, Manohar S, Amatya A. Factors associated with dietary diversity among pregnant women in the western hill region of Nepal: a community based cross-sectional study. PLoS One. 2021; 16(4): e0247085. https://doi.org/10.1371/journal.pone.0247085 PMID: 33831015

41. Erokhin V, Diao L, Gao T, Andrei JV, Ivolga A, Zong Y. The Supply of calories, proteins, and fats in low-income countries: A four-decade retrospective study. Int J Environ Res Public Health. 2021; 18(14): 7356. https://doi.org/10.3390/ijerph18147356 PMID: 34299805

42. Tsegaye D, Tamiru D, Belachew T. Factors associated with dietary practice and nutritional status of pregnant women in rural communities of Ilu Aba Bor Zone, Southwest. Nutr Diet Suppl. 202; 12: 103–112. https://doi.org/10.2147/NDS.S257610

43. Ramulondi M, de Wet H, Ntuli NR. Traditional food taboos and practices during pregnancy, postpartum recovery, and infant care of Zulu women in northern KwaZulu-Natal. J Ethnobiol Ethnomed. 2021; 17 (1): 15. https://doi.org/10.1186/s13002-021-00451-2 PMID: 33743760

44. Lennox J, Petrucka P, Bassendowski S. Eating practices during pregnancy: perceptions of select Maasai women in Northern Tanzania. Glob Health Res Policy. 2017; 2: 9. https://doi.org/10.1186/s41256-017-0028-9 PMID: 29202077

45. Yeneabat T, Adugna H, Asmamaw T, Wubetu M, Admas M, Hailu G, et al. Maternal dietary diversity and micronutrient adequacy during pregnancy and related factors in East Gojjam Zone, Northwest Ethiopia, 2016. BMC Pregnancy Childbirth. 2019; 19(1): 173. https://doi.org/10.1186/s12884-019-2299-2 PMID: 31092223

46. Fite MB, Tura AK, Yadeta TA, Oljira L, Roba KT. Consumption of animal source food and associated factors among pregnant women in eastern Ethiopia: a community-based study. PLoS One. 2022; 17(6): e0270250. https://doi.org/10.1371/journal.pone.0270250 PMID: 35714168

47. Hoffmann JF, Nunes MA, Schmidt MI, Olinto MT, Melere C, Ozcariz SG, et al. Dietary patterns during pregnancy and the association with sociodemographic characteristics among women attending general practices in southern Brazil: the ECCAGe Study. Cad Saude Publica. 2013; 29(5): 970–80. PMID: 23703002

48. Sambo TA, Oguttu JW, Mbombo-Dweba TP. Analysis of the dietary diversity status of agricultural households in the Nkomazi Local Municipality, South Africa. Agric Food Secur. 2022; 11(1): 46. https://doi.org/10.1186/s40066-022-00387-0

49. Obayelu OA, Osho FR. How diverse are the diets of low-income urban households in Nigeria?. J Agric Food Res. 2019; 2: 100018. https://doi.org/10.1016/j.jafr.2019.100018

50. Ba DM, Ssentongo P, Gao X, Chinchilli VM, Richie JP Jr, Maiga M, et al. Prevalence and determinants of meeting minimum dietary diversity among children aged 6–23 months in three sub-Saharan African Countries: The Demographic and Health Surveys, 2019–2020. Front Public Health. 2022; 10: 846049. https://doi.org/10.3389/fpubh.2022.846049 PMID: 36081474

51. Blakstad MM, Mosha D, Bellows AL, Canavan CR, Chen JT, Mlalama K, et al. Home gardening improves dietary diversity, a cluster-randomized controlled trial among Tanzanian women. Matern Child Nutr. 2021; 17(2): e13096. https://doi.org/10.1111/mcn.13096 PMID: 33241924

52. Harrigan J. Food insecurity, poverty and the Malawian Starter Pack: fresh start or false start?. Food Policy. 2008; 33(3): 237–249. https://doi.org/10.1016/j.foodpol.2007.09.001

53. Hidru HD, Berwo Mengesha M, Hailesilassie Y, Tekulu Welay F. Burden and determinant of inadequate dietary diversity among pregnant women in Ethiopia: A systematic review and meta-analysis. J Nutr Metab. 2020; 2020: 1272393. https://doi.org/10.1155/2020/1272393 PMID: 32855822

54. Katenga-Kaunda LZ, Kamudoni PR, Holmboe-Ottesen G, Fjeld HE, Mdala I, Shi Z, et al. Enhancing nutrition knowledge and dietary diversity among rural pregnant women in Malawi: a randomized controlled trial. BMC Pregnancy Childbirth. 2021; 21(1): 644. https://doi.org/10.1186/s12884-021-04117-5 PMID: 34561744

55. Nguyen PH, Sanghvi T, Kim SS, Tran LM, Afsana K, Mahmud Z, et al. Factors influencing maternal nutrition practices in a large scale maternal, newborn and child health program in Bangladesh. PLoS One. 2017; 12(7):e0179873. https://doi.org/10.1371/journal.pone.0179873 PMID: 28692689

56. Nguyen PH, Kachwaha S, Avula R, Young M, Tran LM, Ghosh S, et al. Maternal nutrition practices in Uttar Pradesh, India: role of key influential demand and supply factors. Matern Child Nutr. 2019; 15(4): e12839. https://doi.org/10.1111/mcn.12839 PMID: 31066195

57. Hirvonen K. Rural–urban differences in children's dietary diversity in Ethiopia: a Poisson decomposition analysis. *Econ. Lett.* 2016; 147: 12–15. https://doi.org/10.1016/j.econlet.2016.08.003

## Appendix 14: Similarity report




**Factors associated with maternal dietary practices among pregnant women attending antenatal care services in the Southern Province of Rwanda**

**Thesis Submitted to the Faculty of Health Sciences, University of the Witwatersrand, in fulfilment of the requirements for the degree of Doctor of Philosophy**

**Aline Uwase**

**Student Number 2477108**

---

**University of the Witwatersrand, South Africa**

**This PhD work was directed by:**

**Prof. Jonathan Levin**

Professor, Division of Epidemiology and Biostatistics, School of Public Health, Faculty of Health Sciences, University of the Witwatersrand, South Africa

**Dr Nirvana Pillay**

Senior Researcher, School of Public Health, Faculty of Health Sciences, University of the Witwatersrand, South Africa

and

**Associate Prof. Etienne Nsereko**

Associate professor, School of Health Sciences, College of Medicine and Health Sciences, University of Rwanda, Rwanda.

ORIGINALITY REPORT

| 8% | 0% | 7% | 3% |
|---|---|---|---|
| SIMILARITY INDEX | INTERNET SOURCES | PUBLICATIONS | STUDENT PAPERS |

## Appendix 15: Editing certificate

PRECISION EDUCATION CONSULTANCY

**Centurion**
**Tshwane**
precision4edits@gmail.com
CIPC: (2024/014377/07)

**MANUSCRIPT LETTER OF REVIEW PROOF**

28th March 2025

To Whom It May Concern

This letter is to confirm that the PhD thesis titled **Factors associated with maternal dietary practices among pregnant women attending antenatal care services in the Southern Province of Rwanda**, by Aline Uwase, was edited by a professional language editor. As the language editor, the author was supplied with two versions: comments and edits [track changes], and the APPROVED version with no track changes. As the language editor, I cannot be held responsible for the author or authors' decisions concerning the edits and comments supplied.

Sincerely,



Language Editor

***PRECISION EDUCATION CONSULTANCY***