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ESTIMATING THE IMPACT OF MATERNAL SOCIODEMOGRAPHIC FACTORS ON NUTRITION AND ANTHROPOMETRIC OUTCOMES OF MOTHERS AND CHILDREN IN SOUTH AFRICA

By

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DECLARATION

I **Benjamin Aye Simon** declare that:

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ABSTRACT

The overriding purpose of this study was to determine the impact of maternal socioeconomic and/or sociodemographic factors on both maternal and childhood nutrition and health in South Africa. This study draws on a customised theoretical model that put into account the UNICEF framework and the foetal-maternal interaction model as a probable theoretical model of maternal and neonatal nutrition and morbidities. The framework is structured around four (4) stages that result in both maternal and childhood nutritional intake and morbidity. In it, the interplay between the UNICEF and the foetal-maternal relationship frameworks highlights that maternal and childhood nutrition and health is not a simple problem with a single simple solution. A similarly intricate series of approaches – multifaceted and multisectoral – are necessary to effectively deal with it.

This study adopted a non-experimental quantitative research approach for extracting the required data for this study. The researcher used a secondary data from the 2016 South Africa Demographic and Health Survey (SA-DHS), which complies with common demographic health surveys research design policy. The use of an explanatory research approach allows the researcher to provide an in-depth evaluation, investigation, understanding and insight analysis about the current state of maternal and under-fives health relative to nutrition in South Africa. Consequently, a survey research design was used to enrolled 1460 participants into the study from a total target population of 4081 – indicating that the SA-DHS is representative in nature. The SA-DHS 2016 followed a stratified sample technique by employing a two-stage stratified design with a probability proportional to size and systematic sampling of the dwelling units.

The findings from this study revealed that 73.11% of the respondents met the minimum complementary feeding index relative to the 26.90% who did not. Furthermore, using the household wealth index as a proxy indicator for maternal socioeconomic status of households, the results statistically associate maternal socioeconomic status and complementary feeding practice – where (X^2 = 23.56; p-value = 0.000). Suggesting that high wealth index households are more likely to meet the minimum acceptable dietary diversity relative to those with low wealth index. Similarly, after controlling for confounders, the results from the logistic regression negatively associate minimum acceptable diets with maternal education and household wealth index. Indicating lower or no education and lower wealth index were associated with not meeting the minimum acceptable diets of under-fives. On maternal BMI, the results found that the average BMI for the sample was 28.06 kg/m^2, with 63.60% of the mothers either (overweight 29.85% or obese 33.75%), 33.91% regarded as having normal weight and 2.49% regarded as underweight. As a result, the results from this study statistically associated maternal employment (X^2 = 18.18; p-value = 0.000), place of residence (X^2 = 9.55; p-value = 0.023), and household wealth index (X^2 = 33.19; p-value = 0.000) with maternal nutritional status in South Africa. Indicating that employed mothers, urban mothers and mothers who fell under high income households are associated with higher rates of obesity. On childhood nutritional status, 89.34% of the under-five children had normal weight-for-age (WAZ), while only 5.20% of the children were either severely underweight or underweight (WAZ). Regarding height-for-age Z scores (HAZ), 73.18% of the children had normal height-for-age, 15.66% were stunted, 7.04% were severely stunted, and 4.13% were tall. On weight-for-age Z Scores (BAZ), 58.31% of the children had normal weight-for-age, 22.43% were overweight, 16.09% were obese, and 3.17% were underweight. The results further found that

the level of malnutrition among under-five children were higher among unemployed mothers than employed mothers as follows: severe stunting (77.50% vs 22.50%), being underweight by WAZ (80.00% vs 20.00%), and obesity by BAZ (72.68% vs 27.32%) for unemployed and employed mothers respectively. However, except for severe stunting, the prevalence of malnutrition among under-five children were higher in urban areas than rural areas as follows: underweight by WAZ (57.14% vs 42.86%), severe stunting (48.75% vs 51.25%), and obesity by BAZ (56.28% vs 43.72%) for urban and rural areas children respectively. On the impact of maternal socioeconomic factors on childhood nutritional and health outcomes, the bivariate analyses negatively associated low maternal wealth index and stunting (HAZ) among under-fives. Both the bivariate and multivariate analyses associated maternal BMI with birthweights and childhood nutritional status. Suggesting that higher maternal BMI led to higher weight-for-age as well as higher height-for-age among under-fives.

In conclusion, the results from this study present a direct evaluation of the association between maternal anthropometrics characteristics and childhood nutritional status. Poor infant and young child feeding practices, on the other hand, is caused by low or poor maternal household wealth index working synergistically with other factors such as urbanity, employment and education. In summary, the findings presented in this study suggests that obesity and other maternal- and child-related nutritional and health issues is a consequence of the complex relationship among many factors including environmental (such as dietary intake), genetic (the link between maternal BMI and childhood nutritional status), and socioeconomic/sociodemographic factors (such as maternal age, parity, household wealth index, education, employment, etc) which eventually result in energy imbalance that either directly or indirectly impact on both maternal and childhood nutritional and health outcomes in South Africa.

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CHAPTER ONE

INTRODUCTION

1.1 BACKGROUND

***Key Terms includes*:** Maternal sociodemographic factors, Maternal and child nutrition, social determinants of maternal and child health, breastfeeding, formula-feeding, dietary diversity, complementary feeding, minimum acceptable diets, malnutrition, undernutrition, stunting, obesity, and South Africa.

Adequate nutrition during pregnancy, infancy, and childhood is critical to child health and development as under nutrition and/or malnutrition is a prominent cause of childhood morbidity and mortality (Wells et al., 2019; Khatun et al., 2018; Troeger et al., 2018; Saxena, 2018; Li, 2018; Li et al., 2018; Jin & Mwenda, 2017; Indrio et al., 2017; Lowe et al., 2016; Nicholas et al., 2016; Chu et al., 2016; Hanson et al., 2015; Lee, 2015; Li et al., 2014; Macaulay et al., 2014; Parlee & MacDougald, 2014; Lehnen et al., 2013; Yu, et al., 2013; Alderman et al., 2013; Hardy & Tollefsbol, 2011; Li & Tollefsbol, 2010; Mühlhäusler et al., 2008; Klasen, 2008). More so, evidence shows that good nutrition prepares the stage for realizing the rights of every child (Unicef, 2015a,b) as well-nourished children are more likely to survive, grow and learn; they are more resilient in the face of diseases and crisis; and they are better placed to play a part in and contribute to their societies. As a result, child nutrition is a means of adopting the Sustainable Development Goals (SDGs) for most developing countries as good nutrition promotes economic progress, development and human capital (UNICEF 2015 a, b). Therefore, the profits of good nutrition rotate across generations, sustaining positive results at all levels of society – from the livelihoods of communities to the development goals of nations.

However, the 2016 South African Demographic Health Survey (SA-DHS) report, reveals that 1 in 3 boys are stunted and 1 in 4 girls are stunted. More so, South Africa is still driven with high prevalence of obesity among "the under-five" years children, which is very common among Blacks, with about 20%. According to race and gender, stunted children are more prevalent among Coloured female-children, with about 26% in South Africa (SA-DHS, 2017).

On a global spectrum, the number of stunted children under 5 declined from 169 million in 2010 to 159 million children in 2014 (Unicef, 2015a,b). This is confirmed by success stories in a number of few countries, such as Rwanda, India, Kenya, Ghana, Ethiopia and the United Republic of Tanzania. However, inequalities in stunting and other form of malnutrition persist in most developing countries. In addition, while acute wasting, or malnutrition, still threatens the lives of 50 million children globally, there are also 41 million overweight children in the world – that is – about 10 million more than there were two decades ago (Unicef, 2015a,b). These challenges do not rest at reverse ends of a continuum – but instead are multifaceted and complex – coinciding and interwoven.

As a result, understanding the relative importance of the various determinants of childhood malnutrition in the country, and whether they differ between breastfeeding and formula feeding practices (coupled with minimum acceptable diet) is paramount to unlocking the linkages between these various determinants of childhood malnutrition and child health in the country. More so, the link between breastfeeding and/or formula feeding practices with dietary diversity is not only a proxy for adequate micronutrient density of foods, but also serves as a medium of

understanding child malnutrition. Here, the 2016 South African Demographic Health Survey (SA-DHS) report, reveals that "without adequate diversity and meal frequency, infants and young children are vulnerable to undernutrition, especially stunting and micronutrient deficiencies, and to increased morbidity and mortality" (NDoH, 2019: 182). Thus, accessing minimum acceptable diet promotes appropriate growth and development among infants and young children. Furthermore, breastfeeding has the capacity to saves more lives than any other preventive intervention; whereas, formula-feeding is very expensive and carries high risks of added illness and death – especially where the levels of infectious diseases are highly concentrated and access to safe water is poor (Unicef, 2015a). Therefore, with exclusive breastfeeding rates declining in South Africa (Zweigenthal et al., 2019; Doherty et al., 2012; Nor et al., 2012; Coovadia et al., 2007; Sibeko et al., 2005), these challenges – if not adequately dealt with – raises more questions and alarm about child safety and rights to adequate feeding. Therefore, the minimum meal frequency for breastfed children (for infants age 6-8 months and children 9-23 months) is achieved when they are fed semisolid, solid, and/or soft foods at least two times a day and three times a day, respectively (NDoH, 2017, 2019). While for non-breastfed children age 6-23 months is at least four times a day (NDoH, 2017, 2019). Therefore, assessing infants and young children minimum meal frequency in relation to malnutrition is paramount to this study.

1.2 INTRODUCTION

The case for investing in both maternal and child nutrition and health is a means of adopting the Sustainable Development Goals (SDGs) for most developing countries. Here, good nutrition promotes economic progress, quality wellbeing, development and human capital (Smith & Haddad, 2015; Unicef, 2015b; Nisbett et al., 2014; Bhutta, 2013; Bhutta et al., 2013; Haddad, 2013; World Bank, 2013; Hoddinott et al., 2013; Hoddinott et al., 2011; Martorell et al., 2010; Martorell, 1996). Providing sustainable care and the appropriate responsiveness to children is a demanding task that incorporates both maternal and child nutrition and health – since poor nutrition and physical health in mothers is expected to have adverse consequences on their children's health and development. Using a concept known as epigenetics, the theoretical framework for this study furthers elaborate on the link between maternal dietary intake and/or health with the offspring's health outcomes (Naruse et al., 2019; Weng et al., 2018; Zhou & Xiao, 2018; Tyrrell et al., 2016; Espinoza, 2016; Soubry et al., 2015; Yu et al., 2013; Skinner et al., 2010; Aagaard-Tillery et al., 2008; Haig, 1993).

Other studies have also shown the link between maternal socioeconomic factors with both maternal and childhood nutritional outcomes, morbidity, and mortality (Smith & Haddad, 2015; Unicef, 2015b; Harris, 2014; Nisbett et al., 2014; World Bank, 2013; Apovian, 2013; FAO, 2012; Collier, 2007; (Lamarre) Chronic Poverty Research Centre, 2005, 2008). This entails that countries – especially developing countries – are more likely to improve and secure the future of their nations by exploring the health of mothers and children through the lenses of antenatal and postnatal care in relation to nutrition. Why? Because children with poor dietary intake are prone to diseases, they are physically and mentally underdeveloped throughout their lifetimes, they performed poorly in school, which results in low income jobs as adults, and are more vulnerable to non-communicable disease as adults (Smith & Haddad, 2015; Nisbett et al., 2014; Bhutta, 2013; Bhutta et al., 2013; Haddad, 2013; World Bank, 2013; Hoddinott et al., 2013; Hoddinott et al., 2011; Martorell et al., 2010; ; UNICEF, 1990,1998; Martorell, 1996). More so, children that are born to mothers with poor nutritional intake also has higher risk of foetal growth restriction and death (Naruse et al., 2019; Weng et al., 2018; Zhou & Xiao, 2018; Tyrrell et al., 2016; Espinoza, 2016; Soubry et al., 2015; Harris, 2014; Yu et al., 2013; Black

et al., 2013; Skinner et al., 2010). Here, girls who happen to survive this great ordeal of maternal poor nutritional intake are more likely to remain underdeveloped as children and all through their adulthood, thus, transfer their poor nutritional status to their offspring (Smith & Haddad, 2015; Harris, 2014; Black et al., 2013; UNSCN, 2010).

With exclusive breastfeeding rates declining in South Africa (Zweigenthal et al., 2019; Doherty et al., 2012; Nor et al., 2012; Coovadia et al., 2007; Sibeko et al., 2005), it is very important to note that, breastfeeding has the capacity to saves more lives than any other preventive intervention; whereas, formula-feeding is very expensive and carries high risks of added illness and death – especially where the levels of infectious diseases are highly concentrated and access to safe water is poor (Unicef, 2015a). More so, breastfeeding is an important element that boosts infant health in preventing infectious diseases and malnutrition (Horta and Victora, 2013). Furthermore, mothers in developing countries are faced with many practical challenges that artificial feeding (formula-feeding) poses. For example, is the formula mixed with clean water, can sufficient quantities of formula acquired constantly, is the dilution correct and are the feeding utensils adequately cleaned? These challenges – if not adequately dealt with – raises more questions and alarm about the child safety and rights to adequate feeding. Therefore, formula-feeding is not a completely comparable replacement for breastfeeding as formula – at its best – only replaces most of the nutritional mechanisms of breast milk (UNICEF, 2015a). In other words, it is just a food, while breast milk is a multifaceted and complex living nutritional fluid that contain antibodies, hormones, long chain fatty acids and enzymes – which are impossible to be included in formula-feeding. More so, according to a study published in 2008, children who are breastfed are 6 times more likely to have greater chances of survival in the early months than non-breastfed ones (Black et al., 2008). The study further revealed that an exclusively breastfed child is 14 times less likely to die in the first six months than a non-breastfed one (Black et al., 2008). This entails that breastfeeding drastically reduces deaths from acute respiratory infection and diarrhoea – these are two major child killers in developing countries.

In addition, even though the 2016 South Africa Demographic Health Survey (SA-DHS) report suggested that there is a decline in both the under-five and infant mortality rates, with about 42 deaths and 35 deaths per 1000 live births; and that the neonatal mortality rate has also declined to 21 deaths per 1000 live births, which accounts for about half of under-five mortality rate accordingly (SA-DHS, 2017) – these still raises questions about the care and nourishment of mothers and children in the country. With the decline in infant and child mortality rates and the achievement in clinic-based child delivery (which was estimated at 96% in 2016), South Africa still battles with health issues among children – especially, children under five years – fail to grow at the corresponding pace of their age. Here, the 2016 SA-DHS report, reveals that 1 in 3 boys are stunted and 1 in 4 girls are stunted. More so, South Africa is still driven with high prevalence of obesity among "the under-five" years children, which is very common among Blacks, with about 20% (SA-DHS, 2017). In addition, the 2016 SA-DHS report suggests that, only 23% of children – age 6 to 23 months – are fed a diet regarded as adequate for infants and children (SA-DHS, 2017).

Given the enduring health and development consequences of poor nutrition in early childhood, it is fundamentally appropriate to further investigate the causes and opportunities for the interventions required for improvement in South Africa. Maternal and child undernutrition remain prevalent and damaging conditions especially for economically developing countries. Here, undernutrition includes wasting, stunting, and deficiencies of essential vitamins and minerals (together referred as micronutrients) as one form of the condition described as

malnutrition, with obesity or overconsumption of specific nutrients as another form of malnutrition. Although addressing poverty and wealth disparities would substantially reduce the rate of undernutrition (Haddah et al., 2003) and should be a global priority, major reductions in maternal and child undernutrition can also be achieved through programmatic maternal health and nutrition interventions. This is an indication that undernutrition is an important determining factor of maternal and child health. (Fishman et al., 2004; Caulfield et al., 2004; Pelletier et al., 1993). This study seeks to unravel the societal burden attributable to undernutrition in South Africa and the factors affecting household food availability. This study consists of new analyses (based on developed and/or new customised mathematical models) that measures the prevalence of nutritional conditions, risk factors, and consequent health burden. The links between maternal and child health attributable to maternal and child undernutrition is explore in this study using these mathematical models.

1.3 RESEARCH PROBLEM STATEMENT

Even though existing literatures shows that there has been improvement in child health in South Africa (SADHS, 2017; Say et al, 2014) due to the decline in child mortality rate, it remains unclear whether child nutritional status has improved in the country. More specifically, there are compelling evidence that suggested that exclusive breastfeeding rates in South Africa are declining (Zweigenthal et al., 2019; Doherty et al., 2012; Nor et al., 2012; Coovadia et al., 2007; Sibeko et al., 2005). Again, according to the SA-DHS, only 23% of children who are age between 6 to 23 months have access to diet that are considered as adequate for infants and children (SA-DHS, 2017). In addition, other studies also revealed that socioeconomic factors such as political, economic, environmental, social and cultural factors impact on maternal and child nutritional status (FAO, 2015; Smith & Haddad, 2015; Nisbett et al., 2014; Alderman et al., 2013; Collier, 2007; (Lamarre) Chronic Poverty Research Centre, 2005, 2008). Here, Black et al (2013) also highlighted that undernutrition as the causal factor is accountable for about 45% of all childhood (under five) mortality. This raises questions about the current state of maternal socioeconomic status and childhood anthropometric status (nutritional status) in South Africa with the implications this has for child health, and ultimately child mortality rate in the country.

1.4 SIGNIFICANCE AND JUSTIFICATION OF THE STUDY

On the conceptual framework of child undernutrition determinants, Smith and Haddad (2015) highlight on the hierarchical relationship between the immediate, underlying, and basic determinants of childhood nutritional status. Here, the immediate determinants of childhood nutritional status manifest themselves at the individual child level, health status and nutritional intake (e.g. fat, iron, micronutrients and energy protein). These factors are interdependent. This is suggesting that the absent of any of them poses threat on the child well-being. Thus, a child with an insufficient nutrient intake is prone to diseases, which then depresses appetite; and consequently, impedes the uptake of nutrients in diet and contests for a child's liveliness. Therefore, the significance of this study is to critically investigate the impact of maternal socioeconomic factors on childhood nutrition (including breastfeeding versus formula-feeding). Given the focus on dropping maternal and childhood mortality globally – most especially in South Africa – this study also seeks to investigate how the association between maternal socioeconomic factors impact on both maternal and childhood nutritional intake and morbidity in order to aid the processes of improving maternal and child health in the country. Why? This is simply because essential and accurate control of both social and biological factors – together with effective and functioning policy programmes – has the potential to improve

maternal and child health, and ultimately reducing both maternal and child mortality in South Africa.

In addition, the health of women and their ability to perform social and economic functions are central to achieving the SDGs. Here, a framework developed by UNICEF and subsequent studies over the years have shown that social and economic factors are influencing maternal nutritional intake, health and mortality in developing countries (Mukami et al., 2016; FAO, 2015; Smith & Haddad, 2015; Nisbett et al., 2014; Reinhardt & Fanzo, 2014; Alderman et al., 2013; Apovian, 2013; Collier, 2007; Chronic Poverty Research Centre, 2005, 2008; McCarthy & Maine, 1992). Therefore, this study seeks to unravel the gaps and the relationships between maternal socioeconomic factors and child dietary intake and nutritional status. The study also investigates the link between maternal body mass index (BMI) and childhood anthropometric measurements.

Contribution to the Body of Knowledge

This study seeks to produce new and recent evidence about the associations between maternal socioeconomic factors and its impact on child dietary intake. Also, the study seeks to understand the similarities and differences between breastfeeding and formula-feeding and its impact on childhood health. In addition, the study also seeks to study the link between maternal BMI and childhood anthropometric measurements. This study further aims at alerting all stakeholders (government, business organisation and non-governmental organisation) about the impact of socioeconomic determinants on maternal and child dietary intake and morbidity in South Africa. Thus, it is the believed that the diverse demographics among women and children in South Africa makes this research an interesting one as the respondents are situated all over the country. Consequently, based on the results obtained from this study, at least one published article would be produced.

1.5 RESEARCH OBJECTIVES

1.5.1 Aims of the Study

Using under-five child anthropometric indicators (based on nutritional indicators), this study seeks to explore and investigate child health in South Africa. The study also seeks to understand how maternal sociodemographic factors impacts on nutrition and anthropometric outcomes of mothers and children in the country.

1.5.2 Objectives of the study

The primary aim of this study is to investigate the impact of maternal sociodemographic factors on nutrition and anthropometric outcomes of mothers and children. The specific objectives of the study are:

1. To report on the percentage of under-five children in South Africa with a minimum acceptable diet.

2. To measure the impact of maternal sociodemographic factors on minimum acceptable diet among children under-five.

3. To measure the impact of maternal sociodemographic factors on breastfeeding and formula feeding in South Africa.

4. To determine the relationship between breastfeeding as well as formula feeding and child health in South Africa.

5. To describe the anthropometric status of mothers and under-five children in South Africa.

6. To measure the impact of maternal sociodemographic factors on both maternal and childhood anthropometric (nutritional) outcomes in South Africa.

1.6 RESEARCH QUESTIONS

When addressing the problem statement of this study, the following research questions are fundamental and relevant:

1. What is the percentage of children under-five in South Africa with a minimum acceptable diet?

2. What is the impact of maternal sociodemographic factors on minimum acceptable diet of children under-five?

3. How does maternal sociodemographic factors influence breastfeeding and formula feeding in South Africa?

4. What is the relationship between breastfeeding as well as formula feeding and child health in South Africa?

5. What is the anthropometric status of under-five children in South Africa?

6. How does maternal sociodemographic factors impact on both maternal and childhood anthropometric (nutritional) outcomes in South Africa?

1.7 RESEARCH HYPOTHESES

First Hypothesis

H_0: There is a significant relationship between maternal sociodemographic factors on minimum acceptable diet among children under five.

H_1: There is not significant relationship between maternal sociodemographic factors on minimum acceptable diet among children under five.

Second Hypothesis

H_0: There is a significant difference between breastfeeding and formula feeding about child health.

H_1: There is no significant difference between breastfeeding and formula feeding about child health.

Third Hypothesis

H_0: There is an association between maternal sociodemographic factors on breastfeeding and formula feeding.

H_1: There is no association between maternal sociodemographic factors on breastfeeding and formula feeding.

Fourth Hypothesis

H_0: There is a correlation between maternal sociodemographic factors on both maternal and childhood anthropometric (nutritional) outcomes.

H_1: There is no correlation between maternal sociodemographic factors on both maternal and childhood anthropometric (nutritional) outcomes.

Fifth Hypothesis

H_0: There is a relationship between maternal BMI and childhood anthropometric measurements.

H_1: There is no relationship between maternal BMI and childhood anthropometric measurements.

1.8 DISPOSITION OF THE STUDY

- In Chapter One, the researcher presents the study background, research problem, and the significance of the study. Here, the research objectives and questions were presented together with the research hypotheses, which cross-examine the presented objectives.

- Chapter Two of this study systematically reviewed the relevant literatures based on the objectives of this study. It is positioned around maternal and child nutrition and morbidity – stemming from local and international literature. The reviewed literature assisted the researcher to demonstrate the gap analysis in which the study is based upon. In addition, the measurements used by scholars to assess and to monitor maternal and child nutrition and morbidity results are debated. The chapter also present the theoretical background underpinning the study.

- Chapter Three of this study outlined and presented the framed and/or formulated research design and the applied data collection procedures and the manipulation thereof to achieve the stipulated study objectives. In addition, this chapter also described the population and sampling techniques used, the data collection instruments and including the ethical considerations. Importantly, this chapter presents a detail explanation of the novel mathematical models employed for this study and how they were applied during the data analysis to achieve the research objectives.

- Chapter Four of this study analysed, presented and discussed the research findings in great detail based on the research objectives. In it, each research question and hypothesis were answered and tested by systematically achieving each research objective. Hence, the chapter discussed the collected research findings with the hypothetical framework and literature review.

- Chapter Five presents the summary of the research, the overall study conclusions and recommendations for interventions and future research.

1.9 CHAPTER SUMMARY

This chapter provided a detailed background and introduction to this dissertation by reflecting and drawing attention to some of the existing empirical evidence on the link between maternal socioeconomic factors and maternal and child nutrition, morbidity, and mortality. The chapter also briefly specified research objectives, questions, and hypotheses. The intentions of the study to contribute to the wider literature on the link between maternal socioeconomic factors and its impacts on maternal and child nutrition and morbidity was also highlighted in this chapter.

The next chapter (Chapter Two) presents the relevant literatures on the relationship between maternal socioeconomic factors and its impacts on maternal and child nutrition and morbidity – stemming from local and international literatures.

CHAPTER TWO

LITERATURE REVIEW

2.1 INTRODUCTION

As early as in the 1960s, studies have shown that both women's schooling and unobserved background variables on household productivity impacts child nutrition, with the increased in education level of women being an important means for improvement of child nutrition outcomes especially in economically developing countries (Behrman & Wolfe, 1987, 1984, 1982; Rosenzweig & Schultz, 1984, 1982 a, b; World Bank, 1980; Becker, 1981; Heller & Drake, 1979; Easterlin, 1973, 1968).

Paul Glewwe's schematic framework for examining the determinants of child health and nutritional status is central to understanding the linkages between maternal education and childhood nutrition. According to Glewwe (1999), childhood health is ultimately determined by three (3) sets of factors: *Health and nutritional inputs provided by the household* (household assets including prenatal care, breastfeeding, breastmilk substitutes such as formula feeding, calories from mother's food, medical care); *The local health environment* (encompassing all community characteristics that directly impact on child health and are mostly beyond the control of the parents such as parasites, contagious diseases, access to resources, and social infrastructure); and *The child's health endowment* (genetics and its impact on childhood nutritional and health outcomes).

This chapter systematically reviews and examines the relative importance of these mechanisms based on existing literature. The chapter also seeks to unravel the relationships between maternal sociodemographic and/or socioeconomic factors and its impact on maternal and child nutritional and health outcomes. The chapter is organized as follows: Section 2.2 presents the systematic literature review methods used for Section 2.4 and 2.5 of this chapter. Sections 2.3 presents the theoretical framework underpinning this study based on reviewed literatures; Section 2.4 reviews, in broad terms, the impact of maternal socioeconomic factors on maternal and child nutritional and health outcomes; and Section 2.5 presents a summary of this chapter.

2.2 METHODS

2.2.1 Search Methods for Section 2.4 and 2.5 Systematic Literature Review

A literature search was conducted between January and December 2020 to explore the factors influencing child nutrition. Using Google Scholar as a search engine, the search was limited to articles in English Language published between 2010 – 2020 which addressed the determinants of both maternal and child nutritional and health outcomes (such as obesity, stunting and other nutritional related health complications) in developing countries, including South Africa. Other searches were also conducted specifically to identify reports from the South African government departments. The websites of the United Nations (UN) and as well as international Non-Governmental Organizations such as UNICEF, WHO, the World Bank, and Food and Agriculture Organization (FAO) were also explored.

2.2.2 Inclusion and Exclusion Criteria

The initial search for this study was based on articles that: 1) emanate from studies conducted in economically developing countries; 2) published in English Language; and 3) used the terms and/or keywords such as maternal, child, health, nutrition, undernutrition, malnutrition, breastfeeding, formula feeding, complementary feeding, nutritional status, factors, social determinants, and developing countries. After all potential studies have been identified and selected, a second selection process was employed to assess the eligibility against the inclusion criteria. Thereafter, studies were solely selected based on their relevancy to this study, including keywords and subject headings.

The selected literatures were analysed through all the contents. This allows for the integration of quantitative and qualitative data across studies with similar outcome measures. The analyses comprise of relevant aspect of socioeconomic and/or sociodemographic determinants of maternal and child nutritional and health outcomes in economically developing nations to generate relevant emerging themes.

2.3 THEORETICAL FRAMEWORK UNDERPINING THE STUDY

Globally, there is a rising concern about the nutritional intake, morbidity, and mortality of women and children. An ample body of scientific evidence exists, documenting the factors that impacts on both maternal and child nutritional intake, morbidity, and mortality. Chronic malnutrition, including stunting and childhood obesity, is an important global challenge that spans multiple sectors, specifically agriculture, the environment, the food industry, and health. The objective of this study's theoretical framework is to develop a theoretical model of maternal and childhood nutrition, morbidity, and mortality – organized according to the principles of Structural Equation Modelling, which require specification of the variables associated with the central construct, based on empirical data (Kline, 2011; Byrne, 2010). The model presented in this study synthesizes the results of scientific evidence, representing an advance in theory development in maternal and childhood nutrition, morbidity, and mortality. This model increases the discernibility of conceptual issues about maternal and child health and its correlates. Thus, following empirical testing, may contribute to the improvement of intervention programs for maternal and childhood nutritional intake, morbidity, and mortality.

Currently, maternal and childhood nutrition, morbidity, and mortality is understood as a multidimensional construct, covering a range of factors – encompassing basic causes at societal levels, underlying causes at households and/or community levels, epigenetic causes, and direct causes of maternal-child relationship (Naruse et al., 2019; Weng et al., 2018; Zhou & Xiao, 2018; Tyrrell et al., 2016; Espinoza, 2016; Soubry et al., 2015; Smith & Haddad, 2015; Nisbett et al., 2014; Harris, 2014; Reinhardt & Fanzo, 2014; Darapheak et al., 2013; Yu et al., 2013; Black et al., 2013; Bhutta, 2013; Bhutta et al., 2013; Haddad, 2013; World Bank, 2013; Hoddinott et al., 2013; Prado & Dewey, 2012; Hoddinott et al., 2011; Martorell et al., 2010; Skinner et al., 2010; Hackett et al., 2009; Checkley et al., 2008; UNICEF, 1990,1998; Martorell, 1996; McCarthy & Maine, 1992).

Although there is a vast body of literature on the concept of maternal and childhood nutrition, morbidity, and mortality, there is not yet a comprehensive theoretical model of maternal and childhood nutritional intake, morbidity, and mortality – indicating the relationship between this construct and other variables such as epigenetic processes. Hence, the absence of an empirically-tested theoretical model makes it difficult to build effective tools to guide

professional practice and to improve the quality of research in the field of maternal and childhood nutrition and health. A criterion for the construction of scientific-theoretical models is that they can be empirically tested. According to Byrne (2010), a psychometric approach to the development and evaluation of such models is through the utilization of Structural Equation Models. Consequently, using this approach, the researcher initially examines empirical studies on maternal and childhood nutrition, morbidity, and mortality to obtain evidence about the dimensions of the phenomenon and other variables. In other words, a systematic literature review was conducted to gather scientific data on frameworks and models that are the guiding factors toward the impact of maternal and child nutritional and health outcomes. Thereafter, I proposed a model that indicates probable links among these variables based on literature review. Therefore, the objective of the current study's theoretical framework was to construct an initial theoretical model of maternal and childhood health which integrates results of empirical studies, indicating: (1) the dimensions or components of maternal and child nutrition and health; (2) factors that may affect maternal and child nutritional and health outcomes; and (3) the possible impacts of maternal and child nutrition and health on other constructs (outcomes). See Figure 1.1 and 1.2 for a relatively simple and comprehensive framework for analysing and understanding the determinants of maternal and childhood nutritional intake, nutritional status, and morbidity based on literature review.

2.3.1 Conceptual Framework

The implementation and facilitation of the SDGs has brought global awareness that the future health, economic development, peace, and freedom depend not only on maternal and childhood nutrition, health, and survivorship, but also prosperity. In addition to requiring support for maternal and childhood nutrition and health, prosperity also includes the capacity of children to form relations, learn, take on responsibilities, and ultimately to provide economic stability, establish a family, and contribute to the society. To build the broader picture of prosperity, the theoretical framework underpinning this study outlines the factors that either cultivates (facilitates) or hinders prosperity in maternal and childhood nutritional and health circumstances.

Central to maternal and childhood prosperity is the concept of maternal health since mothers and/or women are considered as the building block of the family. Maternal health is described as the health of women during pregnancy, childbirth, and the postpartum period (WHO, 2014). Consequently, management of maternal health and avoidance of maternal mortality is therefore crucial to ensuring childhood survivorship and prosperity. Their death – especially premature maternal death – may cause an economic breakdown on the society since children mostly depend on mothers for every aspect of their nutrition and health. For example, according to the UNICEF reports on Africa's children affected by AIDS revealed that a motherless child is more likely than an infant with a surviving mother to die before reaching the age of two (UNICEF, 2006). Therefore, as rightly argued by Black et al (2020), maternal and childhood survivorship and prosperity occurs first and foremost within the most proximal settings – the family and the community. This is indicating that children depend on their families and society for guidance, protection, and support throughout childhood and adolescence. Thus, the nurturing care that children receive early in life provides the basis for responsive relationships throughout childhood, adolescence, and beyond. Therefore, even though this study is not geared toward maternal and child mortality, the argument here is that understanding maternal nutritional and health outcomes and how these outcomes are link to maternal socioeconomic factors could serve as a framework toward understanding maternal and child mortality in South Africa.

The utilization of the UNICEF framework in this study is interesting because of the information on the basic causes, underlying causes, and direct causes of maternal and neonatal health, and the strong commitment of nutritionists and scholars to based policy and programs on the framework (Levitt et al., 2009; Dufour, 2007; Young et al., 2004; Pain & Lautze, 2003). The UNICEF framework was developed in 1990 because the lack of common understanding of the causes of malnutrition among scholars and researchers was hindering the development of rational, effective policies, and programs in many countries. As demonstrated in the UNICEF framework, the basic causes addresses systemic-level challenges reflecting the structural and political processes in society such as social, political issues, economic, and environmental issues that lead to the lack of or unequal distribution of resources (capital). Here, capital includes human, social, physical, financial, and natural resources. The underlying causes include household and community food security, feeding practices, access to health services, and living in a healthy environment. The direct causes are the impact of the basic and underlying causes at the individual level through inadequate food intake and disease. In summary, the UNICEF framework presents a link between these systemic-level variables and the society.

Despite broad awareness of the UNICEF framework and frequent reference to it by scholars, the framework fails to account for genetic processes as contributing factors of maternal and child nutritional and health outcomes. Although the UNICEF conceptual framework on the causes of maternal and neonatal morbidity and mortality demonstrates that maternal and neonatal health outcomes are determined by interrelated factors, including nutritional intake, healthcare services, healthy behaviours, water, sanitation and hygiene, and disease control, other studies have added that maternal and child nutritional and health outcomes are also affected by genetic processes that predisposed mothers and their children to potential diseases (Naruse et al., 2019; Weng et al., 2018; Zhou & Xiao, 2018; Tyrrell et al., 2016; Espinoza, 2016; Soubry et al., 2015).

It is important to note that the consequences of undernutrition are both short- and long-term which often impact on the lifecycle and on future generations. Thus, there are gaps in our knowledge of the causes of malnutrition (nutritional outcomes) and its impact on maternal and childhood health outcomes. As a result, this study proposed an additional component of the causes (epigenetic causes and/or perinatal programming) of maternal and child health and its impacts on nutritional, health, and mortality outcomes. Here, the interplay between the UNICEF and the foetal-maternal relationship frameworks as demonstrated in the subsequent paragraphs tends to create a vicious circle: a malnourished child, whose resistance to illness is compromised by epigenetic processes and/or perinatal programming, falls ill, and malnourishment worsens. Offspring who enter this malnutrition- and biological-infection cycle can easily result to a potentially fatal spiral as one condition feeds off the other. Clearly, maternal and child health is not a simple problem with a single simple solution. Multiple and interrelated factors are involved. Thus, a similarly intricate series of approaches – multifaceted and multisectoral – are necessary to effectively deal with it.

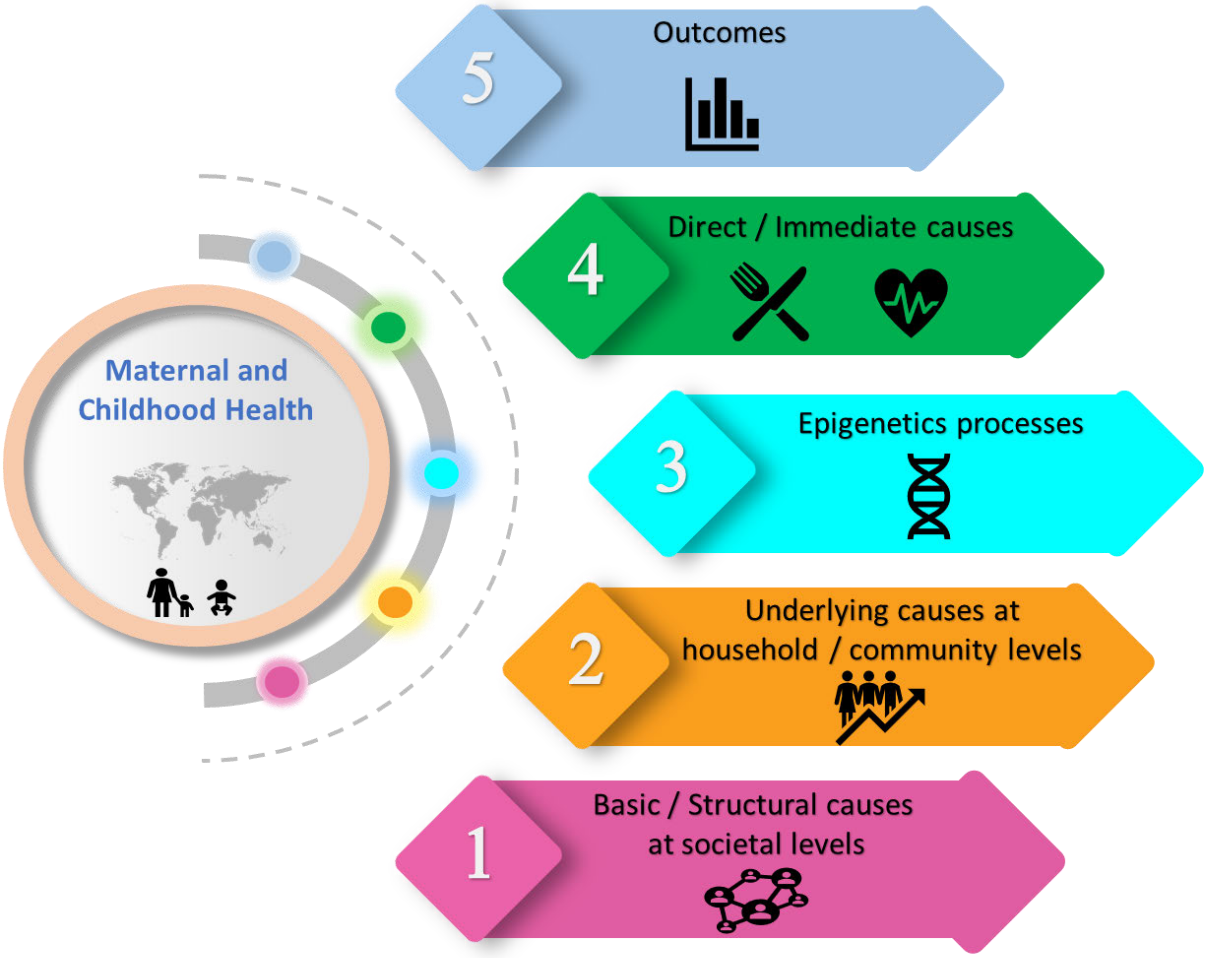

Figure 2. 1: Maternal and Child Nutrition and Health: Construct of a theoretical model based on a literature review (*source: Researcher*)

2.3.2 Conceptualization: The Concepts behind the Framework

Figure 2.2 presents a relatively simple and comprehensive framework for analysing and understanding the determinants of maternal and childhood nutritional intake, morbidity, and mortality based on literature review. This framework includes the basic stages in the process that result in both maternal and childhood nutritional intake, morbidity, and mortality. It also includes a description of other components of maternal and childhood nutrition, morbidity, and mortality. The framework is structured around four (4) stages that result in both maternal and childhood nutritional intake, morbidity, and mortality. Closest to the event of a maternal and/or childhood malnutrition, morbidity, and death are a sequence of direct or immediate causes which include inadequate food intake and risks posed by disease on the individual (Reinhardt & Fanzo, 2014; Darapheak et al., 2013; Prado & Dewey, 2012; Hackett et al., 2009; Checkley et al., 2008; UNICEF, 1990, 1998; McCarthy & Maine, 1992).

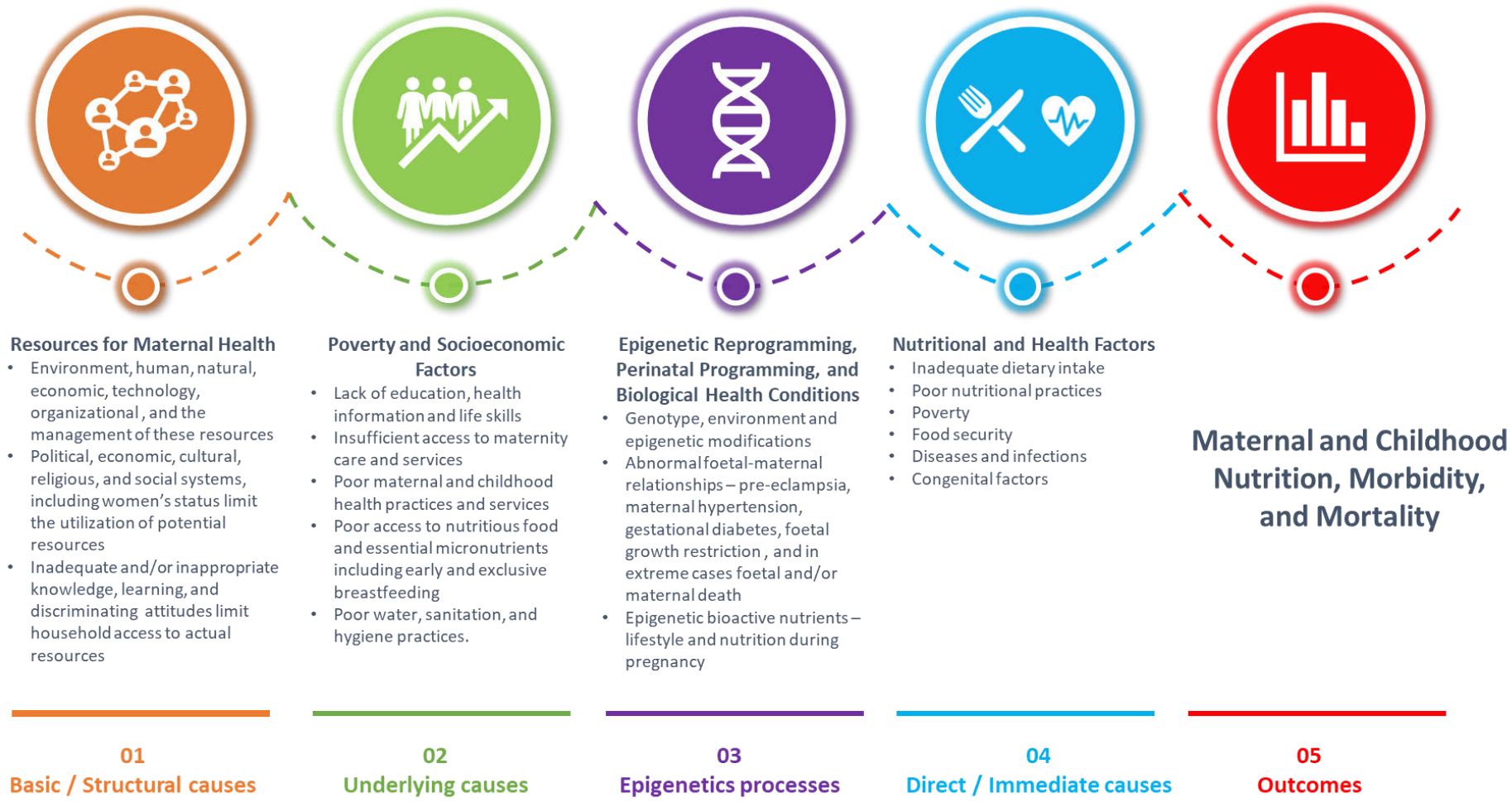

Figure 2. 2: Maternal and Childhood Nutrition, Morbidity, and Mortality: Construct of a theoretical model based on a literature review (*source: Researcher*)

2.2.2.1 Basic/structural causes at societal level

The basic causes of maternal and child health outcomes postulates that to ameliorate maternal and childhood malnutrition, promote healthy living, curb infectious diseases, and improve hygiene practices can partly be achieved only when the social context in which women and girls live-in respects their human rights (Black et al., 2020; Reinhardt & Fanzo, 2014; McCarthy & Maine, 1992; UNICEF, 1990). Providing a supportive social system that promote the human rights of women and girls is therefore crucial to reducing maternal and childhood malnutrition, morbidity, and mortality. At the societal level, studies have shown that there is a link between increased risk of stunting and lack of basic community infrastructures (Fay et al., 2005). Similarly, another study revealed that there is a relationship between decreased risk of stunting and increased household wealth and improved community resources (Schott et al., 2013). Cultural factors have also been highlighted to play an important role in maternal and child health. Here, some of the cultural factors that have been shown to be important to the prevalence of stunting includes women's human rights, cultural and religious practices, and fertility practices. For example, a woman's status in Indian households are related to the birth order of either herself or her husband, which is usually employed to determine the quantity and quality of resources devoted to both the mother and child (Coffey et al., 2013). Due to the cultural influence of feeding and care practices in Pakistan, female children are often regarded as secondary to male children, such that female children were three times more likely to be stunted (Baig-Ansari et al., 2006). Although cultural and religious factors play an important role in maternal and child health (Marabele et al., 2020; Ngandu et al., 2020; Paudel et al., 2018; WHO, 2013; Antai et al., 2009; Caprio et al., 2008; Shatenstein & Ghadririan, 1998; Harrison, 1997), it is important to note that such factors are confined to specific geographical locations and ethnic groups rather than as a general assumption.

More so, over the years, both local and international studies have revealed that disruptions in resources and livelihoods such as droughts, floods, climate events and changes to the natural system impacts on the prevalence of malnutrition through both increases in human morbidity and degradation to the local food system and resources (Martin-Canavate et al., 2020; Hancock, 2019; Datar et al., 2013; Dawson, 2013; Akresh et al., 2011; Olack et al., 2011; Faber et al., 2011; Paavola, 2008; Hoddinott & Kinsey, 2001). Therefore, the basic or structural causes of maternal and child health outcomes postulates that exposures to these types of events and/or many other social/cultural events can be link with maternal and childhood malnutrition, morbidity, and mortality through its impact on the quality and quantity of food and its impact on resources and livelihoods. In addition, exposures to these types of events can be indirectly link to maternal and child nutritional and health outcomes through the impact of the economy, political systems, public infrastructures, and water and sanitation systems.

2.2.2.2 Underlying causes at households/community levels

In addition to the structural or basic causes of maternal and child health at the societal levels, researchers have also studied the influence of underlying causes at household and/or community levels on maternal and child health. Here, the underlying causes are described as the results of basic causes of malnutrition, morbidity, and mortality, such as societal structures and processes leading to poverty by denying or limiting vulnerable population access to essential resources. Suggesting that underlying causes of maternal and child health – found at the household and community levels – scholars postulates that it impacts on the ability of a household and/or community to obtain proper nutrition (Martorell & Young, 2012; Paul et al., 2011; Hackett et al., 2009; Hillbruner & Egan, 2008). Here, many scholars have argued that

the distribution of income within a society or country is the first important consideration of ensuring household food and social security (Barlow et al., 2020; Chavas, 2017; Poulsen et al., 2015; Kotagama et al., 2014; Akter & Basher, 2014; Haddah, 1992).

Furthermore, at the household and/or community levels, inadequate food security is considered as one of the underlying causes of maternal and childhood malnutrition. Reinhard and Fanzo (2014:4) defines food security as "having the combination of available food, access to nutritious foods, and proper utilization of food and can be caused by shocks at the household or community levels either in singular, cyclical, or continuous intervals." At the household and/or community levels, food insecurity as one of the underlying causes of maternal and childhood malnutrition relates to the household economy and contextual determinants of how food is produced, used and consumed. Over the years, studies have highlighted some key elements that make up a sustainable food system which are directly link to food security, such as maternal education, maternal employment, or livelihoods, income, market prices, gender dynamics, dietary diversity, and household and individual practices (Muluye et al., 2020; Humphrey et al., 2019; Pinstrup-Andersen, 2013; Paul et al., 2011; UNICEF, 1990, 1998; Barrera, 1990; Glewwe, 1999; Behrman & Wolfe, 1987). In addition, other underlying causes of childhood malnutrition include inadequate care practices such as immunization, lack of excluding breastfeeding, and poor IYCF practices (UNICEF, 2015, 2011; Arifeen et al., 2009; M'Rabet et al., 2008; Kramer et al., 2003).

In addition, studies have also argued that underlying causes of maternal and childhood malnutrition are link with inadequate services and the presence of unhealthy environment such as poor access to and quality of health services, sanitation services, water services, poor hygiene practices, and inadequate food preparation (Humphrey et al., 2019; Spears, 2013; Dangour et al., 2013; Lin et al, 2013; El Taguri et al., 2009). Therefore, the close interrelationship between the causes of maternal and childhood malnutrition, morbidity, and mortality entails that interventions addressing maternal and child health issues should ideally consider the multiple layers of causes by intervening across the multiple sectors.

2.2.2.3 Epigenetic processes

Beyond basic and underlying causes, epigenetic processes can play an important role in maternal and child health outcomes as shown in Figure 2.2. The foetal-maternal relationship, which have been shown to be important to maternal and child health outcomes is equally useful in assessing and analysing the causes of maternal and child nutrition, morbidity, and mortality and in planning effective programs and actions to improve maternal and child health. Therefore, "foetal-maternal relationship" which is described as a theoretical framework or model through which foetal growth and development can happen sometimes at the detriment of the mother wellbeing and with future health consequences on the offspring's wellbeing (Espinoza, 2016; Fowden et al., 2012; Pijnenborg et al., 2008; Constancia et al., 2002; Haig, 1993).

Imprinted genes, which are also described as 'inactive' genes, are genes that have been 'switched off' by epigenetic processes during the development of an embryo (Elhamamsy, 2017). Here, epigenetics is described as a variety of processes that result to heritable changes in genetic profile with negative changes in DNA sequencing (Li, 2018; Berger et al., 2009; Egger et al., 2004). These genes are usually associated with uncommon syndromes, such as obesity, diabetes and cancer (Santoni et al., 2017). Suggesting that genetic defects due to disruption or loss of imprinting in the specific imprinted loci can result to predispose disease

(Elhamamsy, 2017). For example, in a study that investigate the role and interaction of imprinted genes in human foetal growth revealed that genes that are paternally expressed promotes foetal growth while maternally expressed genes suppress growth in rare imprinting disorders (Moore et al., 2015). Therefore, the regulation of imprinted genes for foetal development through epigenetic bioactive nutrients is very crucial because of the genetic diseases that are associated with imprinting disorders. Currently, obesity is regarded as a global epidemic that impacts on human quality of life and it is strongly associated with increased risk of developing insulin resistance, diabetes, gestational diabetes mellitus, hyperlipidemia, hyperglycaemia, hypertension, cancer, and cardiovascular diseases (Weng et al., 2018; Li, 2018; Wu et al., 2018; Xie et al., 2015; Besseiche et al., 2015; Apovian, 2013; Astrup & Finer, 2000).

As a result, studies on maternal nutrition and obesity development postulates a link between maternal nutritional status and early transmission of obesity (Li, 2018; Parlee & MacDougald, 2014; Apovian, 2013; Astrup & Finer, 2000). These studies revealed that obesity has a strong inherited tendency and the development of obesity in adult life is significantly influenced by foetal exposure to environmental markers such as maternal dietary intakes (Li, 2018; Parlee & MacDougald, 2014; Apovian, 2013; Wadhwa et al., 2009; Mühlhäusler et al., 2008; Hales, 2001; Astrup & Finer, 2000). In addition, Parlee and MacDougald (2014) postulates that the link between maternal nutritional status and early transmission of obesity depend on its qualitative factors (e.g. certain bioactive diets with epigenetic regulatory features) and its quantitative factors (e.g. under- and over-nutrition aspects), which subsequently influences the development of obesity in the offspring's life in the future. Again, other studies revealed that early environmental factors such as maternal diets can affect gut microbiota composition in the progenies via maternal gut microbiota transfer, which can persist until adulthood and ultimately results to long-term effects on metabolic health and disease development (Chu et al., 2016; Zhou & Xiao, 2018). This is a clear indication that nutrition is one of the most important environmental factors that impacts on maternal and child nutritional and health outcomes. In addition, studies conducted in different population setting associated infant and early childhood obesity with obesity in adulthood – especially true if the child has higher BMI or parents who are obese (Gillman, 2010; Venn et al., 2007). These provides further evidence for the perinatal programming of obesity and highlights the impact of early life factors in the development of long-term obesity. This is particularly concerning since obesity in later life is identified as an important risk factor for many chronic diseases (Weng et al., 2018; Li, 2018; Wu et al., 2018; Xie et al., 2015; Besseiche et al., 2015; Gali Ramamoorthy et al., 2015; Apovian, 2013; Astrup & Finer, 2000). Therefore, many researchers have postulated that if the current trend of childhood obesity continues, the current generation of children will have a shorter lifespan than their parents because of childhood obesity and its associated implications (Venn et al., 2007).

Furthermore, because epigenetics processes often occur during the early stages of development (Li, 2002; Santos et al., 2002), early nutritional exposure during this fundamental stage can alter epigenetic modification processes during developmental programming (Lee, 2015; Li et al., 2014). Thereby, causing unique individuals' susceptibility to future development of human diseases such as obesity, GDM, hypertension, cancer, diabetes and others obesity-related metabolic diseases (Lee, 2015; Li et al., 2014; Gluckman et al., 2008; Singhal & Lucas, 2004). Therefore, the arguments presented thus far in this study's theoretical framework suggests that obesity and other maternal- and child-related nutritional and health issues is a consequence of the complex relationship among many factors including environmental, cultural, genetic, socioeconomic, physiological and behavioural factors that eventual result in energy imbalance and propagate excessive fat deposition. Hence, good nutrition is a prerequisite for good health

(Hasan et al., 2011). In other words, it means that the nutritional status of children under-five years old is an important outcome measure of children's health. Likewise, infants' weight at birth – the weight of the foetus or infant at delivery – is also a strong predictor of neonatal health outcomes (Gill et al., 2013). Thus, many studies have associated maternal nutritional status with birthweights and/or genetic predisposition of early transmission of obesity among children (Ojha & Symonds, 2020; Li, 2018; Santoni et al., 2017; Moore et al., 2015; Parlee & MacDougald, 2014; Apovian, 2013; Gill et al., 2013; Mühlhäusler et al., 2008; Astrup & Finer, 2000). Therefore, this called for a feasible maternal diet model as a prevention measure for maternal and child nutritional outcomes, morbidities, and mortality.

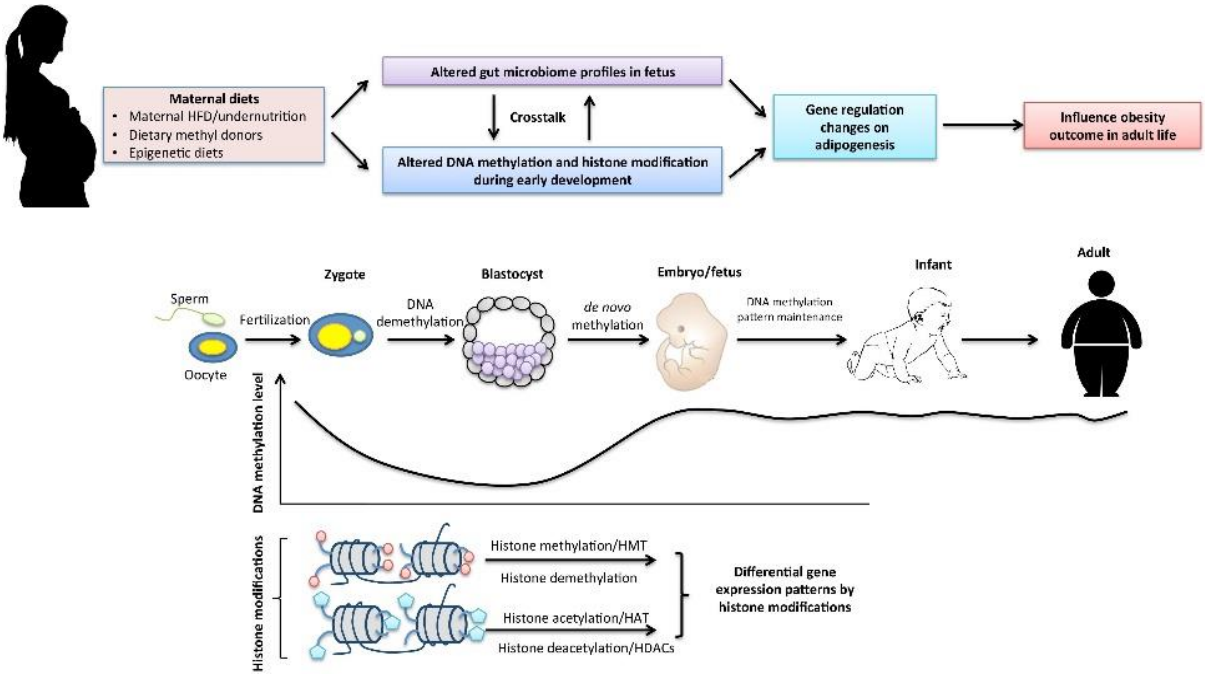

Figure 2. 3: The illustration of DNA methylation, maternal obesity and infant obesity (Li, 2018)

2.2.2.4 Direct/immediate Causes

The direct or immediate causes of maternal and child nutritional and health outcomes as portrayed in the framework encompassing inadequate nutritional intake and risk posed by disease and infection environment of the individuals. Here, inadequate nutritional intake is refers to as both the quality and quantity of the diet (Reinhardt & Fanzo, 2014). The nutritional quality of dietary intake is central to driving the genetic processes that regulate the development and growth of the musculoskeletal and the nervous system. More so, through epigenetic regulation mechanisms, the nutritional quality of dietary intake becomes one of the primary environmental factors that are responsible for influencing gene expression. For example, studies have shown that certain bioactive dietary elements in our daily meals can use their chemo preventive power against many human diseases through modulation of epigenetic pathways (Hardy & Tollefsbol, 2011; Li & Tollefsbol, 2010). Evidence have shown that many bioactive diets such as green tea, soybean, grapes and broccoli sprouts as well as other bioactive compounds extracted from these diets use their chemo preventive power to prevent different human disease such as obesity, cancer, and diabetes by reversing aberrant epigenetic profiles (Hardy & Tollefsbol, 2011; Li & Tollefsbol, 2010).

As rightly argued by Reinhardt and Fanzo (2014) the lack of essential vitamins and minerals within the diet can result to specific conditions. Here, the deficiency in even just one can be a limiting factor for growth. For example, a study conducted in 2013 revealed that vitamin B12 and folate deficiencies during gestation and lactation, resulted in elevated metabolic disorder in crucial metabolic organs such as high central fat mass and liver steatosis in children (Guéant et al., 2013). Similarly, the results from a birth cohort study revealed that maternal folate deficiency can increase obesity-induced child metabolic risk, whereas, adequate or appropriate maternal folate concentrations can eradicate the detrimental influence of maternal obesity in children (Wang, 2016). These bioactive nutrients can also influence developmental processes which result to disease prevention in future if the dietary exposure takes place during critical developmental periods such as early embryogenesis and early postnatal period (Lee, 2015; Li et al., 2014; Darapheak et al., 2013). Thus, it is important to note that where there is one micronutrient or bioactive nutrient deficiency there is a high possibility that there are multiple micronutrient deficiencies (Prado & Dewey, 2012).

As an immediate cause of maternal and child health, disease can also be a cause and consequence of malnutrition due to bioactive nutrient deficiency. For example, Reinhardt and Fanzo (2014:5) argues that "common childhood infections and diarrheal diseases can lead to poor absorption or ability to retain nutrients". As a result, a study revealed that the risk of a child being stunted at 2 years of age intensifies with the occurrence of diarrhoea (Checkley et al., 2008). This is supporting the argument that there is a link between increased diarrhoea incidence and increased risk of becoming stunted (Hackett et al., 2009). Therefore, the findings presented here argued that appropriate and adequate maternal dietary nutritional intake during critical stages of early development can modify epigenetic activities that are link to programming and reprogramming processes and disease phenotype, which can consequently predisposed children to different susceptibilities to diseases in future, such as obesity, diabetes, hypertension and other chronic diseases.

2.4 MATERNAL AND CHILDHOOD (UNDER-FIVE) NUTRITION AND HEALTH

2.4.1 Infant and Young Child Feeding

Adequate nutrition and feeding practices during infancy and childhood is critical to child growth, health, and development. Several studies have revealed that inadequate support for infant and young child feeding (IYCF) is the main contributing factor to inappropriate feeding practices globally (Barir et al., 2019; Zhang et al., 2018; Slemming et al., 2017; Rollins et al. 2016; UNICEF, 2010). These and many other studies suggest that early undernutrition and micronutrient deficiencies are associated with impairment of intellectual performance – overall health and nutritional status, and work capacity during adolescence and adulthood. In addition, studies conducted in South Africa and other developing nations argues that the rising incidences of overweight and obesity in children are also associated with malnutrition during infancy and childhood feeding practices (Campbell, 2018; Redsell et al., 2016; Black et al., 2013; Popkin et al., 2012; Rossouw et al., 2012; WHO, 2009). Not only is early childhood excessive weight gain is associated with the risk of later obesity, but it is also associated with health complications and early morbidity (Gibbs & Forste, 2013). These findings suggest that there is a need for raising awareness on appropriate IYCF practices to provide quality counselling and adequate support to mothers and children.

2.4.1.1 Infant and Childhood Feeding: Breastfeeding and Formula-feeding

Even with its established benefits, breastfeeding is no longer a norm in many South African communities. Recent studies conducted in the country have shown a decline in exclusive breastfeeding (Zweigenthal et al., 2019; Doherty et al., 2012; Nor et al., 2012). These raises more questions about child safety and rights[1] to adequate feeding as stipulated in the *Innocenti Declaration* (Rollins et al. 2016), which declared that all infants should receive exclusive breastfeeding from birth to a minimum of 6 months of age. In fact, the decline in breastfeeding is now a global pandemic that is not only common in developed countries but also common in economically developing nations. Here, a study conducted in 2012 highlighted that breastfeeding became less common in developed countries during the 20th century (Cattaneo, 2012). Likewise, patterns of decline in breastfeeding were also observed with increasing household wealth, and among better-educated, and urban women in economically developing countries (WHO, 1983). As a result, breastmilk substitutes such as formula-feeding were perceived as prestigious and modern – such that breastfeeding was then associated with being unsophisticated and poor (Rollins et al. 2016).

Despite the epidemiological evidence and calls for exclusive breastfeeding, known risk factors and benefits of breastfeeding have been documented in many studies. For example, a meta-analyses study that assess the risk factors for childhood overweight during infancy show that breastfeeding decreased the odds of childhood overweight by 15% (Weng et al., 2012). In addition, other studies also argue that breastfeeding provides a protective effect against childhood obesity (Campbell et al., 2018; Uwaezuoke et al., 2017; Crume et al., 2012; McCrory & Layte, 2012; Wijlaars et al., 2011; Dedoussis et al., 2011). However, single studies have shown that there is a significant association between shorter breastfeeding duration (Song et al., 2020; Redsell et al, 2016) and early introduction of solid foods (Gibbs & Forste, 2013; Pearce et al., 2013; Huh et al., 2011; Taveras et al., 2010) with the risk of childhood obesity.

Furthermore, in a study that assessed socioeconomic status, infant feeding practices and early childhood obesity revealed that infants that were predominantly fed formula-feeding from birth to 6 months of age were about 2.5 times more likely to be obese at 2 years of age as compare to infants that were exclusively breastfed for 6 months of age (Gibbs & Forste, 2013). Another study demonstrated that breastfed infants as compared to formula-fed infants have a lower BMI during childhood (Beyerlein & von Kries, 2011). More so, a study that examines socioeconomic status and weight gain in early infancy also argue that socioeconomically disadvantage children are particularly at risk of obesity in early childhood (Wijlaars et al., 2011). Many studies have demonstrated the negative association between breastfeeding and socioeconomic status, as well as other potentially complex factors that can influence childhood obesity (Li, 2018; Parlee & MacDougald, 2014; Apovian, 2013; Gibbs & Forste, 2013; Wijlaars et al., 2011). Yet, the very children that need this protection the most are also the least likely to be breastfed. Therefore, these authors are suggesting that unhealthy infant feeding practices were the main mechanism mediating the link between socioeconomic status and early childhood obesity (Gibbs & Forste, 2013). Environmental and biological factors also influence

[1] In 2001, the United Nations Convention on the rights of the Child declared breastfeeding as a legal right of the child and the promotion of breastfeeding as a legal obligation of the state. Here, the WHO recommends exclusive breastfeeding from birth to 6 months of age, and thereafter, breastfeeding should continue up to 2 years of age or more but adequately introducing complementary foods in a timely fashion (WHO, 2002).

the risk of childhood obesity. For example, children from low socioeconomic households are more likely to have overweight mothers – a high risk factor of childhood obesity (Gibbs & Forste, 2013). A recent study furthers revealed that mothers of overweight infants had higher BMI (Aldana-Parra et al., 2020).

2.4.1.2 Infant and Childhood Feeding: Complementary feeding and minimum acceptable diets

Although factors affecting childhood weight gain are complex, infant feeding and early complementary diet are primary contributing factors of childhood overweight and obesity. The delicate nature and significance of childhood complementary feeding period cannot be overemphasized. It is a time during which children are nutritionally vulnerable, and a time where life-long eating lifestyles and/or behaviours may be established. Complementary feeding is described as the transition from exclusive breastfeeding at the age of 6 months to the family diet – most importantly, it should occur when the baby is both developmentally ready and when breast milk is not sufficient to fulfil the nutritional needs of the baby (WHO, 2002). Thus, infant and childhood feeding is one such period where parental choice may have significant long-term effects on a child's weight, nutritional, and health status. Unfortunately, parental factors such as socioeconomic, biological, and environmental status can also contribute to childhood overweight and obesity (Keane et al., 2012; Kendzor et al., 2012; Gregori et al., 2012; Fiese et al., 2012). In a study that evaluates complementary feeding practices among mothers and nutritional status of infants in a low-income community in Nigeria demonstrated that children who did not received a minimum dietary diversity were more underweight (38.2% vs 23.8%) as compared to those who received it (Udoh & Amodu, 2016). Similarly, the study revealed that feeding indicators introduction of semi-solid, solid or soft foods; minimum meal frequency and minimum dietary diversity were associated with stunting (Udoh & Amodu, 2016). This study further demonstrated that wasting in children was higher among infants whose mothers do not wash hands with soap before feeding the child as compared to those whose mothers was their hands with soap before feeding the child (Udoh & Amodu, 2016).

Furthermore, in a study conducted in Malawi to assess maternal determinants of optimal breastfeeding and complementary feeding and their association with child undernutrition revealed that urban children were less likely to be breastfed within 1 hour of birth but were more likely to meet minimum dietary diversity (Walters et al., 2019). The study also revealed that there is a significant relationship between women who were in the highest wealth index and optimal IYCF practices (Walters et al., 2019). In general, the study revealed that children (13 – 23 months) who met minimum acceptable diet and minimum meal frequency were less likely to be underweight (Walters et al., 2019). Similarly, in a recent study conducted in Mongolia and South Africa also revealed that increased household wealth was positively associated with meeting minimum meal frequency, minimum dietary diversity, and minimum acceptable diet (Janmohamed et al., 2020; Slemming et al., 2017). More so, another study also demonstrated that children born of mothers with highest educational level had significantly optimal BMI relative to those of mothers with low educational levels (Sarki et al., 2016). Similarly, in another study conducted in Uganda demonstrated that mothers with higher social support scores and empowerment (based on maternal capabilities index such as employment, high wealth index, etc) were significantly associated with feeding the minimum meal frequency, minimum dietary diversity, and minimum acceptable diet (Ickes et al., 2018).

On the contrary, in a recent study conducted in Colombia associated high maternal years of education with overweight in children (Aldana-Parra et al., 2020). Exclusive breastfeeding and predominant breastfeeding were associated with lower diarrhoea prevalence in infants aged 0 – 5 months relative to those who were not exclusively and predominantly breastfed in Tanzanian (Ogbo et al., 2018).

In general, studies have demonstrated that low socioeconomic status households and/or low maternal socioeconomic status were associated with low probability of meeting the minimum meal frequency, minimum dietary diversity, and minimum acceptable diet – resulting to malnutrition and health implications (Khulu & Ramroop, 2020; Janmohamed et al., 2020; Walters et al., 2019; Na et al., 2017; Slemming et al., 2017; Udoh & Amodu, 2016; Keane et al., 2012; Kendzor et al., 2012; Gregori et al., 2012; Fiese et al., 2012). For example, in a study that evaluates the determinants of malnutrition in under-five children in Malawi, Senegal, and Angola demonstrated that mothers' level of education, age and sex of the child, the type of residence, birth interval, wealth index and the birth order were significantly associated with malnutrition in these countries (Khulu & Ramroop, 2020). This study was conducted using the 2016 Demographic Health Survey (DHS) data from Malawi, Senegal, and Angola. In it, the study indicated that children located in rural communities, poor socioeconomic households, with a mother having achieved primary education, are female and are between the ages of 24 and 59 months are statistically correlated with malnutrition in Angola, Malawi and Senegal (Khulu & Ramroop, 2020). The findings of this study further argue that children born in these three countries with mothers who has primary education as their highest educational level are at the highest risk of being affected by malnutrition (Khulu & Ramroop, 2020).

2.4.2 Socioeconomic and Demographic Determinants of Maternal and Child Nutrition and Health

Globally, there are more than 2 billion people who are affected by undernutrition (Nisbett et al., 2014). Again, as argued by Black et al (2013), malnutrition as the underlying factor is accountable for about 45% of all childhood (under-five) mortality. Undernutrition among mothers and children is also a known underlying cause of maternal and child mortality globally – especially in economically developing countries. Undernutrition among mothers (maternal undernutrition[2]) and their offspring is strongly associated with various social and physical factors.

For example, in a study that examines the factors associated with underweight and stunting among children in rural Terai of eastern Nepal revealed that mothers with low body mass index (BMI), higher birth order, low child's age, and poor living conditions are associated with undernutrition among children in eastern Nepal (Singh et al., 2009). Low maternal education and household food insecurity and infections have also been shown to impact on child nutritional status (Khulu & Ramroop, 2020; Janmohamed et al., 2020; Walters et al., 2019; Na et al., 2017; Slemming et al., 2017; Udoh & Amodu, 2016; Wolde et al., 2015; Bharati et al., 2011). Similarly, a study conducted in some rural areas in Indian revealed that hygiene practices, complementary feeding practices, home delivery, and birth weight were significantly associated with undernutrition among infants (Meshram et al., 2013). In addition, in a study that investigate the association between parity and maternal BMI in a population-based cohort

[2] This is defined as the poor nutritional status of women within the childbearing age 15 – 49 years, or with a BMI <18.5 (Ergo et al., 2008)

study revealed that the mean BMI increased for each additional parity group (Iversen et al., 2018). They further argued that on average, women gained 0.62 (0.58-0.65) BMI units for every birth. More so, in another study that investigate the impact of parity on maternal obesity among Iranian women revealed that after controlling for confounders (maternal age, marital status, education, employment, etc), women with ≥3 parities were at higher risk of being obese with (OR 1.74; CI 1.24-2-45; p=0.001) relative to their counterparts (Hajiahmadi et al., 2015). In other words, this study is suggesting that higher maternal BMI is associated with high parity. Similarly, in another study that investigate the relationship between parity and persistent weight gain at age 40-60 years revealed that higher parity is associated with higher BMI (Zoet et al., 2019).

In the sociodemographic determinants of maternal and child nutrition and health, three (3) subthemes including income inequality and poverty, maternal socioeconomic status, and food security were identified and employed by the researcher to understand their impact on maternal and child nutrition and health outcomes. Suggesting that maternal and child nutrition and health in developing countries are in part determined by social factors that include income inequality and poverty (including economic development, politics/policies, political instability), food insecurity, maternal socioeconomic status (including gender inequality, education, occupation, marital status), and parasitic and infectious diseases.

2.4.2.1 Income Inequality and Poverty

Income disparities and poverty influences maternal and child nutritional and health status in most developing countries, as low income affects nutrition and food choices (Khulu & Ramroop, 2020; Janmohamed et al., 2020; Walters et al., 2019; Na et al., 2017; Slemming et al., 2017; Udoh & Amodu, 2016; Wolde et al., 2015; Keane et al., 2012; Kendzor et al., 2012; Gregori et al., 2012; Fiese et al., 2012; Bharati et al., 2011; Baum, 2008; Fujii, 2005). Of course, undernutrition is a by-product of poverty and development (Nisbett et al., 2014). Thus, understanding the political economy of undernutrition both developing and developed countries is paramount to solving the global plague of undernourishment. Nisbett et al (2014) argues that the political economy of nutrition is characterised by basic causes such as economic, political, social, and the ideological factors that defines the social and political philosophies of a country. In addition, Smith and Haddad (2015) argues that political economy of nutrition forms the political, environmental, economic, social and cultural context through which childhood nutritional status are influenced and measured. Here, these authors argue that these basic causes of political economy of nutrition determine how households access basic services and resources, which then defines the knowledge and power relations in a community, as well as gender relations in a community. Again, political economy discourses do not only define the space within which purposeful nutritional actions can operate, but they also affect their very effectiveness. Why? This is simply because economic growth is known to have a large impact on malnutrition rates – positively (Khulu & Ramroop, 2020; Janmohamed et al., 2020; Walters et al., 2019; Na et al., 2017; Slemming et al., 2017; Udoh & Amodu, 2016; Wolde et al., 2015; FAO, 2015; Smith & Haddad, 2015; Alderman et al., 2013; Addison et al., 2008; Collier, 2007; Lamarre, 2005). For example, economic growth (and/or economic stability) can significantly impact on undernutrition rates in developing countries if political undertakings are geared toward reducing income inequality (Haddad, 2014) – such as employment, education, social stability, promoting gender equality, etc. This is particularly significant in South Africa since the apartheid legacy leaves a majority of its population in poverty. For example, using the Gini Coefficient to measure income inequality in the country, the findings from the National

Planning Commission (NPC) revealed that there has been an increase of income inequality from 0.6 in 1995 to 0.679 in 2009 (NPC, 2011).

Therefore, this is an indication that disparities in wealth and access to healthy food are important concerns for political, economic, health and agricultural policies in developing countries such as South Africa. Why? This is simply because public health influences human capital acquisition and economic status. This is highlighting that access to quality healthy food plays a major role toward determining and strengthening other measures of inequality in a society. These factors are specifically relevant within the South African context since the apartheid legacy leaves non-whites in rural and informal-settlement areas, with the majority of them drowning in poverty (Coovadia et al., 2009; Harris et al., 2011). Concerning the underlying determinants of child nutritional status, Smith and Haddad (2015) argues that they manifest themselves at the household level through household food security and household quality of caring practices for children and women. Here, household food security is basically about ensuring that families have access to quality and healthy food in abundance to live an active healthy life.

While caring practices for children involves child appropriate feeding (IYCF), cognitive stimulation and health-seeking behaviours; and the most obvious caring practices for women which affect both women and children involves women's nutritional well-being, care and support during pregnancy and lactation period. It is also important to note here that because women are typically the primary caretakers of children after birth, ensuring that their well-being is continually promoted and propagated is paramount to solving the issues surrounding maternal and child health. On the basic determinants of child nutritional status, Smith and Haddad (2015) argues that they manifest themselves through political, economic, environmental, social and cultural context that defines the nutritional status of children and women at a large scale. Here, income as a key basic determinant of child nutritional status or outlook can influence undernutrition through higher income to reduce poverty level in households. Again, higher national income through pro-poor pattern of growth can reduce household's financial stress through the provision of quality public services such as education, social protection, and healthcare services. For example, according to Ruel and Alderman (2013) there is a strong relationship between higher income and poverty reduction. This is an indication that the ability of a government or a community to effectively formulate and implement good policies can foster good economic and social interactions that can positively impact on individual and national nutritional status.

Undernourishment, particularly among children (under-five years), is a major public health challenge in South Africa (SA-DHS, 2017). This requires a systematic and practical approach in order to improve nutritional services and promote behavioural change. This is very important, because the amount of attention given to children lays the basis for the future of the country. However, with no public system that is geared toward improving maternal and childhood nutrition in the country, South Africa's efforts to improve maternal and child health is impeded by malnutrition through political, economic, environmental, biological, social and cultural factors of health determinants. More so, childhood development is also contingent to policy interpolations and social practices that can change and control the life chances for a new generation and build a more equitable society. Therefore, the cumulative effects of malnutrition in early life of children affects, not only their health but also responsible for their wellbeing and socioeconomic development[3].

[3] Such as educational attainment, employment, and poverty reduction.

2.4.2.2 Maternal Socioeconomic Status

Low or poor maternal socioeconomic status is recognized as one of the social determinants of nutritional and health status of mothers in most developing countries, which influences undernutrition in children. For example, education is recognized as one of social determinants of health (Folayan et al., 2020; Santos Jr et al., 2019; Alosaimi et al., 2019; Dimbuene et al., 2018; Ngoma & Mayimbo, 2017; Alosaimi et al., 2016; Osamor & Grady, 2016; Sepehri & Guliani, 2015; Yu et al., 2014; Urke et al., 2011), which also influence undernutrition in children. Other studies have also argued that high maternal wealth index, years of education and maternal employment are associated with positive relationship between maternal socioeconomic factors and both maternal and childhood bodyweight. For example, several studies have demonstrated a positive association between maternal employment and the bodyweight of their children (Chia, 2008; Ruhm, 2008; Courtemanche, 2007; Cawley & Liu, 2007; Phipps et al., 2006; Liu et al., 2005). Here, economic theory suggests that there are various channels through which maternal employment can influence her child bodyweight, such as: 1) mothers who are employed has less time available to cook and prepare meals, thus opting instead for more restaurant meals, and take out or delivered meals from fast food restaurants; 2) employed mothers may have less time and energy to supervise and take part in their children's daily activities, which result to children choosing their own activities or spend more time at the care of others – either in school or in child care; and 3) employed mothers are often expected to returned back to work sooner after birth, hence were less able to breastfeed or quit breastfeeding earlier and opting instead for formula feeding (Fertig et al., 2009). With that being said, the link between maternal employment and both maternal and childhood nutritional status varies from region to region, with inconsistent findings. For example, most study conducted in developed countries suggest that the rise in maternal employment is significantly associated to the rise in both maternal and childhood overweight and/or obesity (Fitzsimons & Pongiglione, 2019; Courtemanche et al., 2017; Gwozdz, 2016; Gwozdz et al., 2013; Dunifon et al., 2013; Champion et al., 2012; Morrissey et al., 2011; Hawkins et al., 2008).

On the other hand, most studies conducted in developing economies suggest that there is insignificant association between maternal employment status and both maternal and childhood overweight and/or obesity (Debela et al., 2020; Rashad & Sharaf, 2019; Oddo et al., 2017; Nie & Sousa-Poza, 2014). For example, in a study that examines the relationship between maternal employment and childhood obesity in China revealed that there is insignificant association between maternal employment and childhood nutritional status (Nie & Sousa-Poza, 2014). Similarly, in a study that utilized cross-sectional data from the Demographic and Health Surveys to investigate maternal employment and childhood overweight in 45 low- and middle-income countries revealed that neither formal nor informal maternal employment was associated with childhood overweight in most countries (Oddo et al., 2017). However, the study further revealed that children born of employed mothers relative to children born of unemployed mothers had higher BMI Z-scores and higher odds of normal weight. Formally employed mothers were also associated with higher odds of childhood overweight in Ghana, Egypt, and Kenya (Oddo et al., 2017). Consequently, in a study that investigate the impact of maternal education, employment, and family size on nutritional status of children revealed that maternal employment status had insignificant association with childhood growth parameters with a confidence interval of 0.725 to 1.768 (Iftikhar et al., 2017). However, the study revealed that maternal education has a significant effect on nutritional status of children. Here, only a handful of studies conducted in developing countries which suggests that there is a significant association between maternal employment and childhood poor nutritional outcomes (Rashad & Sharaf, 2019; Nankinga et al., 2019; Rivera-Pasquel et al., 2015). In a study that measures

maternal employment and childhood nutritional status in Uganda revealed that children born of mothers who engaged in agriculture and manual work had higher odds of stunting relative to those whose mothers engaged in professional work (Nankinga et al., 2019). Furthermore, in a study that investigate breastfeeding and maternal employment in Mexico revealed that formally employed mothers were negatively associated with breastfeeding with children under 1 year (Rivera-Pasquel et al., 2015). Formally employed women in Mexico were 20% less likely to breastfeed relative to non-formally employed women. Likewise, children born of employed mothers in Mexico were 27% less likely to be breastfed relative to children born of unemployed mothers (Rivera-Pasquel et al., 2015). Similarly, in a study that evaluates maternal employment in 49 low- and middle-income countries and its impact on improved infant and young child feeding revealed that relative to unemployed mothers, the odds of continued breastfeeding at 1 year were lower among mother who are formally employed (CI=1.06 to 1.24) (Oddo & Ickes, 2018). Using a cross-sectional samples from Demographic and Health Surveys in 38 low- and middle-income countries, a study revealed that compared to unemployed mothers, formally employed mothers had higher odds of overweigh in pooled odds ratio (POR) =1.3 with a 95% CI of 1.2 to 1.4 (Oddo et al., 2017).

The main argument here is that gender inequity and socioeconomic status are interrelated in many ways – such as poor access to education, high dependent on men for socioeconomic security, disparities in accessing wealth, and poor wages. These therefore influences both maternal and childhood nutritional and health status in both developed and developing countries. Thus, maternal socioeconomic status, has a bearing on both maternal and child nutrition and health, globally. In addition, the idea that the wealth generated through maternal employment can serve as a catalytic force for quality nutritional intake and healthy nutritional status among mothers and their children is intuitively appealing and acceptable by common sense. However, as demonstrated herein, maternal employment might reduce time spent with children, which could result to increase childhood overweight and/or obesity. The arguments presented herein are not to be taken as arguments against maternal employment. In fact, maternal employment empowers women and improves their socioeconomic status, which is directly in line with the sustainable development goal 8 – for promoting economic growth and productive employment for all. Similarly, the sustainable development goal 2, which is geared toward ending hunger, achieving food security, and improving household nutritional intake can significantly be achieved through maternal employment. Therefore, for many of us who religiously believe that maternal employment is fundamental to achieving healthy nutritional status among mothers and their children – irrespective of their region – it is intrinsically difficult to accept the idea that maternal employment can be hampering for quality nutritional intake and healthy nutritional status. Although there is much published research on the negative relationship between maternal employment and its impact on both maternal and childhood nutritional status, there is no clear guidance on what should be done to lessen, if not avoid totally, its adverse effects on maternal and childhood nutritional status. Previous studies have suggests several key pathways through which maternal employment affects childhood nutrition comprises of level of income and childcare practices (Ukwuani & Suchindran, 2003). More so, income generated and controlled by women plays a major role in contributing to childhood and household food as well as health budget (Shroff et al., 2011), while employment that entails women being absence usually implies partial weaning or cessation of breastfeeding and inability to monitor child feeding and care (Cawley & Liu, 2012; Bernal, 2008; Waldfogel, 2002).

2.4.2.3 Food Security

Food insecurity[4] is one of the most significant social determinants contributing to maternal and child nutritional and health status. The concept of food security is best assessed at the macro- and microeconomic levels. Here, the macroeconomic level indicates a global, regional, or national food security – with a focus on agricultural biodiversity, production, quality, and availability, rather than consumers' access to food. On the other hand, the focus is on household or individuals' access to quality and healthy food without hindrances imposing due to poverty or economic access to sufficient healthy food to meet the dietary requirements for a productive and healthy life. While the concept of food security is best examined at the macro- and microeconomic levels, food security in this study was assessed at the microeconomic level – using maternal household wealth index, employment status, and education. These factors were used in Chapter 4 to measure their impact on minimum acceptable diets of under-fives. Thus, it is important to know that the factors influencing food insecurity are multifactorial, complex, and often interrelated. Lacking sufficient safe, nutritious, affordable, and bio-diversified food can serve as a catalytic force to malnutrition, especially for women and children. Several studies have highlighted that healthy nutrition is central for physical, psychological, and/or mental growth and development for children, and productivity for adults – especially women in their reproductive age (Zhou & Xiao, 2018; Chu et al., 2016; Parlee & MacDougald, 2014; Girard & Sercia, 2013; Melchior, et al., 2012; Ecker & Diao, 2011; Bihan et al., 2010). In other words, these studies are highlighting that healthy nutrition is fundamental to maternal and child physical and social (mental) health outcomes. This is an indication that nutrition is both an important environmental and social factor that impacts on maternal and child health. It is a phenomenon that is very much common in both developed and developing countries, except that it may varies in context and in content.

Food insecurity as a situation in which households lack access to quality and healthy food due to poverty or other resources is said to be one of the leading nutrition and health problem in both developing and developed countries. For example, a study conducted in the United State revealed that in 2013 about 50 million Americans (14.3%) were food insecure (Coleman-Jensen et al., 2014). Again, in a study that assesses food insecurity and hunger in developed countries postulates that the prevalence of household food insecurity or food poverty is relatively high in developed countries – ranging from 8 – 20% of the population (Pollard & Booth, 2019). In developing countries, many studies revealed that household food insecurity impedes on child health (Chakona & Shackleton, 2018; Schmeer & Piperata, 2017; Betebo et al., 2017; Abdurahman et al., 2016; FAO, 2015; Mandal et al., 2014; Black et al., 2013; Saaka & Osman, 2013; Ali et al., 2013; Nti, 2011; Kuku et al., 2011). For example, in a study that evaluates the relationship between household food insecurity and child health indicated that even mild household food insecurity is detrimental to children's health (Schmeer & Piperata, 2017). Using a 48-hours dietary recall method, a more recent study conducted in South Africa, revealed that household food insecurity was accountable for malnutrition in 35% of children and 18% of children were reported wasted in a sample of 216 children between the ages of 2-5 years old (Chakona & Shackleton, 2018). These authors also postulate that child wasting was highest in locations with lowest agro-ecological potential (Chakona & Shackleton, 2018). Suggesting that areas with agro-ecological potential had lower prevalence of food insecurity and wasting among children. Similarly, food-insecure households in Ethiopia, Bangladesh, and Vietnam were statistically associated with having stunted and underweight children (Ali et al.,

[4] This is defined as poor access of quality, nutritious, affordable, and varied and sufficient amount of food for growth and development of an active and healthy life (Gundersen & Ziliak, 2015; Barrett, 2010; Bachmeyer, 2009; Campbell, 1991).

2013). Therefore, ensuring preventive food insecurity at individual and household levels is crucial to reducing the prevalence of maternal and child malnutrition.

2.5 CHAPTER SUMMARY

There is increasing recognition about the nutritional intake and morbidity of women and children globally. An ample body of scientific evidence exists, documenting the factors that impacts on both maternal and child nutritional intake and morbidity. These existing body of knowledge highlighted that nutrition is fundamental to defining the health of all people, infants and children, young and old, women and men, and rich and poor. Thus, reducing barriers to food security and addressing social determinants of health is important to promoting quality maternal and child nutrition and health.

This Chapter present the theoretical framework underpinning the study. The framework is structured around four (4) stages that result in both maternal and childhood nutritional intake, morbidity, and mortality. Furthermore, the Chapter presented key discourses around maternal and child nutrition and health. Building from infant and young child feeding practices, this Chapter demonstrated how maternal socioeconomic and/or sociodemographic factors influences maternal and child nutritional and health outcomes.

The next Chapter presents the Research Methodology guiding the implementation and facilitation of this research.

CHAPTER THREE

RESEARCH METHODOLOGY AND DESIGN

3.1 INTRODUCTION

While the previous chapter of this study critically discussed the key research issues and theoretical status of the identified phenomenon of the study, this chapter provides a methodical perspective through which the research questions and objectives of this study was succinctly realised. In other words, the purpose of this chapter is to clarify the methodological framework used by the researcher to conduct this study.

A research can be described as the systematic procedure or process through which data are collected and logically analysed for a given purpose (Bless et al., 2015; Kumar, 2014; Creswell, 2013; Brink et al., 2012; McMillan & Schumacher, 2010). However, it is important to note that the above definition is generalised to a certain degree, because several techniques or methods are employed by researchers to investigate a problem(s) or question(s). Hence, research methods (constituting a research design and/or methodology) are the ways through which researchers collects and analyses data. These methods have for centuries been developed for acquiring, producing, and/or building knowledge reliably and validly. Therefore, as rightly argued by McMillan and Schumacher (2010), a research methodology is systematic, logical, and purposefully planned to yield and analyse data on a particular research problem or phenomenon.

Consequently, the chapter aims to introduce and explain the rationale for the research approach chosen for this study – a quantitative approach was followed. Here, a justification would be given for the selected study design and research approach. Thus, this chapter begins by restating the research objectives and questions, provides a philosophical positioning of quantitative research and a description of the research design. The research methods used by the researcher are equally explained and justified. In addition, the chapter identifies, describes, and justifies the research population, sampling technique, sample, data collection and ethical consideration. The chapter also discusses the research instruments and the reliability and validity thereof. This chapter further provides a detail description of how the collated data was analysed and discussed; the issue of reliability and validity as it pertains to the current study was also discussed. In summary, this chapter provides a systematic and methodical approach that is consider necessary to accomplish the objectives of this study, and as well as proffering empirical responses to the research questions of this study. The chapter concludes with a summary of the chapter.

3.2 RESEARCH OBJECTIVES

Even though the research objectives of this study have already been established in chapter one, a restatement is deemed necessary in this chapter to adequately evaluate these objectives relative to the research methods adopted for this study. As rightly argued by Creswell (2014), the aim of a research methodology is to help the researcher formulate a guide that allows the researcher to attain the research objectives of a study (Creswell, 2014). Similarly, Sekaran and Bougie (2016), added that the attainment of a research objective(s) is contingent to the adopted research design. Therefore, the prime purpose of this study is to evaluate the impact of maternal socioeconomic and/or sociodemographic factors on maternal and child nutritional and health outcomes. The specific aims are to:

1. To report on the percentage of under-five children in South Africa with a minimum acceptable diet.

2. To measure the impact of maternal sociodemographic factors on minimum acceptable diet among children under-five.

3. To measure the impact of maternal sociodemographic factors on breastfeeding and formula feeding in South Africa.

4. To determine the relationship between breastfeeding as well as formula feeding and child health in South Africa.

5. To describe the anthropometric status of mothers and under-five children in South Africa.

6. To measure the impact of maternal sociodemographic factors on both maternal and childhood anthropometric (nutritional) outcomes in South Africa.

3.3 RESEARCH APPROACH AND DESIGN

According to Neuman (2013), a research design is a framework or blueprint that effectively describes how the research data are collected, measured, and later analysed. It is also defined as 'strategies of inquiry' for formulating the methods and procedures that is employed to answer research question (Creswell, 2013). Hence, research designs have the purpose of maximizing control over factors that can affect the validity of the findings (Grove *et al.*, 2013). Therefore, to answer a research question(s), a researcher may choose either a qualitative, quantitative, or mixed-method research design for data collection, measurement and successive analysis. However, choosing any of these research designs is contingent to the research questions that a researcher seeks to answer. Thus, irrespective of the research design chosen by a researcher, each of these research approach has three categories of: Data collection, Data analysis, and Data construal of a study (Creswell, 2014). Therefore, the research questions guiding this study's research design and approach are as follows:

1. What is the percentage of children under-five in South Africa with a minimum acceptable diet?

2. What is the impact of maternal sociodemographic factors on minimum acceptable diet of children under-five?

3. How does maternal sociodemographic factors influence breastfeeding and formula feeding in South Africa?

4. What is the relationship between breastfeeding as well as formula feeding and child health in South Africa?

5. What is the anthropometric status of under-five children in South Africa?

6. How does maternal sociodemographic factors impact on both maternal and childhood anthropometric (nutritional) outcomes in South Africa?

3.3.1 Research Approach

Therefore, based on these research questions, the researcher deems it fitting to adopt a non-experimental quantitative research approach for extracting the required data for this study. The use of an explanatory research approach allows the researcher to provide an in-depth evaluation, investigation, understanding and insight analysis about the current state of maternal and under-fives health in relation to nutrition in South Africa (Engel & Schutt, 2013). This approach provides the foundation for a quality research with a complete control over the factors that can affect the rationality of the findings thereafter (Bhattacherjee, 2012). Therefore, the chosen research approach is appropriate because it allows the researcher to compare and establish the degree to which the findings from this study are similar or dissimilar with other findings. Here, a quantitative research approach emphasise objectivity in measuring and describing phenomena (McMillan & Schumacher, 2010). As such, the chosen research approach maximises objectivity by using numbers, mathematical models, structure and control. In addition, it explains phenomena based on collated numerical data that are subsequently analysed using mathematical and statistical methods of analysis (Tolmie *et al*., 2011). Thus, quantitative research designs are described as well-structured, purposeful, and specific – such that they ensure precision. These elements of quantitative research approach increase the reliability and validity of the research findings for generalisation (Kumar, 2014). This is different from the qualitative and mixed methods research approach. Therefore, the decision to use a quantitative research method for this study is further necessitated and justified by the fact that quantitative research design enables the study to be precise and to be explicitly defined. Thus, this study approach was used to quantify the differences and similarities that exist within the study groups or the target population – based on the research objectives.

In addition, quantitative research approach is also used for testing models and theories based on scientific methods that evaluate the cause-and-effect interaction between variables (Creswell, 2013; Burns & Grove, 1993). More so, as rightly argued by Bless et al (2015), quantitative research designs are premised on the analysis of numeric data that are collected and measured through structured instruments. These elements of quantitative research Approach fit well with the data analysis techniques used for this study. Therefore, the prime purpose of this research design section is to inform the reader of how the investigation was carried out, in other words, what the researcher did to solve the research problems or to answer the research questions (Brink et al., 2012). Therefore, this study is descriptive and exploratory by nature, such that it described and explore the significant factors influencing both maternal and child nutritional and health outcomes.

3.3.1 Research Design

According to Creswell (2013), a research design provides the framework for data collection techniques and ultimately the analysis necessary for achieving the research objectives, while attempting to provide answers to the research questions. Although there are many research designs that can be adopted in a study, the researcher chose a survey research design. A survey research design is used by researchers to collect original data for describing a population too large to be observed directly (Mouton 1996). In other words, a survey research is one in which a group of people or items is studied by collecting and analysing data from only a few people or items that are a representative of the entire population or target population.

Although only a part of the population or target population is studied, findings from a survey research are expected to be generalized to the entire population or target population (Nworgu,

1991). Therefore, the justification for adopting a survey research design is simply because of its systematic technique for collecting data from a population or target population with a view of understanding, exploring, experimenting, explaining, and comparing attributes amongst items (samples) within the target population based on knowledge, attitude and behaviour (Neuman, 2013). In addition, a survey research was used in this study because it accurately depicts or portrays the characteristics of the studied group such as behaviour, abilities, beliefs, socioeconomic and households' characteristics, and nutritional outcomes. Here, the aim of this research design is to understand the current state of maternal and childhood nutritional status in South Africa and how it impacts on maternal and child health in the country.

3.5 DATA COLLECTION PROCESS

Although data collection is a systematic and precise gathering of information that are appropriate to the research purpose or the specific objectives, questions, or hypothesis of a study (Grove et al., 2013), this current study uses a secondary data to answer the research questions. Therefore, because the methodology of this study is a quantitative research approach, the researcher used the 2016 South African Demographic Health Survey (SA-DHS) dataset to achieve the objectives of this study. The SA-DHS dataset was deemed appropriate for achieving the set objectives of this study by critically investigating the impact of maternal socioeconomic/sociodemographic factors on maternal and childhood nutritional status in South Africa. During the 2016 SA-DHS, a questionnaire was used for each household to collect data pertaining to women aged 15-49, who were considered eligible for the study. More so, in these same households, children aged 0-59 months were eligible for biomarker collection, and for each child aged 0-59 months whose biological mother did not live in the household or was deceased, a godparent was eligible to complete a Caregiver's Questionnaire. Thus, five questionnaires were used to obtain relevant data for the study: the Household Questionnaire, the individual Man's Questionnaire, the individual Woman's Questionnaire, the Caregiver's Questionnaire, and the Biomarker Questionnaire. However, this study uses the 2016 SA-DHS Woman's and Biomarker's Dataset as its ultimate source of information required for this study's analyses. Thus, in each household, eligible women for this study, age 15-49 were asked questions on the following topics:

- ✓ Background characteristics: age, education, media exposure, and so on.
- ✓ Birth history and child mortality
- ✓ Antenatal, delivery, and postnatal care
- ✓ Breastfeeding and infant feeding practices
- ✓ Vaccinations and child illnesses
- ✓ Marriage and sexual activities
- ✓ Woman's work and partner's background characteristics
- ✓ Maternal and childhood anthropometric data

Therefore, by using the secondary data (SA-DHS datasets), the researcher extracted the following information from women and children (under five) as a means of achieving the research objectives: individual-level sociodemographic data (age, marital status, number of children ever born, educational status, employment status, household income, access to healthcare services, anthropometric data) and childcare-related data (nutritional care and healthcare services). The researcher also extracted information on household's ownership of selected assets, such as types of water access and sanitation facilities; materials used for housing construction; access to social amenities; televisions and automobiles which were later utilized by the researcher to estimate maternal household wealth index (See Section 3.8.1.1).

3.5.1 Dependent Variables

Maternal Body Mass Index (BMI); Childhood nutrition (e.g. Breastfeeding, Formula feeding, and infant feeding practices, complementary feeding); and childhood nutritional status (including birthweights) were used as the dependent variables for this study. These were used to quantify and understand the current state of maternal and childhood nutritional and health outcomes in South Africa.

3.5.2 Independent Variables

These are group of variables which were used to examine both maternal and childhood nutritional and health outcomes. These variables are socioeconomic and/or sociodemographic by nature. They were used as explanatory variables in this study to determine their impact on or the relationship between dependent variables and the independent variables. In other words, they were used to determine the relationship between the independent variables and both maternal and under-fives nutritional and health outcomes. These includes the following:

- Maternal age
- Maternal marital status
- Maternal occupational status
- Maternal education
- Maternal place of residence
- Child age and gender
- Number of children ever born
- Child illnesses
- Under-fives' Birthweights
- Household wealth index. Here, the household wealth index was constructed by the researcher using a principal component method.

3.6 POPULATION AND SAMPLING

A study population is described as the entire individuals (or group of people), elements, objects or substances that meets the research sample criteria for inclusion in a study (Sekeran & Bougie, 2016). Whereas sampling is the art of recruiting respondents from the study population or target population. In addition, Cohen et al (2017) argues that sampling is a direct consequence of defining a study's population, while further stating that the reliability, and credibility of a study does not only depend on the appropriateness of the methodology and instruments employed, but also rely on the suitability of the sampling strategy (Cohen *et al.*, 2017). Thus, a study sample size is a representative or a fragment of the whole population whose features can be generalized on the entire population. Therefore, sampling is the process of selecting a fraction or portion of the population to represent the accessible population.

3.6.1 Study Population

The population of this study comprises of all childbearing age women (aged 15-49) and all under-five years children living in South Africa, while the target population comprises of all maternal women (aged 15-49) with their under-five children in South Africa.

3.6.1 Sampling Design and Sample Size

The 2016 South Africa Demographic and Health Survey (SA-DHS) complies with common demographic health surveys research design policy. However, the 2011 South Africa Population and Housing Census provided the constellations which was used to estimate the sampling points from the list of enumeration areas (EAs). This was derived from the Statistics South Africa (Stats-SA) Master Sample Frame (MSF). In the MSF, EAs of manageable size were treated as primary sampling units (PSUs), whereas small neighbouring EAs were clustered together to create new PSUs, and bigger EAs were fragmented into theoretical PSUs. Thus, the SA-DHS is representative in nature. This entails that the SA-DHS 2016 followed a stratified sample design. Here, it employed a two-stage stratified design with a probability proportional to size (PPS) sampling of PSUs at the first stage and systematic sampling of the dwelling units (DUs) at the second stage. Since the country is administratively divided into nine provinces, each province was then stratified into urban, farm, and traditional areas – yielding 26 sample strata for the 2016 SA-DHS. Therefore, a total of 750 PSUs were selected from the 26 sampling strata – yielding 468 selected PSUs in urban areas, 224 PSUs, in traditional areas, and 58 PSUs in farm areas. In each individual household a questionnaire was used to collect data pertaining to women aged 15-49, who were considered eligible for the study. More so, in these same households, children aged 0-59 months were eligible for biomarker collection – anthropometric data such as weight and height/ length for babies, and for each child aged 0-59 months whose biological mother did not live in the household or was deceased, a godparent was eligible to complete a Caregiver's Questionnaire.

Therefore, using inclusion and exclusion criteria, the sample size extracted for this study comprises of only maternal women (aged 15-49) with their under-five children (0-59 months) whose anthropometric data and age were recorded in the 2016 SA-DHS dataset and excluded maternal women (aged 15-49) with their under-five children that do not meet the inclusion criteria. As an inclusion criterion, both maternal and child anthropometric records in the dataset were deemed significant to this study since the researcher seeks to investigate the link between maternal socioeconomic and/or sociodemographic relative to both maternal and child nutritional and health outcomes in South Africa.

Prior to extracting the sample size from the 2016 SA-DHS dataset for this current study, the dataset recorded a total number of 14 144 women who fell within the childbearing age and a total number of 4 081 maternal women who at the time of the data collection had children who were under-five years old. In other words, the 14 144 was the total number of respondents from the dataset who fell within this study's population while the 4 081 was the total number of respondents from the dataset who fell within this study's target population. However, after critically evaluating the 2016 SA-DHS dataset against this study's inclusion and exclusion criteria, only about 1 460 respondents were deemed eligible to be part of the current study's sample size. Thus, this is suggesting that only 35.78% of this study's target population from the 2016 SA-DHS dataset met the inclusion criteria used for this study. Therefore, this study's sample size is 1 460 respondents (maternal women) within the target population.

3.7 ETHICAL CONSIDERATIONS

Prior to writing this research proposal, the researcher obtained the permission from the SA-DHS to use their dataset, which was granted with a written letter permitting the researcher to utilize the SA-DHS for academic research (**See Appendix 1**). In addition, the researcher obtained an ethical approval for the current study from the University of KwaZulu-Natal

Research Ethics Committee. Here, the research proposal was sent to the University of KwaZulu-Natal's Research Ethics Committee for ethical clearance. Thereafter, the ethical clearance was also secured (**See Appendix 2**).

3.8 DATA ANALYSIS METHODS

In this study, STATA software was used to clean, generate, and analyse the extracted data used for this study as presented in Chapter Four. This allowed the researcher to achieve the research objectives and the relative research questions. Therefore, both descriptive and inferential statistical matrices were used to analysis the data for this study. Although STATA was used to compute the descriptive and inferential analyses of this study, the anthropometric measurements for the under-fives were converted to sex-specific Z-scores using the World Health Organisation (WHO) Anthro Software. Thus, childhood anthropometric evaluation – that is – anthropometric measurements of weight and height for each child were determined using the WHO standards procedures (WHO, 2017). Therefore, by using the WHO Anthro software, the researcher converted weight, height, and age measurements of each child to weight-for-age (WAZ), height-for-age (HAZ), and body mass index-for-age (BAZ) Z-scores. These were later used to classified underweight, stunting, and obesity – as further demonstrate in Chapter Four – using STATA. Thus, both descriptive and inferential statistical matrices were used to analyse the data for this study.

3.8.1 Descriptive Statistical Analysis

By using descriptive statistics matrices, the researcher was able to compute the mean, standard deviation, frequencies, and percentages to describe the variables (Quilan *et al.*, 2011). As a result, each variable is described using the descriptive statistics matrices mentioned above in Chapter Four. Thus, descriptive analysis was used to achieve *objective one* of the current study.

Furthermore, the prime purpose of using descriptive statistics was to particularly visualise and simplify the data extracted by using charts, graphs, and tables for graphical representations. In addition, contingency tables were also used by the researcher to compare the relationship between the dependent and independent variables. Thus, contingency tables were used to statistically explore the items of interest in this study.

3.8.1.1 Estimating maternal household wealth index

The distribution of income within a society or country is the first important consideration of ensuring households food and social security (Barlow et al., 2020; Chavas, 2017; Poulsen et al., 2015; Kotagama et al., 2014; Akter & Basher, 2014; Haddah, 1992). Thus, using a statistical procedure known as principal components analysis (PCA), the researcher computes a wealth index, which was used to place individual households on a continuous scale of relative wealth. This is a composite measure of individual household's cumulative living standards based on a household's ownership of selected assets, such as types of water access and sanitation facilities; materials used for housing construction; access to social amenities; televisions and automobiles. Here, household wealth index based on five (5) households' assets and housing quality as listed below was used as a proxy indicator for socioeconomic status of maternal households. Consequently, a household wealth index was computed from data collected on maternal housing quality (floor, walls, and roof material), the presence of electricity, type of cooking fuel, ownership of modern household durable goods (e.g. automobiles, television,

refrigerator, mattress, bed, computers, etc), source of drinking water and type of toilet facility (Howe et al., 2008; Vyas & Kumaranayake, 2006; Rutstein & Johnson, 2004; Filmer & Pritchett, 2001). Durable goods or facilities are often regarded as modern goods which have been shown to reflect household wealth. Thus, a household of zero index score for example means that household had not a single modern good. Therefore, the scores obtained based on the five households' assets and housing quality were utilised to generate a proxy household wealth index. Because the wealth index is very often use to study the influence of wealth on various population, health, and nutrition indicators, the median score of 3 was used as the cut-off point to define low and high household wealth index.

The wealth index allows researchers to evaluate how much household economic status affects nutritional and health outcomes by using both bivariate and more sophisticated multivariate analyses.

3.8.1.2 Estimating maternal nutritional status

To accurately estimate the maternal nutritional status, the researcher uses the World's Health Organization's (WHO) Body Mass Index technique as a measurement for indicating nutritional status in adults. This is a simple index of weight-for-height which is calculated by dividing weight in kilograms by height in metres squared to classified nutritional status into different groups such as overweight and obesity (WHO, 2020; 2000). Here, maternal weight was measured to the nearest 0.1 kg (kilograms) using a calibrated smart D-quip electronic scale and heights for mothers was estimated to the nearest 0.1 cm (centimetres) using a stadiometer based on the WHO recommendation (WHO, 2000). Underweight maternal BMI was classified as <18.5 kg/m^2; Normal BMI was classified as within 18.5 to 24.99 kg/m^2; overweight BMI as from 25 to 29.99 kg/m^2; and obesity ≥ 30 kg/m^2.

3.8.1.3 Estimating childhood nutritional status

Good nutrition is a prerequisite for good health (Hasan et al., 2011). In other words, it means that the nutritional status of children under-five years old is an important outcome measure of children's health. Likewise, infants' weight at birth – the weight of the foetus or infant at delivery – is also a strong predictor of neonatal health outcomes (Gill et al., 2013). Therefore, because many studies have associated maternal nutritional status with birthweights and/or genetic predisposition of early transmission of obesity among children (Ojha & Symonds, 2020; Li, 2018; Santoni et al., 2017; Moore et al., 2015; Parlee & MacDougald, 2014; Apovian, 2013; Gill et al., 2013; Mühlhäusler et al., 2008; Astrup & Finer, 2000), the researcher examined the under-five birthweights relative to maternal nutritional status. Thus, guided by the Centres for Disease Control (CDC) classification of birthweights, in this study infants with birthweights of <2.5kg were classified as Low Birth Weight (LBW); ≥ 2.5kg to ≤ 3.5kg were classified as Normal Birth Weight (NBW); and >3.5kg were classified as High Birth Weight (HBW).

For the subsequent analyses on childhood anthropometric evaluation, anthropometric measurements of weight and height for each child were determined using WHO standards procedures (WHO, 2017). Here, weights of children were measured using an infant electronic digital weight scale, while recumbent length was measured using a non-stretch 150 cm tape measure. Hence, to critically evaluate malnutrition indicators, the anthropometric measurements were converted to sex-specific Z-scores using the WHO Anthro software. The used of the WHO Anthro software enabled the researcher to convert weight, height, and age

measurements of under-five children to weight-for-age (WAZ), height-for-age (HAZ), and BMI-for-age (BAZ) Z-scores for all the children, which were used to classified underweight, stunting, and obesity – respectively. Therefore, children with WAZ, HAZ, BAZ between -2SD to +2SD were classified as normal; those with greater than +2SD were regarded as overweight, tall, and obese; while those with Z-scores between -3SD to -2SD were classified as thin, stunted and underweight – respectively. In addition, severe cases of underweight, stunting and thinness were categorized as Z-scores less than -3SD, whereas BAZ between + 1SD and +2SD were indicators of possible risk of overweight (WHO, 2017).

3.8.2 Inferential Statistical Analysis

Inferential analyses (bivariate and multivariate matrices) such as Chi-Square test, Spearman Correlation, Analysis of Variance (ANOVA) and regression analysis were used by the researcher to assess the degree of association and the nature of relationship between the dependent and independent variables. Therefore, inferential analysis matrices were used by the researcher to achieve *objective two* and *objective three* of this research.

3.8.2.1 Chi-Square Analysis

The Chi-Square analysis was used to determine the goodness of fit among the variables being considered. Since the nature of this study was to investigate and explore the impact of maternal socioeconomic and/or sociodemographic factors on maternal and under-fives nutritional and health outcomes, the researcher deems it necessary to conduct a Chi-Square test on these categorical variables. This allows the researcher to effectively measure the degree of association and the significance thereof between the dependent variables and the independent variables. Therefore, the Chi-Square test involves the use of a contingency table which is mathematical expressed as:

$$X^2 = \sum \frac{(O_i - E_i)^2}{E_i}$$

Where:

O_i = the observed frequencies.

E_i = the expected frequencies.

X^2 = The Chi square statistic.

3.8.2. 1 Regression Analysis

To measure the impact of maternal socioeconomic/sociodemographic factors on minimum acceptable diets, three (3) Multiple Logistic Regression Models were developed. In the context of this study, the nominal variables (formula feeding, duration of breastfeeding, and minimum acceptable diets indexes) were used in the multivariate regression models to investigate the straight -line relationship between the dependable variables and independent variables (the predictors). These mathematical models that aid the researcher to analyse key variables from the dataset is mathematically demonstrated as follow:

$$Y = \beta_0 + \beta_1 x_{1r} + \beta_2 x_{2r} + \beta_3 x_{3r} + \cdots + \beta_c x_{cr} + \varepsilon_j$$

Where:
X's = represents the predictors (independent variables).
Y = represents the dependent variables.
r = the observation (row) number.
β's = represents the unknown factors. Therefore, each *β* denote the original unknown circumference (population).
Ɛ = the error (residual) of observation *r*.

Therefore, because a multiple regression analysis studies the relationship between a dependent variable and predictors, the model of the multiple regression equation that is used for this study is mathematical expressed as:

$$\hat{y}_r = \beta_0 + \beta_1 x_{1r} + \beta_2 x_{2r} + \beta_3 x_{3r} + \cdots + \beta_c x_{cr} + \varepsilon_r$$

Where:

X's = represents the predictors (independent variables).
ŷ = represents the dependent variables.
r = the observation (row) number.
β's = represents the unknown factors. Therefore, each *β* denote the original unknown circumference (population).
Ɛ = the error (residual) of observation *r*.

This mathematical expression represents the linear relationship between minimum acceptable diets and the socioeconomic factors. Therefore, the model is mathematically expressed as:

$$MD_r = \beta_0 + \beta_1 EDU_{1r} + \beta_2 WI_r + \beta_3 EMP_{3r} + \beta_4 CA_{4r} + \beta_5 MA_{5r} + \beta_6 RES_{6r} + \varepsilon_r$$

Where:

MD = Minimum Diets= the dependent variable
EDU = Educational
WI = Wealth index
EMP = Employment
CA = Child Age
MA = Maternal Age
RES = Place of residence
Ɛ = the error

Similarly, the same approach was applied for the models regressing for the factors associated with formula feeding practices, duration of breastfeeding, and childhood nutritional status (See presentations in Chapter 4).

Here, these models were chosen because it functions as a relational model that serves as a good method for understanding the causes of minimum acceptable diets while controlling for confounding variables. Thus, the same conception of probabilities applied to internal component causing childhood malnutrition and health can also be applied to external components such as duration of breastfeeding, maternal health, formula feeding practices, household wealth, maternal education, maternal employment status and so on. The argument here is that the probability of a maternal and child health from fertility to birth and a child surviving to a certain age without suffering from malnutrition or health related issues is the product of all independent risk probabilities. Thus, the purpose of this study was to also

introduce multiple regression models into maternal and childhood nutritional status by applying the methods to measure the influence of socioeconomic factors on maternal and child nutritional and health outcomes as demonstrate in Chapter Four. Therefore, to measure the impact of maternal socioeconomic factors on maternal and child health in South Africa similar regression model approach were used to determine the straight-line relationship between maternal body mass index (BMI), childhood nutritional and health outcomes relative to maternal socioeconomic/sociodemographic factors.

Furthermore, to assess the association between formula feeding and malnourishment (underweight), stunting, obesity, diarrhoea and fever among under-fives in South Africa, the researcher uses a binomial logistic regression. Here, to measure the impact of socioeconomic and/or sociodemographic factors on breastfeeding and formula feeding in South Africa, the binary logistic regression model was developed. In the context of this study, the dichotomous variable was used in the logistic regression model as the dependent variable, which was further expounded by each independent variable category to test for significance with reference to breastfeeding and formula feeding. The dependent variable categories considered were underweight (WAZ), stunting (HAZ), obesity (BAZ), diarrhoea and fever. Here, the coefficients of these variables are represented by the influence of the individual subgroup relative to a reference group that was chosen subjectively. For example, WAZ was coded as (1) if the child is malnourished (underweight), 0 otherwise. Thus, the reference category (0) is *suggesting that the child is not underweight*. In other words, children with Z-scores of less than -2SD were classified as underweight, while the reference group (0) comprises of children with Z-scores of ≥-2SD. Thus, the binomial logistic model used for this study is mathematically expressed as follows:

$$\log\left[\frac{p}{1-p}\right] FF = \beta 0 + \beta 1(WAZ1) + \beta 2(HAZ1) + \beta 3(BAZ1) + \beta 4(Diarrhoea1) + \beta 5(Fever1) + ei$$

Where:
FF = Dietary intake (Breastfeeding or Formula feeding)
P = The probability of a breastfeed or formula fed child
WAZ = 1 if the child is underweight, 0 otherwise
HAZ = 1 if the child is stunted, 0 otherwise
WAZ = 1 if the child is obese or overweight, 0 otherwise
Diarrhoea = 1 if the child has diarrhoea in the past few weeks, 0 otherwise
Fever = 1 if the child has fever in the past few weeks, 0 otherwise

Hence, the data analysis methods used by the researcher is summarized in **Table 3.1** below.

Table 3. 1: Summary of Data Analysis Approach for the Study

Research Objective	**Research question**	**Research Method**
One	One	Descriptive: to explain the central tendencies and dispersion
Two	Two	Multinomial logistic model: to test for degree of association.
Three	Three	Binomial & Multinomial logistic model: to test for degree of association.

3.9 VALIDITY, RELIABILITY AND RIGOUR

Every study has a certain amount of constraint, which needs to be acknowledged during the interpretation and explanation of the study conclusion (Sharma, 2002). The data used in this study is based on a secondary data which is control by SA-DHS model and it is simply a representative data at the national level, which does not reflect the health conditions at the grassroots. However, this study is among the few studies in the country to estimate and comprehend maternal and child health with reference to maternal and childhood nutritional status. The 2016 South Africa Demographic and Health Survey is a reliable dataset that comprises of more than 86% response rate of eligible women aged 15-49. In general, the household response rate was more than 83%. This is an indication that the survey is a statistically representative dataset of the country, thus the results from this study can be generalized to the entire population. More so, the sample size of the 2016 SA-DHS complies with the conventional standard of the Demographic and Health Survey.

3.10 CHAPTER SUMMARY

The main purpose of this survey design study was to assess the impact of maternal socioeconomic and/or demographic factors on both maternal and childhood nutritional and health outcomes in South Africa. Thus, this chapter concisely provided a detail blueprint of the research methodology that was used to achieve the defined research objectives relative to the research questions. The chapter began by restating the research objectives, and questions, before discussing the data extraction procedures, population and sampling techniques, ethical considerations, and the subsequent data analysis techniques used for the study. In the next chapter, the assumptions as well as the findings and discussions are discussed in detail.

CHAPTER FOUR

DATA ANALYSIS, PRESENTATION AND DISCUSSION OF RESULTS

4.1 INTRODUCTION

The prime purpose of this study is to assess the impact of maternal socioeconomic status on both maternal and childhood nutritional outcomes in South Africa. In it, the study focuses on the application of novel mathematical models to understand how maternal socioeconomic factors influences child nutritional outcomes. Thus, this chapter presents the research findings generated from this study and as well as the discussion thereof. The total sample size upon which all statistical measures was carried out for this study was 1460 mothers who met the eligibility criteria as stipulated in the section below. As already mentioned in Chapter 3 of this study, the researcher used the 2016 South African Demographic Health Survey (SA-DHS) dataset to extract the information used for testing the study hypotheses based on the respondents who met the study criteria.

Upon gaining access to use the data, the researcher cleaned the data by generating new variables using the STATA software. This was then used to compute the statistical matrices and values presented in this chapter. Here, the researcher used both descriptive and inferential statistical matrices to analyse the extracted data and to demonstrate the findings from this study. While the descriptive statistical techniques were used to measure the central tendencies and dispersion within the variables, the inferential statistical techniques were used to demonstrate the relationship between variables and to evaluate the degree of association, probability, and the nature of relationship amongst variables in the extracted data. As a result, all inferential tests computed in this study were subject to the traditional p-value of <0.05. Therefore, the results of this study are presented and discussed simultaneously according to the research objectives, which are:

1. To report on the percentage of under-five children in South Africa with a minimum acceptable diet.
2. To measure the impact of maternal sociodemographic factors on minimum acceptable diet among children under-five.
3. To measure the impact of maternal socioeconomic factors on both maternal and child nutritional and health outcomes in South Africa.

4.2 SAMPLE REALIZATION

In this study, the researcher extracted a total sample of 1460 respondents from the 2016 SA-DHS dataset. These were women of childbearing age (15-49 years) whom at the time of the data collection had at least one child under the age of 5 years old. Using inclusion and exclusion criteria, the sample size for this study comprises of only respondents whom children's age was recorded in the 2016 SA-DHS dataset, and for whom anthropometric data were collected for both the mother and the child. On the other hand, the exclusion criteria excluded all respondents who did not meet the inclusion criteria. As an inclusion criterion, the anthropometric records are significant to this study since the study seek to understand how maternal socioeconomic factors impact on maternal and childhood nutritional and health outcomes. The sample includes respondents from all locations and social class within the country in all the nine provinces.

4.3 DESCRIPTIVE STATISTICS

4.3.1 Respondents' Socio-Demographic Assessments

The socio-demographic analysis of this study presents the respondents' region and place of residence, ethnicity, maternal and child age, education, marital status, households' composition, and economic status.

4.3.1.1 Respondents' region and place of residence

The descriptive analysis of this study revealed that out of the 1460 respondents who met this study's criteria, 15.0%, 14.73%, and 14.18% were situated in the province of KwaZulu-Natal, Mpumalanga, and Limpopo – respectively.

The results further revealed that 12.74%, 10.68%, and 10.21% of the respondents were also situated in Eastern Cape, North West, and the Gauteng province – accordingly. However, the results of this study revealed that in the Western Cape, only 4.73% of the respondents met the criteria used for this study.

Table 4. 1: Shows respondents' region according to provinces

Region	Frequency (n)	Percent (%)
Western Cape (WC)	69	4.73
Eastern Cape (EC)	186	12.74
Northern Cape (NC)	125	8.56
Free State (FS)	134	9.18
KwaZulu-Natal (KZN)	219	15.00
North West (NW)	156	10.68
Gauteng (G)	149	10.21
Mpumalanga (M)	207	14.18
Limpopo (L)	215	14.73
Total	**1460**	**100.00**

On place of residence, the descriptive analysis estimated that of the 1460 respondents who met the criteria used for this study, most of them (n=750; 51.37%) were living in urban areas as opposed to those living in rural areas (n=710; 48.63%). **Figure 4.1** present a detail graphic presentation of the results.

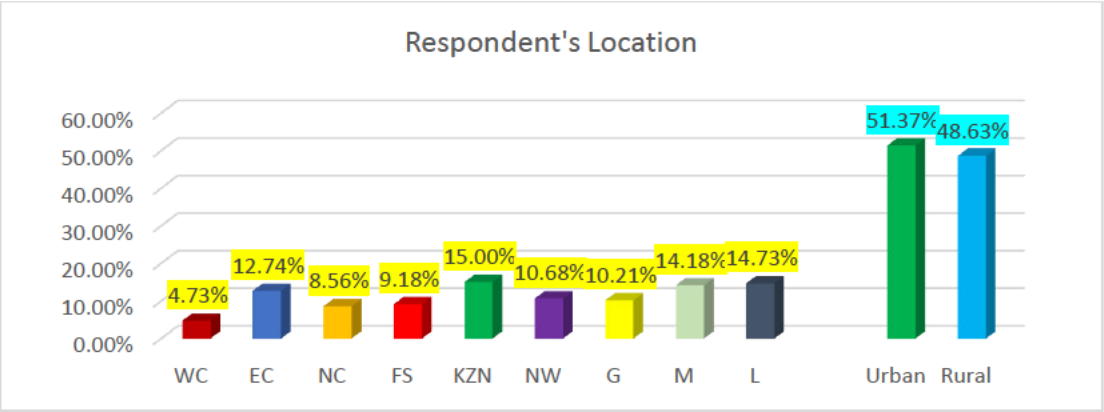

Figure 4. 1: Shows percentage of respondents by location and place of residence

4.3.1.2 Respondents' ethnicity

Of the 1460 respondents that met the criteria used for this study, most of them (n=1297; 88.84%) identified themselves as Black/African; while only one respondent identified herself as belonging to a different ethnic group other than White, Coloured, or Indian/Asian.

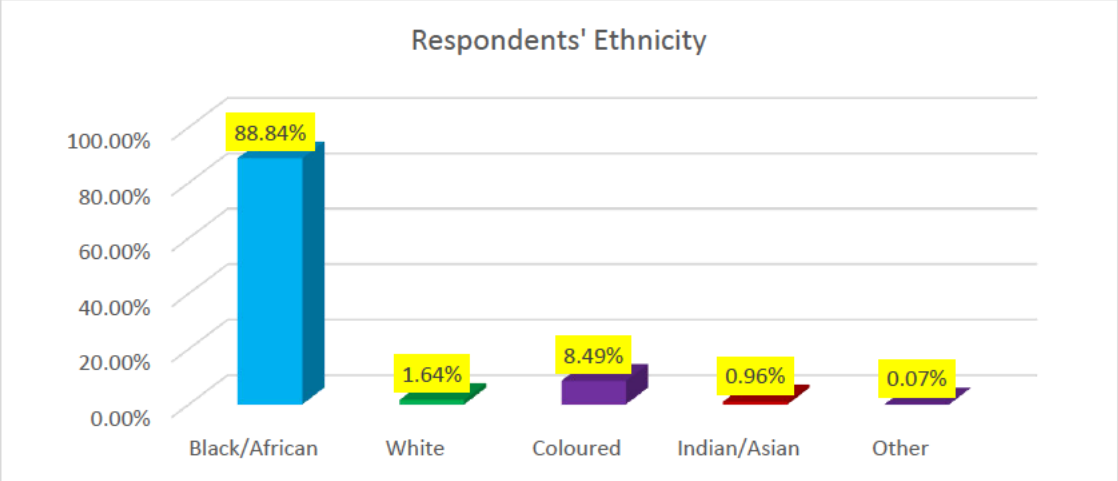

Figure 4. 2: Shows percentage of respondents' ethnicity

4.3.1.3 Maternal and child (under-five) age

With a mean (M) age of 29.01 years and standard deviation (SD) of 6.70 years, the descriptive computation of this study revealed that almost three in ten (n=402; 27.53%) of the respondents fell within the ages of 25-29 years. Furthermore, the results suggested that more than one fifth 22.40% and 21.85% of the respondents fell within the ages of 20-24 years and 30-34 years old, respectively. See **Table 4.2** and **Figure 4.3** for detail presentation of the results.

Table 4. 2: Maternal age in years

Age Groups	Frequency (n)	Percent (%)
15-19 years	93	6.37
20-24 years	327	22.40

25-29 years	402	27.53
30-34 years	319	21.85
35-39 years	200	13.70
40-44 years	106	7.26
45-49 years	13	0.89
Total	**1460**	**100.00**

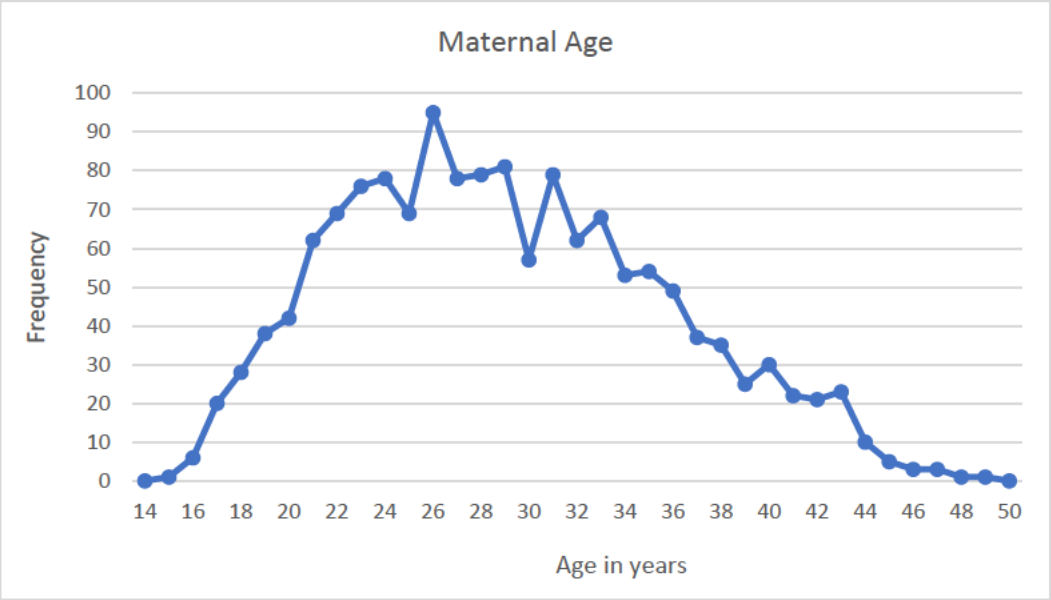

Figure 4. 3: Shows maternal age in years

Furthermore, the descriptive computation on childhood age (under-five) revealed that the mean age of the under-five children was 29.02 months with a standard deviation of 17.46 months. The results on **Table 4.3** shows the distribution of the children based on different categories. In it, the results indicated one fifth of the children (20.41% and 20.14%) fell within the ages of 36-47 months and 12-23 months, accordingly.

Table 4. 3: Childhood age in months

Age Groups	**Frequency (n)**	**Percent (%)**
0-5 months	159	10.89
6-11 months	143	9.79
12-23 months	294	20.14
24-35 months	283	19.38
36-47 months	298	20.41
48-60 months	283	19.38
Total	**1460**	**100.00**

4.3.1.4 Assessing respondents' education and academic literacy level

While assessing respondents' highest educational level, the descriptive analysis of this study revealed that most of the respondents' (n=1155; 79.11%) had secondary school education as their highest educational level. While 9.66% (n=141) of the respondents had tertiary education as their highest educational level, 1.78% (n=26) of the respondents reported not having any formal education.

Upon examining the educational attainment of the respondents, the computational analysis of this study further revealed that 53.29% of the respondents (n=778) reported that they did not complete their secondary school education; while one quarter (25.82%) of them reported that they completed their secondary school education. The results also revealed that of those (9.45%) who reported primary education as their highest educational level, about 5.48% reported that they did not complete their primary education while about 3.97% of them reported that they completed their primary education. In addition, the results on educational attainment revealed that all those who reported higher education as their highest educational level completed a tertiary education. See **Table 4.4** for a detail representation of the results.

Table 4. 4: Shows maternal educational

Educational and Literacy Level	**Frequency (n)**	**Percent (%)**
Highest Educational Level		
No Education	26	1.78
Primary	138	9.45
Secondary	1155	79.11
Higher	141	9.66
Educational Attainment		
No Education	26	1.78
Incomplete primary	80	5.58
Complete primary	58	3.97
Incomplete secondary	778	53.29
Complete secondary	377	25.82
Higher	141	9.66

4.3.1.5 Respondents' Marital Status

The statistical analysis revealed that most of the respondents (n=807; 55.27%) reported that they have never been married, while about (n=587; 40.21%) reported that they are either married or cohabitating. However, the results further indicate that about (n=54; 3.70%) of the respondents are either divorced or separated. In addition, about (n=12; 0.82%) of the respondents reported that they are widowed.

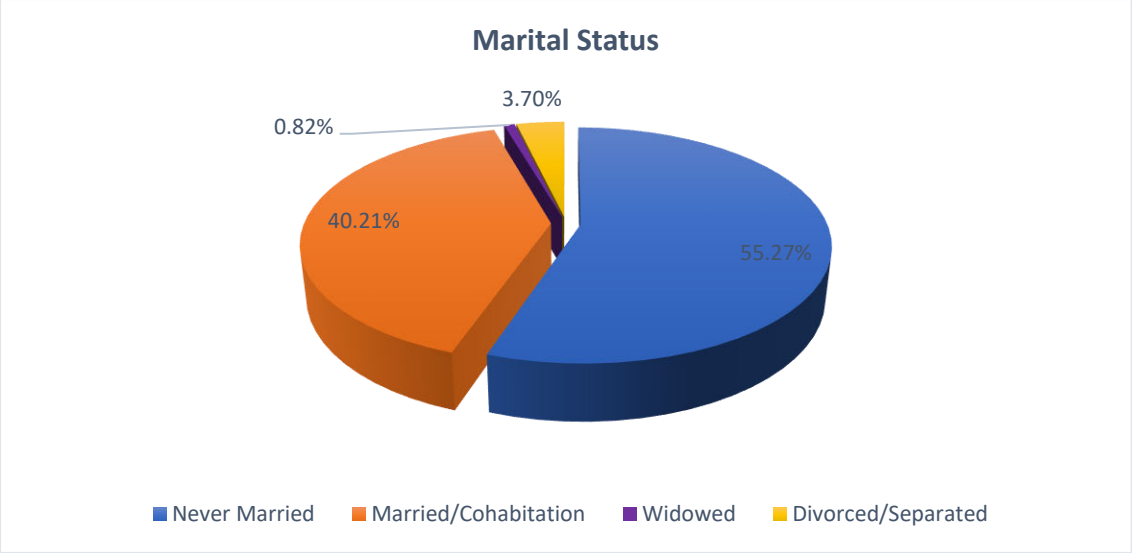

Figure 4. 4: Respondents marital status in percentages

4.3.1.6 Assessing Respondents' Children Ever Born

On total number of children ever born, the descriptive statistics revealed that the total children ever born per woman ranges from 1 to 11 children, with an average number of 2.40 and a standard deviation of 1.46. More than three fifths (62.95%) of women had 1-2 children (n=919). Almost a third (n=478; 32.74%) of the women reported that their total children ever born is between 3-5 children, and (n=63; 4.32%) of the respondents reported that their total children ever born is 6 or more children.

4.3.1.7 Assessing under-fives gender

Furthermore, the findings from this study revealed that half of the under-five children (n=736; 50.41%) were boys as compared to the (n=724; 49.59%) girls.

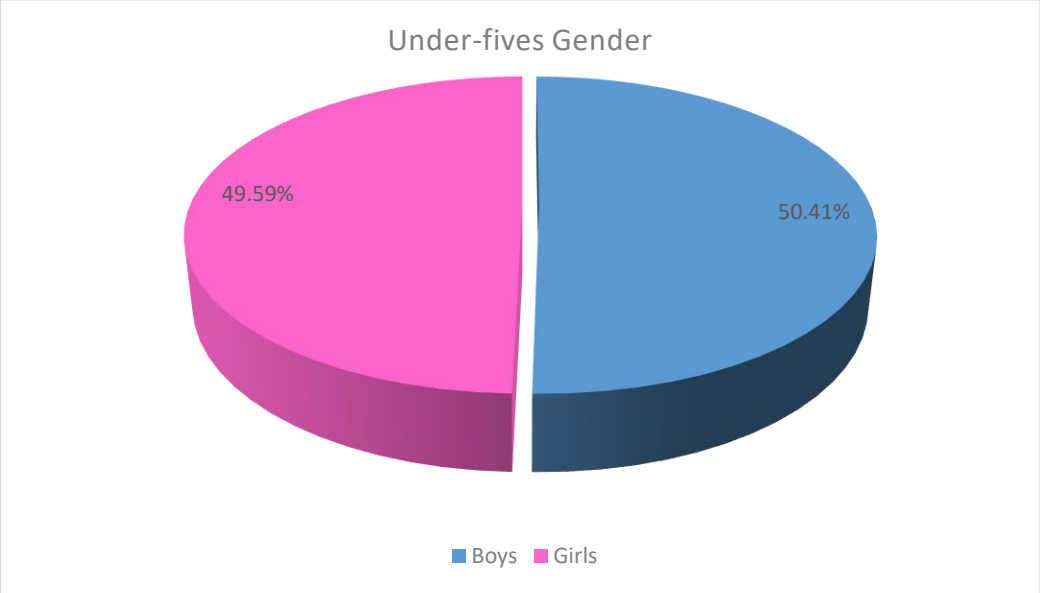

Figure 4. 5: Shows under-fives gender in percentages

4.3.1.8 Assessing Respondents' Economic Status

To assess the economic status of the respondents, the researcher began by determining whether a respondent has an account in a bank or in other financial institutions. Here, the results revealed that just over half of the respondents (n=749; 51.30%) reported that they do not have an account in a bank or in other financial establishments. On the other hand, almost half (n=711; 48.70%) of the respondents reported that they do have an account in the bank or in other financial organizations.

When asked whether respondents were currently working, the descriptive computation revealed that almost three quarter of the respondents (n=1061; 72.67%) reported that they were unemployed, while only just above one quarter (n=399; 27.33%) of the respondents reported that they were employed. Consequently, the assessment on whether a respondent owns a house alone or jointly revealed that more than three quarters (76.16%) of the respondents (n=1112) reported that they do not own a house. Less than one twelfth (n=115; 7.88%) of the respondents reported that they jointly own a house with their partners. Only 9.18% (n=134; 9.18%) of the respondents reported that they both own a house alone and jointly with their partners. The smallest group were the 6.78% that is, (n=99) of the respondents who reported that they own a house alone. In addition, the descriptive computation of this study also revealed that the employment rate of those with higher education is higher with 56.03% relative to their counterparts. Here, the results in **Table 4.5** below seems to suggest that the higher the educational level the better chance of getting employed. Similarly, the results in **Table 4.5** seems to further suggest that women in urban areas are more likely to be employed as compared to those in rural area with 32.00%.

Table 4. 5: Shows respondents' educational level and place of residence relative to employment status

	Employment		
Education	No	Yes	Total
No education	21 (80.77%)	5 (19.23%)	26 (100%)
Primary	113 (88.12%)	25 (18.12%)	138 (100%)
Secondary	865 (74.85%)	290 (25.11%)	1155 (100%)
Higher	62 (43.97%)	79 (56.03%)	141 (100%)
Urban	510 (68.00%)	240 (32.00%)	750 (100%)
Rural	551 (77.61%)	159 (22.39%)	710 (100%)

Using the wealth index computed for this study (See Chapter 3), the descriptive computation of this study suggested that out of the 1460 respondents, 690 of them are poor. The result further indicates that 357 of the total respondents fell within the middle class, while 413 of the total respondents were rich.

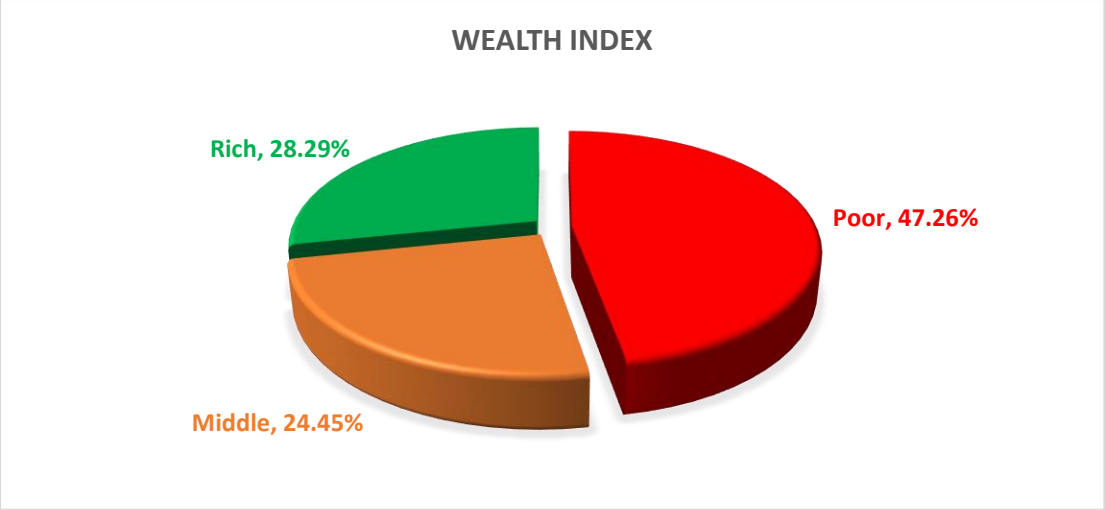

Figure 4. 6: Shows percentage of respondents based on households' wealth index

4.3.3 Evaluating Childhood (Under-five) Nutritional Intake

4.3.3.1 Breastfeeding and formula feeding

When asked whether a child is currently breastfeeding, the descriptive computation of this study revealed that most of the respondents (n=1041; 71.30%) reported that their children are not currently breastfeeding. On the other hand, about (n=419; 28.70%) of the respondents reported that their children were currently breastfeeding. In addition, the descriptive analysis of this study also revealed that most of the children who were reported to be currently breastfeeding fell under the ages of 0-5 and 6-11 months, respectively.

Table 4. 6: Shows child's age relative to breastfeeding

	Currently Breastfeeding		
Child Age in Months	No	Yes	Total
0 – 5 Months	31 (19.50%)	128 (80.50%)	159 (100%)
6 – 11 Months	62 (43.36%)	81 (56.64%)	143 (100%)
12 – 23 Months	194 (65.99%)	100 (34.01%)	294 (100%)
24 – 35 Months	245 (86.57%)	38 (13.43%)	283 (100%)
36 – 47 Months	267 (89.60%)	31 (10.40%)	298 (100%)
48 – 60 Months	245 (85.51%)	41 (14.49%)	283 (100%)
Total	1041 (71.30%)	419 (28.70%)	1460 (100%)

On formula feeding, the descriptive computation revealed that 65.79% of the respondents reported that they were not formula feeding their children, while one third (33.66%) of the respondents reported that they engaged in formula feeding. Here, the descriptive analysis

further revealed that respondents' employment status, place of residence, educational level, and household's wealth index influences formula feeding among women.

It says here that the rate of formula feeding is statistically higher among employed women relative to unemployed women, with 46.67%. Although the rate of formula feeding among women with no education is higher with 42.86% than their counterparts, the results also suggested that women with higher education have higher rates (40.00%) of feeding their children with formula feeding as compare with those with primary and secondary education. In summary, these descriptive analysis results seem to be suggesting that there is a statistical relationship between maternal educational level and formula feeding. The results on formula feeding also suggested that women living in urban areas have higher rates (36.11%) of giving their children formula feeding relative to their counterparts. Similar, the results indicated that women within the brackets of "rich" wealth index have higher rates of feeding their children with formula feeding as compared to their counterparts, with about 46.60%.

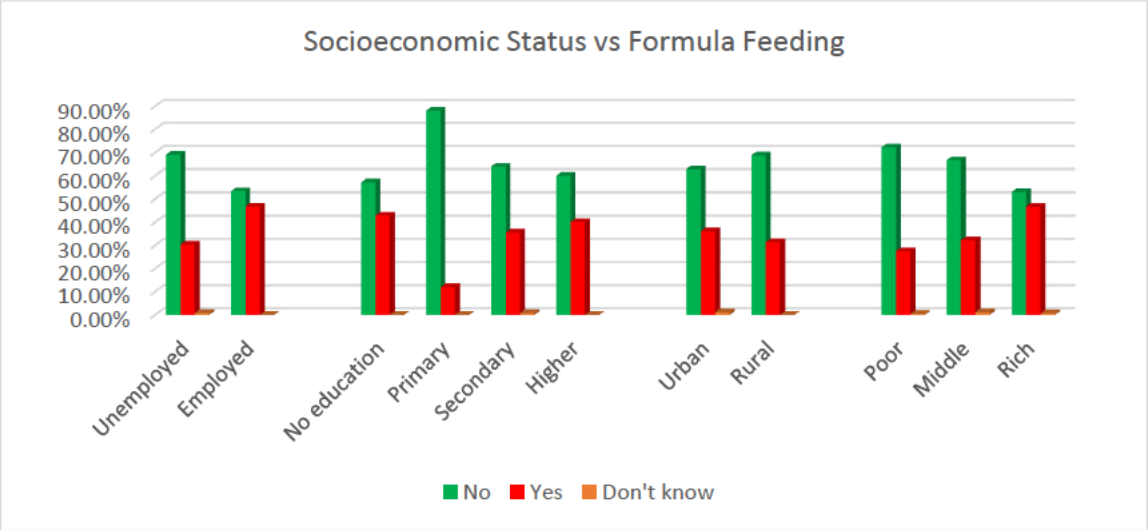

Figure 4. 7: Shows the percentage rate of formula feeding among women across difference socioeconomic status

In addition, the descriptive results revealed that 56.17% of the respondents reported breastfeeding their children for more than at least 6 months or more relative to the 26.68% of the respondents who reported breastfeeding their children for less than 6 months. However, almost one fifth (17.15%) of the respondents reported that they never breastfed their children.

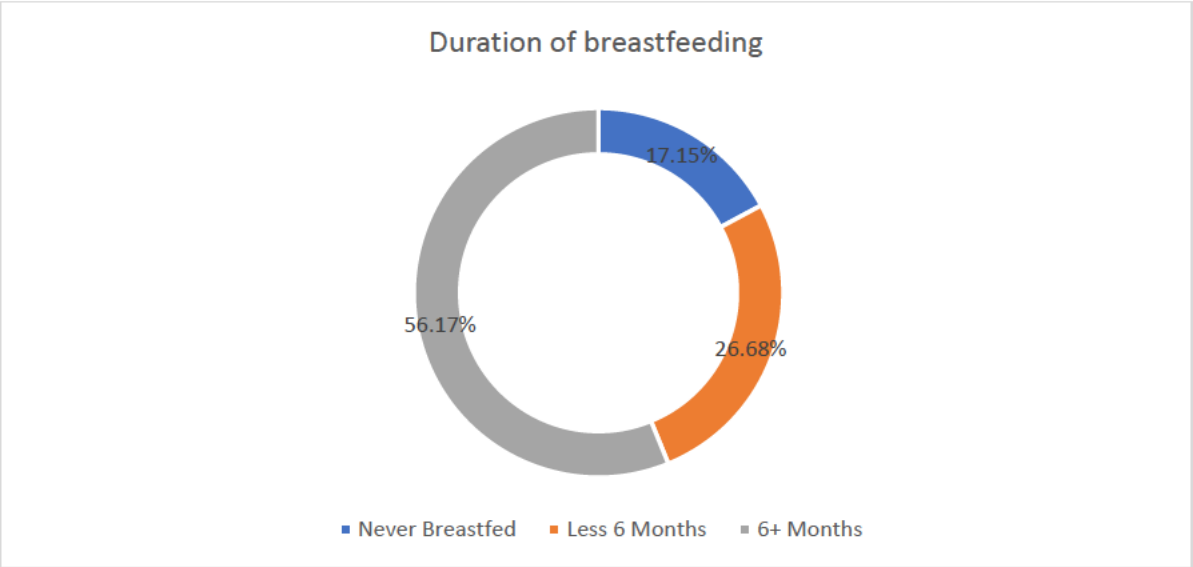

Figure 4. 8: Shows duration of breastfeeding

Relative to maternal socioeconomic status, the descriptive analysis seems to suggest that there is a link between maternal socioeconomic status and the duration of breastfeeding. The results in **Table 4.7** below revealed that women from rich households have 22.96% rate of not breastfeeding their children as compared to their counterparts. The results equally revealed that women from poor households have 55.57% rate of breastfeeding their children for more than 6 months relative to their counterparts. Similarly, the results revealed that women with higher education are more likely to not breastfeed their children as compared to their counterparts, with 24.24% rate. Relative to employment, the results revealed that employed mothers have 20.54% rate of not breastfeeding their offspring as compared to unemployed mothers. In the same trend, the descriptive result also indicated that unemployed mothers have 50.85% rate of breastfeeding their children as compared to their counterparts.

Table 4. 7: Shows maternal socioeconomic factors relative to duration of breastfeeding

	Duration of Breastfeeding		
Socioeconomic Factors	Never breastfed	<6 months	7+ months
Poor	80 (13.11%)	191 (31.31%)	339 (55.57%)
Middle	58 (17.96%)	109 (33.75%)	156 (48.30%)
Rich	87 (22.96%)	150 (39.58%)	142 (37.47%)
Urban	128 (18.80%)	243 (35.68%)	310 (45.52%)
Rural	97 (15.37%)	207 (32.81%)	327 (51.82%)
No education	2 (9.52%)	13 (61.90%)	6 (28.57%)
Primary	13 (10.92%)	34 (28.57%)	72 (60.50%)
Secondary	178 (17.12%)	351 (33.75%)	511 (49.13%)
Higher	32 (24.24%)	52 (39.39%)	48 (36.36%)
Unemployed	149 (15.82%)	314 (33.33%)	479 (50.85%)

Employed	76 (20.54%)	136 (36.76%)	158 (42.70%)

4.3.3.2 Complementary feeding practice

Following the DHS food groups frequency questionnaire, food that were fed to the children was evaluated using a structured 24-hours food frequency questionnaire to quantify child dietary intake. Here mothers were asked to recall the types of food they fed their children in the past 24 hours besides breastmilk, including snacks and meals. Although the WHO defined minimum dietary diversity as the percentage of children between 6-23 months who received foods from at least four out of the seven food groups (WHO, 2010, 2008), the SA-DHS infant and young child feeding (IYCF) indicators were the main dietary indicators used here. These indicators were measured by recall of food and liquid consumption during the previous day or night preceding survey as per SA-DHS food frequency questionnaire. Thus, minimum meal frequency is the proportion of children who received complementary foods adequately.

On complementary feeding, the descriptive analysis of this study revealed that most respondents (69.38%) reported feeding their children plain water relative to the 30.07% of the respondents who reported that they did not feed their children with plain water. The results also suggested that most of the respondents (73.52%) reported that they did not gave their children juice, while about 25.52% of the respondents reported that they gave their children juice. More so, the results revealed that most of the respondents (78.62%) reported that they did not gave their children tinned, powdered or fresh milk, whereas 20.83% of the respondents reported that they gave their children tinned milk, powdered or fresh milk.

Furthermore, the descriptive computation revealed that 63.45% of the respondents reported that they did not feed their children with fortified baby cereals, while about 36.14% of the respondents reported that they feed their children with fortified baby foods. On the contrary, the findings of this study revealed that most of the respondents (87.59%) reported that they feed their children with cold drinks and other sugary drinks, whereas about 11.86% of the respondents reported that they do not feed their children with cold drinks nor sugary drinks.

Just over half (52.83%) of the respondents reported that they feed their children with bread, noodles, or others made from grains. On the other hand, about 46.90% of the women reported that they do not feed their children with bread, noodles, or others made from grains. More so, most of the respondents (72.00%) reported that they do not feed their children with potatoes, cassava, or other tubers; whereas about 27.45% of the women reported that they feed their children with potatoes, cassava, or other tubers. On the same trend, most of the respondents reported that they fed their children with other types of solid/semisolid foods relative to the 27.31% of the respondents who fed their children with other types of solid/semisolid foods.

While most of the respondents reported that they do not feed their children with eggs, about 27.59% of the respondents reported that they feed their children with eggs. Similarly, about 72.28% of the respondents reported that they do not feed their children with meat, whereas about 27.31% of the respondents reported feeding their children with meat such as beef, pork, lamb, or chicken.

In addition, the descriptive analysis results indicated that most of the respondents (73.38%) reported that they did not feed their children with pumpkin, carrots, squash (yellow or orange inside) foods relative to the 26.21% of the respondents who feed their children with pumpkin,

carrots, squash (yellow or orange inside) foods. More so, most of the respondents (85.66%) reported that they did not feed their children with any dark green leafy vegetables as compared to the 13.93% of the respondents who reported feeding their children with dark green leafy vegetables. Relative to the 93.79% of the respondents who reported not feeding their children with mangoes, papayas, or other vitamin fruits, only 5.93% of the respondents reported that they fed their children with mangoes, papayas, or other vitamin fruits. Similarly, most of the respondents (72.41%) reported that they did not feed their children with any other type of fruits as compared to the 27.31% of those who reported feeding their children with other types of fruits.

The descriptive analysis further indicated that most of the respondents (81.10%) reported that they did not feed their children with oil, fats, butter or products made of them; whereas about 18.48% reported that they fed their children with oil, fats, butter or products made of them. Relative to the 76.41% of the respondents who reported that they do not feed their children with chocolates, sweets, candies, or pastries; about 22.90% of the respondents reported that they fed their children with chocolates, sweets, candies, or pastries. Similarly, most of the respondents reported that they do not feed their children with any salty snacks as compared to the 28.97% of the respondents who reported that they feed their children with salty snacks.

4.3.3.3 Complementary feeding practice index

To critically evaluate and understand the impact of maternal socioeconomic status on childhood nutritional intake, the researcher developed a complementary feeding index. In other words, overall dietary quality was assessed using the dietary diversity score. The nutritional diversity score ranged from 0 to 6 with minimum of 0 if none of the six food groups is consumed to 6 if all the food groups are consumed. Therefore, because of the poor response rate recorded on the dietary diversity score, this study defines minimum dietary diversity as the proportion of the children 0-59 months who received foods from at least three out of the five food groups. Here, the nutrition quality index (complementary feeding index) is presented in six (6) categories (Liquid Food, Solid/Semisolid Food, Oil & Fat Food, Junk Food, Protein Foods, and Fruits & Vegetable Food index). When computing the index scores for each of these categories, the researcher estimated the average scores of every respondent based on each sub-category. For example, on liquid food category, the responds of each respondent on the four sub-categories (plain water, juice, soda drinks, and other liquid drinks) were used to determine the respondents' position (average score) on the liquid food index. Thus, a 75% average score was translated into "high quality index"; 50-74% average score was translated into "moderate quality index or minimum"; and less than 50% average score was translated into "poor quality index". The same procedures were applied on subsequent categories. This enables the researcher to construct a holistic and comprehensive view of the emerging discourses or constructions relative to maternal socioeconomic status and as well as childhood nutritional outcomes. Likewise, this was later cumulated into a single complementary feeding index to give a bird-view of childhood nutritional intake relative to maternal socioeconomic impact and as well as childhood nutritional outcomes.

Therefore, with M= 2.67 and SD= 0.78, the descriptive computation of this study revealed that most of the respondents (58.21%) have high liquid food index, suggesting that most of the respondents feed their children with high quality liquid food. The results also revealed that almost two fifths (37.10%) of the respondents have moderate liquid food index as compare to

the 4.69% of the respondents who have poor liquid food index. Furthermore, the results in **Figure 4.9** does not suggest any statistical significance link between maternal socioeconomic status and having high liquid food index, except for maternal employment which suggested that the rate of high-quality food index is higher among employed mothers at 64.67%.

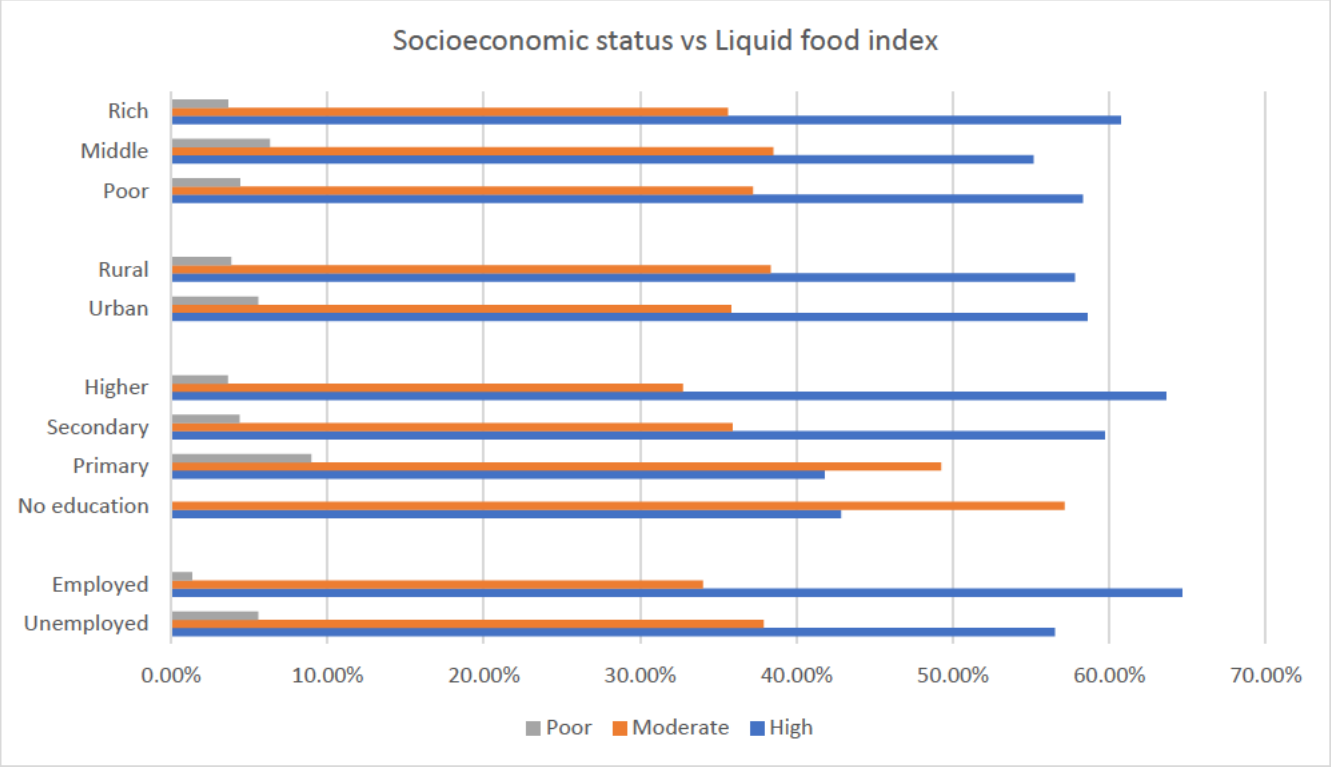

Figure 4. 9: Shows maternal socioeconomic status relative to liquid food index

On solid/semisolid food index, the results revealed that most of the respondents (55.59%) have poor quality index relative to the 21.38% of the respondents with high quality index. This is suggesting that on average, most under-five children in South Africa are not substantially fed with solid/semisolid foods – an indication of nutritional deficiency among under-five children. Here, the results also revealed that 23.03% of the respondents have moderate solid/semisolid foods quality index, where M= 1.44 and SD= 1.24. In addition, the results seem to suggest that there is a statistical link between household wealth index and solid/semisolid foods quality index – indicating that children from "rich" households are more likely to be fed with solid/semisolid foods than their counterparts, with 28.80%. Similarly, the results also seem to suggest that children born of mothers with higher education and employed mothers are more likely to be fed with solid/semisolid foods than their counters, with 38.18% and 28.00%. See **Figure 4.10** below for a detail presentation of the results.

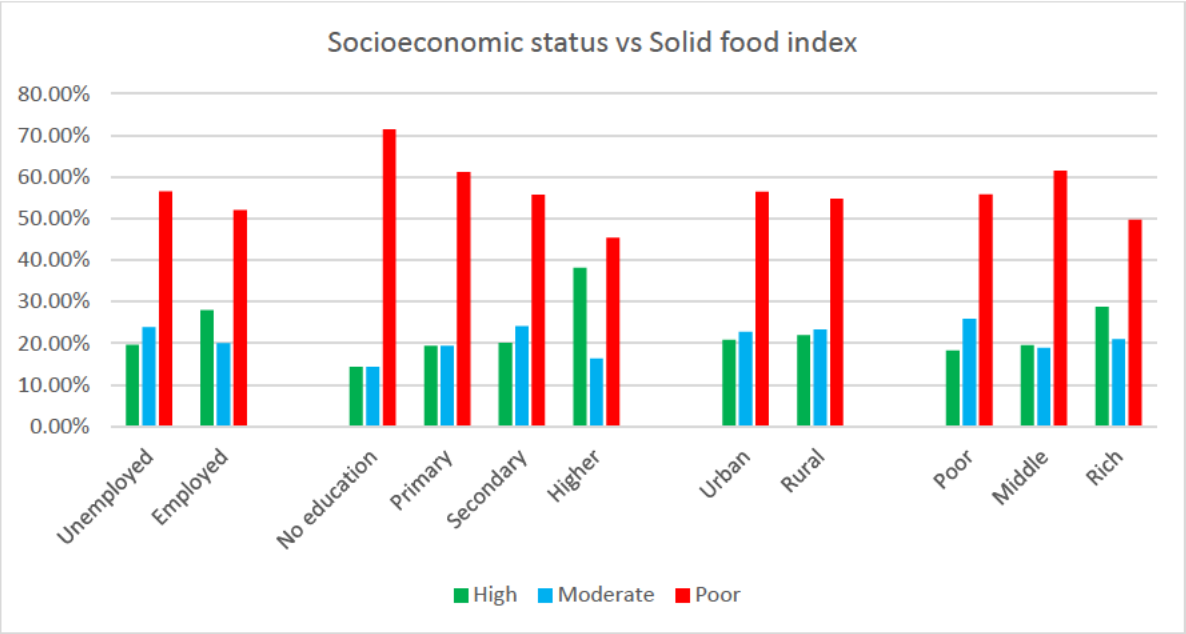

Figure 4. 10: Shows maternal socioeconomic status relative to solid/semisolid food index

With an average score of 1.24 and a standard deviation of 1.20, the descriptive results of this study also revealed that almost have of the respondents (57.38%) have poor oil/fat foods quality index as compared to the 22.34% of the respondents who have high oil/fat foods quality index. This is suggesting that most children in the country suffer from oil/fat foods deficiency. The findings from this study also revealed that about 20.28% of the respondents have moderate oil/fat foods quality index. In addition, relative to maternal socioeconomic status, the results seem to suggest that there is a significant link between maternal place of residence and the probability of having a high-quality index. An indication that children in rural areas are 25.21% more likely to be fed with oil/fat food than their counterparts. **Figure 4.11** presents a detail report of oil/fat foods quality index relative to maternal socioeconomic status.

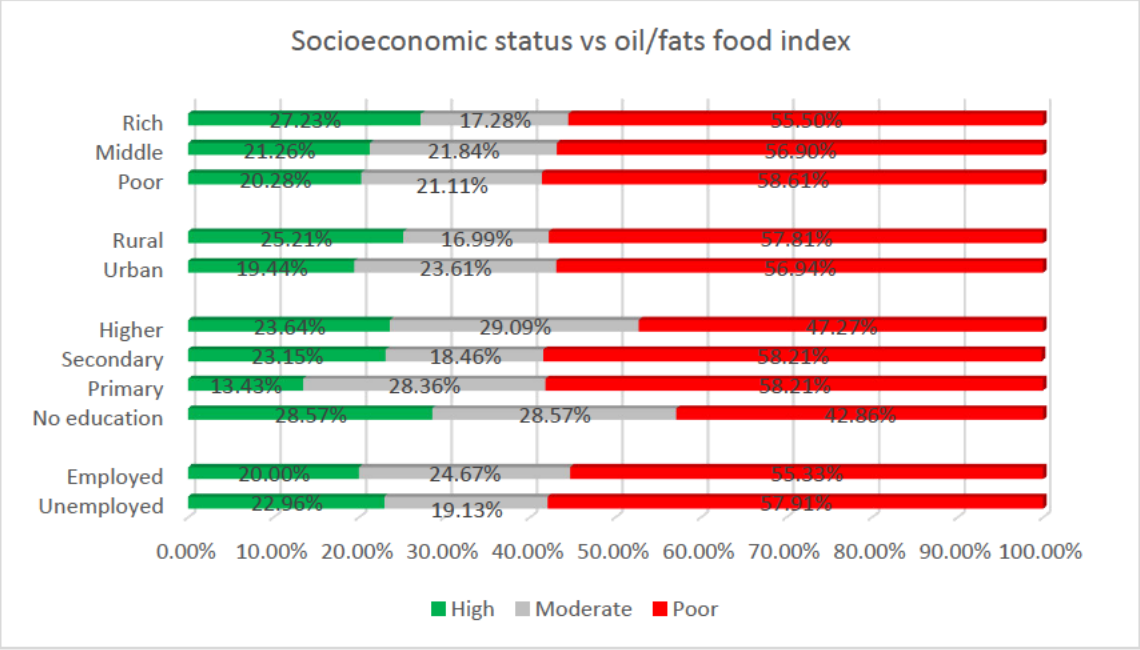

Figure 4. 11: Shows maternal socioeconomic status relative to oil/fat food index

With M= 0.73 and SD= 1.10, it says here that most of the respondents (78.90%) have poor fruits/vegetables food index relative to the 10.21% and 10.90% who have high and moderate quality index, respectively. This is an indication that most under-five children in South Africa suffer from low intake of fruits and/or vegetables. Furthermore, the result herein suggested that there is a statistical link between households' wealth index and the rate of fruits and/or vegetables intake among under-five children – suggesting that children from rich households have 15.71% high rate of been fed with fruits and/or vegetables than their counterparts. See **Figure 4.12** for detail presentation of the results.

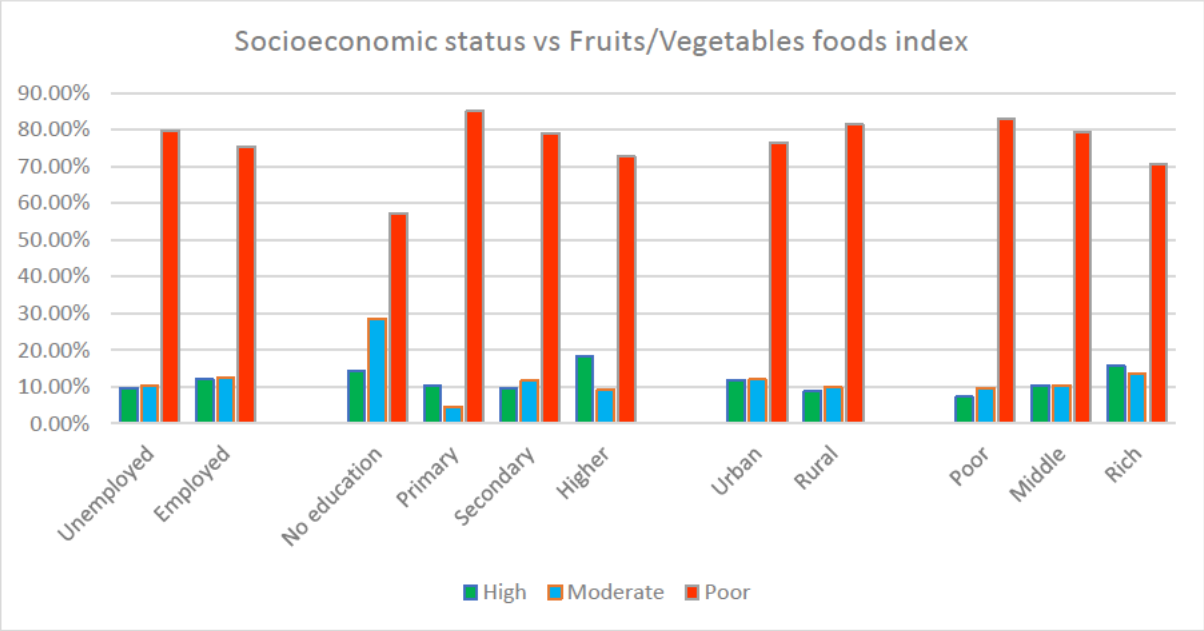

Figure 4. 12: Shows maternal socioeconomic status relative to fruits/vegetables foods index

Concerning protein food index, the descriptive computation of this study estimated that more that more than half (52.83%) of the respondents have high quality protein index compared to the 47.17% of the respondents with poor quality index. However, the results does not seems to suggest any link between maternal socioeconomic index and protein food index.

On junk food index, with M= 1.47 and SD= 0.79, the descriptive results estimated that most of the respondents (65.66%) have high quality index relative to the 18.48% and 15.86% of the respondents who have poor and moderate quality index – respectively. This is suggesting that most under-five children in South Africa are less likely to be fed with junk foods. However, the descriptive results do not suggest any statistical link between maternal socioeconomic status and junk food index. See **Figure 4.13** below.

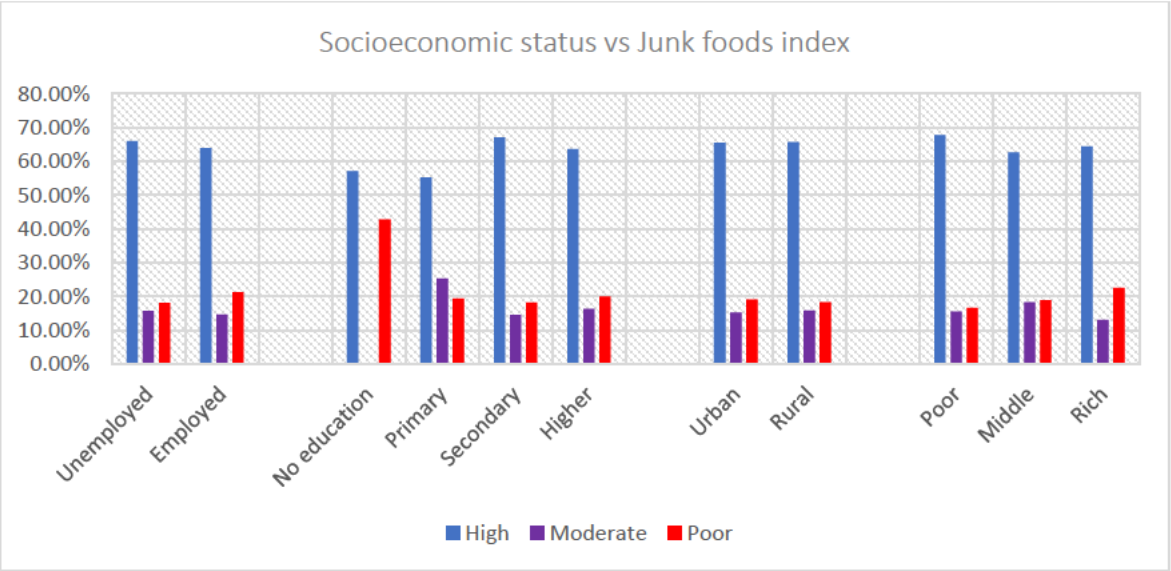

Figure 4. 13: Shows maternal socioeconomic status relative to junk foods index

The mean dietary diversity score was 12 with a standard deviation of 2.42 and more than 73.10% of the children met the minimum dietary diversity (≥3 food groups) and minimum acceptable diet as computed in this study. The results further revealed that children who met the acceptable diet and also breastfed for six months or more as well as started complementary feeding at six months were considered to have high complementary feeding index. In summary, the descriptive computation of this study revealed that most of the respondents (67.59%) have minimum overall complementary feeding index, while only 5.52% of the respondents have high complementary feeding index. Here, the results also revealed that more than one quarter (26.90%) of the respondents have poor complementary feeding index. In addition, relative to household wealth index, the descriptive statistics results revealed that "rich" households have higher rates of having high quality complementary feeding index as compared to their counterparts. This is an indication that children from rich households are more likely to be fed with high quality complementary foods relative to those from middle and poor households, with about 11.52% rate. See **Figure 4.14** for a detail presentation of the results.

These results are consistent with the arguments that the rising incidences of overweight and childhood obesity in developing countries are associated with malnutrition during infancy and childhood feeding practices (Campbell, 2018; Redsell et al., 2016; Black et al., 2013; Popkin et al., 2012; Rossouw et al., 2012; WHO, 2009). Similarly, the results of this study are also consistent with the argument that low socioeconomic households and/or low maternal socioeconomic status were associated with lower rate of meeting the minimum meal frequency, minimum dietary diversity, and minimum acceptable diet (Khulu & Ramroop, 2020; Janmohamed et al., 2020; Walters et al., 2019; Na et al., 2017; Slemming et al., 2017; Udoh & Amodu, 2016; Keane et al., 2012; Kendzor et al., 2012; Gregori et al., 2012; Fiese et al., 2012). Consequently, the results from this study demonstrated that food insecurity is one of the most significant social factors contributing to maternal and childhood nutrition and health. Although the concept of food security is better evaluated using both the macro- and microeconomic levels, the researcher only assessed food security in this study at the microeconomic level by utilizing maternal household wealth index, employment, and education. Thus, food insecurity as a situation whereby households lack access to quality and healthy food due to poverty or

other resources which was determined in this study to be one of the contributing factors of nutrition and health problem in South Africa. This is significantly consistent with many studies conducted in developing countries where food poverty (food insecurity) was determined to impede on child nutrition and health (Chakona & Shackleton, 2018; Schmeer & Piperata, 2017; Betebo et al., 2017; Abdurahman et al., 2016; FAO, 2015; Mandal et al., 2014; Black et al., 2013; Saaka & Osman, 2013; Ali et al., 2013; Nti, 2011; Kuku et al., 2011). Similarly, using a 48-hours dietary recall method, a study conducted in South Africa estimated that household food poverty was responsible for malnutrition in 35% of children, while 18% of children (aged 2-5 years old) were reported wasted in a sample of 216 children (Chakona & Shackleton, 2018). More so, household food poverty was also associated with having stunted and underweight children in Ethiopia, Bangladesh, and Vietnam (Ali et al., 2013). Thus, the impact of food insecurity as demonstrated in this study highlights that even mild household food poverty is detrimental to children nutritional and health outcomes (Schmeer & Piperata, 2017). Therefore, the findings from this study called for preventive measures (such as improving household wealth through economic development, promoting the education and employment of women) that promote food security at individual and household levels to reduce the prevalence of maternal and child malnutrition in South Africa.

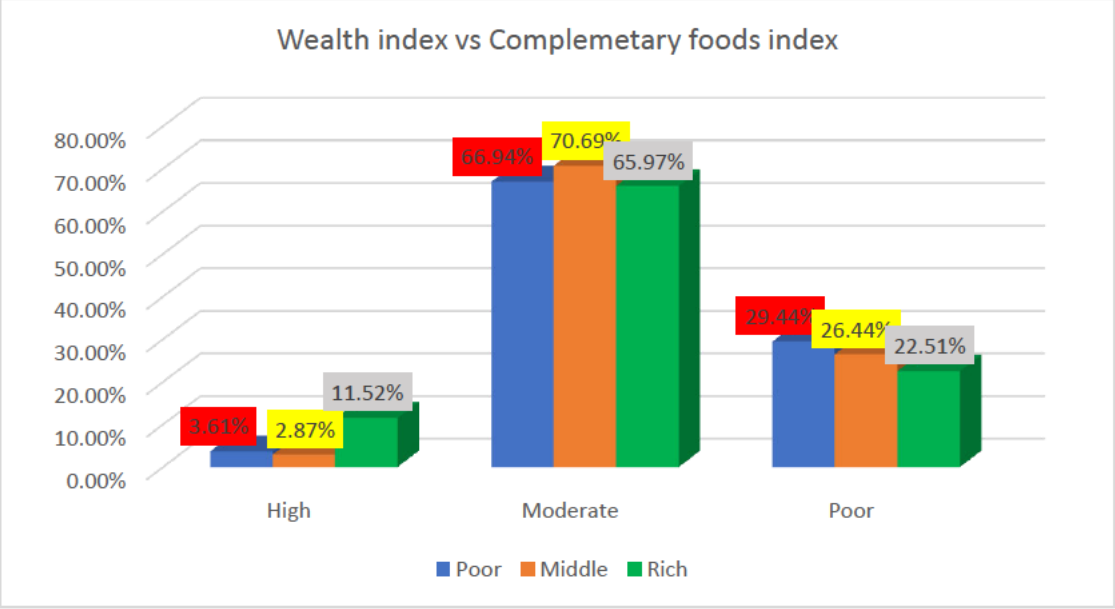

Figure 4. 14: Shows maternal wealth index relative to complementary feeding index

4.3.4 Assessing Maternal and Childhood Nutritional Status

4.3.4.1 Maternal nutritional status

With an average weight of 70.38 kg and an average height of 158.33 cm, the descriptive statistics of this study revealed that the average maternal Body Mass Index (BMI) was 28.06 kg/m^2 and a standard deviation of 6.76 kg/m^2. With only about 2.49% of the respondents who fell under the underweight category, about 33.91 percent of the respondents were regarded to have had normal BMI. The results further revealed that about 29.85% and 33.75% of the respondents fell under the overweight and obesity categories, respectively. This is suggesting that 63.60% of the respondents were either overweight or obese.

These results are very alarming, since maternal obesity poses significant risks to women and offspring. As a result, several studies on maternal nutrition and obesity postulates a link between maternal anthropometric measurements and early transmission of obesity (Li, 2018; Parlee & MacDougald, 2014; Apovian, 2013; Astrup & Finer, 2000). These studies highlight that obesity is genetically related such that the development of obesity in adulthood is significantly associated with foetal exposure to environmental markers such as maternal dietary intakes. This raises questions about the impact of maternal overweight and/or obesity on childhood short- and long-term health outcomes. Why? Because not only does maternal obesity poses high risk on childhood health, but it also poses high risk to maternal health outcomes which are proven to be detrimental to both maternal and childhood health. As a result, obesity in general is described as global epidemic that impacts on human quality of life. Thus, many studies have associated obesity with high risk of developing insulin resistance, diabetes, gestational diabetes mellitus, hyperlipidaemia, hyperglycaemia, hypertension, cancer, and cardiovascular diseases (Weng et al., 2018; Li, 2018; Wu et al., 2018; Xie et al., 2015; Besseiche et al., 2015; Apovian, 2013; Astrup & Finer, 2000). In addition, studies have also associated maternal BMI with birthweights and/or genetic predisposition of early transmission of obesity among children (Ojha & Symonds, 2020; Li, 2018; Santoni et al., 2017; Moore et al., 2015; Parlee & MacDougald, 2014; Apovian, 2013; Gill et al., 2013; Mühlhäusler et al., 2008; Astrup & Finer, 2000).

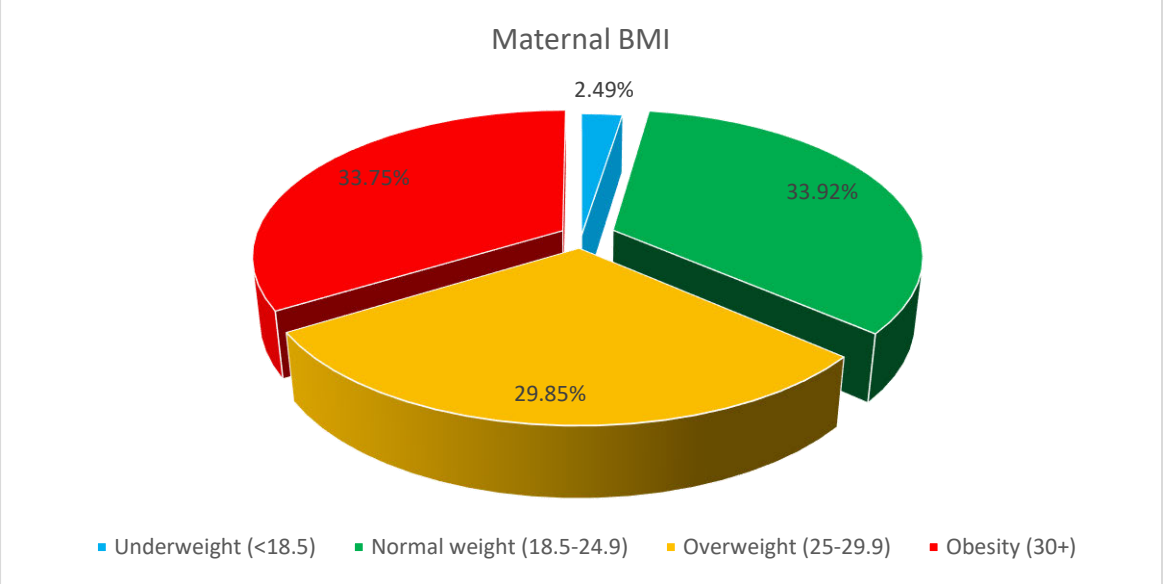

Figure 4. 15: Shows maternal body mass index in percentages

In addition, relative to maternal socioeconomic status, the descriptive computation revealed that the percentage rate of obese women is higher among women who fell within the rich household index than their counterparts, with about 44.62%. This is an indication that women from rich households in South Africa have 44.62% rate of becoming obese as compared to their counterparts. With more than 50% of the women from rich households living in urban areas, the descriptive results also revealed that urban women have 37.63% rate of being obese than their counterparts. Similarly, the results further indicated that employed women have 41.72% rate of being obese relative to unemployed women. These results are suggesting that there is a statistical link between maternal socioeconomic factors and maternal nutritional status. See **Figure 4.16** for a detail presentation of the analysis.

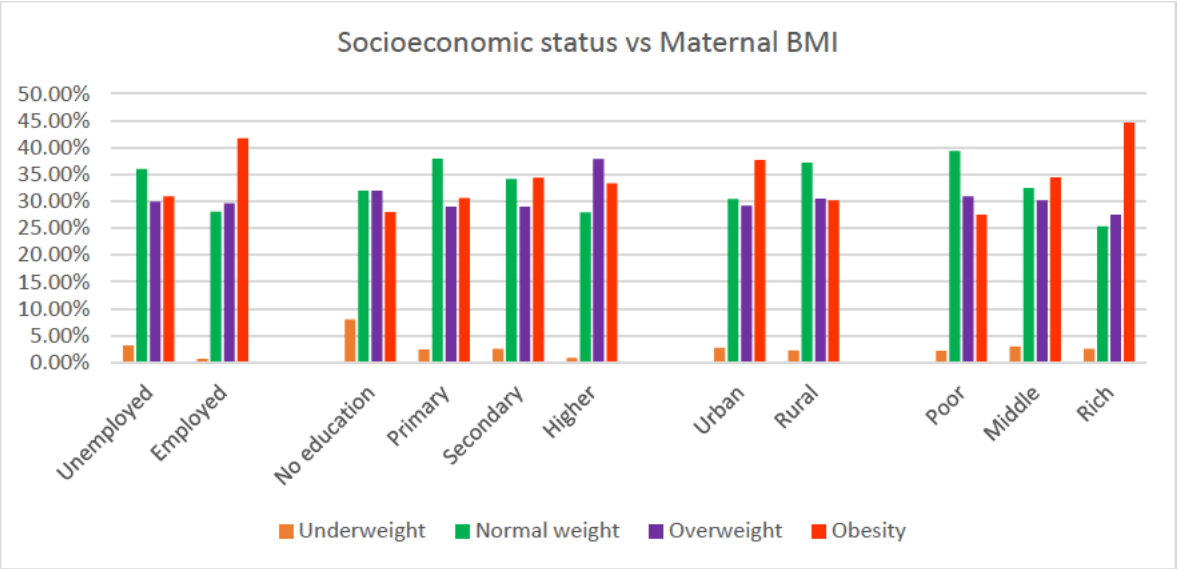

Figure 4. 16: Shows maternal socioeconomic status relative to maternal BMI

4.3.4.1 Childhood (under-five) nutritional status: Anthropometric assessment

With an average birthweight of 3.07kg and a standard deviation of 0.67kg, the descriptive computation revealed that (n=815; 61.11%) of the children were born with Normal Birth Weight (NBW). While about (n=329; 24.70%) were born with High Birth Weight (HBW), (n=189; 14.19%) were born with Low Birth Weight (LBW). Relative to maternal nutritional status, this study further revealed that the rate of HBW is higher among obese mothers with about 31.40% as compare to their counterparts. Similarly, it says here that the rate of LBW is higher among underweight mothers with about 37.04% as compared to their counterparts. These findings seem to suggest that there is a link between maternal nutritional status and infants' birthweights. See **Figure 4.17** for a detail presentation of the analysis.

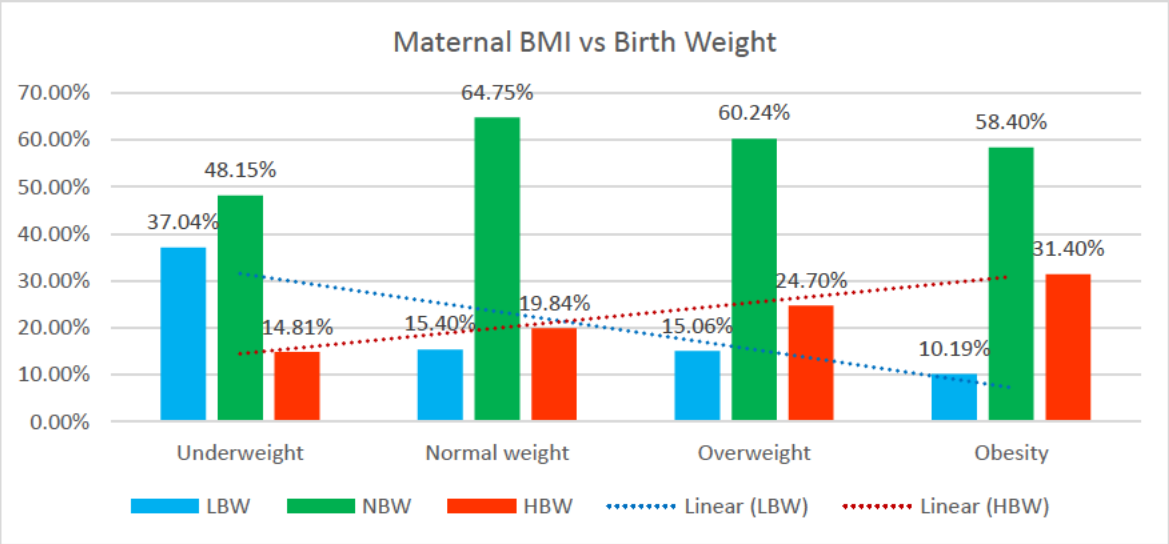

Figure 4. 17: Shows maternal nutritional status relative to infants' birth weight

Furthermore, with an average weight of 12.33 kg and an average height of 84.37 cm, the descriptive computation of this study revealed that the mean WAZ (weight-for-age) and HAZ

(height-for-age) were negative values, -0.08 and -0.94 respectively. Notably, the mean BAZ (BMI-for-age) differed by a positive value of 0.76 approximately. Of the 1460 households that were enrolled, 89.34% of the under-five children had normal weight-for-age, while only 5.20% of the children were either severely underweight or underweight (WAZ). However, the results also indicated that about 5.46% of the children were overweight (WAZ).

Regarding height-for-age Z scores, 73.18% of the children had normal height-for-age, 15.66% were stunted, 7.04% were severely stunted, and 4.13% were tall.

On weight-for-age Z Scores, 58.31% of the children had normal weight-for-age, 22.43% were overweight, 16.09% were obese, and 3.17% were underweight.

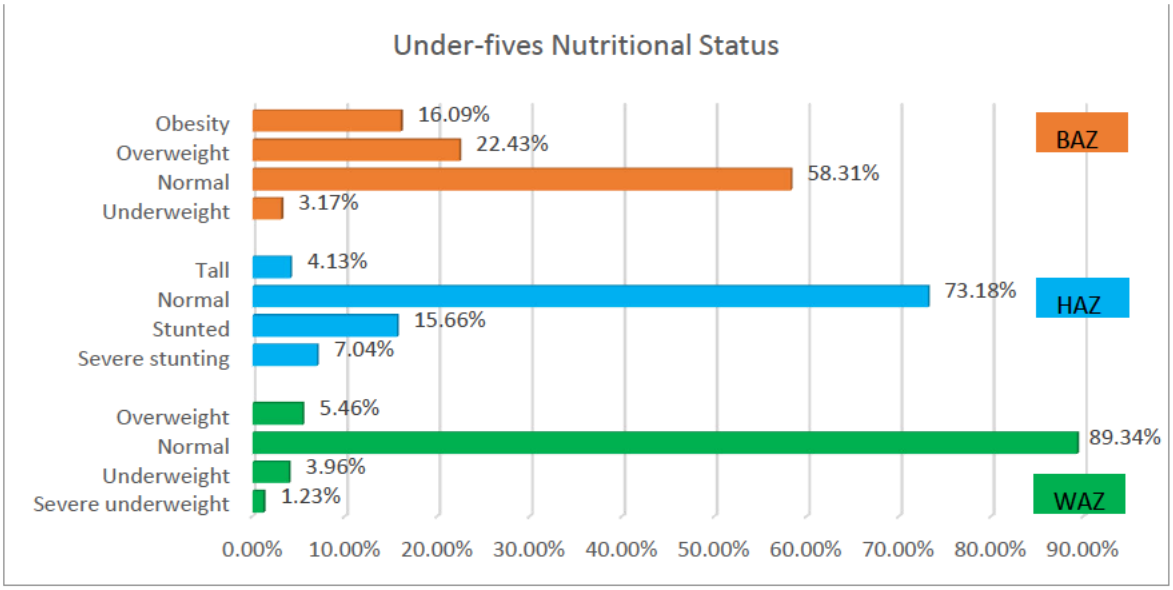

Figure 4. 18: Shows under-fives nutritional status

In this study, the level of malnutrition among under-five children were higher among unemployed mothers than employed mothers as follows: severe stunting (77.50% vs 22.50%), being underweight by WAZ (80.00% vs 20.00%), and obesity by BAZ (72.68% vs 27.32%) for unemployed and employed mothers respectively. However, except for severe stunting, the prevalence of malnutrition among under-five children were higher in urban areas than rural areas as follows: underweight by WAZ (57.14% vs 42.86%), severe stunting (48.75% vs 51.25%), and obesity by BAZ (56.28% vs 43.72%) for urban and rural areas children respectively.

The results on weight-for-age and height-for-age Z-scores are alarming. The weight-for-age z-scores revealed that the prevalence of under-fives overweight and/or obesity in South Africa is 38.52%, which is very alarming due to its implications to long term health outcomes. Already, researchers have argued that if the current trend of global childhood obesity continues, the current generation of children will live shorter lifespans compare to their parents due to childhood obesity and its associated complications (Venn et al., 2007). In addition, even though undernutrition is understood as the commonest cause of stunting, it is hard to comprehend the inner workings of stunting in developing countries due to its multifactorial relationship such as perinatal programming (Espinoza, 2016; Fowden et al., 2012; Pijnenborg et al., 2008;

Constancia et al., 2002; Haig, 1993), infections and diseases (Khulu & Ramroop, 2020; Janmohamed et al., 2020; Walters et al., 2019; Na et al., 2017; Slemming et al., 2017; Udoh & Amodu, 2016; Wolde et al., 2015; Reinhardt & Fanzo,2014; Bharati et al., 2011; Checkley et al., 2008), and socioeconomic factors (Khulu & Ramroop, 2020; Janmohamed et al., 2020; Walters et al., 2019; Na et al., 2017; Slemming et al., 2017; Udoh & Amodu, 2016; Keane et al., 2012; Kendzor et al., 2012; Gregori et al., 2012; Fiese et al., 2012). Therefore, by the current estimation, stunting prevalence is a public health issue in South Africa. This current evidence called for interventions research to improve maternal and child undernutrition and clinical care to comprehensively address both maternal and childhood nutrition and health outcomes.

In general, the results on childhood nutritional status as demonstrated in this study raises questions about the impact of perinatal and genetic epidemiology on under-fives nutritional and health outcomes in South Africa. According to Hales (2001), environmental modifications during this critical period, especially as it relates to the metabolic nutritional state of mothers can result in the foetus or infants making predictive adaptations to the metabolic physiology, which is known as the 'thrifty phenotype'. Although these adaptations are organised in a manner that seeks to improve the chances of survival and success in the long run, these adaptations may have a permanent negative impact on organs and tissues structure as well as functions (Santoni et al., 2017; Moore et al., 2015). Thus, causing the epigenetic profile of foetuses and infants to be altered as well as leading to modifications in gene expressions (Li, 2018; Elhamamsy, 2017; Berger et al., 2009; Egger et al., 2004). Consequently, the physiological function of the body is permanently modified and potentially resulting to energy balance dysfunction and life-long diseases such as obesity, diabetes, and cardiovascular diseases in adulthood (Naruse et al., 2019; Weng et al., 2018; Zhou & Xiao, 2018; Tyrrell et al., 2016; Espinoza, 2016; Soubry et al., 2015; Lee, 2015; Li et al., 2014; Gluckman et al., 2008; Singhal & Lucas, 2004). The risks of these conditions are significantly increased if there is a mismatch between the initial perinatal environment and the postnatal reality (Gluckman et al., 2008; Singhal & Lucas, 2004). Similarly, studies have argued that the risk of obesity is highest among children born with higher BMI or born of parents who are obese (Gillman, 2010; Venn et al., 2007). Thus, the findings of this study provide crucial evidence for the perinatal programming of obesity and its impact on childhood obesity. Therefore, the increasing obesity epidemic seen in this study may be partly explained by environmental markers (Lee, 2015; Li et al., 2014; Gluckman et al., 2008; Singhal & Lucas, 2004) and socioeconomic factors (Janmohamed et al., 2020; Ickes et al., 2018; Slemming et al., 2017; Sarki et al., 2016; Keane et al., 2012; Kendzor et al., 2012; Gregori et al., 2012; Fiese et al., 2012), especially malnutrition during perinatal programming. As demonstrated in this study, several environmental makers with opposing effects, such as undernutrition and over nutrition during perinatal programming results to a similar outcome as recorded in this study.

4.3.5 Evaluating Childhood Health Behaviours and Wellbeing

On childhood wellbeing, the descriptive computation of this study indicated that most of the children (n=1289, 88.29%) were reported not to had have diarrhoea recently. On the other hand, the results revealed that one tenth (n=158; 10.82%) of the children were reported to have had diarrhoea in the last two weeks. More so, the results further indicated that most of the children (n=1157; 79.25%) were reported not to have had fever in the last two weeks. However, the

results revealed that almost one fifth (n=291; 19.93%) of the children were reported to have had a fever in the last two weeks.

In addition, the descriptive analysis suggested that most of the children (n=1075; 73.63%) were reported not to have had a cough in the last two weeks. On the other hand, the results also suggested that one quarter (n=378; 25.86%) of the children were reported to have had a cough during the last two weeks. Furthermore, the results also suggested that most of the children (n=1365; 93.49%) were reported not to have had short or rapid breaths in the last two weeks. However, only (n=89; 6.10%) of the children were reported to have had short or rapid breaths in the last two weeks. See **Figure 4.19** below for a detail presentation of the results herein.

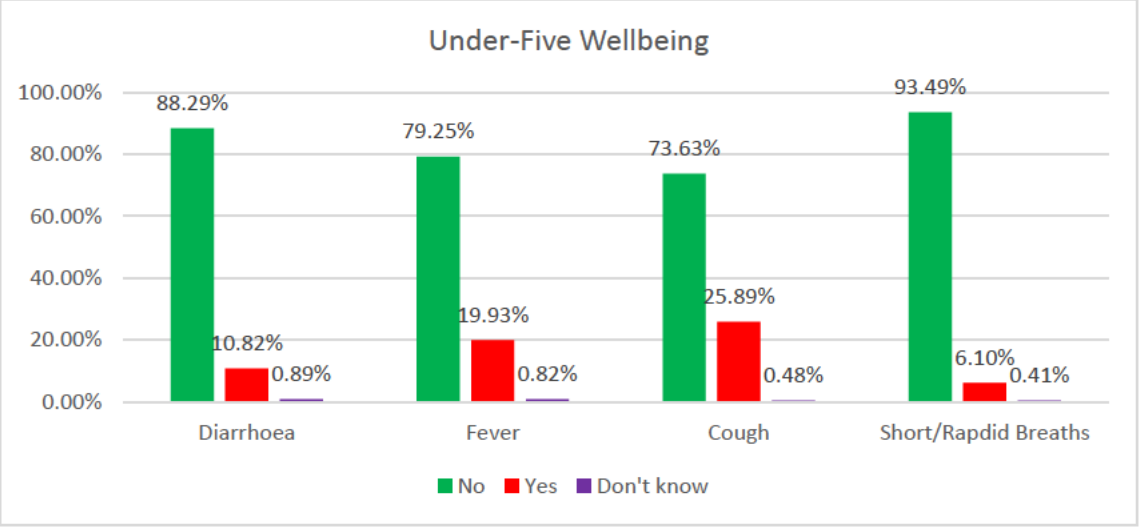

Figure 4. 19: Shows percentage of childhood wellbeing according to different indicators

4.3 INFERENTIAL STATISTICS

The researcher employed both bivariate and multivariate analyses to identify the determinants of minimum acceptable diet and as well as the factors influencing underweight, stunting and obesity among children under-five years. Similarly, both bivariate and multivariate analyses were performed to identify the determinants of maternal and childhood health outcomes. Chi-square (X^2) tests and t-tests were performed to identify the predictors of obesity, underweight, and stunting significant at $p < 0.05$. Analysis of Variance (ANOVA) was also performed to compare mean anthropometric Z-scores and selected predictors.

Binary and multiple logistic regression modelling were both used to determine the association between malnutrition and the independent variables. Similarly, the association between health outcomes and the independent variables was determined using both binary and multiple logistics regression models. These test statistics were used because underweight, stunting and obesity were later coded into two categories (i.e. underweight and normal, stunted and normal, and obese and normal). Here, all the potential predictors of underweight, stunting and obesity that were significant at $p < 0.05$ in bivariate analyses using chi-square (X^2) test, t-test, and ANOVA were included in the regression modelling.

The relationship between selected factors and WAZ, HAZ and BAZ were determined using multiple linear regression modelling. This was performed because the dependent variables WAZ, HAZ, and BAZ were continuous variables. In addition, prior to testing for the

association between predictors and the dependent outcomes, the data was cleaned and outliers removed.

Therefore, these techniques were used to determine the impact of maternal socioeconomic/sociodemographic factors on maternal and child nutrition and health outcomes.

4.4.1 Assessing the Impact of Maternal Sociodemographic factors on minimum acceptable diets

Here, the researcher seeks to assess the association between maternal socioeconomic factors and minimum acceptable diet. In other words, the researcher seeks to determine if maternal socioeconomic/sociodemographic factors influence the nutritional intake of under-five children.

4.4.1.1 Bivariate analyses

With a p-value set at <0.05, the correlation analysis of this study indicated that there is a strong significant relationship between maternal educational level and employment status, where (X^2 = 68.10; p-value = 0.000). Similarly, the correlation computation revealed that there is a strong relationship between maternal place of residence and employment status, where (X^2 = 16.94; p-value = 0.000). Therefore, these correlations findings are suggesting that the probability of a respondent getting employed are strongly influence by the mother's level of education and place of residence – indicating that mothers with higher education level and mothers residing in urban areas are more likely to be employed relative to their counterparts.

On minimum acceptable diet (complementary feeding practice), a bivariate analysis of the predictors of the average minimum dietary diversity scores was computed. In other words, a host of explanatory variables were tested for the association with meeting the minimum dietary diversity. The variable tested included maternal education, employment status, marital status, maternal and child age, place of residence, number of children ever born, and household wealth index.

Consequently, on breastfeeding, the correlation computation of this study revealed that there is a strong relationship between mothers' level of education and breastfeeding – suggesting that mothers with higher level of education are less likely to breastfeed their children as compare to their counterparts – where (X^2 = 23.10; p-value = 0.000). Similarly, the correlation analysis of this study further revealed that mothers who are employed are less likely to breastfeed as compared to those who are unemployed. This is suggesting that there is a strong relationship between mothers' employment status and breastfeeding – where (X^2 = 29.04; p-value = 0.000).

On duration of breastfeeding, the results revealed that there is also a strong relationship between maternal education and duration of breastfeeding – suggesting that women with no or lower education levels are more likely to breastfeed their children for at least 6 months or more as compared to women with higher education (X^2 = 14.63; p-value = 0.023). Likewise, it says here that maternal employment status and type of residence are also associated with duration of breastfeeding – suggesting that unemployed mothers and rural women are more likely to breast their children for at least 6 months or more as compare to their counterparts – with p-values of 0.041 and 0.030 respectively. In addition, the correlation results revealed that

maternal wealth index is strongly associated with duration of breastfeeding – suggesting that women with lower class (poor wealth status) are 63.77% more likely to breastfeed for at least 6 months or more relative to middle class women (56.35%) and high-class women (43.80%) where (X^2 = 39.11; p-value = 0.000). These findings are indicatives of the impact of maternal socioeconomic status on breastfeeding in South Africa – suggesting that there is a strong association between maternal education, employment status, and place of residence relative to breastfeeding among mothers in the country.

On formula feeding, the correlation analyses also revealed that there is a strong association between maternal employment status and formula feed – where (X^2 = 13.05; p-value = 0.000). It says here that mothers who are employed are more likely to practice formula feeding as compared to those who are not employed – with about 46.67%. Similarly, the results of this study further revealed that formula feeding is also determined by mothers' level of education, where (X^2 = 16.74; p-value = 0.001). This entails that there is a strong association between maternal education and formula feeding – suggesting that mothers with higher education are 40.00% more likely to practice formula feeding in South Africa relative to their counterparts. More so, it says here that there is a relationship between maternal place of residence and formula feeding, with (X^2 = 6.33; p-value = 0.042). Indicating that the prevalence of formula feeding is higher among urban women relative to rural women. In addition, the correlation results revealed that there is a strong association between maternal wealth index and formula feeding – suggesting that women from rich households are 46.60% more likely to practice formula feeding relative to their counterparts. Interestingly, these results revealed that the prevalence of formula feeding simultaneously increases with households' wealth index – the poorer a mother is the less likely to practice formula feed while the wealthier a mother is the more likely to practice formula feeding (X^2 = 20.82; p-value = 0.000). Furthermore, the bivariate analysis revealed that there is a strong relationship between child age and formula feeding – where (X^2 = 22.32; p-value = 0.000).

The results for maternal education and employment are largely consistent with previous studies from developing and developed countries (where maternal education and employment is predominant), which find that maternal education and employment is associated with lower odds of breastfeeding (Rivera-Pasquel et al., 2015; Cawley & Liu, 2012; Fertig et al., 2009; Bernal, 2008; Waldfogel, 2002). Other studies conducted in South Africa have highlighted that breastfeeding is no longer a norm in many South African communities – suggesting a decline in exclusive breastfeeding (Zweigenthal et al., 2019; Doherty et al., 2012; Nor et al., 2012). Furthermore, the findings on duration of breastfeeding are also consistent with the argument that the odds of continued breastfeeding were lower among mothers who are employed (Oddo & Ickes, 2018). The findings on formula feeding as demonstrated in this study are largely echoing the argument that formula feeding is perceived as prestigious and modern (Rollins et al. 2016). Here, we can see that the rate of formula feeding is higher among better-educated, employed, and urban mothers – such that it can be argued that breastfeeding is either perceived as being unsophisticated and poor and/or as a side-effect of maternal economic stability on childhood nutrition and health. In fact, several studies had already link patterns of decline breastfeeding with increasing household wealth, better-educated women and urban women in developing countries (Walters et al., 2019; Rollins et al. 2016; Cattaneo, 2012; WHO, 1983). Thus, the lower odds ratio of breastfeeding and continued breastfeeding determined among employed mothers, better-educate mothers, and urban mothers in this study, limit the protective

effect that breastmilk offers children against childhood obesity in South Africa (Campbell et al., 2018; Uwaezuoke et al., 2017; Crume et al., 2012; McCrory & Layte, 2012; Wijlaars et al., 2011; Dedoussis et al., 2011). Therefore, the findings of this study echo the findings of the studies that demonstrated the negative association between breastfeeding and socioeconomic status, as well as other potentially complex factors that can influence childhood obesity (Li, 2018; Parlee & MacDougald, 2014; Apovian, 2013; Gibbs & Forste, 2013; Wijlaars et al., 2011).

Using the household wealth index – based on household assets and housing quality – as a proxy indicator for maternal socioeconomic status of households, it says here that there is a strong statistical association between maternal socioeconomic status and complementary feeding practice. In other words, the correlation analysis revealed that there is a strong relationship between maternal household wealth index and meeting the minimum acceptable dietary diversity – where (X^2 = 23.56; p-value = 0.000). The results suggested that high wealth index households are more likely to meet the minimum acceptable dietary diversity relative to those with low wealth index. These findings are consistent with the findings of several studies conducted in developing countries (Janmohamed et al., 2020; Walters et al., 2019; Ickes et al., 2018; Slemming et al., 2017; Sarki et al., 2016). For example, Walters et al (2019), argues that there was a significant association between high maternal wealth index and optimal complementary feeding practices. They further added that children (13-23 months) who made the minimum acceptable diet and minimum meals frequency were less likely to be underweight (Walters et al., 2019). More so, the findings of this study also echo the findings of the study conducted in Mongolia and South Africa, which argues that increased household wealth was positively linked with meeting minimum meals frequency, minimum dietary diversity, and minimum acceptable diet (Janmohamed et al., 2020; Slemming et al., 2017). Similarly, another study demonstrated that children born of mothers with high educational qualifications were associated with optimal BMI relative to those born of mothers with lower educational levels (Sarki et al., 2016). However, the findings of this study seem to contradict the findings of a study recently conducted in Colombia which associated high maternal years of education with overweight children (Aldana-Parra et al., 2020). Not only does the findings of this study contradict the findings of the study conducted in Colombia, but it also contradicts the findings of several studies conducted in developed countries which linked increasing maternal socioeconomic status with overweight and/or obese children (Fitzsimons & Pongiglione, 2019; Courtemanche et al., 2017; Gwozdz, 2016; Gwozdz et al., 2013; Dunifon et al., 2013; Champion et al., 2012; Morrissey et al., 2011; Hawkins et al., 2008). Hence, this further indicates that the association between maternal socioeconomic status and both maternal and childhood nutrition varies from region to region, with inconsistent findings even within regions. Although the descriptive results of this study estimated that more than 73.10% of the children met the minimum dietary diversity, the results also estimate that of 26.90% of those who did not met the minimum dietary diversity were highly associated with low or poor household wealth index. This is an indication that low or poor maternal socioeconomic status is a determinant of nutritional and health status of mothers and their children in South Africa. This is consistent with the argument that undernourishment among under-fives is a major public health challenge in the country (SA-DHS, 2017). Therefore, the findings of this study revealed that disparities in wealth and access to healthy food are important concerns for the South African society if both maternal and childhood nutrition and health status are to be significantly improved.

4.4.1.2 Multivariate analyses

Table 4.8 shows the results of the models regressing the impact of maternal socioeconomic/sociodemographic factors on minimum acceptable diet. Although, model 1 measures the association between maternal socioeconomic factors and formula feeding, model 2 and 3 measures the impact of maternal socioeconomic factors on duration of breastfeeding and minimum acceptable diets. These three models in **Table 4.8** seeks to assess the impact of maternal socioeconomic/sociodemographic factors on minimum acceptable diets of under-five children in South Africa.

Regressing for formula feeding practice based on socioeconomic data in model 1, it shows that there is a strong relationship between maternal socioeconomic data toward formula feeding. With p-values of <0.05, the results show that there is a linear relationship between mothers who are employed and high wealth index households towards formula feeding. Children with employed mothers and resident in wealthier households are more likely to be given formula feeding relative to their counterparts. In addition, while controlling for other variables, the results in model 2 show that there is a significant association between maternal education, household wealth index, child age, maternal age, and duration of breastfeeding. These multivariate results are consistent with the bivariate results of this study. Thus, these findings are consistent with several findings which associated maternal employment and higher maternal wealth index with formula feeding or lower rate of breastfeeding (Rivera-Pasquel et al., 2015; Cawley & Liu, 2012; Fertig et al., 2009; Bernal, 2008; Waldfogel, 2002). This raises questions about the risk associated with infants who were predominantly engaged in formula feeding from 0-6 months of age and having higher BMI as children (Gibbs & Forste, 2013; Beyerlein & von Kries, 2011). Of course, the factors influencing childhood weight gain are complex and multifaceted, infants feeding practices, duration of breastfeeding, and complementary diet are contributing factors of childhood overweight and/or obesity. Unfortunately, maternal factors such as socioeconomic status, biological, and environmental status also serves as catalytic forces for childhood overweight and/or obesity (Keane et al., 2012; Kendzor et al., 2012; Gregori et al., 2012; Fiese et al., 2012).

Furthermore, after controlling for other variables, model 3 results show that there is a significant statistical relationship between the dependent variable (minimum acceptable diets) and maternal education, household wealth index and child age. Therefore, with the negative correlations indicated in model 3 between the dependent variables and (maternal education and household wealth index) suggest that on average the values of each of the dependent variable is lower for mothers with no education and low wealth index in comparison to their counterparts. Similarly, the negative correlation coefficients in model 2 for maternal education, household wealth index and maternal age suggest that on average the values of each dependent variable (duration of breastfeeding) are lower for respondents with no education, low wealth index and younger mothers than their counterparts. These findings are indicative of the impact of poor or low maternal socioeconomic status on infant and child feeding practices, dietary diversity, dietary frequency, and childhood complementary feeding practices. These findings are consistent with many studies conducted in developing economies which associated maternal poor living conditions, low maternal education, and poor household food security with malnutrition among children (Chakona & Shackleton, 2018; Schmeer & Piperata, 2017; Singh et al., 2009) and directly affect their nutritional status (Khulu & Ramroop, 2020;

Janmohamed et al., 2020; Walters et al., 2019; Na et al., 2017; Slemming et al., 2017; Udoh & Amodu, 2016; Wolde et al., 2015; Bharati et al., 2011). Of course, this is suggesting that income disparities and high poverty rate in South Africa influences both maternal and child nutritional and health status because high income inequality and poverty in most low-income households defines their nutrition and food choices. Hence, studying the political economy of undernutrition in the country holds the key to improving both maternal and childhood malnutrition in South Africa. Here, political economy of nutrition is described as the political, environmental, economic, social and cultural context through which childhood nutritional status are influenced and measured (Smith & Haddad, 2015, Nisbett et al., 2014). Thus, the impact of economic development on maternal and childhood nutritional and health outcomes has been proven to be very effective in most developing countries (Janmohamed et al., 2020; Walters et al., 2019; Ickes et al., 2018; Slemming et al., 2017; Sarki et al., 2016). Many studies have also argued that economic growth has a large impact on improving malnutrition rates in developing countries (Khulu & Ramroop, 2020; Janmohamed et al., 2020; Walters et al., 2019; Na et al., 2017; Slemming et al., 2017; Udoh & Amodu, 2016; Wolde et al., 2015; FAO, 2015; Smith & Haddad, 2015; Alderman et al., 2013; Addison et al., 2008; Collier, 2007; Lamarre, 2005). Therefore, the findings from this study are consistent with several studies that associated low socioeconomic status households and/or low maternal socioeconomic status with low probability of meeting the minimum meal frequency, minimum dietary diversity, and minimum acceptable diet in developing countries – resulting to malnutrition and health implications (Khulu & Ramroop, 2020; Janmohamed et al., 2020; Walters et al., 2019; Na et al., 2017; Slemming et al., 2017; Udoh & Amodu, 2016; Keane et al., 2012; Kendzor et al., 2012; Gregori et al., 2012; Fiese et al., 2012). For instance, in a recent study that evaluates the determinants of malnutrition in under-five children from Malawi, Senegal, and Angola revealed that mothers' level of education, age and sex of the child, the type of residence, birth interval, wealth index and the birth order were significantly associated with malnutrition in these countries (Khulu & Ramroop, 2020). In other words, the study argues that children located in rural communities, poor socioeconomic households, with a mother having achieved primary education, are female and are between the ages of 24 and 59 months are statistically associated with malnutrition in these countries (Khulu & Ramroop, 2020). Thus, ensuring food security at individual and household levels through economic development and/or economic stability – such as employment, education, social stability, promoting gender equality, etc – is essential to reducing the prevalence of maternal and childhood malnutrition in South Africa. Why? This is simply because the distribution of income within a given society or country is paramount to ensuring households' food and social security (Barlow et al., 2020; Chavas, 2017; Poulsen et al., 2015; Kotagama et al., 2014; Akter & Basher, 2014; Haddah, 1992). This is particularly important in South Africa because the apartheid legacy still leaves most of its peoples in poverty (NPC, 2011; Harris et al., 2011; Coovadia et al., 2009). Therefore, based on the bivariate and multivariate analyses of this study, there is a significant association between maternal socioeconomic factors on minimum acceptable diet among children under five. Similarly, based on the bivariate and multivariate analyses of this study, the results suggested that there is a significant association between maternal socioeconomic factors on breastfeeding and formula feeding.

Table 4. 8: Results of the regression analysis that measures the impact of maternal sociodemographic factors on minimum acceptable diets

FACTORS	**MODEL 1** Formula Feeding		**MODEL 2** Breastfeeding Duration		**MODEL 3** Minimum Acceptable Diets	
	Coefficient	*Robust S.E.*	*Coefficient*	*Robust S.E.*	*Coefficient*	*Robust S.E.*
Employment	0.111**	0.047	-0.041	0.050	-0.155	0.152
Education	0.067	0.039	-0.102**	0.042	-0.392***	0.118
Type of Residence	0.021	0.040	-0.030	0.049	-0.206	0.134
Wealth Index	0.081***	0.025	-0.137***	0.031	-0.204*	0.090
Child Age	-0.009	0.012	0.066***	0.013	-0.197***	0.040
Maternal Age	0.009	0.014	-0.061***	0.016	0.047	0.045
Constant	0.007***	0.123	1.860***	0.144	12.257***	0.389
F Statistics, df	*5.38, (6)*		*14.10, (6)*		*7.96, (6)*	
R-Square	*0.0442*		*0.0558*		*0.0557*	
Note: **p<0.05; **p<0.01; ***p>0.001*						

4.4.2 Assessing the Impact of Maternal Socioeconomic/sociodemographic factors on maternal and childhood nutritional and health outcomes

Here, the research seeks to assess the impact of maternal socioeconomic factors on both maternal and childhood nutritional and health outcomes. In other words, the researcher evaluates the impact of maternal socioeconomic factors on maternal and child nutritional status. In addition, the researcher or determines the impact of maternal BMI on childhood nutritional outcomes. Regarding maternal and childhood nutritional status, a bivariate analysis of the predictors of the average nutritional status scores were computed. In other words, a host of explanatory variables were tested for the association with both maternal and childhood nutritional status. The variable tested included maternal education, employment status, marital status, maternal and child age, place of residence, number of children ever born, birthweight, formula feeding, breastfeeding, complementary feeding practice index, and household wealth index.

4.4.2.1 Bivariate analyses

The correlation computation matrices of this study revealed that there is a statistical association between maternal socioeconomic factors and maternal and childhood nutritional status. For example, when computing for the association between maternal BMI and whether a respondent is employed, the results revealed that the prevalence of obesity is higher among employed mothers (41.72% vs 30.94%) where (X^2 = 18.18; p-value = 0.000). This is suggesting that there is a strong relationship between maternal employment status and maternal BMI. More so, the

bivariate computation revealed that there is a relation between types of residence and maternal BMI. It says here that urban women are 37.63% more likely to be obese relative to their counterparts – where (X^2 = 9.55; p-value = 0.023). Similarly, upon computing for the relationship between maternal BMI and household's wealth index, the results revealed that there is a strong association between household wealth index and maternal BMI – where (X^2 = 33.19; p-value = 0.000). Suggesting that the prevalence of obesity among high wealth index mothers is 44.62% relative to low wealth index women (27.52%) and middle wealth index women (34.43%). Interestingly, the results revealed that the prevalence of normal weight is higher among mothers with poor wealth index (39.32%) relative to middle class women (32.46%) and high wealth index mothers (25.32%). These results raise questions about the impact of maternal socioeconomic status on both maternal and child nutritional and/or health outcomes. With that being said, the findings of this study contradict the results from other studies which demonstrated a positive association between high maternal wealth index, years of education and maternal employment with both maternal and childhood bodyweight (Chia, 2008; Ruhm, 2008; Courtemanche, 2007; Cawley & Liu, 2007; Phipps et al., 2006; Liu et al., 2005). More so, these findings contradict other studies conducted in developing countries which argues that there is insignificant link between maternal employment status and both maternal and childhood overweight and/or obesity (Debela et al., 2020; Rashad & Sharaf, 2019; Oddo et al., 2017; Nie & Sousa-Poza, 2014). Instead, the findings of this study are consistent with the results of other studies conducted in developed countries which associated maternal employment with the rise in both maternal and childhood overweight and/or obesity (Fitzsimons & Pongiglione, 2019; Courtemanche et al., 2017; Gwozdz, 2016; Gwozdz et al., 2013; Dunifon et al., 2013; Champion et al., 2012; Morrissey et al., 2011; Hawkins et al., 2008). This is contrary to the argument that children from low socioeconomic households in developing countries are more likely to have overweight mothers – which predisposed them to childhood obesity (Gibbs & Forste, 2013). Here, we see that the rate of maternal normal BMI is relatively higher among poor wealth index households (39.32%) compared to middle class women (32.46%) and high wealth index mothers (25.32%). While this might not be the case in others developing countries, these findings are indicative of the impact of maternal lifestyle (such as dietary intake and sedentary caused by maternal employment and/or increasing wealth index) on maternal BMI (Fertig et al., 2009).

In addition, the correlation computation revealed that there is a strong association between maternal age and maternal BMI – where (X^2 = 122.25; p-value = 0.000). It says here that the prevalence of obesity is higher among older women (aged 25+) raging between 30% to 54% prevalence rate. More so, the results revealed that there is a strong relationship between the number of children ever born by women and maternal BMI, with (X^2 = 28.97; p-value = 0.000). Likewise, the results also suggested that there is a strong association between maternal marital status and maternal BMI, with (X^2 = 31.59; p-value = 0.000). It says here that the prevalence of obesity is higher among widows (55.56%) and married/cohabitating women (40.65%) relative to their counterparts. These findings add value to the existing body of knowledge on maternal BMI. Here, one can argue that the link between maternal age, children ever born, and marital status with maternal BMI reflects the cumulative fats gain during pregnancies – the main argument here is that lower parity reflects lower fat gain during pregnancies and vice versa. It can also be argued that it is a causal link between maternal degenerative effects and high BMI or a dual effect of high maternal parity and degenerative effects relative to high maternal BMI. This is an indication that older women are more likely to be pregnant more than

once. Likewise, women who are married/cohabitating or widowed are more likely to be pregnant more than once, as compared to their counter parts. This is a feasible cause since the findings from this study revealed that there is a strong relationship between maternal age and the total number of children ever born, with (X^2 = 449.61; p-value = 0.000). It says here that the rate of having 1-2 children is higher among women aged 15-19, 20-24 and 25-29 years, with 100.00%, 94.19% and 70.90% respectively. On the other hand, the results revealed that the rate of having ≥3 children is higher among women aged 30-49 years (which ranges between 49.84% to 92.31%). These results suggest that the higher the maternal age the higher the parity and the lower the maternal age the lower the parity. In addition, the results from this study also revealed that there is a strong relationship between maternal marital status and the total number of children ever born, where (X^2 = 100.85; p-value = 0.000). It says here that the rate of having 1-2 children is 74.23% among never married women compared to married/cohabitating women (49.91%) and widowed (33.33%). On the other hand, it revealed that the rate of having ≥3 children is higher among married/cohabitating women (50.9%) and widowed (66.67%) as compared to never married women (25.77%). Thus, the results from this study are consistent with other study which associated higher maternal parities and higher maternal BMI (Zoet et al., 2019; Iversen et al., 2018; Hajiahmadi et al., 2015). For instance, women with ≥3 parities were associated with higher risk of being obese relative to their counter parts (Hajiahmadi et al., 2015). Therefore, these results are suggesting a possible link or highlighting the impact of others under-studied factors that impact on maternal obesity and possibly childhood overweight and/or obesity.

On childhood nutrition status, the bivariate analyses of this study revealed that there is a strong association between maternal BMI and birthweights – where (X^2 = 27.89; p-value = 0.000). It says here that the rate of high birthweights simultaneously increases relative to maternal BMI – suggesting that the prevalence of high birthweight is higher among obese women (31.40%) relative to their counterparts. Interestingly, the results also revealed that the rate of low birthweight is higher among underweight women (37.04%) relative to their counterparts. Therefore, these results reveal that the higher the maternal BMI the higher the rates of high birthweight, whereas the lower the maternal BMI the higher the rate of low birthweight. In addition, an analysis of variance revealed that there is no difference between birthweight variances and under-fives weight-for-age (WAZ) variances, with (F= 0.30; p-value = 0.741). Here, the Bartlett's test for equal variances revealed that there is a strong relationship between birthweight and WAZ, where (X^2 = 37.7125; p-value = 0.000). Similarly, the analysis of variance also revealed that there is no difference between birthweight variances and under-fives BMI-for-age (BAZ), with (F= 0.91; p-value = 0.401). Again, the analysis of variance further suggested that there is no difference between maternal BMI variances and under-fives BAZ variances, (F= 0.80; p-value = 0.494). These findings are significantly consistent with several studies that associated maternal BMI with birthweight and/or childhood overweight or obesity. For example, several studies on maternal nutrition and obesity associated maternal nutritional status and early transmission of obesity in infants (Li, 2018; Parlee & MacDougald, 2014; Apovian, 2013; Astrup & Finer, 2000). These studies further adds that obesity in children has a strong inherited tendency and the development of obesity in adult life is significantly associated by foetal exposure to environmental markers such as maternal dietary intakes (Li, 2018; Parlee & MacDougald, 2014; Apovian, 2013; Mühlhäusler et al., 2008; Astrup & Finer, 2000). Consequently, Parlee and MacDougald (2014) argues that the relationship between maternal nutritional status and early transmission of obesity depend on its qualitative factors

(e.g. certain bioactive diets with epigenetic regulatory features) and its quantitative factors (e.g. under- and over-nutrition aspects). They further argue that these factors serve as catalytic forces for the development of obesity in the offspring's life in the future. Likewise, other studies associated early environmental factors such as maternal diets and its impact on gut microbiota composition in children via maternal gut microbiota transfer – to which they further argue that it can persist until adulthood and ultimately results to long-term effects on metabolic health and disease development in the offspring (Zhou & Xiao, 2018; Chu et al., 2016). Therefore, the findings from this study highlights that quality maternal and childhood nutrition (especially maternal nutrition during and after pregnancy) is a prerequisite for good health outcomes in mothers and their children (Hasan et al., 2011). Hence, these results are consistent with the studies that associated maternal nutritional status with birthweights and/or genetic predisposition of early transmission of obesity among children (Ojha & Symonds, 2020; Li, 2018; Santoni et al., 2017; Moore et al., 2015; Parlee & MacDougald, 2014; Apovian, 2013; Gill et al., 2013; Mühlhäusler et al., 2008; Astrup & Finer, 2000). Similarly, other studies conducted in South Africa and other developing countries also revealed that the rising incidences of overweight and obesity in children are also associated with malnutrition during infancy and childhood feeding practices (Campbell, 2018; Redsell et al., 2016; Black et al., 2013; Popkin et al., 2012; Rossouw et al., 2012; WHO, 2009). Thus, even though factors affecting maternal and childhood weight are complex, infant feeding and early complementary diet are primary contributing factors of childhood overweight and obesity. The delicate nature and significance of childhood complementary feeding period cannot be overemphasized. Without doubt, this is also an indication that nutrition is a key environmental factor in South Africa, which influences both maternal and childhood nutritional and health outcomes. Therefore, this called for a concerted and/or customized maternal diet model(s) in the country as a prevention measure for maternal and child nutritional outcomes and morbidities. The results of this study highlights that the profits of good nutrition rotate across generations – from the livelihoods of communities to the development goals of the nation. Hence, good nutrition promotes economic progress, quality wellbeing, development and human capital (Smith & Haddad, 2015; Unicef, 2015b; Nisbett et al., 2014; Bhutta, 2013; Bhutta et al., 2013; Haddad, 2013; World Bank, 2013; Hoddinott et al., 2013; Hoddinott et al., 2011; Martorell et al., 2010; Martorell, 1996).

Furthermore, a Spearman's correlation was run to assess the relationship between formula feeding and diarrhoea. The results revealed that there is a strong negative relationship between formula feeding and diarrhoea among children under 24 months old, which was statistically significant, $r_s = -0.1045$, p-value = 0.005. Although upon evaluating the relationship between maternal socioeconomic/sociodemographic factors and under-fives underweight (WAZ), the findings of this study revealed that there is no relationship between socioeconomic/sociodemographic factors and underweight among under-fives. However, when testing the relationship between socioeconomic/sociodemographic factors and stunting (HAZ) among under-fives, the results revealed that there is a strong negative relationship between maternal wealth household index and stunting, which was statistically significant, $r_s = -0.0727$, p-value = 0.0167. Similarly, the findings revealed that there is a negative relationship between formula feeding and stunting among under-fives, which was statistically significant, $r_s = -0.0854$, p-value = 0.0479. Equally, the results revealed that there is a negative relationship between diarrhoea and stunting among children under 24 months old, which was statistically significant, $r_s = -0.0566$, p-value = 0.0461. In addition, when assessing the bivariate

relationship between socioeconomic/sociodemographic factors and under-fives obesity, the correlation matrices employed in this study revealed that there was no statistical relationship between socioeconomic/sociodemographic factors and under-fives obesity. Therefore, as an immediate cause of maternal and child health, diseases have been postulated to be causes and consequences of malnutrition due to bioactive deficiency. As a result, these findings are consistent with the argument that diarrheal diseases and other common infections in children are associated with poor absorption or ability to retain nutrients in under-fives (Reinhardt & Fanzo, 2014). Similarly, a study also revealed that the risk of children being stunted increases with the occurrence of diarrhoea among under-fives (Checkley et al., 2008). Therefore, the findings of this study reiterate the argument that there is a link between increased diarrhoea incidence and increased risk of becoming stunted (Hackett et al., 2009). Likewise, other studies revealed that childhood infections have also been shown to impact on child nutritional status (Khulu & Ramroop, 2020; Janmohamed et al., 2020; Walters et al., 2019; Na et al., 2017; Slemming et al., 2017; Udoh & Amodu, 2016; Wolde et al., 2015; Bharati et al., 2011).

On the impact of maternal socioeconomic factors on childhood health outcomes, the bivariate analyses matrices used in this study suggested that there is a strong negative statistical relationship between low maternal wealth index and stunting (HAZ) among under-fives. This result is consistent with the argument that low maternal education and low maternal wealth index is associated with childhood nutritional status (Khulu & Ramroop, 2020; Janmohamed et al., 2020; Walters et al., 2019; Na et al., 2017; Slemming et al., 2017; Udoh & Amodu, 2016; Wolde et al., 2015; Bharati et al., 2011). This is further highlighting that childhood nutritional status are also by-product of poverty and development in developing countries (Nisbett et al., 2014). However, the bivariate analyses revealed that there is no statistical relationship between maternal wealth index and childhood malnutrition (WAZ) and obesity (BAZ). Therefore, based on the bivariate analyses of this study, there is a significant association between maternal socioeconomic factors on maternal and childhood nutritional and health outcomes.

4.4.2.2 Multivariate analyses

Multivariate analyses such as binomial and multiple logistics regression models were employed in this study to determine the significant factors associated with maternal and under-fives health.

A multiple logistics regression model was used to assess the factors associated with maternal BMI. The results in **Table 4.9** revealed that while controlling for others maternal socioeconomic/sociodemographic factors, maternal employment status, household wealth index and maternal age are positively associated with maternal BMI. Therefore, with the positive correlations indicated in this model between the dependent variable and (maternal employment status, household wealth index and maternal age) suggest that on average the values of each of the dependent variable is higher for mothers who are employed, high wealth index and older mothers in comparison to their counterparts. These findings support the findings in the bivariate analyses conducted herein, which suggested that the prevalence of obesity is higher among employed mothers, mothers with high wealth index and older mothers.

Table 4. 9: Logistics regression model to determine significant factors associated with maternal obesity

Factors	Coefficient	Robust Std. Error	95% Confidence Interval	
			Lower Bond	*Upper Bond*
Employment	1.1680**	0.4672	0.2514	2.0846
Place of residence	-0.3864	0.4242	-1.2186	0.4459
Wealth index	0.8814***	0.2643	0.3629	1.3999
Marital status	0.2452	0.2780	-0.3002	0.7906
Maternal age	1.2131***	0.1788	0.8624	1.5639
Children Ever Born	-0.4131	0.4154	-1.2282	0.4020
Constants	23.1129***	1.0963	20.9618	25.2640
F Statistics, df	*20.89, (6)*			
R-Square	*0.0957*			
Note: **p<0.05; **p<0.01; ***p>0.001*				

A binomial logistic regression was run to understand the relationship between formula feeding and malnourishment (underweight), stunting, obesity, diarrhoea and fever among under-fives in South Africa. The results revealed that formula feeding is statistically associated with stunting and diarrhoea among under-fives (p-value = <0.05), but revealed no statistical relationship between formula feeding and underweight, obesity and fever (p-value = >0.05). Therefore, based on the bivariate and multivariate analyses of this study, there is a significant difference between breastfeeding and formula feeding relative to child health.

Table 4. 10: Binomial logistics regression model to determine the relationship between formula feeding and child health

Factors	Coefficient	Standard Error	95% Confidence Interval	
			Lower Bond	*Upper Bond*
Malnourished (WAZ)	2.1842	1.2039	0.7415	6.4340
Stunting (HAZ)	0.5811*	0.1448	0.3565	0.9471
Obesity (BAZ)	1.1774	0.2394	0.7905	1.7538
Diarrhoea	2.4715***	0.6660	1.4574	4.1912
Fever	1.0799	0.2613	0.6720	1.7354
Constants	0.4849***	0.0678	0.3685	0.6380
LR Chi2, df	*17.01, (5)*			
Log Likelihood	*-312.8754*			
Pseudo R2	*0.0265*			
Note: **p<0.05; **p<0.01; ***p>0.001*				

Furthermore, multiple logistics regression models were used to assess the factors significantly associated with childhood nutritional status. **Table 4.11** shows the results of the models regressing for the factors significantly associated with childhood nutritional status. Here, model 1 measures the factors associated with WAZ, model 2 measures the factors associated with HAZ and model 3 measures the factors associated with BAZ. These three models in **Table 4.11** seeks to determine the factors significantly associated with childhood nutritional status in South Africa. Hence, the results in model 1 and 3 significantly associated the number of children ever born with underweight (WAZ) and lower body weight (BAZ). Here, the negative correlation coefficients in model 1 and 3 for parity suggest that on average the values of each of the dependent variables (WAZ and BAZ) are lower for respondents with lower parity compared to those with higher parity. These findings are indicative of the causal link between maternal degenerative effects and high BMI or a dual effect of high maternal parity and degenerative effects relative to high maternal BMI and how this directly impact on childhood nutritional status. The main argument here is that because women usually gain more fat during pregnancy (Zhou & Xiao, 2018; Chu et al., 2016), if unchecked after delivery, this could result to accumulating more fats during subsequent pregnancies, thus, potentially impacting on childhood overweight and/or obesity. If so, these results are consistent with the findings of this study which already established a relationship between maternal BMI and childhood nutritional status.

Furthermore, the results in model 1 and 2 associate maternal BMI and WAZ as well as BAZ. Hence, the positive correlation coefficient in model 1 and 2 for maternal BMI suggest that the values of each of the dependent variables (WAZ and HAZ) are higher for respondents with higher BMI compared to those with lower BMI. In other words, it is an indication that higher maternal BMI results to higher weight-for-age as well as higher height-for-age among under-fives. Thus, the results from this study present a direct evaluation of the association between maternal anthropometrics characteristics and childhood nutritional status. In it, it revealed strong positive relationship of maternal and child nutritional status. Mothers of low BMI had children with lower weight and mothers with central obesity had taller children. Therefore, based on the bivariate and multivariate analyses of this study, there is a significant association between maternal BMI and childhood nutritional status.

Table 4. 11: Logistics regression model to determine significant factors associated with childhood nutritional status

FACTORS	**MODEL 1** WAZ		**MODEL 2** HAZ		**MODEL 3** BAZ	
	Coefficient	*Robust S.E.*	*Coefficient*	*Robust S.E.*	*Coefficient*	*Robust S.E.*
Wealth Index	0.089	0.106	-0.120	0.209	-0.063	0.143
Children Ever Born	-0.220***	0.080	0.093	0.192	-0.359***	0.105
Maternal BMI	0.139***	0.052	0.245*	0.128	0.057	0.072
Birthweight	0.036	0.078	0.005	0.173	-0.001	0.104
Minimum diets	-0.066	0.357	-0.903	0.915	0.555	0.775

Maternal Age	0.080*	0.036	0.005	0.083	0.017	0.090
Constant	-0.372	0.269	-0.978	1.012	1.205***	0.347
F Statistics, df	*4.51, (6)*		*1.77, (6)*		*3.16, (6)*	
R-Square	*0.0195*		*0.023*		*0.0141*	
Note: **p<0.05; **p<0.01; ***p>0.001*						

4.5 CHAPTER SUMMARY

This chapter presents and discusses the research findings based on the research objectives of the study. By focusing on the study objectives, the researcher descriptively and inferential compute the impact of maternal socioeconomic factors on both maternal and childhood nutritional and health outcomes in South Africa. This study showed that overall, 38.52% of the under-fives were overweight or obese, 22.70% were stunted or severely stunted and 5.19% were underweight or severely underweight. These results indicate that there is considerable variability in the nutritional status of children across different parts of the country relative to maternal socioeconomic factors such that national averages may not clearly depict what really occur at community and household levels. Therefore, the findings presented in this study suggests that obesity and other maternal- and child-related nutritional and health issues is a consequence of the complex relationship among many factors including environmental (such as dietary intake), genetic (the link between maternal BMI and childhood nutritional status), and socioeconomic/sociodemographic factors (such as maternal age, parity, household wealth index, education, employment, etc) which eventually result in energy imbalance that either directly or indirectly impact on both maternal and childhood nutritional and health outcomes in South Africa.

Poor infant and young child feeding practices, on the other hand, is caused by low or poor maternal household wealth index working synergistically with other factors such as urbanity, employment and education. Here, the rural-urban differences in this study still point to the socioeconomic and environmental inequalities between rural and urban residents. Therefore, this study showed that child under-nutrition remains a serious public health issues in South Africa from the results of maternal and childhood nutritional status among households in different parts of the country.

The next chapter presents the summary of the research, conclusions of the research major findings, and recommendations for interventions and future research.

CHAPTER FIVE

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

5.1 INTRODUCTION

Since the previous chapter of this study analysed and discussed the research results, this chapter present the summary of the findings, conclusions and recommendation on the data analysed in the previous chapter. The conclusions are based on the research's major findings and the literature review. The last section presents the summary to the chapter. Here, the impact of maternal socioeconomic factors on acceptable diets of children under-five years old in South Africa was researched by determining to what degree some of the maternal socioeconomic factors impacts on both maternal and childhood nutrition and health.

5.2 SUMMARY OF THE RESEARCH

The overriding purpose of this study was to determine the impact of maternal socioeconomic and/or sociodemographic factors on nutrition and anthropometric outcomes of mothers and children in South Africa. To accomplish that goal the researcher deemed it necessary to reach some prerequisite goals. Determining what maternal sociodemographic factors and childhood nutrition means and how these ideals are associated with both maternal and childhood nutritional and health outcomes. This assumed a high degree of importance during the literature review conducted for this research. In relation to that effort, it became essential to reach an understanding about the nature and concept of maternal and childhood nutrition and health. Thus, to provide for the possibility that maternal socioeconomic and/or sociodemographic factors could be perceived and measured as a viable component of these constructs, it was deemed important by the researcher to develop a theoretical model with the potential for encompassing the totality of the factors associate with both maternal and childhood nutritional and health outcomes. Hence, both the background and the introduction of the study in chapter one, and as well as the literature review in chapter two were done by studying the literature on the phenomenon both internationally and nationally. After these fundamental steps were achieved to a certain degree, this research was able to go forward. Therefore, using under-five children's anthropometric indicators (based on nutritional indicators), this study explored and studied new-born and childhood nutritional and health outcomes in the country. In it, the study also unravelled how maternal sociodemographic factors impacts on both maternal and childhood nutritional and health outcomes in the country.

The study was an exploratory, descriptive and quantitative study. Thus, the researcher adopted a non-experimental quantitative research approach for extracting the required data for this study. Using an explanatory research approach also allowed the researcher to provide an in-depth evaluation, investigation, understanding and insight analysis about the current state of maternal and under-fives health in relation to nutrition in South Africa. This was significant toward achieving the research objectives. Therefore, the chosen research approach was appropriate because it allowed the researcher to compare and establish the degree to which the findings from this study are similar or dissimilar with other findings (Kumar, 2014; Engel & Schutt, 2013; Creswell, 2013; Tolmie et al., 2011; McMillan & Schumacher, 2010; Burns & Grove, 1993).

Even though data collection is a systematic and precise gathering of information that are deem necessary and specific for research purposes (Grove et al., 2013), this study used a secondary data to answer the research questions. Therefore, because of its significance to the primary goal of this study and how it fit well with the methodology of this study, the researcher used the 2016 South African Demographic Health Survey (SA-DHS) dataset to achieve the objectives of this study. The 2016 SA-DHS used questionnaires for each household to collect data pertaining to women aged 15-49 years old and their children aged 0-59 months old. These target population were central to achieving this study's aim and objectives. Thus, five questionnaires were used to obtain relevant data for this researcher: the household questionnaire, the individual man's questionnaire, the individual woman's questionnaire, the caregiver's questionnaire, and the biomarker questionnaire. Therefore, through the use of the 2016 SA-DHS dataset for this study, data were extracted, cleaned and analysed to address the research problems posed in chapter one. The results of this study are therefore presented and discussed relative to the reviewed literatures as seen in chapter four of this study.

5.3 CONCLUSIONS

The conclusions section presents a bird-view of the results from the quantitative study that assessed the influence of maternal socioeconomic and/or sociodemographic factors on both maternal and childhood nutrition and health in South Africa. These conclusions are presented based on the literature review and the research's major findings. The conclusions on the research major findings are presented according to the research objectives.

5.3.1 Conclusion on the Literature Review

An ample body of scientific evidence exists, documenting the factors that impacts on both maternal and child nutritional intake and morbidity. Many studies highlighted that inadequate support for infant and young child feeding (IYCF) is associated with inappropriate feeding practices globally (Barir et al., 2019; Zhang et al., 2018; Slemming et al., 2017; Rollins et al. 2016; UNICEF, 2010). These and many other studies suggest that early undernutrition and micronutrient deficiencies are associated with impairment of intellectual performance, overall health and nutritional status, and work capacity during adolescence and adulthood. Consequently, studies conducted in South Africa and other developing countries associated the rising incidences of overweight and obesity in children with malnutrition during infancy and childhood feeding practices (Campbell, 2018; Redsell et al., 2016; Black et al., 2013; Popkin et al., 2012; Rossouw et al., 2012; WHO, 2009). In addition, Gibbs and Forste (2013), furthers argues that early childhood excessive weight gain is associated with health complications and early morbidity. These findings suggest that there is a need for raising awareness on appropriate IYCF practices to provide quality counselling and adequate support to mothers and children. More so, even though factors affecting childhood nutritional status are complex, infant feeding and early complementary diet are primary contributing factors of childhood underweight, overweight and obesity (Walters et al., 2019; Udoh & Amodu, 2016). In general, many studies associated increased household wealth index or high maternal socioeconomic factors with meeting minimum meal frequency, minimum dietary diversity, and minimum acceptable diets in developing countries (Janmohamed et al., 2020; Walters et al., 2019; Ickes et al., 2018; Slemming et al., 2017; Udoh & Amodu, 2016; Sarki et al., 2016). While low maternal socioeconomic status was associated with low probability of meeting the minimum meal frequency, minimum dietary diversity, and minimum acceptable diet – resulting to malnutrition and health implications (Khulu & Ramroop, 2020; Janmohamed et al., 2020; Walters et al.,

2019; Na et al., 2017; Slemming et al., 2017; Udoh & Amodu, 2016; Keane et al., 2012; Kendzor et al., 2012; Gregori et al., 2012; Fiese et al., 2012).

In the social determinants of maternal and childhood nutrition and health, three (3) themes including income inequality and poverty, maternal socioeconomic status, and food poverty were identified and employed by the researcher to understand how they influence maternal and childhood nutritional and health outcomes. Thus, from the literature review, there seems to be a consensus that there is a link between maternal socioeconomic factors and both maternal and childhood nutrition and health. For example, several studies have associated maternal socioeconomic status with both maternal and childhood nutrition and health in developing countries (Khulu & Ramroop, 2020; Janmohamed et al., 2020; Walters et al., 2019; Na et al., 2017; Slemming et al., 2017; Udoh & Amodu, 2016; Wolde et al., 2015; Keane et al., 2012; Kendzor et al., 2012; Gregori et al., 2012; Fiese et al., 2012; Bharati et al., 2011; Baum, 2008; Fujii, 2005). Here, maternal lower education is identified as one of the socioeconomic factors that negatively influence childhood nutrition and health (Folayan et al., 2020; Santos Jr et al., 2019; Alosaimi et al., 2019; Dimbuene et al., 2018; Ngoma & Mayimbo, 2017; Alosaimi et al., 2016; Osamor & Grady, 2016; Sepehri & Guliani, 2015; Yu et al., 2014; Urke et al., 2011). Other studies have also demonstrated a positive link between maternal employment and the bodyweight of their children (Chia, 2008; Ruhm, 2008; Courtemanche, 2007; Cawley & Liu, 2007; Phipps et al., 2006; Liu et al., 2005). However, other studies suggested that there is no significant link between maternal employment status and both maternal and childhood overweight and/or obesity (Debela et al., 2020; Rashad & Sharaf, 2019; Oddo et al., 2017; Nie & Sousa-Poza, 2014). With that being said, the link between maternal socioeconomic factors on both maternal and childhood nutritional status varies from region to region, with inconsistent findings. This does not disregard the fact that maternal and child nutrition and health in developing countries is in part determined by social factors that include income inequality and poverty (including economic development, politics/policies, political instability), food insecurity, maternal socioeconomic status (including gender inequality, education, occupation, marital status), and parasitic and infectious diseases.

In addition, studies conducted in developing countries revealed that household food insecurity is significantly associated with childhood nutrition and health (Chakona & Shackleton, 2018; Schmeer & Piperata, 2017; Betebo et al., 2017; Abdurahman et al., 2016; FAO, 2015; Mandal et al., 2014; Black et al., 2013; Saaka & Osman, 2013; Ali et al., 2013; Nti, 2011; Kuku et al., 2011). For example, a study conducted in South Africa revealed that household food insecurity was accountable for malnutrition in 35% of children and 18% of children in a sample of 216 children were reported wasted between the ages of 2-5 years old (Chakona & Shackleton, 2018). Other scholars argues that even mild household food insecurity is determined to be detrimental to children's health (Schmeer & Piperata, 2017). Hence, for decades now, many studies have highlighted some key elements that make up a sustainable food system which are directly link to food security, such as maternal education, maternal employment, or livelihoods, income, market prices, gender dynamics, dietary diversity, and household and individual practices (Muluye et al., 2020; Humphrey et al., 2019; Pinstrup-Andersen, 2013; Paul et al., 2011; UNICEF, 1990, 1998; Barrera, 1990; Glewwe, 1999; Behrman & Wolfe, 1987). In other words, these studies and many others cited in chapter 2 are highlighting that healthy nutrition is central to maternal and child physical and social (mental) health outcomes. This is an indication that nutrition is both an important environmental and social factor that influences both maternal and child health. It is a phenomenon that is very much common in both developed and developing countries, except that it may varies in context and in content. Therefore, these existing body of knowledge highlighted that nutrition is fundamental to

defining the health of all people, infants and children, young and old, women and men, and rich and poor. Thus, reducing barriers to food security and addressing social determinants of health is important to promoting quality maternal and child nutrition and health.

Beyond maternal socioeconomic factors and IYCF practices, epigenetic processes and/or perinatal programming are associated with both maternal and childhood nutritional and health outcomes. As a result, foetal-maternal interaction has been shown to be important to maternal and child health outcomes. It is equally important in assessing and analysing the causes of maternal and childhood nutritional and health outcomes and in planning effective programs and actions to improve maternal and child health (Espinoza, 2016; Fowden et al., 2012; Pijnenborg et al., 2008; Constancia et al., 2002; Haig, 1993). For example, several studies on maternal nutrition and obesity development associated maternal nutritional status and early transmission of obesity in children (Li, 2018; Parlee & MacDougald, 2014; Apovian, 2013; Wadhwa et al., 2009; Mühlhäusler et al., 2008; Hales, 2001; Astrup & Finer, 2000). These and many studies cited in chapter 2 revealed that obesity in children has a strong inherited tendency and the development of obesity in adult life is significantly influenced by foetal exposure to environmental markers such as maternal dietary intakes. Here, Parlee and MacDougald (2014) further elaborate that the connection between maternal nutritional status and early transmission of obesity depend on its qualitative factors (e.g. certain bioactive diets with epigenetic regulatory features) and its quantitative factors (e.g. under- and over-nutrition aspects). This is a clear indication that nutrition is one of the most important environmental and/or biological factors that influences both maternal and child nutritional and health outcomes. It also provides further evidence for the perinatal programming of obesity and highlights the impact of early life factors in the development of long-term obesity. Therefore, since epigenetics processes often occur during the early stages of development (Li, 2002; Santos et al., 2002), early nutritional exposure during this fundamental stage can altered epigenetic changes during developmental programming (Lee, 2015; Li et al., 2014). Therefore, the arguments presented thus far highlights that obesity and other maternal- and child-related nutritional and health issues is a consequence of the complex relationship among many factors including environmental, genetic, socioeconomic, physiological, and behavioural factors that eventual result in energy imbalance with negative health implications. As a result, studies have associated maternal nutritional status with birthweights and/or genetic predisposition of early transmission of obesity among children (Ojha & Symonds, 2020; Li, 2018; Santoni et al., 2017; Moore et al., 2015; Parlee & MacDougald, 2014; Apovian, 2013; Gill et al., 2013; Mühlhäusler et al., 2008; Astrup & Finer, 2000). This called for a feasible maternal diet model as a prevention measure for maternal and child nutritional outcomes and morbidities. Hence, good nutrition is a prerequisite for good health (Hasan et al., 2011). Therefore, the close interrelationship between the causes of maternal and childhood nutritional and health outcomes entails that interventions addressing maternal and child health issues should ideally consider the multiple layers of causes by intervening across the multiple sectors.

5.3.2 Conclusions on the Research's Major Findings

5.3.2.1 Under-fives minimum acceptable diets

The findings of this study estimated that most of the respondents (71.30%) reported that their children were not currently breastfeeding at the time of data collection relative to the 28.70% of those who were breastfeeding their children. Of those children being breastfed, the results from this study found that most of them where within the ages of 0-5 months (80.50% vs 19.50%) and 6-11months (56.54% vs 43.36%). However, the results revealed a huge declined

in breastfeeding among children age 12 months and above, with percentages ranging between 65.99 to 89.60%. In summary, the results revealed that most of the respondents 56.17% reported feeding their children for at least ≥6 months relative to the 26.68%. On formula feeding, the results estimated that 65.79% of the respondents do not engaged in formula feeding compared to the 33.66% who engaged in formula feeding. Furthermore, the results revealed that formula feeding was strongly associated with employed mothers, urban women, women with higher years of education and women with high wealth index. On wealth index, the results further revealed that women within the bracket of rich wealth index have higher rates of engaging in formula feeding.

In this study, six (6) food groups (Liquid Food, Solid/Semisolid Foods, Oil & Fat Foods, Junk Foods, Protein Foods, and Fruits & Vegetable Foods index) were used to evaluate under-fives food diversity. In it, the results found that 58.21% have high liquid food index, while 37.10% met the minimum liquid food diversity. In general, the results revealed that 95.31% of the respondents met the minimum diversity score for liquid food compared to the 4.69% of those who did not. On solid/semisolid food diversity index, the results found that most of the respondents 55.59% have poor diversity score relative to the 44.41% of the respondents who met the minimum food diversity for solid/semisolid food. This is suggesting that on average, most under-five children in South Africa are not substantially fed with solid/semisolid foods – an indication of nutritional deficiency among under-five children. Here, the results further revealed that there is a statistical link between household wealth index and meeting minimum food diversity for solid/semisolid foods – indicating that children from "rich" households are more likely to be fed with solid/semisolid foods than their counterparts. More so, the results found that most of the respondents (57.38%) have poor minimum diversity for oil/fat foods compared to the 42.62% who met the minimum diversity for oil/fat foods. This is suggesting that most children in the country suffer from oil/fat foods deficiency. In addition, the results on minimum diversity for fruits/vegetables food revealed that most of the respondents (78.90%) have poor fruits/vegetables food index relative to the 21.10% who met the minimum diversity for fruits/vegetables food. This is an indication that most under-five children in South Africa suffer from low intake of fruits and/or vegetables. Again, the results revealed that there is a statistical association between households' wealth index and the rate of fruits and/or vegetables intake among under-five children – suggesting that children from rich households have 15.71% high rate of been fed with fruits and/or vegetables than their counterparts. Concerning protein food index, the descriptive computation of this study estimated that more than half (52.83%) of the respondents have high quality protein index compared to the 47.17% of the respondents with poor quality index. On meeting the minimum diversity for junk food index, most of the respondents (84.24%) met the minimum diversity score compared to the 15.86% who did not.

In summary, the results revealed that most of the respondents (67.59%) met the minimum complementary feeding index relative to the 5.52% and 26.90% who have high and poor complementary feeding index. In addition, relative to household wealth index, the descriptive statistics results revealed that "rich" households have higher rates of having high quality complementary feeding index as compared to their counterparts. This is an indication that children from rich households are more likely to be fed with high quality complementary foods relative to those from middle and poor households, with about 11.52% rate. Therefore, these results on under-fives minimum acceptable diets are consistent with the arguments that low socioeconomic households and/or low maternal socioeconomic status were associated with lower rate of meeting the minimum meal frequency, minimum dietary diversity, and minimum acceptable diet (Khulu & Ramroop, 2020; Janmohamed et al., 2020; Walters et al., 2019; Na et al., 2017; Slemming et al., 2017; Udoh & Amodu, 2016; Keane et al., 2012; Kendzor et al.,

2012; Gregori et al., 2012; Fiese et al., 2012). Thereby indicating that food insecurity is one of the most significant social factors contributing to maternal and childhood nutrition and health in South Africa.

5.3.2.2 The impact of maternal sociodemographic factors on minimum acceptable diets

On complementary feeding practice (minimum acceptable diets), a bivariate analysis of the predictors of the average minimum dietary diversity scores was computed. The bivariate analyses results revealed that there is a statistical association between minimum acceptable diets and maternal socioeconomic factors (education, employment status, marital status, place of residence, and household wealth index), with p-values of <0.05. The results revealed that there is a relationship between breastfeeding and maternal level of education and employment. Indicating that mothers with higher level of education and employed mothers are less likely to breastfeed their children as compare to their counterparts – with p-values of 0.000). The results also revealed that there is a statistical association between duration of breastfeeding and maternal education, employment, and place of residence – with p-values of >0.05. In other words, women with no or lower education levels, unemployed and rural mothers were more likely to breastfeed their children for at least ≥6 months compared to their counterparts. In addition, maternal wealth index was statistically associated with duration of breastfeeding. Indicating that women with lower wealth index (poor wealth status) are 63.77% more likely to breastfeed for at least ≥6 relative to middle class women (56.35%) and high-class women (43.80%) where (X^2 = 39.11; p-value = 0.000). Likewise, while controlling for other variables, the results from the logistic regression model show that there is a significant association between maternal education, household wealth index, child age, maternal age, and duration of breastfeeding. Thus, these findings are consistent with several findings which associated maternal employment and higher maternal wealth index with formula feeding or lower rate of breastfeeding (Rivera-Pasquel et al., 2015; Cawley & Liu, 2012; Fertig et al., 2009; Bernal, 2008; Waldfogel, 2002). Although this also raises questions about the risk associated with infants who were predominantly engaged in formula feeding from 0-6 months of age and having higher BMI as children (Gibbs & Forste, 2013; Beyerlein & von Kries, 2011).

The results of this study also associate formula feeding with maternal employment status (X^2 = 13.05; p-value = 0.000), level of education (X^2 = 16.74; p-value = 0.001), place of residence (X^2 = 6.33; p-value = 0.042), and household wealth index (X^2 = 20.82; p-value = 0.000). It says here that mothers who are employed, has higher educational levels, and comes from high wealth index households were 46.67%, 40.00%, and 46.60% more likely to practice formula feeding as compared to their counterparts – respectively. Interestingly, these results revealed that the prevalence of formula feeding simultaneously increases with households' wealth index – indicating that the poorer a mother is the less likely to practice formula feeding while the wealthier a mother is the more likely to practice formula feeding. Similarly, after controlling for other variables, the results show that there is a linear relationship between formula feeding and employed and high wealth index mothers – with p-values of <0.05. Furthermore, using the household wealth index as a proxy indicator for maternal socioeconomic status of households, the results statistically associate maternal socioeconomic status and complementary feeding practice – where (X^2 = 23.56; p-value = 0.000). The results suggested that high wealth index households are more likely to meet the minimum acceptable dietary diversity relative to those with low wealth index. Similarly, after controlling for confounders, the results from the logistic regression negatively associate minimum acceptable diets with maternal education and household wealth index. Indicating lower or no education and lower wealth index were associated with not meeting the minimum acceptable diets of under-fives. These findings are

consistent with the findings of several studies conducted in developing countries which associated maternal socioeconomic factors with meeting the minimum acceptable diets (Janmohamed et al., 2020; Walters et al., 2019; Ickes et al., 2018; Slemming et al., 2017; Sarki et al., 2016). Therefore, the findings of this study echo the findings of the studies that demonstrated the negative association between breastfeeding and socioeconomic status, as well as other potentially complex factors that can influence childhood obesity (Li, 2018; Parlee & MacDougald, 2014; Apovian, 2013; Gibbs & Forste, 2013; Wijlaars et al., 2011). More so, studies conducted in developing economies also associated maternal poor living conditions, low maternal education, and poor household food security with malnutrition among children (Chakona & Shackleton, 2018; Schmeer & Piperata, 2017; Singh et al., 2009), which directly affect their nutritional status (Khulu & Ramroop, 2020; Janmohamed et al., 2020; Walters et al., 2019; Na et al., 2017; Slemming et al., 2017; Udoh & Amodu, 2016; Wolde et al., 2015; Bharati et al., 2011).

Therefore, the results from the *under-fives minimum acceptable diets* and the *impact of maternal sociodemographic factors on minimum acceptable diets* validate the theoretical model underpinning this study in the context of basic/structural and underlying causes of both maternal and childhood nutrition and health. For example, the structural causes of maternal and child nutrition and health outcomes argued that to ameliorate maternal and childhood malnutrition, promote healthy living, curb infectious diseases, and improve hygiene practices can partly be achieved only when the social context through which women and girls live-in respects their human rights (Black et al., 2020; Reinhardt & Fanzo, 2014; McCarthy & Maine, 1992; UNICEF, 1990). Providing a supportive social system that promote the human rights of women and girls is therefore crucial to reducing maternal and childhood malnutrition and morbidity. Thus, as argued by many scholars, the distribution of income within a society or country is the first important consideration of ensuring household food and social security (Barlow et al., 2020; Chavas, 2017; Poulsen et al., 2015; Kotagama et al., 2014; Akter & Basher, 2014; Haddah, 1992). In addition to structural causes of maternal and child nutrition and health at a societal level, scholars also argued that underlying causes plays significant role on both maternal and childhood nutrition and health at household and/or community levels. As demonstrated in this study, the underlying causes are described as the consequence of basic causes of both maternal and childhood nutrition. Thus, scholars have argued that underlying causes found at household and community levels, influences the ability of a household and/or community to obtain proper nutrition (Martorell & Young, 2012; Paul et al., 2011; Hackett et al., 2009; Hillbruner & Egan, 2008). Here, at the household and/or community levels, food poverty is considered as one of the underlying causes of maternal and childhood malnutrition. As a result, food insecurity at the household and/or community levels as one of the underlying causes of maternal and childhood malnutrition manifest itself on household economy and contextual determinants of how food is produced, used and consumed. Therefore, the results of this study called for preventive measures (such as improving household wealth through economic development, promoting the education and employment of women) to promote food security at individual and household levels. This will significantly reduce the prevalence of maternal and child malnutrition in South Africa.

5.3.2.2 The impact of maternal sociodemographic factors on both maternal and childhood nutritional and health outcomes

On maternal BMI, the results found that the average BMI for the sample was 28.06 kg/m^2 and a standard deviation of 6.76 kg/m^2. It further says here that only 2.49% of the mothers fell under the underweight category, while most of the mothers (63.60%) were either overweight

(29.85%) or obese (33.75%). Only one third (33.91%) of the sample were regarded as having normal weight. Furthermore, in relation to maternal socioeconomic status, the results also found that mothers from rich households in South Africa have 44.62% rate of becoming obese as compared to their counterparts. With more than 50% of the women from rich households living in urban areas, the descriptive results also revealed that urban women have 37.63% rate of being obese than their counterparts. Similarly, the results further indicated that employed women have 41.72% rate of being obese relative to unemployed women. Therefore, the results from this study statistically associated maternal employment (X^2 = 18.18; p-value = 0.000), place of residence (X^2 = 9.55; p-value = 0.023), and household wealth index (X^2 = 33.19; p-value = 0.000) with maternal nutritional status in South Africa. Indicating that employed mothers, urban mothers and mothers who fell under high income households are associated with higher rates of obesity. In addition, the results of this study strongly associated maternal age (X^2 = 122.25; p-value = 0.000), number of children ever born (X^2 = 28.97; p-value = 0.000), and marital status (X^2 = 31.59; p-value = 0.000) with maternal BMI. Indicating that the rate of obesity is higher among older women (aged 25+), women with high parities (≥3 children), and among widows and married/cohabitating women. These results are very alarming, since maternal obesity poses significant risks to women and their offspring. Here, several studies have associated higher risk of childhood obesity with maternal obesity (Li, 2018; Parlee & MacDougald, 2014; Apovian, 2013; Astrup & Finer, 2000). Therefore, the results on maternal overweight and obesity raises questions about the impact of maternal nutritional status on childhood short- and long-term nutritional and health outcomes in South Africa.

On under-fives nutritional status, the results revealed that the average birthweight of the sample was 3.07kg and a standard deviation of 0.67kg. Consequently, just above three fifths (61.11%) of the sample were born with normal birthweights, while 24.70% and 14.19% were born with high birthweights and low birthweights, respectively. The results further found that childhood birthweights are significantly associated with maternal BMI or nutritional status (X^2 = 27.89; p-value = 0.000). It says here that the rate of high birthweights simultaneously increases relative to maternal BMI – suggesting that the prevalence of high birthweights is higher among obese women (31.40%) relative to their counterparts. Interestingly, the results also revealed that the rate of low birthweights is higher among underweight women (37.04%) relative to their counterparts. Hence, these results revealed that the higher the maternal BMI the higher the rates of high birthweight, whereas the lower the maternal BMI the higher the rate of low birthweight. Of the 1460 households that were enrolled, 89.34% of the under-five children had normal weight-for-age (WAZ), while only 5.20% of the children were either severely underweight or underweight (WAZ). However, the results also indicated that about 5.46% of the children were overweight (WAZ). Regarding height-for-age Z scores (HAZ), 73.18% of the children had normal height-for-age, 15.66% were stunted, 7.04% were severely stunted, and 4.13% were tall. On weight-for-age Z Scores (BAZ), 58.31% of the children had normal weight-for-age, 22.43% were overweight, 16.09% were obese, and 3.17% were underweight. The results further found that the level of malnutrition among under-five children were higher among unemployed mothers than employed mothers as follows: severe stunting (77.50% vs 22.50%), being underweight by WAZ (80.00% vs 20.00%), and obesity by BAZ (72.68% vs 27.32%) for unemployed and employed mothers respectively. However, except for severe stunting, the prevalence of malnutrition among under-five children were higher in urban areas than rural areas as follows: underweight by WAZ (57.14% vs 42.86%), severe stunting (48.75% vs 51.25%), and obesity by BAZ (56.28% vs 43.72%) for urban and rural areas children respectively.

Furthermore, the analysis of variance further suggested that there is no significance difference between maternal BMI variances and under-fives BAZ variances, (F= 0.80; p-value = 0.494). These findings are significantly consistent with several studies that associated maternal BMI with birthweight and/or childhood overweight or obesity. For example, several studies on maternal nutrition and obesity associated maternal nutritional status and early transmission of obesity in infants (Li, 2018; Parlee & MacDougald, 2014; Apovian, 2013; Astrup & Finer, 2000). These studies further adds that obesity in children has a strong inherited tendency and the development of obesity in adult life is significantly associated by foetal exposure to environmental markers such as maternal dietary intakes (Li, 2018; Parlee & MacDougald, 2014; Apovian, 2013; Mühlhäusler et al., 2008; Astrup & Finer, 2000). Other studies also associated maternal nutritional status with birthweights and/or genetic predisposition of early transmission of obesity among children (Ojha & Symonds, 2020; Li, 2018; Santoni et al., 2017; Moore et al., 2015; Parlee & MacDougald, 2014; Apovian, 2013; Gill et al., 2013; Mühlhäusler et al., 2008; Astrup & Finer, 2000). Therefore, the findings from this study highlights that quality maternal and childhood nutrition (especially maternal nutrition during and after pregnancy) is a prerequisite for good health outcomes in mothers and their children (Hasan et al., 2011). Without doubt, this is also an indication that nutrition is a key environmental factor in South Africa, which influences both maternal and childhood nutritional and health outcomes. Therefore, this called for a concerted and/or customized maternal diet model(s) in the country as a prevention measure for maternal and child nutritional outcomes and morbidities. The results of this study highlights that the profits of good nutrition rotate across generations – from the livelihoods of communities to the development goals of the nation.

On the impact of maternal sociodemographic factors on childhood nutritional and health outcomes, the bivariate analyses negatively associated low maternal wealth index and stunting (HAZ) among under-fives. This result is consistent with the argument that low maternal education and low maternal wealth index is associated with childhood nutritional status (Khulu & Ramroop, 2020; Janmohamed et al., 2020; Walters et al., 2019; Na et al., 2017; Slemming et al., 2017; Udoh & Amodu, 2016; Wolde et al., 2015; Bharati et al., 2011). This is further highlighting that childhood nutritional status are also by-product of poverty and development in developing countries (Nisbett et al., 2014).

As noted throughout this study, there is a need for clear understanding of given measures, concepts, and risk factors in the area of maternal and child nutrition and health in South Africa. This is simply because perinatal and genetic health also serves as indicators of overall public health both in developed and developing nations. Therefore, infrastructures, economic development, community, and clinical focus are required to address continued disparities and inequalities that exist around maternal and childhood nutrition and health in the country. Furthermore, the results on *the impact of maternal sociodemographic factors on both maternal and child nutritional and health outcomes* also validate the theoretical model for this researcher in the context of structural, underlying causes, epigenetics processes and/or perinatal programming, and direct causes of both maternal and childhood nutrition and health. For example, the increasing obesity recorded in this study may be partly explained by socioeconomic factors and/or environmental (biological) factors – especially malnutrition and maternal obesity before, during, and after delivery. Either way, the timing and intensity of these events play significant role in the perinatal programming of obesity mothers and their children. Therefore, various maternal sociodemographic and/or environmental factors (such as maternal

nutritional intake and BMI) with opposing effects, such as undernutrition and over nutrition during the perinatal period end in similar outcomes in children. The results from this study are highlighting that beyond structural and underlying causes of maternal and childhood nutritional and health outcomes, epigenetic processes and/or (perinatal programming) play an important role in studying both maternal and child health outcomes in South Africa. This entails that the foetal-maternal interaction is vital to assessing and analysing the causes of maternal and child nutrition and health and in planning effective programs and actions to improve maternal and child health in the country. Because epigenetics processes often occur during perinatal programming (Li, 2002; Santos et al., 2002), early nutritional exposure during this fundamental stage can alter epigenetic modification processes during developmental programming (Lee, 2015; Li et al., 2014). Thereby, influencing maternal and childhood nutritional and health outcomes (Lee, 2015; Li et al., 2014; Gluckman et al., 2008; Singhal & Lucas, 2004). Therefore, in relation to the theoretical framework, the arguments presented in this study revealed that obesity and other maternal- and child-related nutritional and health issues is a consequence of the complex relationship among many factors including environmental, genetic, socioeconomic, physiological and behavioural factors which eventual impact on maternal and childhood nutritional and health outcomes in South Africa.

The evidence from this study also indicate that nutrition is one of the most important environmental factors that impacts on maternal and child nutritional and health outcomes. Hence, a better understanding of the biological mechanism of maternal and child nutrition and health is required to help identify modifiable determinants of obesity, stunting, and underweight as well as other health outcomes that could result from maternal and child nutrition. These determinants can be use in future research to develop intervention strategies during pregnancy and early postnatal period to prevent maternal- and child-related nutritional and health issues and metabolic disorders in adulthood. Because perinatal programming of maternal and child nutritional outcomes is a complex pathway, the interventions to tackle them should take into account the complexity of these issues. This is significantly important in developing countries where undernutrition and growth stunting are still very common.

5.4 RECOMMENDATIONS

The following recommendations are offered for interventions and further research in the field of maternal and childhood nutrition and health:

- The results from this study express the need for comprehensive research and longitudinal studies of mothers from at least early pregnancy to extended postpartum period to understand how maternal nutrition and health change and thereby influencing childhood nutrition and health. In relation to interventions, women require continuity of care to ensure adequate complementary feeding practices.
- To understand the connection between nutrition and sociodemographic determinants among mothers and their children in South Africa, social policies beneficial to maternal and child nutrition promotion need to be taken urgently. The important social policies suggested by the researcher include improving household economic conditions in the country, balancing economic development and wealth (resource) distribution, and focusing on maternal and child dietary intake.

- As noted throughout this study, maternal education and employment is not a supportive and enabling factor for most women who want to breastfeed. Thus, the promotion of breastfeeding should be a collective social responsibility in South Africa. Unfortunately, the formula feeding industry is large and growing, and its marketing undermines the effort to improve breastfeeding. Hence, political support and financial investment are required in the country to promote, protect and support breastfeeding to achieve its advantages to children, women, and the society. Therefore, instead of advertising breastmilk substitutes on the media, breastfeeding should be a focal point on the media as a way of promoting healthy society.
- As maternal malnutrition has intergenerational effects, the nutrition of young girls must be addressed very early in life. In other words, special emphasis must be place on improving the nutrition of young girls who are approaching reproductive roles. Already, studies have revealed that girls who happen to survive this great ordeal of maternal poor nutritional intake are more likely to remain underdeveloped as children and all through their adulthood, thus, transfer their poor nutritional status to their offspring (Smith & Haddad, 2015; Harris, 2014; Black et al., 2013; UNSCN, 2010). More so, supplementary and/or therapeutic feeding programmes for pregnant and lactating women with high risk of maternal malnutrition should be studied and implemented. Similarly, maternal nutrition education should be a strong component of antenatal and postnatal care in South Africa. Emphases should be made on dietary diversification, the use of fortified foods, organic-source foods, and the use of therapeutic supplements to improve the quality of diet for mothers and their children.

5.5 CHAPTER SUMMARY

This chapter provided a summary of this research. The chapter also presented the conclusions of the research major findings. Thereafter, the conclusions were followed by the research recommendations for interventions and future research. This chapter ended with this summary to the chapter.

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APPENDIX 1: ETHICAL CLEARANCE LETTER

UNIVERSITY OF
KWAZULU-NATAL
INYUVESI
YAKWAZULU-NATALI

17 December 2020

Mr Benjamin Aye Simon (216065924)
School Of Built Env & Dev Stud
Howard College

Dear Mr Simon,

Protocol reference number: HSSREC/00002247/2020
Project title: INVESTIGATING MATERNAL SOCIOECONOMIC FACTORS AND ACCEPTABLE DIET OF CHILDREN UNDER FIVE YEARS OLD IN SOUTH AFRICA
Degree: Masters

Approval Notification - Expedited Application

This letter serves to notify you that your application received on 11 November 2020 in connection with the above, was reviewed by the Humanities and Social Sciences Research Ethics Committee (HSSREC) and the protocol has been granted **FULL APPROVAL** on the following condition:

Any **alteration/s to the approved research protocol i.e. Questionnaire/Interview Schedule, Informed** Consent Form, Title of the Project, Location of the Study, **Research** Approach and Methods must be reviewed and **approved through the amendment/modification prior to its implementation. In case you have** further **queries,** please quote the above **reference** number. **PLEASE NOTE: Research** data should be securely stored in the discipline/department for a period of 5 years.

This approval is valid until 17 December 2021.
To ensure uninterrupted approval of this study beyond the approval expiry date, a progress report must be submitted to the Research Office on the appropriate form 2 - 3 months before the expiry date. A close-out report to be submitted when study is finished.

All research conducted during the COVID-19 period must adhere to the national and UKZN guidelines.

HSSREC is registered with the South African National Research Ethics Council (REC-040414-040).

Yours sincerely,

[redacted]

Professor Dipane Hlalele (Chair)

/dd

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