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The role of antenatal care on childbirth weight in South Africa

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2021
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THE ROLE OF ANTENATAL CARE ON CHILDBIRTH WEIGHT IN SOUTH AFRICA

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This research dissertation is submitted in partial fulfilment of the Master of Arts in Demography and Population Studies at the University of the Witwatersrand

DATE:

ABSTRACT

Background: Low birth weight is a public health concern because infants below 2500 grams contribute to a wide range of poor health outcomes. These infants are prone to high infant mortality, morbidity and developmental problems in their childhood lives. Infants' weight at birth contributes to the highest percentage of infant mortality and morbidity. To ensure women's health and mental well-being, the World Health Organisation recommends at least four maternity care visits. Even so, in South Africa, 95 percent of the mothers who attended antenatal care had a live birth and only 76 percent of the mothers attended at least four visits. This study explores socio-demographic factors and on pregnant women, the antenatal care and how it impacts the child weight at birth.

Methodology: This study used secondary data from the South Africa Demographic and Health Survey (SADHS) of 2016. The population of interest includes infants born five years preceding the survey. The sample size included 3015 children whose mothers responded to questions on maternal health. The leading independent variable is number of antenatal care visits. Birth weight of the children was recorded into ranked categories: large (4000-6000g) average (2500-3980g) and low (500-2490g). The other independent variables used were the sex of the child, birth order, birth type, maternal age, maternal educational level, duration of pregnancy, race, wealth index, place of residence and exposure to media. The dependent variable is birth weight coded as a dichotomous variable: average birth weight and low birth weight. Data analysis is in three levels. The first level includes the background characteristics of the respondents using a series of frequencies and percentage distributions. The second level involved the cross-tabulation of the outcome variables, birth weight with all the independent variables using the Pearson's chi-square test. The third level involved using stepwise forward Ordinal logistic regression to examine the association between birth weight with antenatal care, socio-economic and demographic characteristics.

Results: The findings revealed that more than half (60%) of children were reported being in average birth weight while about 24% reported being in the large birth weight and only 16% of infants born were low birth weight. This study found a statistically significant relationship between no. of antenatal care visits and birth weight. The unadjusted odds ratios depict the odds of the combined large and average birth weight versus low birth weight is 4.0 times [OR=4.037, CI 2.258-7.216] greater among children born in multiple birth type compared to single birth type. The findings further revealed that children born in 9-10 months were significantly less likely to be low birth weight than other pregnancy durations. These findings do support the hypothesis that antenatal care is associated with the child's birth weight.

Conclusion: Based on these findings, birth weight is associated with the number of ANC visits attended by the child's mother during gestation.

Keywords: Birth weight; Antenatal care; intrauterine growth restriction and Gestation

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DEDICATION

To a little village girl in me, you can achieve anything you put your mind to through hard work and dedication.

ACKNOWLDEGEMENTS

I want to thank the Almighty God for giving me wisdom, strength, grace and mercy throughout my academic years. It was not by my might nor by power but by His spirit.

Thank my supervisor, Dr Sasha Frade, for your patience throughout the months of working together. I believe in your approach and I will continue to strive to unlock my potential. Thank you for the time you have always provided for me despite your other academic and professional commitments.

Many thanks to my mother, Molly Molefi and siblings Khumo Kole, Johannes Kole, Kefilwe Molefi, Segomotso Molefi and Thabang Kolobe for the endless support, believing in me, motivating, encouraging me in every step and full support throughout my academic years. My friends, for your encouraging spirit during the academic years. I would also like to thank everyone who contributed directly and indirectly; you are highly appreciated.

Lastly, I want to extend my gratitude to the University of the Witwatersrand to study at their institution and give special thanks to the National Research Foundation and Gauteng City Regional Academy for funding my master's degree.

DECLARATION

I, Omphile Ouma Princess Molefi, declare that this report is my work except where specific references are provided. It is being submitted to the faculty of humanities, the University of the Witwatersrand, in fulfilment of the degree Master of Arts in Demography and Population Studies. This paper has not been submitted to any other Institution or University as a requirement for any other qualifications.

Signature:  Date:

LIST OF ACRONYMS

ANC- Antenatal Care

LBW- Low Birth Weight

MDG- Millennium Development Goals

SADHS- South African Demographic and Health Survey

SDG- Sustainable Development Goals

UN- United Nations

WHO- World Health Organisation

CHAPTER 1

1.1 Introduction

The chapter presents the background of the study, which discusses the levels of low birth weight among children in South Africa and the role of antenatal care, socio-economic and demographic factors on birth weight. The chapter proceeds to highlight the problem statement, justification, objectives and critical definitions of the study.

1.2 Background

Globally, birth weight contributes the highest percentage of infant mortality and morbidity. Birth weight refers to the infant's first post-birth foetal weight (Gebregzabiherher et al., 2017). According to the World Health Organisation (WHO, 2014), infants' weight at birth should be above 2500g; infants that weigh less than <2500 grams at birth are considered low birth weight and those weighing above >2500 grams at birth as average birth weight. Low birth weight among newborns is due to premature birth or restricted intrauterine growth during pregnancy (Siyoum & Melese, 2019). The foetus's growth and development are significant in the human life-cycle process and any anomalies will decide the outcome of a child's life at a later stage (Metgud et al., 2012).

Low birth weight is a public health concern because infants below 2500 grams contribute to a wide range of poor health outcomes (Belbasis et al., 2016; Mohammad et al., 2014; Girma et al., 2019; Titaley *et al*., 2010). These infants are prone to high chances of infant mortality, morbidity and developmental problems in their childhood lives (Girma et al., 2019; Metgud et al., 2012). Countries with high levels of adverse outcomes have shown to reflect their socio-economic development in reducing the outcomes and the type of health care providers to the people (Oulay et al., 2018). A vest of literature on low birth weight has proved that it is more prevalent in developing countries than developed countries (Banchani & Tenkorang, 2020; Hailu & Kebede, 2018; Mahumud et al., 2017; Oulay et al., 2018). Developed countries have better socio-economic development and health care provision (Rouhi et al., 2019; Rouhi et al., 2019).

Over the past decades, there has been a significant improvement in maternal and prenatal health. From 1990 to 2003, the neonatal mortality rate has decreased by 40% worldwide (Arunda et al., 2017). About 303 000 maternal deaths accounted for in 2015 were due to pregnancy and childbirth complications (Lori et al., 2017). Areas, where health care resources are low, reported 2.6 million stillbirths and 2.8 million deaths of newborns before they reached 28 days of life (WHO, 2014). UNICEF reported that approximately sixty eight percent of infant mortality worldwide is due to low birth weight. Mortality is one percent higher among LBW infants and 0.2 percent among average birth weight infants (Oulay et al., 2018).

Antenatal care (ANC) is a worldwide intervention designed to offer pregnant women and their foetus health care services during pregnancy until the day of delivery and provided by skilled health care practitioners (Muchie, 2017). ANC has been recommended globally as an effective measure to help curb maternal and infant mortality due to pregnancy complications. The services include screening pregnant women where practitioners can detect any pregnancy complications, which some might be due to underlying diseases (Arunda et al., 2017). Also, they offer health education and promotion during the visits (Tesfaye et al., 2017). ANC plays a significant role in reducing maternal and infant mortality through increasing pregnancy outcomes positively (Servan-Mori et al., 2016). ANC's benefits are intrauterine growth, reduced risk of infection and the fetus's survival (Metgud et al., 2012; Tafere et al., 2018a).

South African public sector organizations are forced to provide reliable and efficient services. Providing quality service is a key strategy for organizational success and sustainability in a global competitive climate (Ramseook-Munhurrun et al., 2010). Quality of hospital services has become a crucial determinant of organizational success and sustainability in an environment in which the quality of healthcare services that patients receive is increasingly important and selective (Mensah et al., 2014).

1.3 Problem Statement

Globally, antenatal, delivery and postnatal care programmes are among the key strategies recommended to minimise adverse outcomes (Titaley *et al*., 2010). To ensure women's health and mental well-being, the WHO recommends four maternity care visits and maternal care six hours, six days, six weeks and six months after childbirth (WHO, 1998). However, the statistics from developed countries show that maternal health is still low and most women

have no access to maternal health services. According to a United Nations [UN] study, approximately 74% of pregnant women received prenatal care in 2005, at least once (UN, 2004); 40% of deliveries were carried out in health facilities (UNFPA, 2004).

There has been high use of ANC among pregnant mothers in South Africa. The South African Demographic and Health Survey (SADHS) reported that there has only been a slight change since 1998 for ANC usage was 94% and in 2016, it was 95%. Despite the relatively fixed attendance of ANC coupled with programme and policy efforts to reduce pregnancy complications resulting in maternal and infant mortality among women and children in South Africa, low birth weight cases remain high (Ngxongo, 2018).

Around the World, births due to low birth weight are 15.5% and most of these births occur in developing countries (Zhou et al., 2019). High prevalence of below average birth weight babies was evident in developing countries like Burkina Faso (13.4%), Senegal (15.7%), Ghana (10.2%) and Uganda 10% (He et al., 2018) with no difference to South African (15%) prevalence (Tshotetsi et al., 2019). This rate poses an area of public health concern.

In South Africa, infant mortality rates have decreased over the past years from 45 deaths per 1000 live births in 1998 to 35 deaths per 1000 live births in 2016 (SADHS, 2016). In the past ten years, childbirth weight has been the leading cause of infant mortality in South Africa, 83% of infant mortality due to low birth weight. WHO recommended that pregnant women should at least attend four antenatal care visits (WHO, 2016), and the recommendation was revised later in 2016 to a minimum of eight (Tesfaye et al., 2017).

Even so, in South Africa 95% of the mothers who attended antenatal care had a live birth and only 76% of the mothers attended at least four visits. Non-attendance of ANC visits among pregnant women results in preventing adverse pregnancy outcomes not being achieved (Budree et al., 2017). The consequences of insufficient attendance of antenatal care can be severe. This study explores socio-demographic factors on pregnant women attending ANC and how it impacts the child's weight at birth.

1.4 Justification

The child's birth weight is a primary determinant of infant mortality, child growth and development in the child's later life (Girma et al., 2019; Metgud et al., 2012; Sinha et al., 2018; Smith et al., 2017). Since 2000, the United Nations Millennium Declaration launched the Millennium Development Goals (MDGs) to support countries with socio-demographic problems. One of its goals was to reduce two thirds of under 5 mortality rates including infant mortality (WHO, 2019). Despite those efforts, South Africa's infant mortality remains 45 deaths per 1000 live births in 1998 to 35 deaths per 1000 live births in 2016.

After the end of MDG's, the Sustainable Development Goals (SDGs) were introduced to help curb infant mortality rates to 12 deaths per 1000 live birth (WHO, 2019). Conversely, South Africa is far from reaching the goal of SGDs. The SADHS report shows that approximately 83% of infant mortality accounted for low birth weight despite the high attendance of ANC visits reported among pregnant women.

A large body of literature has found a correlation between antenatal care and the child's weight at birth (Appiah et al., 2020; Atuhaire, n.d.; Zhou et al., 2019). However, few studies have explored why low birth weight continues to occur among women attending ANC visits in South Africa. This study will contribute to the existing literature on maternal and child health though the initiation of Kangaroo care in health care facilities which is important for low birth weight infants. It will show the importance of maternal and child factors between antenatal care and its impact on birth weight. When pregnant women are conscious about their adverse pregnancy outcomes and attend all their ANC visits, South Africa will experience fewer low birth weight children and achieve SDG goal: 5.

In the context of high levels of low birth weight as a public health issue, this research intends to help policymakers consider the relation of socio-economic, demographic factors and antenatal care to ensure easy access including affordability of ANC services to pregnant women. Also, the study highlighted the need for policy measures to concentrate on the implementation of services and accommodate different maternal factors. Consequently, the initiatives will decrease the adverse pregnancy outcomes, for instance, low birth weight and infant mortality. This study's importance is to offer yet another solution that can be incorporated into the policy to help reduce the high rate of low birth weight among children

by understanding the role of antenatal care socio-economic and demographic characteristics.

1.5 Research Questions

What is the association between antenatal care and childbirth weight in South Africa?

1.5.1 Sub-Questions

1. What are the childbirth weight levels by key socio-economic, demographic factors and antenatal care in South Africa?
2. What is the relationship between antenatal care -economic, demographic factors and childbirth weight in South Africa?

1.6 Research Objectives

To examine the association between antenatal care and childbirth weight in South Africa.

1.6.1 Sub-Objectives

1. To assess the levels of childbirth weight by key socio-economic, demographic factors and antenatal care in South Africa.
2. To investigate the relationship between antenatal care, socio-economic and demographic factors of childbirth weight in South Africa.

1.7 Definition of keywords

Birth weight: Refers to the first post-birth foetal weight (Gebregzabiherher et al., 2017).

Antenatal care: Refers to medical services designed to offer pregnant women and foetus health care services during her pregnancy until the day of delivery provided by skilled health care practitioners (Muchie, 2017).

Intrauterine growth restriction: Refers to a condition in which a foetus is smaller than it should be during pregnancy (Sharma et al., 2016).

Gestation: Refers to the time between conception and delivery of a child. During this period an infant grows and develops inside its mother's womb throughout this time. It is typical throughout pregnancy to refer to one's gestational age as one's stage of pregnancy (Zammito, 2017).

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Many years of research on child health have produced diverse findings on the factors of antenatal care and its adversity on child health. Consistently, the literature found that maternal and child health outcomes are generally deficient in sub-Saharan Africa and South Asia; the two sub-regions are the significant contributors to high infant mortality rates and poor child health care services. Thus, this chapter provides a general overview of past studies and the current state of knowledge on the role of antenatal care and socio-economic and demographic factors in the first section. For clarity, the review of literature in this section is presented in four sub-headings:

1. The global overview of low birth weight
2. An overview of low birth weight in Africa
3. An overview of low birth weight in South Africa

Section two discusses the theory that guides this study, its appropriateness and its limitations. The third section presents a multi-factor conceptual framework used for analysis and critical hypotheses of the study.

2.2 Global overview

Low birth weight is an indicator of infant mortality and determines the child's chances of survival. Female infants have high prevalence rate low birth weight than male infants; this can be because male children have a high intrauterine growth rate. A study in Afghanistan found that there are higher odds of having low birth weight female infants than male infants and the study reported that the weight difference between male and the female child starts after 28 weeks of pregnancy (Das Gupta et al., 2019). Furthermore, a multicounty study found the same results even though it is unclear what causes the birth weight disparity (Mahumud et al., 2017). Das Gupta et al., 2019 explained that this difference might be caused

by Y chromosomes found only in males, which carriers the development of external and internal male genetic materials. Furthermore, the prevalence of low birth weight among female infants raises intergenerational low birth weight alarm. Girls who were low weight at birth have higher chances of giving birth to low-birth-weight infants when they become mothers (Sabbaghchi et al., 2020).

Maternal age, parity and income status were significant factors associated with low birth weight in North Carolina, USA, as it increased birth weight (Swamy et al., 2012). Therefore, this suggests that women who give birth at an early age were more likely to have a third child in the age group of 20 with no time interval between pregnancies than women who gave birth to three children in 30 with an adequate time interval between the births. Also, older women are more likely to have a more stable financial situation. Thus, they can take better care of themselves during gestation and influence birth weight in a positive way. A study has indicated that pregnancy within the advanced maternal age groups has higher chances of giving birth to low birth weight (LBW) babies. However, a study in Afghanistan revealed that proper uptake of nutrition complemented with ANC attendance reduces LBW babies' risk among these age groups (Das Gupta et al., 2019). Also, research revealed that women who conceived advanced maternal age and those underweight were more likely to have low birth weight infants when compared to their counterparts (Mahumud et al., 2017).

A study on the risky maternal factors associated with low birth weight children found that birth spacing, exposure to tobacco, inadequate antenatal care and maternal education were risk factors associated with low birth weight (Mumbare et al., 2012). The risk factors have been found to reduce the intrauterine growth of the foetus, thus reducing chances of higher weight as the foetus receives less food and nutrients transmitted due to the small size of the umbilical cord (Sabbaghchi et al., 2020). Besides, the authors found that nicotine, tobacco and alcohol use were also risky factors leading to low birth weight.

Writings on timely initiation of antenatal care in Mexico (Servan-Mori et al., 2016) noted that the time it takes for indigenous and non-indigenous women to attend antenatal care visits impacts the child's weight at birth. The paper revealed a high prevalence of low birth weight newborns delivered to indigenous Mexican mothers. Also, indigenous women in Mexico require essential care services to help monitor their health and achieve better pregnancy outcomes (Servan-Mori et al., 2016). In India, only half of the women attended adequate antenatal care and had lesser chances of delivering low birth weight infants than women who

did not attend any ANC (Ogbo et al., 2019). The autonomy of Indian women might explain this because to visit health care, women do not make decisions but ask for permission from their husbands to attend antenatal care visits. Furthermore, a study conducted in four maternal units in Paris revealed that factors such as inadequate ANC, late initiation and few consultations were associated with severe morbidity (Linard et al., 2018).

2.3 Overview of African studies

The current body of knowledge on maternal health and child well-being predicts young and advanced maternal age associated with low birth weight. However, an old Tanzanian study surprisingly revealed that the recommended women's childbearing years (25-35) experienced a high prevalence rate of low birth weight children (Siza, 2008). The children born to these women had a high likelihood of delivering low birth weight children. These not-so-common findings can be explained by high malnutrition in Tanzania. Thus, malnutrition mothers delivered low birth weight infants despite the recommended age for childbearing. ANC is attended more often by most parents who are 30 years old than by teenage and older women. Many et al., (2020) explained that because of dismissal from school and stigma, most young girls under the age of 20 are likely to hesitate to disclose pregnancy, thus less likely to attend antenatal care within the first trimester of the pregnancy. In contrast, maternal age was not associated with low birth weight (Arsenault et al., 2018).

The literature claimed that maternal education and residence were associated with low birth weight (Dahlui et al., 2016). This study explains that educated pregnant women have fewer odds of giving birth to low birth weight infants because their higher level of education helps them make informed decisions about their well-being and the child's well-being. It further explains that women living in rural areas are more likely to have insufficient nutrition, pregnancy infections and inadequate ANC facilities (Dahlui et al., 2016). A risk factor study of low birth weight in South-East Ethiopia revealed an association between educated mothers and low birth weight infants. It is important to note that education affects how people see things and behave such as proper maternal feeding practices and mothers' health services. Some females might be educated but because of their cultural beliefs, some may hide the pregnancy to avoid being bewitched in the early months of pregnancy, thus some might start the initiation of antenatal care late. A Malawian revealed that preventing women from starting early initiation of antenatal care is due to cultural beliefs as women seek advice from

their husbands' counsellors before their first initiation (Chimatiro et al., 2018). Such barriers delay the time for antenatal care and increase the chances of a mother to give birth to low birth weight children as literature showed that delayed time of antenatal care increases the odds of infants born with low birth weight (Gebresilassie et al., 2019; Manyeh et al., 2020; Tariku et al., 2010).

2.4 Overview of South African Studies

A South African case-control study in Tshwane identified maternal age, inadequate antenatal care, maternal HIV preterm birth and infant sex as factors associated with low birth weight among children (Tshotetsi et al., 2019). Women in the advanced childbearing years had higher odds of delivering low birth weight infants and the study found that advanced maternal age was associated with low birth weight (Tshotetsi et al., 2019). In contrast, Hoque et al., (2014) revealed that adolescent girls were greater associated with low birth weight infants while his other study comparing obstetrics and prenatal outcomes of teenagers and older women in rural South Africa found no difference in adverse outcomes among women of different ages (Hoque & Hoque, 2010).

Premature birth exposes children to health risks such as diseases, low birth weight and mortality. Tshotetsi et al., (2019) study associated preterm births with a low birth weight; however, the factors that expose mothers to preterm birth are not always the same for every mother. It might be due to the medication one takes during pregnancy (Wumba et al., 2015). The antenatal care attendance can reduce the odds of an infant being premature during the gestational period as recommended. Thus, Tshotetsi et al., (2019) found a significant relationship between antenatal care and low birth weight. As such, antenatal care is among predictors of low birth weight; even so, ANC's attendance across pregnant women differs. Besides, it is even more important to take into consideration the confounders of ANC on low birth weight.

2.5 Theoretical Framework

This study explores the association between antenatal care and birth weight among South African children. The study relied on the Behavioural Model of Health Service Use (BMHSU) to describe the usage of antenatal care and birth weight. The BMHSU is among public health models and was developed around the 1960s by Andersen. The model was used to help comprehend family engagement of health services (Andersen, 1995). At first, its focus was on the family unit, which assumed that individuals' medical services explained the demographic, social and economic characteristics of a family unit. However, Andersen, in his subsequent work, stressed individuality as the focus of interest.

In 1995, he reversed the behavioural model. He made emphasis that there were multiple influences on health care service use and health status (Andersen, 1995). The model consists of environmental and population characteristics as elements that can influence antenatal care and health outcomes. Environmental factors included the health care system and the external environment, whereas population characteristics tried to understand the predisposing, enabling resources and need (Andersen, 1995). This model's main assumptions were that how people use health care service was justified by their predisposing factors including demographic and social structure, enabling factors (resources) which use people's need for health care (Andersen, 1995). However, this study only addressed the population characteristics (individual, household, enabling factor and community), no. of ANC visits and outcome (low birth weight).

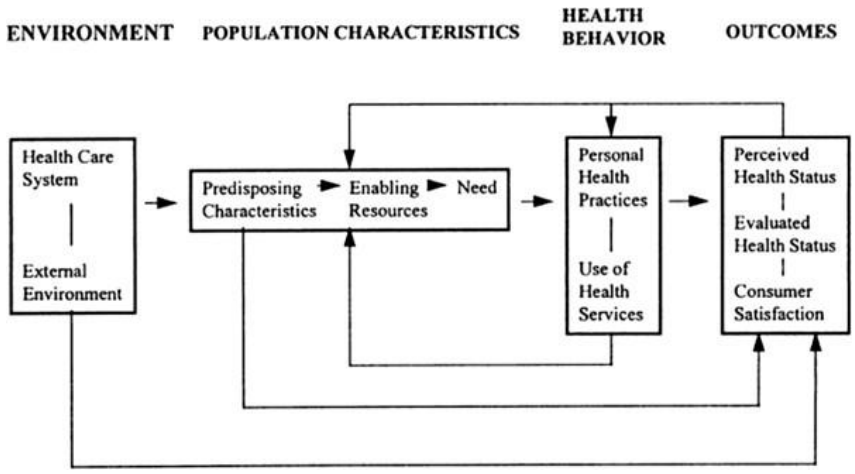

Figure 1: Diagrammatic portrayal of Behavioural Model of Health Service Use. Source. Adapted from Andersen (1995).

2.6 Conceptual Framework

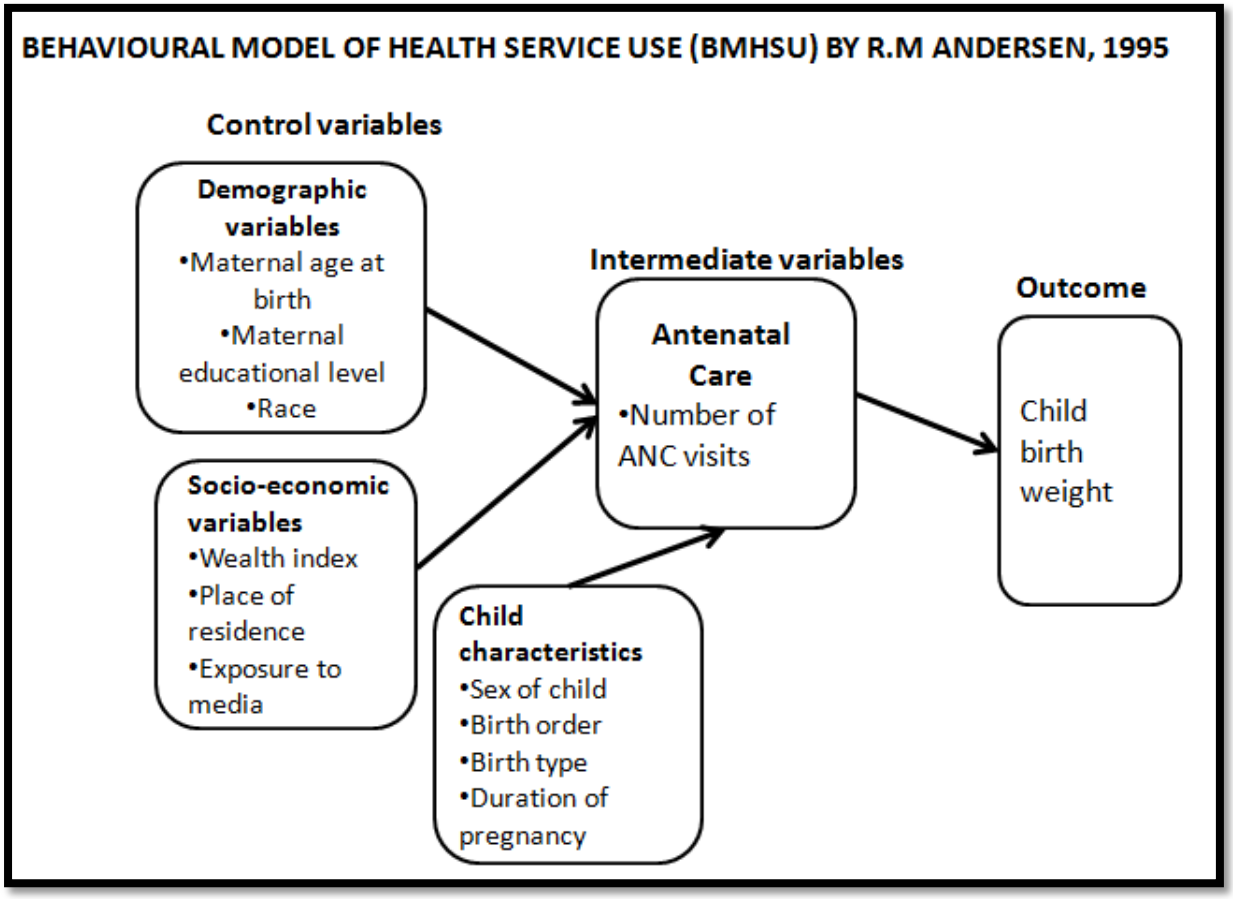

Figure 2: Conceptual framework adapted from the Behavioural Model of Health Service Use.

Drawing upon the work of (R.M Andersen on Behavioural Model of Health Service Use), this study's conceptual framework will be adopted from BMHSU. As noted earlier, this study will only consider population characteristics and antenatal care. There have been factors that are identified as significant predictors of child birth weight. Among these have been maternal age, wealth index, highest educational level and residence type (Andersson et al., 2000; Isiugo-Abanihe & Oke, 2011) under population characteristics. Population characteristics will influence the person's health behaviour, which will impact the outcome, in this case, child birth weight.

2.7 Hypotheses

H_0= There is no association between antenatal care and a child's birth weight in South Africa.

H_A= There is an association between antenatal care and a child's birth weight in South Africa.

CHAPTER 3

METHODOLOGY

3.1 Introduction

In this chapter, the methodology for the research is discussed. The data source and population of the sample were established. Also, there is a discussion of the sample and questionnaire design. The last part of this chapter ends with summarising the shortcomings of the analysis following a review of the variables in the study.

3.2 Study Design

This study used data from the South Africa Demographic and Health Survey (SADHS) conducted in 2016 implemented by the Department of Health. In the survey, representative of health and population data were collected and published nationally in developing countries. The survey includes a national sample of households with at least one female childbirth age. All women included in the Demographic and Health Survey is drawn from these families as representatives of the total population of females in South Africa who are of reproductive age (SADHS, 2016). The survey represents 15,292 individuals and 8,514 females of childbearing ages 15-49 years included in the interview. Information gathering was conducted from 27 June 2016 to 4 November 2016. The data obtained from the women's questionnaire provide sufficient information on necessary variables.

3.3 Data source

The 2016 SADHS is a nationally representative sample survey, the third of its kind since 1990. SADHS was conducted through Statistics South Africa and was in partnership with the South African Medical Research Council (SAMRC). The agency was responsible for collecting, collating, analysing and disseminating population census and survey data at all levels that influence policy formation and population activity management. 2016 SADHS is the third demographic and health survey carried out by StatsSA in South Africa at a National

Department of Health (NDoH). The cross-sectional survey was carried out using a stratified three-stage cluster sample design. The South African Master Sample Frame (MSF) used for this survey is the list of enumeration areas (EAs) designed using census 2021. The small EAs were formed into groups to create a new primary sampling unit (PSUs) and large EAs (SADHS, 2016).

The frame included information about the geographic and the estimated number of residential dwelling units (DUs). The SADHS 2016 followed a stratified two-stage sample design with a probability proportional to size sampling of PSUs at the first stage and systematic sampling of DUs at the second stage. About 750 clusters were selected with 468 urban areas, 224 rural areas and 58 PSUs farm areas. A cluster is the primary sampling unit (PSU) with a fixed sample of 45 households. All women who were aged 15-49 years who were either resident of a house sampled or a visitor the night before the survey were eligible to be interviewed (National Population Commission, 2015).

3.4 Study Population

The population of interest for this study are infants in South Africa born to women from 15-49 years. The population is extracted from the women's questionnaire to obtain information about the backgrounds of the mother. Other information collected from the mother includes background information and health wellbeing. Therefore, the condition to be included was that a woman had a live birth at least within five years of the survey. This reference period was selected to examine events that occurred in the recent past.

3.5 Sample size

It was a nationally representative sample of 15,292 households identified in the country; of these households, 9, 878 women aged 15-49 were eligible but 8,514 interviewed, thereby giving a response rate of 86.2% (SADHS, 2016). The sample for this study was a weighted distribution of 3015 (3010 unweighted) infants born from mothers of reproductive ages. This was to insure national representation of the data. Women who did

not give birth 5 years before preceding the survey were excluded in this study and children whose mothers do not recall their birth weight and those not weighted at birth.

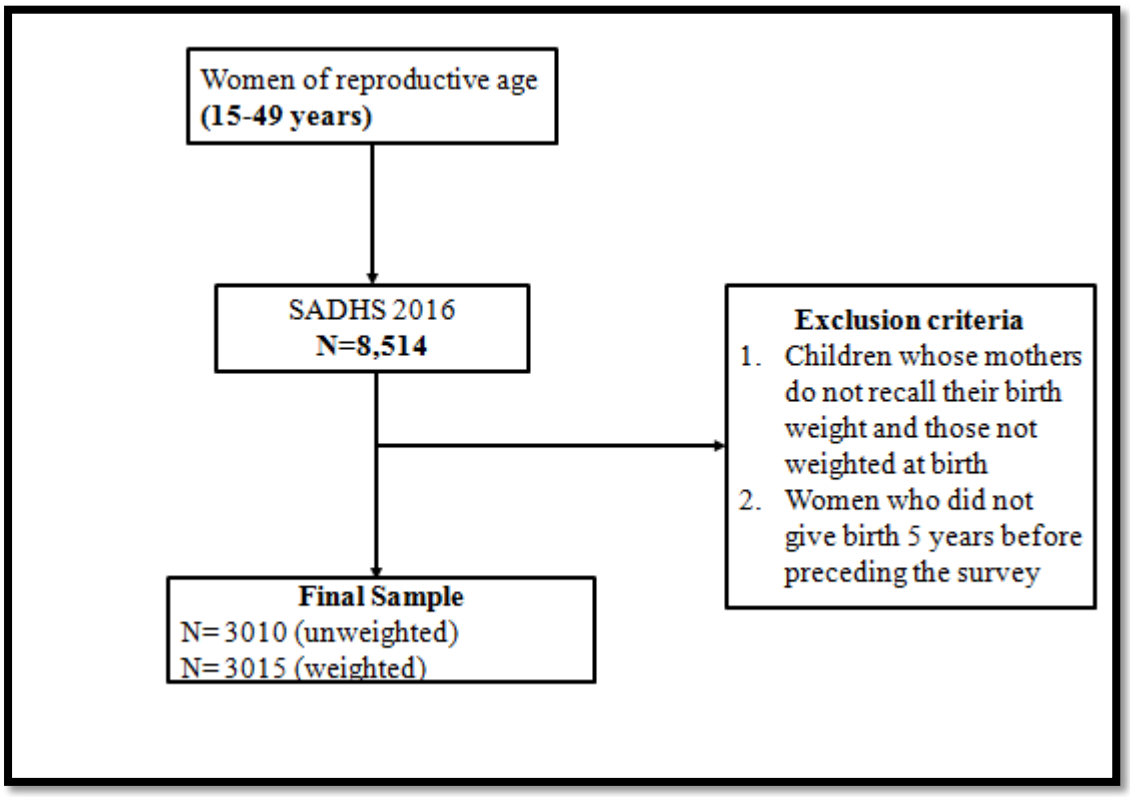

Figure 3: The step by step procedure of the final sample (information from SADHS, 2016)

3.6 Questionnaire Design

In South Africa, the survey collected data in five questionnaires: household's, men's, women's, caregiver's and biomarker's questionnaires. This study utilised the woman's questionnaire that included information on background characteristics, family planning, domestic violence, HIV/AIDS and maternal and child health. The questions were prepared in English and translated into ten other South African official languages.

3.7 Study Variables

The SADHS data sets 2016 included the dependent and independent variables for this analysis. The relevant variables are maintained while irrelevant variables are removed with the Stata program (Stata version 15.1).

3.7.1 Outcome Variable

The outcome variable for this study is birth weight of children. The responses were grouped as very small (500g-1500g), smaller than average (1500g-2490g), average (2500g-3980g), larger than average (4000g-4900g) and very average (5000g-6000g). However in this study these responses were categorised into a ranked variable low=500g-2490g, average=2500g-3980g and large 4000g-6000g. These data were extracted from the birth recode dataset.

3.7.2 Independent Variables

The other independent variables were operating as control variables. Their variables helped examine the maternal factors of birth weight children in South African. The variables are as follows:

ANC visits

The antenatal care variable was measured as the number of ANC visits a pregnant woman has to attend offered by a skilled health personal: a nurse or doctor to pregnant women. Previous studies have shown that ANC visits are vital in preventing pregnancy complications and adverse outcomes (Metgud et al., 2012; Servan-Mori et al., 2016; Tafere et al., 2018b). The 2016 SADHS asked respondents: “how many times did you receive antenatal care during pregnancy?” The response visits were classified into 3 groups, which are no ANC visits, 1-3 ANC visits and lastly 4+ visits meaning ANC visits that equal to 4 upwards and dropping those who did not know.

Sex of child

At the time of birth, male children have greater birth weight as compared to female children. This might be explained biologically as various foetal sizes of both the male and female foetuses would likely play an essential role in determining their growth differences between

the sexes (Halileh et al., 2008). Respondents were asked whether they gave birth to a boy or girl in the years 2011-2016.

Birth order

Studies have shown inconsistent connections with childbirth weight in respect of the childbirth order. According to Kamal (2012), while some studies indicated an increased risk of neonatal mortality among higher-ranked births, other studies have found the risk increased for the first or lower-ranked births (Abate et al., 2020). The respondents were asked the birth order of their child born within five years before the survey. The answers were recorded as a country variable. However, this study categorised the answers into 1st birth order, 2-4 birth order and 5+ birth order.

Birth type

It is believed that birth type impacts the infant/s weight at birth and that the risk to singletons is not as high as infants born multiple. Mothers of infants were asked whether any of these births were twins. Moreover, the answers were recorded as single and multiple. This paper renamed the answers as single and multiple.

Maternal age

Mother's age at the time of last birth was found to play a significant role in choosing maternal health care and is related to the awareness and experience, which in turn, leads to the use of maternal health services (Adamu et al., 2011). However, the questionnaire did not include the direct question of this variable. Therefore, this study created an interval variable by the difference in months between the child's date of birth and the mother's date of birth using both century month codes (CMC). The difference was divided by 60 months, which is equitable to 5 years preceding the survey. The respondents were asked: "How old were you at your last birthday?" For the child, the mother was asked: "In what month and year was the child born?"

Maternal educational level

The mother's educational level has been shown to influence the mother's health seeking behaviour during her pregnancy period. The educational level of the mother affects the health

and nutrition of children in different ways. Mothers' with better education turns to earn higher wages, which they spend on higher food and better nutrition for the development of the foetus and health services access. The 2016 South Africa DHS asked a question about the highest level of school the respondent attended: no education, primary, secondary and higher education.

Pregnancy duration

When a woman is pregnant, it is expected that her gestational period will last about 280 days or 40 weeks which is equivalent to nine months. If the women give birth before that, within 37 weeks, the baby is considered premature and most children born within these weeks have a higher chance of being low birth weight (Moffat et al., 2017). Respondents were asked a question: "how many months were you pregnant before the birth of (name)?" The answers were recorded into months from the 4th month to the 10th month. However, this study coded the months into categories as follows: <6 months, 7-8 months and 9-10 months.

Race

Every country has its different ethnic groups and research has affected every country's issues, making it challenging to compare race across countries. South Africa has four types of ethnic groups and it is expected to see different results amongst these groups. Respondents were asked: "which population group do you consider yourself: black, white, coloured, Indian or something else?" In this study, it was coded as African (1), White, Coloured and Asian were coded as Other (2). This was due to the small values between these racial groups.

Wealth index

Wealth status has been widely recognised as a significant factor in decisions about maternal health. Also, this variable may be financial independence and may enhance our understanding of how family income affects the inclination of a woman to pursue maternal health care. In the questionnaire, the wealth index was initially coded as 1=Poorest, 2=Poor, 3=Middle, 4= Richer and lastly 5= Richest. However, in this study, categories will be grouped as: 1. Poor, 2.Middle and 3. Rich.

Place of residence

Place of residence determines women's decision to seek health care and the availability of the community. About the type of residence, respondents were asked: "Just before you moved here, where you lived?" Responses were coded into urban and rural areas.

Exposure to media

Concerning exposure to the media, participants were asked: "Do you watch television at least once a week, less than once a week or not at all?" "Do you listen to the radio at least once a week, less than once a week or not at all?" "Do you read a newspaper or magazine at least once a week, less than once a week or not at all?" Responses coded as follows: "At least once a week =1, Less than once a week= 2, Not at all= 3". The responses to exposure to information shared through media will help construct a community exposure to media and be changed to 1= low, 2= medium and 3= high.

Table 3. 1: Definition of variables used in this study

Characteristics	**Category**
DEPENDENT VARIABLE	
Birth weight	Large birth weight (1) Average birth weight (2) Low birth weight (3)
Main Independent variables	
No. of ANC visits	No ANC visits (0) 1-3 ANC visits (1) 4+ visits (2)
Independent variables	
Sex of child	Male (1) Female (2)
Birth order	1st birth order(1) 2-4 birth order (2) 5+ birth order (3)
Birth type	Singlet (1) Multiples (2)
Maternal age at birth	15-19 years (1) 25-34 years (2) 35-49 years (3)
Maternal educational level	Lower education(1) Secondary education (2) Higher education (3)
Duration of pregnancy	<6 months (1) 7-8 months (2) 9-10 months (3)
Race	African (1) Other (2)

Wealth index	Poor (1) Middle (2) Rich (3)
Type of residence	Urban Area (1) Rural Area (2)
Community media exposure	Low (1) Medium (2) High (3)

3.8 Data management plan

The SADHS dataset will be downloaded as a STATA version and loaded in the statistical package STATA version 15.1 for analysis. Weights will be applied to control sample errors and make the study sample representative of the entire population. The STATA sample design calculations are as follows:

gen weight= v005/1000000

svyset[pw=weight], PSU(v001)strata(v022)

where:

- pweight= sampling weight
- PSU (primary sampling unit) v001 is the cluster number.
- v022 will be the sample strata for the sampling error number. (SADHS, 2016)

3.9 Data analysis

Objective 1: To assess childbirth weight levels by key socio-economic, demographic factors and antenatal care in South Africa.

This objective was addressed using descriptive analysis to statistically describe the respondents' selected maternal and child characteristics using a pie chart, frequency and percentage tables, bar graphs, cross-tabulation and the chi-square test of association. The pie chart shows the levels of birth weight among children in South Africa, while frequency tables are used to give a description of antenatal care, socio-economic and demographic factors

Furthermore, it involved the cross-tabulation of outcome variable birth weight and all independent variables using Pearson's chi-square test. It was shown in two ways: bar graphs used to illustrate the number of antenatal care visits by birth weight and frequency/percentage table only illustrating the socio-demographic factors by birth weight. The results are interpreted in percentages and the significance level for antenatal care is stated as ($p>0.05$), and as for the socio-demographic, it is shown by (*) close to the variables. With this ***Denotes p-value<0.005; **Denotes p-value<0.010** at the end of the percentage table.

Objective 2: To investigate the relationship between antenatal care, socio- economic and demographic characteristics by childbirth weight in South Africa

The third phase was done to present the ordinal logistic regression was used to identify the association between antenatal care, socio-economic and demographic factors. The association was illustrated in an unadjusted and adjusted model. This unadjusted model was used to identify the association between each independent variable and dependent variable while controlling for other independent variables. So, in the adjusted model, to identify the association between independent variable and dependent variable the variables were executed at the same time.

The ordinal logistic regression was used because the outcome variable 'childbirth weight' is an ordered/ranked variable; it consists of 3 categories. The first category is large birth weight= 1, average birth weight= 2 and low birth weight=3.

The cumulative logistic regression equation for this association was modelled as follows:

$\ln\left(\frac{Birth\ weight}{1-Birth\ weight}\right) = \beta 0 - (\beta sm\chi sm + \beta s\chi s + \ldots\ldots + \beta k\chi k)$ ---------- equation i (Kleinbaum & Mitchel, 2010).

$\ln\left(\frac{Birth\ weight}{1-Birth\ weight}\right) = \beta 0 - (\beta sm\chi sm + \beta s\chi s + \ldots\ldots + \beta k\chi k)$ ---------- equation ii (Kleinbaum & Mitchel, 2010).

Where βsm is the regression coefficient for the main predictor variable (social cohesion);
and other βs are the regression coefficients for other predictor variables or controls
χsm= is the main predictor variable and other χs are control variables
β0 = the intercept of the regression model.

Interpretations of results were made using odd ratios (OR) with OR>1 indicating a higher risk, OR<1 indicating a lower risk and OR=1 indicating no risk difference. The level of significance was set at 0.05, and a confidence interval (CI) of 95% was used. Data and variables were weighted using "iweights" to correct for survey design sampling errors and to ensure that the sample reflects truly, the population from which it was drawn.

3.10 Ethical issues

This study will use secondary data from the South African Demographic and Health Survey (2016), which is publicly accessible online https://dhsprogram.com/what-we-do/survey/survey-display-390.cfm website. The first move was to review if there were questions about maternal health care in the South Africa 2016 DHS questionnaire. After seeing that the questions were included, permission to access the dataset from the DHS website after the registration was obtained. In the registration process, it was required to provide a brief overview of why the data set was requested. The study survey of interest in South Africa DHS 2016 was selected upon approval to download the data collection. From the survey, the birth recodes data were selected since they comprised data on maternal and child health module, which was appropriate for review of the purposes of this study.

The Statistics South African (StatsSA) and South African Medical Research Council (SAMRC) obtained ethical approval when the data were collected. In the data collection process, the respondents were informed about the purpose of the interviews and they voluntarily participated. Besides, they made them aware that they could terminate their participation at any time they felt like or they could refuse to answer any questions they felt uncomfortable with. SADHS 2016 was conducted anonymously and therefore, informed consent was unnecessary. After all, no personal information of the respondents was identified on the dataset.

No ethical approval was needed from the University of the Witwatersrand Human Research Ethics Committee as this study secondary data. However, an ethics waiver form was filled and submitted to the ethics committee which allocated a student protocol number **WDEMG2020/07/03** for the clearance of this study.

3.11 Limitations

No causality

A consideration that this study is a cross-sectional design can only determine the association between predictor variables and the outcome variable. Therefore, this study cannot explore the causal relationship between antenatal care and childbirth weight among South African children.

CHAPTER 4

RESULTS

4.1 Introduction

This chapter presents the results of the study in three sections. The first section begins with a description of the study's sample and further provides descriptive statistics of the outcome variable - birth weight. Further, it presents the background characteristics using descriptive statistics. After that, section two assessed the association of socio-economic, demographic factors and antenatal care by a child's weight at birth using cross-tabulation and chi-square test. Lastly, the statistical relationship between socio-economic, demographic factors and antenatal care by childbirth weight was investigated using Ordinal logistic regression. In this section, the results of the unadjusted and adjusted odds ratios of the variables are presented in models 1 and 2 to determine whether an association exists between birth weight with antenatal care, socio-economic and demographic variables.

4.2 Birth weight of children in South Africa

As presented in **Figure 4** below, more than half (60%) of children in South Africa reported being in average birth weight while about 24% reported being in large birth weight and only 16% reported being small birth weight (low birth weight)

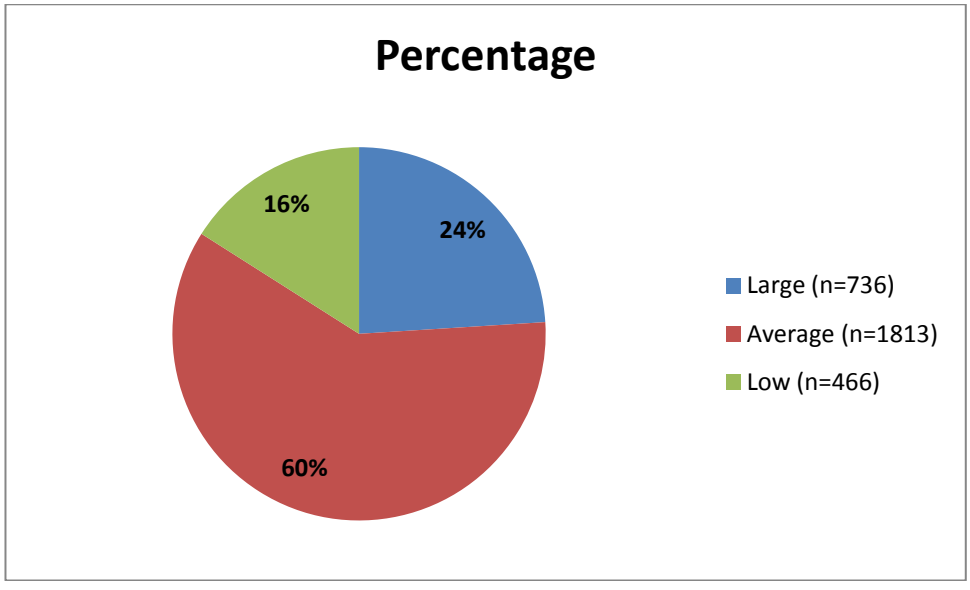

Figure 4: Birth Weight of Children

4.3 Birth Weight of Children in South Africa by Antenatal Care

As shown in Figure 5 below, the percentage of children reported no ANC visits is quite lower for children in the large and average birth weight (4% & 5%) compared to those in the small birth weight (6%). On the contrary, the percentage of children reported 4+ ANC visits is higher among large birth weight children (84%) compared to 76% among those in the small birth weight. The relationship was statistically

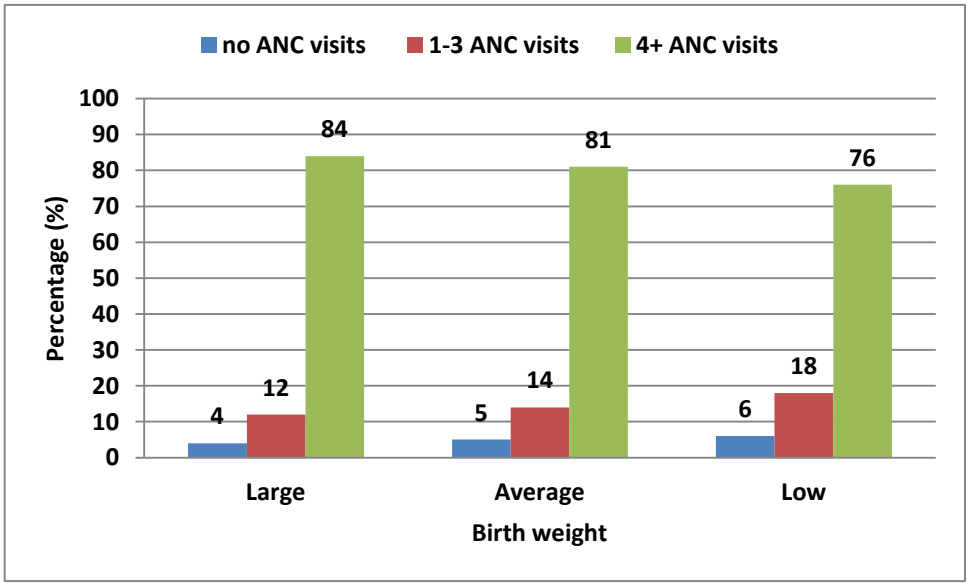

Figure 5: Birth weight of children in South Africa

4.4 Descriptive profile of children in South Africa and their mothers

The percentage distribution of the children's sex showed that male and female proportion was almost the same, with 51% males and 49% of female children. Slightly more than one-third (35%) of the children were of 1st birth order, more than half (59%) were between 2nd-4th birth orders and around 6% of children were 5+ birth order. Most (98%) of the children were singletons while 2% were multiple births.

For maternal age at birth, the results revealed that almost half of the children (45%) were delivered by mothers aged 25-34 years and 43% of births were delivered by mothers' 15-24. Only 12% of the children were delivered by mothers aged 35-49 years. **Table 4.1** shows that 2% of the children were born in the <6 months of pregnancy duration, with only 10% of children born in the 7-8 months. On the other hand, 88% of the children were born in the 9-10 months of pregnancy.

Regarding maternal educational level, results showing the proportion of children belonging to mothers with highest educational level are as follows: (79%) belonged to mothers with above secondary educational level, 12% were of the mothers with higher level and 9% were children of mothers with lower educational level.

Table 4.1 further indicated the percentage distribution of the wealth index. Forty four percent of the children belonged to poor mothers while the proportion of children belonging to middle mothers was 22 percent and only 34 percent belonged to rich mothers. Race results showed that 89% of children belonged to African mothers while 7% were children of coloured mothers. In contrast, 2% and 1% of children belonged to White and Indian/Asian respectively.

The percentage distribution of characteristics presented in **Table 4.1** showed that 65% were children of mothers who resided in urban areas and only 35% of the children were of mothers living in rural areas. Lastly, concerning exposure to media, 80% were children of mothers who experienced high media exposure, 8% were of low exposure to media and 12% were of mothers with medium exposure to media.

Table 4. 1: Descriptive profile of participants

Background description	Frequency	Percentage
No. of ANC visits		
No ANC visits	169	5
1-3 visits ANC visits	467	16
4+ visits	2379	79
Sex of child		
Male	1549	51
Female	1466	49
Birth order		
1st birth order	1027	34
2-4 birth order	1819	60
5+ birth order	169	6
Birth Type		
Single	2977	99
Multiple	38	1
Maternal age		
15-24 years	1247	42
25-34 years	1367	45
35-49 years	401	13
Pregnancy duration		

< 6 months	68	2
7-8 months	292	10
9-10 months	2655	88
Educational level		
Lower educational level	284	9
Secondary educational level	2383	79
Higher educational level	348	12
Wealth index		
Poor	1378	46
Middle	669	22
Richer	968	32
Race		
Black	2731	91
Other	284	9
Media exposure		
Low exposure	356	12
Medium exposure	246	8
High exposure	2413	80

4.5 Birth weight of children in South Africa and selected characteristics

Examining the birth weight of children across selected characteristics, results from **Table 4.2** below showed that both male and female children in small birth weight (50%) unlike children in the large birth weight, more males (58%) than females (42%) and the relationship is statistically significant ($p<0.05$). Across birth order number, about 59% of children in the 2nd-4th birth order reported being in small birth weight while more than half are in large (60%) and average (58%) birth weight. More than half of single birth type children are reported to be in small birth weight (96%) while only 4% of multiple birth type children are reported being and the relationship was statistically significant ($p<0.05$). About 42% of mothers between the ages of 15-24 and 25-34 gave birth to small birth weight children while 17% of those aged 35-49 years reported to have given birth to low birth weight children and the relationship was statistically significant ($p<0.05$). About 93% of children born in 9-10 months were reported to be larger birth weight while almost 64% reported to small birth weight and the relationship was statistically significant ($p<0.05$). More than half of the mothers with secondary educational level (79%) and those with higher educational level (9%) reported to have given birth to small birth weight infants while only about 13% of those with primary educational level given birth to small birth weight infants and the relationship is also statistically significant ($p<0.05$). Across racial groups, more than half of black mothers (91%)

reported to have given birth to large birth weight infants while 9% mothers of other racial group gave birth to large birth weight children.

The results revealed that half (51%) of small birth weight children were delivered by poor mothers; almost a quarter of small birth weight children were delivered by rich mothers (28%) and only 21% delivered by middle wealth mothers ($p>0.05$). Concerning the type of residence, over half of the small birth weight children were delivered among mothers residing in the urban centres (54%) and over a quarter (46%) was among mothers residing in rural areas ($p>0.05$). Lastly, **Table 4.2** depicts that 15% of small birth weight children were delivered among mothers exposed to low and medium media exposure (9%), with over half of small birth weight children delivered by mothers exposed to high media (76%) and the relationship was not statistically significant ($p>0.05$).

Table 4. 2: Percentage distribution of birth weight by selected socio-demographic characteristics

Respondents' Characteristics	Birth weight		
	Large	Average	Small
Sex of child **	**% (N)**	**% (N)**	**% (N)**
Male	58 (440)	59 (875)	50 (239)
Female	42 (295)	51 (938)	50 (232)
Birth order number			
1st birth order	35 (249)	35 (625)	33 (154)
2nd-4th birth order	60 (451)	58 (1087)	59 (281)
5+ birth order	5 (36)	6 (101)	8 (38)
Birth type**			
Single	100 (734)	99 (1790)	96 (453)
Multiple	1945 (0)	23 (1)	14 (4)
Age group**			
15-24 years	45 (332)	42 (729)	42(186)
25-34 years	44 (322)	45 (850)	42 (195)
35-49 years	11 (81)	14 (235)	17 (81)
Duration of pregnancy**			
< 6 months	1 (10)	1 (20)	6 (37)
7-8 months	6 (33)	7 (124)	30 (135)
9-10 months	93 (692)	91 (1669)	64 (294)
Highest educational level **			

Lower educational level	12 (74)	9 (162)	13 (49)
Secondary educational level	80 (605)	79 (1409)	79 (368)
Higher educational level	8 (57)	12 (242)	9 (50)
Race			
Black	669 (91)	1643 (89)	419 (88)
Other	66 (9)	170 (11)	12 (48)
Wealth index			
Poor	48 (322)	48 (822)	51 (235)
Middle	23 (179)	23 (409)	21 (82)
Richer	28 (235)	29 (583)	28 (150)
Type of residence			
Urban	52 (454)	53 (1186)	54 (288)
Rural	48 (281)	47 (628)	46 (178)
Exposure to media			
Low exposure	11 (68)	13 (219)	15 (69)
Medium exposure	10 (63)	9 (146)	9 (36)
High exposure	79 (605)	78 (1448)	76 (361)

***Denotes p-value<0.005; **Denotes p-value<0.010**

4.4 Analysis showing the statistical relationship between socio-economic, demographic factors and antenatal care by child birth weight

This section presents the results of the unadjusted and adjusted odds ratios. Also shown are the associated confidence intervals for the relationship between socio-economic, demographic variables and antenatal care by birth weight among children in South Africa. The confidence interval has been set at 95%, with a level of significance of 0.05.

Table 4. 3: Unadjusted and adjusted odds ratios of the relationship between Antenatal care and Child Birth Weight in South Africa

	Unadjusted model		Adjusted model	
	OR [95% CI]	**P-value**	**OR [95% CI]**	**P-value**
ANC visits				
No ANC visits	**Ref.**			
1-3 ANC visits	0.982 [0.678-1.422]	0.92	0.871 [0.598-1.270]	0.47
4+ ANC visits	0.720 [0.519-0.999]	0.05*	0.669 [0.598-0.916]	0.02*
Sex of child				
Male	**Ref.**			
Female	1.268 [1.02-1.459]	0.00*	1.323 [1.104-1.587]	0.00*
Birth order				
1st birth order	**Ref.**			
2-4 birth order	1.006 [0.866-1.167]	0.94	0.897 [0.710-1.134]	0.36
5+ birth order	1.283 [0.946-1.739]	0.11	0.980 [0.627-1.531]	0.93
Birth type				
Single birth type	**Ref.**			
Multiple birth type	4.037 [2.258-7.216]	0.00*	1.983 [1.057-3.719]	0.03*
Maternal age				
18-24 years	**Ref.**			

25-34 years	1.043 [0.898-1.213]	0.58	1.122 [0.897-1.403]	0.31
35-49 years	1.355 [1.088-1.688]	0.01*	1.507 [1.116-2.035]	0.01*
Duration of pregnancy				
<6 months	**Ref.**			
7-8 months	0.654 [0.369-1.159]	0.15	0.831 [0.313-2.204]	0.71
9-10 months	0.139 [0.081-0.238]	0.00*	0.153 [0.063-0.368]	0.00*
Maternal educational level				
Lower educational level	**Ref.**			
Secondary educational level	1.070 [0.845-1.353]	0.55	1.189 [0.874-1.618]	0.27
Higher educational level	1.267 [0.931-1.726]	0.13	1.618 [1.068-2.443]	0.02*
Race				
Black	**Ref.**			
Other	1.206 [0.961-1.515]	0.11	1.070 [0.793-1.4474	0.66
Wealth index				
Poor	**Ref.**			
Middle	0.913 [0.765-1.090]	0.31	0.794 [0.612-1.030]	0.08
Richer	0.977 [0.828-1.152]	0.78	0.800 [0.595-1.076]	0.14
Type of residence				
Unban	**Ref.**			
Rural	0.9425 [0.819-1.084]	0.40	0.948 [0.747-1.202]	0.66
Exposure to media				
Low exposure	**Ref.**			
Medium exposure	0.727 [0.539-0.982]	0.04*	0.701 [0.477-1.031]	0.07
High exposure	0.789 [0.638-0.977]	0.03*	0.734 [0.519-1.032]	0.08

Unadjusted odds ratio

Unadjusted model which included the unadjusted ordinal logistic regression showed that the odds of the combined large and average birth weight versus low birth weight is 2% [OR=0.989, CI 0.678-1.442] less among mothers who attended 1-3 ANC visits, but the relationship was not statistical significant. Among mothers who attended 4+ ANC visits the odds of the combined large and average birth weight are 28% [OR=0.720, CI 0.519-0.999] significantly less compared to low birth weight. Female children are 1.27 times more likely [OR=1.268, CI 0.021-1.459] to be reported small birth weight than their male counterparts, and the relationship was statistically significant.

For one unit increase in the child's birth order, the odds of low birth weight versus large and average is 1.0 times greater among children born in the 2nd-4th birth compared to children in the 1st birth order [OR=1.006, CI 0.866-1.167]. The odds of low birth weight verse combined large and average birth weight is 1.3 times [OR=1.283, CI 0.946-1.739) greater among children born in the 5th+ birth order compared to children in the 1st birth order; given that that all variables are held constant. For child type, the unadjusted model showed that the odds of the combined large and average birth weight versus low birth weight is 4.0 times [OR=4.037, CI 2.258-7.216] greater among children born in multiple birth type compared to single birth type.

Table 4.3 showed a non-significant relationship between maternal age at birth and birth weight. Even after controlling for other variables in the study, as age increases, the odds of birth weight increase among different age groups. Among children who were born by women aged 25-34 years, the odds of combined large and average birth weight versus low birth weight was 51% more likely [OR= 1.043, CI 0.898-1.213] compared to children who were born by mothers aged 15-24 years. Among children who were born by women aged 35-49 years, the odds of combined large and average birth weight versus low birth weight was 57% significantly more likely, [OR=1.355, CI 1.088-1.688] compared to children who were born by women aged 15-24 years.

In terms of pregnancy duration, **unadjusted model** depicts that the probability of low birth weight versus the large and average birth weight among children delivered in 7-8 months is 34% lower than children delivered in <6 months [OR=0.654, CI 0.369-1.213]. The probability of the large and average birth weight versus low birth weight among children

delivered in 9-10 months is 86% lower than children born in <6 months [OR=0.139, CI 0.081-0.23] and the relationship was statistically significant. The odds ratio of educational level revealed that the odds of combined large and average birth weight versus low birth weight among children increased with the mothers' educational level. The odds of combined large and average birth weight versus low birth weight among children born by mothers with the secondary educational level were 7% greater than children of mothers with primary education (OR=1.070, CI 0.845-1.353). The odds of combined large and average birth weight versus low birth weight among children born by mothers with higher education are 27% greater than children of mothers with lower education [OR=1.267, CI 0.0.931-1.726].

The unadjusted odds of low birth weight versus the combined large and average birth weight is 1.2 times more likely among children of Other racial group mothers [OR=1.206, CI 0.961-1.515] compared to children of African mothers given all other variable were controlled. Regarding the wealth index in **Table 4.3**, the probability of low birth weight versus large and average birth weight among children born by middle mothers showed to be 0.9 times less likely [OR=0.913, CI 0.765-1.090] compared to children of poor mothers. Moreover, among children born by rich mothers low birth weight versus the combined large and average birth weight is 0.9 times less likely [OR=0.977, CI 0.828-1.152] compared to children born by poor mothers. Further, the results indicated that the relationship between residence and birth weight is statistically insignificant in both models. The unadjusted model shows that the odds of low birth weight versus the combined large and average birth was 6% less likely for children born by mothers who live in rural areas than those from urban areas [OR=0.943, CI 0.819-1.084].

In relation to exposure to media, mothers' who were exposure to medium media are 27% less likely [OR=0.727, CI 0.539-0.982] to report large or average birth weight of the children compared to those of low media exposure, and 21% lesser [OR=0.789, Cl 0.638-0.977] among children of mothers' high media exposure compared to children whose mothers' experienced low media exposure. The relationship was statistically significant while controlling for covariates in the model. The model is also statistically significant ($p<0.05$).

Adjusted odds ratio

Adjusted model which is the full model examined the relationship between antenatal care and birth weight while controlling for demographic characteristics and socio-economic

characteristics. Results from this model showed that among respondents who attended 1-3 [OR=0.871, CI 0.598-1.270] and 4+ [OR=0.669, CI 0.598-0.916] ANC visits were less likely to report low birth weight versus the combined large and average birth weight among children compared to respondents who did not attended ANC but the relationship was statistically significant among mothers who attended 4+ ANC visits. Other statistically significant predictors of child's birth weight in this model are sex of the child, birth type, age, pregnancy duration, maternal educational level.

With regards to the child's sex, female [OR=1.323, CI 1.104-1.587] were less likely to be in large or average birth weight compared to male children. A significant relationship is found. Additionally, the results indicate that the odds of low birth weight among children in the 2nd-4th birth order is 10% lower as compared to the 1st birth order [OR=0.897, CI 0.710-1.134] and the odds ratio of combined large and average among children born in order 5+ is 2% less likely than children in the 1st birth order [OR= 0.980, CI 0.627- 1.531]. After controlling for the effects of antenatal care and socio-demographic variables in adjusted model, the relationship between the child's birth order and birth weight remained statistically insignificant.

As shown in **Table 4.3**, among multiple children compared to singlet, the odds of low birth weight compared to large or average birth weight are expected to increase by a factor of 1.983 [CI 01.057-3.719]. The results indicate a statistical significant relationship between birth type and birth weight. Regarding maternal age at birth, the odds of low birth weight compared to combined large or average birth weight among children born by young women aged 25-34 years is expected to decrease by a factor of 1.122 [CI 0.897-1.403] compared to children born by mothers aged 15-24 years. Among children born by women aged 35-49 years, the significant odds of low birth weight compared to large or average birth weight were expected to be increased by a factor of 1.507 [CI 0.116- 2.035] compared to children born by women aged 15-24 years.

In terms of duration of pregnancy, the odds ratio of combine large and average birth weight compared to low birth weight among children delivered in 7-8 months is 17% [OR=0.831, Cl 0.313-2.20] less likely as compared to children delivered in <6 months and significantly 85% less [OR=0.153, Cl 0.063-0.368] among children delivered in 7-8 months compared to children delivered in 9-10 months. Meanwhile, the odds ratio of low birth weight among children born by mothers with secondary education is 19% more likely compared to children

born to mothers with lower education [OR=1.189, Cl 0.874-1.618]. Also, it is 62% less likely among mothers with higher education [OR=1.618, Cl 1.068-2.443) and a significant between mother's educational level and birth weight.

As illustrated in **Table 4.4**, the odds of low birth weight differed across racial groups. Moreover, the probability of low birth weight compared to combined large and average birth weight among children of Other racial groups is 1.0 times more likely compared to children of African mothers [OR=1.070, Cl 0.793-1.447]. There was no significant association across the two groups of wealth index and birth weight. The odds ratio of birth weight among children by middle mothers as compared to poor was expected to decrease by 21% [OR=0.794, Cl 0.612-1.030] and 20% [OR=0.800, Cl 0.595-1.076] among children born by rich mothers as compared to children born by poor mothers.

However, when comparing children from rural and urban areas, an insignificant relationship was found between residence and birth weight. Among children born by mothers from rural areas compared to those from urban areas, the odds of low birth weight compared to combined large or average birth weight is 5% less likely [OR=0.948, Cl 0.747-1.202]. Lastly, among children of mothers exposed to medium media exposure, the odds of low birth weight compared to large or average birth weight is 30% lesser [OR=0.701, Cl 0.477-1.031] compared to children of mothers in low exposure. The odds ratio of low birth weight compared to large or average birth weight among children of mothers in high exposure is 13% lesser [OR=0.734, Cl 0.519-1.032] compared to children of mothers in low exposure. As a result, there is no significant relationship between exposures to media. Overall, the model is statistically significant ($p<0.000$).

CHAPTER 5

DISCUSSION

5.1 Introduction

This study has addressed the two specific objectives. First it examined the birth weight of children in South Africa. Second, it assessed the birth weight of children in South Africa by antenatal care, socio-economic and demographic factors. Third, it explored the relationship between antenatal care visits and birth weight of children in South Africa. The purpose of this chapter is therefore to present the findings of this study. In presenting this discussion, the various findings from this study unified and integrated within the context of what is known about the topic globally.

5.2 Discussion of the results

The findings from this study showed that majority of children in South Africa are of average birth weight and only one of sixth are of low birth weight. The level found in South Africa was lower compared to levels (17.7%) found in a meta-analysis study conducted in Ethiopia (Endalamaw et al., 2018). However, the rate is two times the developing world average, 7% (Mahumud et al., 2017).

The study's second objective was to investigate the pattern of childbirth weight by antenatal care, socio economic and demographic characteristics in South Africa. This study hypothesised that number of antenatal care visits affects the child's birth weight. This assumption is based on both the theoretical and analytical frameworks such that greater number of ANC visits would contribute to the child's birth weight and the elimination maternal and child adverse outcomes. Findings from this study were consistent with the hypothesis as children whose mothers attended more than 4 ANC visits was significant associated with lower likelihood of being reported low birth weight. This finding is also consistent with other previous studies in Ghana, Brazil, Lao PDR, India and Afghanistan where a substantial improvement in average birth weight among infants whose mothers attended recommended number of antenatal care visits was seen (Appiah et al., 2020; Banchani & Tenkorang, 2020; Branco da Fonseca et al., 2014; Oulay et al., 2018, Gupta & Talukdar, 2017; Das Gupta et al., 2019). However, mothers who attended fewer visits had a

highly significant risk of delivering low birthweight infants. One potential reason is has been explained by theoretical framework terms of individual's engagement of health services. It may also foster lifestyle behaviour such as taking supplements during pregnancy, exposure of tobacco and alcohol (Mumbare et al., 2012; Sabbaghchi et al., 2020). According to existing literature, the timing of antenatal care visits among mothers plays a significant role in reducing the chances of low birth weight among newborns (Gebresilassie et al., 2019; Gupta & Talukdar, 2017; Manyeh et al., 2020; Tariku et al., 2010; Reddy et al., 2015). The reason could be because of early ANC attendance, which exposes the mother to benefits that include preventive and premature disease detection, iron and folate supplements to treat anaemia.

Other significant predictors of birth weight as evident in this study are sex of child, birth type, maternal age, duration of pregnancy and maternal educational level. Typically, male children have a higher birth weight than female children. In a cross-sectional study conducted in Afghanistan after 28 days of gestation, a gap between male and female birth weight began (Das Gupta et al., 2019). This gap might be caused by androgen activity or by the Y chromosome carrying foetal growth genetic material resulting in higher intrauterine growth among male infants (Das Gupta et al., 2019). However, even though female children are significantly more likely to be reported low birth weight. This paper is inconsistent with previous research, suggesting that females have a significantly greater chance of low birth weight than males. Biologically speaking, the various foetal sizes of both the male and female foetuses would likely play an essential role in determining their growth differences between the sexes. Besides, there might be other psychological causes such as preference for boys, depression during pregnancy, lack of social assistance and denial of pregnancy (Halileh et al., 2008).

It is believed that birth type impacts the infant/s weight at birth and that the risk to singletons is not as high as infants born multiple. This study provides a clear indication those infants born as multiples more likely to be of low birth weight than the singlet. These findings are in line with a study "another look at returns to birth weight" (Maruyama & Heinesen, 2020). The reason for this could be the increased levels of premature delivery and restricted foetal development in twin pregnancies (Santana et al., 2018).

Results from several studies find mixed evidence that of an association between age and low birth weight. According to existing literature, a mother's age impacts the child's birth weight, with mothers above 35 years having a greater risk of giving birth to low birth weight infants

(Mohammad et al., 2014). At the same time, others found that the risk is high among teenage mothers (Banchani & Tenkorang, 2020). This hypothesis on age and birth weight might be explained by the fact that the threshold age for foetus and mother health threats is age ">35 years" (Mohammad et al., 2014). As for teenage girls, literature explains that it might be because it is their first birth and this has been proved to be associated with greater chances of poor birth outcomes, which includes low birth weight (Aras, 2013; Banchani & Tenkorang, 2020). Nevertheless, some works have shown that maternal age is not significantly associated with birth weight (Bhaskar et al., 2015; Das Gupta et al., 2019; Tafere et al., 2018).

Previous studies have also documented that full-term pregnancy was a significant predictor of child's birth weight (Hailu & Kebede, 2018). The finding of this study supports a case-control study in Malaysia that identified that gestation weeks are a vital factor in deciding the weight of children (Sutan et al., 2014) implying that children born in 38-42 weeks are less prone to be low birth weight.

With regards to maternal educational level, this study provides a clear indication that higher educated mothers know more about maternal education and other essential resources needed for a woman during pregnancy. According to existing literature, women with a better educational level are empowered (Tafere et al., 2018). A literature review identified that mothers' health seeking behaviour is highly associated with high levels of education among pregnant women (Aziz Ali et al., 2018). It can be argued that educational status might help put women on more information and campaigns on health education, allowing them to identify hazardous signs and complications and take effective action.

In this paper infants born to other racial group mothers were insignificantly associated to birth weight. Racial disparities persisted in South Africa and the segregation that happened during the apartheid era has been used in literature to explain the racial disparities in socioeconomic status, level of education, living conditions, access to health and health outcomes (Kon & Lackan, 2008; Lau et al., 2018; Nkonki et al., 2011). Some previous studies have identified smoking during gestation as one of the risk variables that increases the odds of pregnant women giving birth to low birth weight infants (Mumbare et al., 2012; Sabbaghchi et al., 2020). In South Africa, coloured women have a high prevalence rate of smoking (34.4%), followed by white women (12.9%), 7.5% for Asian women and 3.3% for black women (Reddy et al., 2015). Therefore, this might help explain why the results revealed a high risk of mothers giving birth to low birth weight infants. The racial disparities

are controversial, making it difficult to explain without linking any social ills with the apartheid segregation.

Some scholars argue that some socio-economic conditions such as wealth index and residence place negatively affect the infant's weight. In this connection, research conducted in Tanzania and India found that mothers living in rural areas were more susceptible to low-birth weight babies (Siza, 2008; Wilcox, 2001). Contrary to that, Demelash found that urban mothers were more susceptible to low birth weight babies than mothers who lived in rural areas (Demelash et al., 2015). However, in this study, none is significant including the wealth index of the mothers, thus giving a picture that socio-economic condition does not affect birth weight in South Africa.

The exposure to media as a determinant variable was tested in previous studies. It was found in all of them that exposure to mass media has positive influence mother's health seeking behaviour (Tekelab et al., 2019). Thus, this paper hypothesizes that mothers exposed to high media coverage reduced their odds of low birth weight. However, the results revealed no association between exposure to media and low birth weight. In other studies conducted on antenatal care services, exposure to media remains a significant variable. This significant relationship is because women with high income and living standards have been shown to have greater access to the media, raising awareness that prenatal care is being used (Edward, 2011; Tekelab et al., 2019).

5.3 Strengths of the study

Even though this study is a cross-sectional study, it still possesses quite pronounced strengths. Firstly, the SADHS 2016 used validated and standardised interview methods. Secondly, this study used birth weight data checked by documents to eliminate the recall bias.

5.4 Limitations of the study

The research is a cross-sectional study and causality cannot be inferred. The use of ordinal logistic regression cannot establish the causal relationship between antenatal care and childbirth. Besides, the research focused on only one type of antenatal care: number of antenatal care visits without taking other forms of antenatal care into account.

CHAPTER 6

CONCLUSION AND RECOMMENDATION

This study examined the childbirth weight in South Africa; its patterns across selected characteristics were also explored. Attention was brought to the relationship between antenatal care and birth weight.

The findings reveal that antenatal care was a protective factor of adverse birth weight when mothers who attended more than 4 ANC visits had fewer odds of giving birth to low birth weight children concerning mothers who attended less than 4 ANC visits.

Female children were at a greater chance of adverse birth weight as compared to male children. Full-term pregnancy proved to be a protected factor to low birth weight and multiple birth type infants' probe to low birth weight. Based on these findings, birth weight among children in South Africa particularly in female children is necessary for improvement in health. Infant health and well-being are still impacted by low birth weight. A better understanding of the risk factors for LBW allows for more targeted therapy.

Low birth weight is a major public health problem in Africa, and this is especially true in South Africa. LBW has to be made more widely known to expectant moms so that they can better protect themselves and their unborn child while they are pregnant. As well as community-oriented primary care and social media through mom—connect which helps pregnant women, new moms, and health care providers to have access to vital information as well as critical data for Maternal and Child Health programs. Thus this will also promote ANC attendance for early interventions to prevent LBW through various platforms. In South Africa and other places where infant mortality and morbidity are high, lowering the prevalence of LBW will assist. This research also feeds broader public health programs, such as earlier antenatal checkups and ultrasound screenings, and prevents the high morbidity of poor birth outcomes in South Africa and other LMICs.

Given the limitations of this study's inability to establish causality between antenatal care and child's birth weight, future studies may need to explore this relationship through a national case-control study design. It will be the best approach to compare what happened in every category to determine how the risk factor is related to adverse birth weight amongst two groups. By employing this type of observational study it will make it possible to establish the effect of ANC on low birth weight. This is because a case-control study recognises patients and then sees whether many exposed patients develop the disease. This type of research will include choosing pregnant mothers who attend antenatal care and those who do not conduct thorough interviews. It will also assist in examining multiple risks at the same time and since the disease has occurred, this will make the study less time-consuming. However, this might introduce bias because a case-control study is retrospective and the data quality relies on memory, therefore introducing recall bias.

REFERENCES

Abate, M. G., Angaw, D. A., & Shaweno, T. (2020). Proximate determinants of infant mortality in Ethiopia, 2016 Ethiopian demographic and health surveys: Results from survival analysis. *Archives of Public Health*, *78*(1), 4. https://doi.org/10.1186/s13690-019-0387-4

Acharya, D., Singh, J. K., Kadel, R., Yoo, S.-J., Park, J.-H., & Lee, K. (2018). Maternal Factors and Utilisation of the Antenatal Care Services during Pregnancy Associated with Low Birth Weight in Rural Nepal: Analyses of the Antenatal Care and Birth Weight Records of the MATRI-SUMAN Trial. *International Journal of Environmental Research and Public Health*, *15*(11), 2450. https://doi. org/ 10.3390 /ijerph15112450

Adamu, M. A., Weck, M. N., Rothenbacher, D., & Brenner, H. (2011). Incidence and risk factors for the development of chronic atrophic gastritis: Five year follow-up of a population-based cohort study. *International Journal of Cancer*, *128*(7), 1652-1658. https://doi.org/10.1002/ijc.25476

Aras, R. (2013). Is maternal age risk factor for low birth weight? *Archives of Medicine and Health Sciences*, *1*(1), 33. https://doi.org/10.4103/2321-4848.113558

Arsenault, C., Jordan, K., Lee, D., Dinsa, G., Manzi, F., Marchant, T., & Kruk, M. E. (2018). Equity in antenatal care quality: An analysis of 91 national household surveys. *The Lancet Global Health*, *6*(11), e1186–e1195. https://doi.org/10.1016/S2214-109X(18)30389-9

Arunda, M., Emmelin, A., & Asamoah, B. O. (2017). Effectiveness of antenatal care services in reducing neonatal mortality in Kenya: Analysis of national survey data. *Global Health Action*, *10*(1), 1328796. https://doi.org/10.1080/16549716.2017.1328796

Austin, P. C., & Merlo, J. (2017). Intermediate and advanced topics in multilevel logistic regression analysis. *Statistics in Medicine*, *36*(20), 3257-3277. https://doi. org/ 10.1002 /sim.7336

Aziz Ali, S., Ahmed Dero, A., Aziz Ali, S., & Bano Ali, G. (2018). Factors affecting the utilization of antenatal care among pregnant women: A literature review. *Journal of*

Pregnancy and Neonatal Medicine, *02*(02). https://doi.org/10.35841/neonatal-medicine. 2.2.41-45

Banchani, E., & Tenkorang, E. Y. (2020). Determinants of Low Birth Weight in Ghana: Does Quality of Antenatal Care Matter? *Maternal and Child Health Journal*, *24*(5). https://doi.org/10.1007/s10995-020-02895-6

Bhaskar, R. K., Deo, K. K., Neupane, U., Chaudhary Bhaskar, S., Yadav, B. K., Pokharel, H. P., & Pokharel, P. K. (2015). A Case-Control Study on Risk Factors Associated with Low Birth Weight Babies in Eastern Nepal. *International Journal of Pediatrics*, *2015*, 1-7. https://doi.org/10.1155/2015/807373

Budree, S., Stein, D. J., Brittain, K., Goddard, E., Koen, N., Barnett, W., Myer, L., & Zar, H. J. (2017). Maternal and infant factors had a significant impact on birthweight and longitudinal growth in a South African birth cohort. *Acta Paediatrica*, *106*(11), 1793–1801. https://doi.org/10.1111/apa.14015

Dahlui, M., Azahar, N., Oche, O. M., & Aziz, N. A. (2016). Risk factors for low birth weight in Nigeria: Evidence from the 2013 Nigeria Demographic and Health Survey. *Global Health Action*, *9*(1). https://doi.org/10.3402/gha.v9.28822

Das Gupta, R., Swasey, K., Burrowes, V., Hashan, M. R., & Al Kibria, G. M. (2019). Factors associated with low birth weight in Afghanistan: A cross-sectional analysis of the demographic and health survey 2015. *BMJ Open*, *9*(5). https://doi.org/ 10.1136 /bmjopen-2018-025715

David, M., & Sutton, C. D. (2011). *Social Research: An Introduction*. SAGE.

Demelash, H., Motbainor, A., Nigatu, D., Gashaw, K., & Melese, A. (2015). Risk factors for low birth weight in Bale zone hospitals, South-East Ethiopia: A case-control study. *BMC Pregnancy and Childbirth*, *15*(1), 264. https://doi.org/10.1186/s12884-015-0677-y

Edward, B. (2011). Factors influencing the utilisation of antenatal care content in Uganda. *The Australasian Medical Journal*, *4*(9), 516–526. https://doi.org/ 10.4066 /AMJ.2011.849

Endalamaw, A., Engeda, E. H., Ekubagewargies, D. T., Belay, G. M., & Tefera, M. A. (2018). Low birth weight and its associated factors in Ethiopia: A systematic review and meta-analysis. *Italian Journal of Pediatrics*, *44*(1), 141. Edward, B. (2011). Factors influencing the utilisation of antenatal care content in Uganda. *The Australasian Medical Journal*, *4*(9), 516-526. https://doi.org/10.4066/AMJ.2011.849

Gaiva, M. A. M., Fujimori, E., & Sato, A. P. S. (2014). Neonatal mortality in infants with low birth weigh. *Revista Da Escola de Enfermagem Da USP*, *48*(5). https://doi.org/10.1590/S0080-62342014000005000002

Gebregzabiherher, Y., Haftu, A., Weldemariam, S., & Gebrehiwet, H. (2017). The Prevalence and Risk Factors for Low Birth Weight among Term Newborns in Adwa General Hospital, Northern Ethiopia. *Obstetrics and Gynecology International*, *2017*. https://doi.org/10.1155/2017/2149156

Girma, S., Fikadu, T., Agdew, E., Haftu, D., Gedamu, G., Dewana, Z., & Getachew, B. (2019). Factors associated with low birth weight among newborns delivered at public health facilities of Nekemte town, West Ethiopia: A case-control study. *BMC Pregnancy and Childbirth*, *19*(1). https://doi.org/10.1186/s12884-019-2372-x

Hailu, L. D., & Kebede, D. L. (2018). Determinants of Low Birth Weight among Deliveries at a Referral Hospital in Northern Ethiopia. *BioMed Research International*, *2018*. https://doi.org/10.1155/2018/8169615

Halileh, S., Abu-Rmeileh, N., Watt, G., Spencer, N., & Gordon, N. (2008). Determinants of Birthweight; Gender Based Analysis. *Maternal and Child Health Journal*, *12*, 606-612. https://doi.org/10.1007/s10995-007-0226-z

He, Z., Bishwajit, G., Yaya, S., Cheng, Z., Zou, D., & Zhou, Y. (2018). Prevalence of low birth weight and its association with maternal body weight status in selected countries in Africa: A cross-sectional study. *BMJ Open*, *8*(8), e020410. https://doi.org/10.1136/bmjopen-2017-020410

Kon, Z. R., & Lackan, N. (2008). Ethnic Disparities in Access to Care in Post-Apartheid South Africa. *American Journal of Public Health*, *98*(12), 2272-2277. https://doi.org/10.2105/AJPH.2007.127829

Kruk, C., Huszar, V. L. M., Peeters, E. T. H. M., Bonilla, S., Costa, L., Lürling, M., Reynolds, C. S., & Scheffer, M. (2010). A morphological classification capturing functional variation in phytoplankton. *Freshwater Biology*, *55*(3), 614–627. https://doi.org/10.1111/j.1365-2427.2009.02298.x

Linard, M., Blondel, B., Estellat, C., Deneux Tharaux, C., Luton, D., Oury, J. F., Schmitz, T., Mandelbrot, L., & Azria, E. (2018). Association between inadequate antenatal care utilisation and severe perinatal and maternal morbidity: An analysis in the PreCARE cohort. *BJOG: An International Journal of Obstetrics & Gynaecology*, *125*(5). https://doi.org/10.1111/1471-0528.14794

Lori, J. R., Ofosu-Darkwah, H., Boyd, C. J., Banerjee, T., & Adanu, R. M. K. (2017). Improving health literacy through group antenatal care: A prospective cohort study. *BMC Pregnancy and Childbirth*, *17*(1). https://doi.org/10.1186/s12884-017-1414-5

Lau, Y. K., Tam, J., Fleischer, N. L., & Meza, R. (2018). Neighbourhood deprivation, smoking, and race in South Africa: A cross-sectional analysis. *Preventive Medicine Reports*, *11*, 202-208. https://doi.org/10.1016/j.pmedr.2018.07.001

Macdonald, P. D., Ross, S. R. M., Grant, L., & Young, D. (2003). Neonatal weight loss in breast and formula fed infants. *Archives of Disease in Childhood - Fetal and Neonatal Edition*, *88*(6), F472-F476. https://doi.org/10.1136/fn.88.6.F472

Mahumud, R. A., Sultana, M., & Sarker, A. R. (2017). Distribution and Determinants of Low Birth Weight in Developing Countries. *Journal of Preventive Medicine and Public Health*, *50*(1). https://doi.org/10.3961/jpmph.16.087

Manyeh, A. K., Amu, A., Williams, J., & Gyapong, M. (2020). Factors associated with the timing of antenatal clinic attendance among first-time mothers in rural southern Ghana. *BMC Pregnancy and Childbirth*, *20*(1), 47. https://doi.org/10.1186/s12884-020-2738-0

Maruyama, S., & Heinesen, E. (2020). Another look at returns to birthweight. *Journal of Health Economics*, *70*, 102269. https://doi.org/10.1016/j.jhealeco.2019.102269

Metgud, C. S., Naik, V. A., & Mallapur, M. D. (2012). Factors Affecting Birth Weight of a Newborn – A Community Based Study in Rural Karnataka, India. *PLoS ONE*, *7*(7). https://doi.org/10.1371/journal.pone.0040040

Mensah, P., Yamoah, E.E. & Adom, K. 2014. Empirical Investigation of Service Quality in Ghanaian Hospitals. *European Journal of Business and Management*, 6(18):157-178.

Mohammad, K., Kassab, M., Gamble, J., Creedy, D. K., & Foster, J. (2014). Factors associated with birth weight inequalities in Jordan. *International Nursing Review*, *61*(3), 435-440. https://doi.org/10.1111/inr.12120

Muchie, K. F. (2017). Quality of antenatal care services and completion of four or more antenatal care visits in Ethiopia: A finding based on a demographic and health survey. *BMC Pregnancy and Childbirth*, *17*. https://doi.org/10.1186/s12884-017-1488-0

Mumbare, S. S., Maindarkar, G., Darade, R., Yenge, S., Tolani, M. K., & Patole, K. (2012). Maternal risk factors associated with term low birth weight neonates: A matched-pair case-control study. *Indian Pediatrics*, *49*(1). https://doi.org/10.1007/s13312-012-0010-z

Nkonki, L. L., Chopra, M., Doherty, T. M., Jackson, D., & Robberstad, B. (2011). Explaining household socio-economic related child health inequalities using multiple methods in three diverse settings in South Africa. *International Journal for Equity in Health*, *10*(1), 13. https://doi.org/10.1186/1475-9276-10-13

Ngxongo, T. S. P. (2018). Basic Antenatal Care Approach to Antenatal Care Service Provision. *Selected Topics in Midwifery Care*. https://doi.org/10.5772/intechopen.79361

Oulay, L., Laohasiriwong, W., Phajan, T., Assana, S., & Suwannaphant, K. (2018). Effect of antenatal care on low birth weight prevention in Lao PDR: A case-control study. *F1000Research*, *7*, 1138. https://doi.org/10.12688/f1000research.15295.1

Ramseook-Munhurrun, P., Lukea-Bhiwajee, S.D. & Naidoo, P. 2010. Service quality in the public service. *International journal of management and marketing research*, 3(1):37-50.

Reddy, P., Zuma, K., Shisana, O., Jonas, K., & Sewpaul, R. (2015). Prevalence of tobacco use among adults in South Africa: Results from the first South African National Health and Nutrition Examination Survey. *South African Medical Journal, 105*(8), 648-655.

Rouhi, M., Stirling, C., Ayton, J., & Crisp, E. P. (2019). Women's help-seeking behaviours within the first twelve months after childbirth: A systematic qualitative meta-aggregation review☆ *Midwifery, 72*, 39–49. https://doi.org/10.1016/j.midw.2019.02.005

Sabbaghchi, M., Jalali, R., & Mohammadi, M. (2020). A Systematic Review and Meta-analysis on the Prevalence of Low Birth Weight Infants in Iran. *Journal of Pregnancy, 2020,* e3686471. https://doi.org/10.1155/2020/3686471

Santana, D. S., Silveira, C., Costa, M. L., Souza, R. T., Surita, F. G., Souza, J. P., Mazhar, S. B., Jayaratne, K., Qureshi, Z., Sousa, M. H., Vogel, J. P., & Cecatti, J. G. (2018). Perinatal outcomes in twin pregnancies complicated by maternal morbidity: Evidence from the WHO Multicountry Survey on Maternal and Newborn Health. *BMC Pregnancy and Childbirth*, *18*. https://doi.org/10.1186/s12884-018-2082-9

Servan-Mori, E., Sosa-Rubí, S. G., Najera-Leon, E., & Darney, B. G. (2016). Timeliness, frequency and content of antenatal care: Which is most important to reducing indigenous disparities in birth weight in Mexico? *Health Policy and Planning*, *31*(4). https://doi.org/10.1093/heapol/czv082

Shan, X., Chen, F., Wang, W., Zhao, J., Teng, Y., Wu, M., Teng, H., Zhang, X., Qi, H., Liu, X., Tan, C., & Mi, J. (2014). Secular trends of low birth weight and macrosomia and related maternal factors in Beijing, China: A longitudinal trend analysis. *BMC Pregnancy and Childbirth*, *14*(1), 105. https://doi.org/10.1186/1471-2393-14-105

Sharma, D., Shastri, S., & Sharma, P. (2016). Intrauterine Growth Restriction: Antenatal and Postnatal Aspects. *Clinical Medicine Insights: Pediatrics*, *10*, CMPed.S40070. https://doi.org/10.4137/CMPed.S40070

Siza, J. E. (2008). Risk factors associated with low birth weight of neonates among pregnant women attending a referral hospital in northern Tanzania. *Tanzania Journal of Health Research*, *10*(1), 1-8. https://doi.org/10.4314/thrb.v10i1.14334

Siyoum, M., & Melese, T. (2019). Factors associated with low birth weight among babies born at Hawassa University Comprehensive Specialized Hospital, Hawassa, Ethiopia. *Italian Journal of Pediatrics*, *45*(1), 48. https://doi.org/10.1186/s13052-019-0637-7

Sutan, R., Mohtar, M., Mahat, A. N., & Tamil, A. M. (2014). Determinant of Low Birth Weight Infants: A Matched Case-Control Study. *Open Journal of Preventive Medicine*, *2014*. https://doi.org/10.4236/ojpm.2014.43013

Tafere, T. E., Afework, M. F., & Yalew, A. W. (2018a). Providers adherence to essential contents of antenatal care services increases birth weight in Bahir Dar City Administration, north West Ethiopia: A prospective follow up study. *Reproductive Health*, *15*(1), 163. https://doi.org/10.1186/s12978-018-0610-8

Tampah-Naah, A. M., Anzagra, L., & Yendaw, E. (2016). Factors Correlated with Low Birth Weight in Ghana. *Journal of Advances in Medicine and Medical Research*. https://doi.org/10.9734/BJMMR/2016/24881

Tesfaye, G., Loxton, D., Chojenta, C., Semahegn, A., & Smith, R. (2017). Delayed initiation of antenatal care and associated factors in Ethiopia: A systematic review and meta-analysis. *Reproductive Health*, *14*(1), 150. https://doi.org/10.1186/s12978-017-0412-4

Tekelab, T., Chojenta, C., Smith, R., & Loxton, D. (2019). Factors affecting utilization of antenatal care in Ethiopia: A systematic review and meta-analysis. *PLOS ONE*, *14*(4), e0214848. https://doi.org/10.1371/journal.pone.0214848

Tshotetsi, L., Dzikiti, L., Hajison, P., & Feresu, S. (2019). Maternal factors contributing to low birth weight deliveries in Tshwane District, South Africa. *PLOS ONE*, *14*(3), e0213058. https://doi.org/10.1371/journal.pone.0213058

United Nations Administrative Committe on Coordination Subcommitte on Nutrition. Mainstreaming nutrition: oppourtunities to improve development outcomes. Fifth report on

the world nutrition situiation. Geneva: United Administrative Committe on Coordination Subcommitte on Nutrition; 2004.

World Health Organization. (2019). World health statistics 2019: Monitoring Health for the SDGs, Sustainable Development Goals. Geneva

Zhou, H., Wang, A., Huang, X., Guo, S., Yang, Y., Martin, K., Tian, X., Josephs-Spaulding, J., Ma, C., Scherpbier, R. W., & Wang, Y. (2019). Quality antenatal care protects against low birth weight in 42 poor counties of Western China. *PLOS ONE*, *14*(1), e0210393. https://doi.org/10.1371/journal.pone.0210393

World Health Organization. Global targets 2025. To improve maternal, infant and young child nutrition (www.who.int/nutrition/topics/nutrition_ globaltargets2025/en/, accessed 17 October 2014)

Wilcox, A. J. (2001). On the importance—And the unimportance—Of birthweight. *International Journal of Epidemiology*, *30*(6), 1233-1241. https://doi.org/ 10.1093 /ije/30.6.1233

Zammito, J. H. (2017). The Gestation of German Biology: Philosophy and Physiology from Stahl to Schelling. In *The Gestation of German Biology*. University of Chicago Press. https://doi.org/10.7208/9780226520827