Dietary salt intake, dietary practices and hypertensive status among pregnant women in Thulamela municipality

by

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Full dissertation submitted in fulfilment of the requirement for the degree:

Master of Science in Public Nutrition (MScPNUT)

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March, 2022

DECLARATION

***I, TSHIFHIWA ELPHAS MUNYAI (*11601680)**, hereby declare that the dissertation for the Master of Science in Public Nutrition, at the University of Venda, hereby submitted by me, has not previously been submitted for a degree at this or any other University, and that it is my own work in design and execution, and that all reference material contained therein has been duly acknowledged.

Signature  **Date signed** 24 March 2022

DEDICATION

This study is dedicated to Jesus Christ for being the light throughout this work. I also dedicate it to my family members, namely: my mother, Madzida Matodzi Meltha, my late grandmother, Nemalale Muofhe and my siblings, Khathutshelo and Maria Munyai, for being supportive during my studies; you are simply the best. Love you all, may the grace of God be with you all the days of your life.

ACKNOWLEDGEMENTS

I would like to express my sincere appreciation to the following individuals and institutions that played an important role in the success of this dissertation:

- My supervisors, Dr L.F Mushaphi, Ms H.V Mbhatsani and Dr A. De Villiers for the guidance, openness, strength that they showed and their valuable input throughout the entire period of this project.
- Financial assistance for the research project was made possible by the following establishments:
    1. South African Medical Research Council (SAMRC), special thanks to the Research Capacity Development Initiative (RCDI),
    2. University of Venda Research Publication Committee (RPC),
    3. The National Research Foundation (NRF) and,
    4. Health and Welfare Sector Education and Training Authority (HWSETA),
- The Provincial Department of Health (DoH, Limpopo Province), Clinic and Health center managers in Vhembe District for granting permission to conduct the study.
- All participants (pregnant women) who formed part of this study; it would not have been possible without their contributions.
- All lecturers from the School of Health Sciences for their inputs during proposal presentation, especially, to the Department of Nutrition.
- Laubscher Ria (SAMRC Cape Town) for statistical analysis.
- Joelaine Chetty (SAMRC Cape Town) for assistance in using Food Finder 3 (version 1.1.3) computer software.
- Prof ML Netshikweta for her guidance, support and provision of work station during literature search.
- Dr P Kaburise for proof reading/editing this document.
- To my mother and my late grandmother, thank you for your love, financial support, prayers and for patience throughout the years.
- My siblings, for always believing in me and for having provided the necessary support during my studies.
- Nemalale Khathutshelo for assistance in dietary data entering.
- My friend Monyayi Ndivhuho Shadrack for encouragement and believing in me.

ABSTRACT

Salt intake in South Africa is beyond the 4 to 6g/day as recommended by the World Health Organization (WHO); no doubt, this is due to a high-salt diet. It is well known that high-salt diets are related to hypertension, which is the most prevalent maternal complication worldwide, and is associated with significant morbidity and mortality of the mother and foetus. Pre-eclampsia and eclampsia are the two hypertensive disorders of pregnancy; these are considered as the main causes of maternal and perinatal morbidity and mortality. High maternal deaths have been recorded in South Africa where eclampsia was the direct cause. The aim of this study was to describe dietary salt intake, dietary practices and hypertensive status among pregnant women in Thulamela Municipality (Limpopo Province).

The study adopted a quantitative cross-sectional survey design where three local areas were purposively selected. Two clinics from each local area were randomly selected to give a total of three Community Health Centres (CHC) and six clinics. Pregnant women were selected by means of convenience sampling. The sample size was calculated using Slovin's formula which resulted in a total number of 379 pregnant women. Data obtained were captured using Microsoft Excel 2016 and exported to the IBM Statistical Package for Social Sciences (SPSS) version 26 for analysis. The dietary intake was analysed using Medical Research Council of South Africa (SAMRC) Food Finder 3 (version 1.1.3) computer software. Logistic regression was used to identify factors associated with high Blood Pressure risk.

Most of the participants (62.0%) were single and had passed Grade 12; majority of participants (88.1%) were unemployed and depended on parents/parents-in-law and social grant. At the time of the study, 38.3% of participants' gestational age was 31 to 38 weeks. Analyses of the macronutrient intake by the pregnant women indicated that the mean energy intake was 5304.4±2217.5KJ per day and the mean protein intake was 35.1±16.8g per day. Majority of participants (81.0%) had received nutrition education and they usually ate three meals or more per day. Most participants (71%) indicated that they bought salt from supermarkets and added salt when cooking.

Almost all the pregnant women (99.7%) were below the EAR reference values for iron while 15.0% of pregnant women were within the Estimated Average Requirement (EAR) reference value for folate intake. The study revealed that the mean diastolic pressure was 73.56±9.5mmHg and systolic pressure was 113±11.2mmHg. The majority of these pregnant women were at low risk of developing high BP. High BP risk was not associated with marital

status, however, there was a significant association with the educational level. Gestational age was significantly associated ($p<0.05$) with having a HBP risk, with those 38+ weeks having the highest risk.

The study concluded that pregnant women were not meeting their daily nutrient intake, hence, there is a need to advocate for improved nutrient intake. There is also a need for other research projects to be conducted on dietary salt intake and dietary practices of pregnant women in the Thulamela Municipality.

Keywords: Salt intake, dietary practices, hypertension, pregnant women and hypertensive status

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LIST OF ACRONYMS AND ABBREVIATION

ACOG	: American College of Obstetricians and Gynecologists
AI	: Adequate Intake
ANC	: Ante-natal Care services
BMI	: Body Mass Index
BP	: Blood Pressure
Cl	: Chloride
CM	: Centimetre
CVD	: Cardiovascular Diseases
DBP	: Diastolic Blood Pressure
DHA	: Docosahexaenoic Acid
DNA	: Deoxyribonucleic Acid
DoH	: Department of Health
DRI	: Dietary Reference Intakes
EAR	: Estimated Average Requirement
EDHS	: Ethiopian Democratic and Health Survey
EER	: Estimated Energy Requirements
EU	: European Union
FBDG	: Food Based Dietary Guidelines
Fe	: Iron
FFF	: Folate Food Fortification
FFQ	: Food Frequency Questionnaire
FSAI	: Food Safety Authority of Ireland
GDM	: Gestational Diabetes Mellitus
GHTN	: Gestational Hypertension
HDP	: Hypertensive Disorders of Pregnancy
HELLP	: Haemolysis Elevated Liver Enzymes Low Platelets
HIC	: High Income Countries
HIV/AIDS	: Human Immunodeficiency Virus/ Acquired Immune Deficiency
HSD	: High-salt diets
ID	: Iodine Deficiency
IDA	: Iron Deficiency Anaemia
IDP	: Integrated Development Plan
IMMR	: Institutional Maternal Mortality Ratio
IOM	: Institute of Medicine

IQ	: intelligence Quotient
ISSHP	: International Society for the Study of Hypertension in Pregnancy
IU	: International Units
IUGR	: Intra-Uterine Growth Retardation
LBW	: Low Birth Weight
LMIC	: Low and Middle-Income Countries
MDG	: Millennium Development Goal
MMR	: Maternal Mortality Ratio
Na	: Sodium
NIHCE	: National Institute for Health and Clinical Excellence
NHBPEP	: National High Blood Pressure Education Program
NHMRC	: National Health Medical Research Council
NICU	: Neonatal Intensive Care Unit
NNM	: Neonatal Mortality
NVP	: Nause and vomiting pregnancy
NTD	: Neural Tube Defects
PIH	: Pregnancy-Induced Hypertension
PTH	: Parathyroid Hormone
PNMR	: Perinatal Mortality Rate
RDA	: Recommended Dietary Allowance
RDI	: Recommended Daily Intake
SA	: South Africa
SAHS	: South African Hypertension Society
SBP	: Systolic Blood Pressure
SD	: Standard Deviation
SDG	: Sustainable Development Goal
SGA	: Small-for-gestational-age
SMR	: Saving Mothers Report
SSA	: sub-Saharan Africa
UK	: United Kingdom
VLBW	: Very Low Birth Weight
WHA	: World Health Assembly
WHO	: World Health Organization

CHAPTER ONE

INTRODUCTION

1.1. Background and motivation of the study

Evidence demonstrates that salt intake levels worldwide exceed the salt intake recommendations from the World Health Organization (WHO). The average salt intake worldwide is estimated to be approximately 9.87 (5.45–13.77) g per day (Mozaffarian *et al.,* 2014). The average salt intake in the United States (US) is approximately 9 g per day, and less than 5 % of the US population consumes less than 3.75 g per day (Fulgon *et al.,* 2014). In Japan, the estimated salt intake has remained at approximately 10–15 g per day for decades (Mozaffarian *et al.,* 2014). Germany, Cyprus, Bulgaria and Latvia reported the lowest salt intake (6.3–7.3 g/day), whereas the Czech Republic, Slovenia, Hungary and Portugal reported the highest salt intake (12.3–13.6 g/day) (WHO, 2007). Powles *et al.* (2013) also reported notably different salt intake levels with the lowest intake values observed in Denmark, Netherlands and Belgium (8.3–8.8 g/day) and the highest in Hungary, Slovenia, Slovakia, Portugal and Italy (10.7–11.2 g/day).

According to Brown *et al.* (2009) and Oyebode *et al.* (2016), populations in sub-Saharan Africa (SSA) consume an average of more than the recommended sodium intake of 2 g/day with levels in South Africa (SA) being 2-3 times more than the recommended daily allowance (RDA) of 5 g (Mash, Fairall & Adejayan, 2012; Wentzel-Viljoen, Laubscher & Steyn, 2013). The WHO, however, continues to recommend restriction of sodium intake to <2 g/d (<5 g/d salt) in the general population, as compared to the usual dietary intake of 3.5 g/d (9 g/d salt) worldwide (McCarron, Kazaks & Geerling, 2013).

Salt is added to foods for a variety of reasons, including preservation, flavouring, microbial safety and other technological purposes (Australian Department of Health and Ageing, National Health and Medical Research Council, & New Zealand Ministry of Health, 2006). Some of the salt consumed comes from the salt used when cooking, and some from the salt added at the table. About 75% of the recommended salt intake have already been added to the ready-made food people buy. Most of this comes from the salt added to everyday foods, like processed meat products, snacks such as crisps and biscuits, ready meals, soup, pasta sauces, bread and some breakfast cereals (British Dietetic Association, 2016).

In most African countries, salt is commonly added to food at the table and during cooking, and is a major ingredient found in commonly used sauces and seasonings (WHO, 2007). Up to 46% of the salt consumed is added during preparation of food or at the table, thus, much of the salt consumed is found in processed foods since they account for 54% of the dietary salt, which on the average is produced by the food industries in SA. Bread and the cereal groups were found to be the major contributor to total sodium intake from processed food (Charlton *et al.,* 2005). Other sources of salt in SA include meat and meat products, milk and dairy products, processed meats, meat pies and margarine (Webster *et al.,* 2011).

Sodium in the form of salt is used in a variety of foods to improve flavour and increase palatability (Dötsch *et al.,* 2009). In addition to taste, sodium has two other important functions - processing and preservation. The oldest use of sodium (in the form of salt) is as a preservative, since, when salt is added to a product, it lowers water activity and prevents microbial growth (Kilcast & Angus, 2007). It also has a specific processing function for different food categories. In most bakery products, gluten development and fermentation is regulated by salt and in meat products, the water-binding capacity of proteins is enhanced by salt (Desmond, 2006; Taormina, 2010). Another technological property of salt is that, it influences the activity of micro-organisms and enzymes needed for cheese maturation (Kilcast & Angus, 2007); maintaining microbiological stability and structure, therefore, are essential aspects of salt that need to be taken into account. There are, however, multiple strategies that industry can follow to reduce the sodium content without compromising its above-mentioned properties. These include, adaptation (reducing sodium gradually), flavours (multisensory principles), salt substitutes (use of mineral salts) and salt boosters (Dötsch *et al.,* 2009).

In the field of hypertension research, a salt intake of 6 g per day has long been recommended for hypertensive patients, regardless of the presence of or absence of diabetes or chronic kidney diseases (Raymond *et al.,* 2015). Evidence shows that excess salt intake is a risk factor for the development of hypertension (Piecha *et al.,* 2012; Koleganova *et al.,* 2011). Furthermore, it has been proven that cardiovascular diseases (CVDs) are often an outcome of hypertension, which in turn is the major cause of mortality worldwide (Ezzati, 2002). Many studies have established long-term cardiovascular risk in women with a history of pre-eclampsia and those with gestational hypertension (Martillotti *et al.,* 2013; Steegers *et al.,* 2010). Most morbidity is concentrated among pregnancies complicated by pre-eclampsia/ eclampsia, which is the leading or second-leading cause of maternal death in the United Kingdom (UK), Canada and the developing world (Health Canada, 2004; Khan *et al.,* 2006).

In Asia and Africa, nearly one tenth of all maternal deaths are associated with hypertensive disorders during pregnancy (Khan *et al.,* 2014), Hypertensive Disorders of Pregnancy (HDP) account for ~15% of all maternal deaths in SA (South African National Department of Health, 2017). A study conducted in rural KwaZulu-Natal (KZN) reported 58 cases (out of 60 pregnant women) of eclampsia with complete data during the 6-month study period (Makhanya, Moodley & Govender, 2016).

Evidence shows that pre-eclampsia and eclampsia are hypertensive disorders that pose very serious health risks for the pregnant woman and the fetus (Say *et al.,* 2014). A high maternal mortality ratio of 500 per 100,000 live births of pre-eclampsia and eclampsia was noted in sub-Saharan Africa (SSA). Pre-eclampsia and eclampsia are the third leading causes of death in Zimbabwe (Boene *et al.,* 2016). These diseases affect between 3% and 5% of all pregnancies and account for more than 60,000 maternal and 500,000 fetal deaths per year worldwide (Kuklina, Ayala & Callaghan, 2009). According to a population-based study in SA, the prevalence of HDP was 12%; hospital-based studies show that HDP was the commonest cause of maternal death at 20.7% in South Africa (Moodley, 2004). Hypertensive disorders of pregnancy remain a life-threatening common and serious disease which represents the third most common cause of maternal mortality worldwide (Randriambololona *et al.,* 2009).

Sustainable Development Goal (SDG) number three states that “Ensure healthy lives and promote well-being for all at all ages” (Sachs, 2012). This SDG focuses primarily on the needs of developing countries; it promotes adequate access to health care, healthier lifestyles, thereby reducing major causes of ill health and inequitable access to health services. The SA Minister of Finance (Pravin Gordhan) in his 2010 medium-term budget policy statement, described South Africa’s maternal mortality as “high and rising”, having increased from 369 in 2001 to 625 in 2007 (National Treasury, 2010).

Ascendancy of maternal mortality to Human Immunodeficiency Virus (HIV) prevalence, as described also in the report shows complications that are arising from hypertension and shortfalls in obstetric services (National Treasury, 2010). Most of the maternal, perinatal mortality and morbidity in developing countries are caused by hypertension. These include - preterm birth, intrauterine growth restriction, placental abruption, eclampsia and haemolysis elevated liver enzymes low platelets (HELLP) syndrome (Naidu, Moodley & Adhikari, 2001). South Africa has experienced this situation from the 1990s; hypertensive deaths have constituted the second most important cause of maternal death, contributing to 20.7% of all deaths (Moodley, 2004).

Pregnancy is a very critical and demanding stage of life, for both the mother and the fetus (Goldberg, 2002). According to Ruchi, Suman and Sulekha (2006), a well-balanced diet is not only essential for the mother's health but also for the normal growth of the fetus and prevention of diseases which may arise during pregnancy. This is because the need for energy and nutrients increases during pregnancy, although both excessive and inadequate consumption of foods can cause health problems (Lucyk & Furomoto, 2008). In this regard, it is necessary to know what to eat in the different trimesters of pregnancy to allow pregnant women to modify food intake to prevent disorders that might be caused by inappropriate dietary intake. Two longitudinal studies have reported that global dietary patterns remain relatively stable from pre-pregnancy and throughout pregnancy (Crozier *et al.,* 2009; Pinto, Barros & dos Santos, 2009). However, women are known to increase their intake of fruits from pre-pregnancy to the first half of pregnancy, whereas reports in changes in vegetable consumption are mixed during the stages indicated above (Chen *et al.,* 2014).

Duckitt and Harrington (2005) report that the salt requirement during pregnancy is the same as for non-pregnancy, however, it was indicated that pregnant women should manage their salt intake, to avoid high Bp that can affect the baby's blood pressure. Changes in dietary salt intake present a major challenge to the kidneys which have to excrete a large amount of salt; hence, a high salt intake leads to a rise in blood pressure (Meneton *et al.,* 2005) thereby increasing the risk of CVDs (Swift *et al.,* 2005).

The incidence of dietary inadequacies is higher during pregnancy when compared to any other stage of the life cycle. Many women in developing countries restrict their food intake during pregnancy for different reasons, such as to have smaller infants as they carry a lower risk of delivery complications, and for cultural reasons (Kuche, Singh & Moges, 2015; Daba *et al.,* 2013).

Brown *et al.,* (2009) found that dietary habits of a population are the primary contributors to dietary sodium consumption. Baseline information gathered on salt perceptions and dietary behaviors indicated that 18% of participants used more salt in food preparation than is recommended in the recipe, while 77% added salt to food at the table. Even in this context, the majority (90%) did not consider themselves to be high-salt users (Malherbe, Walsh & Van der Merwe, 2010).

1.2. Problem statement

It has been documented that the average salt intake in SA adults (8.1g/day) is higher than the 4-6g/day recommended by the WHO (WHO, 2013a). Up to 46% of the salt consumed is added during food preparation or at the table; much of the salt consumed is found in processed foods produced by the food industry in SA (Charlton *et al.,* 2005). This contributes to an increasing burden of hypertension and cardiovascular diseases (He, Li & MacGregor, 2013). The WHO and World Health Assembly (WHA) targets reducing non-communicable diseases requires a 30% reduction in the world population's salt intake by 2025 (Charlton *et al.,* 2018).

South Africa was among the first countries to implement mandatory legislation in July 2016 for maximum salt levels permitted in a wide range of processed foods (Report number R214: Foodstuffs, cosmetics and disinfectants Act, 1972, 2013) that are significant contributors to the sodium intake of the population (Webster *et al.,* 2011; Trieu *et al.,* 2015). Bread was identified as the major contributor to salt intake in SA and this legislation was introduced to gradually decrease the sodium content of bread. The legislation has been predicted to decrease population-level salt intake by 0.85 g/day and reduce annual deaths from cardiovascular diseases by 11% (Bertram, Steyn & Wentzel-Viljoen, 2012).

It is well recognized that high-salt diets (HSDs) are associated with hypertension as well as renal illnesses in adults. There is a large body of research on the impacts of salt exposure in pregnancy (Digby *et al.,* 2010); hypertension is acknowledged as accounting for maternal complications, worldwide. It is known that pre-eclampsia and eclampsia are hypertensive disorders that involve the most significant health risks for a pregnant woman and her fetus (Kuklina, Ayala & Callaghan, 2009). The maternal mortality rate of approximately 300 per 100 000 lives, which has been published in SA, is high compared to industrialized countries (Dorrington, Moultrie & Timaeus, 2004).

Pre-eclampsia is characterized by new-onset hypertension and proteinuria at ≥20 weeks of gestation. In the absence of proteinuria, diagnosis requires the presence of hypertension together with evidence of systemic disease (Lindheimer *et al.,* 2009). This gestation-specific syndrome affects 3–5% of all pregnancies and is a leading cause of maternal and perinatal morbidity and mortality. Pre-eclampsia can progress to eclampsia, which is characterized by a new-onset of grand mal-appropriations; this affects 2.7–8.2 women per 10,000 deliveries (Hutcheon, Lisonkova & Joseph, 2011). Complications of pre-eclampsia or eclampsia include - cerebrovascular accidents, liver rupture, pulmonary oedema or acute renal failure that can

result in maternal death (Thornton *et al.,* 2013). Eclampsia is a direct cause of maternal death in SA, which is of concern because it is preventable when detected and managed early. HDP are the commonest medical complication in pregnancy and remain the commonest direct cause of maternal mortality in South Africa. The Saving Mothers Report (SMR) (2014) indicates that there were 149 maternal deaths from HDP during the period of the study.

Due to the limited number of published studies pertaining to dietary salt intake and dietary practices during pregnancy in Thulamela Municipality, the researcher undertook the study given the high consumption of salt nationally and the high hypertension prevalence among pregnant women, to close the gap in information, in this area of concern.

1.4. Research question

What is the dietary salt intake, dietary practices and hypertensive status among pregnant women in Thulamela Municipality?

1.5. Aim of the study

The aim of the study was to describe dietary salt intake, dietary practices and hypertensive status among pregnant women in Thulamela Municipality.

1.6. Objectives of the study

- To assess the dietary intake of pregnant women using a quantitative food frequency questionnaire (FFQ).
- To investigate the dietary practices of pregnant women.
- To assess the Bp of pregnant women using an automated BP monitor.
- To determine the association between dietary salt intake and BP.

1.7. Significance of the study

The study may provide baseline information regarding dietary salt intake, dietary practices and hypertensive status among pregnant women in the selected geographical area. Little data exists about these aspects and the study may contribute to the body of nutrition knowledge on existing maternal health in the Thulamela Municipality. The study may, furthermore,

investigate a possible association between dietary salt intake and Bp of pregnant women in the area, leading the way for more rigorous studies.

The study may, hence, contribute nutrition information to policymakers, researchers, healthcare workers, civil society organizations, as well as communities and families who need to be aware of the nature of the problem so as to advocate for more action towards improving dietary salt intake and practices of pregnant women. Such nutrition information may be used to initiate further studies in Thulamela Municipality.

1.8. Definitions of terms

Dietary practices - observable dietary actions, behaviour or habits which can be classified as either good or poor (Daba *et al.,* 2013). In this study, practices refer to an actual application or use of salt by pregnant women at the stage of gestation.

Dietary salt intake - refers to the daily eating patterns of an individual, including specific foods and calories consumed and relative quantities (Aburto *et al.,* 2013). In this study, dietary intake refers to daily consumption patterns of pregnant women towards specific foods and calories consumed and relative quantities.

Hypertension - a systolic BP ≥140 mmHg or a diastolic BP ≥90 mmHg. An elevation of a systolic BP >30mmHg and diastolic >15 mmHg, no longer suffices but rather warrants close monitoring (Lowe *et al.,* 2009). In this study, hypertension refers to a systolic BP ≥140 mmHg and a diastolic BP ≥90 mmHg.

Hypertensive disorders in pregnancy (HDP) - these are disorders associated with severe maternal obstetric complications and are a leading contributor to maternal mortality. HDP are the most common direct cause of maternal mortality and account for 18% of all maternal deaths in SA (Moodley, 2018; South African National Department of Health, 2017). In this study, hypertensive disorders refer to severe maternal obstetric complications which are leading contributors to maternal mortality.

Pre-eclampsia - Pre-eclampsia is a multisystemic disease characterized by the development of hypertension after 20 weeks of gestation in a previously normotensive woman, with the presence of proteinuria or, in its absence, signs or symptoms indicative of target organ injury

(Moussa, Arian & Sibai, 2014). In this study, pre-eclampsia refers to hypertension just after 20 weeks of gestation.

Eclampsia - represents the consequence of brain injuries caused by pre-eclampsia. It is defined as pre-eclampsia with the abrupt development of seizures or coma during the gestational period or post-partum; these are non-attributable to other neurologic diseases that can justify the convulsive state (namely, epilepsy or cerebral stroke) (Moussa, Arian & Sibai, 2014). In this study, eclampsia refers to the onset signs of pre-eclampsia during pregnancy, labour or within 7 days of delivery.

1.9. Structure of the dissertation

The dissertation consists of six chapters with referencing which follows the Harvard style. Below is the structure of the dissertation:

Chapter 1: Introduction

This chapter introduced the title of the study including and its background details showing the intention of describing dietary salt intake, dietary practices and hypertensive status among pregnant women in Thulamela Municipality. The research aim, objectives and questions, are also presented in this chapter.

Chapter 2: Literature review

The chapter presents an overview of the literature on consumption of salt, acknowledged globally, as one of the leading factors in the development of hypertension. Themes covered include nutritional practices of pregnant women, dietary intake of pregnant women, and hypertension during pregnancy, nutritional status and lastly risk factors for hypertension in pregnant women.

Chapter 3: Methodology

This chapter describes the research methodology used in this study and includes the study approach and design, study population and sampling. Data collection techniques, analysis, validity and reliability are discussed. The discussions lastly focus on the ethical considerations and methods for the dissemination of results.

Chapter 4: Results

Data obtained from selected pregnant women in Thulamela Municipality are presented in this chapter. This includes participants' socio-demographic data, such as age and educational information; pregnancy information, such as number of children per household and the association between blood pressure and gestational age.

Chapter 5: Discussion of results

The results are discussed in the context of other local and international research findings. Themes discussed in this chapter include socio-demographic information, chronic diseases of lifestyles and the relationship between dietary salt intake and BP.

Chapter 6: Conclusion, recommendations and limitations

This chapter presents the conclusions, recommendations and limitations of the study. The chapter concludes by highlighting recommended dietary practices for pregnant women.

CHAPTER TWO

LITERATURE REVIEW

2.1. Overview

This chapter outlines existing literature concerning the research questions. Good dietary practices during pregnancy contribute to proper development of the baby, while unhealthy dietary practices, such as high salt intake may lead to undesirable health outcomes, such as hypertension. There are a lot of factors contributing to hypertension, however, the present study focused on salt consumption as a potential contributor to hypertension during pregnancy.

Salt plays an important role in helping to regulate and maintain body fluid (British Dietetic Association, 2016). It is used by all cells in the body to function properly; it is also needed to transmit messages between the brain and the rest of the body (British Dietetic Association, 2016). The body fluid levels change during pregnancy to support the development of the baby, however, a well-documented problem with high-salt intake is its association with blood pressure (National Health Service (NHS) UK, 2015). Salt affects the kidneys, causing the body to retain water. This extra fluid results in greater blood volume, which causes blood pressure to rise. A low salt diet during pregnancy can help to keep blood pressure within a healthy range, reducing the risks of stroke and heart problems, as well as other conditions (Action on Salt, 2017).

Beliefs and values regarding nutrition during pregnancy, advice from health professionals, and physical and physiological changes may possibly change eating behaviour. Szwajcer *et al.,* (2007) indicate that some of the channels from where women can receive nutritional information include, health professionals, peers and educational resources; this information may influence their dietary choices during pregnancy. Some women are aware of healthy eating during pregnancy, although, some lack knowledge of specific dietary recommendations (Reyes, Klotz & Herring, 2013).

In 2005, about 78% of households in SA bought salt for household uses from typical food stores, however, some of households (8%–37%), in all provinces of South Africa, use unconventional channels including agricultural and other sources to obtain salt (Jooste & Zimmermann, 2008; Symington *et al.,* 2015). Salt works as an iodine carrier and adequate

iodine nutrition is essential during pregnancy for foetal-maternal production of thyroid hormones required for optimal foetal neurodevelopment. The consequences of severe iodine deficiency (ID) include spontaneous abortion, stillbirth, congenital abnormalities and endemic cretinism (Hynes *et al.,* 2017). Increasing evidence suggests that even transient, mild gestational ID has subtle negative impacts on the infant, including reductions in intelligence Quotient (IQ), poor educational outcomes and language skills (Markhus *et al.,* 2018; Abel *et al.,* 2018). Dietary iodine requirements increase during pregnancy, which is usually driven by increased thyroid synthetic demands, increased renal iodine clearance, and transfer of iodine and thyroxine, from the mother, to the foetus (Abel *et al.,* 2018).

Most countries have focused specifically on salt reduction to lower population-level blood pressure. The European Union (EU) launched a framework for National Salt Initiatives in 2008, aiming for a 16% salt reduction within four years, across all food categories, to achieve the WHO recommendations of an intake of less than 5 g/day of salt (< 2 g/day sodium) for adults (WHO Regional Office for Europe Mapping salt reduction initiatives in the WHO European Region, 2014). Most Western diets (which are high in processed foods) carry a lot of salt, whereas in other places, salt is added during food preparation (Brown *et al.,* 2009). Cost-effective strategies to reduce dietary salt intake may take a long period to be established and may differ between countries (Cobiac, Vos & Veerman, 2010). The current Minister of Health (Dr A Motsoaledi) has amended regulations on food commodities, cosmetics and disinfectants (Act no. 54 of 1972); this is with the intention of reducing sodium in certain foodstuffs and related matters [Amendment on Salt: sub-section 15(7)(b) of the Act]. The amendments reduced the sodium content of class 5 food items from 1300 mg to 600 mg Na, on 30 April 2020 (DoH, 2019).

Furthermore, the WHO and the World Health Assembly aim to decrease non-communicable diseases (NCDs) by reducing population salt intake by 2025 (Webster *et al.,* 2011; Trieu *et al.,* 2015). A meta-analysis of randomised salt-reduction trials suggests that a reduction of 6 g/day in salt intake would reduce stroke by 24% and coronary heart disease by 18% (He, Campbell & MacGregor, 2012). Currently, SA has legislated salt reduction of the main contributors to salt, in the country's diet (Hofman & Tollman, 2013). In July 2016, South Africa became the first country to implement mandatory legislation for maximum salt levels allowed in processed foods that are significant contributors to the sodium intake of the population. The legislation is predicted to decrease population-level salt intake by 0.85 g/day and reduce annual deaths from cardiovascular diseases by 11% (Charlton, Webster & Kowal, 2014).

Hormonal changes affect sodium metabolism and glomerular filtration, although, salt requirements remain the same during pregnancy (Erick, 2012). Salt is an essential mineral that plays an important role in heart health, and specifically in pre-eclampsia and eclampsia but the consumption needs to be monitored (Steffen, 2014; Rakova *et al.,* 2014). Excessive sodium intake during pregnancy can lead to eclampsia (Rakova *et al.,* 2014), while insufficient intake or excessive loss of sodium (as with Nause and vomiting pregnancy (NVP) or hyperemesis gravidarum) can lead to electrolyte imbalances and possible hospitalisation for rehydration and nutritional support (Matthews *et al.,* 2014; Erick, 2012).

2.2. Dietary practices of pregnant women

2.2.1. Dietary practices

Dietary practices play a significant role in determining the long-term health status of both the expectant mother and the growing foetus; it may also influence make the child to be more susceptible to hypertension, diabetes and heart disease in later life (Hauger *et al.,* 2008). Poor dietary practices of pregnant women have been reported to have led to increased rates of stillbirths, premature birth, low birth weight and maternal and prenatal deaths (Daba *et al.,* 2013). Nutrients the baby receives is derived from the foods consumed by the mother during pregnancy; adequate nutrition is important for both mother and foetus to prevent malnutrition (Castrogiovanni & Imbesi, 2017). Furthermore, Zheng (2011) indicated that inadequate nutrition during pregnancy leads to intra-uterine growth retardation (IUGR), contributing to low birth weight and stunting of babies of babies and increased risk of sicknesses due to common infections, such as diarrhoea, pneumonia, measles and malaria.

The occurrence of dietary inadequacies from habits and patterns in pregnancy is highly noticeable when compared to other stages of the life cycle. Deficiency or excess of nutrients can lead to permanent modifications of the body's hormonal and metabolic processes. Deficiencies combined with a variety of gene expressions, during the prenatal period may change metabolism and the development of physiological processes (Kumar *et al.,* 2013). Pregnant women in poor urban settlements in Delhi were reported to have poor dietary intake with the majority of them consuming less than 50% of the recommended dietary allowance (RDA); their nutrients intake was not different from their non-pregnant counterparts (Kumar *et al.,* 2013).

Multiple factors can impact dietary intake, including income, food availability and affordability, individual beliefs and preferences, cultural traditions, as well as educational, social, geographical, and environmental aspects (WHO, 2015). The socio-cultural context can exert considerable influence on a diet at different stages of life, in particular, during conception and pregnancy (Withers, Kharazmi & Lim, 2018).

Daba *et al.* (2013) discovered that many women in developing countries limit their food intake during pregnancy. There are different reasons provided; these include to have smaller infants because of a lower risk of delivery complications, cultural reasons and perceived severity of delivery complications with big babies (Kuche, Singh & Moges, 2015). Patterns of food consumption varies invariably between pregnant women residing in urban and rural areas (Caplan, 2001).

2.2.2. Food taboos

Food taboos among rural women have been identified as one of the leading causes of maternal undernutrition in pregnancy (Oni & Tukur, 2012). Pregnant and lactating women in various parts of the world are forced to abstain from nutritious foods which are rich in iron, carbohydrates, animal proteins and micronutrients (Mohamad & Yee Ling, 2016). It was found that pregnant women in various parts of the world are forced to abstain from nutritious foods as a part of their traditional food habits (Parmar, Khanpara & Kartha, 2013). Studies in the western parts of Nigeria reported that 75% of pregnant women had inadequate dietary energy intake; investigations from the Eastern part reported that 15% adhered to traditional beliefs or taboos about feeding practices during pregnancy (Maduforo, 2011).

In a study conducted in a rural area of West Bengal in India, majority of the pregnant women indicated that their mothers, mothers-in-law, other senior female family members and neighbours are the advisors on these taboos (Gamuchirai & Charlie, 2019). Reasons provided for not consuming taboo foods or avoiding some foods spanned from issues that may affect the mother during delivery as some were presumed to increase the size of the foetus, and dark colored fruits and vegetables which were assumed to cause dark complexion of the baby. Certain foods are believed to stimulate continuous menstruation, leading to infertility in women (Chakrabarti & Chakrabarti, 2019).

The most common-known taboo foods for pregnant women, who admitted to following food taboos, within the Kat River Valley (Eastern Cape) included - papaya, pineapples, nartjies,

orange fruit, juices, chicken, potatoes, fish and wild animals (Chakrabarti & Chakrabarti, 2019). Other foods like beans, eggs, watermelon, pumpkin and butternut were cited as taboo foods during pregnancy because they are known to cause miscarriage (Chakrabarti & Chakrabarti, 2019). The first 1000 days of a child's life are critical for optimal growth, health and development, therefore, intake of diverse and good quality food, and of adequate quantity is crucial (WHO, 2015). Food taboos have been acknowledged as one of the contributing factors to maternal undernutrition during pregnancy in SSA; this makes women more vulnerable to several micronutrient deficiencies. According to the UNICEF Food-Care Health Conceptual Framework, cultural norms, taboos and beliefs lie within the contextual factors included as one of the basic causes of malnutrition (Ekwochi *et al.,* 2016). This is because poor nutritional practices, especially during pregnancy and early childhood, can have marked consequences on children's growth and development, as it may result in poor school performance, reduced physical work capacity and decreased productivity later in life (Kariuki *et al.,* 2017; Ugwa, 2016).

2.2.3. Food cravings

Food cravings are very common during pregnancy, along with food aversions in many instances, yet their underlying causes are not well understood. Food cravings are usually satisfied with the consumption of the craved food, which generally include unhealthy foods such as sweet/fat and salty/spicy foods (Hormes & Rozin, 2010). Food cravings can also be formed by women's beliefs about what they should consume to ensure a healthy status for their baby. Women often eat certain foods believing that they are precautionary measures to satisfy nutritional needs of the unborn foetus (Orloff & Hormes, 2014). Cultural background and traditions can also greatly control behaviour during pregnancy (Zahhura, Nilan & Germov, 2012). Tradition tie into the availability of foods and preferences for food, and how daily life influences pregnancy and the chance of satisfying food cravings. Physiological and psychological changes that occur during pregnancy may also result in food cravings (Hainutdzinava, 2017).

The aetiology of food cravings is unknown, although it has been suggested that the physical and hormonal changes that occur during pregnancy may play a role in their development (Gunderson & Abrams, 2000). Evidence suggests that an increased requirement for energy or other nutrients may result in physiological changes in taste and olfactory sensitivity, which may trigger the consumption of specific foods, thus, altering the nutritional content of the diet. Changes in food intake resulting from cravings may modify a pregnant woman's diet by the

selection of specific foods to feed the craving, although, the consequences of such dietary changes have not been studied. It is well known that overconsumption of energy-dense foods may lead to excessive gestational weight gain, which is an established risk factor for future obesity in both mother and offspring (Mamun *et al.,* 2010).

It has been documented that those changes in food-related behaviours take place more often during pregnancy than at any other stage of life. Pica is a deliberate desire for substances that are largely non-nutritive, such as paper, clay, metal, chalk, soil, glass, or sand. Most of the respondents in a study conducted in the General Hospital in Kano, Northwest Nigeria did not practice pica (Ugwa, 2016), however, Al-Rmalli *et al.* (2010) observed that pica is prevalent among pregnant women across sub-Saharan African countries, such as Kenya, Ghana, Rwanda, Nigeria, Tanzania and South Africa.

2.3. Dietary intake of pregnant women

According to Kavle & Landry (2018) and Zeisel (2011), nutrition is an essential part of human life, health and development throughout the entire life span. Healthy food and good nutrition are vital for survival, physical growth, mental development, performance and productivity, health and wellbeing. Pregnant women are expected to eat a variety of foods in order to get adequate nutrients that are essential during pregnancy. The most important nutrients include, carbohydrates (energy), protein, fats, vitamin (folate), calcium, iron and iodized salt. Inadequate diet and insufficient access to food has been acknowledged to have a negative impact on the overall health status of the mother and foetus as both, under- and over-nutrition, can have an adverse impact on the long-term health status and life expectancy for both mother and the foetus (Zeisel, 2011).

Diet is an important and modifiable lifestyle behaviour that can reduce risk factor development for optimal health and well-being (National Institute for Health and Clinical Excellence (NIHCE), 2008). The dietary recommendations for pregnant women are very similar to those of other adults, with a few notable exceptions. The main recommendation is to follow a healthy, balanced diet taking into consideration RDAs and RDIs. Improved dietary quality has also been associated with a decreased risk of pre-eclampsia (Reyes *et al.,* 2012).

2.3.1. Important nutrients needed during pregnancy

2.3.1.1. Carbohydrates

Carbohydrates are the main source of energy during pregnancy and the amount needed is the same as those recommended for the general population (50–60% of total energy intake). Foods consumed by pregnant women should provide enough energy to ensure the delivery of a full-term, healthy infant of adequate size with appropriate body composition, to help control blood glucose levels and further provide protection against ketosis (Goldberg *et al.,* 2006). The recommended sources of carbohydrates are whole grain products and potatoes. Consumption of sugar should be limited and should not exceed 5% of energy intake or 25g/day (five teaspoons full); excess sugar intake increases the risk for obesity. Expectant mothers should avoid sugar-sweetened soft drinks, which increase the risks for pre-eclampsia and premature birth (Cuervo *et al.,* 2014).

2.3.1.2. Protein

Healthy development of the foetus depends on the availability of adequate protein because it provides the building blocks necessary for the formation of collagen, antibodies, muscle and enzymes. Collagen is responsible for the framework of the skin/ blood vessels, bones and other body tissues. Pregnant women should consume adequate protein so that the baby may grow and to meet her own needs as she physically readies herself to carry her baby (Institute of Medicine (IOM), 2004). There is an additional protein requirement for pregnancy to support the synthesis of maternal and fetal tissues, but the required increase is uncertain. Protein requirements increase throughout gestation and is maximized during the third trimester. The current RDA for protein is 0.8 g/kg/ day for pregnant women in the first half of pregnancy; this is the same for non-pregnant women. Protein needs increase in the second half to 71 g/ day, based on 1.1 g/day of pregnant weight (National Health Medical Research Council (NHMRC), 2006). For each additional foetus, another 25 g/day of protein is recommended; this may be as much as 175 g/day for a normal-weight woman carrying a twin gestation and is consuming 3500 kcal/day (Goodnight & Newman, 2009). Protein deficiency during pregnancy has very adverse consequences. Limited intakes of protein and reduction in energy usually occur together, making it difficult to separate the effects of energy and protein deficiencies (National Health Medical Research Council (NHMRC), 2006).

2.3.1.3. Lipids/Fats

During pregnancy, the quality of fats is more significant than their total amount, especially, for fetal and infant growth. It is necessary to improve the relative proportion of polyunsaturated fats rather than to increase the intake of total fats; an adequate intake of docosahexaenoic acid (DHA, of the n-3 series), is essential for the growth and development of the brain and retina, (Koletzko, Cetin & Brenna, 2007).

According to Innis and Friesen (2008), pregnant woman should consume adequate fat to meet the needs of her growing foetus. Lipids, which include sterols, triglycerides and phospholipids are made up of fatty acids which form building materials for the body tissues and body functioning. Lipids are responsible for hormones and cell membrane formation necessary for proper eye and brain development, particularly, during pregnancy and the first few years after birth. Fat is also an important source of concentrated calories and benefits women at risk of malnutrition during pregnancy (Innis & Friesen, 2008).

Dietary fat intake (through butter, vegetable oils, whole milk, visible fat on meat, oily fish, seeds and nuts) during pregnancy should make up 20-35% of total energy intake. Less than 10% of total energy intake should come from saturated fatty acids, while polyunsaturated fatty acids should represent 5-10% of the total energy intake (Innis & Friesen, 2008).

2.3.1.4. Vitamin A, C and D

Henderson, Gregory and Irving (2003) assert that vitamin A plays a significant role during pregnancy, for example, for maternal tissue growth and maintenance of the foetus. There is a great need for vitamin A during the third trimester, when fetal growth is most rapid. Vitamin A intakes during pregnancy should be increased throughout pregnancy by 100 mg per day (to 700 mg per day) to allow for adequate maternal storage so that vitamin A is available to the foetus during late pregnancy. Vitamin A deficiency is widespread and occurs when the intake of dairy products, carotene-rich vegetables and fruit are limited and, occasionally, with malabsorption syndrome. Vitamin A deficiency in pregnancy is known to result in night blindness (Henderson, Gregory & Irving, 2003).

The Food Safety Authority of Ireland (2005) explains that the increment in vitamin C intake of 10 mg per day, in the last trimester of pregnancy is to guarantee that maternal stores are maintained, mainly, near the final stages of pregnancy. The rapidly growing foetus places an

extra drain on tissue stores, as it absorbs more vitamin at the expense of circulating vitamin levels and maternal stores. Vitamin C enhances the absorption of non-haem sources of iron, therefore, pregnant women are encouraged to consume foods or drinks containing vitamin C, together with iron-rich meals, to help with iron absorption (Food Safety Authority of Ireland, 2005).

Vitamin D helps the body's nerves, muscles and immune system to work; the immune system protects the body from infection. The baby needs vitamin D to help bones and teeth grow and pregnant women need 600 IU (international units) of vitamin D each day. This amount can be obtained from food or supplements (Food Safety Authority of Ireland, 2005). Vitamin D, however, is obtained more from exposure to sunlight rather than through diet. Some vitamin D can be found in foods like eggs, meat and oil-rich fish; it plays a role when it comes to absorption and utilisation of calcium, importantly for the calcification of the fetal skeleton during the later stages of pregnancy. Pregnant women, therefore, need a good supply of vitamin D and supplements of 10mg per day which is recommended for all pregnant women (Food Safety Authority of Ireland, 2005).

2.3.1.5. Calcium

Calcium is an essential mineral for many diverse functions in the body, including bone formation, muscle contraction, enzyme and hormone functioning (Buppasiri *et al.,* 2011). Another notable function of calcium is that it helps the baby's heart, muscles and nerves to develop. Inadequate calcium consumption by pregnant women can lead to adverse effects in both the mother and the foetus, producing osteopenia, tremor, paraesthesia, muscle cramping, tetanus, delayed fetal growth, low birth weight, and poor fetal mineralization (Villar *et al.,* 2004). Low dietary calcium intake and low serum calcium concentrations are linked to pre-eclampsia (Ephraim *et al.,* 2014).

Buppasiri *et al.* (2011) indicate that calcium supplementation during pregnancy significantly reduces the risk of pre-eclampsia and high blood pressure (with or without proteinuria). Adequate calcium intake during pregnancy and lactation has been shown to have the potential to prevent pre-eclampsia, pre-term birth, neonatal mortality (NNM), improve maternal bone mineral content, breast milk concentration and bone development of neonates. Based on the study by Hofmeyr *et al.* (2010), the recommended calcium intake for all adults above 18 years is 1000mg/day per day and there is no increment during pregnancy. This amount is obtainable from prenatal mineral supplements and eating foods that are good sources of calcium

(Hofmeyr *et al.,* 2010). Calcium supplementation has been shown to have a beneficial effect in reducing the risk of pregnancy-induced hypertension (PIH) (Villar *et al.,* 2004), whereas studies evaluating the effect of supplementation on maternal bone mineral density and fetal mineralization have been less conclusive (Hofmeyr *et al.,* 2010).

2.3.1.6. Iron

Findings from a study done by Gebre and Mulugeta (2015), reported that although statistics on global prevalence of iron deficiency is not available, it was assumed that 52% of pregnant women in developing countries are anaemic. Iron deficiency might occur due to the habit of consuming foods with insufficient quantities of iron. Anaemia is harmful to both woman and child and is associated with a higher risk of maternal and fetal morbidity and mortality (WHO, 2001). Actions to prevent anaemia during pregnancy include, not only food fortification but also educating women, so that they increase their consumption of natural iron sources and foods that favour the absorption of this mineral, as well as limit their consumption of foods that inhibit iron absorption. Inadequate intakes satisfy the increased demand during pregnancy, increase iron deficiency risk among pregnant women. This may affect growth and development of the foetus and increase the risk of preterm delivery, low birth weight and post-partum haemorrhages (Arnold *et al.,* 2009).

A study carried out with adolescent pregnant girls showed that the iron storage was below 300mg for 32% of them, and 64% had less than 500mg of stored iron (WHO, 2008). Women need to have adequate storage of iron to meet the high requirements of this mineral during pregnancy. The total iron required during pregnancy is about 1000mg, but majority of women do not meet this demand (Bothwell, 2000); although, the RDA for iron for the latter half of pregnancy is 30mg. Absorption of iron increases three-fold by the third trimester, with iron requirements increasing from 1-2mg to 6mg per day (Bothwell, 2000). According to Beard (2008), there is an increased iron demand during pregnancy to supply iron to the growing foetus and placenta and for increased production of maternal red blood cells. The foetus needs high quantities of iron in the last trimester of pregnancy; these needs are met at the expense of maternal iron stores (Bothwell, 2000).

2.3.1.7. Folate

Folate is a vitamin B that helps prevent neural tube defects (NTD), serious abnormalities of the brain and spinal cord (Sengpiel *et al.,* 2014). The synthetic form of folate found in

supplements and fortified foods is known as 'folic acid' and has been shown to decrease the risk of premature birth. A recommended intake of 400 to 800 micrograms a day of folate or folic acid, before conception and throughout pregnancy, is required (Dietary Supplement Fact Sheet, 2016).

Folate requirements increase during pregnancy for maternal erythropoiesis, Deoxyribonucleic Acid (DNA) synthesis, and fetal and placental growth. The Centers for Disease Control and Prevention (CDC) recommends that all women of childbearing age increase their intake of folic acid (Goldberg *et al.,* 2006). More than half of all pregnancies are unplanned, and the neural tube closes by 28 days of gestation, before most women realize they are pregnant (Goldberg *et al.,* 2006). The average amount of folic acid received through food fortification (grains) in the US is only 128 mcg/day, there is, hence, a need for the additional 400 mcg/day of synthetic folic acid from supplements or fortified foods, by women who might become pregnant. (Simpson *et al.,* 2010). The South African Government introduced legislation in 2003 for the mandatory fortification of maize meal and wheat flour, at a concentration of 150µg/100 g of folic acid. National programmes to mandate folate food fortification (FFF), including that in SA, have reduced the prevalence of NTD, significantly, worldwide.

In addition, folic acid deficiency during pregnancy is marked by a reduced rate of DNA synthesis and mitotic activity in individual cells. White cell morphologic and biochemical changes signaling deficiency precede overt megaloblastic anaemia, the latest stage of folate deficiency, which may not present until the third trimester. Maternal folate deficiency is associated with an increased incidence of congenital malformations, including palate and NTDs. Red blood cell folate concentrations exceeding 906 mmolL (400 ng/mL) are associated with the fewest NTDs. Losses of folate in milk during lactation has also been seen to increase the requirement for folic acid for lactating mothers. Symptoms of folate deficiency include weakness, fatigue, difficulty in concentrating, irritability, headache, palpitations, shortness of breath and atrophic glossitis (Suzana *et al.,* 2004).

2.3.1.8. Zinc

The RDA for zinc increases during pregnancy from 8mg per day to 12mg for adults. Zinc plays a very crucial role in normal growth and development of the foetus and the production of pregnancy-related tissues in the mother (Erick, 2012). Deficiencies of zinc during pregnancy have been associated with preterm birth, intrapartum haemorrhage, infections, (Brown *et al*.,

2009), low birth weight (LBW), congenital defects and abnormal foetal brain development. The possible role of zinc deficiency in the onset of preeclampsia is being investigated (Erick, 2012).

2.3.1.9. Sodium and chloride

Excessive sodium consumption has been shown to produce a significant increase in BP and has been linked with the onset of hypertension and its cardiovascular complications. A large meta-analysis showed that modest reduction in salt intake over four or more weeks caused a significant fall in BP in both hypertensive and normotensive individuals (Strazzullo *et al.,* 2009). He *et al.* (2013) adds that a reduction in salt intake can have a favourable effect on the cardiovascular system, inducing a reduction in BP values in hypertensive patients. The WHO (2014) recommends consumption of less than 5g of salt per day, while other agencies recommend that salt consumption per day should be limited to no more than 1500 g of sodium. Presently, populations consume far greater amounts of salt than those provided in natural, unprocessed foods which can put pregnant women at a risk of hypertension (Charlton *et al.,* 2018).

Excessive dietary salt intake has been acknowledged to be the cause of cardiovascular diseases, hypertension and stroke (Mozaffarian *et al.,* 2014; Blaustein *et al.,* 2012). Few studies talk about the involvement of high salt intake in pregnancy complications. It has been reported that high dietary salt intake increased the risk of gestational hypertension and preeclampsia (Martillotti *et al.,* 2013; Scheelbeek *et al.,* 2016). Abdoli (2016) and Rakova *et al.* (2014) contend that high salt intake can result in the pathophysiology of miscarriage and preeclampsia through involvement of Th17 cells and their associated inflammatory reactions. The link between high salt intake and pregnancy complications is seen as logical, because high salt intake plays a role in the induction of severe inflammatory reactions (Kleinewietfeld *et al.,* 2013; Wu *et al.,* 2013) and these are involved in the pathophysiology of pregnancy complications (Saini *et al.,* 2011; Christiansen, Nielsen & Kolte, 2006).

2.3.1.10. Iodine

Charlton *et al.* (2018) reported that the mandatory iodisation of table salt in SA is at a level of 40–60 ppm; iodine is a mineral the body needs to make thyroid hormones. The thyroid gland in the neck makes hormones that help the body use and store energy from food. Iodine is needed during pregnancy to help the baby's brain and nervous system develop. The nervous

system (brain, spinal cord and nerves) helps the baby move, think and feel; during pregnancy, 220 mg of iodine is needed every day.

There is a growing concern that many pregnant women are not getting enough iodine, so replacing regular table salt with an iodised variety can support the intake. Although salt is a carrier for iodine, it should not be used to increase iodine levels as it is just its fortification role that may help. It is always better to get nutrients from their natural food source (Glinoer, 2007). Globally, although, nearly a third of school-age children (246 million) are estimated to have insufficient iodine intake (Pearce, Andersson & Zimmermann, 2013), this commonly-used surrogate measure, likely, results in greatly underestimating the number of pregnant and lactating women with inadequate iodine nutrition status (Wong *et al.,* 2011). Depending on the timing and severity, insufficient iodine intake increases the risk of negative reproductive outcomes, such as perinatal and infant mortality, and intellectual impairment; the most extreme form being cretinism (Zimmermann, 2012).

2.4. Hypertension during pregnancy

In SA, more than 90% of hypertensives are not controlled at < 140/90 mmHg. Redefining hypertension to a level of 130/80 mmHg significantly increases the prevalence of hypertension by 43%. New targets necessitate greater use of health services for increased health visits to monitor patients, greater use of antihypertensives to achieve the lower targets, and increased use of laboratory services to monitor adverse effects (Rayner *et al.,* 2019). De Cherney *et al.* (2012) reported that hypertension is a common medical problem because it affects 20% - 30% of the adult population and more than 5% - 8% of pregnancies around the world are said to be affected by this condition. Similar observations were highlighted in the report of the National High Blood Pressure Education Program in SA (De Cherney *et al.,* 2012).

According to the study by Familoni, Adefuye and Olunuga (2004), pre-eclampsia has been reported at a global prevalence of 5% and is influenced by parity, race, ethnicity, environmental factors, socio-economic status, multiple pregnancies, and maternal obesity. Usually, hypertensive mothers give birth to preterm babies, who need the Neonatal Intensive Care Unit (NICU) for better care as a result of their IUGR and LBW. Hypertensive disorders related to pregnancy include gestational hypertension, pre-eclampsia, eclampsia and chronic hypertension and they are well known to be the major cause of maternal mortality, worldwide. Despite the high incidences and outcomes with HDP, clinical manifestations, pathogenesis and clinical courses differ and at times complicate diagnosis (Hnat *et al.,* 2002). Hypertensive

disorders of pregnancy are a significant cause of severe morbidity, long-term disability and death among both mothers and their babies. Worldwide, they account for approximately 14% of all maternal deaths, whereas in Latin America and the Caribbean, they contribute to approximately 22% of all maternal deaths (WHO, 2015).

Hypertensive disorders of pregnancy include aggravation of (pre-existing) chronic hypertension and gestational hypertension, pre-eclampsia and eclampsia. Pre-eclampsia is diagnosed when gestational hypertension (maternal blood pressure > 140/90 mmHg for the first time in the second half of pregnancy) is accompanied by proteinuria greater than 300 mg in a 24-hour period (WHO, 2011). Chronic hypertension may also be complicated by super-imposed pre-eclampsia. The pathogenesis of pre-eclampsia has not been thoroughly elucidated; however, it is related to disturbances in placentation in early pregnancy, followed by generalized inflammation and progressive endothelial damage (WHO, 2011). Among the hypertensive disorders that complicate pregnancy, pre-eclampsia and eclampsia stand out as major causes of maternal and perinatal mortality and morbidity. Majority of deaths due to pre-eclampsia and eclampsia are avoidable through the provision of timely and effective care to the women presenting with these complications (National Committee on Confidential Enquiries into Maternal Deaths, 2009).

The International Society for the Study of Hypertension in Pregnancy (ISSHP) (2014) has defined pre-eclampsia as hypertension presenting after 20 weeks of gestation combined with proteinuria (>300 mg/day), other maternal organ dysfunction, such as renal insufficiency, liver involvement, neurological or haematological complications, uteroplacental dysfunction, or fetal growth restriction (Tranquilli *et al.,* 2014). Pre-eclampsia is also related to fetal growth restriction and preterm birth, either spontaneous or through iatrogenic delivery. Children born to mothers with pre-eclampsia have an increased risk of bronchopulmonary dysplasia and cerebral palsy, caused by preterm birth and being small for their gestational age (Hansen *et al.,* 2010). Pre-eclampsia decreases health-related quality of life and increases the risk of post-partum depression. Prick *et al.* (2015) conclude that the cause of pre-eclampsia is unclear, while Williams and Broughton (2011) maintain that some women's genetics may play a role because the condition runs in the family.

In high-income countries (HICs), eclampsia is linked with a low maternal death rate of 0.1%. The low occurrence of eclampsia and low morbidity and mortality rates in HICs are due to easy access to antenatal care, good transport systems and populations being fully up-to-date with the benefits of healthcare during pregnancy, childbirth and the puerperium (Tranquilli *et*

al., 2014; Mol *et al.,* 2016). In poor countries, numerous factors, including poor access to health facilities, particularly in rural areas, present the main challenge and probably account for these countries' high morbidity and mortality rates (SADHS, 2016).

Von-Dadelszen *et al.* (2011) mention that maternal adverse outcomes are recorded in every 10% of women with pre-eclampsia, whereas this risk increases to 15% in women with early-onset of the disease. Once pre-eclampsia has been diagnosed, blood pressure should also be measured regularly, depending on the severity of the disorder (Turnbull *et al.,* 2004). Monitoring of women with pre-eclampsia includes the assessment of haematological parameters and biochemical tests to track progression of the disease or to diagnose deterioration of the disease (Mol *et al.,* 2016).

Pregnancy outcomes in women with hypertension alone, without proteinuria, can be compared to those of women with normal Bp; the outcomes weaken once pre-eclampsia develops. Complications of pre-eclampsia are linked with increased rate of morbidity and maternal mortality. Hypertensive disorders that occur during pregnancy or post-partum include pre-eclampsia, gestational hypertension, and pre-existing chronic hypertension (DoH, 2002). Global estimates show that hypertensive disorders of pregnancy complicate 2–8% of all pregnancies, thus, contributing to a major extent, to maternal mortality, worldwide (Duley, 2009). Chronic hypertension is now prevalent in 3% of women falling pregnant in the US (Seely & Ecker, 2011). A confidential inquiry into maternal deaths in SA reported that of the 4867 deaths reported over 2 years, 14% were due to hypertensive disorders, with another 8.8% due to medical and surgical conditions (Seely & Ecker, 2011).

2.4.1. Risk factors for hypertension

Hypertension has been associated with various factors whose prevalence varies in different populations due to differences in cultural, economic and social environments (Alberti, 2001). According to Rodgers *et al.* (2004), smoking is known to be a leading cause for the development of hypertension and cardiovascular diseases like stroke, thrombosis and heart attack. Smoking facilitates an immediate increase in blood pressure resulting in higher ambulatory blood pressure levels for smokers than for non-smokers. Abstaining from smoking during pregnancy is mandatory, because of the increased risk of preterm delivery and LWB (WHO, 2016). The negative effects of smoking can also extend beyond early childhood, as suggested by studies showing an increase in overweight infants born to smoking mothers (Oken, Levitan & Gillman, 2007). Substantial scientific evidence also supports the relationship

between maternal smoking and respiratory diseases, especially, in children exposed to smoke even in the prenatal period. Among this group, a 20% increase in the incidence of asthma and bronchospasm was detected (Burke *et al.,* 2012).

Exercise may decrease the incidence of gestational diabetes mellitus (GDM) by attenuating the increase in insulin resistance that is associated with pregnancy. Exercise may decrease the risk of gestational hypertension (GHTN) disorders by reducing oxidative stress, therefore, improving endothelial function (Di-Mascio *et al.,* 2016). The incidence of caesarean delivery decreases by improving maternal physical fitness and lowering birthweight (Magro-Malosso *et al.,* 2017). There are many benefits of physical activity for the fetus, including decreased resting fetal heart rate, improvement in the viability of the placenta and increased amniotic fluid levels (Prather *et al.,* 2012; Artal, 2017).

2.5. Nutritional status of pregnant women

The food women eat during pregnancy is the main source of nutrients for the baby, hence, malnutrition occurs when the daily food consumed does not fully provide the required nutrients (UNICEF, 2013). Maternal nutritional status is a significant determinant of pregnancy outcomes since pre-pregnancy underweight has been well known to cause adverse gestation outcomes. Obesity also increases pregnancy complications, such as gestational diabetes, hypertensive disorders, and perinatal morbimortality (Luciana *et al.,* 2001). The WHO (2015) defines malnutrition as the cellular imbalance between the supply of nutrients and energy and the body's demand for them to ensure growth, maintenance, and specific functions. An adequate nutritional status in pregnant women is essential for their health and pregnancy outcomes. Weight gain during pregnancy depends on the existing weight and height of the women; weight gain during pregnancy is normal due to the development of the foetus, placenta and amniotic fluid. Optimal fetal growth and development are supported by healthy eating, although, physical activity along with good nutrition contribute to a healthy pregnancy weight (Wojtyła *et al.,* 2011).

Pregnant women must meet all nutrient requirements and gain sufficient weight since these two main modifiable-risk factors influence maternal and infant outcomes. Good nutrition and weight gain helps pregnant women to meet the demands of her offspring, her own body needs, and to prepare her body for lactation (Taleb, Kaibi & Deghboudj, 2011). Low weight gain during pregnancy poses a risk as it causes the delivery of infants too small for their gestational age

leading to neonatal mortality and morbidity, failure to grow, slow cognitive development and chronic diseases in adulthood (Kuche, Singh & Moges, 2015).

Incidences of dietary inadequacies as a result of dietary habits and patterns in pregnancy are higher during pregnancy when compared to any other stage of the life cycle (Tena & Bacalo, 2002). Different scholars have discovered that many women in developing countries restrict their food intake during pregnancy for different reasons, such as to have smaller infants since they carry a lower risk of delivery complications and for cultural reasons (Daba *et al.,* 2013). Low intake of essential nutrients, such as protein, energy, vitamins C and A and iron due to inappropriate nutrition practices, together with environmental and socio-economic factors (Madhavi & Singh, 2011).

Poor nutrition in pregnancy, in combination with infections, is a common cause of maternal and infant mortality and morbidity, LBW and IUGR (Latifa, Manal & Nihal, 2012). Maternal overnutrition (that is, exceeding energy needs) can result in altered insulin, glucose, and lipid metabolism in the infant (Agosti *et al.,* 2017), while inadequate micronutrient intake can increase risk of LBW and pre-eclampsia (Keats *et al.,* 2019). Many women enter pregnancy already overweight or obese, and this is associated with a range of complications for both mother and baby. Losing weight during pregnancy is not recommended due to the increased risk it poses of having a baby with LBW, however, the amount of weight gained during pregnancy can be modified (Catalano *et al.,* 2014). Gestational weight gain (GWG) is associated with preterm birth and increased risk for small-for-gestational-age (SGA) infants (Alavi *et al.,* 2012; Chung *et al.,* 2013). Table 2.1 below shows the expected weight gain during pregnancy (WHOb, 2013).

Table 2.1: Expected weight gain during pregnancy

BMI (kg/m²)		**Total gestational weight gain (GWG) in kg**	**Mean rate of GWG (kg/week) 2nd and 3rd trimester**
Underweight	<18.5	12.5-18	0.51
Normal	18.5-24.9	11.5-16	0.51
Overweight	25-29.9	7-11.5	0.28
Obese	≥30	5-9	0.22

Kapadia *et al.* (2015) reported that both excessive GWG and low GWG are linked with negative perinatal outcomes. Studies on the effects of famine, conducted in Holland, were the first to report an increase in the cases of poor fetal growth and preterm birth in women who had low maternal weight gain during pregnancy. A systematic review of 18 cohort studies conducted in developed nations in 2015 evaluated the association between adverse

pregnancy outcomes and GWG in women with obesity. Women who gained less weight than is currently recommended by the IOM (2005) guidelines, were found to have a higher chance of preterm birth. Pre-pregnancy women who are overweight or obese are more likely to experience excessive GWG and postpartum weight retention (National Center for Health Statistics, 2016). The increasing prevalence of obesity and its associated pregnancy-related adverse effects, have been proven from cross-sectional and longitudinal studies; these show a direct, strong and consistent relationship between weight gain and Bp (Campbell *et al.,* 2016).

Individuals who gain weight have a greater risk of developing hypertension (Chung *et al.,* 2013). Obesity is defined as a condition in which excess body fat has accumulated to such an extent that health may be adversely affected. Being overweight or obese is a major risk factor for developing heart disease and diabetes (Australian Institute of Health and Welfare, 2012). In South African blacks, a relationship between the degree of obesity and BP was observed (Chung *et al.,* 2013). Several observational studies have reported that obesity or high body mass index (BMI) prior to pregnancy increases the risk of pre-eclampsia and gestational hypertension. A similar pattern was also observed in Australia (Driul, 2007). Poor quality diets high in energy, fat, and sugar, and low in fibre, contribute to increasing rates of obesity (Marangoni, Colombo & Galli, 2004).

The high prevalence of obesity in the general population, and therefore in women of childbearing age, increases the risk of complications in pregnancy; infants with excessive weight at birth are at increased risk of obesity in early life (WHO, 2013B). Weight loss before conception is effective in reducing the risk of having an infant with very high or very low birth weight (VLBW) and increases infant survival (Bodnar *et al.,* 2016). Excessive weight gain during pregnancy leads to morphological alteration of the placenta due to the high degree of systemic inflammation associated with poor nutritional status, as observed in overweight Italian women (Mandò *et al.,* 2016). Even in obese pregnant women, the caloric intake should not fall below 1600 kcal/day, with an adequate supply of nutrients, especially protein and calcium. This is more particularly essential during lactation, when the energy intake should be sufficient for the women to reach a healthy weight and to compensate for the energy expenditure associated with galactopoiesis (Sbraccia, Vettor & Società, 2016).

2.6. Prevalence, consequences and causes of folate, iron and calcium deficiencies

2.6.1. Folate

Nutritional deficiency of folate is common amongst people consuming an inadequate diet. This can be intensified by malabsorption conditions, including celiac disease and tropical sprue. Significant increases in folate requirement, especially, during periods of rapid foetal growth (second and third trimester) puts pregnant women at risk of deficiency (FAO/WHO, 2002). Folate deficiency during pregnancy can result in NTD. Losses of folate in milk during lactation also increases the requirement for the lactating mother. Furthermore, inadequate folate intake results in a decrease in serum folate concentration, and a subsequent decrease in erytrocyte folate concentration. This is followed by a rise in homocysteine concentration and Megaloblastic changes in the bone marrow and other tissues with rapid-dividing cells (FAO/WHO, 2002).

2.6.2. Iron

A global picture of the prevalence of this nutritional deficiency are not available, although, it is estimated that 52% of pregnant women in developing countries is anemic. In Brazil, the prevalence of anemia is estimated at about 30 to 40% in pregnant women and 30% in reproductive-age women. Anaemia affects 1.62 billion people worldwide, which corresponds to 24.8% of the world population (McLean *et al.,* 2009*)*. Iron deficiency is the most common cause of anaemia and even in the developed world an estimated 30-40% of preschool children and pregnant women have iron depletion. Iron deficiency may contribute to maternal morbidity through its effects on immune function. This results in increased susceptibility or severity of infections, poor work capacity and performance, disturbances of postpartum cognition, emotions, LBW and prematurity (Beard *et al.,* 2005; Sekhavat, Davar & Hosseinidezoki, 2011).

2.6.3. Calcium

Poor maternal and new-born health and nutrition remain significant contributors to the burden of disease. Worldwide an estimated 287 000 women died in 2008 from pregnancy-related causes and 99% of these deaths occurred in Low and Middle-Income Countries (LMIC) (Duley, 2009; WHO, 2010). Approximately 2.6 million babies globally were stillborn and 3.1 million babies died in the first 28 days of life, mostly due to maternal health complications, preterm birth, LBW, severe infections and asphyxia (Trends in Maternal Mortality, 2010).

Calcium supplementation has been shown to have a beneficial effect in reducing the risk of PIH (Villar *et al.,* 2004). Inadequate calcium consumption by pregnant women can lead to adverse effects in both the mother and the fetus; this can produce osteopenia, tremor, paraesthesia, muscle cramping, tetanus, delayed fetal growth, low birth weight, and poor fetal mineralization (Villar *et al.,* 2004).

In the 1980s, it was reported that there was an inverse relationship between calcium intake and PIH. PIH has been estimated to complicate 5% of all pregnancies and 11% of first pregnancies, often resulting in preterm birth (Villar *et al.,* 2004).

Preeclampsia is a condition in which hypertension (as defined above) occurs during the latter half of gestation and is associated with an increase in urinary protein. Low calcium intakes during pregnancy may stimulate level of parathyroid hormone (PTH) secretion, increasing intracellular calcium, smooth muscle contractibility, and/or release of renin from the kidney, leading to vasoconstriction and retention of sodium and fluid (Ananth & Basso, 2010).

2.7. Summary of literature review

Dietary intake plays a significant role during pregnancy as it promotes the well-being of the mother and the developing foetus. Salt is responsible for regulating and maintaining body fluid, although, the intake should be moderated to avoid complications like hypertension. Hypertension is known to be the major cause of maternal mortality worldwide and poor nutrition in pregnancy; this, in combination with infections leads to maternal and infant mortality and morbidity. Pre-eclampsia and eclampsia are among the hypertensive disorders that complicate pregnancy, although, deaths due to pre-eclampsia and eclampsia, worldwide, can be avoided. High consumption of salt has been acknowledged to cause a significant increase in Bp and has been linked with the onset of hypertension and its cardiovascular complications.

It is important to meet the RDAs by consuming a variety of foods that provide different nutrients to the body. Cultural practices should be considered as it has an influence on dietary intake. For good health of the mother and the baby, an adequate nutritional status is vital during pregnancy. Weight gain during pregnancy is normal due to the development of the foetus, however, excessive GWG and low GWG at this stage can have negative perinatal outcomes.

Avoiding risk factors associated with hypertension, such as smoking and lack of physical activity can promote a healthy pregnancy. Smoking during pregnancy increases risk of preterm delivery and low birth weight of the infant, hence, the recommendation to abstain. Physical activity has many benefits to the foetus, such as decreasing resting fetal heart rate and for the mother it decreases the chances of gestational hypertension disorders.

CHAPTER THREE

METHODOLOGY

3.1. Introduction

This chapter outlined detailed methods employed to answer the research question. The following themes will be covered - study approach and design, population and study area, sampling method, inclusion and exclusion criteria, subject recruitment, data collection instruments and the plan for data collection. Furthermore, statistical analysis, quality control of data, pretesting and pilot study, institutional approvals, ethical consideration and dissemination of results.

3.2. Study approach and design

The study design was cross-sectional. According to Brink, van der Walt and van Rensburg (2011); Burns and Grove (2011) and De Vos *et al.* (2011), a cross-sectional study involves obtaining data from a cross-section of the entire population at a point of time and once from a specific sample. This study adopted this study design, as data was collected at one point in time and from this process, the dietary salt intake of pregnant women was described through a quantitative method. This approach emphasizes objective measurements and the statistical, mathematical, or numerical analysis of data collected through polls, questionnaires, surveys, or by manipulating pre-existing statistical data using computational techniques (Labaree, 2009).

3.3. Population and the study area

The target population in this study was pregnant women attending antenatal services at Thulamela Primary Health Care Facilities. The Thulamela Integrated Development Plan (IDP) Census (2011) indicated that there was a population size of 618 462 in the Thulamela Local Municipality. The Thulamela statistics between April 2016 to March 2017 from clinics and Community Health Centres showed that there were 7208 antenatal visits and deliveries from five local areas. Thulamela has five local areas with 32 clinics and three Community Health Centres (CHCs). The study setting for this project was CHCs and clinics under Thulamela Local Municipality (Appendix 1).

3.4. Sampling

Three local areas with CHCs were purposively selected; two clinics from each local area were randomly selected to make a total of three CHCs and six clinics. The following procedure was followed for the random selection: three containers representing the selected local areas were used. The names of all clinics under each local area were written on a small paper, folded and placed into a container. An independent person was requested to select two names from each container. Convenience sampling is defined as a set of techniques in which participants are selected by convenience due to their proximity, availability, accessibility or other ways that the researcher may decide upon (Abrams, 2010). Convenience sampling method was used to select pregnant women on the day of data collection. A sample size of 379 pregnant women was determined using Slovin's formula (Hitang, 2013), where n is the sample size, N is the total number of the population, which in this case was 7208 and e is the margin of error (0.05).

$$\mathbf{n = \frac{N}{1 + (Ne^2)}}$$

$$\mathrm{n} = \frac{\mathbf{7208}}{\mathbf{1 + (7208 \times 0.05^2)}}$$

$$\mathbf{n = 379\ participants}$$

The number of participants per clinic and CHC was determined by dividing the total sample per local area, by the number of clinics per the local area.
379/9 =42 participants

Each clinic and CHC was allocated 42 participants for data collection.

Figure 3.1 shows the number of pregnant women interviewed per facility.

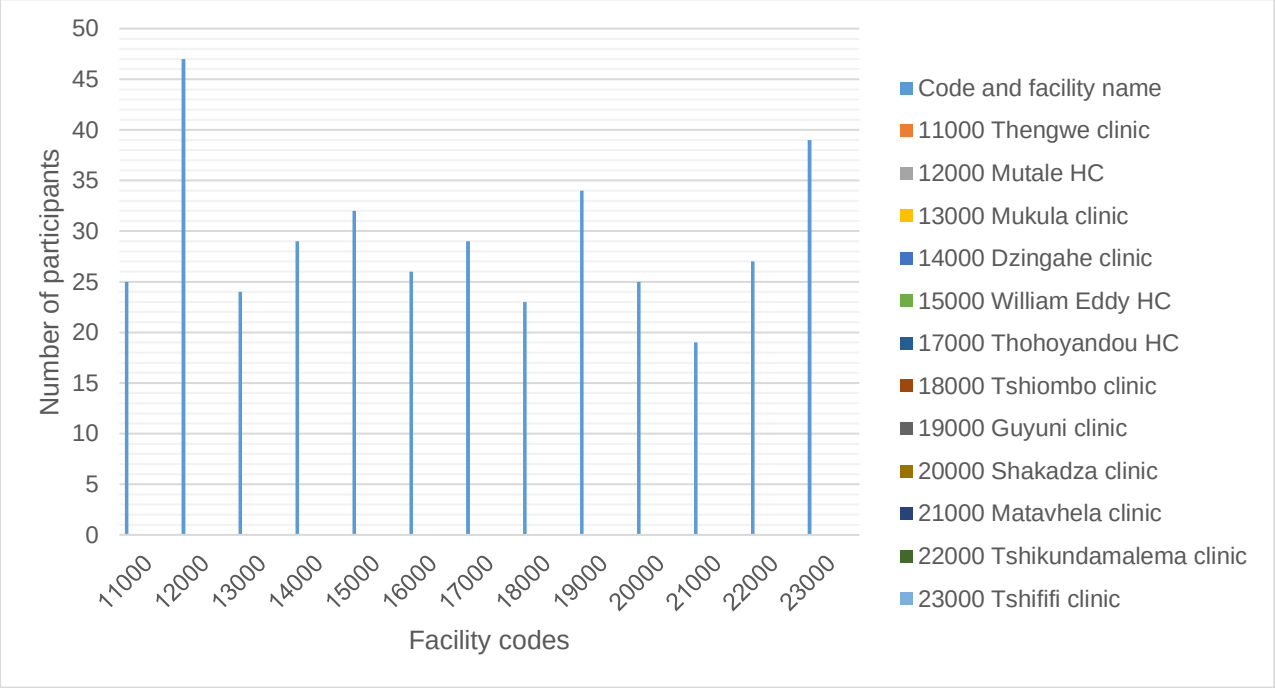

Figure 3.1: Number of pregnant women interviewed per facility

3.5. Inclusion and exclusion criteria

3.5.1. Inclusion criteria

Pregnant women, in all trimesters, from 18 years and above, free from illness, who agreed to participate in the study, were included.

3.5.2. Exclusion criteria

Pregnant women with known pre-eclampsia and other diseases that elevate blood pressure were excluded. All known participants who were taking blood pressure medication were excluded. In addition, pregnant women who were visiting Thulamela Municipality and came in for antenatal services at the time of data collection were excluded.

3.6. Subject recruitment

The researcher handed in a letter of request (Appendix 2) to use clinics and CHCs and further presented the purpose of study to the managers of each facility during the first visit. In addition, posters were pasted on the clinic walls with more information about the study. Permission to conduct data collection was requested and granted. Prior to data collection initiation, the researcher visited all selected health facilities to distribute the information letter (Appendix 3). At the time, a discussion was held with a group of pregnant women who were coming in for antenatal care (ANC). During the session, the purpose of the study was explained, and they were encouraged to partake.

3.7. Data collection instruments

3.7.1. Instrument development

The questionnaire (Appendix 4A) and a consent form (Appendix 5A) were developed in English, in line with relevant literature and objectives of the study. Supervisors from the Department of Nutrition were consulted to validate the questionnaire. It was further presented to the School of Health Sciences and the University Higher Degree Committee. Added to the items were questions – 31: “Do you crave for food or non-food items?”, 6: “Are you employed?” and 27: “Do you usually skip meals?” Both the questionnaire (Appendix 4B) and the consent form (Appendix 5B) were then translated to the local language (Tshivenda) and cross-checked by a person competent in both languages. The back-to-back translation enabled the retaining of their original meaning. Majority of people living in Thulamela Municipality speak the Tshivenda language, hence the need for the questionnaire to be translated. The questionnaire consisted of four sections, namely - section A: Socio-demographic information, section B: Blood pressure readings, section C: Dietary practices and section D: Dietary salt intake.

(A) Socio-demographic information - questions to obtain the socio-demographic data were adopted from an unpublished Honours project titled “Consumer knowledge on salt intake in Matavhela village, Limpopo in South Africa” (Munyai and Mbhatsani, 2014). Both authors were part of the current study and granted permission for the use of the questionnaire. Socio-demographic information refers to age of participants, educational level and source of income (Appendix 4A, section A).

(B) Dietary practices were developed using South African Food Based Dietary Guidelines as well as Krause’s Food, Nutrition and Diet Therapy book (Mahan & Escott-Stump,

1996) (Appendix 4A, section C). General meals consumed by pregnant women were based on four groups (carbohydrates, vitamins, protein and fats) of foods which are normally consumed three times in a day (Aaltonen *et al.,* 2010). “Dietary practices” refer to the number of meals and types of foods usually consumed, and the frequency in consuming certain foods (Kuche, Singh & Moges, 2015). The type of foods usually consumed are from different food groups, such as carbohydrates, vitamins, protein and fats. In addition, the dietary practices also included the consumption of food items known to have high levels of sodium. Dietary practices were determined through asking questions on food intake of pregnant women; the information was obtained from questionnaires [FFQ (food frequency questionnaire) and 24-hour recall].

(C) Dietary salt intake – refers to the usual sodium chloride intake per day (Appendix 4A, section D). Salt is made up of sodium and chloride; sodium can be obtained from other sources besides salt. The adequate salt intake was compared to the RDA for sodium chloride. The cut-off point for adequate salt intake is at 1.5 g/day during pregnancy [Dietary Reference Intakes (DRI)], which is the same for non-pregnant adults. The quantitative FFQ quantitative was used to determine the women’s dietary salt intake. A twenty-four (24) hour-recall (Appendix 6) was administered once to determine commonly consumed foods by pregnant women. The list of commonly consumed foods was then added to quantitative the FFQ.

(D) Blood pressure measurements were taken using an electronic-sphygmomanometer (digital) (Hunan Honngao Electronic Technology Co. Ltd, Model B872, Guangdong, China) and recorded in section B of Appendix 4A.

3.7.2. Data collection techniques

The techniques used to obtain information from the participants are explained as follows:

(A) Interviews

Pregnant women were interviewed in a private room at the health care facility, using the local language (Tshivenda) to ensure consistency. The researcher interviewed all the pregnant women to standardized the interview and to deal with the low literacy levels rate in the targeted population. According to the Stats SA report (2019), Limpopo had the lowest literacy rate in 2013 (88.0%), hence the researcher found it necessary to use the interview method for data collection, for consistency. Furthermore, food models, food pictures as well as household utensils were used to estimate portion sizes in the quantitative FFQ. Probing and follow-up questions were used to assist participants to remember the food items, as well as portion sizes. Pregnant women were interviewed using quantitative FFQ; they were asked to recall the exact frequency of consumption of listed food item in the past seven days.

(B) Blood pressure measurement

Blood pressure was measured using an electronic-sphygmomanometer (digital) (Hunan Honngao Electronic Technology Co. Ltd, Model B872, Guangdong, China) following the report of the National High Blood Pressure Education Program (2005).

Blood pressure was measured after the participants had been quietly and comfortably seated with both feet on the floor and their backs supported. The blood pressure machine was positioned on a level with the heart of the participant whose BP was being measured. A professional nurse positioned the participant's arm through the cuff loops and the arm was positioned correctly. The bottom edge of the cuff should be 1 or 2 centimetres above the elbow (National High Blood Pressure Education Program, 2005). The Velcro fastener was closed when the cuff snugly circled the upper arm. After the START / STOP button was pressed, systolic and diastolic pressure readings were noted down and these was done in 5 minutes with the participants seated between measurements; these were repeated on at least three additional occasions. This was done to confirm that the readings were accurate.

(i) Interpretation of blood pressure measurements

Blood pressure is considered to be normal when SBP is <120 mmHg and DBP is <80 mmHg. It is optimal when SBP is 120-129 mmHg and DBP is <80 mmHg. High normal blood pressure is defined by SBP of 130–139 mmHg and DBP of 80-90 mmHg while, hypertension is defined by SBP of ≥ 140 mmHg and DBP of <90 mmHg. The study was conducted following the South African Hypertension Society (SAHS) definition of hypertension mentioned in Table 3.1.

Table 3.1: Current South African Hypertension Society (SAHS) definition of hypertension (Rayner *et al*., 2019).

Blood Pressure classification	***SBP (mmHg)***	***DBP (mmHg)***
Normal	<120	and <80
Optimal	120-129	and <80
High normal	130–139	or 80-89
Hypertension		
Grade 1	140-159	or 90-99
Grade 2	160-179	or 100-109
Grade 3	≥ 180	or ≥110
Isolated systolic	≥ 140	and <90
*Individuals with SBP and DBP in two categories should be designated to higher BP based on two or more careful readings obtained on two or more occasions.		

SBP = Systolic Blood Pressure DPB = Diastolic Blood Pressure

3.8. Data collection

The researcher was provided with a private room for data collection at CHCs and clinics. The room was arranged into two stations. In station one, the researcher interviewed participants on socio-demographic data, dietary practices, 24 hour-recall and dietary salt intake (FFQ). In station two, a professional nurse was responsible for taking blood pressure measurements. The interview and blood pressure measurement took place on the same day; data collection took place from August to December 2018. The dates for data collection were communicated with the health facility manager prior to the visit.

3.9. Statistical analysis

Data obtained was analysed using IBM Statistical Package for Social Sciences (SPSS) version 25; normality of the data was checked using Kolmogorov tests. Descriptive statistics such as means and standard deviations were used to interpret the data. Graphs and Tables were used to present findings. The dietary intake from FFQ was analysed using MRC Food Finder 3 (version 1.1.3) (Wolmarans *et al.,* 2010), a computer software. The nutrient intake of

the participants was low as compared to the DRIs stipulated by IOM (Dietary Reference Intakes) (2005). Logistic regression was used to identify factors associated with high BP risk. Due to the skewness of Na and Cl data, quantile regression was used to test the difference between the mean intake between high BP risk (> 120/80 mmHg) and low BP risk (< 120/80 mmHg).

3.10. Quality control of data

3.10.1. Validity

Grimes and Schulz (2002) define 'validity' as an expression of the degree to which a test is capable of measuring what it is intended to measure. The inputs from supervisors, presentation to the Nutrition Department, presentation to School of Health Sciences and the University of Venda Ethics Committee enhanced the validity of the questionnaire. Furthermore, the questionnaire was pretested and piloted and the nutritionists (3) were consulted to give their reviews on the questionnaire. The questionnaire was translated from English to the local language (Tshivenda) to ensure consistency and to accommodate the literacy level of the participants. The MER Mathivha Center for Languages was consulted to check the correctness of the translated instrument against the original text. This back-to-back translation ensured the retention of the meaning of the original questions, since the process was done by an expert competent in both languages.

3.10.2. Reliability

Heale and Twycross (2015) defined reliability as a way of assessing the quality of a measurement procedure used to collect data. The researcher interviewed a sub-sample of 40 participants from Phiphidi clinic, over a two-week period, to check if similar results will be obtained; there were no differences observed. An appointed professional nurse took the BP readings, following carefully the proper procedure (calibrated electronic device with adjustable sized cuff, a defined interval of five minutes apart and repeated measurements twice).

3.11. Pretesting

Pretesting was done purposively to check the quality of the instrument and the way in which people responded to the questions. Ten (10) pregnant women from Phiphidi clinic were used for the pretesting. Questions 25, 26, 27 and 34 were added to the instrument, while questions 10 and 29 were rephrased.

3.12. Pilot study

Piloting was conducted to the check the feasibility of the entire study and to detect possible flaws in the methodology. It was done to check if the researcher will be able to recruit participants, how long it would take to interview one participant, whether they would understand the questions and whether they would agree for their blood pressure to be measured. Pregnant women from Phiphidi clinic gave their consent before they participated in the pilot study, since the clinic forms part of the Thulamela Municipality. The researcher ensured that pregnant women who participated during the piloting doesn't form part of the main study, since the list of those participants were noted down. The study used 40 pregnant women for piloting and it took 45 minutes to complete one interview. Analysed data from the pilot study was used to improve the instrument, data collection process and the research as a whole.

3.13. Institutional approval

The proposal was presented to the Department of Nutrition and School Higher Degree Committee (SHDC) for recommendation and for quality assurance. The University Higher Degree Committee (UHDC) (Appendix 7) and the University Ethics Committee for Ethical Clearance (SHS/18NUT/06/2406) (Appendix 8) approved the study. The Limpopo Provincial Department of Health (Appendix 9) and the Department of Health, Vhembe District (Appendix 10) also granted permission for the researcher to conduct the study. In addition, arrangements with the clinics and CHCs managers, from the selected health facilities, were made regarding the study. Permission to conduct the study were granted by all clinics and CHCs managers.

3.14. Ethical considerations

Ethics approval was granted by the University of Venda Ethics Committee (SHS/18NUT/06/2406) (Appendix 7). The study was conducted in line with the principles of the Helsinki Declaration (2013).

3.14.1. Informed consent

The researcher observed the principle of voluntary consent or willingness to participate in a study with participants. For a participant to give informed consent, the researcher sufficiently explained all the information about the purpose of the research being conducted. The principle of voluntary consent was observed; therefore, participants were informed of their right to refuse to participate in the study or to withdraw from the study at any time without any penalties. Attention was given to the specific information needs of individual potential subjects as well as to the methods that would be used to deliver the information. Participants were given the option of being informed about the general outcome and results of the study. In this study, informed consent (Appendix 5A) was developed in English and translated to the local language (Tshivenda) (Appendix 5B). Written consent was obtained from pregnant women who were the target population for the study prior data collection.

3.14.2. Privacy and confidentiality

The researcher explained to the participants the purpose of the study, and guaranteed the confidentiality of the research participants' details by observing anonymity. Participants remained anonymous (nameless), since codes, instead of names were used throughout the study. The researcher assured participants that the information given in confidence would be protected and that completed interview schedules would be kept in a safe locked place and only accessed by the researcher and the study supervisors. Completed interview schedules would be kept until the research report has been accepted by the authorities concerned.

3.15. Dissemination of results

The dissertation will be available at the University of Venda library. A report will be submitted to the Department of Health Limpopo Province with recommendations made from the study. A manuscript based on the study will be submitted to a peer-reviewed accredited journal for consideration for publication and for presentation at conferences and symposiums.

CHAPTER FOUR

RESULTS

4.1. Introduction

The results of the study are presented in this chapter under the following sub-headings: socio-demographic information, pregnancy information, dietary intake of pregnant women, dietary practices of pregnant women (nutrition information during pregnancy, meal patterns of pregnant women and salt-related dietary practices). The blood pressure status of pregnant women, association between blood pressure and other variables (blood pressure risk and sodium chloride, association between BP risk, gestational age, marital status, education level and employment status of participants, logistic regression for blood pressure risk and gestational age and education level of participants) would also be presented.

4.2. Socio-demographic information

The socio-demographic information of pregnant women is presented below in Table 4.1. A total number of 379 pregnant women were interviewed. The mean age of participants was (26.82 ± 5.25) years with a minimum age of 16 years and a maximum age of 45 years. Table 4.1 shows the socio-demographic information of participants. Majority of participants (71.2%, n=270) were aged 21 to 30 years, followed by 20.8% (n=270) aged 31 years and older. Most of the participants (62.0%, n=235) were single, while 27.7% (n=105) were married. Most participants (95.5%, n=362) were Tshivenda speaking, while very few (1.6%, n=6) were Xitsonga speaking. More than half of the participants (56.5%, n=214) had passed grade 12 and 19.8% (n=75) had attained tertiary education.

Majority of participants (88.1%, n=334) were unemployed, while 11.9% (n=45) were employed. From those who were employed, 66.7% (n=30) were self-employed, 8.9% (n=4) were domestic workers and 4.4% (n=2) were school teachers. The study showed that financially, 30.3% (n=115) of participants depended on parents/parents-in-law, while just above one quarter (28.0%, n=106) depended on a social grant and 2.6% (n=10) obtained an income from other relatives (uncles, grandmothers). Just over 45% (n=171) of participants reported a monthly income of <R2000, followed by 33.2% (n=126) with R2001-R5000 and 2.4% (n=9) with R15000 and above (Table 4.1).

Table 4.1: Socio-demographic characteristics of pregnant women

	Frequency (n=379)	Percent (%)
Age (years)		
Less than 20	30	7.9
21-30	270	71.2
31-40	72	19.0
41-50	7	1.8
Marital status		
Single	235	62.0
Married	105	27.7
Living with a partner	38	10.0
Divorced	1	0.3
Ethnic group		
Venda	362	95.5
Tsonga	6	1.6
Pedi	2	0.5
Foreign Nationals (Shona, Mozambican, Nigerian and Ghanaian)	9	2.4
Educational level		
Never attended	2	0.5
Grade 5-7	2	0.5
Grade 8-10	30	7.9
Grade 11-12	56	14.8
Passed grade 12	214	56.5
Tertiary	75	19.8
Employment Status		
Yes	45	11.9
No	334	88.1
Type of employment (n=45)		
School teacher	2	4.4
Health care worker	2	4.4
Security guard	5	11.1
Domestic worker	4	8.9
Labourer	2	4.4
Self-employed	30	66.7
Source of income/type of income		
Social grant	106	28.0
Husband	97	25.6
Parents	115	30.3
Guardian	10	2.6
Not applicable	51	13.5
Household income per month		
<R2000	171	45.1
R2001- R5000	126	33.2
R5001- R10 000	57	15.0
R10 001- R15 000	16	4.2
Above R15 000	9	2.4

4.3. Pregnancy information

Table 4.2 below shows the gestational age of participants. At the time of the interview, 38.3% (n=145) of participant's gestational age was 31 to 38 weeks, and 10.6% (n=40) were at 38 weeks or above.

Table 4.2: Gestational age of participants

Gestational age of participants	Frequency (n=379)	Percent (%)
12-20 weeks	86	22.7
21-30 weeks	108	28.5
31-38 weeks	145	38.3
Above 38 weeks	40	10.6
Total	379	100.0

Figure 4.1 presents the number of previous pregnancies. Pregnant women were asked how many pregnancies they had had prior to the current one. Majority of participants (71%, n=269) had had more than one pregnancy, while 29% (n=110) were primigravida (first time pregnancy) (Figure 4.1).

Figure 4.1: NUMBER OF PREVIOUS PREGNANCIES

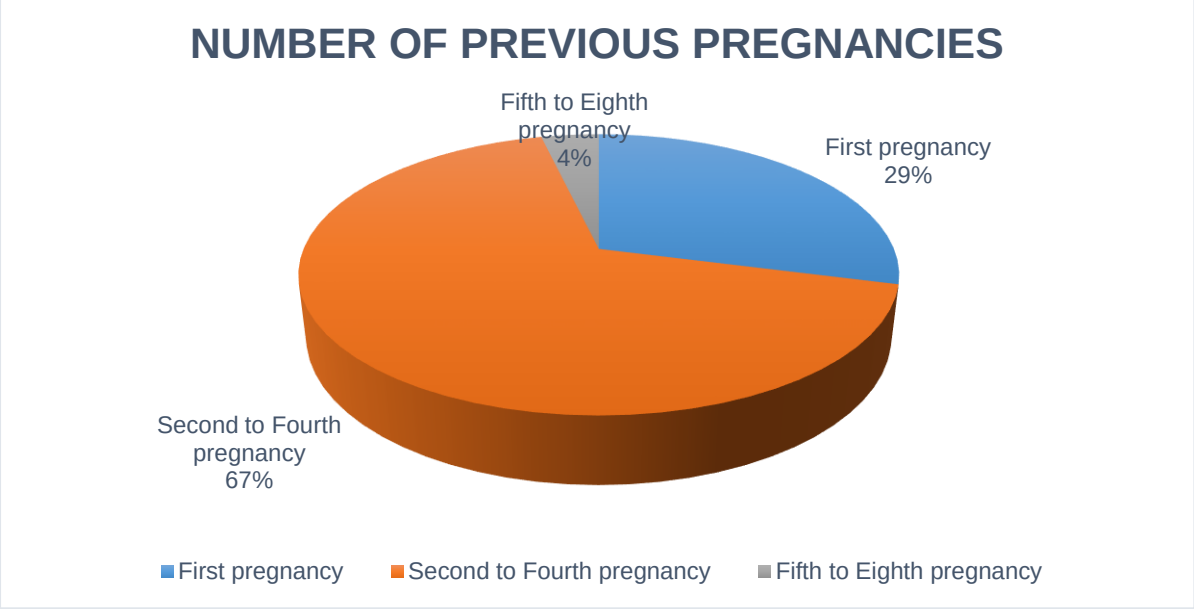

Figure 4.1: Number of previous pregnancies

At the time of the interview, 29.8% (n=113) had one child, 22.7% (n=86) had two children alive, while a few participants (9%, n=34) had three and/or more children alive. Majority of participants (83.6%, n=317) had never experienced maternal mortality, although, 16.4%

(n=62) had lost children. Of those who had lost children, 14% (n=53) had lost one child, whereas 2.4% (n=9) had lost more than one child (Table 4.3).

Table 4.3: Number of children alive and dead per mother

	Frequency (n=379)	**Percent (%)**
Number of children alive per mother		
0	146	38.5
One	113	29.8
Two	86	22.7
Three and above	34	9
Number of children dead per mother		
0	317	83.6
One	53	14.0
Two and above	9	2.4

Table 4.4 shows the self-reported disease profile. At the time of the interview, very few participants reported having any allergies (2.6%, n=10) and chronic diseases of lifestyle, such as ulcers (2.9%, n=11), hypertension (1.1%, n=4), diabetes mellitus (0.5%, n=2) and cardiovascular diseases (0.3%, n=1). Majority of participants (96.6%, n=368) were not on a special diet, while 3.4% (n=13) reported being on a special diet. From those who were on a special diet, 2.1% (n=8) were on a light diet, 0.3% (n=1) on a diabetic diet, 0.3% (n=1) low fat and 0.3% (n=1) were on a diet programme to achieve weight gain and 0.5% (n=2) were on a low-salt diet (Table 4.4).

Table 4.4: Self-reported disease profile

Allergies	**Frequency (n=379)**	**Percent (%)**
Yes	10	2.6
No	369	97.4
Ulcer		
Yes	11	2.9
No	368	97.1
Hypertension		
Yes	4	1.1
No	375	98.9
Diabetes mellitus		
Yes	2	0.5
No	377	99.5
Cardiovascular diseases		
Yes	1	0.3
No	378	99.7
Stroke		
No	379	100.0
Special diet		
Yes	13	3.4
No	366	96.6
Diet followed		
Ulcer	8	2.1
Diabetic	1	0.3
Low fat	1	0.3
Diet to achieve eight gains	1	0.3
Low salt	2	0.5

4.4. Dietary intake of pregnant women

Table 4.5 presents the major nutrients consumed during pregnancy by participants in this study. It is important to note that there is no DRI and RDA for Na. The mean energy intake was (5304.4±2217.5KJ) which was higher than the recommended in all trimesters and the mean protein intake was 35.1±16.8g. The 2005 DRI for energy for a pregnant female is the same as for the non-pregnant female in the first trimester, then increased by 340 to 360 kcal/day during the second trimester and by another 112 kcal/day in the third trimester (IOM, 2005). The mean intake of chloride (Cl) 287.4mg, folate 284.4mcg, iron (Fe) 4.3mg, carbohydrate 165.9g, fibre 10.8g, calcium (Ca) 191mg, Vitamin C 49.0mg and zinc (Zn) 4.2mg was below the DRI (EAR), RDA, EER and AI during pregnancy (Table 4.5).

Table 4.5: Energy and nutrient intake of pregnant women (n=379)

Nutrients	DRI (EAR)		RDA	AI	EER		Mean ±Std Deviation	Median	Mini	Maxi
	0-18.99 years	10-50.99 years	0-50.99 years	14-50 years						
Energy (kJ)					1st to 3rd trimester	±2403 to ±2855	5304.4±2217.5	4891.0	3877.0	6171.0
Total protein (g)			60				35.1±16.8	32.0	24.0	42.0
Total fat (g)				13			33.2±20.8	29.0	20.0	40.0
Carbohydrate (g)		135	175				165.9±79.5	155.0	115.0	198.0
Total dietary fibre (g)				28			10.8±6.5	10.0	7.0	13.0
Ca (mg)	1300	1000	1200				191.0±129.7	162.0	103.0	245.0
Fe (mg)	27	27	30				4.3±3.9	4.0	2.0	6.0
Na (g)		2.3 UL		1.5			804.8±538.0	693.0	489.0	959.0
Cl (mg)	450	450					287.4±245.0	225.0	132.0	361.0
Folate (mcg)	600	600	400				284.4±174.9	241.0	194.0	367.0
Vitamin C (mg)	80	85	70				49.0±49.8	33.0	17.0	65.0
Zn (mg)	13	11	15				4.2±3.2	4.0	2.0	5.0

Abbreviations: EER = Estimated Energy Requirements; EAR= Estimated Average Requirement; RDA= Recommended Dietary Allowance; AI = Adequate Intake; UL= Tolerable Upper Intake Level, Min= Minimum, Max= Maximum

Table 4.6 below presents the DRI values for pregnant women. Majority of the pregnant women (94.5%) had an energy intake above the EER reference values. Nearly all (92.6%) of pregnant women had a protein intake that was below the RDA reference values for protein intake. Almost all pregnant women (99.7%) had an iron intake that was below the EAR reference values for iron intake. The study found that only 15.0% of pregnant women fell within the EAR reference value for folate intake. Almost all pregnant women (98.7%) did not meet the EAR reference value for zinc intake (Table 4.6).

Table 4.6: Comparison of nutrient intakes of pregnant women to DRI values (n=379)

Nutrient	Reference value	Below reference value n (%)	Within reference value n (%)	Above reference value n (%)
Energy (kJ)	2403-2855	7 (1.8%)	14 (3.7%)	358 (94.5%)
Total protein (g)	60-64	351 (92.6%)	7 (1.9%)	21 (5.5%)
Total fat (g)	13-17	26 (6.9%)	49 (12.9%)	304 (80.2%)
Carbohydrate (g)	135-175	146 (38.5%)	88 (23.2%)	145 (38.3%)
Total dietary fibre (g)	28-32	374 (98.7%)	3 (0.8%)	2 (0.5%)
Ca (mg)	1000-1300	378 (99.7%)	1 (0.3%)	0 (0%)
Fe (mg)	27-30	378 (99.7%)	0 (0%)	1 (0.3%)
Na (mg)	1.5-2.3	0 (0%)	0 (0%)	379 (100%)
Cl (mg)	450-454	320 (84.4%)	0 (0%)	59 (15.6%)
Folate (mcg)	400-600	318 (83.9%)	57 (15.0%)	4 (1.1%)
Vitamin C (mg)	70-85	298 (78.6%)	21 (5.6%)	60 (15.8%)
Zn (mg)	11-15	374 (98.7%)	4 (1.0%)	1 (0.3%)

4.5. Dietary practices of pregnant women

The dietary practices of participants are divided into sources of nutrition information, meal consumption patterns and salt-related intake, as indicated below:

4.5.1. Nutrition education/ information during pregnancy

Participants were asked to indicate if they received any nutrition information during pregnancy and the source of this information. The results indicate that most participants (81.0%, n=307) received nutrition education on what to eat during pregnancy. Approximately two thirds of participants (65.4%, 248) received nutrition information from nurses, followed by 31.4% (n=119) who received it from “mom-connect” (mobile health messaging service and helpdesk for South African mothers) and the least participants received information from nutritionist/dietitian, radio and television, at 2.4% (n=9), respectively (Table 4.7).

Table 4.7: Nutrition education/ information

Nutrition education/ information received	Frequency (n=379)	Percent (%)
Yes	307	81.0
No	72	19.0
Source of nutrition education/ information		
Nurse	248	65.4
Relatives (Mother, grandmother)	113	29.8
Nutritionist/Dietitian	9	2.4
Radio, TV	9	2.4
Internet	77	20.3
Read from printed materials	38	10.0
Mom-connect	119	31.4

4.5.2. Meal consumption, frequency of fruits and vegetables intake, cravings and visible fat intake.

The meal patterns revealed that more than 90% (n=348) of the participants usually ate three meals or more per day and very few participants (8.2%, n=31) ate two or less meals per day. When participants were asked whether they usually skipped meals, 86.8% (n=329) of participants indicated that they did not skip meals, while 13.2% (n=50) indicated that they usually skipped meals. Of those who skipped meals, 38% (n=19) skipped breakfast, 42% (n=21) skipped lunch and 20% (n=10) skipped dinner (Table 4.8).

Participants were asked about their cravings for food/non-food items. About 14.5% (n=55) indicated that they experienced cravings. From those who experienced cravings, 8.2% (n=31) craved soil, 2.9% (n=11) craved mopani worms, 2.1% (n=8) craved locusts and 1.3% (n=5) craved termites. With regards to vegetable and fruit consumption practices of participants, nearly half of participants (48.0%, n=182) consumed vegetables 2 to 3 times a week. More than half of the participants (53.0%, n=201) consumed fruits 2 to 3 times per week. Participants were asked if they removed visible fats from meat or meat products before cooking or when eating. About 64.4% (n=244) of participants indicated that they removed visible fat before cooking or eating (Table 4.8).

Table 4.8: Meal consumption, frequency of fruits and vegetables intake, cravings and visible fat intake.

Number of meals eaten per day	**Frequency (n=379)**	**Percent (%)**
One to two	31	8.2
Three to four	296	78.1
Five and above	52	13.7
Skipped meals		
Yes	50	13.2
No	329	86.8
Meal usually skipped		
Breakfast	19	38
Lunch	21	42
Dinner	10	20
Vegetable consumption frequency		
Daily	169	44.6
2-3 times a week	182	48.0
Once a week	18	4.7
Did not consume	10	2.6
Fruit consumption frequency		
Daily	153	40.4
2-3 times a week	201	53.0
Once a week	16	4.2
Didn't consume	9	2.4
Cravings for food/non-food items		
Yes	55	14.5
No	324	85.5
Craved food/non-food items		
Craving soil	31	8.2
Craving mopani worms	11	2.9
Craving locust	8	2.1
Craving termites	5	1.3
Removal of visible fats before cooking or eating		
Yes	244	64.4
No	135	35.6

4.5.3. Dietary salt intake

The information sourced from the participants on their dietary salt intake included salt outlets, types of salt used, time of adding salt to the meals, adding salt at the table and reading labels on food packages when buying groceries (Table 4.9). Most participants (71%, n=269) indicated that they bought salt from supermarkets, 17.9% (n=68) from social grant pay stations and 11.1% (n=42) from spaza shops. Majority of participants (87.9%, n=333) reported that they used soup as a source of salt followed by fortified table salt (82.1%, n=311), spices (55.7%, n=211), crunch animal salt (19.5%, n=74), mono-sodium glutamate (Aromat, soy, tomatoes, sauces, sausages) (18.7%, n=71), while a few (0.8%, n=3) reported that they used iodated coarse salt (Table 4.9).

Just over two thirds of participants (67.3%, n=255) reported that they added salt when cooking meals, 32.2% (n=122) added salt when cooking and eating meals, while 0.5% (n=2) did not add salt to their meals at all. Participants were asked if they read information on the labels before buying food items. About 70.4% (n=267) indicated that always they read information on the label before buying food items, 20.8% (n=79) sometimes read information on the label, whereas 8.7% (n=33) indicated that they never read information on the label (Table 4.9).

Table 4.9: Salt-related dietary practices

Salt outlets	**Frequency (n=379)**	**Percent (%)**
Spaza	42	11.1
Supermarkets	269	71.0
Social grant stations	68	17.9
Sources of salt		
Fortified table salt	311	82.1
Coarse salt (iodated)	3	0.8
Crunch animal salt	74	19.5
Spices (as a source of salt)	211	55.7
Mono-sodium glutamate (Aromat, soy, tomatoes, sauces, sausages)	71	18.7
Soup (as a source of salt)	333	87.9
Adding salt in meals		
Never add salt	2	0.5
Cooking	255	67.3
Cooking and eating	122	32.2
Reading of information on the labels before buying food items		
Always	267	70.4
Sometimes	79	20.8
Never	33	8.7

4.6. Blood pressure status of pregnant women

The mean DBP was 73.56±9.5mmHg and the mean SBP was 113±11.2 mmHg in the overall sample. Nearly three quarters (74.7% to 74.9%, n= 283 to 284) of participants had normal SBP and normal DBP. Between 23.0% to 24.3% (n= 87 to 92) of participants were at the pre-hypertensive stage of SBP and DBP respectively, while very few (1.3% to 2.1%, n= 5 to 8) were hypertensive (Table 4.10).

Table 4.10: Blood pressure status

mmHg	**Mean ±SD**	**Median**	**Minimum**	**Maximum**
Diastolic (mmHg)	73.6 ± 9.5	74.7	47.0	140.0
Systolic (mmHg)	113.6 ± 11.2	115.7	81.0	194.0
Blood pressure categories		**Interpretation**	**Frequency (n = 379)**	**Percentage (%)**
SBP				
<120 mmHg		Normal	283	74.7
120-139 mmHg		Prehypertension	92	24.3
≥ 140 mmHg		Hypertension	5	1.3
DBP				
<80 mmHg		Normal	284	74.9
80-89 mmHg		Prehypertension	87	23.0
>90 mmHg		Hypertension	8	2.1

SD= standard deviation; SBP= systolic blood pressure; DBP= diastolic blood pressure

4.7. Association between blood pressure and other variables

4.7.1. Blood pressure risk and sodium and chloride intake

The pregnant women who were at risk of high blood pressure were classified into two categories, high-risk and low-risk. The high BP risk group were those with ≥140/90 mmHg and the low-risk BP group were those with a BP of <139/89 mmHg. Majority of the pregnant women were at low risk of developing high BP. The results also show that the mean intake of sodium (Na) and chloride (Cl) was lower in the high BP risk group and was also respectively lower than the low BP risk group (Table 4.11).

Table 4.11: Mean sodium and chloride intake between the high and low BP risk groups

Variable	N (%)	Mean±SD	Minimum	Maximum
BP risk and Na (mg) mean intake				
Low BP risk	236.00 (62.3%)	839.08±591.3	507.50	736.50
High BP risk	143.00 (37.7%)	748.32±432.1	479.00	652.00
Total	379.00 (100%)	804.84±537.9	489.00	693.00
BP risk and Cl (mg) mean intake				
Low BP risk	236.00 (62.3%)	292.50±256.1	135.00	225.50
High BP risk	143.00 (37.7%)	278.92±226.2	126.00	223.00
Total	379.00 (100%)	287.38±245.0	132.00	225.00

A high BP risk was negatively associated with sodium and chloride intake. The results suggest that the mean intake of sodium (Na) in the high BP risk group was significantly lower (86mg, P=0.04) and that similar findings for chloride (Cl) were observed, where the intake was lower by -3mg but this was not significant (P=0.88) as shown in Table 4.12.

Table 4.12: Logistic regression (Na, Cl intake vs BP risk)

	Coef.	Std. Err.	t	P>|t|	95% Confidence Interval
Sodium (Na in mg)					
1.BPrisk	-86	42.17118	-2.04	0.04	-168.9202-3.079811
_cons	738	25.90384	28.49	0.00	687.0659-788.9341
Chloride (Cl in mg)					
1.BPrisk	-3	19.39857	-0.15	0.88	-41.14296-35.14296
_cons	226	11.91566	18.97	0.00	202.5705-249.4295
p<0.00					

Coef= Coefficiency, Std. Err.= Standard Error

4.7.2. Association between BP risk, gestational age, marital status, education level and employment status of participants

Pearson correlation and chi-square T-test were used to determine the association between variables and the association was set at P<0.05, which indicates statistical significance. Gestational age was significantly associated (P<0.00) with having a high BP risk, with 38+ weeks having the highest risk (65%), while the risk for those with gestational age ≤ 38 weeks ranged between 31.5% - 36.0% (n= 31 to 34) (Table 4.13). High BP risk was not associated with marital status (Table 4.13). Single participants had the highest risk (40.3%, n=95) versus those living together with a partner, who had the lowest risk (31.6%, n=12). Being single was strongly associated with a higher risk of developing high BP (Pr = -0.410).

There was a significant association (Pr = 0.04) between education level and high BP risk, with those who had passed Grade 12 having the highest risk (43.9%, n=94) (Table 4.13). The

results also suggest that there was no association (Pr =0.51) between the employment status of participants and a high BP risk (Table 4.13).

Table 4.13: Correlation between blood pressure risk with other variables

Gestational age	**Low BP risk group (n= 236)**		**High BP risk group (n=143)**		**TOTAL**	Pearson chi2(3) =14.7746 Pr = 0.00 p<0.00
	Frequency (n)	**Percent (%)**	**Frequency (n)**	**Percent (%)**		
12-20 weeks	55	64.0	31	36.0	86	
21-30 weeks	74	68.5	34	31.5	108	
31-38 weeks	93	64.1	52	35.9	145	
38+ weeks	14	35.0	26	65.0	40	
Marital status						Pearson chi2(2) – 1.7822 Pr – 0.410
Single	141	59.7	95	40.3	236	
Married	69	65.7	36	34.3	105	
Living together	26	68.4	12	31.6	38	
Education level						Pearson chi2(3) = 8.1642 Pr = 0.04
None- grade10	23	67.6	11	32.4	34	
Grade11-12	40	71.4	16	28.6	56	
Passed grade 12	120	56.1	94	43.9	214	
Tertiary	53	70.7	22	29.3	75	
Employed						Pearson chi2(1) = 0.4203 Pr =0.51
Yes	30	66.7	15	33.3	45	
No	206	61.7	128	38.3	334	

4.7.3. Logistic regression for blood pressure risk, gestational age and education level of participants

Regression analysis as summarised in Table 4.14 shows that the greater the number of gestation weeks, the higher the risk of high blood pressure. Pregnant women at a gestational age above 38 weeks were significantly more likely to be in the high-risk BP group (OR=3.29; P=0.00), than those with a gestational age of 12-20 weeks. The association of education level versus BP risk revealed that those with Grade 11-12 (P=0.04) and a tertiary education (P=0.03) had a significantly lower BP risk than those who had passed Grade 12. Those with a lower education level had a similar risk (P=0.21) to those who had passed Grade 12 (Table 4.14).

Table 4.14: Logistic regression

BP risk	Odds Ratio	Std. Err.	Z	P>|z|	95% Confidence Interval
Gestational age (P=0.00)					
21 - 30 weeks	0.815	0.25	-0.67	0.50	0.45-1.48
31 - 38 weeks	0.99	0.28	-0.03	0.98	0.57-1.73
Above 38 weeks	3.29	1.32	2.98	0.00	1.50-7.22
_Cons	0.56	0.13	-2.55	0.01	0.36-0.88
Education level (P=0.04)					
None- grade 10	_6105458	_2390963	-1.26	0.21	_2833861-1.3154
Grade11-12	_5106383	_1666212	-2.06	0.04	_2693807-_9679666
Tertiary	_5299077	_1529352	-2.20	0.03	_3009798-_9329601
_Cons	_7833333	_1078944	-1.77	0.08	_5980041-1.026098

4.8. Summary of results

The total number of pregnant women interviewed were 379 with the majority being unemployed. The majority had had more than one pregnancy (71%, n=269); more than 83.6% (n=317) had never experienced maternal mortality and majority of pregnant women received nutrition education from nurses. Just above two thirds of participants reported that they added salt when cooking meals. Majority of participants indicated that they did not skip meals, while 74.4% to 74.9% (n= 283 to 284) of participants had normal SBP and normal DBP. Almost all pregnant women (99.7%) were below the EAR reference values for iron intake. The mean intake of sodium (Na) and chloride (Cl) was lower in the high BP risk group and also lower than the low BP risk group. High BP risk was not associated with marital status, however, there was a significant association to the educational level. Gestational age was significantly associated with a high BP risk, with >38 weeks being at the highest risk (65%, n=26).

CHAPTER FIVE

DISCUSSION OF RESULTS

5.1. Introduction

The study aimed to describe dietary salt intake, dietary practices and hypertensive status of pregnant women in Thulamela Municipality. In this chapter, the study findings are discussed and compared with those of other studies.

5.2. Socio-demographic information

Majority of participants in this study were aged 21 years and older indicating low levels of teenage pregnancy. In SA, more than 30% of teenage girls fall pregnant (Willan, 2013), while between 65% and 71% of the pregnancies among the youth are unplanned (Adeniyi *et al.,* 2018). Adolescents contributed to 13.6% of the registered births in SA in 2016; a rate far higher than in high-income countries (Reddy, Sewpaul & Jonas, 2018). Teen years are associated with erratic eating habits and food behaviours that may result in poor nutrition. Undernutrition during pregnancy is associated with higher mortality and morbidity amongst women and their young children (Balayla *et al.,* 2011). NDoH, Stats SA, SAMRC and ICF reported that from the SADHS (2016), 16% of women aged 15-19 years had begun childbearing; 12% had given birth, and an additional 3% were pregnant with their first child. Childbearing among teenagers ranged from a low of 8% in the Western Cape to a high of 20% in both the Northern Cape and North West (SADHS, 2016).

Studies in Bangladesh and Malaysia conducted by Hafizur *et al.,* (2013) and Lim *et al.,* (2018) concurred with the current study as they indicated that the majority of pregnant women were aged 20 years and above. On the contrary, Abuya, Ciera and Kimani-Murage (2012) reported that majority of pregnant women in rural Bangladesh were less than 20 years of age. Lim *et al.,* (2018) report a higher mean age (32.06 ±5.56 years) of participants in a study in Hospital University Sains Malaysia Kelantan as compared to the current study (26.82± 5.25 years). The findings of the current study confirm that, although, most pregnant women studied were above the age of 20 years, not many of them fell above the ideal child bearing age of above 35 years.

The risk and consequences (comorbidities such as hypertension and diabetes, antepartum haemorrhage, malpresentation, operative vaginal delivery, LBW and preterm delivery) of falling pregnant beyond the ideal child-bearing age of above 35 years have been well documented and communicated widely to the South African public via various mediums. There are many reasons why women conceive beyond the medical ascribed age of 35 years. For the rural South African community which is affected by high rates of unemployment and the need to get social grants, the researcher presumed that most women would fall pregnant at an older age to escape poverty and for economic benefits. Fertility declines as a woman grows older which means that the best reproductive years are in the 20s. Fertility gradually declines in the 30s, particularly, after age 35 years (Age & Fertility, 2012).

The current study found that the majority of women in this study were single as compared to the one third that were married. The NDoH, Stats SA, SAMRC and ICF reported that from the SADHS (2016), six in 10 women (59%) aged 15 to 49 years had never been in a union (never married or lived together with a partner as though married). The never-married distribution of (62%) was higher than the national rate for women (56.5%) in 2016 in the country. This is contrary to the study conducted by M'soka, Mabuza and Pretorius (2015) in Zambia, where the majority of participants (94.9%) were married. This is worrisome as there has been evidence related to the health and nutritional status of children raised by single parents as opposed to both parents. The health of a pregnant woman and her foetus is mutually dependent on food security; they both require good-quality food (Laraia *et al.,* 2006).

Tshitaudzi (2003) made a similar observation where the majority of participants (97.5%) who attended the antenatal clinic at Siloam Hospital (a public hospital situated in Siloam village, in Limpopo Province, 33.8km West of Vhembe District Municipality) were not married. Marriage status is an important indicator of the household income and maternal outcomes of pregnancy. If both partners were working, the household was more likely to be food-secure, hence, these pregnant women would be able to eat nutritious food (Han *et al.,* 2014). Above one quarter of pregnant women in this study were married, while the majority were single. The NDoH, Stats SA, SAMRC and ICF reported that early unions (marriage or living together with a partner as though married) are rare in SA (SADHS, 2016), however, studies done in Ghana and North East Ethiopia found that the majority of pregnant women were married (Gebre & Mulugeta, 2015; Aliwo *et al.,* 2019).

A study conducted in Malaysia demonstrated that antenatal mothers with a higher education level may have learned more and had a better understanding when being exposed to nutrition information (Zahara *et al.,* 2014). With regards to education level of the participants, most pregnant women had passed Grade 12 and/or had tertiary education indicating a high literacy rate. Studies by Abuya, Ciera and Kimani-Murage (2012) in Bangladesh and Napier *et al.* (2019) in rural KZN also confirmed that majority of participants had completed secondary education and/or tertiary education. On the contrary, Zelalem *et al.* (2017) and Aliwo *et al.* (2019) reported that very few participants in a study done in Addis Ababa, Ethiopia had completed secondary and/or tertiary education, while 68.3% of participants in a study in North East Ethiopia were not educated (Aliwo *et al.,* 2019).

According to Zelalem *et al.* (2017), high educational levels helped pregnant women to make healthy dietary decisions for their own and for the baby's health because they are literate enough to know what was good for their health. A previous study done in Ethiopia had shown participants' low literacy rate when compared with the study done in Bangladesh as well as in the current study (Hafizur *et al*., 2013). In a study conducted in KZN, the socioeconomic status of the women showed that 72.7% had completed secondary school education (Napier *et al.,* 2019).

The Quarterly Labour Force Survey released by Stats SA (2015), confirmed that the official unemployment rate in SA has been relatively high since 2008. The rate of unemployment amongst women was 29.5% in the second quarter of 2018 (Stats SA, 2019). Majority of pregnant women in the current study were unemployed, similar to a study conducted in rural KZN, where it was found that 65% of the pregnant women were unemployed (Napier *et al.,* 2019), and about 11.9% of employed pregnant women came from rural settings. Loqani (2015) reported a similar trend where the majority of pregnant women in selected Port Elizabeth communities were unemployed. In a study conducted in the South West of England, evidence offered by Rogers *et al.,* (1998) showed that pregnant women who experienced financial difficulties had a lower intake of different micronutrients, including niacin, pyridoxine, iron, zinc, magnesium, and potassium. Unemployment among pregnant women leads to food insecurity in the households; this causes a reduction in the average number of meals and the amount of food consumed, resulting in reduced micronutrient intakes. Inadequate intake of nutrients during pregnancy may lead to irreversible damage to the foetus that can compromise adults' future work capacity and survival (Castrogiovanni & Imbesi, 2017).

Nearly one quarter of participants (28.0%) in the present study depended on social grants for income. When people depend on social grants, it means they are unemployed and this affects food security in the household. Inadequate diet and/or insufficient access to food is said to have a negative effect on the overall health status of the mother and foetus; both under- and over-nutrition can have a serious impact on the long-term health status and life expectancy of the mother and the foetus (Kavle & Landry 2018; Zeisel, 2011). No person receiving pension, or other social grants participated in the study conducted in Port Elizabeth (Loqani, 2015). The current study found that the majority of households (78.4%) had a monthly income of less than R5000. An observation made by Loqani (2015) on two communities in Port Elizabeth (Kwazakhele and New Brighton) showed that most of the pregnant women (74%) earned less than R5000 per month, similar to the current study. This indicates that the majority of the participants were engaged in low-paying jobs. A common finding is that the majority of pregnant women were unemployed, and this is an indicator of low-household income, which adversely affects food security, which in turn could impact adversely on pregnancy outcome (Black, 2014).

5.3. Source of nutrition information

It has been established that nutrition education during pregnancy is associated with positive pregnancy outcomes (Streuling, Beyerlein & Kries, 2010). Most pregnant women in this study received nutrition information during their pregnancy period, similar to the findings of Lim *et al.* (2018), where the majority of participants (95.5%) in Malaysia received information on maternal nutrition during pregnancy. The findings from the current study revealed that most mothers had received nutrition information from nurses during ANC visits, with a significant number receiving nutrition information from the internet as well as social media. It is not surprising that there was a shift from a general way of sourcing information to the internet. This is because, currently, most information is available through digital platforms. Most respondents in Kenya (93.3%) indicated that they were provided with information on food sources of the essential nutrients (Amegah-Kofi *et al.,* 2018). Furthermore, Hainutdzinava, Weatherstone and Worobey (2017) reported that fewer than two in five of the surveyed mothers reported that they had received any nutrition education, with most indicating that they educated themselves by browsing the internet and reading books.

Nowadays, the internet is increasingly becoming the main source of nutrition information as many people have access to it. The size and scale of the internet raises concerns about the credibility and reliability of the nutrition and dietary information available (Brug *et al.,* 2005).

Most people use general search engines to find health information online (Fox & Duggan, 2013) which presents search results based on a page ranking system; this is open to manipulation through website design (Modave *et al.,* 2014).

In August 2014, the National Department of Health through the Minister, Dr Aaron Motsoaledi, launched an initiative to use mobile phone technology (Mom-connect) as part of a suite of interventions to address the relatively high maternal mortality ratio (MMR), child mortality rate and perinatal mortality rate (PNMR) in SA (Chola *et al.,* 2015; SANDH, 2016). Mom- connect allows pregnant women to receive stage-based messages to help them improve their health and that of their babies (Peter, Barron & Pillay, 2016). In the current study, nearly one third of mothers received nutrition information through Mom-connect. Kiczorowska *et al.* (2017) report that internet and commercials are the most popular sources of nutrition information in France.

Gambia (1995) reported that study participants (35%) in Kenya, were informed on nutrition and diet by their ANC providers and further acknowledged that the knowledge of pregnant women on nutrition during pregnancy increased from 53.9% to 97% after the provision of nutrition education, while the pregnancy-specific-dietary practices of the pregnant women increased from 46.8% to 83.7%. In Ethiopia and India, the main source of information reported by the study participants (pregnant women) were health professionals (59%), families and friends (20%) as well as mass media, like television and radio (Zelalem *et al.,* 2017; Ajantha *et al.,* 2015). The current study reported similar findings where health professionals (nurses and nutritionist/dietitian), relatives, mass media (radio, television), commercials (internet, printed materials and Mom-connect-internet messaging application) had played a major role in delivering information regarding maternal nutrition during pregnancy (Nutrition Education). In addition, most of the study participants had frequent contacts with health professionals, mass media and commercials (Wakefield, Loken & Hornik, 2010).

5.4. Dietary practices of pregnant women and food labels

Majority of pregnant women in the current study ate three to four meals per day. These findings are in accordance with a study (Aliwo *et al.,* 2019) conducted in the Regional Specialist Hospital of Biała Podlaska (Poland) and in North East Ethiopia, where the majority of pregnant women had three or more meals per day (Piotr *et al.,* 2014). A study conducted in Polokwane Local Municipality revealed that pregnant women had two meals per day with the common-skipped meal being breakfast (Bopape, Alberts & Mbhenyane, 2018). A similar trend was observed in the study by Whisner, Bruening and O'Brien (2016) and Wise (2015) and the

current study, where breakfast was the most commonly skipped meal. These results are comparable with the results in the study by Crozier *et al.* (2009), where the proportion of pregnant women skipping breakfast in London was 91.8% (5 days and over). The reason for skipping of meals could be attributed to poor household income, food insecurity, low educational level, nausea, satiety and busy a schedule. Inadequate nutrient intake during pregnancy leads to irreversible damage to the foetus (Castrogiovanni & Imbesi, 2017).

Cravings for food/non-food items are a common phenomenon during pregnancy, and it remains a significant barrier to healthy eating in pregnant women (Goodrich *et al.,* 2013). In a study in western Kenya, Kariuki *et al.* (2016) reported that the majority (73.8%) of participants craved foods such as maize, followed by animal protein (beef, fish, eggs, milk) and fruits (mangoes, bananas) differing by locations and cultures. More than 60% of pregnant women in Australia experienced food/non-food cravings (Bayley *et al.,* 2002). On the contrary, approximately only 15% of participants in the current study experienced food/non-food cravings for soil (8.2%), mopani worms (2.8%), locusts (2.1%) and termites (1.4%). It is generally acknowledged, however, that the most common-craved foods during pregnancy are chocolate, chips, citrus fruits, pickles, and ice cream (Kaiser & Allen, 2008). The current study suggests that cravings during pregnancy may be based on geographic location and/or socio-economic status, however, food, like the protein-rich foods being craved by pregnant women in this study are unique to the study population. These foods also provide Na, Cl and iodine for women during pregnancy, since locusts, termites and mopani worms are preserved using salt (van der Merwe & Venter, 2010).

Nutrition labels and symbols are used to guide peoples' food consumption behaviour. Food labels perform a significant communicative function, since they provide consumers with information for them to select the most suitable food, during the pre-purchase decision-making phase (Dimara & Skuras, 2005). The current study revealed that the majority of participants (91.6%) did not read nutrition information on food labels. This is, however, contrary to the findings reported by Nedaa and Al-Khamees (2014), where pregnant women in Kuwait University stated that they read food label information. Findings from the current study also showed that the majority (88.1%) of participants did not read salt information on labels. This is, however, contrary to the findings by Nedaa and Al-Khamees (2014) and Alawwa *et al.* (2018) who reported that majority of participants in Kuwait University and in Lebanon read/checked salt information on labels, regularly. In addition, Satia *et al.* (2005) indicated that several past cross-sectional studies have concluded that nutrition knowledge is associated with reading food labels.

One of the South African Food Based Dietary Guidelines (FBDG) indicates that fats should be consumed sparingly (Vorster, Badham & Venter, 2013). About 64.4% of pregnant women in the current study indicated that they removed visible fat before cooking or when eating, while 35.6% did not remove visible fat. Majority of pregnant women in Canberra indicated that they regularly consumed discretionary foods which shows that they did not reduce/ discard fats when cooking and or when eating. Discretionary foods generally contain higher amounts of fat (particularly saturated fat), sugars and/or salt and are lower in fibre (National Health and Medical Research Council, 2013).

Diets which contain a variety of fruits and vegetables are associated with reduced risk of congenital anomalies, preterm birth and more favourable foetal growth (Brantsæter *et al.,* 2014). They also resulted in lower frequency of maternal complications such as excessive gestational weight gain, pre-eclampsia and gestational diabetes. Pregnant women should consume fruits and vegetables, especially, locally grown ones because they provide vitamins and minerals including folate and iron, which help prevent anaemia during pregnancy (Tryggvadottir *et al.,* 2015).

The current study reported that the majority of the pregnant women consumed vegetables more than three times a week. Comparable findings reported by Wojtyła *et al.* (2011) showed that a larger proportion of participants in Norway consumed vegetables in sandwiches at least daily, while Rodríguez-Bernal *et al.* (2013) reported that 47% of Spanish women had an intake of vegetables which was below the recommended amount in the first trimester of pregnancy. Contrary to the current study, Hall *et al.* (2009) indicated that pregnant women in the rural environment of Kielce Region (a city in south-central Poland) rarely consumed vegetables. According to the Ministry of Health, Labour and Welfare of Japan (2012), the recommended number of servings to prevent diet-related chronic diseases is more than 5 servings (350 g) of vegetables per day and an additional of 1–2 servings of vegetables are recommended during pregnancy for improving the wellbeing of both mothers and babies.

In the current study, just over half of participants (53.0%) consumed fruits 2 to 3 times per week while, 40.7% consumed fruits daily. Piotr *et al.* (2014) reported that participants (17.2%) from the Regional Specialist Hospital in Biała Podlaska (Poland) consumed fruits 2 to 4 times a week while, 77.8% consumed them daily. Less than half (44.1%) of pregnant women in Addis Ababa reported eating at least two fruits per day (Zelalem *et al.,* 2017). In a study conducted in California and Georgia, majority of the pregnant women reported high

consumption of fruits during pregnancy (Santiago *et al.,* 2013; Duke *et al.,* 2017); bananas were the most commonly-consumed fruit (95.4%), followed by oranges (88.8%), and apples (88.3%). Similar findings from the current study showed that the most consumed fruits were apples followed by oranges and bananas, which could have been due to the availability of these fruits throughout the year.

5.5. Dietary intake

5.5.1. Dietary salt intake of pregnant women

The finding shows that three quarters of the participants agreed with the information that salt should be avoided during pregnancy and needs to be addressed by healthcare practitioners. Salt is essential for the body to function normally, whether a woman is pregnant or not, because the biochemistry of nerve and muscle function depends on sodium and potassium (Stufflebeam, 2008), however, it needs to be emphasized that salt should be taken in moderation rather than in excess (Appel *et al.,* 2006). Pregnant women should also be made aware of foods high in salt, such as processed and most fast foods. Results of a systematic review of clinical trials regarding salt consumption during pregnancy, however, indicate that it should remain a matter of personal preference (Duley, Henderson-Smart & Meyer, 2005).

Swanepoel (2017) reported that Indian women in SA had the lowest ($p<0.001$) calculated salt intake, the median for this population being 7.1g/day. Results from a study conducted in SA by Ware *et al.* (2017) shows that 69% of adult women had salt intakes that were above the WHO recommendation of 5 g/day, with 28% consuming more than twice this level (10 g/day) and 11% consuming at least three times the recommended level (15 g/day). In a study conducted in Cape Town by De Bruyn (2015), sodium intake was above the AI for 81.1% of the study sample, with a mean intake of 2315.0 mg per day. In the current study, 82.1% of the participants used iodated salt. Adequate iodine nutrition is essential during pregnancy for foeto-maternal production of thyroid hormones required for optimal foetal neurodevelopment. Dietary iodine requirements rise by approximately 50% during pregnancy, driven by increased thyroid synthetic demands, increased renal iodine clearance, and transfer of iodine and thyroxine to the foetus (Abel *et al.*, 2018). More than half of the pregnant women at the University of Gondar Hospital in North Ethiopia (Takele *et al.,* 2018) and in Nepal had a positive attitude towards iodized table-salt utilization (Agrawal *et al.,* 2013). The current study reported similar findings where majority of pregnant women (82.1%) used iodated table salt.

In Brazil, the majority of pregnant women added salt during meal preparation (Brown *et al.,* 2009). Similarly, in the current study it was reported that more than two thirds of participants (67.3%) added salt during meal preparation, while 32.2% reported that they added salt when eating and cooking. This is similar to the proportion of pregnant women in Jordan (25.5%) (Australian Bureau of Statistics, 2001) and Australia (21%), where salt was usually added after meal preparation (Alawwa *et al.,* 2018). Charlton *et al.* (2018), reported a similar trend where pregnant women reported that they added less salt while cooking and at the table.

5.5.2. Dietary intake compared to reference values of selected nutrients in pregnant women

5.5.2.1. Macro nutrients

Energy

In the study conducted in Cape Town by De Bruyn (2015) the mean energy intake (10 168kJ) was high as similarly reported by Kesa and Oldewage-Theron (2005) where pregnant women in Gauteng (16 to 35 years old) had a mean energy intake of 8 425.7kJ. In contrast, majority of the pregnant women (94.5%) in the current study had an energy intake that was above the EER reference value with a mean of 5304.4±2217.5KJ. A study conducted in the western part of Nigeria found that 75% of pregnant women had inadequate dietary energy intake (Ojofeitimi *et al.,* 2008). Williamson (2006) has suggested that this increase may be caused by new tissue creation (amniotic fluid, foetus, placenta), growth of the existing maternal tissue, and extra fat deposition. Energy expenditure also increases due to the 15% increase in metabolic rate that is typical of each trimester (Erick, 2012). Total energy requirements depend on the mother's pre-pregnancy BMI, her age, as well as the rate of weight gain during pregnancy (Kaiser & Allen, 2002).

Protein

The mean protein intake (78.8 ±28.1g) of pregnant women in Cape Town seems to be exceeding the RDA recommendation and contributed 10.1% to total energy intake (de Bruyn, 2015). In the current study, the mean protein intake was 35.1±16.8g showing that 92.6% of pregnant women fell below the RDA reference values, therefore indicating inadequate intake. Protein requirements increase substantially during pregnancy (Erick, 2008; Williamson, 2006). Inadequate protein intakes hold serious risks, especially, for the foetus, and can negatively impact neurological and cognitive development (Antonow-Schlorke *et al.,* 2011; Tolsa, Zimine & Warfield, 2004). This also increases the risk of insulin resistance and hypertension in the child in later life (Sinclair & Watkins, 2013).

Carbohydrates

According to Jaffer *et al.* (2008), carbohydrates refer to starch-based foods and most frequently consumed foods. Several studies have reported high carbohydrate intakes among pregnant women (Kesa & Oldewage-Theron, 2005; Mostert *et al.,* 2005; Klinger, 2004; Tshitaudzi, 2003; and Bopape, Mbhenyane & Alberts, 2008). Similarly, the study conducted in Cape Town reported that no participants had an inadequate carbohydrate intake (De Bruyn, 2015). However, very few pregnant women (23.2%) in the current study were able to meet the RDA for carbohydrates with a mean intake of 165.9±79.5g.

Fat

The mean fat intake (89.9g) in the study conducted in Cape Town by De Bruyn (2015) was greater than that found by Kesa and Oldewage-Theron (2005) (62.3g) and Tshitaudzi (2003) (48.4g). In the current study, the mean intake of fat (33.2±20.8g) was lower compared to previous studies with 12.9% within AI reference values. High-fat intakes may be linked to the greater palatability of fatty foods, such as fried foods, fatty meat cuts, full cream dairy products, as well as satiation effects when compared to low-fat options, such as lean meats and low-fat spreads (Weltens *et al.,* 2015; Grabenhorst & Rolls, 2014). Brooks *et al.* (2010) maintain that high-fat foods are also generally cheaper and more readily available than lower fat options in lower socio-economic status communities.

5.5.2.2. Micronutrients

Folate

Greenberg et al. (2011), explain that increased folate requirements during pregnancy, is caused by the demand for fetal growth. It has long been established that adequate folic acid intake at or around the time of conception reduces the risk of neural tube defects (De-Regil *et al.,* 2010). It is currently recommended that 400mcg folic acid supplementation be taken three months before and early on in pregnancy (IOM, 2011). Maternal folate status is largely determined by folate supplement use and through a number of other factors such as dietary folate intake and genetic variations (Greenberg *et al.,* 2011). The current study reported a mean intake of 284.4±174.9mcg of folate among participants which was below the recommendation given by the IOM (2005) with 83.9% of pregnant women being below the EAR reference value.

Vitamin C

Vitamin C acts as a reducing agent essential for collagen synthesis which is required for foetal bone development. Vitamin C works as an antioxidant, facilitating immune function, and may

help in preventing preeclampsia and premature membrane ruptures (Erick, 2012; Gallagher, 2012). In the study conducted in Cape Town by De Bruyn (2015), the mean intakes of vitamin C were above the EAR. Mostert *et al.* (2005) and Tshitaudzi (2003) reported that 73.9% and 25% of women in their samples, respectively, had vitamin C intakes of less than 67% of the RDA. The current study reported a mean intake of 49.0±49.8mg with a few pregnant women (56%) who met the EAR for vitamin C.

Calcium

The current study showed that the majority of pregnant women (99.7%) did not meet the recommended calcium intake (191.0±129.7mg). Mostert *et al.* (2005) and Klinger (2004) reported similar results with 85.6% below the RDA and 89.1% <67% of the RDA respectively, which indicates a general poor intake of dairy products. Daily calcium requirements for adult pregnant women do not increase because of the hormonal changes that increase the efficiency of calcium absorption and resorption (Erick, 2012). Women with long-term calcium inadequacy may be at increased risk for bone loss during pregnancy. Short term deficiencies may also lead to osteoporosis (Gallagher, 2012).

Iron

In the study conducted by De Bruyn (2015) in Cape Town, the mean intake of iron was well below the EAR for pregnant women and 99% of participants had an intake below the cut-point. Nearly all pregnant women (99.7%) in the current study did not meet the recommended RDA for iron intake (4.3±3.9mg). Iron requirements are increased in pregnancy to ensure adequate expansion of maternal plasma volume for sustaining foetal growth and nutrient transport. Low iron intakes thus clearly put the mother and foetus at risk of poor pregnancy outcomes (Scholl, 2011). Low iron intakes are usually the result of poor consumption of meat, eggs, legumes, whole-grain foods and fortified cereals (Gallagher, 2012).

Zinc

Tshitaudzi (2003) and Mostert *et al.* (2005) reported that zinc (62.5% and 93.5%) intakes were below 67% of the RDA. This could be explained by low intakes of red meat, poultry, dairy products and dark green leafy vegetables; as concluded by Jaffer *et al.* (2008), Kesa and Oldewage-Theron (2005) and Mostert *et al.* (2005) this could have been the main cause of deficiency. The current study reported a similar trend, where the majority of pregnant women (98.7%) did not meet the RDA for zinc, with a mean intake of 4.2±3.2mg.

5.6. Blood pressure status of pregnant women

The results of this study found that most pregnant women had normal SBP and DBP. According to Saving Mothers Report (2008 – 2010), hypertensive disorders were responsible for maternal death, stillbirth, and neonatal death. Nearly half of the pregnant women in Algeria, Tebessa town and England suffered from hypertension and diabetes (Taleb, Kaibi, & Deghboudj, 2011; Nzelu *et al.,* 2018). Studies by Taliep *et al.* (2010); Leunen *et al.* (2003) and Hall (2009) explains that during the 2008-2010 triennium, hypertensive disorders accounted for 14% of all maternal deaths in SA. The perinatal outcomes of the 679 hypertensive maternal deaths that occurred in SA, included 144 (21%) stillbirths and 18(2.7%) neonatal deaths, while 226 (33.3%) of the women died before delivery of their child.

5.7. Association between blood pressure and other variables

The results from the current study suggest that the majority of pregnant women were at low risk of developing high BP and that the mean intake of sodium (Na) and Chloride (Cl) was higher in the high-BP risk group and lower in the low-risk group, respectively. The INTERSALT study in SA indicated that BP increases with gestational age only if accompanied by increased salt intake (Sung, 2014). The current study showed a significant association between education level and high BP risk, with those who had passed Grade 12 having the highest risk (43.9%).

Majority of pregnant women in the current study had low risk for high BP, while a few had a high risk for high BP of above 120/80 mmHg. The mean intake of Na in mg in the high-risk BP group was significantly lower compared to the low-risk BP group. The mean intake of Cl in mg was similar in the high and low risk BP groups, with the high-risk group with only 3mg lower intake. A gestational age above 38 weeks was significantly more likely, than those with a gestation age of 12-20 weeks, to have been in the high-risk BP group (OR=3.29; p=0.00). Results from multiple linear regression analysed from the studies conducted in China, Japan, UK, and US were consistent with the preceding cross-classification findings on the Na– BP relation; thus all, the 4680 participants had higher Na urinary excretion in the previous 24-hours (134.0 and 118.7 mmol/24-h), were associated with SBP/DBP which was significantly higher (Stamler *et al.,* 2018).

CHAPTER SIX

CONCLUSIONS AND RECOMMENDATIONS OF THE STUDY

6.1. Introduction

This chapter presents the conclusions, limitations and recommendations of the study which was conducted on pregnant women from clinics and CHC of Thulamela Municipality. The aim of the study was to describe dietary salt intake, dietary practices and hypertensive status among pregnant women in Thulamela Municipality with the following objectives: to assess the dietary intake of pregnant women using a quantitative food frequency questionnaire (FFQ), to investigate the dietary practices of pregnant women, to assess the Bp of pregnant women using an automated BP monitor and lastly to determine the association between dietary salt intake and BP.

6.2. Conclusions

The objectives of the study were accomplished and the following conclusions were drawn:

6.2.1. Socio-demographic information

The study interviewed 379 pregnant women, attending antenatal services at Thulamela Primary Health Care Facilities. Majority of the pregnant participants were aged 21 to 30 years and unemployed. More than half of the pregnant women had passed Grade 12.

6.2.2. Dietary salt intake

In the study conducted in Cape Town (De Bruyn, 2015), sodium intake was above the AI of the study sample, with a mean intake of 2315.0 mg per day hence in the current study, 82.1% of the participants used iodated salt. Results from a study conducted in SA by Ware *et al.,* (2017) shows that adults' women had salt intakes far above WHO recommendations (5g/day). The study conclude that pregnant women were not meeting their daily nutrients intake.

6.2.3. Dietary practices

Majority of participants in the current study had received nutrition education. In this study, majority of pregnant women had accessed nutrition education from various platforms and nearly one third had received information from Mom-connect. Participants consumed fruits and vegetables at least 2 to 3 times a week which shows that they were able to acquire vitamins and minerals. Most participants indicated that they bought iodated salt from supermarkets and that they added salt when cooking and/or eating meals. Reading of labelled information before buying food items is essential as it allows pregnant women to make healthy choices of foods when buying.

6.2.4. Association between blood pressure and salt intake

The study discovered that the majority of pregnant women were at low risk of developing high BP. There was an association between gestational age and high-BP-risk group of pregnant women with gestational age above 38 weeks. The study also found low mean intake of sodium (Na) in the high-BP- risk group a high BP risk was negatively associated with sodium and chloride intake.

The data on the association between high salt (sodium chloride) intake and hypertension in black people from Africa have been summarised by Seedat (1996), who suggests that black people have an abnormal transport mechanism for sodium and a low rennin activity. A high intake of sodium is common in South Africa, particularly in poor settings, as it is used to preserve food or to make food tastier. Substantial amounts of salt are added to food, while cooking and monosodium glutamate-based flavouring cubes or salts are widely used to give taste to food. In addition to a high salt intake, people in sub-Saharan Africa frequently eat small amounts of fruit and vegetables resulting in low potassium intakes. Bread is a staple food for many people in this country and it contains high salt levels. Salt facilitates the baking process of bread.

6.3. Limitations of the study

The study did not determine the amount of salt consumed by pregnant women, the amount added in their meals and the pots' size used during food preparation. Anthropometric measurements where not taken as it would be difficult to associate the findings as a possible confounder for a high blood pressure, hence, the study findings can only be generalized to Thulamela Municipality.

6.4. Recommendations

- National initiatives should reduce the over-consumption of salt as part of non-communicable disease prevention and health nutrition policies to limit salt intake to less than 5 g/day should be implemented.

- There are several social platforms to deliver nutrition education, however, pregnant women who visit health facilities for ANC should always be given education because it may improve their nutrition knowledge and improve their dietary intake during pregnancy.

- To improve the control of high BP among South Africans, both the promotion of a healthy lifestyle and the early diagnoses and treatment of high BP are necessary.

- Previous research focused more on salt intake and hypertension yet, very little is known about the dietary salt intake, dietary practices and hypertension status among pregnant women. It is recommended, therefore, that more research be conducted on the same topic in different settings to generate more information.

- Consumer bodies, health experts including nutritionists and dietitians should plan programs/campaigns and awareness to sensitize consumers about the health impact of high salt consumption.

- The Department of Health should promote educational interventions for pregnant women to look at - labelled information, labelled salt information, terminologies used and foods that they are expected to consume during pregnancy.

- The study conclude that pregnant women were not meeting their daily nutrient intake, although, healthy eating during pregnancy, supports optimal growth and development

of the fetus and the physiological changes that occur in the mother. There is, therefore, an urgent need to educate women on healthy eating during pregnancy.

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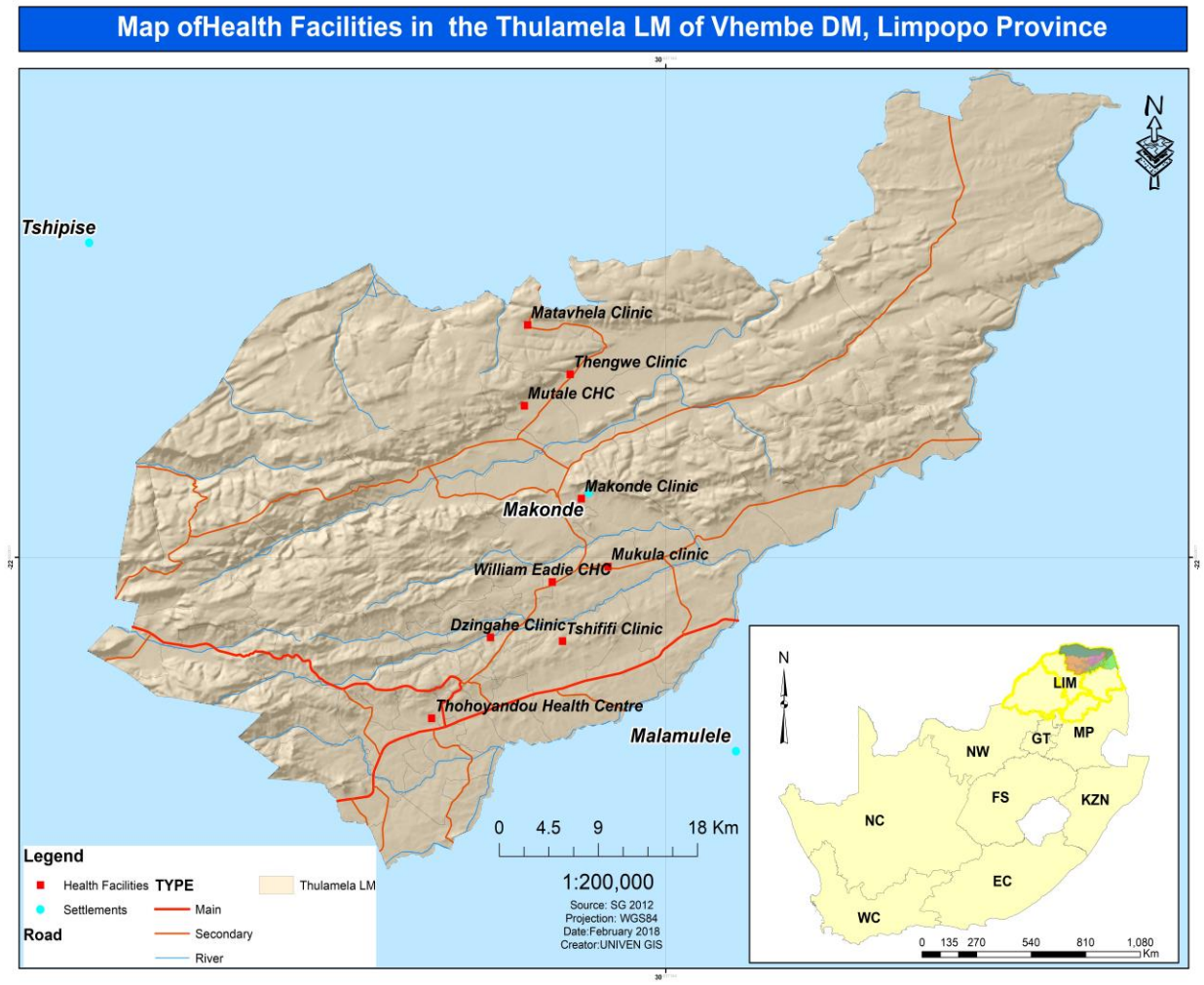
LIST OF APPENDICES

Appendix 1: Map of study area



Appendix 2: Request for permission to conduct research

University of Venda
P/Bag x5050
Thohoyandou 0950
06 June 2018

Thulamela district municipality
Department of Health
Thohoyandou 0950

Dear Sir/Madam

RE: Permission to conduct a research project"*Dietary salt intake, dietary practices and hypertensive status among pregnant women in Thulamela municipality".*

I, Munyai Tshifhiwa Elphas (11601680), a Masters Student in the Department of Nutrition in the University of Venda, hereby request permission to conduct a study in clinics and health centres within Thulamela municipality. The aim of the study is to describe dietary salt intake, dietary practices and hypertensive status among pregnant women in Thulamela municipality.

See the attached Ethical Clearance (Appendix 8) obtained form the University of Venda, proof of registration, permision letter (Appendix 9) from the Limpopo Provincial Department of Health and the research project proposal.

Looking forward for your positive response

Sincerely
Munyai Tshifhiwa Elphas
munyaite@gmail.com cell: 078 049 4045
Signature..... Date.....

Appendix 3: Information letter

RESEARCH ETHICS COMMITTEE

Information letter

Title of the Research Study: ***Dietary salt intake, dietary practices and hypertensive status among pregnant women in Thulamela municipality***

Principal Investigator/s/ researcher: Munyai TE, Bsc Nutrition

Co-Investigator/s/supervisor/s: Dr LF Mushaphi (Phd in Nutrition), Ms HV Mbhatsani (Msc in Nutrition) and Dr A. De Villiers (Phd in Nutrition)

Brief Introduction and Purpose of the Study:

The aim of the study was to describe dietary salt intake, dietary practices and hypertensive status of pregnant women in Thulamela municipality. The study adopted a quantitative cross-sectional survey design. Three local areas with Community Health Centers were purposively selected. Two clinics from each local area were randomly selected to make a total of three CHCs and six clinics. Moreover, pregnant women were selected by means of convenience sampling method. Sample size of pregnant women from antenatal visits was 379.

Outline of the Procedures:

The researcher interviewed pregnant women in a private room to ensure privacy and the professional nurse was responsible for taking blood pressure measurement. Pregnant women were asked questions based on Socio-Demographic information, Dietary salt intake and Dietary Practices. Two (2) stations were used during data collection, first station was for interview while the second station was for blood pressure measurement. A questionnaire written in a local language was used to collect data. Blood pressure measurements and interview was taken on the same day.

Risks or Discomforts to the Participant:

There was no risk in this study since participants were asked questions and measured their Blood pressure.

Benefits:

Pregnant women should know that a well-balanced diet is important on their health and for the normal growth of the fetus and that they should know what to eat in different trimesters of pregnancy to prevent diseases which may arise during this stage. Also, the study would help increase knowledge (dietary salt intake and dietary practices), provide baseline information and make it available to policymakers, researchers, health care workers, civil society organizations as well as families and communities who need to be aware on the size of the problem and advocate for more action towards better dietary salt intake, dietary practices at

any stage of life. The department of Health would benefit in the way that there would be a decrease in hypertensive status during pregnancy.

Reason/s why the Participant May Be Withdrawn from the Study:

Researcher clearly and sufficient explained information about the purpose of the study to participants, and also check the principle of voluntary consent or willingness to participate in research. For example, that the study is voluntary, participants have a right to refuse to participate in the study, and that they have a right to withdraw at any time from the study without getting any penalties.

Remuneration:

Participants did not receive any monetary or types of remuneration

Costs of the Study:

No cost was expected to be covered by participants for the study.

Confidentiality:

Participants remained anonymous (nameless) where codes instead of names was used throughout the study, and this will always be adhered to by the researcher. The researcher assured participants that the information given in confidence will be protected, completed interview schedules were kept private in a safe locked place and only be accessed by the researcher and the study supervisors. Furthermore, it would be kept until the research report is accepted by the authorities concerned.

Research-related Injury:

No compensation was offered hence responsible people (Researcher, Supervisors, and Health facility manager) will be contacted to offer their help.

Persons to Contact in the Event of Any Problems or Queries:

(Dr LF Mushaphi and Ms HV Mbhatsani Supervisor and details) Please contact the researcher (tel no.0780494045), my supervisor (tel no.0159628334) or the University Research Ethics Committee Secretariat on 015 962 9058. Complaints can be reported to the Director: Research and Innovation, Prof GE Ekosse on 015 962 8313 or Georges Ivo.Ekosse@univen.ac.za

Appendix 4A: Questionnaire (English) **CODE** | | | | |

Name of the interviewer_____
Date of the interview **DD**_____**MM**_____**YY**_____
Instructions:

- Please answer all the questions
- Indicate your answer by X or fill in gaps
- No wrong or right answer

SECTION A: SOCIO DEMOGRAPHIC INFORMATION

1. Date of birth _____(Day)_____(Month)_____(Year)
2. Age_____(Years)
3. Marital status

Single	1
Married	2
Living with a partner	3
Widow	4
Divorced	5
Other, specify	6

4. Ethnic group

Venda	1
Tsonga	2
Tswana	3
Pedi	4
Sotho	5
Other, specify	6

5. Educational level

Never attended	1
Grade 1-4	2
Grade 5-7	3
Grade 8-10	4
Grade 11-12	5
Passed grade 12	6
Tertiary	7

6. Are you employed?

Yes	1	No	2

7. If Yes to Q6, what type of employment?

School teacher	1
Health care worker	2
Police, traffic officers	3
Security guards	4
Domestic worker	5
Labourer	6
Other, specify	7
Not applicable	8

8. If No to Q6, what is the source of income?

Social grant (Specify)	1
Husband	2
Parents	3
Guardian	4
Not applicable	5

9. Total household income per month

≤R2000	1
R2001 –R5000	2
R5001 – R10000	3
R1001 – R15000	4
Above R150000	5

10. Is this your first pregnancy?

Yes	1	No	2

<u>If No to Q10, answer the following</u>

11. Number of pregnancies including this one……..
12. Number of children lived……
13. Number of children died……

14. Gestational age

12 - 20 weeks	1
21 - 30 weeks	2
31 - 38 weeks	3
Above 38 weeks	4

<u>Have you been previously diagnosed of any of the following chronic diseases?</u>

15. Diabetes mellitus

Yes	1	No	2

16. Hypertension

Yes	1	No	2

17. Cardiovascular diseases

Yes	1	No	2

18. Stroke

Yes	1	No	2

19. Ulcer

Yes	1	No	2

20. Allergies

Yes	1	No	2

21. Other (specify)……

22. Are you on special diet?

Yes	1	No	2

23. If Yes to Q22, what kind of diet do you follow?

Diabetic	1
Diet to achieve eight gain	2
Low Fat	3
Low cholesterol	4
Low salt	5
Ulcer	6
High potassium	7
Other, specify	8
Not applicable	9

24. Are you taking any medication for the condition mentioned above?

Yes	1	No	2

25. Did you receive nutrition advices on what to eat during pregnancy?

Yes	1	No	2

26. If Yes to Q25, was the nutrition advice received from?

	Yes	No
Nurse	1	2
Relatives (Mother, grandmother etc.)	1	2
Nutritionist/Dietician	1	2
Radio, TV	1	2
Internet	1	2
Read from printed material	1	2
Mom connect	1	2
Not applicable	1	2

SECTION B: BLOOD PRESSURE READINGS

Systolic 1……..2……3……
Diastolic 1…….2……3……

SECTION C: DIETARY PRACTICES

Dietary practices will be assessed in terms of number of meals consumed per day, food preparation methods and also fast-food outlets.

27. Number of meals per day…….
28. Do you usually skip meals?

Yes	1	No	2

29. If Yes to Q29, which one do you usually skip?

Breakfast	1	Lunch	2	Dinner	3	Not applicable	4

30. Reason(s) for skipping meals…….
……
……
31. Do you crave for food or non-food items?

Yes	1	No	2

32. If Yes to Q32, indicate food or non-food items you crave for.....

……
……

33. Where do you usually buy salt?

Spaza	1
Supermarkets	2
Social grant stations	3

34. Which type of salt do you use?

Types of salt		Yes	No
35.1	Fortified (Iodated) table salt	1	2
35.2	Corse salt (Iodated)	1	2
35.3	Crunched animal salt	1	2
35.4	Spices	1	2
35.5	Mono-sodium glutamate (Aromat, soy, tomatoes, sauces, sausages)	1	2
35.6	Soup	1	2
35.7	Don't know	1	2

35. When do you usually add salt in your meals?

Never add	1
Cooking	2
Eating	3
Cooking and eating	4

36. Do you remove visible fats from meat and meat products before cooking or when eating?

Yes	1	No	2

37. How often do you eat vegetable?

Did not eat	1
Once a week	2
2-3 times a week	3
Daily	4

38. How often do you eat fruits?

Did not eat	1
Once a week	2
2-3 times a week	3
Daily	4

39. Do you check the label before you buy food items?

Yes	1	No	2	Sometimes	3

40. Do you know how to read nutrition information on food items?

Yes	1	No	2

41. If Yes to Q41, do you read nutrition information regarding salt labelling on food products?

Yes	1	No	2	Not applicable	3

SECTION D: DIETARY SALT INTAKE (FFQ)

Food item	Per week				Per day				Portion size estimation				Comments relating to *Frequencies that needed to be explored further (seemed unlikely high) *Preparation
									Standard (std)	**Portion size**			
Starchy food													
Maize dishes-Pap	Did not eat	1-2 per week	3-4 per week	5-6 per week	1 per day	2 per day	3 per day	4 per day	Use flour model	¼ cup	½ cup	1 cup	
Samp	Did not eat	1-2 per week	3-4 per week	5-6 per week	1 per day	2 per day	3 per day	4 per day	Use flour model	¼ cup	½ cup	1 cup	
Rice	Did not eat	1-2 per week	3-4 per week	5-6 per week	1 per day	2 per day	3 per day	4 per day	Use flour model	¼ cup	½ cup	1 cup	
Bread-brown	Did not eat	1-2 per week	3-4 per week	5-6 per week	1 per day	2 per day	3 per day	4 per day	Bread: DAEK pictures	Thin	Med	Thick	
Bread-white	Did not eat	1-2 per week	3-4 per week	5-6 per week	1 per day	2 per day	3 per day	4 per day	Bread: DAEK pictures	Thin	Med	Thick	
Rolls	Did not eat	1-2 per week	3-4 per week	5-6 per week	1 per day	2 per day	3 per day	4 per day	Roll: Std = DAEK pictures	½ x Std	1 x Std	1½ x Std	
Other please specify…….	Did not eat	1-2 per week	3-4 per week	5-6 per week	1 per day	2 per day	3 per day	4 per day					
Protein food													
Chicken	Did not eat	1-2 per week	3-4 per week	5-6 per week	1 per day	2 per day	3 per day	4 per day	One size only	30g			
Beef	Did not eat	1-2 per week	3-4 per week	5-6 per week	1 per day	2 per day	3 per day	4 per day	Spoons: DEAK pictures or wood spoon in kit	Teasp	Tabsp	Ladle	
Offal (Beef, Chicken, etc)	Did not eat	1-2 per week	3-4 per week	5-6 per week	1 per day	2 per day	3 per day	4 per day	Spoons: DEAK pictures or wood spoon in kit	Teasp	Tabsp	Ladle	
Feet	Did not eat	1-2 per week	3-4 per week	5-6 per week	1 per day	2 per day	3 per day	4 per day	Spoons: DEAK pictures or wood spoon in kit	Teasp	Tabsp	Ladle	
Boerewors	Did not eat	1-2 per week	3-4 per week	5-6 per week	1 per day	2 per day	3 per day	4 per day	Use DEAK picture, indicate in centimeters	……cm			
Pork	Did not eat	1-2 per week	3-4 per week	5-6 per week	1 per day	2 per day	3 per day	4 per day	Spoons: DEAK pictures or wood spoon in kit	Teasp	Tabsp	Ladle	

Fish	Did not eat	1-2 per week	3-4 per week	5-6 per week	1 per day	2 per day	3 per day	4 per day	Spoons: DEAK pictures or wood spoon in kit	Teasp	Tabsp	Ladle	
Eggs	Did not eat	1-2 per week	3-4 per week	5-6 per week	1 per day	2 per day	3 per day	4 per day	Spoons: DEAK pictures or wood spoon in kit	Teasp	Tabsp	Ladle	
Mopani worms	Did not eat	1-2 per week	3-4 per week	5-6 per week	1 per day	2 per day	3 per day	4 per day	Spoons: DEAK pictures or wood spoon in kit	Teasp	Tabsp	Ladle	
Soya mince	Did not eat	1-2 per week	3-4 per week	5-6 per week	1 per day	2 per day	3 per day	4 per day	Spoons: DEAK pictures or wood spoon in kit	Teasp	Tabsp	Ladle	
Other please specify……	Did not eat	1-2 per week	3-4 per week	5-6 per week	1 per day	2 per day	3 per day	4 per day					
Vegetables													
Cabbage	Did not eat	1-2 per week	3-4 per week	5-6 per week	1 per day	2 per day	3 per day	4 per day	Spoons: DEAK pictures or wood spoon in kit	Teasp	Tabsp	Ladle	
Spinach	Did not eat	1-2 per week	3-4 per week	5-6 per week	1 per day	2 per day	3 per day	4 per day	Spoons: DEAK pictures or wood spoon in kit	Teasp	Tabsp	Ladle	
Chinese's leaves	Did not eat	1-2 per week	3-4 per week	5-6 per week	1 per day	2 per day	3 per day	4 per day	Spoons: DEAK pictures or wood spoon in kit	Teasp	Tabsp	Ladle	
Beetroot	Did not eat	1-2 per week	3-4 per week	5-6 per week	1 per day	2 per day	3 per day	4 per day	Spoons: DEAK pictures or wood spoon in kit	Teasp	Tabsp	Ladle	
Butternut	Did not eat	1-2 per week	3-4 per week	5-6 per week	1 per day	2 per day	3 per day	4 per day	Spoons: DEAK pictures or wood spoon in kit	Teasp	Tabsp	Ladle	
Carrots	Did not eat	1-2 per week	3-4 per week	5-6 per week	1 per day	2 per day	3 per day	4 per day	Spoons: DEAK pictures or wood spoon in kit	Teasp	Tabsp	Ladle	
Potatoes	Did not eat	1-2 per week	3-4 per week	5-6 per week	1 per day	2 per day	3 per day	4 per day	Use flour model	¼ cup	½ cup	1 cup	
Other please specify……	Did not eat	1-2 per week	3-4 per week	5-6 per week	1 per day	2 per day	3 per day	4 per day					
Fruits													
Apple	Did not eat	1-2 per week	3-4 per week	5-6 per week	1 per day	2 per day	3 per day	4 per day	Use DEAK pictures	Small	Med	Large	
Banana	Did not eat	1-2 per week	3-4 per week	5-6 per week	1 per day	2 per day	3 per day	4 per day	Use DEAK pictures	Small	Med	Large	
Orange	Did not eat	1-2 per week	3-4 per week	5-6 per week	1 per day	2 per day	3 per day	4 per day	Use DEAK pictures	Small	Med	Large	
Pawpaw	Did not eat	1-2 per week	3-4 per week	5-6 per week	1 per day	2 per day	3 per day	4 per day	Use DEAK pictures	Small	Med	Large	

Other please specify……	Did not eat	1-2 per week	3-4 per week	5-6 per week	1 per day	2 per day	3 per day	4 per day					
Dairy products													
Milk full cream	Did not eat	1-2 per week	3-4 per week	5-6 per week	1 per day	2 per day	3 per day	4 per day	Std=1full mug/ glass use mug/ glass kit	½ x std	1x std	1 ½ x std	
Milk low fat	Did not eat	1-2 per week	3-4 per week	5-6 per week	1 per day	2 per day	3 per day	4 per day	Std=1full mug/ glass use mug/ glass kit	½ x std	1x std	1 ½ x std	
Sour milk	Did not eat	1-2 per week	3-4 per week	5-6 per week	1 per day	2 per day	3 per day	4 per day	Std=1full mug/ glass use mug/ glass kit	½ x std	1x std	1 ½ x std	
Milk skim	Did not eat	1-2 per week	3-4 per week	5-6 per week	1 per day	2 per day	3 per day	4 per day	Std=1full mug/ glass use mug/ glass kit	½ x std	1x std	1 ½ x std	
Yoghurt	Did not eat	1-2 per week	3-4 per week	5-6 per week	1 per day	2 per day	3 per day	4 per day	Use unit volume	75 ml	100 ml	125 ml	
Other please specify……	Did not eat	1-2 per week	3-4 per week	5-6 per week	1 per day	2 per day	3 per day	4 per day					
Fatty food and sweets													
Potato chips	Did not eat	1-2 per week	3-4 per week	5-6 per week	1 per day	2 per day	3 per day	4 per day	Unit weight				
Pizza	Did not eat	1-2 per week	3-4 per week	5-6 per week	1 per day	2 per day	3 per day	4 per day	Std = DEAK picture	½ x std	1x std	1 ½ x std	
Fat cakes	Did not eat	1-2 per week	3-4 per week	5-6 per week	1 per day	2 per day	3 per day	4 per day	Std= DEAK picture	½ x std	1x std	1 ½ x std	
Cake	Did not eat	1-2 per week	3-4 per week	5-6 per week	1 per day	2 per day	3 per day	4 per day	Std= DEAK picture	½ x std	1x std	1 ½ x std	
Archar	Did not eat	1-2 per week	3-4 per week	5-6 per week	1 per day	2 per day	3 per day	4 per day	Spoons: DEAK pictures or wood spoon in kit	Teasp	Tabsp	Ladle	
Margarine	Did not eat	1-2 per week	3-4 per week	5-6 per week	1 per day	2 per day	3 per day	4 per day	Card	Thin	Med	Think	

Peanut butter	Did not eat	1-2 per week	3-4 per week	5-6 per week	1 per day	2 per day	3 per day	4 per day	Card	Thin	Med	Think	
Jam	Did not eat	1-2 per week	3-4 per week	5-6 per week	1 per day	2 per day	3 per day	4 per day	Card	Thin	Med	Think	
Biscuits	Did not eat	1-2 per week	3-4 per week	5-6 per week	1 per day	2 per day	3 per day	4 per day	Unit weight = 1 biscuits				
Simba	Did not eat	1-2 per week	3-4 per week	5-6 per week	1 per day	2 per day	3 per day	4 per day	Use unit weight				
Polony	Did not eat	1-2 per week	3-4 per week	5-6 per week	1 per day	2 per day	3 per day	4 per day	How big (small or Big slice) How think	Thin	Med	Think	
Vienna	Did not eat	1-2 per week	3-4 per week	5-6 per week	1 per day	2 per day	3 per day	4 per day	Use DEAK pictures (shorter / longer vienna)				
Mageu	Did not eat	1-2 per week	3-4 per week	5-6 per week	1 per day	2 per day	3 per day	4 per day	Std = 1 full mug / glass	½ x std	1x std	1 ½ x std	
Cool drink	Did not eat	1-2 per week	3-4 per week	5-6 per week	1 per day	2 per day	3 per day	4 per day	Std = 1 full mug / glass	½ x std	1x std	1 ½ x std	
Squash	Did not eat	1-2 per week	3-4 per week	5-6 per week	1 per day	2 per day	3 per day	4 per day	Std = 1 full mug / glass	½ x std	1x std	1 ½ x std	
100% juice	Did not eat	1-2 per week	3-4 per week	5-6 per week	1 per day	2 per day	3 per day	4 per day	Std = 1 full mug / glass	½ x std	1x std	1 ½ x std	
Other please specify……	Did not eat	1-2 per week	3-4 per week	5-6 per week	1 per day	2 per day	3 per day	4 per day					

Appendix 4B: Translated Questionnaire (Tshivenda) **KHOUDU**

Madzina a muvhudzisi_____
Datumu **DD**_____**MM**_____**YY**_____
Ndaela:

- Vha humbelwa ufhindula mbudziso dzothe
- Vha swaye phindulo nga X na nga udadza zwikhalo zwoneiwaho
- Ahuna phindulo ire yone na isi yone

SECTION A: SOCIO DEMOGRAPHIC INFORMATION

1. Duvha la mabebo _____(Duvha)_____(Nwedzi)_____(Nwaha)
2. Minwaha_____
3. Tshiomo tsha mbingano

Thingo malwa	1
Ndo maliwa	2
Ndi dzula na muthu wanga	3
Ndo lovhelwa	4
Ndo taliwa	5

4. Murafho

Venda	1
Tsonga	2
Tswana	3
Pedi	4
Sotho	5

5. Pfunzo

Thingo dzhena	1
Murole 1-4	2
Murole 5-7	3
Murole 8-10	4
Murole 11-12	5
Phasa murole wa 12	6
Gudedzini la ntha	7

6. Vhaya shuma/ Vho tholiwa na?

Ee	1	Hai	2

7. Arali vho fhindula uri Ee kha Q6, ndi mushumo wa lushaka de?

Mudededzi	1
Mushumeli wa zwa mutakalo	2
Pholisa, Mulanga vhuendi	3
Mulindi wa zwa tsireledzo	4
Mushumi wa nduni	5
Mishumo ilemelaho	6
Minwevho mishumo	7

8. Arali vhori Hai kha Q6, masheleni vha a wana gai?

Mudende (Vhataluse)	1
Mukalaha/Munna	2
Vhabebi	3
Muundi	4

9. Muholo nganwedzi

≤R2000	1
R2001 –R5000	2
R5001 – R10000	3
R1001 – R15000	4
Ntha ha R150000	5

10. Vha muimana lwauthoma?

Ee	1	No	2

Arali vhori Hai kha Q10, avha fhindule zwitevhelaho

11. Tshivhalo tsha vhana tsha thumbu ro katela nayeyi……..
12. Tshivhalo tsha vhana vhane vha khou tshila……
13. Tshivhalo tsha vhana vholovhaho……

14. Vha muimana nga vhege nngana

12 - 20 weeks	1
21 - 30 weeks	2
31 - 38 weeks	3
Above 38 weeks	4

Vhono vhuya vha farwa nga malwadze asa fholi?

15. Vhulwadze ha swigiri

Ee	1	Hai	2

16. Mutsiko wa malofha

Ee	1	Hai	2

17. Malwadze a mbilu

Ee	1	Hai	2

18. Sitirouku

Ee	1	Hai	2

19. Ulcer

Ee	1	Hai	2

20. Aledzhi

Ee	1	Hai	2

21. Zwinwevho (avha taluse)……

22. Huna zwiliwa mbetshelwa zwine vha la?

Ee	1	Hai	2

23. Arali vhori Ee kha Q22, ndi zwiliwa de zwine vha zwila?

Diabetic	1
Diet to achieve weight gain	2
Low Fat	3
Low cholesterol	4
Low salt	5
Ulcer	6
High potassium	7
Other, specify	8
Not applicable	9

24. Huna dzilafho line vhali dzhia malugana na malwadze are afho ntha?

Ee	1	Hai	2

25. Vhono vhuya vha fhiwa ngeletshedzo yanga ha kulele kwa zwiliwa musi vha muimana?

Ee	1	Hai	2

26. Arali vhori Ee kha Q25, vho fhiwa nga nnyi?

	Ee	Hai
Muongi	1	2
Mashaka (Mme, makhulu etc)	1	2
Mudivhi wa zwiliwa	1	2
Radio, thelevishini	1	2
Inthanenthe	1	2
U vhala kha zwirathisi zwoto gandiwaho	1	2
Mom connect	1	2

27. Tshikalo tsha kutshimbilele kwa malofha
Systolic 1……..2……3……
Diastolic 1…….2……3……

SECTION C: DIETARY PRACTICES

Ku lele kwa zwiliwa kudo tolwa musi ho sedzwa tshivhalo tsha zwiliwa zwono liwa nga duvha, ku bikele na zwiliwa zwono rengwa nnda zwo bikwa.

28. Tshivhalo tsha zwiliwa zwine vhala nga duvha…….
29. Vhaya ita vha tshi pfuka zwiliwa?

Ee	1	Hai	2

30. Arali vhori Ee kha Q29, vha pfuka zwifhio?

Vhuragane	1	Zwa masiari	2	Tshiswitulo	3	Azwi weli	4

31. Muhumbulo muhulwane wau pfuka ula zwiliwa……
……
……
32. Vhana dzangalelo la u la zwiliwa na zwisi zwiliwa?

Ee	1	Hai	2

33. Arali vhori Ee kha Q32, avha sumbedzise zwiliwa na zwisi zwiliwa zwine vha vha na dzangalelo nazwo.....
.....

34. Muno vha u renga fhi?

Tshiphazani	1
Suphamakete	2
Mundendeni	3

35. Vha shumisa muno ufhio?

Types of salt		Ee	Hai
35.1	Fortified (Iodated) table salt	1	2
35.2	Corse salt (Iodated)	1	2
35.3	Crunched animal salt	1	2
35.4	Spices	1	2
35.5	Mono-sodium glutamate (Aromat, soy, tomatoes, sauces, sausages)	1	2
35.6	Soup	1	2

36. Ndi lini hune vha shela muno zwiliwani?

Thi sheli muno	1
Musi ndi tshi bika	2
Ndi tshi la zwiliwa	3
Ndi khou bika na musi ndi tshi la	4

37. Vhaya bvisa mapfura avhonalaho kha nama na kha zwinwe zwibveledzwa zwa nama vhasathu bika namusi vha khou la?

Ee	1	Hai	2

38. Vha la miroho lungana?

A thili	1
Luthihi nga vhege	2
Luvhili uya kha luraru nga vhege	3
Duvha linwe na linwe	4

39. Vha la mitshelo lungana?

A thili	1
Luthihi nga vhege	2
Luvhili uya kha luraru nga vhege	3
Duvha linwe na linwe	4

40. Vhaya sedza zwonwalwaho kha zwiliwa vha sathu renga

Ee	1	Hai	2	Tshinwe tshifhinga	3

41. Vhaya kona u vhala mafhungo angaha thimbanywa kha zwiliwa

Ee	1	Hai	2

42. Arali vhori Ee kha Q41, vhaya vhala mafhungo a thimbanywa ya muno kha zwiliwa

Ee	1	Hai	2	Azwi weli	3

Appendix 5A: Univen informed consent

Statement of Agreement to Participate in the Research Study:

- I hereby confirm that I have been informed by the researcher, (*Munyai Tshifhiwa Elphas*), about the nature, conduct, benefits and risks of this study - Research Ethics Clearance Number: SHS/18NUT/06/2406,
- I have also received, read and understood the above written information (*Participant Letter of Information*) regarding the study.
- I am aware that the results of the study, including personal details regarding my sex, age, date of birth, initials and diagnosis will be anonymously processed into a study report.
- In view of the requirements of research, I agree that the data collected during this study can be processed in a computerized system by the researcher.
- I may, at any stage, without prejudice, withdraw my consent and participation in the study.
- I have had sufficient opportunity to ask questions and (of my own free will) declare myself prepared to participate in the study.
- I understand that significant new findings developed during the course of this research which may relate to my participation will be made available to me.

Full Name of Participant Date Time Signature

I, ……. …… …… ……..

(*Munyai Tshifhiwa Elphas*) herewith confirm that the above participant has been fully Informed about the nature, conduct and risks of the above study.

Full Name of Researcher

…….Date……. Signature……

Full Name of Witness (If applicable)

…….Date ……. Signature……..

Full Name of Legal Guardian (If applicable)

…….....Date…… Signature…….

Appendix 5B: Translated consent form (Tshivenda)

Dietary salt intake, dietary practices and hypertensive status among pregnant women in Thulamela municipality

Tshitatamende tsha thendelano ya u dzhenelela kha thoduluso:

- Nne ndi khou tenda uri ndo divhadzwa nga mutodulusi, (*Munyai Tshifhiwa Elphas*), malugana na vhuvha ha thoduluso, mbuyelwa na khombo dza ngudo heyi - Research Ethics Clearance Number: SHS/18NUT/06/2406,
- Ndo tanganedza, nda vhala nda pfesesa mafhungo o nwalwaho afho ntha ngaha ngudo.
- Ndi na ndivho nga ha mawanwa a ngudo, zwitshi angaredza zwidodombedzwa zwavhune zwitshiya kha mbeu yanga, minwaha, mabebo, madzina,
- Malugana na thodea dza thoduluso, ndo tenda uri mafhungo makuvhanganywa kha hedzi ngudo anga dzudzanywa nga khomphiyutha nga mutodulusi.
- Ndi nga, tshifhinga tshinwe na tshinwe, ndi songo kombetshedzwa, u litsha uvha tshipida tsha hedzi ngudo
- Ndo nekedzwa tshikhala tsholinganaho u vhudzisa mbudziso na (uya ngaha lufuno lwanga) udinekedzela uvha tshipida tsha ngudo.
- Ndia pfesesa uri vhundeme ha mawanwa maswa vhukatini ha thoduluso zwine zwiyelana na u di dzhenisa hanga zwido itwa uri ndi zwi divhe.

Madzina nga vhudalo Duvha Tsaino

Nne, …… …….. ……..

(*Munyai Tshifhiwa Elphas*) ndi khou tenda uri avho vho madzina are afho ntha vho talutshedzwa nga ha tshivhumbeo na maitele a hedzi thoduluso nga vhudalo.

Madzina a mutodulusi Datumu Tsaino

…… ……. ……

Appendix 6: 24 HOUR RECALL

The researcher will conduct 24-hour recall to create food list for FFQ, check food list against food composition table/ food finder and also check level of sodium.

Food Item	Serving Size	Quantity	Time Consumed (Morning, Afternoon & Evening)

Appendix 7: University Higher Degrees Committee (UHDC) Approval

UNIVERSITY OF VENDA

OFFICE OF THE DEPUTY VICE-CHANCELLOR: ACADEMIC

TO : MR/MS T.E MUNYAI

SCHOOL OF HEALTH SCIENCES

FROM: SENIOR PROFESSOR L.B KHOZA

DEPUTY VICE-CHANCELLOR: ACADEMIC

DATE : 23 APRIL 2018

DECISIONS TAKEN BY UHDC OF 23RD APRIL 2018

Application for approval of Master's research proposal in Health Sciences: **T.E Munyai (11601680)**

Topic: "Dietary salt intake, dietary practices and hypertensive disorders among pregnant women in Thulamela Municipality."

Supervisor	UNIVEN	Dr. L.F Mushaphi
Co-supervisors	UNIVEN	Ms. H.V Mbhatsani
	UNIVEN	Dr. A. De Villiers

UHDC approved Master's proposal

13/June 2018

Senior Professor L.B. Khoza
ACTING DEPUTY VICE-CHANCELLOR: ACADEMIC

Appendix 8: Ethical clearance - University of Venda

RESEARCH AND INNOVATION
OFFICE OF THE DIRECTOR

NAME OF RESEARCHER/INVESTIGATOR:
Mr TE Munyai

Student No:
11601680

PROJECT TITLE: **Dietary salt intake, dietary practises and hypertensive disorders among pregnant women in Thulamela Municipality.**

PROJECT NO: **SHS/18/NUT/06/2406**

SUPERVISORS/ CO-RESEARCHERS/ CO-INVESTIGATORS

NAME	INSTITUTION & DEPARTMENT	ROLE
Dr LF Mushaphi	University of Venda	Supervisor
Ms HV Mbhatsani	University of Venda	Co - Supervisor
Dr A De Villiers	SAMRC	Co - Supervisor
Mr TE Munyai	University of Venda	Investigator – Student

ISSUED BY:
UNIVERSITY OF VENDA, RESEARCH ETHICS COMMITTEE

Date Considered: July 2018
Decision by Ethical Clearance Committee Granted
Signature of Chairperson of the Committee: .....
Name of the Chairperson of the Committee: Senior Prof. G.E. Ekosse

UNIVERSITY OF VENDA
DIRECTOR
RESEARCH AND INNOVATION
2018 -07- 04
Private Bag X5050
Thohoyandou 0950

University of Venda
PRIVATE BAG X5050, THOHOYANDOU, 0950λ LIMPOPO PROVINCEλ SOUTH AFRICA
TELEPHONE (015) 962 8504/8313 **FAX** (015) 962 9060
"A quality driven financially sustainable, rural-based Comprehensive University"

Appendix 9: Permission letter - Limpopo Provincial Department of Health

LIMPOPO
PROVINCIAL GOVERNMENT
REPUBLIC OF SOUTH AFRICA

DEPARTMENT OF HEALTH

Enquiries: Stander SS (015 293 6650) Ref: **LP_2018_07_018**

Munyai TE
University of Venda

Greetings,

RE: Dietary salt intake, dietary practises and hypertensive disorders among pregnant women in Thulamela Municipality.

The above matter refers.

1. Permission to conduct the above mentioned study is hereby granted.
2. Kindly be informed that:-
   - Research must be loaded on the NHRD site (http://nhrd.hst.org.za) by the researcher.
   - Further arrangement should be made with the targeted institutions, after consultation with the District Executive Manager.
   - In the course of your study there should be no action that disrupts the services, or incur any cost on the Department.
   - After completion of the study, it is mandatory that the findings should be submitted to the Department to serve as a resource.
   - The researcher should be prepared to assist in the interpretation and implementation of the study recommendation where possible.
   - The above approval is valid for a 3 year period.
   - If the proposal has been amended, a new approval should be sought from the Department of Health.
   - Kindly note, that the Department can withdraw the approval at any time.

Your cooperation will be highly appreciated.

Head of Department

06/08/2018
Date

Private Bag X9302 Polokwane
Fidel Castro Ruz House, 18 College Street. Polokwane 0700. Tel: 015 293 6000/12. Fax: 015 293 6211.
Website: http/www.limpopo.gov.za

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Appendix 10: Permission letter – The Department of Health, Vhembe District

LIMPOPO
PROVINCIAL GOVERNMENT
REPUBLIC OF SOUTH AFRICA

DEPARTMENT OFHEALTH
VHEMBE DISTRICT

Ref: S5/6
Enq: Muvari MME
Date: 14 August 2018

Dear Sir/ Madam:

PERMISSION TO CONDUCT RESEARCH ON : MUNYAI T.E

1. The above matter bears reference
2. Your letter received on the 14/08/2018 requesting for permission to conduct research in our facilities is hereby acknowledged
3. The District has no objection to your request.
4. Permission is therefore granted for the request to be conducted within Vhembe District.
5. You are however advised to make the necessary arrangements with the facilities concerned.
6. Wishing you success in your research in the Vhembe health facilities.

.....
CHIEF DIRECTOR

27/08/2018
DATE

Private Bag X5009 THOHOYANDOU 0950
OLD parliamentary Building Tel (015) 962 1000 (Health) (015) 962 4958 (Social Dev) Fax (015) 962 2274/4623
Old Parliamentary Building Tel: (015) 962 1848, (015) 962 1852, (015) 962 1754, (015) 962 1001/2/3/4/5/6 Fax (015) 962 2373, (015) 962 227

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Appendix 11: Editor's certificate

PROOF OF EDITING

19 October, 2021

This is to certify that I, Dr P Kaburise, of the English Department, University of Venda, have proofread the research report, titled - **DIETARY SALT INTAKE, DIETARY PRACTICES AND HYPERTENSIVE STATUS AMONG PREGNANT WOMEN IN THULAMELA MUNICIPALITY** - by **Munyai Tshifhiwa Elphas** (student number: 11601680). I have indicated some amendments which the student has undertaken to effect, before the final report is submitted.

Dr P Kaburise (0794927451, 0637348805; email: phyllis.kaburise@gmail.com)

Dr P Kaburise: BA (Hons) University of Ghana (Legon, Ghana); MEd University of East Anglia (Cambridge/East Anglia, United Kingdom); Cert. Teaching English as a Foreign Language (Cambridge University, United Kingdom); Cert. English Second Language Teaching, (Wellington, New Zealand); PhD University of Pretoria (South Africa)