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Nsimbo, Kayumba Bin Assumani

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FOOD INSECURITY AND ITS RELATIONSHIP TO GLYCAEMIC CONTROL IN DIABETIC PATIENTS ATTENDING JABULANI DUMANI COMMUNITY HEALTH CENTRE

Kayumba Bin Assumani Nsimbo

A research report submitted to the Faculty of Health Sciences

at the University of the Witwatersrand, Johannesburg

in partial fulfilment of the requirements

for the degree

Master of Medicine in Family Medicine

Supervisors: Dr Neetha Erumeda and Mrs Deidré Pretorius

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Declaration

I, Kayumba Bin Assumani Nsimbo, declare that this research report is my own, unaided work. It is being submitted for the degree of Master of Medicine in Family Medicine (MMed Fam Med) at the University of the Witwatersrand, Johannesburg. It has not been submitted before for any degree or examination at any other university.

KBA Nsimbo

Signature  Date: 09/10/2018

Dedication

To Allah, because all the glory is yours and without you I could not make it. To my late parents, my father Al hajj Assumani Nsimbo and my mother Aisha Binti Shabani for all your sacrifices.

Without the unconditional support, encouragement and love of my precious wife, Yasmin Nsimbo, I doubt whether this research report would have been completed. My children: Lola Khasim Nsimbo, Arafat Nsimbo, Siddick Nsimbo, Ousman Nsimbo, Aisha Nsimbo, Latifah Nsimbo, and Furaha Nsimbo for your encouragements. Despite being absent from home, you persevered without me and without complaining. I think that this experience will be an inspiration for you to never give up. You have to struggle for success. From now on I will try my best to dedicate most of my time to you.

To my brothers: Khasim Assumani Nsimbo, Sangwa Assumani Nsimbo, Dr. Assumani Nsimbo, Dr. Bienvenu Bokoli, Abdi Assumani Nsimbo and Amuri Assumani Nsimbo for your valuable support and encouragement. My gratitude is extended to my sisters: Amunazo Nsimbo, Furaha Nsimbo, Aisha Nsimbo, Zabibu Nsimbo, and Azza Nsimbo for your love. You were always able to find a word to tell me when I was feeling down.

To my sisters in law: Vumilia Khasim Nsimbo, Lydia Sangwa Nsimbo, Maman Jacky Nsimbo, Dr. Pitchou Kasela and Belinda Odimboleko for your sacrifices. To my friends and colleagues: Drs. Dalton Kabundji, Stephane Nyanga, and Albert Odimboleko. Find through this research report the expression of my deep gratitude.

Abstract

Background: Food insecurity can predispose diabetic patients to poor glycaemic control. The study aimed to assess the prevalence of food insecurity and its relationship with glycaemic control and other demographic characteristics among diabetic patients attending Jabulani Dumani Community Health Centre.

Method: A cross-sectional descriptive study using an administered questionnaire, analysed using nQuery software, Release 7.0. Descriptive statistics were used to analyse independent variables. Chi-square test and logistic regression were used to test associations between variables.

Results: Among the 250 participants, 63.6% reported being food insecure and 69.9% had poor glycaemic control. There were statistically significant associations between food insecurity and immigration status (p=0.049), household size (p=0.045), employment status (p=0.033), and glycaemic control (0.000)**.**

Conclusion: Overall there is higher prevalence of food insecurity in diabetic populations at the primary healthcare level; hence there is a need for regular screening for food insecurity in all diabetic patients for better glycaemic control.

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Abbreviations

ACS: Acute Coronary Syndrome

CHC: Community Health Centre

CKD: Chronic Kidney Disease

CTOP: Choices on Termination of Pregnancy

DKA: Diabetic Keto-Acidosis

DM: Diabetes Mellitus

DOT: Direct Observation of Treatment

EPI: Expanded Programme of Immunisation

HbA1c: Glycosylated Haemoglobin

HCP: Health Care Provider

HFIAS: Household Food Insecurity Access Scale

HREC: Human Research Ethics Committee

HSRC: Human Sciences Research Council

IDF: International Diabetes Federation

JDCHC: Jabulani Dumani Community Health Centre

LMICs: Low and Middle Income Countries

SEMDSA: Society of Endocrinology, Metabolism and Diabetes of South Africa

PAD: Peripheral Arterial Disease

PHC: Primary Health Care

PMTCT: Prevention of Mother-to-Child Transmission of HIV

RSA: Republic of South Africa

SANHANES: South African National Health and Nutrition Examination Survey.

SEP: Socio-economic position

T2DM: Type 2 Diabetes Mellitus

TB: Tuberculosis

TV: Television

UK: United Kingdom

USA: United States of America

USDA: United States Department of Agriculture

USD: United States Dollars

HIV: Human Immunodeficiency Virus

WHO: World Health Organization

CHAPTER 1

INTRODUCTION

1.1 **Background information**

Diabetes mellitus (DM) constitutes a serious public health problem worldwide, including developing countries in Africa.[1] The World Health Organization (WHO) in its global report on diabetes 2016, estimated that 422 million adults were living with DM in 2014, compared to 108 million in 1980.[2] Its global prevalence has nearly doubled since 1980, rising from 4.7% to 8.5% in the adult population. However, according to the International Diabetes Federation (IDF), in 2015 there were 14.7 million diabetics in African countries, with South Africa accounting for 3.8 million cases, representing 7% of its overall population.[3] In 2010, the prevalence of diabetes in the Republic of South Africa (RSA) was estimated at 4.5% compared to 7% in 2015.[4] These data show that the prevalence of DM has nearly doubled since 2010. This increase in its prevalence is due mainly to the lifestyle changes of the population, including urbanisation, unhealthy diet and decreased physical activity.[5, 6] DM accounts for significant morbidity and mortality worldwide.[7] IDF has shown that worldwide, diabetes-related mortality for the year 2013 was estimated at 5.1 million deaths (about 8.4% of global total deaths) in adults aged 20 to 79 years, with over half a million in Africa.[8] In the RSA, in 2013, 4.8% deaths were DM related, which placed DM as the fifth leading cause of death.[9] Health care costs related to DM are devastating worldwide, and are significant for both patients and health care systems.[10] For example, in the United States of America (USA) it has been well documented that diabetic patients spent on average 2.5 times more on medical care than people without DM.[10] In the USA, the total annual global expenditure for DM in 2010 was estimated between USD376 and USD672.2 billion.[10] In 2009 the RSA spent an average of USD2.250 per diabetic patient compared to USD1.500 for non-diabetic patients.[11] This constitutes a huge burden on the South African health system, which is already exhausted by other significant health problems such as Human Immuno-deficiency Virus (HIV) infection, tuberculosis (TB) and other non-communicable diseases including hypertension, asthma and chronic obstructive pulmonary disease.

Diabetes is defined as a metabolic disorder with heterogeneous aetiologies, characterised by chronic hyperglycaemia and disturbances of carbohydrate, fat and protein metabolism resulting from defects in insulin secretion, insulin action, or both.[12] There are two types of DM: type 1 DM accounts for only 5% to 10% of cases.[13] Its pathogenesis is associated with selective destruction of insulin-producing pancreatic β-cells due to a chronic autoimmune disease.[13] The destruction of the pancreatic β -cells leads to a deficiency of insulin secretion, which results in the metabolic derangements associated with type 1 DM. Type 2 DM is the most common, representing more than 90% of cases. Its pathogenesis is mainly predominated by a combination of disorders of insulin action and secretion.[13] Risk factors of DM include age, obesity, and hypertension, family history of diabetes, physical inactivity and dyslipidaemia.[14] The diagnosis of DM is based on one of the three methods of blood glucose measurement.[12, 15] DM is diagnosed if the patient has a fasting (no caloric intake for at least eight hours) blood glucose level of ≥7 mmol/l or a random blood glucose level of ≥11.1mmol/l, or classic symptoms of diabetes (polyuria, polydipsia and weight loss), or glycosylated haemoglobin levels ($HbA1_C$) are ≥6.6%.

The Society of Endocrinology, Metabolism and Diabetes of South Africa (SEMDSA 2017) guidelines summarise the treatment of diabetes, including non-pharmacological and pharmacological therapy.[12] The primary purpose in treating DM is to get tight glycaemic control to prevent or delay chronic complications, including acute coronary syndrome (ACS), peripheral arterial disease (PAD), diabetic retinopathy, and chronic kidney disease (CKD).[12] A study conducted by Seligman has shown that the prevalence of chronic complications of diabetes among DM patients is high: retinopathy ranged from 7% in Kenya, to 63% in South Africa.[16] In Tanzania, Stanifer et al. documented that diabetes-associated complications were common, with prevalence depending on age of the patient and duration of the disease. The prevalence of ophthalmic, neurologic, and renal complications was 49.6%, 28.8% and 12.0% respectively.[17]

There are many patient-related factors that predispose diabetic patients to poor glycaemic control, which include poor knowledge of DM, poor compliance to medical treatment and lifestyle changes and other factors, including low levels of education and low socio-economic status.[18] With regard to knowledge of DM, many studies have documented that generally there is poor knowledge among diabetics both in developed and developing countries. [19, 20, 21] Concerning compliance with

diabetic treatment, in 2003 the WHO and other studies stated that compliance with diabetes treatment had an impact on glycaemic control.[22, 23, 24] The above-mentioned studies also found that there is a proportional relationship between highly compliant patient groups and positive health outcomes. Levels of education also have an impact on glycaemic control in DM, as documented in a study conducted by Kubais et al.[25] They reported that education levels showed a significant difference among HbA1c readings between the no formal education group, the secondary education group, and the tertiary education group; the readings of HbA1c were 8.1%, 6.9% and 6.5 % respectively. Among these patient-related factors mentioned above, it is postulated that food insecurity is one of the potential patient-related factors that predispose diabetic patients of low socio-economic status to poor diabetes control.[26]

According to the Human Sciences Research Council (HSRC),[27] food security has three dimensions: food availability, food access and food use. Food availability implies the availability of sufficient quantities of food on a consistent basis at both national and household levels. Food accessibility implies the ability of nations and their households to acquire sufficient food on a sustainable basis. Food usage refers to the appropriate use of food based on knowledge of basic nutrition and care. Households are defined to be food insecure whenever "the availability of nutritionally adequate and safe foods or the ability to acquire food in socially acceptable ways (e.g., without resorting to emergency food supplies, scavenging, stealing, or other coping strategies), is limited or uncertain". [28] Hunger and food insecurity are related concepts but have distinct definitions. Hunger is simply defined as the painful sensation caused by lack of food. Food insecurity is a broader concept: it encompasses physical sensations of hunger as well as anxiety related to the fact that food budgets are inadequate; the experience of running out of food without money to buy more; and perceptions that the available food is inadequate in quality and quantity.[29] Whenever a household suffers from food insecurity, it usually develops a compensatory strategy for caloric intake in order to avoid the pain related to hunger by relying on low-cost, energy-dense foods with little nutritional value. The above compensatory mechanism explains not only how members of households with low socio-economic status may develop diabetes, but also the association between food insecurity and poor glycaemic control in diabetic patients.[16]

According to a study facilitated by the Oxford Health Alliance, food insecurity affects not only low- and middle-income countries (LMICs), but also affects high-income countries.[30] With regard to LMICs, the prevalence of food insecurity rate of 0.5% has been reported in Hangzhou city, China, 14.3% in Mexico City, and 14.8% in the Kerala state in India. Faye et al. found that in Nigeria, only 20% of households were food secure compared to studies from South Africa estimating that among the general population, 20% of South African households were food insecure.[31] Prevalence of food insecurity in some high-income countries is increasing, especially among vulnerable groups. In the USA in 2009, 14.5% of households were food insecure; households headed by single mothers, and black and Hispanic households were the most affected.[32, 33.] In Australia, as opposed to USA, food insecurity is low and affects only 5% of the general population.[34] In the United Kingdom (UK), a recent study conducted among Sure Start households showed that 20% of women live in food insecure households.[35]

In South Africa, a majority of the population attends public health facilities and most patients access primary health care (PHC) within the district health systems for their health problems[36]. District health systems delivering PHC consist of a district hospital and primary health care clinics, which include the Community Health Centres (CHCs), bigger and smaller clinics. Patients who attend these facilities generally have poor socio-economic status and usually have difficulties in accessing healthy food.[36] In the PHC setting, once a patient is diagnosed with DM, appropriate lifestyle modification and medications are prescribed. However, while managing these patients, clinicians are often not aware of the affordability and accessibility of appropriate food and its importance to these diabetic patients. As South Africa is a developing country facing many resource constraints, these patients might be experiencing food insecurity. This issue is extremely important to both the health care provider (HCP) and the patient, as it can potentially affect the overall health outcome of the disease. Therefore, it is important for the HCPs to know about the role of food insecurity as a contributing factor to poor glycaemic control among these diabetic patients.

1.2 **Rationale of the study**

In the course of working at Jabulani Dumani Community Health Centre (JDCHC), the researcher noticed that a significant number of diabetic patients were not well controlled. This was despite the fact that patients were on correct treatment regimens and dosages and complying with their treatment while regularly keeping their booked appointment dates. During consultation the patients agreed to adhere to the prescribed lifestyle practices including no smoking, reduced alcohol consumption and regular physical exercise. On further inquiry, some of the adult diabetic patients admitted that they took treatment when they didn't have anything to eat, as they were advised not to skip taking their medication by the health care providers. Some of the patients found that to avoid getting low blood sugar levels when taking medication without eating, to overcome this they ended up eating whatever food was available, even unhealthy food. Other patients disclosed that availability of healthy foods at home was a problem during times when there was not enough money to buy them. Therefore, the researcher did not know if food insecurity had an effect on glycaemic control in diabetic patients attending JDCHC.

To the best of the researcher's knowledge, there have been no South African studies done to determine the prevalence of food insecurity among diabetic patients in primary health care (PHC) settings. However, the South African National Health and Nutrition Examination Survey (SANHANES-1), which was conducted in 2013, was a comprehensive study investigating the prevalence of non-communicable diseases (particularly cardiovascular disease, diabetes and hypertension) and their risk factors (diet, physical activity and tobacco use).[37] The study also assessed overall food insecurity in all South African provinces, and it was found to be 19%. Therefore, the researcher set out to determine the prevalence of food insecurity among the diabetic population alone, and its relationship with glycaemic control. This study is relevant to Family Medicine since food insecurity in diabetic patients leads to poorer glycaemic control, which contributes to high morbidity and mortality, particularly in the primary health care settings of South Africa (SA).

1.3 The research report

The current research report has six chapters. The first chapter consists of an introduction which outlines a description of diabetes mellitus, its complications, and patient factors affecting glycaemic control, including food insecurity, and the rationale of the current research. Chapter 2 presents the literature review, which discusses previous relevant studies done on the current research topic of food insecurity and glycaemic control. The third chapter deals with the methodology and materials used. Chapter 4 presents the study results, and the fifth and sixth chapters respectively cover a discussion, the conclusions and recommendations. The literature review appears in the following chapter.

1.4 **Study aim**

The aim of the study was to assess the prevalence of food insecurity and its relationship with glycaemic control among diabetic patients attending JDCHC.

1.5 **Study objectives**

1. To describe the socio-demographic characteristics of diabetic patients attending JDCHC.
2. To determine the prevalence of food insecurity in diabetic patients attending JDCHC.
3. To determine the glycaemic control based on HbA_{1c} among diabetic patients with food insecurity.
4. To determine the possible associations between food insecurity, glycaemic control and socio-demographic characteristics.

CHAPTER 2
LITERATURE REVIEW

The literature review that follows briefly discusses concepts such as the prevalence of food insecurity in diabetic patients, factors associated with food insecurity (demographics and social factors) and lastly, the relationship between food insecurity and glycaemic control in diabetic patients. Previous studies relevant to the above concepts developed in the current literature review were obtained and reviewed by the researcher searching different databases such as PubMed, Up to date, Cochrane library, Essential Evidence Plus, and Google scholar.

2.1 **Prevalence of food insecurity in diabetic patients**

Studies on the prevalence of food insecurity in diabetic patients have been conducted in developed countries, and indicate that the prevalence of food insecurity in diabetic patients is high.[38] In Canada, Gucciardi et al. conducted a study in 2005 to determine the household food insecurity prevalence among Canadians with diabetes, and its relationship with diabetes management, selfcare practices and health.[39] This was a cross-sectional survey of 132 947 individuals, which found that household food insecurity was more prevalent among individuals with diabetes (9.3%) than among those without diabetes (6.8%). Though the study sample was very large, a self-reported survey is more subjective, and hence potentially subject to recall bias, which was one of the main limitations of the study. Galesloot et al. also conducted a review on food insecurity in Canadian adults receiving diabetes care.[40] They found that the prevalence of adult-level household food insecurity among clients receiving outpatient diabetes care services was 15% among 314 respondents. The difference in findings between these Canadian studies is mainly due to fact that they were conducted in different sub-regions (Ontario and Alberta respectively), with socio-economic discrepancies.

In the United States, Seligman et al. conducted a study in 2007, evaluating the relationship between food insecurity and diabetes.[41] This was a cross sectional analysis with a national representative population, with a National Health Examination and Nutrition Examination Survey (NHANES) conducted. Diabetes prevalence in the food secure, mildly food insecure, and severely food insecure categories was 11.7%, 10.0%, and 16.1% respectively. It was found that participants with severe food insecurity were more likely to have diabetes than those without food insecurity. In

Chicago, the same researcher, Seligman, conducted a study in 2012 on food insecurity and glycaemic control among low-income patients with type 2DM.[42] She found a prevalence of food insecurity of 46%, and that food insecure participants were significantly more likely than food secure participants to have poor glycaemic control. When analysing these study findings from the USA, it was found that in Chicago, the study reported a very high prevalence rate of 46% compared to the NHANES study, with a prevalence rate of 26%, when combining mild and severe food insecurity. The main difference between these American studies is in the study population. The NHANES study was conducted countrywide, combining diabetic populations of different socio-economic levels, whereas the study conducted in Chicago was mainly within the disadvantaged diabetic population of unemployed blacks with low income levels, and other minority ethnic groups.

A cross sectional study was conducted in 2011 by Bawadi et al. on food insecurity and glycaemic control deterioration in patients with type 2 DM in northern Jordan.[43] The objectives of the study were to assess the prevalence of food insecurity among type 2 DM in the hospital setting that serves the area of northern Jordan, and to investigate its relation to glycaemic control. The study, with a sample of 843 participants, found that 22% of the participants were food secure; 51% were moderately food insecure; and 27% were severely food insecure. In comparing these findings, the current study found that the number of participants with food insecurity was much higher compared to studies done in Canada and the USA. This might be due to the fact that many higher income countries may have higher food security in terms of accessibility and affordability of healthy food, and that they may have different, well established food assistance programs to help those who are food insecure, while such interventions do not always exist in many other developing countries in Asia and Africa.

In Africa, few studies have been done focusing on the prevalence of food insecurity in diabetic patients, but the researcher found a study done in Kenya in 2013 on the prevalence of food insecurity in diabetic patients.[44] The study aimed to determine the proportion and characteristics of diabetic patients who reported food insecurity in three clinics in Western Kenya, which served patients with low socio-economic status, and who frequently used public health care facilities. This was a cross-sectional study with a sample size of 1 733 participants. The food security status of

participants was assessed by using a household food insecurity access scale (HFIAS) questionnaire, which is a validated tool for use in resource-constrained settings. The study found that the prevalence of food insecurity in these three Kenyan clinics was 32.1%, which was higher when compared to Canada, but surprisingly similar to other studies done in the USA. The difference of prevalence in food insecurity between the Kenyan study and studies conducted in the developed world (Canada), was mainly due to participants' characteristics and socio-economic discrepancies. However, the prevalence of food insecurity found in the Kenyan study was determined based on patients who attended the three public health care clinics, without considering patients attending private sector facilities. This factor may have caused the prevalence to be overestimated. There are still not enough studies looking into the prevalence of food insecurity in diabetic patients in different African countries, especially in South Africa. No studies have been conducted establishing the relationship of food insecurity and its impact on glycaemic control in diabetic patients in South Africa. In summary, a review of the above studies on the prevalence of food insecurity in diabetic patients shows that the highest prevalence was the approximately 78% figure in the Jordan study, followed by the USA, Africa, and lastly, Canada.

2.2 **Socio-demographic factors affecting household food insecurity**

2.2.1 Demographic factors

Many demographic characteristics are reported to be associated with food insecurity, as they play an important role in household food insecurity. These include age, gender and race/ethnic group of the head of the household, employment, and socio-economic factors.

2.2.1.1 Age of the head of the household

The age of the head of the household is expected to have an impact on food insecurity. Many studies have been conducted in different settings with different outcomes.

In a cross-sectional study conducted in Nigeria by Omonona et al. (2007) on the food security situation among Nigerian households,[45] it was found that the incidence of food insecurity was high when the age of the head of household ranged between 61 and 70 years and was lowest within the

age group of 31–50 years. Another Nigerian study conducted by Arene et al. in 2010[46] found contradictory results where the younger household heads had a high probability of being food insecure compared to the older ones. These differences could be due to the fact that studies were conducted in two different socio-economic contexts. Omonona et al. conducted their study where participants' incomes were based on farming activities. This may explain the fact that food insecurity was low between the 31 to 50 years age group, compared to the 61 to 70 years group, since the age group 31–50 years constitutes an active labour force. Arene et al. on the other hand, conducted their study where participants' incomes were mainly based on their employment. The higher income level of these participants was due to long periods of employment.

According to the NHANES study, Seligman et al. found that there was a direct relationship between age and food insecurity. This relationship was statistically significant (p-value<0.001).[41] The same findings have been reported in many other studies.[43, 44] However, in another study conducted on food insecurity and its association with chronic disease among low-income participants, Seligman et al. found non-significant associations between age and food insecurity (p-value=0.6).[47]

2.2.1.2 Sex of the head of the household

The sex of the person who has the responsibility of providing for household needs may have a huge impact on the food insecurity of that household. Omonona, et al.in their review conducted in Nigeria, found that households in which females have a primary role of providing household needs have a high probability of being food insecure, which is similar to the study done by Charlton and Rose in South Africa.[39, 48, 49] Different studies conducted in the USA and Canada also reported similar findings.[50, 51] The above study findings were different from those of Arene et al. in Nigeria, which did not find any sex differences.[46] The relationship between sex and food insecurity has been found to be significant in several studies [41, 42, 43] In their study on factors contributing to household food insecurity in a rural upstate New York county, Olson et al. found that households headed by females were a significant factor associated with food insecurity (OR=1.36, CI=1.031.81).[52]

2.2.1.3 Race or ethnic group of the head of the household

With regard to race/ethnicity, in their national survey on the prevalence of household food poverty in South Africa conducted in 2002, Charlton et al. found that food insecurity rates were highest among households headed by blacks (56%), followed by coloureds, Indians and whites (3%).[48] In their review on household food security in the United States in 2012, Coleman, et al.[53] found that African American, American Indian, and Hispanic households experienced food insecurity at higher rates than white or non-Hispanic households. Economic hardship, including unemployment and low socio-economic status were key determinants of food insecurity among these racial groups.[42]

2.2.2 Social factors

2.2.2.1 Household size

It is expected that as the number of people to be fed increases, the probability of food insecurity increases and vice-versa. In their review conducted in the USA by Olson et al. on factors contributing to household food insecurity in a rural upstate New York County, the study found higher rates of food insecurity in households of six or more people (OR=1.363, CI=1.027 to 1.810).[52] Nigerian studies found higher food insecurity rates in households with five or more family members.[45, 46] The Nigerian studies emphasised that household size may have different effects on food security, depending on the location of the household and the ages of the household members. They added the fact that in urban regions, food insecurity is likely to increase in households with higher household size, especially when household members are children or unemployed adults, whereas in rural regions the effect could be different. Rural households with more adult members had a greater probability of the household having low food insecurity, possibly due to the fact that more people work on farms in rural areas, thus increasing the level of agricultural production within the household, and consequently decreasing the level of food insecurity.[45]

2.2.2.2 Immigration status of the head of the household

Studies have demonstrated that the immigrant status of diabetic patients may contribute to food insecurity. In their study on hunger in legal immigrants in California, Kasper et al.[54] recruited 630 participants, including Vietnamese and Cambodian immigrants attending primary care clinics. The HFIAS was used to collect data. The study found that the prevalence of food insecurity among low-income legal immigrants was as high as 40%. Factors such as decreased job opportunities and access to food assistance programs offered by the US government, which are based on immigrant status, might explain the high prevalence of food insecurity in these immigrants.

In the RSA, a study conducted by Crush, et al.[55] on the food insecurity of Zimbabwean migrants in urban South Africa had similar results. They found that the food insecurity of Zimbabwean migrant households in poorer areas of the two major South African cities (Johannesburg and Cape Town) was extremely high (over 80%). This may be explained firstly by the fact that these migrants do not have the same chance of being employed compared to their local counterparts, and secondly, most Zimbabwean migrant households do not have access to South Africa's social protection systems, such as social grants. Finally, these migrants must send money to Zimbabwe to help those who are left at home, and by doing so they compromise their limited income, with food appearing to be the first sacrifice.

2.2.2.3 Occupation or employment status of the head of the household

The employment status of the household head is expected to play an important role in food insecurity, especially in the urban regions where employment is the major source of income. Studies have indicated that being unemployed or not having an income-generating activity is strongly associated with household food insecurity.[39] Studies have demonstrated that there is a relationship between employment, household income, and levels of food security: the more household heads engage in gainful employment, the higher the income, and the higher the probability of being food secure. Members of a household who hold full-time jobs are therefore more likely to be food secure than those with part-time jobs. [56, 57]

2.2.2.4 Socio-economic status

Socio-economic status has an impact on the food security level of a household since it determines the purchasing power of a household. In a systematic review on socio-economic differences done in Europe by Estevez et al. it was found that a higher socio-economic status was associated with greater consumption of both fruit and vegetables.[58] In Australia, a similar study was conducted by Turrell et al. in 2004, who reported that living in a socio-economically advantaged area was associated with a tendency to purchase healthier food.[59]

Researchers have used several indicators to measure the socio-economic position (SEP) of households, including current income, level of education, occupation status, and wealth of the head of the household.[60] The choice of one of the above indicators depends on its relevance to the population and its outcome under study.[61] Each of the indicators listed above has its own limitations. With regard to participants' income, the latter is age-dependent and is associated with a higher non-response rate compared to other socio-economic status measures. Level of education may have an impact on a person's SEP if he/she is employed; therefore, the level of education achieved can be used as indicator of a person's SEP only if it is followed by employment. Economic returns may differ significantly across racial, ethnic and gender groups,[62] as with the same level of education, women and individuals from minorities or disadvantaged racial groups generally realise lower returns than white men. Occupation as an indicator of SEP demonstrated its limitations through a lack of precision in measurement.[60]

A higher rate of error of reporting is shown regarding wealth, and therefore it is difficult to assess. From the above indicators of SEP, in their review on the development of indicators to assess hunger, Radimer et al. documented that income and the education level of the household head are the most-used indicators to define the SEP of households in the USA.[63]

However, considering the limitations articulated above, many other researchers have used household assets such as cell phones, television, refrigerators, and any other kind of appliances including electrical or gas stoves and washing machines as indicators of the SEP of poor populations, and have indirectly related these to food insecurity of families.[64] In a study conducted by Safraj et al. (2012) in India,[65] the socio-economic position (SEP) of participants was determined

on the basis of household assets. Researchers collected information on household assets from participants and scores were allocated for each item that participants had in their home. The score of each item was added in order to reach a household total score. Households were then divided into four groups, from SEP1 to SEP4. The higher the score, the higher the socio-economic position of the household.

2.3 **Biographic factors**

2.3.1 Food insecurity and glycaemic control in diabetic patients

Food insecurity is identified as being one of the contributing factors that predisposes adults of low socio-economic status to poor diabetes control.[16] Seligman et al. (2012) conducted a cross-sectional study in the USA on food insecurity and glycaemic control among 711 type 2 diabetic patients with low incomes.[42] The aim of the study was to determine if there was an association between food insecurity and poor glycaemic control. They then examined if difficulty in following a diabetic diet and emotional distress related to diabetes mediated the relationship between food insecurity and glycaemic control. They found that food insecure participants were more likely to have poor glycaemic control than food secure participants, with an odds ratio of 1.48 (95% CI 1.07-2.04). The difficulty in following a diabetic diet and emotional distress also partially mediated the relationship between food insecurity and poor glycaemic control.

Many other studies conducted in the USA establishing the relationship between food insecurity and glycaemic control also had similar study findings.[66 ,67, 68] For example, in a study conducted by Fitzgerald et al. (2011) on food insecurity, it was found that food insecurity is related to increased risk of T2DM among Latinas, and that these participants with food insecurity were 3.3 times more likely to have T2DM (OR 3.33, 95% CI 1.34-8.23).[66] In contrast to the above, Holben, et al. (2006) conducted a study on diabetes risk and obesity in food insecure households in rural Appalachian Ohio.[69] The study found that food insecurity had no relationship to T2DM control (p-value> 0.05).

Furthermore, in their review on food insecurity in relation to changes in HbA1c, self-efficacy, and fruit and vegetable intake during a diabetes educational intervention,[70] Lyles et al. conducted a

secondary, observational analysis of 665 low-income diabetic patients. The objective of the study was to assess if food insecurity makes diabetes self-management more difficult. At the end of the study period, the study showed improvement in mean HbA1c in the food insecure group compared to the food secure group (8.1% vs 7.8% p-value= 0.14). The findings of the above study were essentially due to the fact that participants who were food insecure were able to engage in a diabetes education intervention focused on fruit and vegetable intake, even though the intervention did not address the budget needed to improve dietary intake.

Different mechanisms by which food insecurity in adult diabetic patients lead to poor glycaemic control have been studied, especially in the developed world. Lopez et al. conducted a study in the USA in 2012,[71] and found that food insecure adults were at high risk of developing diabetes, and that those who were already diabetic and food insecure, were at high risk of poor glycaemic control. The study showed that the underlying factor by which individuals of low socio-economic status develop diabetes is through financial constraints. These individuals were found to rely more on low-cost, energy dense foods of little nutritional value for much of their caloric intake, which explains not only how individuals of low socio-economic status may develop diabetes, but also the relationship between food insecurity and poor glycaemic control.[66] Furthermore, in a large urban centre of Ontario, Canada, Chan et al. (2015) conducted a qualitative study on "Challenges of diabetes self-management in adults affected by food insecurity".[72] The aim of the study was to explore lived experiences and to understand how food insecurity affects people's ability to manage their diabetes.

The study firstly found that accessibility to appropriate food and lack of certain household appliances constitutes serious challenges, and that due to budget constraints experienced by most of the participants, they ended up buying junk food. Household appliances were also identified as a challenge for most of the participants, many of the whom did not have stoves, and this situation led most of them to use high sodium foods such as canned foods, due to lack of proper cooking facilities.

In the UK, Heerman et al. (2015) examined the relationship between food insecurity, diabetes selfcare behaviours and glycaemic control, using a cross-sectional study.[73] They found that food insecurity was significantly associated with self-care behaviours, including less adherence to a

general diet (p=0.002), less physical activity (p=0.004), and less medication adherence (p=0.0002). Food insecurity may increase the difficulty for diabetic patients to follow the recommended diet, and at the same time may decrease self-care behaviour. Hence, addressing food insecurity in diabetic patients becomes crucial.

The majority of studies done to identify the relationship of food insecurity and glycaemic control are conducted in developed countries, resulting in a paucity of similar research done in developing countries, especially in African settings.

2.3.2 Obesity and food insecurity

Studies conducted by several researchers have shown that a high body mass index is associated with food insecurity.[74, 75] They found that food insecurity among adults is associated with overweight or obesity, especially among women. A study conducted by Adams et al. found that women who were food insecure without hunger were 36% more likely to be obese.[76] Adams et al. further reported that food insecurity was associated with increased risk of obesity for Asians, blacks and Hispanics, but not for non-Hispanic whites. The relationship between food insecurity and overweight or obesity may be explained by the fact that food insecure participants relied on low cost and high energy-dense foods, which are nutritionally poor. Townsend categorised household food insecurity (mild, moderate, severe) using the United States Department of Agriculture (USDA) food insufficiency indicator, and found that overweight or obesity was associated more with mild or moderate food insecurity, and decreased with the severity of food insecurity.[75] Seligman et al.[42] found that there was a significant association between overweight/obesity and food insecurity (p-value=0.03). Bawadi et al. also documented similar results (p-value=0.023).[43]

2.4 **Summary of the literature review**

The study's literature review demonstrates that the prevalence of food insecurity in diabetic patients worldwide is high (in developed and developing countries), including in the Sub-Saharan African region. It also shows that demographic factors like age, gender, household size, marital status and employment status of the head of household, play a major role in household food

insecurity. Food insecurity has been identified as one of the factors which predispose adult diabetic patients of low socio-economic status to poor glycaemic control. There is a significant relationship between food insecurity and glycaemic control, as found in many studies conducted in developed countries. Food insecure diabetic patients experience difficulty in following their recommended diet, which also negatively affects patient self-care behaviours that lead to non-adherence, physical inactivity and even increased BMI, which finally lead to poor glycaemic control.

CHAPTER 3

METHODOLOGY

This chapter includes the following: study design, site and population, sample size, inclusion and exclusion criteria, pilot study, the data collection tool and data collection, data analysis, and ethical considerations.

3.1 Study design

This was a cross-sectional descriptive study.

3.2 Study site

This study was conducted at the Jabulani Dumani, which is one of the Community Health Centres (CHC), and is located in Vosloorus between extensions 2, 14 and 28 in the municipality of Ekurhuleni, Gauteng province, in South Africa. Vosloorus covers an area of four square kilometres and has a population of 60,436. Most of the population has access to electricity, sanitation and piped water. The JDCHC administratively belongs to the local government authority. It employs one facility manager, 15 chief professional nurses, five enrolled nursing auxiliaries, three administrative clerks, one health promoter, eight general assistants, one dentist, two dental assistants, three rehabilitation staff, one Direct Observation of Treatment (DOT) supporter, one driver and five lay counsellors. There are three permanent medical officers, one sessional medical officer and one family physician. The facility and its environs are maintained by the provincial government.

The clinic provides services in different domains including ambulatory primary health care adults; an expanded programme of immunisation (EPI); oral health services; rehabilitation; a primary mental health service; prevention of mother-to-child transmission of HIV (PMTCT) and voluntary counselling and testing (VCT); choices on termination of pregnancy (CTOP); speech and hearing therapy; physiotherapy; youth-friendly services; school health services; 24-hour emergency services; chronic conditions services (diabetes mellitus, hypertension, epilepsy and asthma); antenatal and post-natal care, and paediatrics. Recently, the JDCHC introduced a ward-based primary health care outreach team, which includes community health workers visiting the

community and addressing disease prevention and health promotion, thus improving overall access to primary health care services within the community.

Chronic care services at JDCHC are mainly run by primary health care nurses supported by doctors. They consult with all patients, do initial investigations and book patients for doctors. Doctors see all booked patients, review their blood results and do consultation especially on their annual check-up visits. Upon arrival at the clinic, patients get their files at the reception and are directed to a waiting room. From the waiting room, patients go to a room where blood pressure, blood sugar and their weight are recorded, and available blood results are put into their files. Finally, patients are distributed in different consultation rooms in order to be reviewed by the doctors. Professional nurses also see chronic patients, especially those who have come for treatment or for acute problems that may or may not be related to their chronic condition.

3.3 Study population

The study population included all diabetic patients aged 18 years and above, who attended the JDCHC (N=2950)

3.4 Study sample size and its rationale

For the current study, a sample size of 250 patients was extracted from the 2 950 diabetic patients attending the JDCHC. Sample size estimation was done on nQuery Advisor, Release 7.0. The sample size calculation was based on a reliable estimation of the glycaemic control rate (percentage) using the following assumptions: [37]

- A proportion of 0.192 (19.2%) of patients had glycaemic control.
- Accuracy of ± 0.05 (5%) for estimation of the glycaemic control rate. With a sample size of 239 patients, a two-sided 95% confidence interval for the glycaemic control rate was within ± 0.05 (5%) of the control rate that was calculated from the sample. In order to allow for a 5% drop rate, a rounded sample size of 250 patients was proposed for this study. Systematic sampling was used to select the required number of participants.

3.5 Inclusion criteria

- All patients older than 18 years, living with diabetes.
- Patients on diabetic treatment for at least one year, with or without comorbidities or complications. (One year is sufficient to assess the effectiveness of treatment in diabetic patients.)
- Patients able to give consent were included in the study.

3.6 Exclusion criteria

- Pregnant patients living with diabetes.
- Very ill patients with diabetes were excluded.

3.7 Pilot study

In order to assess whether participants understood the questionnaire, a sample of seven participants was piloted. This was conducted a few months prior to data collection and helped to test if the questionnaire was well understood by the participants, and to plan on time needed for administering the questionnaire. The researcher did not find it necessary to change anything on the questionnaire after the pilot study. The results of the pilot study were not included in the data analysis.

3.8 Data collection tool

An administered questionnaire was used to collect data. The questionnaire was divided into two parts: the first part determined the socio-demographic characteristics of participants such as age, gender, marital status, household size and immigration status (categorised as citizen or non-citizen depending on place of birth; non-citizens referred to all participants who were born outside South Africa). The second part assessed household food insecurity. In order to assess the participants' food insecurity status, the Household Food Insecurity Access Scale (HFIAS) measurement tool was used in the study. (See appendix A).

The HFIAS is a validated questionnaire that has been used internationally, most specifically in the US, to estimate the prevalence of food insecurity. Studies have been conducted in developing countries such as Kenya, Ethiopia and Tanzania, not only to evaluate the scale's validity, but also

it adaptability to developing countries. Both studies (Tanzanian and Ethiopian) found that the scale had good internal consistency, with Cronbach's alphas of α=0, 83-0, 90; Cronbach's alphas for the values of rounds 1 and 2 were 0.76 and 0.73 respectively.[44,77, 78]

Since the HFIAS is widely used and has shown internal consistency in other developing countries, the researcher decided to use it in the present research conducted in South Africa. The HFIAS consists of nine questions, which investigate whether participants are affected by food insecurity. Each question has two related sub-questions. The first sub-question assesses the occurrence of specific conditions related to the experience of food insecurity over the past 30 days. The occurrence question has two response options (0=no, 1=yes). If the answer to the occurrence question is no, the participant was asked to skip that specific question and answer the following question on the questionnaire; but if the answer to the occurrence question was in the affirmative, the participant then proceeded to the second sub-question. The latter assessed the severity or the frequency of the occurrence question. There were three response options to the frequency of the occurrence question (1=rarely, 2=sometimes, 3=often). Each participant's score was calculated by adding the code for each frequency of the occurrence question. The maximum score for a participant was 27 if he/she replied often=3 to all nine questions; and the minimum score was 0 if a participant replied no to all nine occurrence questions. The higher the score, the more food insecure the participant was. The lower the score, the less food insecure the participant was. For the purpose of this study, participants were considered food secure if the score was between 1 and 9, and food insecure if the score was between 10 and 27. A data collection sheet on biographical data was attached to the questionnaire, which contained information such as HbA1c, weight, height and a body mass index (BMI): participants were considered to have a normal BMI when the range was between 18.50 to 24.99kg/m^2; overweight, 25 to 29.9kg/m^2; and obese, ≥30kg/m^2. In the present study, participants under the age of 65 years were considered to be well controlled when HbA1c levels were ≤7mmol/l, and patients above the age of 65 with an HbA1c level <8mmol/l.

The socio-economic position (SEP) of participants was assessed based on the family's assets. This method proved a better indicator of socio-economic status than income.[60] Questions were asked to assess the ownership of the following household appliances: stove, fridge, TV, cell phone and washing machine. Scores were assigned to the responses to each individual question. There were two possible response options for each item. For ownership of any type of stove (0=no, 1=yes),

cell phone (0=no, 1=yes), fridge (0=no, 2=yes), TV (0=no, 2=yes), and washing machine (0=no, 4=yes). Scores for each item were then added up to create a total household score. The maximum attainable score was 10, with the minimum of 0. The households were then divided in three socio-economic position groups: socio-economic position one (SEP1) represented all the households with a total score between 0 to 4; SEP2 households with a total score between 5 to 7; and SEP3 households with a total score between 8 to 10. The higher the score, the higher the SEP of the household.

3.9 Data collection process

The researcher trained the research assistant to co-facilitate the research process. The assistant was fluent in the local languages, and assisted participants to understand the questionnaire. The study proceeded as follows: the researcher and the research assistant recruited diabetic patients attending the JDCHC as they presented to a consulting room. Systematic sampling was done by including every third patient who was willing to participate between 08:00h–16:00hrs on week days. After their consultation with a nursing sister or a doctor, the researcher approached participants individually to introduce them to the study. Participants were recruited from patients who came either for monthly or six monthly reviews. Those who agreed to participate were then asked to sign a consent form, after which the questionnaire was administered by the researcher. This was done in a separate room to secure confidentiality and explain the study. If a third patient declined, the fourth one was approached and included in the study if he/she agreed to participate. This process continued until an adequate sample size of 250 participants was achieved. Participating patients' files were checked for height, weight and HbA1c, and results were entered onto a data collection sheet attached to each questionnaire, along with the BMI that was calculated for each patient. If these results went missing, they were excluded, and the patient could join in the next round if that information was available. All these results were entered onto the data collection sheet. In addition, to ensure that data was not collected twice from the same file, the researcher labelled files already used in the study.

Data collection was initially planned to be collected over a three-month period, from October to December 2016. However, during this period the researcher unfortunately was not able to recruit a sufficient number of participants. This was due to the number of controlled diabetic patients who were seen in August and September of the same year, who were given repeat scripts for the

following six months of treatment. Secondly, this was at the time of the year when many patients went home for the December holidays, and only came back during the second half of January. In order to overcome these obstacles, the data collection period was extended for a month and half. The actual collection period was from October 2016 to mid-February 2017 (four and a half months). Other difficulties were related to the patients' records: lost files, missing data, and routine blood results, including HbA1c, were not in the files or had just not been done. With regard to missing routine blood results, the latter was requested (including HbA1c) for those who needed it as part of their annual tests.

3.10 Data analysis

An Excel spread sheet was used to capture the data, which were later verified. Stata 14.0 software was used to analyse the data. Socio-demographic characteristics were summarised where appropriate. Categorical variables were reported as frequencies, and proportions and percentage calculations were done. Continuous variables were reported in terms of mean and standard deviation. Inferential statistics were done using Pearson's Chi-square tests and logistic regression. These tests were done in order to test associations between socio-demographic characteristics, glycaemic control and food insecurity. Where statistically significant associations were detected, further analyses were carried out using bivariate and multivariate logistic regression to assess the strength of the associations. Significance level was taken as 0.05, and data on a total of 250 participants were analysed.

3.11 Ethical considerations

In order to conduct the current study, approval was obtained on several different levels. Approval was firstly obtained from the Human Research Ethics Committee (HREC) of the University of the Witwatersrand (Protocol approval number: M160202. See appendix H). Secondly, the researcher also obtained permission from the Ekurhuleni Health District Research Committee (Research project number: 10/12/2015-1. See Appendix G). Finally, approval was obtained from the facility manager of JDCHC.

Research participants were informed about the study. Information sheets were distributed to the patients, and questionnaires were administered to those who agreed to participate in the study.

Participants' information was kept confidential. To maintain this confidentiality, a participant identification number (PIN) was given to each participant, instead of using their name. The PIN was known only by the researcher. Research participants were informed that there would be no negative consequences should they decide not to participate and withdraw from the study.

3.12 Validity and reliability

During the sample selection process, all diabetic patients attending JDCHC were given the same chance to be part of the study through systematic sampling, which was done by including every third patient who was willing to participate. The sample size met the criteria of a 95% confidence level, ensuring that the information was valid for the population from which the sample was drawn. The study can be generalised to the diabetics in the JDCHC. Reliability of the study was ensured by using a standardised and validated questionnaire.[44,60,77,78] The questionnaire had both construct and face validity, which ensured reliability. A solid methodology was followed, which increased test-retest validity, should someone in the future want to repeat the process.

CHAPTER 4

RESULTS

This chapter describes the findings of the study. It includes the following results: participants' socio-demographic characteristics, including age, sex, marital status, immigration status, household size, socio-economic position and employment status, the proportion of participants with food insecurity, proportion of participants with glycaemic control; and finally, associations between food insecurity, socio-demographic characteristics, and glycaemic control. Three hundred and five eligible participants were approached to get a sample size of 250 participants with a response rate of 81.69%.

4.1 Socio-demographic factors of the study participants

4.1.1 Age

Table 4. 1: Age distribution of participants

Age group	Number (n=250).	Percentage (%)
<30yrs	1	0.40
30-39yrs	12	4.80
40-49yrs	31	12.40
50-59yrs	83	33.20
≥60yrs	123	49.20
Total	250	100.00

Variable	Obs	Mean	Std. Dev.	Min	Max
Age	250	58.672	10.55319	29	88

The mean age of participants was 58.67 years. The oldest and youngest participants were 88 years and 29 years respectively. Participants aged 40 years and above accounted for 94.8% (237/250); 49% of the participants were age 60 years and above.

4.1.2 Sex

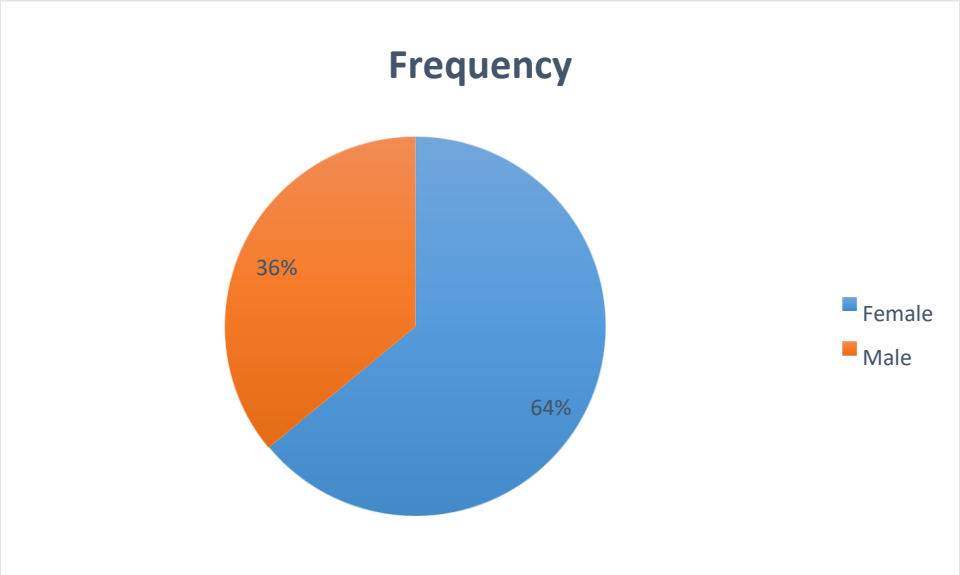


Figure 4. 1: Sex distribution of participants

As shown in Figure 4.1, 64% of participants were female and 36% were male.

4.1.3 Marital Status

The marital status findings of the participants are displayed in Figure 4.2.

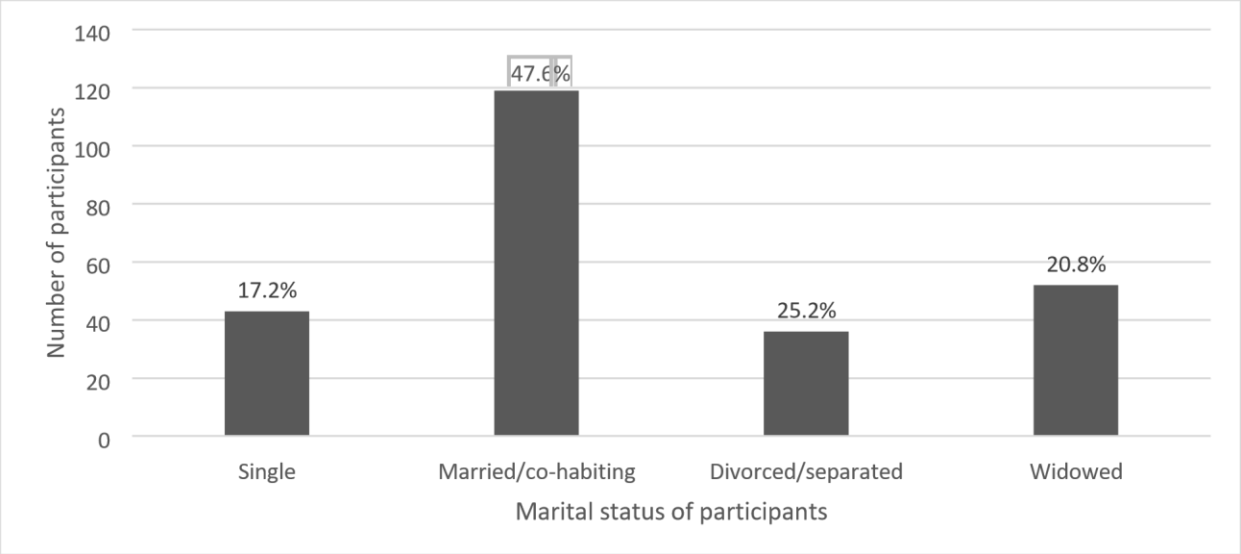


Figure 4. 2: Marital status distribution of participants

As depicted in Figure 4.2 above, married or co-habiting participants represented 47. 6%. Single participants were the least, at 17.2%.

4.1.4 Immigration status

Table 4. 2: Immigration status distribution of participants

Immigration status	Number(n=250)	Percentage (%)
Citizen	222	88.80
Non-Citizen	28	11.20
Total	250	100.00

In terms of immigration status, South African citizens accounted for 88.8% while non-South African citizens were at 11.2%.

4.1.5 Household size

Table 4. 3: Household size distribution of participants

Household size	Number (n=250) Freq.	Percentage (%)
Less than 5	144	57.60
Equal or more than 5	106	42.40
Total	250	100.00

Table 4.3 above shows 57.6 % of participants had less than five members in their household; the rest had five or more family members in their households. The choice of 5 as the divide between the two groups was based on the findings of previous studies as mentioned in the literature review.

4.1.6 Employment Status

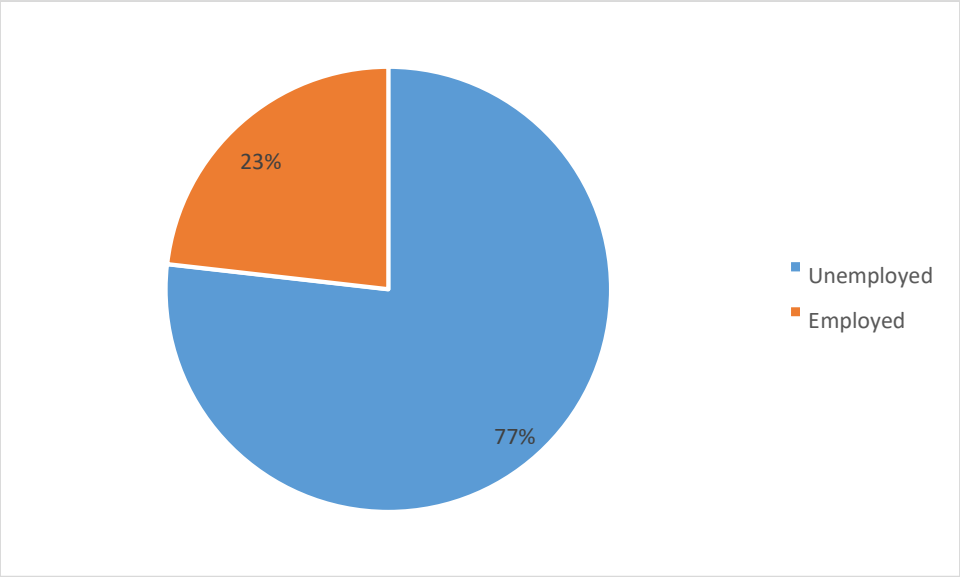


Figure 4. 3: Employment status distribution of participants

As shown in Figure 4.3, 77% of participants were unemployed, with 23% of participants being employed.

4.1.7 Socio-economic status according to the Asset Register

Household appliances were used as indicators to determine the socio-economic position of participants. Participants who had all five household appliances listed below were considered financially stronger than people not having these items.

Table 4. 4: Household appliances distribution of participants

House appliances	Number(n=250)	Percentage (%)
Stove	250	100
TV	234	93.6
Refrigerator	236	94.4
Cell phone	234	93.6
Washing Machine	163	65.2
Participants with all the above	145	58.0

100% of participants had stoves and 65% had washing machines; 58% of participants had all the above appliances.

Table 4. 5: Socio-economic position of households

SEP	Number(n=250)	Percentage (%)
1	14	5.60
2	77	30.80
3	159	63.60
Total	250	100.00

Participants in the SEP3 category were considered to be in higher socio-economic positions, according to the score obtained. As shown in Table 4.5 above, 63.60% of participants belonged in the SEP3 category, and 14% belonged in SEP1.

4.1.8 Number of years in Ekurhuleni

Table 4. 6: Distribution of number of years living in Ekurhuleni district among participants

Number of years in Ekurhuleni	Number (n=250)	Percentage (%)
10yrs or less	50	20.00
11 to 20yrs	45	18.00
21 to 30yrs	98	39.20
31 to 40yrs	27	10.80
41 to 50yrs	9	3.60
>50yrs	21	8.40
Total	250	100.00

Number of years in Ekurhuleni	Observation	Mean	SD	Minimum	Maximum
	250	25.30	13.39	1	77

As shown in Table 4.6 above, the mean number of years of participants living in Ekurhuleni was 25 years.

4.1.9 Number of grants per participant

Table 4. 7: Distribution of number of grants received per participant

Number of grants	Number(n=250)	Percentage (%)
0	116	46.40
1	117	46.80
2	17	6.80
Total	250	100.00

Table 4.7 above shows that 46.4% of participants did not receive grants and that 6.8% of participants received two different types of grants. The remaining participants received one type of grant.

4.1.10 Type of grant received by participants

Table 4. 8: Distribution of grant type received by participants

Grant type	Number(n=134)	Percentage (%)
Disability grant	10	7.46
Old age grant	89	66.42
Child grant	27	20.15
Multiple grants	8	5.97
Total	134	100.00

Table 4.8 above shows that 66.42% of participants received old age grants, followed by child grants and disability grants; 5.97% of participants received multiple grants.

4.2 Food insecurity

Table 4. 9: Proportion of participant households with food insecurity

Household food security	Number(n=250)	Percentage (%)
Secure	91	36.40
Insecure	159	63.60
Total	250	100.00

Table 4.9 above shows that 63.6% of households experienced food insecurity, while 36.4% of households were food secure.

4.3 Glycaemic control

Table 4. 10: Proportion of glycaemic control among participants

Glycaemic control	Number(n=250)	Percentage
Controlled	76	30.40
Uncontrolled	174	69.60
Total	250	100.00

As shown in Table 4.10 above, 69.6% of participants were found to have uncontrolled glycaemic levels, and 30.4 % had well controlled glycaemic levels.

4.4 Body Mass Index

Table 4. 11: Body mass index distribution among participants according to different age groups

	Number/percentage of participants					
BMI	**<30yrs**	**30-39yrs**	**40-49yrs**	**50-59yrs**	**>60yrs**	**Total**
16-19 kg/m^2	0	0	0	2	3	5
	0.00	0.00	0.00	2.41	2.44	2.00
20-24 kg/m^2	0	3	1	9	14	27
	0.00	25.00	3.23	10.84	11.38	10.80
25-29 kg/m^2	1	5	7	31	45	89
	100.00	41.67	22.58	37.35	36.59	35.60
30-34 kg/m^2	0	3	16	20	37	76
	0.00	25.00	51.61	24.10	30.08	30.40
35-39 kg/m^2	0	1	4	14	17	36
	0.00	8.33	12.90	16.87	13.82	14.40
>40 kg/m^2	0	0	3	7	7	17
	0.00	0.00	9.68	8.43	5.69	6.80
Total	1	12	31	83	123	250
	100.00	100.00	100.00	100.00	100.00	100.00

As shown in Table 4.11 above, 35.60% of participants were found to be overweight (BMI 25-29 kg/m^2), of which half belonged to the age group 50 and above. The overweight group was followed by those participants having obesity (BMI≥30kg/m2) which represented 51.6%, of which half were also 50 years and above.

Table 4. 12: Body mass index distribution according to sex among participants

	Number/percentage of participants		
BMI	**Female**	**Male**	**Total**
16-19 kg/m^2	2	3	5
	1.25	3.33	2.00
20-24 kg/m^2	10	17	27
	6.25	18.89	10.80

25-29 kg/m^2	56	33	89
	35.00	36.67	35.60
30-34 kg/m^2	52	24	76
	32.50	26.67	30.40
35-39 kg/m^2	26	10	36
	16.25	11.11	14.40
>40 kg/m^2	14	3	17
	8.75	3.33	6.80
Total	160	90	250
	100.00	100.00	100.00

As depicted in Table 4.12 above, 35.6% of participants were overweight (BMI 25-29kg/m^2), of which 56 were female vs 33 male. The overweight group was followed by the obese group at 30.40% (BMI 30-34 kg/m2).

4.5 Association between food insecurity, socio-demographic variables, and glycaemic control

4.5.1 Association between food insecurity and socio-demographic variables

4.5.1.1 Age and food insecurity

Table 4. 13: Age and food insecurity among participants

	Household food security			
Age group	**Secure**	**Insecure**	**Total**	**P-value**
<30yrs	0	1	1	0.473
	0.00	100.00	100.00	
	0.00	0.63	0.40	
30-39yrs	6	6	12	
	50.00	50.00	100.00	
	6.59	3.77	4.80	
40-49yrs	13	18	31	
	41.94	58.06	100.00	
	14.29	11.32	12.40	
50-59yrs	25	58	83	
	30.12	69.88	100.00	
	27.47	36.48	33.20	
>60yrs	47	76	123	
	38.21	61.79	100.00	
	51.65	47.80	49.20	
Total	91	159	250	
	36.40	63.60	100.00	
	100.00	100.00	100.00	

Table 4.13 above shows that there was no statistically significant association between household food insecurity and the age of the participants (Chi-square, p=0.473).

4.5.1.2 Sex and food insecurity

Table 4. 14: sex and food insecurity

	Household food security			
Sex	**Secure**	**Insecure**	**Total**	**P value**
Female	56	104	160	0.540
	35.00	65.00	100.00	
	61.54	65.41	64.00	
Male	35	55	90	
	38.89	61.11	100.00	
	38.46	34.59	36.00	
Total	91	159	250	
	36.40	63.60	100.00	
	100.00	100.00	100.00	

As depicted in Table 4.14 above, there was no statistically significant association between household food insecurity and the gender of the participants (Chi-square, p=0.540).

4.5.1.3 Marital status and food insecurity

Table 4. 15: Marital status and food insecurity

	Household food security			
Marital status	**Secure**	**Insecure**	**Total**	**P value**
Single	20	23	43	0.490
	46.51	53.49	100.00	
	21.98	14.47	17.20	
Married/co-habiting	42	77	119	
	35.29	64.71	100.00	
	46.15	48.43	47.60	
Divorced/separated	12	24	36	
	33.33	66.67	100.00	
	13.19	15.09	14.40	
Widowed	17	35	52	
	32.69	67.31	100.00	
	18.68	22.01	20.80	
Total	91	159	250	
	36.40	63.60	100.00	
	100.00	100.00	100.00	

As shown in Table 4.15 above, there was no statistically significant association between household food insecurity and the marital status of participants (Chi-square, p=0.490).

4.5.1.4 Immigration status and food insecurity

Table 4. 16: Immigration status and food insecurity

	Household food security			
Immigration status	**Secure**	**Insecure**	**Total**	**P value**
Non-citizen	15	13	28	***0.045**
	53.57	46.43	100.00	
	16.48	8.18	11.20	
Citizen	76	146	222	
	34.23	65.77	100.00	
	83.52	91.82	88.80	
Total	91	159	250	
	36.40	63.60	100.00	
	100.00	100.00	100.00	

Table 4.16 above shows that there was a statistically significant association between immigration status (citizens or non-citizens) and food insecurity (Chi-square test, P=0.04). 65.77% of citizens were food insecure compared to 46.43% of non-citizens.

4.5.1.5 Household size and food insecurity

Table 4. 17: Household size and food insecurity

	Household food security			
Household size	**Secure**	**Insecure**	**Total**	P value
Less than 5	60	84	144	***0.044**
	41.67	58.33	100.00	
	65.93	52.83	57.60	
Equal or greater than 5	31	75	106	
	29.25	70.75	100.00	
	34.07	47.17	42.40	
Total	91	159	250	
	36.40	63.60	100.00	
	100.00	100.00	100.00	

There was a statistically significant association between household size and food insecurity (Chi-square test, P=0.044). 70.75% of participants were food insecure in household sizes equal or greater than 5, compared to 58.33% in those households with less than 5 members

4.5.1.6 Employment status and food insecurity

Table 4. 18: Employment status and food insecurity

	Household food security			
Employment status	**Secure**	**Insecure**	**Total**	**P value**
Unemployed	63	129	192	
	32.81	67.19	100.00	
	69.23	81.13	76.80	
Employed	28	30	58	
	48.28	51.72	100.00	***0.032**
	30.77	18.87	23.20	
Total	91	159	250	
	36.40	63.60	100.00	
	100.00	100.00	100.00	

With respect to employment status, Table 4.18 above shows a statistically significant difference between the employment status of participants and food insecurity (Chi-square test, P=0.032). 81, 13% food insecure were unemployed compared to 18.87 % in the employed group.

4.5.1.7 Association between socio-economic position and food insecurity

Table 4. 19: Socio-economic position and food insecurity

SEP	Secure	Insecure	Total	P-value
1	2	12	14	0.195
	14.29	85.71	100.00	
	2.20	7.55	5.60	
2	28	49	77	
	36.36	63.64	100.00	
	30.77	30.82	30.80	
3	61	98	159	
	38.36	61.64	100.00	
	67.03	61.64	63.60	
Total	91	159	250	
	36.40	63.60	100.00	
	100.00	100.00	100.00	

Table 4.19 shows that there was no statistically significant association between household food insecurity and the socio-economic profile of the participants (Chi-square, p=0.195). 98% of participants belonged to SEP3

4.5.1.8 Body Mass Index and food insecurity

Table 4. 20: Body mass index and food insecurity

	Household food security			
BMI	**Secure**	**Insecure**	**Total**	**P-value**
16-19kg/m2	2	3	5	
	40.00	60.00	100.00	
	2.20	1.89	2.00	
20-24kg/m2	10	17	27	
	37.04	62.96	100.00	
	10.99	10.69	10.80	
25-29kg/m2	35	54	89	
	39.33	60.67	100.00	
	38.46	33.96	35.60	
30-34kg/m2	28	48	76	
	36.84	63.16	100.00	
	30.77	30.19	30.40	
35-39kg/m2	12	24	36	
	33.33	66.67	100.00	
	13.19	15.09	14.40	
>40kg/m2	4	13	17	
	23.53	76.47	100.00	
	4.40	8.18	6.80	
Total	91	159	250	
	36.40	63.60	100.00	
	100.00	100.00	100.00	0.891

Table 4.20 shows that there was no statistically significant association between household food insecurity and the BMI of the participants (Chi-square, p= 0.891).

4.5.1.9 Association between number of grants received by participants and food insecurity

Table 4. 21: Grants and food insecurity

Number of grants	Secure	Insecure	Total	P-value
0	45	71	116	0.479
	49.45	44.65	46.40	
1	42	75	117	
	46.15	47.17	46.80	
2	4	13	17	
	4.40	8.18	6.80	
Total	91	159	250	
	100.00	100.00	100.00	

Table 4.21 shows that there was no statistically significant association between the number of grants received by participants and food insecurity.

4.5.1.10 Association between type of grant received by participants and food insecurity

Table 4. 22: Type of grant and food insecurity

Grant type	Secure	Insecure	Total	P-value
Disability grant	1	9	10	0.168
	2.17	10.23	7.46	
Old age grant	36	53	89	
	78.26	60.23	66.42	
Child grant	7	20	27	
	15.22	22.73	20.15	
Multiple grants	2	6	8	
	4.35	6.82	5.97	
Total	46	88	134	
	100.00	100.00	100.00	

As shown in Table 4.22 above, there was no statistically significant association between household food insecurity and the type of grant/s received by participants (Chi-square, p=0.168).

4.5.1.11 Glycaemic control and food insecurity

Table 4. 23: Glycaemic control and food insecurity

Glycaemic control	**Household food security**			
	Secure	**Insecure**	**Total**	**P value**
Controlled	47	29	76	***0.000**
	61.84	38.16	100.00	
	51.65	18.24	30.40	
Uncontrolled	44	130	174	
	25.29	74.71	100.00	
	48.35	81.76	69.60	
Total	91	159	250	
	36.40	63.60	100.00	
	100.00	100.00	100.00	

Table 4.23 above shows that there is statistically significant association between glycaemic control and food insecurity. 74.71 % of uncontrolled diabetic patients were food insecure compared to 38.16% in the controlled patients. (Chi-square test, P=0.000).

4.6 Logistic regression

Where statistically significant associations were detected, bivariate and multivariate logistic regression was carried out to assess the strength of the associations between variables. Therefore, bivariate logistic regression was carried out for factors such as immigration status, household size, employment status, and glycaemic control. The results are shown below.

4.6.1 Immigration status and food insecurity

Table 4. 24: Immigration status with food insecurity

Household food security	Odds Ratio	P value	[95% Confidence Interval]
Immigration status	0.4511416	0.049	0.2041862 - 0.9967801

Logistic regression analysis revealed that non-South African participants compared to their South African counterparts were 55% less likely to have experienced food insecurity (P value 0.049, Odds ratio 0.45, 95% CI 0.2041862 – 0.9967801). This association is marginally statistically significant P=0.049.

4.6.2 Household size and food insecurity

Table 4. 25: Household size with food insecurity

Household food security	Odds Ratio	P value	[95% Confidence Interval]
Household size	1.728111	0.045	1.013363-2.946985

Households with five or more members were 1.7 times more likely to have experienced food insecurity compared to households with less than five members. This association was marginally significant, with P value of 0.045, odds ratio of 1.72 and 95% confidence interval 1.013363 – 2.946985.

4.6.3 Employment status and food insecurity

Table 4. 26: Employment status with food insecurity

Household food security	Odds Ratio	P value	[95% Confidence Interval]
Employment status	1.911111	0.033	1.052354 - 3.470645

Logistic regression analysis shows that participants who were unemployed were almost twice as likely to have experienced food insecurity when compared to participants that were employed. P value 0.033, odds ratio 1.911, and 95% confidence interval 1.052354 – 3.470645.

4.6.4 Glycaemic control and food insecurity

Table 4. 27: Glycaemic control with food insecurity

Household food security	Odds Ratio	P value	[95% Confidence Interval]
Glycaemic control	4.788401	0.000	2.693455 - 8.512779

Participants with poor glycaemic control were about 4.8 times more likely to have experienced food insecurity when compared to participants who had good glycaemic control. This association was strongly significant (p=.0000) with an odds ratio of 4.788401 and a 95% confidence interval of 2.693455 – 8.512779.

4.6.5 Multivariate analysis with adjusted predicting factors associated with food insecurity

Table 4. 28: Multivariate logistic model of factors associated with food insecurity

	Odds Ratio & 95% CI Bivariate model	**p-value**	**Odds Ratio & 95% CI Multivariable model**	**p-value**
Employment status				
Employed	1		1	
Unemployed	1.91 (1.05-3.47)	0.033	2.94 (1.51-5.75)	0.002

Immigration status				
Non-South African Citizen	1		1	
South African Citizen	2.21 (1.00-4.90)	0.049	1.60 (0.66-3.86)	0.299
Household size				
Less than five members	1		1	
Five or more members	1.73 (1.01-2.95)	0.045	1.77 (0.98-3.19)	0.056
Glycaemic control				
Controlled	1		1	
Uncontrolled	4.79 (2.69-8.51)	<0.001	5.38 (2.91-9.96)	<0.001

Table 4.28 above is a multivariable model for testing factors associated with food insecurity. In this model, employment status and glycaemic control were statistically significant with food insecurity. The odds of being food insecure were 2.94 for unemployed participants compared to those who were employed (OR: 2.94; 95% CI: 1.51-5.75; p= 0.002). Participants with poor glycaemic control were 5.38 times more likely to have experienced food insecurity when compared to participants who had good glycaemic control (OR: 5.38; 95% CI: 2.96-9.96; p= <0.001). Immigration status and household size did not demonstrate any statistically significant association with food insecurity in the multivariable model.

4.7 Summary of the main study findings

The key findings from the study are as follows: the proportion of diabetic patients presenting with food insecurity at JDCHC was 63.60%. The majority of them were older (>60yrs, 123/250); females (64%); married/co-habiting (47.6%); South African citizens (88%); with less than five members in their households (57.60%); unemployed (77%); with uncontrolled DM (69.6%). Results showed a statistically significant association between the following variables and food

insecurity: immigration status (p-value=0.049); household size (p-value=0.045); employment status (p-value=0.033); and glycaemic control (p-value=0.000). The above findings are discussed in the following chapter.

CHAPTER 5

DISCUSSION

To the best of our knowledge, this is the first study conducted in Southern Africa that has assessed food insecurity and its relationship with glycaemic control in the diabetic population. The majority of studies done globally were conducted in a hospital setting, whilst this South African study focuses on the primary health care setting.[39, 42-44]

The study results are thus discussed and analysed in this section within the framework of primary health care. The present study was conducted in the JDCHC located in Vosloorus, a semi-urban area within the municipality of Ekurhuleni, Johannesburg, in South Africa. The study participants live in this disadvantaged area, with its high unemployment rates, low-income levels, and few job opportunities. Overall there was a good response rate of 81.69% from the participants.

This discussion follows the objectives of the study, namely:

- To describe the socio-demographic characteristics of diabetic patients attending JDCHC.
- To determine the proportion of food insecurity in diabetic patients attending JDCHC.
- To determine the glycaemic control based on HbA1c among diabetic patients with food insecurity.
- To determine the possible associations between food insecurity, glycaemic control and socio-demographic characteristics.

5.1 Socio-demographic characteristics of study participants

The present study found that the majority of diabetic patients attending JDCHC were female, as seen in the majority of other studies.[43, 48, 49, 52] The predominance of female participants in our study sample (Figure 4.1) might be explained by the fact that females in general have shown more health awareness and are more regular in accessing health-related activities than males.[36] This present study does not differ from other studies regarding the average age of the study participants.[45, 46] Forty seven point six per cent of the female participants in this study were married or co-habiting. The importance placed on the marital or relationship status was based on an

assumption that there could be a second income or other financial support of some kind. However, this study did not elicit this information, which, with hindsight, was a limitation.

With regard to race, the study conducted by Charlton et al. (2012) in South Africa showed that food insecurity rates were highest among households headed by African populations (56%), followed by coloureds, Indians and Caucasians (3%).[48] In the present study, all the participants were African, due to the catchment area being mainly populated by that racial group. The present study found that most of the participants were South African citizens as opposed to immigrants, while similar studies globally suggest that immigrant populations were more prominent.[54, 55]

With regard to the employment of the study participants, the current study found that a significant number of participants were unemployed (77%), which is consistent with other studies on food insecuirty.[47, 48] With regard to household size, our study showed that the majority of African households had five or less family members. Other studies refer to six or more members in a household.[47, 48, 52] It therefore seems that unemployment and the number of members in African households are consistent factors in the presence of food insecurity. The percentage of participants either dependent on or supplementing their income with social grants was 53.6%. Due to diabetes being a disease associated with age, 66.42% of participants received an old age grant. When considering these grants, one's initial assumption is that the recipient is poor. However, the participants in this study were in higher socio-economic positions (SEP3), according to the Assets Register findings. This was confusing. However, when considering the means test for social grants, the following applies: a single person's assets should not total more than R1 056 000.00. Married people's joint assets are double that amount. A single person should not earn more than R73 800.00 per year, or R 6 150.00 per month. The value of a house that a person lives in is not taken into account, regardless of who owns it.[79]

The majority of participants in this study lived in informal settlements, but this did not exclude the possibility of them having a second home or traditional dwelling in areas formerly known as homelands. The study did not elicit this information, and in the case of the 20.8% widows, no information was elicited on the existence of other income e.g. pension from the deceased spouse. This was a limitation to a full interpretation of the results. Another limitation of this study was that

the researcher worked on the assumption that incomes were well managed, and no questions were asked regarding budgeting or financial planning.

Two biographic factors were included in the study: BMI and blood glucose control. BMI (Table 4.11) was high, in line with other studies.[74, 75] Increased BMI observed in this study was probably due to the fact that the majority of participants in the sample were Africans, and that in most African communities overweight is perceived as a sign of happiness, hence they eat whatever is to hand in order to meet the above perception.[80] Another aspect is the fact that food insecurity leads to malnutrition as well as imbalanced diets. Patients are anecdotally known for their lack of exercise, and obesity.[79] The disease itself is associated with obesity when glycaemic control is not optimal, and/or insulin resistance is not managed. This study also found that in 69.60% of patients, glycaemic control was not optimal (Table 4.10). This was in line with other studies. [42, 43] Possible reasons for this are explored in the following section.

5.2 Diabetic patients and food insecurity

The results of the present study have shown that the proportion of diabetic patients with food insecurity attending JDCHC was high (63.6%), although lower than the 78% found in a study done in Jordan.[44] The researchers in the Jordan study suggested that low socio-economic factors could contribute to their findings, which is an aspect that applies in this present study. Food insecurity in the present study was higher when compared to the Kenyan and other studies done elsewhere.[39, 40, 42, 44] For example, a Canadian study conducted by Galesloot et al. (2012) on food insecurity among adults receiving diabetes care, reported a proportion of food insecurity as low as 15%.[40] Canada is a high-income, developed country. Many high-income countries such as Australia, the United Kingdom, Canada, and the USA have food aid programmes in place to help diabetic patients who are food insecure.[32] These countries also have higher employment rates. When comparing the Kenyan study results with the results of this present study, food insecurity was double that of Kenya. Both Kenya and South Africa are developing countries, but South Africa has a marginally better economy. The Kenyan study did not look into the employment status of its participants, and this unknown factor might explain the difference in proportion of food insecurity between these two studies. It is thus clear that the main difference in studies is the socio-economic well-being of

the country versus the food insecurity outcome. In addition, developed countries have a broader tax base and can compensate for food insecurity with food relief for diabetic patients.

5.3 Association between food insecurity, socio-biographic characteristics and glycaemic control

For the purpose of this discussion, objectives three and four were combined. Age, sex, household size, immigration status, socio-economic position (SEP), employment status, and food insecurity were the most prominent associations found in the demographic domain. The body mass index and glycaemic control will be covered as biographic characteristics.

There was no statistically significant association between age and food insecurity (p=0.473); this was similar to a study conducted in the USA by Seligman et al.[47] Despite the lack of statistically significant association, the present study found that food insecurity increased as participants got older (Table 4.13). Other studies reported contradictory findings.[42, 43] The study conducted by Bawadi et al. in northern Jordan, found that age was a significant factor associated with food insecurity in diabetic patients.[43]

In the current study, no significant association was found between sex and food insecurity. However, it was mainly the females who presented at the clinic and participated in this research that suggested a high prevalence of food insecurity. South Africa is still paying the consequences for having excluded African women from the economy during the apartheid years. From a statistical point of view, these findings were different from the USA study conducted by Olson et al. which found that female-headed households were more likely to have experienced food insecurity among their participants[52].

The statistically significant association between household size and food insecurity in diabetic patients attending JDCHC (p-value=0.044) came as no surprise. Olson et al. found a significant association between household size and food insecurity in New York, USA.[52] Similar findings were reported in Nigeria by Omonona et al. (2007) and Arene and Anyaeji (2010).[45, 46] These results cannot be clearly interpreted if one does not also take employment status into account. In this study, employment was generally low, thus causing a lack of steady income. Although the Asset Register placed the participants in a socio-economic category that was not so low, the participants could not be seen as having a sufficiently steady income to secure sustainable food

acquisition. With this in mind, it is clear that feeding multiple family members on limited income results in food insecurity.

Anecdotally, the perception is that food insecurity mainly presents in informal settlements with large numbers of legal and illegal immigrants. The present study showed that South African citizens are more food insecure when compared to immigrant participants. The current study findings are in contrast with previous studies conducted elsewhere.[54, 55] In California, Kasper et al. (2000) found that the prevalence of food insecurity among legal immigrants (Vietnamese and Cambodians) was much higher when compared to American citizens.[54] Although the Kasper et al. study was done 18 years ago, it was the only study the researcher found referring to food insecurity in immigrants. This current study's findings can be interpreted in various ways. Firstly, immigrants may not have access to clinics, and thus are not monitored. Those having access may have other means of support, which was not elicited in this study. For South Africans, we know that the philosophy of *Ubuntu* suggests that South Africans will support each other; the challenge in this country is, however, that African families in South Africa have more members per household than the immigrants, and the country itself has low economic growth. Thus the overall struggle to make ends meet. There is just not enough financial support available for all.

The socio-economic position of the study participants was generally difficult to determine since patients may have preferred not to declare all their income; alternatively, in many cases the income was not steady, making it difficult for participant's to declare their monthly income as regular income. Thus, in South Africa, the Asset Register is considered a more reliable tool than employment and income status alone.[61] There was no significant statistical association between socio-economic position as measured by the Asset Register, and food insecurity ($p = 0.195$). Other studies, conducted in Europe, used employment and income as a measure for socio-economic status, and found a significant association between belonging to a higher social class and healthier diet consumption.[58] In their review conducted in Australia, Turrell et al. (2004) supported the European study results.[59]

Estevez et al. (2000) assessed the SEP of their study participants on the basis of education levels and employment status, while in this present study, the participants' SEP was assessed on the basis of household assets (stove, TV, fridge, cell phone and washing machine). The issue of using household assets as an indicator of the SEP of a household, is the fact that it might not reflect the

current SEP of the family, since there are some appliances such as a stove or washing machine that the family may have acquired several years ago, while the head of the household was still employed. However, despite the lack of direct or significant association between the SEP and food insecurity, owning these appliances could have a positive impact on diabetic care and the food security level of the household by increasing its cooking ability and storage capacity, while a cell phone would give access to information and support. In the researcher's opinion, having a fridge in a household of a diabetic patient might have a double positive impact. On one hand, fridges allow a patient to buy vegetables and keep them in the fridge and eating healthily for the entire month, compared to a household without a fridge, which needs to buy vegetables on a daily basis, with the risk of running short of money. Along the same lines, having a cell phone alarm might improve a diabetic patient's adherence to treatment, and having a TV might empower a diabetic patient with diabetic knowledge. Finally, inadequate cooking facilities (for example not owning a stove), may lead diabetic patients to rely heavily on canned, high sodium and high carbohydrate food, consequently contributing to uncontrolled blood sugar.

This study found a statistically significant relationship between the employment status and food insecurity of a household ($p=0.032$), which was found globally. [43, 44, 51] Furthermore, the analysis of our study shows that participants who were unemployed were almost twice as likely to have experienced food insecurity when compared to participants who were employed, which is similar to the study conducted by Alaimo et al.[50] There are many other studies with similar findings.[43, 44, 51] The majority of participants in our study were unemployed. However, within this group of unemployed participants, there were some who were still food secure. This links with the previously mentioned limitations in terms of income, grants, and the means test. It may also be supported by the fact that being unemployed does not necessarily mean that one is not engaged in activities that generate income. Some participants reported selling things on the street, and renting their back yard to other people, while some reported receiving groceries every month from their children, with pocket money included. All the above generate income, which can alleviate the level of food insecurity in a household.

Obesity was measured by BMI. It was found that approximately two-thirds of the participants were either overweight or clinically classified as obese. With regard to obesity, this study's results showed that there is no statistically significant association between household food insecurity and

the BMI (Chi-square, p=0.891). Other studies reported a statistical relationship between overweight and obesity with food insecurity.[39, 40, 41, 43, 44] The question then arises whether there are any differences between this study and the others. The difference in findings between our study and that of Seligman et al. is essentially due to the setting within which our study was conducted.[42] This study was conducted in a resource-constrained setting, as opposed to the Seligman et al. study, which was conducted in US, a developed country with far more resources than a developing country such as South Africa. In developing countries, people tend to suffer more from severe food insecurity,[41] meaning that access to nutritious food poses a problem and consequently people tend either to maintain or lose weight, whereas in developed countries, people tend to suffer more from mild or moderate food insecurity. This means that access to food does not constitute a problem. Rather, it is the consumption of nutritious and healthy food that poses a problem. People must rely more on inexpensive, calorically dense food, consequently gaining weight and becoming overweight or obese.[41] Considering the explanation above, the contradictory results found in our study compared to those in the previous literature, could be due to the severe food insecurity that our participants experienced, which led to food deprivation and caused lean bodyweight. Again, a limitation may be in the sample size of our study, which might have been small, thus failing to find the expected association between obesity and food insecurity. Even though BMI is not significantly associated with food insecurity in this study, it must still be considered a major factor that is most commonly associated with food insecurity.

On glycaemic control, the current study findings confirmed once again the fact that there is a significant statistical relationship between glycaemic control and food insecurity in diabetic patients. Furthermore, the present study also revealed that participants with poor glycaemic control were about five times more likely to have experienced food insecurity. Other studies had similar findings, although not as severe as in this study, as it was often found that the likelihood of glycaemic control was about three times more for patients with food insecurity.[39, 57, 64, 66] The researcher found two studies that did not reflect a positive association between glycaemic control and food insecurity.[61, 62]

Which factors contribute most to food insecurity and apply to this study's participants? Firstly, most of the participants were food insecure (74.71%), with limited financial resources. The latter affected food accessibility. These patients struggled to obtain nutritious foods because of the high cost, and consequently ended up eating cheaper, high-carbohydrate foods, which most likely

contributed to their poor glycaemic control in our participants. Secondly, when accessibility of food poses a problem, this leads to a shortage of food. It has been documented in a previous study that shortage of food is associated with anxiety and stress,[66] which in turn are associated with poor self-care behaviour (such as poor adherence) and decreased physical activity. All the above contribute to poor glycaemic control.

As per Table 4.23, a quarter of the participants with poor glycaemic control were actually food secure. This interesting result shows that besides food insecurity as a contributing factor of poor glycaemic control in diabetic patients, there might be other factors that could have affected the results. Firstly, being unemployed and having multiple family members or low income, does not necessarily lead to food insecurity (see limitations of the study). Factors such as poor compliance to pharmacological and non-pharmacological treatment, longer duration of the disease and poor knowledge of DM, could have contributed to the results. These factors were documented in a study conducted by Khattab et al. (2010) as contributing factors apart from food insecurity, though they were not included in the current study.[18]

Food insecurity is globally associated with poor glycaemic control. [39, 57, 64, 66] In their US study, Fitzgerald et al. also reported that participants with poor glycaemic control were about three times more likely to have experienced food insecurity compared to participants who had good glycaemic control, [66] whereas the present study found that diabetic patients with poor glycaemic control were five times more food insecure compared to those with good glycaemic control. This difference could be due to the fact that the current study was conducted in a developing country and thus participants experienced higher levels of food insecurity compared to developed countries, based on socio-political, socio-economic and cultural differences.[81] According to the SEMDSA guidelines,[12] the major focus is on following a healthy diet which includes low carbohydrate and low fat intake, and certain Mediterranean diets that help to control blood glucose in diabetic patients. In reality, the majority of our diabetic patients are unemployed. Therefore, it is difficult for patients to follow the above dietary instructions, as maize meal forms a staple diet for the impoverished population in South Africa.

In light of this discussion on the results of the study, the researcher thus concludes that the socio-economic climate and its associated unemployment, as well as the predominance of females with

multiple dependents in the study setting, can be considered significant factors in food insecurity and poor glycaemic control.

5.4 Limitations of study

Some limitations were identified prior to the study, and a few were subsequently identified during the research, therefore, the discrepancy between the limitations stated in the methodology chapter and those stated in this final phase of the report.

Firstly, the study design was cross-sectional, in which causal inferences cannot be concluded. Secondly, all data collected using a validated food insecurity questionnaire were self-reported, and participants could have been unwilling to disclose perceived private information. The Asset Register used as an indicator to measure the SEP of participants over-scored the current SEP of participants, since having certain house appliances does not necessarily reflect the current SEP of participants. This could be considered a bias and a limitation. Thirdly, when interpreting the results, the researcher became aware of a few other factors not elicited in the questionnaire, which could have influenced the interpretation of the results: for instance, no questions regarding budgeting or financial planning were asked, and there were no questions asked to find out the existence of a second income or any other financial support. Fourthly, the sampling of this study was geographically biased to African, low income or unemployed participants, and the findings may have differed if the study was repeated in a different area. Finally, other patient-related factors such as adherence to treatment, diabetic distress, and self-management were not included in the current study. If included, they could have affected the overall study results. This could be an area for further research.

CHAPTER 6

CONCLUSIONS AND RECOMMENDATIONS

The aim of this study was to determine the proportion of food insecurity and its relationship with glycaemic control among diabetic patients attending JDCHC. The researcher concluded that food insecurity has a statistical association with glycaemic control. In addition, other factors that statistically contributed to food insecurity in this study were immigration status, household size, and unemployment. The researcher became aware of how social determinants of health, such as income and social status, social support, and (in this study) more dependents, employment, and economic climate, health practices, sex/gender, and politics play out in the management of diabetes and /or glycaemic control. Health services as a social determinant of health were not measured in this study, but the findings have a great impact on the responsibility of the health services to improve the bio-psychosocial management of the diabetic patient.

Overall, food insecurity in diabetic patients constitutes a serious challenge, hence it becomes crucial to address this to minimise the proportion of patients with poor glycaemic control. A multidisciplinary approach should be guiding our actions to address food insecurity, while keeping in mind other social determinants of health. Action must be taken at different levels (health provider level, patient level, community level and others). With regard to the main findings of the study, the researcher recommends the following:

- **Health provider level**
  - As demonstrated in the current study, poor glycaemic control is significantly associated with food insecurity. Health care workers should screen all diabetic patients attending their facilities for food insecurity, since this is most often forgotten as a contributing factor of poor glycaemic control in diabetic patients. This also includes adequate education of the health care workers about food insecurity and its various aspects of availability, accessibility and food use.
  - When given dietary advice, HCWs must assess the availability and accessibility of these different types of diets, thus healthy food choices should be tailored to individual needs.
  - Food insecurity is not only related to the lack of or poor income of diabetic patients, but can also be due to poor budget planning, poor use of food and lack of food

storage facilities. Therefore, HCWs must have the family medicine principle of networking in mind; they must make use of other experts such as social workers and dieticians in order to help patients plan appropriately with the few resources available to them. This will motivate behavioural change and also encourage appropriate food use, with help from dieticians.

- The health care worker can also explore if the patient is aware of available resources, e.g. community gardens, emergency food relief, etc.

- **Patient level**
  - It is important to recognise the financial and nutritional challenges that diabetic patients who belong to low-income groups experience, in order to manage their condition. The patient must understand that food insecurity is just as bad for their health as poor dietary habits.
  - Patients can be taught to utilise available income to buy and prepare food that can improve their glycaemic control. This includes planning to maximise their food intake for the entire month.
  - The patient must optimise the use of social and family networks in the spirit of *Ubuntu*, to ensure food security.
- **Community level**
  - At community level, awareness activities should be initiated, such as talks or campaigns through media focus on the major role that food insecurity plays in controlling blood sugar in DM patients, along with other important factors like adherence, and the need for better glucose control.
  - Within communities, services that can be used to relieve hunger should be identified (food aid programmes, churches, NGOs, and others). Food assistance programmes are used elsewhere in the world as an emergency measure to relieve hunger at a given time, and although this is not a sustainable strategy for eradicating food insecurity, its establishment is still important in the South African context for those who are unemployable.
  - Community leaders, stakeholders, and ward-based primary health care teams (WBPHCOT) can play a big role in relieving hunger in the community. Community

leaders and stakeholders can facilitate access to the land and water available to community members, and information on income generating projects should be discussed with diabetic patients. WBPHCOTs should mobilise the community, and specially DM patients, to establish support groups; they can also actively participate in establishing community garden which can, to a certain extent, alleviate hunger.

- **Provincial level**

  The results of this study should be disseminated to all health facilities in the Ekurhuleni district, as well as other districts in Gauteng Province, so that the overall prevalence of food insecurity in DM can be assessed at district and even provincial level.

- **National level**

The recommendations identified above pertain, such as increasing awareness of food insecurity in the diabetic population, improving their income, and identifying different support systems able to relieve food insecurity in diabetic population. In order to address our diabetic patients' income issues in the South African context, the following policy development must be considered:

- The mean age of our participants was 58 years, which is still within the labour force group. South Africa as a country, together with its political leaders and policy- and decision-makers, should create an environment conducive to economic growth. This will stimulate job creation and allow diabetic patients to actively participate in the economy. Job creation as a result of economic growth will alleviate poverty and improve food security, consequently improving glycaemic control and decreasing DM-related complications and mortality.
- Considering that diabetic patients are immuno-compromised, they might need to take more sick leave than healthy workers or may even exhaust their sick leave days as laid down by the South African labour laws. They might also take longer to recover from their illness. All the above works against them in the labour market. They can easily lose their job, or even remain unemployed. South African policymakers must find ways of keeping this vulnerable population employed, despite their condition.

Upon reflection since the completion of this research, the author finds he no longer sees uncontrolled diabetes simply as a non-adherence problem. He now actively screens patients for food insecurity and refers them for assistance.

7. APPENDICES

Appendix A: Study questionnaire

Part I: Socio-demographic characteristics

1.	How old are you (in years)?		
2.	Sex (Indicate with a 'X')	Male	
		Female	
3.	a. What is your marital status? (Indicate with a 'X')	Never married, or single	
		Currently married	
		Co-habiting	
		Separated	
		Divorced	
		Widowed	
	b. Who lives with you?	Living alone	
		With family members	
		With friends	
4.	Were you born in South Africa?	Yes	
		No	
5.	How long have you been living in the Ekurhuleni district? Please state the number of years.	Years	

6.	What type of work do you currently do?		
7.	If you get any grant(s), please mark with an X on the type of grant you receive. You can mark more than one if it applies.	Old age grant	
		Disability grant	
		Child grant	
		Caregiver grant	
		Foster care grant	
		Other(specify)	
8.	Tick every item in the list that you have at home:	Cell phone	
		Fridge	
		TV	
		Electrical stove	
		Gas stove	
		Washing machine	
9.	How many people of the following ages live with you in the house?	Children (up to 13 years)	
		Children (>13-18 years)	
		Adults	

Part II. Household Food Insecurity Access Scale (HFIAS) Measurement Tool

No.	Question	Response Options	Code

1.	In the past four weeks, did you worry that your household would not have enough food?	0 = No (skip to Q2) 1=Yes	….|___|

1.a	How often did this happen?	1 = Rarely (once or twice in the past four weeks) 2 = Sometimes (three to ten times in the past four weeks) 3 = Often (more than ten times in the past four weeks)	….|___|
2.	In the past four weeks, were you or any household members not able to eat the kinds of foods you preferred because of a lack of resources?	0 = No (skip to Q3) 1=Yes	….|___|
2.a	How often did this happen?	1 = Rarely (once or twice in the past four weeks) 2 = Sometimes (three to ten times in the past four weeks) 3 = Often (more than ten times in the past four weeks)	….|___|
3.	In the past four weeks, did you or any household member have to eat a limited variety of foods due to a lack of resources?	0 = No (skip to Q4) 1 = Yes	….|___|
3.a	How often did this happen?	1 = Rarely (once or twice in the past four weeks) 2 = Sometimes (three to ten times in the past four weeks) 3 = Often (more than ten times in the past four weeks)	….|___|

4.	In the past four weeks, did you or any household member have to eat some foods that you really did not want to eat	0 = No (skip to Q5) 1 = Yes	….|___|

	because of a lack of resources to obtain other types of food?		
4.a	How often did this happen?	1 = Rarely (once or twice in the past four weeks) 2 = Sometimes (three to ten times in the past four weeks) 3 = Often (more than ten times in the past four weeks)	….|___|
5.	In the past four weeks, did you or any household member have to eat a smaller meal than you felt you needed because there was not enough food?	0 = No (skip to Q6) 1 = Yes	….|___|
5.a	How often did this happen?	1 = Rarely (once or twice in the past four weeks) 2 = Sometimes (three to ten times in the past four weeks) 3 = Often (more than ten times in the past four weeks)	….|___|

6.	In the past four weeks, did you or any other household member have to eat fewer meals in a day because there was not enough food?	0 = No (skip to Q7) 1 = Yes	….|___|

6.a	How often did this happen?	1 = Rarely (once or twice in the past four weeks) 2 = Sometimes (three to ten times in the past four weeks) 3 = Often (more than ten times in the past four weeks)	….|___|
7.	In the past four weeks, was there ever no food of any kind to eat in your household	0 = No (skip to Q8) 1 = Yes	….|___|
	because of a lack of resources to buy food?		
7.a	How often did this happen?	1 = Rarely (once or twice in the past four weeks) 2 = Sometimes (three to ten times in the past four weeks) 3 = Often (more than ten times in the past four weeks)	….|___|
8.	In the past four weeks, did you or any household member go to bed hungry at night because there was not enough food?	0 = No (skip to Q9) 1 = Yes	….|___|
8.a	How often did this happen?	1 = Rarely (once or twice in the past four weeks) 2 = Sometimes (three to ten times in the past four weeks) 3 = Often (more than ten times in the past four weeks)	….|___|
9.	In the past four weeks, did you or any household member go a whole day and night without eating anything because there was not enough food?	0 = No (questionnaire is finished) 1 = Yes	….|___|

9.a	How often did this happen?	1 = Rarely (once or twice in the past four weeks) 2 = Sometimes (three to ten times in the past four weeks) 3 = Often (more than ten times in the past four weeks)	….|___|

Appendix B: Data analysis summary

Objectives	**Variables**	**Analysis**
1. To determine sociodemographic characteristics.	**Age**	Mean age
	Gender • Male • Female	• The proportion of males • The proportion of females
	Marital status • Married • Never married (single) • Others	• The proportion of married participants • The proportion of single participants • Others
	Immigration status • Recent <5years • Long standing >5years • South African citizen	• Proportion of immigrants • Proportion of South Africans
	Size of household	Number of people living with the participants

2. To assess the proportion of food insecurity in diabetic patients.	Scoring of food insecurity ranges: 0-27. • Food insecure (score≤9) • Food secure (score≥10)	Proportion of food insecure patients among all the participants
3. To determine glycaemic control based on HbA1c.	**HbA1c** **Controlled** (HbA1c≤ 7mmol/l for patients below 65 years, and	The proportion of controlled and uncontrolled participants
	< 8 mmol/l 65 years and above) **Uncontrolled** HbA1c>7 for patients below 65years, and >8 for patients above 65 years	

<table>
<tr>
<td>4. To determine the relationship between food insecurity, glycaemic control and sociodemographic factors.</td>
<td>Example: 2x2 contingency table of food insecurity vs glycaemic control:
<table>
<tr><th></th><th>HbA1C≤7 or 8</th><th>HbA1C>7or 8</th></tr>
<tr><td>Insecure (score≤9)</td><td></td><td></td></tr>
<tr><td>Secure (score>9)</td><td></td><td></td></tr>
</table>
Similarly, associations will be drawn for socio-demographic variables: age, gender, marital status, immigration status and food insecurity.</td>
<td>Fisher Exact test.</td>
</tr>
</table>

Appendix C: Participants Information Sheet

Dear Sir/Madam

Good day! I am Dr Nsimbo, a third-year registrar in the Department of Family Medicine at the University of the Witwatersrand. I am doing research and inviting you to volunteer as a participant for this research study.

The aim of the study is to determine how many diabetic patients attending J Dumani CHC have food shortage. This will be done using the medical records with all your personal details. Questions will also be asked to you directly in the consulting room. Your participation in this study is entirely voluntary and you are free to decline to join or withdraw your consent at any time, without consequences. If you agree, the steps below will be followed:

- I will ensure that you fit the inclusion criteria of the study, and then will collect all the necessary information for the study (e.g.: age, gender, level of education, marital status ...)
- Confidentiality will be protected when collecting necessary information by giving you a PIN. The latter will be known only to the researcher and the supervisor of the study.
- The results of the study will be published without mentioning your name. Possible recommendations of the study will be reported to the staff working at J Dumani CHC and the Ekurhuleni district authorities in order to improve the care of diabetic patients attending this clinic.

If you need any further information regarding this study, you are welcome to contact us any time on (011) 863-7791. Finally, I would also like to inform you that as a research participant, you must to know your rights. Should you have any complaints regarding this research study, you are welcome to contact the Chairperson of the University of the Witwatersrand, Human Research Ethics Committee, which is an independent committee established to help and protect the rights of research participants. (011)717-2230/1.

Thank you.

Yours sincerely

Appendix D: Consent Form

JABULANI DUMANI CHC

Consent form: Use of clinical information

This document must be explained to the patient/family member/guardian by a member of the clinical staff, and a copy of the signed document is to be given to the patient.

Dear Sir/Madam

You are currently attending J Dumani CHC for the treatment of diabetes. This clinic not only renders treatment but is also actively involved in conducting research aimed at improving the quality of care we deliver. From time to time, such research involves the use of patient information for research purposes. The use of such information is subject to:

1. Approval from the Committee for Research on Human Subjects (University of the Witwatersrand).
2. Approval from the District Research Committee.
3. Anonymity, i.e. the identity of the patient from whose file information is extracted is never revealed to
4. Anyone but the researcher unless specific consent is obtained to do so.

The researcher would like to obtain your consent to use information that you will provide by answering questions for the purpose of this project, “Food insecurity among diabetic patients attending J. Dumani CHC”, subject to the aforementioned conditions.

Human Research Ethics Committee (HREC) protocol approval number M160202 I hereby confirm that

I have been informed about the above research.

I have understood the nature, the benefits and risks related to this research as explained to me by the study doctor, and as stated in the above information.

I am aware that the results of this research, including personal details regarding my age, sex and medical condition, will be dealt with in this research in an anonymous way.

If required, I agree that the data collected during this study can be processed in a computerised system by the study doctor.

All my concerns and questions have been fully addressed by the study doctor; I offer my consent to participate in this study.

If I choose not to give consent, this will not compromise my treatment in any way. I can choose to withdraw the consent at any time, and am free to do so, and will not be prejudiced in any way.

APPENDIX E: Consent form to answer the questionnaire

I----------hereby give/do not give consent for my information to be used as per the abovementioned conditions for the purposes of the research.

Patient---------- Witness---------- Date----------

---------- Date:----------

Should you wish to contact the researcher at any stage regarding this consent, contact J Dumani CHC at (011) 863-7797.

Appendix F: Data collection sheet

Date	PIN	Height(m^2)	Weight(Kg)	BMI	BP	HbA1c

Appendix G: Ekurhuleni clearance certificate

Ekurhuleni
METROPOLITAN MUNICIPALITY

GAUTENG PROVINCIAL GOVERNMENT

EKURHULENI RESEARCH CLEARANCE CERTIFICATE

Research Project Title: Food insecurity and its relationship to glycemic control in diabetic p atients attending Jabulani Dumani Community Health Centre.

Research Project Number: 10/12/2015-1

Name of Researcher(s): Dr KBA Nsimbo

Division/Institution/Company: DoH – Jabulani Dumani Community Health Centre

DECISION TAKEN BY THE EKURHULENI HEALTH DISTRICT RESEARCH COMMITTEE (EHDRC)

- *THIS DOCUMENT CERTIFIES THAT THE ABOVE RESEARCH PROJECT HAS BEEN FULLY APPROVED BY THE EHDRC. THE RESEARCHER(S) MAY THEREFORE COMMENCE WITH THE INTENDED RESEARCH PROJECT.*
- *NOTE THAT THE RESEARCHER WILL BE EXPECTED TO PRESENT THE RESEARCH FINDINGS OF THE PROPOSED RESEARCH PROJECT AT THE ANNUAL EKURHULENI RESEARCH CONFERENCE.*
- *THE RESEARCH COMMITTEE WISHES THE RESEARCHER(S) THE BEST OF SUCCESS.*

DR. J. SEPUYA

DEPUTY CHAIRPERSON: EKURHULENI METROPOLITAN MUNICIPALITY
Dated:

Dr. Molleman

CHAIRPERSON: GAUTENG DEPARTMENT OF HEALTH (EKURHULENI REGION)
Dated: 10/12/2015.

Appendix H: Witwatersrand University Clearance Certificate

R14/49 Dr Kayumba Bin Assumani Nsimbo

HUMAN RESEARCH ETHICS COMMITTEE (MEDICAL)

CLEARANCE CERTIFICATE NO. M160202

NAME: (Principal Investigator)	Dr Kayumba Bin Assumani Nsimbo
DEPARTMENT:	Family Medicine Jabulani Dumani Community Health centre
PROJECT TITLE:	Food Insecurity and its Relationship to Glycaemic Control in Diabetic Patients Attenting Jabulani Dumani Community Health Centre
DATE CONSIDERED:	26/02/2016
DECISION:	Approved unconditionally
CONDITIONS:	
SUPERVISOR:	Dr Neetla Erumeda
APPROVED BY:	Professor P. Cleaton-Jones,Chairperson, HREC (Medical)
DATE OF APPROVAL:	08/04/2016

This clearance certificate is valid for 5 years from date of approval. Extension may be applied for.

DECLARATION OF INVESTIGATORS

To be completed in duplicate and **ONE COPY** returned to the Research Office Secretary in Room 10004,10th floor, Senate House/2nd floor, Phillip Tobias Building, Parktown, University of the Witwatersrand. I/We fully understand the the conditions under which I am/we are authorised to carry out the above-mentioned research and I/we undertake to ensure compliance with these conditions. Should any departure be contemplated,from the research protocol as approved, I/we undertake to resubmit to the Committee. **I agree to submit a yearly progress report**. The date for annual re-certification will be one year after the date of convened meeting where the study was initially reviewed. in this case, the study was initially review in February and will therefore be due in the month of February each year.

Principal Investigator Signature Date

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