AN ANALYSIS OF MATERNAL AND CHILD NUTRITIONAL STATUS IN SOUTH AFRICA AND ITS IMPACT ON MATERNAL LABOUR SUPPLY

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DECLARATION

I declare that "An analysis of maternal and child nutritional status in South Africa and its impact on maternal labour supply" is my own work and has not been submitted for any degree or examination in any university. All the sources I used or quoted have been indicated and acknowledged by complete references.

Fru Awah Wanka

Signature: ---

ABSTRACT

The significance of malnutrition in public health has increasingly gained recognition in South Africa due to its negative effect on the quality of life, both at the individual and societal levels. The most vulnerable groups to suffer from malnutrition are pregnant and lactating women as well as children below 5 years of age. Given the importance of maternal and child health, this study is set out to assess the prevalence and trend of maternal and child malnutrition in South Africa. In addition to the health cost, there is also economic cost, resulting from malnutrition. Therefore, the association between malnutrition and labour force participation is of academic and policy interest due to the crucial role the labour force plays in stimulating economic growth. It is in this regard that this thesis is both timely and vital particularly with the limited literature on the relationship between mothers' and children's nutritional status, and mothers' labour force participation in South Africa.

To achieve the objectives, the study adopted a quantitative cross-sectional research approach using secondary data obtained from the National Income Dynamics Study (NIDS) collected in 2008, 2012, 2014/2015 and 2017, respectively. It is a rich and nationally representative panel survey dataset of South African households administered by the South African Labour and Development Research Unit (SALDRU). These data were used as cross-sectional data because the research involved assessing prevalence and trends at a given time. The study focused on children aged below 5 years and their mothers. In computing maternal and child malnutrition status, anthropometric measures were used, while for the labour force participation, the narrow definition was the main focus of analysis and the broad definition was used for robustness check. Descriptive analyses and econometric techniques were used for estimation. For maternal obesity regression, the data could not reject the exogeneity of obesity. As such, single equations (univariate probit and linear probability models) were estimated. Meanwhile, for the child regression, the instruments used were valid and not weak, resulting in the validity of the use of bivariate probit and two-stage least square (2SLS) models.

The analyses conducted revealed that at a 95% confidence interval, there was no statistically significant change in the rate of maternal underweight and overweight across the periods under investigation, respectively. However, obesity was on the rise between 2008-2017. Maternal obesity which is one of the contributing factors of non-communicable diseases was the highest form of maternal malnutrition, followed by overweight. Additionally, on the association between maternal obesity and maternal labour force participation (MLFP), the study ascertained that there was no statistically significant relationship after controlling for other individual and household characteristics.

For the child analysis, it was also seen that at 95% confidence interval there were no statistically significant changes in the level of stunting, wasting and overweight, while underweight decreased across the periods. Stunting which is detrimental to a child's cognitive and physical development remained the most prevalent form of childhood malnutrition followed by overweight (including obesity). It was observed that caring for a stunted child is associated with a 20%-30% reduction in maternal labour force participation at the 5% significance level. For the controls, the *a priori* expectations were met. Education and age of the mother and child were associated with increased MLFP. Nevertheless, age was seen to have a quadratic effect. In addition, living in an urban area and a household with an adult female, and being Coloured were associated with increased MLFP. Being married was negatively associated with maternal labour force participation.

Given the double burden of malnutrition faced in the country, there is a need for double duty action to curb the rates to prevent the population from the risk of mortality and morbidity, and other negative outcomes resulting from overweight/obese or stunting. This could include nutrition education programmes, promotion of exclusive breastfeeding practice and maternal nutrition. In addition, since stunting negatively affects maternal labour force participation, these solutions together with more flexible work arrangements that allow mothers to work from home would enable those with stunted children to engage in the labour force to some extent.

Keywords: obesity, stunting, malnutrition, health, maternal labour force participation, endogeneity, bivariate probit, young children, South Africa.

RESEARCH OUTPUTS EMANATING FROM MY WORK

Oral Presentations:

1. Wanka, F. A., Jonah, C. M. and May, J., 2019. Combating childhood undernutrition: is South Africa making progress? *At the 13th SANORD Annual Scientific Conference*. Digital conference from 08th -10th September 2021.
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4. Wanka, F. A., Jonah, C. M. and May, J., 2019. An examination of the patterns and distribution of overweight among children in South Africa. At the 4th International Congress Hidden Hunger. Stuttgart, Germany from 27th Feb-1st March 2019.

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ABBREVIATIONS

AERC	African Economic Research Consortium
AIDS	Acquired Immune Deficiency Syndrome
CI	Confidence Interval
DoH	Department of Health
ECHP	European Community Household Panel
EEA	Employment Equity Act
EEP	Extrahousehold Environmental Parameters
FLFPR	Female Labour Force Participation Rate
HDI	Human Development Index
HIV	Human Deficiency Syndrome
IFPRI	International Food Policy Research Institute
ILO	International Labour Organisation
LF	Labour Force
LFPR	Labour Force Participation Rate
MLFPR	Maternal Labour Force Participation Rate
NCDs	Non-Communicable Diseases
NCDS	National Child Development Study
NDoH	National Department of Health
NFCS-FB-I	National Food Consumption Survey-Fortification Baseline
NIDS	National Income Dynamics Study
NIS	New Immigrant Survey
OECD	Organisation for Economic Co-operation and Development
OLS	Ordinary Least Square
QoL	Quality of Life
SA	South Africa
SADC	Southern Africa Development Community
SADHS	South African Demographic Health Survey
SALDRU	South African Labour and Development Research Unit
SAMRC	South African Medical Research Council
SANHANES	South African National Health and Nutrition Examination Survey
SANT	South African National Treasury

SDA	Skills Development Act
SDG	Sustainable Development Goals
Statistics SA	Statistics South Africa
TB	Tuberculosis
UN	United Nations
UNDP	United Nation Development Programme
UNICEF	United Nations Children’s Emergency Fund
WB	World Bank
WHO	World Health Organisation
LFP	Labour Force Participation

CHAPTER ONE

INTRODUCTION TO THE STUDY

1.1 Background of the study

Nutrition as a public health concern has increasingly gained recognition owing to its potential impact on health-related quality-of-life (QoL), both at the individual and societal levels (Asfaw, 2006; Friel, 2017; Lenoir-Wijnkoop et al., 2011). This is because an individual's nutritional status is an indicator of his/her health (Currie and Madrian, 1999; Martin-Gronert and Ozanne, 2006; Abu-Saad and Fraser, 2010; Senbanjo et al 2013; Adair, 2014; Péter et al., 2015) which is considered as one of the main components of human capital development (Borjas, 2009; Branson et al., 2012). The evidence of improved human capital is mostly observed in the labour market through the labour force participation (LFP) of the populace (Novignon, Nonvignon and Arthur, 2015).

Well-nourished children incur fewer medical expenditures due to their good health (Hoddinott et al., 2013; Friel, 2017). As a result, less attention is required for the child, which increases the time available for the adult household members to take advantage of the labour market opportunities (Adair, 2014; Tambi, 2017). Similarly, well-nourished women are at a health and social advantage. Good nutritional status positively affects their health, life expectancy and work productivity, and thus motivates them to participate in the labour market (Lock et al., 2010). Hence, quality maternal and child nutrition indicate progress in health and community productivity (Hoddinott et al., 2008; Alderman, 2010; Arthur et al. 2015).

The impact of nutrition on LFP through human capital development plays a role in both the demand and supply side of the labour market. On the demand side, employers are more willing to hire people with better human capital attributes. Meanwhile, on the supply side, improved human capital creates economic incentives for people to supply their labour because wages may increase and the risk of unemployment[1] decrease (Laplagne, Glover and Shomos, 2007). This chapter introduces research undertaken on maternal and child malnutrition, and maternal labour force participation (MLFP) in South Africa (SA).

1.2 Problem Statement

Globally, women account for more than half of the world's population. However, their contribution to economic activity, economic growth and well-being is far below their potentials (Organisation for Economic Co-operation and Development, 2008). According to Elborgh-Woytek et al. (2013) women represent approximately 40% of the global LF and country-wise, SA is no different (Statistics SA, 2019; 2020a). The number of women in SA in the working-age population (15-64) is 19, 625, 000 compared with 19, 249, 000 men (Statistics SA, 2020a). Notwithstanding, the female labour force participation rate (FLFPR) is still low when compared with their male counterparts (Ackermann and Velelo, 2013; Casale and Posel, 2005; Statistics SA, 2019).

According to Elborgh-Woytek et al. (2013), the average gender participation gap, that is, the difference between the participation rates of men and women in the labour force, has been decreasing since 1990. This may be the result of a decrease in the male labour force participation rate[2] rather than an increase in FLFPR. Thus, the male-female gap is still substantial. Inequalities within the labour market may have far-reaching consequences in other

[1] The internationally acceptable definition of unemployment by the International Labour Organisation (ILO) is the narrow definition which excludes the discouraged job seekers (ILO, 1999). However, in South Africa (SA) unemployment is defined by Statistics South Africa (Statistics SA) and most labour analysts in terms of the narrow and broad definitions. The broad definition includes discouraged job seekers as part of the unemployed (Kingdon and Knight, 2000). This came as a result of a debate on which definition of unemployment is appropriate. The ILO recommended the narrow definition to aid international comparability and objectivity (ILO, 1995). The ILO Report (ILO, 1996) argues that the level of unemployment is often exaggerated when the broad definition of unemployment is used as it may capture those who are out of the LF or did not actively look for work over the past week.

[2] The ILO defines LFPR simply as the sum of the searching unemployed plus total employed divided by the working age population (ILO, 1999).

areas (Davis and Greenstein, 2004). This is particularly true for women, who also face other disadvantages within the labour market. Women globally, and in SA in particular, face significant challenges in the labour market (ILO, 2017). These challenges include amongst others, interruption of LFP related to childcare. This is due to women being seen as caregivers within the family, while men are viewed as breadwinners (Edlund, 2007; Floro and Komatsu, 2011). Apart from labour market inequalities faced by women, they also have the highest rate of malnutrition (Alliance, 2011). When a person's energy and / or nutrient intake is deficient, excessive, or imbalanced, it is called malnutrition (Das and Gulshan, 2017; Mamić et al., 2018).

SA and the world at large are faced with a malnutrition problem particularly obesity and stunting. Obesity amongst adults greatly affects women more than men (Ardington and Gasealahwe, 2012), while stunting predominantly affects children aged below 5 years, and are of serious public health concern (Labadarios et al., 2008; Kimani-Murage, 2013; Modjadji and Madiba, 2019). Malnutrition is recognised as a prominent cause of morbidity and mortality (Ng et al., 2014; Tzioumis and Adair, 2014; Arthur et al., 2015; Negash et al., 2015; Bourke, Berkley and Prendergast, 2016; Friel, 2017; Negash et al., 2017; Branca et al., 2019). According to Haddad et al. (2016), maternal and child malnutrition is amongst the top six contributors to the global disease burden. Morbidity increases the medical cost for individuals as well as households (Friel, 2017; Hoddinott et al., 2013). In addition, undernutrition is responsible for approximately 45% of the 16, 000 children under the age of five who die each day (Haddad et al., 2016).

Health costs are not the only way that malnutrition can have a catastrophic impact on individuals, families, or communities. Productivity or labour participation is another aspect where malnutrition affects individuals, families or communities. For example, stunted children who survive are always disadvantaged, do worse in school, and are deprived of future income that can support themselves and their families. However, very little is known about the association of maternal and child malnutrition, and MLFP. The limited understanding of this relationship is particularly true in the South African context. It is therefore imperative to substantiate these disadvantages with evidence.

1.3 Gaps in the literature

Five main gaps were identified in the literature that needs to be considered. First is the paucity of South African-specific research on the topic. Current research is mostly from the developed country perspective. South African studies related to maternal health such as those conducted by Tlebere et al. (2007); Silal et al. (2012); Tsawe and Susuman, (2014); Wabiri et al. (2016); Damian et al. (2019); Zar et al. (2019) and Bomela (2020) either focused on maternal mortality and its causes, inequalities in maternal health, maternal health and birth outcomes or factors influencing maternal health services. Studies on the topic of this thesis (Some, Rashied and Ohonba, 2014; Henry and Kollamparambil, 2017) carried out in SA focused exclusively on employed individuals, with the unemployed section of the LF excluded. Given that some individuals are not voluntarily unemployed it is important to focus on LFP as a whole, which includes the employed and unemployed individuals. The availability of data for SA compared with other African countries allows for extensive exploration of this topic.

The second gap identified is related to the lack of research that focuses solely on the association between maternal obesity and LFP. In the literature search process, it is clear that many studies have focused on the impact of obesity or disease on male and female labour market outcomes (Morris, 2007; Greve, 2008; Cawley, Han and Norton, 2009; Zhang, Zhao and Harris, 2009; Lindeboom, Lundborg and Van der Klaauw, 2010; Mora, 2010; Harkonen, Rasanen and Nasi, 2011; Larose et al., 2016), many of which were discussed in the literature review. Rarely did the studies focus solely on mothers, comparing the impact of malnutrition on LFP. Women with children respond differently in the labour market compared with women without children as their reservation wage may be higher. It is, therefore, necessary to understand the impact malnutrition will have on their LFP.

The third gap in the literature is the lack of sufficient studies on the impact of child malnutrition particularly stunting on maternal labour supply both at the global and South African levels to the best of my knowledge. Most of the research (Powers, 1999; Porterfield, 2002; Corman, Noonan and Reichman, 2005; Reichman, Corman and Noonan, 2008; Frijters et al.2009; Yamauchi, 2012) done mostly focused on child health in general or disability in particular and its effect on maternal/parental labour supply.

Fourth, in SA, there has been a lot of debate on whether child undernutrition particularly stunting has improved or not (May and Timaeus, 2014; Said-Mohamed et al., 2015; Devereux and Waidler, 2017; Devereux, Jonah and May, 2019). These debates tend to arise because the surveys vary in terms of the age range of children sampled and measured, the sample size, as well as the sampling frame. This research is important as it contributes to the literature on childhood malnutrition using the most recent NIDS dataset 2017. It takes into consideration the confidence intervals which helps to determine if there is any statistical difference in the rate of malnutrition across the years under consideration.

Finally, limited research has been done in SA concerning the prevalence and trend of overweight/obesity amongst children aged between 0-59 months that includes children age below 12 months. To the best of my knowledge, an in-depth analysis of this condition has not been done particularly with the NIDS dataset. Most of the South African studies about overweight children (Armstrong et al., 2006; Jinabhai et al., 2007; Reddy et al., 2009; Kimani-Murage et al., 2010; Monyeki et al., 2012; Mamabolo et al., 2014; Pienaar, 2015; Symington et al., 2016; Adom et al., 2019) focus on children aged one and above and do not monitor the trend of childhood overweight. This may arise from that fact that childhood overweight and obesity are not systematically defined for children younger than 2 years.

1.4 Rationale of study

In 2012, the global nutrition target of the World Health Organisation's (WHO) member countries, including SA, aimed at improving maternal, infants and young children's nutrition by 2025 (WHO, 2014; Haddad et al., 2015; Hoseini et al., 2015). To align with the deadline year of 2030 for all sustainable development goals (SDG) targets, WHO and United Nations Children's Emergency Fund (UNICEF) (2018) revised and extended the nutrition targets to 2030. This includes, but is not limited to a 50% reduction in the number of children under five years of age who are stunted, a 30% reduction in low birth weight, a reduction in and maintenance of childhood overweight and wasting to less than 3%. Based on the South African Department of Health (DoH) National Health Promotion Policy and Strategy for 2015-2019. The goal was to prevent both communicable diseases and non-communicable diseases (NCDs), and improve maternal, neonatal, infant and child nutritional status (DoH, 2014). Given the importance of early childhood development on future adult health, identifying mothers and children that are malnourished helps to optimise long-term health and human capital (Adair, 2014). Therefore, monitoring the related trends of maternal and child malnutrition in SA helps policymakers and other organisations to;

a. Evaluate their current policies and intervention programmes aimed at curbing malnutrition.
b. Implement appropriate policies/programmes that can help achieve their targets.

SA presents an interesting case study to investigate the association between maternal and child malnutrition and MLFP not just because the evidence on this is largely lacking, but due to the high rate of malnutrition particularly obesity amongst women and stunting amongst children below the age of 5 years. Children under 5 years were considered because they need family members or, in most cases, more care from their mothers. According to Statistics SA Report (2020b), the majority of children below the age of five years live with their biological mothers only. Hence, the effect of child malnutrition will be greatly felt by their mothers. It is therefore important to establish the relationship between maternal and child malnutrition, and MLFP in SA.

Finally, the quality of the LF for a given country is very important to promote economic growth. As such, analysing factors necessary to improve the quality and quantity of labour supply is very important. Determining this association in SA will provide insights into the low rates of FLFP compared with male LFP in SA, despite having the largest share of the population in the country. This analysis is also important because if maternal and child malnutrition reduces MLFP, in addition to health costs, low LFP will also reduce labour supply, productivity, and living standards by increasing poverty amongst women and children. From an economic viewpoint, knowing the magnitude of the impact is an essential input when conducting a cost-benefit analysis (CBA) of intervention programmes required to enhance the health of the populace (Rabarison et al., 2015).

1.5 Objective

The primary objective of this study is to investigate how maternal and child malnutrition influences maternal labour supply in SA using the National Income Dynamics Study (NIDS). This will be achieved by pursuing the following specific objectives:

i) Explore the trend of maternal labour supply in SA.
ii) Determine the prevalence and trend of maternal malnutrition in SA.
iii) Investigate the association between maternal obesity and maternal labour supply.
iv) Determine the prevalence and trend of childhood malnutrition in SA.
v) Examine the association between childhood stunting and maternal labour supply.

1.6 Research Questions and Hypotheses

The main research question is: How is maternal and child malnutrition associated with MLFP in SA? The sub-questions and corresponding hypotheses are;

a) What is the level of maternal labour force participation and how has it changed over time?
b) What is the state of maternal malnutrition in SA and how has it varied over time?
c) How does MLFP vary by maternal obesity amongst working-age mothers in SA?
   - Hypothesis 1.1: There is a negative association between maternal obesity and MLFP.
d) What is the extent of child malnutrition in SA and how has it changed over time?
e) How does MLFP vary by the stunting status of a child amongst working-age mothers in SA?
   - Hypothesis 2.1: There is a negative association between childhood stunting and MLFP.

1.7 Context, Data and Methodology

The empirical analyses of this study are quantitative. The secondary data are publicly available and were obtained from the NIDS (Chinhema et al., 2016). The NIDS is the first nationally representative panel dataset of South African households, meant to track changes in the welfare of South Africans over time (Chinhema et al., 2016). So far five waves have been collected and are publicly available to use for research and learning. In this thesis, 2008, 2012, 2014/15 and

2017 datasets were used[3]. The quantitative analysis will combine descriptive statistical analysis and regression models. Several regression models were applied (specified in the methodology chapter). Given that the outcome variable is binary the probit model was considered an appropriate model to use in analysing the association of malnutrition (maternal obesity and childhood stunting) with MLFP.

1.8 Structure of the Study

Chapter One (Introduction) outlines the background of the study, the research problem, the gap in the literature, as well as objectives, hypotheses, and importance of carrying out the research and a summary of the methodology used to conclude the research findings.

Chapter Two (Labour Supply Decisions) first of all, provides an overview of female labour force participation both globally and in Africa. It then focuses on some selected theories on labour supply which include the individual neoclassical labour supply theory, the allocation of time, sexual division of labour and development, the unitary model of household labour supply, and collective household labour supply models. The selected theories that suit the study are also discussed.

Chapter Three (General information on malnutrition) examines the types of malnutrition categorised as undernutrition and overnutrition, and their possible consequences. The chapter then looks at the extent of malnutrition globally, in Africa and Southern Africa. It then discusses the causes of malnutrition.

Chapter Four (Nutrition and labour market success) presents the theoretical link between nutrition and labour force participation. It highlights the empirical literature on labour supply and nutrition wherein a review of the endogeneity of malnutrition is followed by an empirical literature review on the link between malnutrition and labour supply.

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[3] 2010 dataset was not included due to some irregularities (for instance the inexplicable nontrivial drop in the unemployment rate) that can negatively affect results as documented by Cichello, Leibbrandt and Woolard (2012).

Chapter Five (Research Methodology) describes the empirical methods and models applied in answering the research questions and achieving the research objectives. It also explains the NIDS data used for the analysis. In addition, it presents an overview of SA emphasising aspects that are pertinent to the thesis.

Chapter Six (Maternal malnutrition and maternal labour force participation) examines how maternal malnutrition affects maternal labour force participation by exploring the levels of maternal malnutrition in the country. This chapter presents findings of the prevalence and pattern of maternal labour force participation and malnutrition in SA using the NIDS datasets for the period 2008-2017. It then goes further to investigate the link between maternal obesity and maternal labour force participation with the use of regression analyses and the 2017 NIDS data.

Chapter Seven (Child malnutrition and maternal labour force participation) discusses the pattern and distribution of child malnutrition that is stunting, wasting, underweight and overweight in SA for the period 2008-2017. Given the high rate of stunting within the country, this chapter further investigated the relationship of child stunting with MLFP using the 2017 NIDS data and regression analyses.

Chapter Eight (Conclusion and Recommendations) recapitulates the purpose of the dissertation. It then highlights the achievements of the thesis and its contribution to existing knowledge. It also looks at the limitations of the study, the implications of the research findings and makes possible recommendations for researchers and policymakers.

1.9 Summary

This chapter introduced the research. It provided the background of the study, research problems, gaps in the literature and research objectives and questions. In addition, it provided a summary of the research methods as well as the research structure. The chapter revealed amongst others, that one way of increasing maternal labour force participation is by improving maternal and child nutrition. The next chapter reviews the literature on female labour force participation.

CHAPTER TWO

LABOUR SUPPLY DECISIONS

2.1 Introduction

The objective of this chapter is to review the literature on female labour supply. Given that the dissertation focuses on the impact of maternal and child nutrition on maternal labour supply, discussions in this chapter seek to understand the level of female labour force participation (FLFP) globally and in Africa, and what factors prompt women to participate in the LF. The chapter starts with an overview of FLFP, followed by discussions on the economic theories of labour supply and how it has been extended over time to account for gender disparities in the labour market and household settings.

2.2 An overview of Female Labour Force Participation (FLFP)

Labour supply is defined as the amount of labour, measured in person-hours, offered for hire during a given period. The labour supply decisions of individuals can be divided into two categories: the "extensive margin" which refers to the decision of whether or not to work and the "intensive margin" which refers to the hours worked (Chen et al., 2014). This implies that the quantity of labour supplied in a given society depends on the number of people employed or unemployed, which together make-up the LF (Borjas, 2009), and the number of hours each person is willing to supply once in the LF.

This section focuses on the extensive margn of female labour supply decision. FLFP refers to the number of women in the working-age population that are in the LF (Black, Schanzenbach and Breitwieser, 2017). The working-age bracket may differ from one country to the other but is usually between 15 and 65 years, and reflects potential participants in the labour market. In SA, while the working-age bracket is between 15 and 64 years (Bhorat et al., 2015; Statsistics SA, 2019), the pension age starts at 60 years for both men and women (Statsistics SA, 2018).

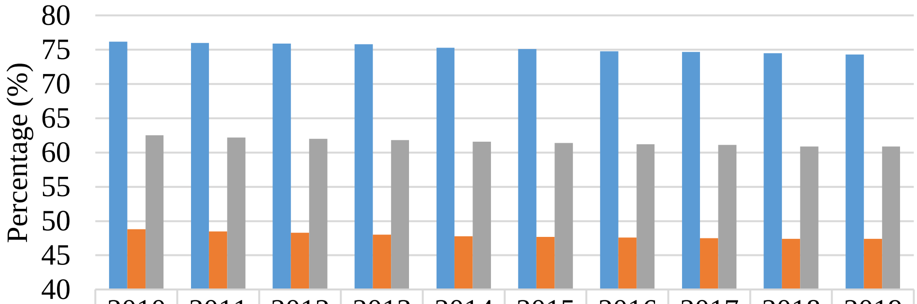
> *"More women participate in paid employment than at any other time in history. The entry of women into the labour force has meant that, in many cases, the economic opportunities available to them have grown. However, equality of opportunity remains elusive. Sex segmentation of labour markets*

is endemic, with women concentrated in lower quality, irregular and informal employment. Economic stabilisation programmes and the process of global integration have frequently squeezed household incomes, pushing women to enter the paid labour force. At the same time, economic reforms have intensified demands on women's unpaid work, creating a situation in which increasing the supply of women's labour is a central strategy by which families cope with fundamental economic change. At a basic level, women's employment, paid and unpaid, may be the single most important factor for keeping many households out of poverty" (Heintz, 2006: 1).

The aforementioned quote portrays the importance of female participation in the labour market. High FLFP has proven to be highly beneficial (Bbaale and Mpuga, 2011). The increase of female participation in economic activities are desirable conditions to realise women's rights and achieve broader development goals such as improved health, poverty reduction, education, economic growth and welfare (Edlund, 2007; Hoque and Itohara 2009; Hussain and Kirmani, 2010; Kabeer, 2012; Verick, 2014). Therefore, FLFP is very important for the improvement and socioeconomic development of a country since it promotes efficiency and equity. Despite the importance of FLFP, the males LFPR still exceeds that of females.

Using data from the International Labour Organisation (ILO), Verick (2014) argues that over the two decades (1992 to 2012), the global FLFPR has remained fairly stable, declining slightly for the total female working-age population (15+) from approximately 52% in 1992 to 51% in (2012). A similar result was found by Chaudhary and Verick (2014) using the same data from 1993 to 2013. The participation rate for men on the other hand decreased steadily over the same periods. Although approximately 345 million women have entered the LF over the past 20 years, they only account for about 40% of the global LF (Verick, 2014; Chaudhary and Verick, 2014). For both men and women, the LFPR decreased between 2010 and 2019 (ILO modelled estimates, 2020a), but the LFPR for men is higher than the global average across the years as seen in Figure 2.1. Despite the slight drop in the percentage of LFP for both men and women in 2018, the gender gap has narrowed only slightly from 27.5% in 1998 to 26.6% in 2018

(Verick, 2018)[4]. Figure 2.1 presents the gender trend of LFP for men and women aged 15+ globally from 2010 to 2019. A similar trend in LFPR for men and women aged 15+ is observed in the African region from 2010-2019 (Figure 2.2).



	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Men	76.2	76	75.9	75.8	75.3	75.1	74.8	74.7	74.5	74.3
Women	48.8	48.5	48.3	48	47.8	47.7	47.6	47.5	47.4	47.4
Total	62.5	62.2	62	61.8	61.6	61.4	61.2	61.1	60.9	60.9

Year

Men Women Total

Figure 2.1: Global trend of labour force participation rate by sex, 2010-2019
Source: ILO modelled estimates (2020a)

	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Men	74.5	74.4	73.9	73.5	73.1	72.7	72.5	72.4	72.5	72.5
Women	54.6	54.6	54.2	54.1	53.9	53.9	53.9	54.0	53.9	54.0
Total	64.4	64.3	63.9	63.6	63.4	63.2	63.1	63.1	63.1	63.2

Year

Men Women Total

Figure 2.2: Trend of labour force participation rate by sex in Africa, 2010-2019
Source: ILO modelled estimates (2020a)

[4] Several factors might be responsible for low FLFPR which includes amongst others; urbanisation and economic development (Verick, 2014), educational attainment and household income (Kapsos, Bourmpoula and Silberman, 2014) and barriers to entry to the labour market and cultural restrictions (Elder and Kring, 2016)

At the global level, employment-to-population ratios[5] are lower for women than men and the gender gap is stable (Anyanwu and Augustine, 2013). In 2011, the global male employment-to-population ratio was about 72.7%, while the global female employment-to-population ratio was close to 47.9% (Anyanwu and Augustine, 2013). The trend from 2010-2019 reveals that the global employment-to-population ratio for men decreased from 71.7% in 2010 to 70.4% in 2019, while that of women decreased from 45.9% to 44.8% respectively (ILO modelled estimates, 2020b). Notwithstanding, the rate for men is still higher than the global average. Figure 2.3 presents the gender trend in the employment-to-population ratio for those aged 15+ globally from 2010 to 2019.

The employment-to-population ratio for both men and women in African has also decreased between 2010 and 2019 (ILO modelled estimates, 2020b). Despite the decrease, the rate is still higher for men than the continental rate in general and women in particular. Figure 2.4 presents the trend of the employment-to-population ratio for men and women aged 15+ in Africa[6] for the period 2010 to 2019.

[5] The employment-to-population ratio refers to the percentage of the working-age population in a country that is employed.

[6] Within the different African regions there are great disparities in employment ratio for women in North Africa than in Sub-Saharan African. In addition, there is less gender inequality in employment in Sub-Saharan Africa than North Africa. One of the reasons could be the acute social exclusion of women in employment in this region compared with Sub-Saharan Africa (Fernández, 2010; Campa et al., 2011; Anyanwu and Augustine, 2013).

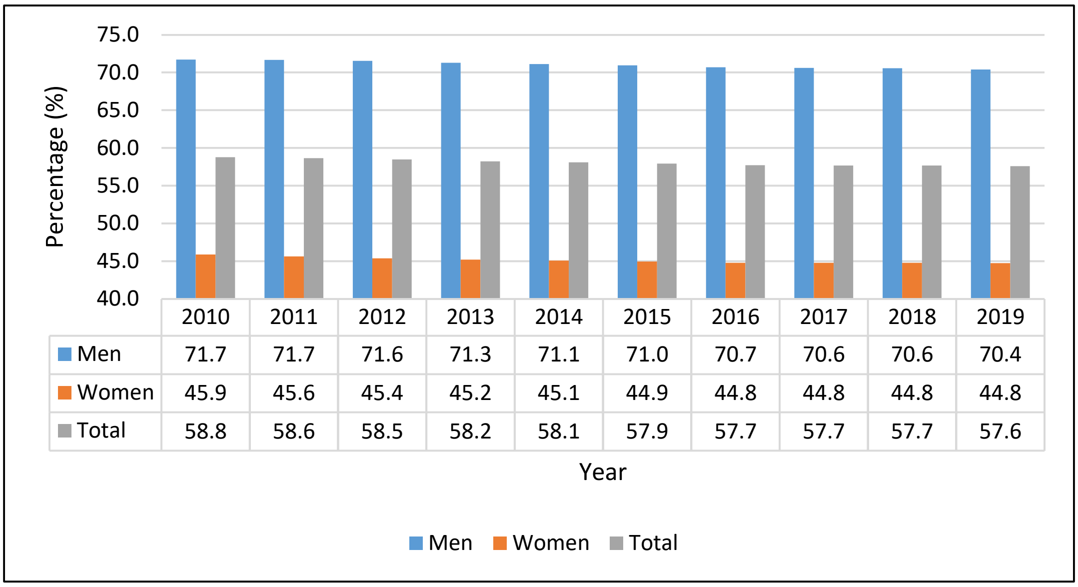


Figure 2.3: Global trend of employment-to-population ratio by sex, 2010-2019
Source: ILO modelled estimates (2020b)

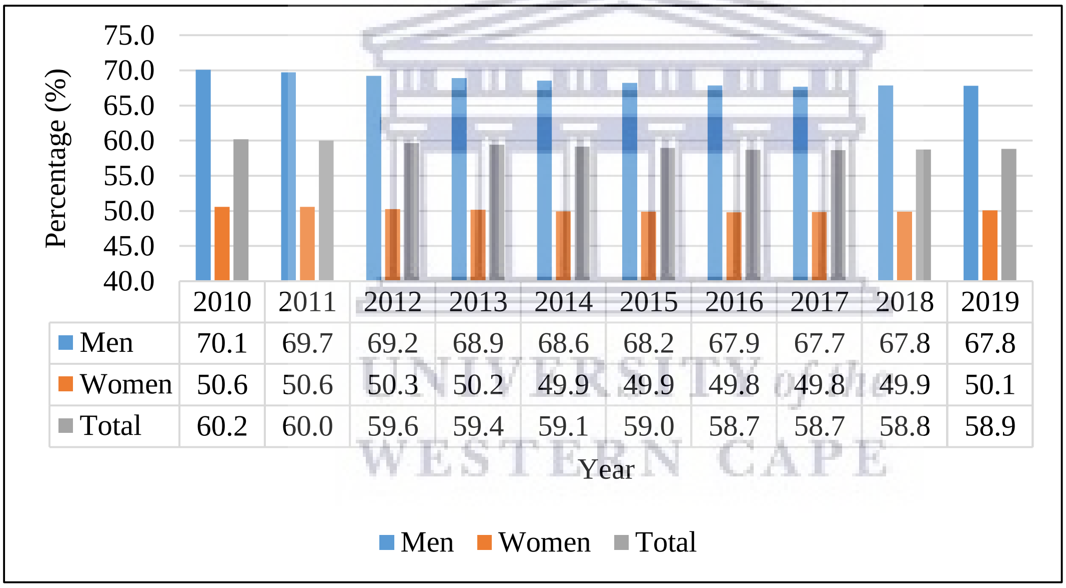
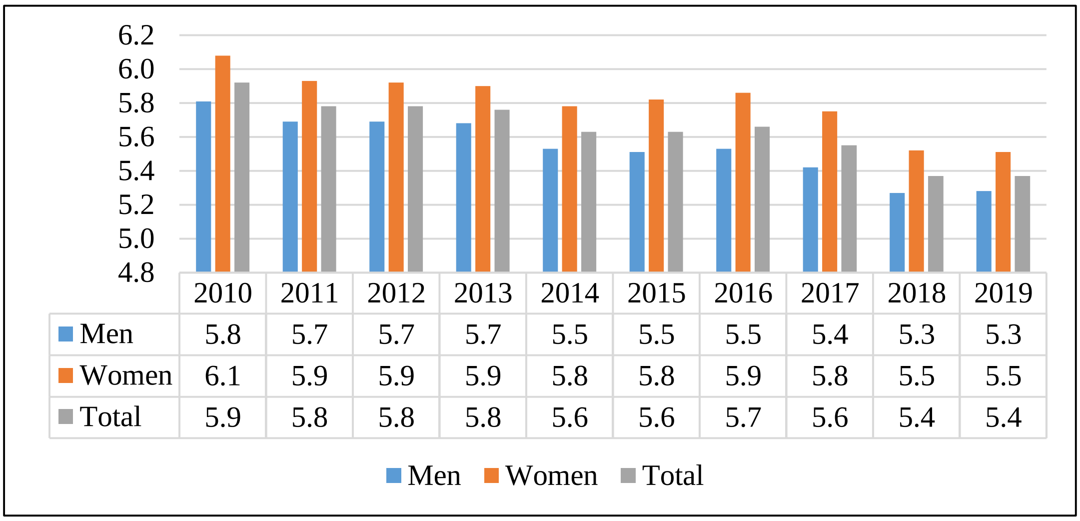


Figure 2.4: Trend of employment-to-population ratio by sex in Africa, 2010-2019
Source: ILO modelled estimates (2020b)

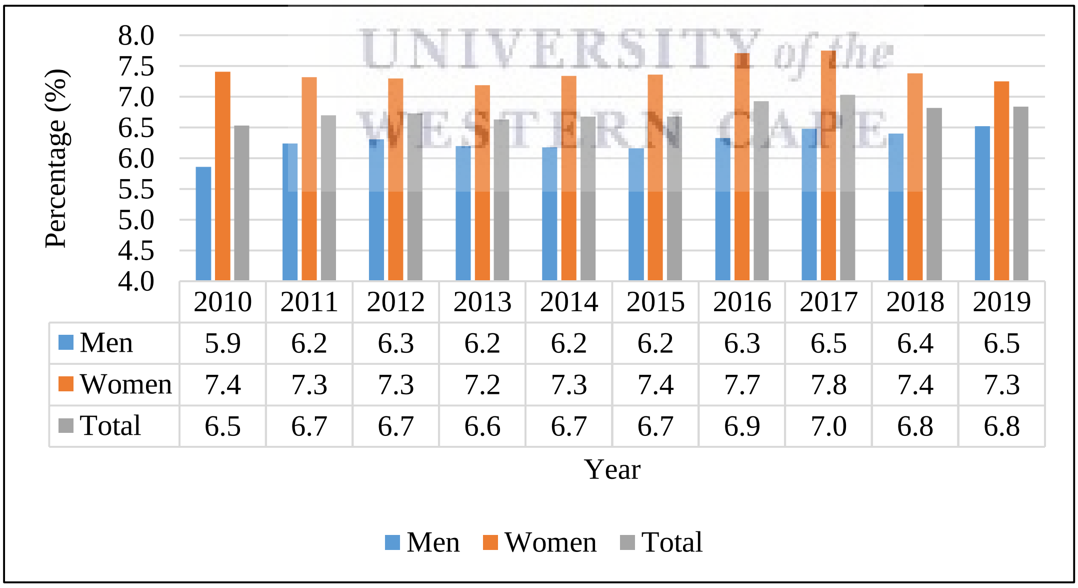
Not only are women less likely than men to participate in the LF, but those who do are also less likely to find employment. Globally, the rate of unemployment has decreased between 2010 and 2019 amongst those aged 15+. The global unemployment rate is estimated at 5.5% for women and 5.3% for men in 2019 (ILO, 2020c). When compared with the 2010 rate of 6.1% for women and 5.8% for men, it shows that the unemployment rate has decreased globally. Figure 2.5 identifies the percentage of unemployed by sex globally, 2010-2019.



	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Men	5.8	5.7	5.7	5.7	5.5	5.5	5.5	5.4	5.3	5.3
Women	6.1	5.9	5.9	5.9	5.8	5.8	5.9	5.8	5.5	5.5
Total	5.9	5.8	5.8	5.8	5.6	5.6	5.7	5.6	5.4	5.4

Figure 2.5: Global trend of unemployment by sex, 2010-2019
Source: ILO modelled estimates (2020c)

In Africa, the male unemployment rate increased from approximately 5.9% in 2010 to 6.5% in 2019, while the female unemployment rate decreased slightly from approximately 7.4% in 2010 to 7.3 % in 2019, but higher than the continent's total of 6.8%. (ILO modelled estimates, 2020c). Figure 2.6 represents the trend in the rate of unemployment within the African region from 2010-2019.



	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Men	5.9	6.2	6.3	6.2	6.2	6.2	6.3	6.5	6.4	6.5
Women	7.4	7.3	7.3	7.2	7.3	7.4	7.7	7.8	7.4	7.3
Total	6.5	6.7	6.7	6.6	6.7	6.7	6.9	7.0	6.8	6.8

Figure 2.6: Trend of unemployment by sex in Africa, 2010-2019
Source: ILO modelled estimates (2020c)

FLFPR is expected to continue to decline over the next ten years or so, reaching a low of 45.9% by 2030 (Verick, 2018). This is a glaring reminder that if policy measures are not taken to reverse these trends, it will be difficult for countries to improve the conditions of women in the labour market.

Economic analysis on FLFP has increased in both developing and developed countries (Boserup, 1970; Hill, 1983; Yakubu, 2010; Atasoy, 2017; Idowu and Owoeye, 2019) since the pioneering work of Mincer (1962) on LFP of married women, as per the “Work-Leisure Theory” developed in the twentieth century. This was followed by other theories in the field, including Becker and Mincer's "Household Production Theory" and Schultz and Becker's "Human Capital Theory." The purpose of these theories was to figure out the factors that would affect a female’s decision on whether or not to participate in the labour market. These have served as a theoretical and empirical foundation for numerous studies on FLFP (see Galor and Weil, 1996; Bloom et al, 2009; Klasen and Lamanna, 2009; Verick, 2014, 2018; Karbownik and Myck, 2016).

Numerous studies on FLFP have been motivated by the intense interest in evaluating the consequences of public policies which range from welfare programs and tax to the modification of the labour market institutional features (Blundell and MaCurdy, 1999). The purpose of these reforms was to encourage the employed to augment their work effort. However, this poses challenges of job creation in high unemployment regions such as SA (Ntuli, 2009). The next section presents some of the selected economic theories on labour supply.

2.3 Selected Economic Theories of Labour Supply

Theoretical developments in the conceptualisation of labour supply have been well documented (Bowen and Finegan, 1969; Pencavel, 1986; Blundell and MaCurdy, 1999). These theories, generally focus on how many hours of labour an employed person supplied to the labour market. Despite considering those with zero-hour of market work as non-participants, these theories are useful in explaining individual participation in the labour market and the factors influencing participation decisions.

The labour supply decisions of individuals are influenced by many factors including the household structure. Households are economic entities that act as both producers and consumers of goods and services (Schreyer and Diewert, 2014). A household can be made up of one person (Hoffmeyer-Zlotnik and Warner, 2009) or a group of individuals who have different preferences and among whom an intra-household decision-making process needs to be made (Vermeulen, 2002).

In economics, the household is most often analysed as an entity interacting either within itself or with the outside economy (Chiappori, 1992). Examples of the former are often found only in literature specialised in intra-household allocation or game theory while the latter is mostly found in poverty, inequality and labour analysis (Lundberg and Pollak, 1993; Haddad, Hoddinott and Alderman, 1994, 1997; Duflo, 2000; Armstrong, Lekezwa and Siebrits, 2008). This section looks at five different static theoretical labour supply models; the individual neoclassical, allocation of time, sexual division of labour and development, unitary and collective approaches, which have developed over time to explain labour supply decisions of individuals particularly for females at the household level. The allocation of time, sexual division of labour and development, and unitary models are both extensions of the individual model while the collective models are extensions of the unitary model.

2.3.1 The Individual Neoclassical Labour Supply Theory

The neoclassical static model treats a household as comprising of a single individual (Chiappori, 1992; Apps and Rees, 2009). Apps (2003) and Ehrenberg and Smith (2017) note that in this model the individual receives satisfaction from the consumption of market goods and leisure, which depends on time, a scarce resource, and the income used to purchase the given set of commodities known as the budget constraint. Part of the individual's income is independent of his/her working hours and is denoted as non-labour income (Cahuc and Zylberberg, 2004). This utility maximising individual labour supply depends on two alternative uses of his/her time, work and leisure (Apps, 2003). It is assumed that this utility-maximising individual has all the necessary information to decide rationally between work and leisure. Based on the cost and benefit of each activity, and given the scarcity of time, the individual is faced with the problem of how many hours to allocate for each activity. This model is based on two assumptions; homogeneity[7] and the satisfaction of the Slutsky conditions[8] (Varian, 2006).

Given that an individual cannot pursue both leisure and market work at the same time, each hour engaged in one of the two activities will result in a costly trade-off of the other (Borjas, 2009). This signifies that the opportunity cost of each additional hour of leisure is the hourly wage rate the individual should have earned if market work was done (Nicholson and Snyder, 2014). Meanwhile, the opportunity cost of an additional hour of market work is the satisfaction lost from forgone leisure time (Kool and Botvinick, 2014). The individual's labour supply is therefore represented by the number of hours allocated to work and leisure (Varian, 2006). The optimal allocation of time between leisure and work, that maximises benefits while minimising costs, is determined by the individual's preferences towards the two activities; the prevailing market wage rate; and the availability of non-labour income such as cash transfer (Reynolds, Masters and Moser, 1998; Cahuc and Zylberberg, 2004).

Given that an individual's wage rate changes, this will have two effects (that is income and substitution effect) on his/her labour supply decision (Gronau, 1977). For instance, an increase in the wage rate will cause an individual to either increase working hours or leisure time. Assuming the individual's wage increased and real income held constant, the individual will prefer to supply more working hours. This is called the substitution effect, which positively affects hours of labour supplied (Varian, 2006). An increase in wage rate while holding price constant increases an individual's real income, thus enabling the individual to increase leisure

[7] Homogeneity: implies that an equi-proportional change in wages, prices and non-labour income should have no impact on LFP decision. As such, money illusion does not determine the labour supply decisions but rather real variables only.

[8]The Slutsky condition implies that;

i) Negativity of the income compensated own wage substitution effect: This indicates that if an individual's wage rate decreases, this results to an increase in leisure time. This negatively affects labour force participation as the price of non-market time decreases thus, more consumption of non-market time compared with market time

ii) Negative income elasticity: This signifies that if an individual's income increases due to an increase in wage, more leisure is demanded leading to decrease in labour supply than before the wage increment. Provided non-market time is a normal good, this effect will be negative.

time if leisure is assumed to be a normal good. This is termed the income effect and affects hours of supplied labour negatively (Mincer, 1962; Ehrenberg and Smith, 2017). Hence, the decision to work or be at leisure depends on the expected real wage (Kryńska and Kopycińska, 2015). The overall impact of a rise in wage rate on hours of labour supplied will depend on which of the two effects dominates.

If the substitution effect is greater (smaller) than the income effect, hours supplied to the labour market will increase (decrease) and less (more) time will be devoted to leisure (Ehrenberg and Smith, 2017; McConnell, Brue and Macpherson, 2016). Non-labour income also influences labour supply decisions (Kozel and Alderman, 1990). A decrease (increase) in an individual's non-labour income, ceteris paribus, will result in a pure income effect and the individual will increase (decrease) his/her working hours (Bemdt, 1991; Ehrenberg and Smith, 2017). This explains why the individual labour supply curve is backward sloping (Vercherand, 2014). Oguz (2018) points out the following: 1) For classical economists, the real wage is what determines the labour supply, with the income effect less than the substitution effect; 2) For Keynesian economists, it is the nominal wage that determines the labour supply. This causes labour suppliers to make wrong decisions because nominal wage does not take into consideration changes in price levels and therefore, an individual's purchasing power is unknown and 3) For monetarist economists, labour supply is a function of the expected wage rate. Hence, the decision to work or leisure depends on the expected real wage (Kryńska and Kopycińska, 2015).

The basic neoclassical work-leisure model is often used to determine how many hours of work will be supplied. It can also be used to determine if an individual will participate or not in the labour market. An individual will consider working if the market wage offered exceeds his/her specific reservation wage, that is, the lowest hourly wage at which he/she is willing to supply his/her first unit of labour to the labour market (Gronau, 1977; Ehrenberg and Smith 2017; Brown and Taylor, 2013). In case the reservation wage exceeds the prevailing market wage rate, an hour of leisure will offer more utility than the wage they will earn for an hour of work. In this case, the individual will not participate in the labour market (Walker, 2003; Blundell et al., 2007). This implies that an individual's reservation wage plays an important role when faced with the decision to participate or not in the labour market. Therefore, individuals set their reservation wage depending on their circumstances (Cogan, 1981; Möller and Aldashev, 2007; Brown, Roberts and Taylor, 2010; De Coen, Forrier and Sels, 2015). It should be noted that the reservation wage for mothers is not only related to non-labour income, it also differs by individual motherhood preferences. Mothers with strong time preferences with children face a higher reservation wage and are more likely not to work irrespective of relatively high wages (Youderian, 2014).

A key assumption of the individual work-leisure model is that at any given wage, workers can choose their working hours. However, it fails to recognise that some institutions have standard working hours and those supplying their labour may not have the freedom to choose their working hours (Joll et al., 2018; Gielen, 2009). The relevance of the model in today's labour market is questionable since most companies have fixed operating times. As such, labour supply decisions would be binary. This implies that the individual is either supplying zero or fixed working hours. Although McConnell, Brue and Macpherson (2016) recognise this fact, they argue that individuals can adjust their working hours than is commonly believed. They emphasise that:

- **i)** Self-employed individuals can choose their working hours (and often work more than forty hours).
- **ii)** Though forty-hour work per week is common amongst companies/organisations, this might not apply to all companies. Some employers, when need be (especially during peak periods), prefer to pay existing workers for overtime than to hire new persons. This shows that employees, depending on where they are working, can choose their working hours.
- **iii)** An individual can determine the amount they work if they can hold more than one job.
- **iv)** Some jobs do have leave without pay.

Indifference curves and the budget constraint analyses can be used to explain an individual's decision to work and the number of working hours. The indifference curve (U) in Figure 2.7 shows the different combinations of consumption of goods (real income) and leisure/work time for which an individual is indifferent in that, it provides the individual with the same level of utility (Vercherand, 2014; McConnell, Brue and Macpherson, 2016). The individual's optimal consumption of goods and leisure/work is at point A since the indifference curve is tangential to the budget line (B).

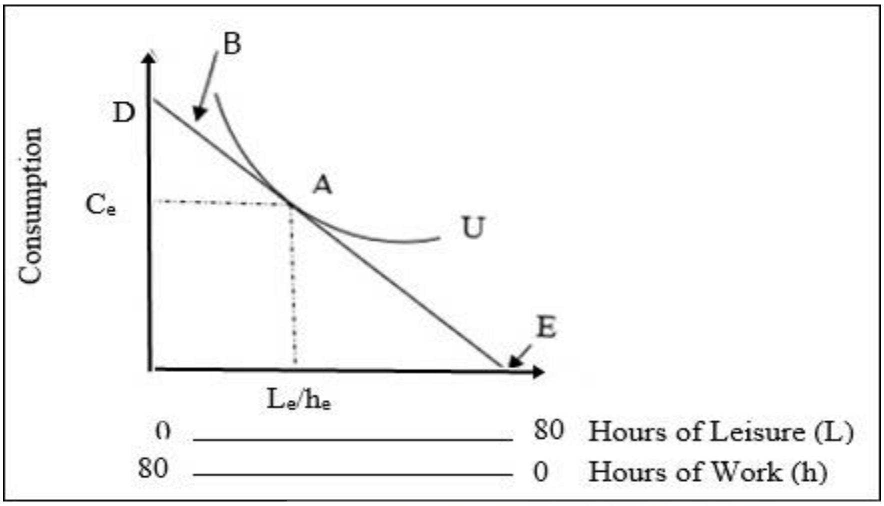


Figure 2.7: Trade-off between Labour and Leisure
Source: Borjas and Van Ours (2010); Vercherand (2014)

At point A in Figure 2.7, the slope of the budget line equals the slope of the indifference curve (Borjas and Van Ours, 2010; McConnell, Brue and Macpherson, 2016). Point A as noted by Borjas and Van Ours (2010) and Vercherand (2014) is the optimal work-leisure position known as the marginal rate of substitution (the rate at which an individual is willing to sacrifice hours of leisure for extra consumption), which equals the wage rate (the rate at which the market allows the individual to substitute one hour of leisure time for consumption). This implies that the interaction between the individual's preferences and the budget constraint determines the individual's amount of consumption and labour supply. This is known as the interior solution since the individual is not at either corner of the opportunity set (Borjas and Van Ours, 2010; Vercherand, 2014). At point D the individual uses all available 80 hours on work while at point E he/she uses all the 80 hours on leisure. However, since individual preference or taste between work and leisure varies, the indifference curve will be represented differently from the standard one above, but this is not the focus of our discussion.

Despite being used to explain labour supply decisions the individual work-leisure model has been criticised by some researchers. The rigidity of the neoclassical model has been rejected by feminist economists. Based on their claims, at all times, the decisions people make are neither gender-neutral nor value-free and cannot be viewed simply via a utility maximising and self-interested lens. It rather involves complex interests, which are not necessarily selfreflective, but take into consideration the consequences it may have in a family or a society as well (Barker, 1999). Men and women perform multiple tasks in a community or a family, of which some are not captured in the individual work-leisure model.

During adulthood, most individuals form households through marriage and/or for women having children is a factor. These are some of the important factors influencing an individual's levels and trends in labour supply, particularly for women. The basic neoclassical model is also criticised for its simplicity in explaining female labour supply and its failure in interrogating the different ways in which leisure time is spent (Mincer, 1962; Apps and Rees, 1997; Donni, 2008). It assumes that an individual's labour supply decision is based on a dichotomous choice between market work and leisure (Apps, 2003; Rapoport, Sofer and Solaz, 2011). As such, household production activities are subsumed within leisure time, a broad and gender-blind assumption (Benhabib, Rogerson and Wright, 1991; Mincer, 1962; Becker 1965).

Mincer's (1962) study on the LFP of married women is one of the pioneering works on female labour supply that discredited the broad use of leisure time. Mincer (1962) noted that the model fails to recognise that the decision to supply hours of work is more complex than just a simple choice between labour and leisure. He argues cogently that the decision about the number of hours for market work is often made within a family setting. Therefore, a family member's working hour is dependent not only on his/her wage nor on variables that are specifically related to him/her, but also on similar variables of other household members and on variables that are common to a family unit.

An individual may not be doing market work but using his/her non-market time to produce both goods and services, which provides utility to the household (Mincer, 1962; Becker 1965). For instance, compared with men who are mostly involved in full employment and less in household production (housework), many women are either not doing market work or may be working part-time. Women are highly involved in household production or unpaid non-market work which are time-intensive such as childcare, food preparation, cleaning and other types of production of goods and services for their homes and families (Gronau and Hamermesh, 2001; Cahuc and Zylberberg, 2004; Anderson and Grossman, 2009; Miranda, 2011). Classifying the non-market work or household production as pure leisure leads to a biased estimate as it incorrectly associates a lower FLFP with more female leisure (Benhabib, Rogerson &Wright, 1991; Apps and Ree, 1997; Rapoport, Sofer and Solaz, 2011).

The basic work-leisure model assumes that there is a similar trade-off between market work and household consumption (or pure leisure), as there is between market work and household production (Apps, 2003). This signifies that if there is a market shock, for example a decrease in wages, to decrease the supply of labour men need to substitute pure leisure for market work, while women substitute housework for market work. The substitutability between market work and pure leisure is not as high as household production and market work (Casale, 2003). This is because household production (housework) can be increased for instance, by investing in time-intensive commodities/activities such as personal child care, cleaning, washing and cooking (Mincer, 1962).

Undoubtedly, the household plays a vital role in the economy, hence, there is a need for a formal model that includes both the interaction of household members between each other and the outside economy. Becker’s analysis of the allocation of time serves as a major extension of the basic work-leisure model in analysing household behaviour on labour supply decisions. Mincer (1962) was the first to note that for women, in particular, there is a need for a distinction between leisure and work at home. Gronau (1977) advances two reasons why this distinction was not taken into consideration in Becker's more general formulation:

i) Practical challenges in differentiating between the two, given a large number of uncertain cases (for example, is playing with a child work or leisure at home?).
ii) There is no evidence that the distinction of the two will enrich our understanding of household behaviour.

2.3.2 Model of the Allocation of Time

In this model, a household rather than an individual is seen as the main unit of analysis (Schreyer and Diewert, 2014). In an article titled “Theory of The Allocation of Time” by Becker (1965), the concepts of non-market work and household production were introduced. Commodities were seen as the main influence of the utility function, for which inputs are needed by an individual for their production. These inputs are consumer goods on the market (market goods) and the time taken to produce these commodities. When formulating the model, it was assumed that households combine these inputs through the household's production function to produce commodities that directly enter their utility function (McConnell, Brue and Macpherson, 2016). As such, households are treated as both producing units and utility maximisers (Heckman, 2015). The theory, therefore, recognises that individuals and households allocate time between non-market work, market work and leisure subject to time, budget and household technological constraints (Stancanelli, Donni and Pollak, 2012).

This model brings in the value of non-market time when pricing a commodity or activity. For instance, the value of a good (meal) or service (medical check-up) is often attributed to its market price without considering the time spent in preparing the meal or visiting a doctor. Meanwhile, this time should have been spent productively. This implies that in valuing a commodity or activity the market price, as well as production time, need to be summed up (Becker, 1965). The forgone earnings in the labour market are used to value time spent for non-market work (Mattila-Wiro, 1999. Therefore, when discussing the time spent on non-market work, the indirect costs should be taken into consideration.

Becker's theory assumes that individuals aim at maximising a single household (more details on this is discussed in section 2.2.3) utility derived from the consumption of different commodities/activities produced at home or in the market which are dependent to some extent on time (Chiappori and Lewbel, 2015). This utility-maximising household is subject to a budget constraint, which consists of the time individuals in the household used in the labour market to earn income and non-labour income (Pollak, 2012). Nonetheless, commodities or activities vary depending on the mix of goods and the time needed to produce them. Time-intensive activities/commodities include childcare, washing clothes or preparing food, while goods-intensive activities/commodities include amongst others childcare outside the home or in house nanny, washing machine or fast food.

Becker (1965) ascertain that the income and substitution effects of the individual work-leisure model still hold and extending these effects between time and goods–intensive commodities/activities, provide a more inclusive and realistic view of how individuals or households allocate their time. For example, a decrease in the wage rate will lead to an increase in the relative price of goods-intensive activities and will cause a substitution effect in favour of time-intensive activities. Assume a working mother whose salary was R2000 and later drops to R1000 per month, her demand for an in-house nanny will drop. As such, the time devoted to market activities (work) falls, while that of non-market activities (childcare) rises. Conversely, based on the income effect, a decrease in wage rate holding price constant will lead to an increase in the time for market work. Even so, the domination of the income/substitution effect is based on the preferences of the individual or household. The substitution between time and goods particularly within household production activities is relevant for female labour supply because women are generally more involved in non-market activities than men.

Becker's theoretical framework has been used extensively in many models to explain household behaviour such as models on nutrition, health, fertility and most especially labour supply (Grossman, 1972; Behrman and Deolalikar, 1990; Strauss and Thomas, 1995; Chiappori and Lewbel, 2015). The main advantage of this model is based on the fact that it explicitly treats the different ways in which non-market time may be put to use. As such, detailed analyses can be conducted on household members' non-market behaviour (Gronau, 1977). The model also provides a useful framework on many factors that can affect labour supply, for instance, the presence of household technology such as washing machines, lawn mowers and refrigerators. In the context of the model of time allocation, it is natural to treat such technological changes as progress in the household production function (Killingsworth and Heckman, 1986).

The allocation of time can be used to explain how individuals within a given household schedule their time between market and non-market work. Becker (1981) in his book "A Treatise on the Family" suggests that individual household members allocate their time on activities based on their comparative advantage. They will prefer to allocate more time to activities where they are more efficient. This implies that, if a household member is less productive in the labour market it will be relatively better for the individual to specialise in non-market work since it will have a lower opportunity cost to the household. Jaumotte (2003) also show that if the opportunity cost of working is lower or the elasticity of female labour supply to wages is greater than that of household production, then work will be preferred. Hence, the market efficiency of one household member will determine the allocation of time for the others in the household. As such, a household member's allocation of time will depend on the opportunities presented to him/her or other members in the household (Becker, 1965).

Although the allocation of time is useful in analysing various uses of non-market time, the originality of the model and its potential usefulness in analysing the market time of labour supply may be more superficial than real. Pollak and Wachter (1975) criticised the household production function approach, pointing out that problems will occur if the model is applied to variables that can be understood as "utilities" (numbers representing preference orderings) rather than "commodities" (the outputs of production processes). As a result, this approach loses its uniqueness and cannot be differentiated from numerous hypotheses about the structure of the household's preferences. The activities that generate utility can be examined, but the analysis should focus on the household's allocation of time and goods in these activities, rather than in their production.

This model does not provide a satisfactory method for commodity demand and time allocation based on commodity prices. Pollak and Wachter (1975) note that analysing non-market commodity as a function of price, the household production function method needs strong assumptions about the household's technological structure which includes amongst others the absence of joint production. Assuming that the assumption is not satisfied, the price of the commodity will depend on the household consumption pattern. Therefore, the price difference between households is a reflection of the difference in technology and taste. Since commodity prices are not entirely determined by technology and goods prices, but also reflect the consumption patterns chosen by households, it is misleading to treat the demand for commodities as a function of commodity prices. If time is an input for commodities, this may be problematic, because joint production is often needed in producing these commodities.

2.3.3 The Sexual Division of Labour and Development

Gender theorists propose that in the labour market, the trade-off between a female's decision to participate involves choosing between paid work and unpaid household work. The latter includes inter alia different forms of investment in oneself, and the production of goods and services for the household and the family (Mincer, 1962; Becker, 1965; Mackintosh, 1993). Although the time fathers spend with their children has increased in recent decades (Gauthier, Smeeding and Furstenberg, 2004; Hook, 2006; Höfner, Schadler and Richter, 2011), research shows that mothers are still engaged in more child-related work at home, regardless of their employment status (Hamermesh, Frazis and Stewart, 2005; Miranda, 2011; Cawley and Liu, 2012).

Building on the allocation of time, Bakker (1999) ascertains that the act of cleaning, managing a household, washing clothes, cooking and caring for a family member, friend and neighbour refer to reproductive labour. The sexual division of labour is the division between reproductive and productive work (Bullock, 1994; Barker, 1999; Lundberg, 2010; Bird and Codding, 2015). Based on the sexual division of labour, women are mostly responsible for household production (reproductive work), while men are mostly responsible for market work (productive work). Though this is partly seen as a rational strategy to maximise household welfare, it is also partly due to inherent differences between the genders (Becker, 1981).

Women have a comparative advantage in household production not only because averagely they have lower earnings potential than men in the labour market due to lower human capital investments[9], but because biological differences make women more productive in the household (Becker, 1981)[10]. In addition, based on the economic dependency approach (Brines, 1994), wives are predominantly responsible for housework because of their economic dependency on their husbands. The greater the comparative advantage the husband has in market work, resulting from higher levels of human capital development (education or income), the less time he will invest in reproductive labour (Bianchi et al., 2000).

In a family setting, the issue of childbearing and caring also sets in. As seen in the previous section this is a highly time-intensive commodity. Parents LF status is an important determinant of time devoted to childcare. When both parents are not working or one not working, the unemployed parent particularly mothers spend more time on childcare (Miranda, 2011). Due to the traditional gender division of labour (women spend less time in paid work compared with men), working mothers in most cases spend more time on childcare than non-working fathers (Miranda, 2011).

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[9] Based on the human capital theory the differences in earnings between employees, both men and women, are ascribed to differences in educational levels, years of experience, and the skills a person acquires (Borjas, 2009; Leibbrandt et al., 2012).

[10] He notes that "Women not only have a heavy biological commitment to the production and feeding of children, but they also are biologically committed to the care of children in other, more subtle ways" (Becker, 1981: 37).

Brines (1994) argues that the contribution of husbands to housework does not follow logical rules of economic exchange. In most cases, when a husband depends on his wife economically, he is more likely to do less housework as a way to reiterate his masculinity (Brines, 1994). Recent research shows that the sexual division of housework is becoming less unequal between men and women over time. This is partly a result of women doing less housework (Cooke and Baxter, 2010; ILO, 2017), and both men and women now spending considerable time on childcare (Craig, 2006; Höfner, Schadler and Richter, 2011). However, the egalitarian rule of gender division of housework depends on the society under study. Cooke (2006) argues that in a patriarchal society, men's preferences may determine the division of household work.

According to neoclassical theorists, women are mostly involved in household production because they have a greater preference for family life than men, as such, are willing to make many sacrifices for the family (Folbre, 1994). Nevertheless, others argue that societal expectations for men and women in terms of work make it more complex for women than men to decide whether or not to participate in the LF (Coleman, 1999; Davis and Greenstein, 2004; Wall and Arnold, 2007; Lundberg, 2010). The heavy burden placed on women by housework responsibilities reinforces segregation in productive occupations (Folbre, 1994; Carr and Chen, 2004; Bloom et al., 2009). Hence, women's decision to supply labour tends to depend on complex needs including gender determined non-market responsibilities, social goals for well-being, financial necessity and personal interest (Coleman, 1999). Lim (2002) further notes that the opportunity cost of having children significantly rises as a result of conflict between women's reproductive and productive roles and that if this persists fertility rates are more likely to decrease, especially as women become more educated.

The gender composition of LF shows systematic changes through long-term economic development (Olivetti, 2013; Tsani et al., 2013; Lechman and Kaur, 2015). Heath and Jayachandran (2016) note that the female labour supply is U-shaped in development. For instance, both rich and poor countries have high LFP rates, but in the early stages of development, the participation rate of poor countries decreases (Fatima and Sultana, 2009). During the early stages of economic development (that is, a shift from subsistence agriculture to an industrialised and labour-intensive economy) the LFPR for women declines and as the country develops further, it starts to increase (Olivetti, 2013; Chaudhary and Verick 2014; Atasoy, 2017). This is known as the U-shaped hypothesis (Boserup, 1970; Goldin, 1994). There is now an extensive amount of research favouring this hypothesis (Mammen and Paxson, 2000; Lee and Wolpin, 2010; Alesina, Giuliano and Nunn, 2013). Generally, the literature proposes that sectoral shifts and structural changes in employment and production have important repercussions for the dynamics of FLFP (Gaddis and Klasen, 2014). Several factors contribute to this U-shaped pattern, some of which can cause the FLFPR to either increase or decrease.

Boserup (1970) for instance, established that men's privileged access to education and new technology in the early stages of development supersede women. However, as development progresses, women gain access to education and technology, leading to an increase in FLFR. These long-term changes interact with women's responsibilities as reproducers and producers and subsequently lead to the Feminisation-U development (Cagatay and Ozler, 1995). In contrast, it is observed that men's labour force fall with economic development (ILO, 2017).

2.3.4 Unitary Model of Household Labour Supply

The unitary model is typically associated with Gary Becker (Grossbard, 2011). This model provides an in-depth analysis of how the household acts as a unit. The main difference with the neoclassical individual model is that it adds symmetry[11] to the assumptions of the individual labour supply function which are; homogeneity and satisfaction of the Slutsky conditions (Fortin and Lacroix, 1997; Beblo, 2001). In line with the individual labour supply model, households aim at maximising household utility while minimising the household production cost (Becker, 1965). This approach is the oldest and still the most common way of representing household decision-making.

Alderman et al. (1995) ascertain that this model is called the unitary model because it describes how households are assumed to act as one. It is sometimes called the altruistic model, the common preference model, or the benevolent dictator model (Alderman et al., 1995). These labels reflect how households are hypothesised to act as a unit. One of the assumptions of the

[11] Symmetry means that, for example, the effect of a change in the husband's income on the work effort of the wife should be the same as the effect of a change in the wife's income on the work effort of the husband (Ashenfelter and Heckman, 1974).

model is the existence of a household head, who is a benevolent dictator and makes decisions based on the best interest of all other members of the family/household to maximise family/household well-being. This suggests that the household head monitors the activities of other household members and is altruistic. Thus, the household is regarded as a single utility maximising individual, though for the different household members it may allow for differing prices (Alderman et al., 1995; Anderson and Grossman, 2009; Grossbard, 2011). Other assumptions were noted by Becker (1964; 1965), Chiappori, (1992), Alderman et al. (1995) and Beblo (2001) which are as follows:

i) The household consists of two or more members with common preferences.
ii) Household resources (capital, income, labour and land) are pooled. This is called the income pooling hypothesis which means that the intra-household allocation of resources is independent of those who receive non-labour income.
iii) The inequitable distribution of resources or leisure within a household represents a willful act by all household members (Pareto-efficient outcomes within households).
iv) Households combine time and market goods to produce more basic commodities that directly enter their utility functions.

Income and substitution effects are applicable in this model. Assuming a decrease in the income of a family member, this will have a pure income effect and will cause other family members to increase their labour supply. This is because with the income pooling hypothesis assumption the decrease in income of one household member reduces the income available to be spent by the household. This will motivate other members in the household to supply their labour. What differentiates the unitary or joint household model from the basic work-leisure model is the fact that there are additional substitution effects on labour supply for each family member when a member’s wage rate changes. This is known as the Slutsky cross-substitution effect (Beblo, 2001). Based on the property of the Slutsky symmetry assumption, the Slutsky cross-substitution effect needs to be equal.

To illustrate the foregoing, assume two individuals are living in a household, say persons A and B. Decreases in A’s wage should have the same effect on the labour supply of B as B’s wage decrease has on A’s labour supply. Despite the egalitarian rule of the Slutsky cross-substitution effect in the aforementioned illustration, the sign can be negative or positive, based on whether the leisure time of A is a complement or a substitute for B’s leisure time (Pencavel, 1986). A change in the wage rate of person A or B will also lead to an income effect. In most empirical estimates, it is assumed that the cross-substitution effect is zero, and only when A's wage rate changes, will there be an income effect on B's labour supply. In the unitary model, what matters is the pooled household income. The opportunity cost of household membership does not matter for the intra-household distribution of income and household demand (McElroy, 1990).

The assumption of the income pooling hypothesis might turn out to be problematic if one of the household members is not altruistic. Becker’s “Rotten Kid Theorem” in an influential article in 1974, and further discussed in his book “A Treatise on the Family” (Becker, 1981) was an attempt to solve the aggregation and enforcement problems. The main idea of the theorem is that within a household each member should have altruistic behaviour. Consequently, all members of the family or household need to act harmoniously for the best interest of the household in case they know what is good for them. Unfortunately, this theorem holds only under certain conditions[12] (Bergstrom 1989; Haddad, Hoddinott and Alderman 1994). Efficiency in a household can be accomplished through patriarchal manipulation (Hart, 1992).

The unitary model allows households to be treated in the same fashion as individuals would. This implies that the familiar assumptions, axioms and methodology of the neoclassical consumer theory can be applied (Samuelson, 1956; Chiappori, 1992; Vermeulen, 2002). As such, it is frequently used in economic analysis. The neoclassical consumer theory applies to individuals rather than groups (Browning and Chiappori, 1998). Based on Arrow’s impossibility theorem, group preference relations do not necessarily behave like individual preference relations, so they cannot be modelled in the same way (Browning and Chiappori, 1998; Jehle and Reny, 2011; Arrow, 2012). It is on this basis and other reasons that the unitary

[12] An important condition under which this theorem can hold is for the altruistic household member to have enough resources so as to change his/her transfers as a function of the decisions the other household member has taken.

model is criticised for some of its unrealistic assumptions and occasional failures when confronted with data.

Chiappori, (1992); Alderman et al. (1995) and Fortin and Lacroix (1997) postulate that although the unitary model allows price differences between household members, the assumption that all household resources are pooled (joint utility function) is problematic. This is because the way resources are allocated within households is not included in the model. The model fails to note that each household member may have resources and preferences. The assumption of a joint household utility function requires that at least one household member controls and sanctions other members who do not abide by the rules. For the joint utility function to be efficient, the model relies on altruistic behaviour in the household. Nevertheless, in real life, though altruism may exist within households, so too is self-interest. As a result, members who are out to satisfy their own needs will act selfishly. If self-interest overshadows altruistic behaviour in a household, this may have great implications for women than men in most households. This is because women face different constraints from men in terms of the allocation of labour and distribution of resources within households. This influences the choices women make and the opportunities that are available to them.

Evidence on intra-household inequality renders the assumption of pooling resources at the very least problematic (Haddad and Kanbur, 1990; Agarwal, 1994; Haddad, Hoddinott and Alderman, 1994; Iversen, 2003). There might be members in the household who have more powers than others since their income may be greater and, in some cases, resources are not distributed equally between men and women. This may influence household decision-making. Take for instance a husband and wife, in most traditional settings women specialise in non-market activities (for example, childcare and other household chores), while men specialise in market activities. Based on comparative advantage, this may reflect a rational household strategy. As such, these men tend to earn more than their wives do. If altruism does not exist in the household, the husband tends to have more powers than the wife does in decision-making, and may act in his own interest to the detriment of his wife. Thus, the central problems of cooperative conflicts are avoided in this model (Sen, 1987).

If there are children in the households, pooling resources can also become a problem. A child’s nutritional outcome depends on the gender of the household member managing household income (Blundell, Chiappori and Meghir, 2005). Male and female non-labour incomes impact differently on children's nutrition, health and demographics (Schultz, 1990; Thomas, 1990; Browning et al., 1994; Lundberg, Pollak, and Wales, 1997; Phipps and Burton, 1998; Duflo, 2003). Therefore, providing benefits (say social grant) to a specific household member (such as women) may have a significant impact on the end-use of the welfare. The income pooling hypothesis of the unitary model directly implies that targeting is not effective, because different sources of income are pooled at the household level to make decisions.

Although the unitary model does not take into account either key intra-household differences (Haddad and Kanbur, 1992) or strategic interactions identified as important in modelling household decisions, and fails methodological individualism, it still provides some insight into the intra-household distribution of welfare (Haddad, Hoddinott and Alderman, 1997; Alderman et al, 1995). For instance, investment in children (the distribution of resources amongst children). Due to parental altruism, to equalise children's wealth, parents tend to invest more in a poorly endowed child. This approach according to Behrman (1997) refers to the wealth model. Critics of the unitary model developed the collective models which try to incorporate the differences that may arise within households such as conflict of interest (Sen, 1987) and inequitable distribution of resources (Chiappori, 1992; Fortin and Lacroix, 1997; Haddad, Hoddinott and Alderman, 1997). Folbre (1986) as cited in Song (2008: 4) argues:

> *"The suggestion that women and female children voluntarily relinquish leisure, education and food would be somewhat more persuasive if they were in a position to demand their fair share. It is the juxtaposition of women's lack of economic power with the unequal allocation of household resources that lends the bargaining power approach much of its persuasive appeal."*

Even though collective models may not address all issues within households, it recognises the fact that a household is made up of different individuals who seek to further their own interests as discussed below. The difference between the collective model and the unitary model lies in the rules governing the allocation of resources. The next section focuses on the collective model.

2.3.5 Collective Household Labour Supply Models

Collective models, which also builds on the individual neoclassical model of labour supply (Pencavel, 1986; Blundell and MaCurdy, 1999) is sometimes called bargaining models (Alderman et al., 1995). Collective models address the question of how individual preferences lead to collective choice (Chiappori, 1992; Vermeulen, 2002; Cherchye, De Rock and Vermeulen, 2012). These models focus on the personalities of household members (Apps and Rees, 1988; Chiappori, 1988). In a collective model, a household is formed by individuals when it is more beneficial to them than staying alone. In this case, higher returns can be achieved because forming a family can be a more efficient way to produce household goods, or because certain goods are better produced and shared by married couples than by single ones (Alderman et al., 1995). For instance, the formation of a family can produce benefits such as companionship or love or children. The benefits that accrue from family/household formation needs to be shared across all members in the household.

The collective model is divided into two broad categories: non-cooperative approach (Apps, 1982; Apps and Jones, 1986); and cooperative approach (Ashworth and Ulph, 1981). This implies that with the collective approach, intra-household interactions contain elements of both cooperation and conflict (Agarwal, 1997). The Nash bargaining game theory (Nash, 1951, 1953) is used to include a more complex understanding of intra-household decision-making (Agarwal, 1997; Fortin and Lacroix, 1997; Chen, 2006; 2013). Within households, individuals seek to maximise their utility and household resources based on the intra-household power relationships (McElroy, 1990; Alderman et al., 1995; Agarwal, 1997; Fortin and Lacroix, 1997; Chen, 2006; 2013). The Nash models permit and resolve conflicts within the household (McElroy, 1990).

The Nash cooperative bargaining model was proposed by McElroy and Horney (1981). When household members can negotiate and enter into a binding and costless enforceable agreement, this is called cooperation. Negotiation starts at each individual's "fall-back position", that is, the outside options that determine his/her level of satisfaction if cooperation failed, also known as the "threat point" (Agarwal, 1997; Chen and Woolley, 2001; Chen, 2006). If a household member's fall-back position is higher, his/her relative valuation of goods as revealed in the household's demand becomes stronger (McElroy, 1990). Like the unitary model, the cooperative approach is characterised by generating Pareto-efficient outcomes (where no one can be made better off without someone being made worse off) in a symmetrical relationship between the individuals involved concerning available information and bargaining ability (Bourguignon and Chiappori, 1992; Agarwal, 1997).

Considering the different cooperative outcomes (which may be related to who gets what goods and services, how each member is treated, and who does what), in some cases, it may favour one party over the other. (Sen, 1987; Agarwal, 1997). That is, one person gains while the other loses. This can lead to conflict amongst the cooperating household members. As such, different possible influences, including the bargaining power of the household members will determine the outcome that will emerge. The strength of an individual's fall-back position defines his/her bargaining power (Sen, 1987; Agarwal, 1997). The fall-back position depends on what McElroy (1990) terms as the extra-household environmental parameters (EEPs). Using married individuals as an example, he defines EEPs as parameters that shift the fall-back position but have no effect on nonwage income and prices married individuals face. This includes among others incomes, parental wealth and the legal structures governing marriage and divorce, for instance, property rights. Perceptibly, someone with the strongest fall-back position tends to achieve a better outcome, than the one with weaker outside options if he/she failed to cooperate (Hart, 1992; Katz, 1997).

The non-cooperative approach developed by Leuthold (1968) relaxed the following assumptions including; enforceable and binding contracts, income pooling and Pareto efficiency. In addition to allowing different preferences between individuals, this approach also permits individual production decisions and asymmetries between those involved in information and the rules of the game (Kanbur, 1991; Lundberg and Pollak, 1993, Konrad and Lommerud, 1995; Chen and Woolley, 2001; Chen, 2006). In this case, the action of an individual is conditional on that of others (Chen and Woolley, 2001; Chen, 2006). The main aspect of the non-cooperative framework is that each person's behaviour maximises his or her well-being, hence, the equilibrium point is self-enforcing (Chen and Woolley, 2001).

Some models combine both approaches but recognise the possibilities of "separate spheres" activities in the cooperative production and/or consumption of certain joint goods or services (Agarwal, 1997). Lundberg and Pollak (1993) pioneered the concept of "separate spheres" and determined that for many small decisions in a marriage, divorce is not a reliable threat if cooperation fails. Instead, the couple may decide to remain in the marriage but on separate spheres, based on, for instance, division of labour that socially recognises gender roles that emerge without explicit bargaining. This constitutes an "internal" threat point. The couple will still bargain over jointly shared goods and services, such as meals and childcare (if children are present), and the bargaining is like a Nash cooperative game. Simply put, non-cooperative approaches are used as threat points in cooperative games (Jones 1983; McElroy 1997).

In general, in the collective approach what matters is who has control over the various sources of income (Ghatak and Madheswaran, 2014). Individuals who do not participate in the labour market may not have direct access to wages (Braunstein, 2008; Schönfeldt, Pretorius and Hall, 2013). Access to direct income is very important particularly in collective household models because individuals who contribute to the household's total income have more bargaining power compared with those who do not (Fengdan et al., 2016). Therefore, consumption vectors and financial resources will be distributed in the contributor's favour (Blundell, Chiappori and Meghir, 2005). As such, if a woman contributes substantially to the total income of the household, the distribution of household resources is more likely to be skewed towards her preferences (Braunstein, 2008; Doss, 2013). This, in turn, leads to an increase in her welfare which may spill over to her children (Schönfeldt, Pretorius and Hall, 2013). The opportunity cost of household membership matters for the intra-household distribution of income and household demand (McElroy, 1990). Although these collective models have greatly improved on the unitary model, these models still encounter conceptual and empirical difficulties.

Sen (1987) cooperative conflict model builds on the household bargaining models. Nonetheless, he criticised these models for using too restrictive informational bases and stressed the important influence of perceptions on the household bargaining process which was ignored. He argues that within a household it is individual or shared perceptions of individual contributions, interests and fall-back positions, instead of these factors' objective values that affect the intra-household allocation. For instance, each household member's contribution may be valued differently depending on the source, that is, market work versus household production or by gender. Due to "social technology", outcomes may not be efficient (Sen, 1987). For women, social norms and their perceptions of self-worth might prevent them from recognising and resisting intra-household inequality. Breen and Cooke (2005) further add that given that economic resources are a primary source of bargaining power the gendered division of labour strengthens the male's superior bargaining power in the family.

Some collective models like the Nash cooperative bargaining model by McElroy and Horney (1981) maintained some of the properties of the unitary model like homogeneity. To empirically test whether this bargaining model reduces to the unitary model, hours of work (Manser and Brown, 1980) and LFP (Bjorn and Vuong, 1984, 1985) were used. Unfortunately, it is complicated to carry out these tests. Killingsworth and Heckman (1986: 133) note that the problem with these tests is that; "*precisely to the extent that bargaining models generalise the conventional model, one in effect abandons the sharp testable implications of the latter without necessarily putting alternative clear-cut predictions in their place*." The main reason for this is that bargaining models are equivalent to Basmann's (1956) model with the presence of prices or total expenditure in the utility function. Nonetheless, it is not possible to test for a unitary model with prices in the sharing rule (Browning, Chiappori and Lechene, 2006).

The difficulty in measuring some vital variables in collective models, such as exogenous income flows under a particular individual household member's control, makes it difficult to test these models empirically. Accumulated wealth and the income accrued from this wealth is also difficult to measure for the individual. This is because, in many households, properties including assets, income or wealth might be jointly owned. Consequently, most survey questionnaires do not unravel which individual in the household has control over these properties (Killingsworth and Heckman, 1986). Therefore, empirical research is constrained by the availability of only the more conventional types of variables usually collected in surveys (McElroy, 1990).

2.3.6 Discussion of models of choice

As discussed in section 2.3.1, using just the basic neoclassical model was not suitable for the analyses performed in this dissertation. This is because the framework assumes there is no unemployment as jobs are available instantly at the market-clearing wage rates known to workers (Mortensen, 1986) and does not take into account time devoted for household production such as childcare (Becker, 1965). Therefore, it is inappropriate to explain labour supply decisions in real-life.

Many studies on household labour supply have criticised the unitary model as unrealistic and problematic when confronted with data (Chiappori, 1992; Alderman et al., 1995; Agarwal, 1997; Fortin and Lacroix, 1997; Bateman and Munro, 2003). However, it remains popular empirically. This is because no significant progress has been made in developing a common framework for collective models that are widely accepted by practitioners (Chiappori, 1992; Lundberg and Pollak, 1993). The unitary approach is also appealing because it can be used with relative ease to analyse the impact of changes in other relevant variables on individual behaviour. It can also address diverse issues (Samuelson, 1956; Chiappori, 1992; Vermeulen, 2002).

Since the unitary household model is considered to be a fairly accurate description of the situation in SA, it is appropriate for this study, particularly considering the country's patriarchal family setting (Ntuli, 2009). Conversely, there are empirical studies (Bertrand, Mullainathan and Miller, 2003; Duflo, 2003; Wittenberg, 2009) on SA that have given credibility to the collective model. Given that an individual (mother) is the main object of the analyses, while capturing important household-related MLFP determinants, important aspects of both unitary and collective household decision making were incorporated into the analyses by modelling MLFP as a function of both individual and household characteristics. The key determinants of a mother's labour supply decision analysed in this dissertation is the nutritional status of the mother and her child.

Nutrition is one of the most essential components in human capital development, which leads to higher economic productivity. Despite this, less attention has been given to its economic impact. Elia (2009) in her study on the economics of malnutrition note the following reasons for the limited literature; first, it is difficult to value the adverse consequences of malnutrition in monetary terms since the values may vary substantially depending on the disease status, life expectancy and socioeconomic status of the individuals; second, economic analysis vary and may be confused with one another or misunderstood. As such, a formal economic analysis has not been incorporated in most research designs on malnutrition; third, most often malnutrition coexists with other diseases making it difficult to separate their independent effects particularly as they both influence each other. Consequently, the economic costs of malnutrition and disease-related malnutrition are often considered together. This study seeks to establish how malnutrition influences maternal labour supply decisions. Before discussing the link between malnutrition and labour supply, it is important to first understand the basic concept of malnutrition. This is discussed in the next chapter.

2.4 Summary

This chapter explored the state of female labour force participation around the world and some economic theories on labour supply. It was evident that globally and in Africa women compared with men participate less in the labour market. Based on the different labour supply theories, an individual's labour supply decision is dependent on time, which is a scarce resource. The neoclassical theory of labour supply treats a household as a single and unproductive unit. In this case, time was used for either paid work or leisure. However, Becker's theory on the allocation of time extended the work-leisure framework by treating a household as comprising of other members and a productive unit with time used for market and non-market work. The unitary model assumes the household acts as an entity. For the sexual division of labour, in a patriarchal society, women tend to bear the responsibility of household production. While the sexual division of development followed a feminisation u-shape.

The collective theory identified that individuals come to an agreement based on their threat point and that members within a household can either enter a cooperative or non-cooperative agreement. In a nutshell, these theories showed that apart from individual characteristics, household characteristics are important aspects in determining maternal labour supply. The selected theories applicable in this thesis are the unitary and collective approaches. It was quite clear that female labour force participation is very complex and theoretically, there are many contradicting factors concurrently at play. One possible factor that can affect a mother's decision to work or not is her or her child's nutritional status. The next chapter focuses on the concept of malnutrition.

CHAPTER THREE

GENERAL INFORMATION ON MALNUTRITION

3.1 Introduction

The nutritional status of a given population indicates progress in health and community productivity in that society. The outcome of poor nutrition is malnutrition, which mostly affects women and children (Siddiqui et al., 2020). The nutritional status of mothers, both undernutrition and overnutrition, are linked to pregnancy outcomes and the subsequent nutrition and health of their children (Salam et al., 2015). Maternal malnutrition is a key contributor to poor fetal growth, intrauterine growth restriction and low birth weight (Abu-Saad and Fraser, 2010). The adverse effects of maternal and child malnutrition include short-term consequences, such as the increased risk of mortality and morbidity as well as long-term consequences, such as decreased economic productivity and increased risk of non-communicable diseases later in life (Black et al., 2008).

By providing an understanding of malnutrition and highlighting its different aspects, this chapter establishes a framework for analysing the relationship between maternal and child nutritional status, and maternal labour supply. The chapter starts with an understanding of the different forms of malnutrition and their related consequences. It then goes further to look at the extend of malnutrition in the world and finally what triggers malnutrition.

3.2 Classification and consequences of malnutrition

In 1963, the Council on Foods and Nutrition of the American Medical Association defined nutrition as the science of food, the nutrients and substances therein, their interactions, actions and balance about disease and health, as well as the process by which organisms ingest, digest, absorb, transport, utilise and excrete food substances (Council on Foods and Nutrition, 1963). It is a central aspect of the Sustainable Development Goals (SDGs) (Hawkes and Fanzo, 2017). Malnutrition is an indication of poor nutrition (Bain et al., 2013).

There is no universally accepted definition for the term malnutrition (Saunders and Smith, 2010). It has been used to describe excess, deficiency or imbalance of a wide range of nutrients needed by the body, which results in a measurable adverse effect on body form, tissue and function (Shetty, 2003; Roseboom, De Rooij and Painter, 2006; Saunders, Smith and Stroud, 2015; Das and Gulshan, 2017; Mamić et al., 2018). Stein (2010) highlights that in humans, malnutrition refers to chronic hunger. It is also known as hidden hunger because those who suffer from it do not feel the immediate effect (Faber and Wenhold, 2007; Burchi, Fanzo and Frison, 2011).

The different definitions of malnutrition represent its different forms and are discussed in the following section. Generally, the term malnutrition is commonly used as an alternative for undernutrition, but it is a broad term that also reflects overnutrition (Kurz and Johnson-Welch, 2001; Faber and Wenhold, 2007; Black et al., 2008; Arthur et al., 2015; Das and Gulshan, 2017). Figure 3.1 presents the different forms of malnutrition that manifest differently in an individual as will be expounded in this sub-section.

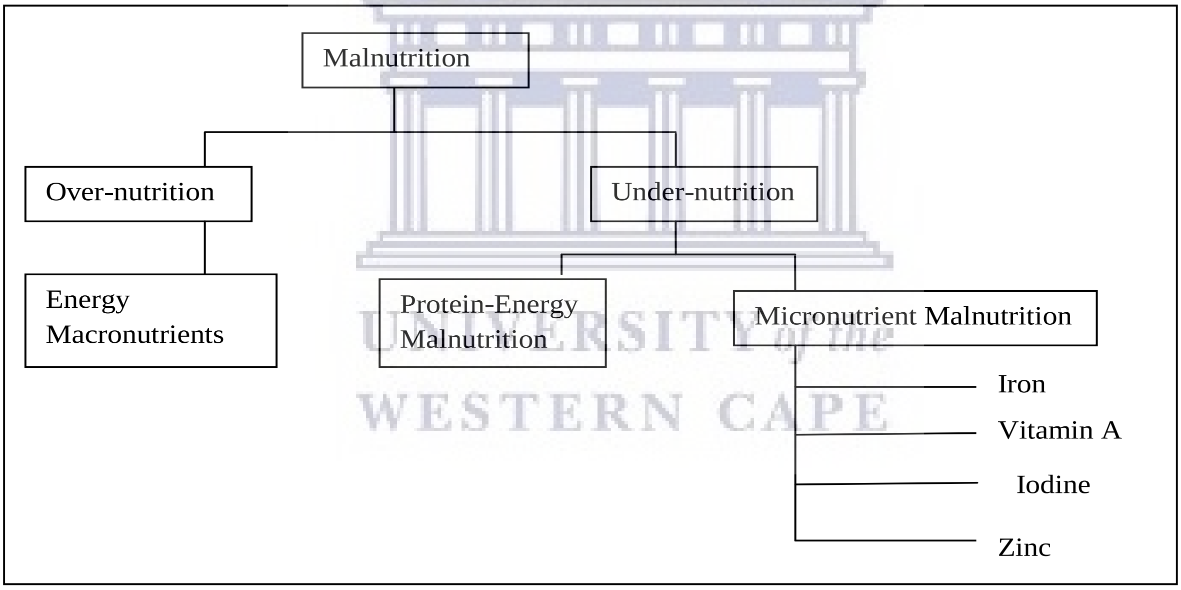

Figure 3.1: Classification of Malnutrition
Source: Faber and Wenhold (2007)

3.2.1 Undernutrition

Failure in consuming the required micro and/or macronutrients (protein and energy) for growth and development combined with interactions from infections, leads to undernutrition (Shetty, 2003; Reddy et al., 2009; Babu, Gajanan and Hallam, 2016). Although children and adults suffer from undernutrition, adult undernutrition receives less attention than childhood malnutrition (Arthur et al., 2015), and it is linked with behavioural disorders and the development of the brain's neurochemistry, anatomy and metabolism (Black et al., 2008). Undernutrition is further classified as protein-energy malnutrition (PEM) and micronutrient malnutrition (Faber and Wenhold, 2007). The different forms of undernutrition are briefly explained below. However, protein-energy malnutrition is the main focus of this research since the data used in this research cannot be used to fully understand or estimate micronutrient deficiency.

3.2.1.1 Micronutrients Deficiencies:

Micronutrients are nutrients (mainly vitamins and minerals) that humans need throughout their lives to perform a wide range of physiological functions (Burchi, Fanzo and Frison, 2011; Prado and Dewey, 2014). When measured for all individuals, micronutrient deficiency is defined as a functional lack of one or more essential vitamins and minerals (Bailey, West Jr and Black, 2015). Iron, iodine, zinc and vitamin A are the most common and clinically significant micronutrient deficiencies in children and women of reproductive age worldwide (Faber and Wenhold, 2007; Harika et al., 2017). Nonetheless, the three most prevalent micronutrient deficiencies are; Iron Deficiency Anaemia (IDA), Iodine Deficiency Disorders (IDD) and Vitamin A Deficiency (VAD) (Kretchmer, Beard and Carlson, 1996; Kennedy, Nantel and Shetty, 2003; Faber and Wenhold, 2007; Mirmiran et al., 2012).

IDA is a term used to signify an individual's deficiency in oxygen-carrying red blood cells (Black, 2003; Kennedy, Nantel and Shetty, 2003; Camaschella, C., 2015). ***IDD*** is used to signify an individual's deficiency in iodine. Iodine is an element found in some animal proteins such as eggs, meat, milk and seaweed (Kennedy, Nantel and Shetty, 2003; Pehrsson et al., 2016). It is needed for the synthesis of two thyroid hormones; tri-iodothyronine and thyroxine, and the regulation of the body's metabolism (Kapil, 2007; Zimmermann and Andersson, 2012; Choudhry and Nasrullah, 2018; Panth, Guerin and DiMarco, 2019). ***VAD*** has also been identified to be harmful to human health and is a major nutritional challenge facing public health in developing countries (West Jr, 2002, 2003). Vitamin A is required for the growth and repair of all body tissues (Mirmiran et al., 2012). Deficiencies in iodine, iron and vitamin A, are a major hazard to the development of a healthy population and affects particularly pregnant women and children in low-income countries (Crush et al., 2011).

3.2.1.2 Protein-Energy Malnutrition (PEM):

PEM is defined as a lack of sufficient macronutrients (energy or protein) to meet the body's metabolic needs due to insufficient dietary protein intake, increased demand due to disease, or increased nutritional loss (Kuhlmann et al., 2007; Uchendu and Atinmo, 2011; Kathleen and Hammond, 2016). PEM is present at any stage in life but is more common in the extreme ages that is, during infancy/childhood and in the elderly (Castaneda et al., 1995; Jensen et al., 2009). According to Tanphaichitr (1994) and Akombi et al. (2017), stunting, underweight and wasting are indicators used to detect PEM in children, while Body Mass Index (BMI) is used for adults.

Stunting: It refers to growth faltering or short height for age (Waterflow, 1974; DeBoer et al., 2012, Martorell and Young, 2012; Mamić et al., 2018). It is an indicator of long-term or chronic food and nutrition deprivation (Tanphaichitr, 1994; Müller and Krawinkel, 2005; Duggan and Golden, 2005; Briend, Khara and Dolan, 2015; Pomati and Nandy, 2020) that starts in the uterus (Onis, Frongillo and Blössner, 2000; Shetty, 2003) and serves as a proxy of the effects of socioeconomic development on the well-being of children (Zottarelli, Sunil and Rajaram, 2007; Willey et al., 2009; McGovern et al., 2017; Mary, 2018). It is the first clinical symptom of malnutrition (Piercecchi-Marti et al., 2006). Women with developmental delays pose risks to the health, survival and development of their offspring (Lawn et al.2009; Dewey and Begum, 2011). Early life growth restriction is not only related to short stature in adulthood, but also certain metabolic disorders and chronic diseases in adulthood (Victora et al., 2008). Stunting is likely a common cause of short stature and brain damage, thus delaying the development of cognitive functions and permanent cognitive impairments (Kar, Rao and Chandramouli, 2008; Hoddinott et al., 2013). This decrease learning ability in school (Ricci and Becker, 1996; De Onis et al., 2013).

Wasting: It refers to a health problem whereby a child's weight is too low in proportion to his/her length/height (Waterflow, 1974; Martorell and Young, 2012). It is caused by a lack of weight gain or weight loss (Ricci and Becker, 1996) as a result of ill-health and/or food and nutrition deficiency (Tanphaichitr, 1994; Duggan and Golden, 2005; Richard et al, 2012; Pomati and Nandy, 2020). It occurs very early in life, but the prevalence peaks at the age between 12 to 24 months (Ricci and Becker, 1996). It is used as an indicator of acute malnutrition (Briend, Khara and Dolan, 2015). Tanphaichitr (1994); and Briend, Khara and Dolan (2015) ascertain that if both moderate and severe wasting is not treated the affected individual is likely to become stunted resulting in severe acute malnutrition (SAM). Wasting in children is life-threatening (UNICEF, WHO and World Bank 2019) and compromises the provision of fuel to vital organs, such as the liver, kidney, heart, gut and the immune system particularly if there is the presence of infection (Briend, Khara and Dolan, 2015) and it is severe (UNICEF, WHO and WB, 2019).

Underweight: It refers to a situation where an individual's weight is low for his/her age (Blössner, De Onis and Uauy, 2006; Mgongo et al., 2017), either because of wasting or stunting or both (Pomati and Nandy, 2020). It is a composite indicator that includes both acute and chronic malnutrition in children (Mgongo et al., 2017). Underweight may be difficult to interpret since it is a composite indicator. Therefore, underweight children may also be stunted, wasted or both (Myatt et al., 2018; Khan, Zaheer and Safdar, 2019). It is common in children and is an important manifestation of PEM, but overlooked many times. Children will fail to gain weight or lose weight, and/or experience a slowdown of linear height if there is inadequate protein and/or energy in their diet (Lifshitz, 2009). This occurs when the children are exposed to an acute food shortage (Golden and Golden, 2000). They must be identified early through growth monitoring[13] (Garner, Panpanich and Logan, 2000; Lifshitz, 2009).

Underweight in adults: Body mass index (BMI) is an index value often used as a measure of body fat computed from the anthropometric measurement of weight and height (Kuhlmann et al., 2007; Chung, 2015). BMI which is defined as the weight (kilograms) divided by height (m) squared, is used to reflect the nutrition status of adults (Wenhold and Faber, 2008; Nuttall, 2015). Height is a measure of past nutritional status (Perkins et al., 2016) and reflects in part the cumulative effect of social and economic outcomes on access to nutritious foods during childhood and adolescence (Moradi, 2010). An adult is said to be chronic energy deficient when his/her BMI < 18.5kg/m^2. Black et al. (2008, 2013); Senbanjo et al. (2013); Arthur et al. (2015); and Negash et al. (2015) further note that while undernutrition remains a problem amongst children, overnutrition which was usually a problem in developed countries is now

[13] Growth monitoring is a process of regularly weighing and/or measuring height, and comparing the results with a standard (Mangasaryan, Arabi and Schultink, 2011)

increasingly prevalent amongst all population groups in developing countries, particularly women and children (Kimani-Murage et al., 2010).

3.2.2 Overnutrition

Overnutrition is defined as the excess consumption of calories or nutrients, which is severe enough to cause disease or increase the risk of disease (Greve, 2008; Arthur et al., 2015). It is associated with overweight and obesity[14]. Studies on malnutrition have indicated that the development of obesity starts in early childhood (Rossouw, Grant and Viljoen, 2012; Black, et al., 2013). Stunted children are at increased risk of obesity later in life (Sawaya and Roberts, 2003; De Lucia Rolfe et al., 2018). Overweight and obesity are one of the main risk factors for many NCDs (Esmailnasab, Moradi and Delaveri, 2012) such as; diabetes (Greve, 2008; Wang et al., 2014), cardiovascular diseases, cancer (Prospective Studies Collaboration, 2009; Nethan, Sinha and Mehrotra, 2017) and musculoskeletal disorders (Anandacoomarasamy et al., 2008; Krul et al., 2009; Viester et al., 2013).

Mortality caused by malnutrition may result from the different morbidities associated with malnutrition. The risk of mortality from under- and over-nutrition varies in terms of the cause and timing of death (Caulfield et al., 2004; Rodríguez, Cervantes and Ortiz, 2011). Cardiovascular diseases which are a major cause of mortality in most developed countries are now very common in developing countries (Black et al., 2008; Senbanjo et al., 2013; Negash et al., 2015). The rise in mortality from NCDs is thought to be linked to nutrition transition (Crush, Frayne and McLachlan, 2011; Steyn et al., 2012). Nutrition transition refers to change in lifestyles and dietary habits (Schönfeldt, Pretorius and Hall, 2013). It is characterised by a shift from traditional diets to a more westernised diet (Tydeman-Edwards, Van Rooyen and Walsh, 2018). Traditional diets mostly have low salt, sugar and fat content, and are high in fibre which prevents the risk of developing NCDs (Popkin, 2006). Western diets are mostly associated with a high risk of developing NCDs due to low carbohydrate and fibre, and high fat content in the diet (Bourne, Lambert and Steyn, 2002).

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[14] Obesity is characterised by an excess of body fat or adiposity (Güngör, 2014) and can develop in the absence of a poor diet and persist even after switching to a healthier diet (Bourke, Berkley and Prendergast, 2016)

3.3 Extent of malnutrition[15]

The purpose of this section is to provide estimates of the state of malnutrition amongst women and children both globally and within Africa as a whole and Southern Africa region based on the indicators that are pertinent to this thesis. Globally, almost a third of people suffer from at least one form of malnutrition. Based on current trends, it is projected that this might change to one in two people by 2025 (Branca et al., 2019). The next section focuses on malnutrition amongst women.

3.3.1 The state of malnutrition amongst women (globally, Africa and Southern Africa)

This section provides a review of the levels of underweight, overweight and obesity amongst women globally, in Africa at large and Southern Africa region.

3.3.1.1 Underweight

Globally, according to the 2018 Global Nutrition Report, amongst women aged 20-49 years the rate of underweight ($BMI<18.5kg/m^2$) decreased from 11.6% in 2000 to 9.7% in 2016, while for adolescent girls aged 15-19 years the rate of underweight[16] increased from 5.5% to 5.7% (Development Initiatives, 2018). According to the Global nutrition report (2020), for those 18 and above, the rate of underweight decreased from 11.5% in 2000 to 9.4% in 2016. Figure 3.2 shows the global trend of underweight amongst women aged 15-49 years between 2000 and 2016.

[15] Two systemic review papers will be developed from this section

[16] Those greater than two standard deviations below the median weight-for-age of the WHO Child Growth Standards (Development Initiatives, 2018).

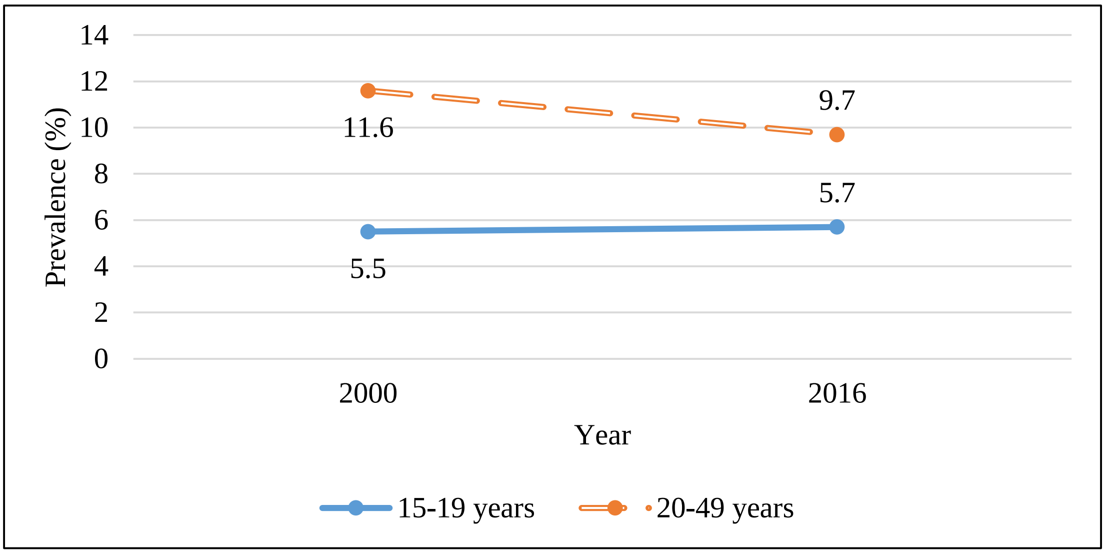


Figure 3.2: Global trend of underweight amongst women aged 15-49 between, 2000-2016
Source: *Development Initiatives (2018)*

3.3.1.2 Overweight and obesity in adults

Ng et al. (2014) in their report, found that from 1980 to 2013, the proportion of those overweight and obese increased in both developing and developed countries. According to their research results, between 1980 and 2013, the global prevalence of overweight and obesity in men increased from 28.8% to 36.9%, and in women, it increased from 29.8% to 38.0%. In 2014, more than 1.9 billion adults over the age of 18 were overweight, and more than 600 million of them were obese (Nuertey et al., 2017). Similarly, in 2014, 13% of the global adult population, 11% of men and 15% of women were obese (Biadgilign et al., 2017). The majority of the world's populace live in regions where overweight and obesity cause more deaths than underweight (Antwi et al., 2013; Raeisi et al., 2017). The findings of Ng et al. (2014) show that though the age-standardised rate is lower than that of developed countries, about 64% of obese people in the world live in developing countries. Figure 3.3 provides the global trend of overweight (BMI≥25 kg/m^2)[17] and obesity (BMI≥30 kg/m^2) amongst women age 18+.

[17] This measure also includes obese individuals.

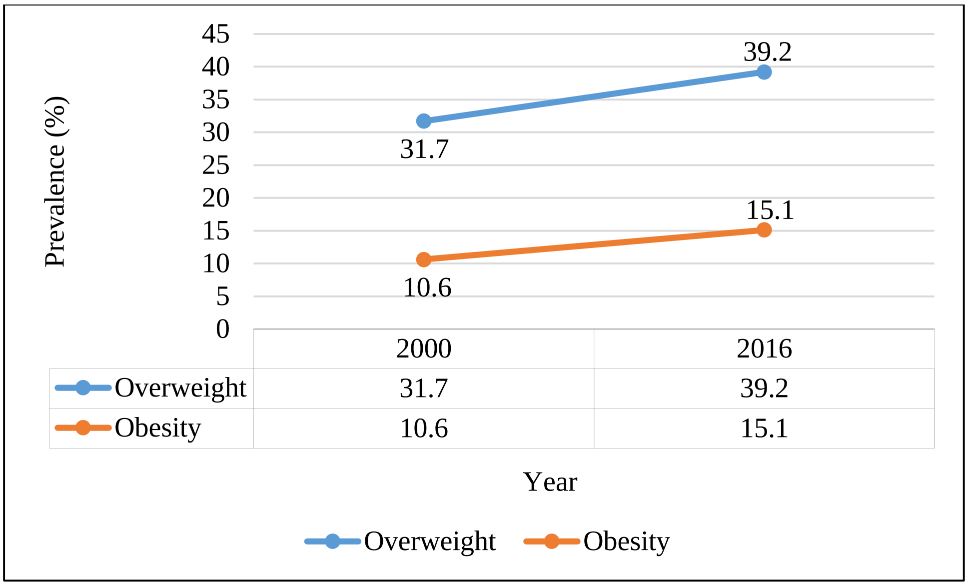


Figure 3.3: Global trend of overweight and obesity amongst women age 18+, 2000-2016
Source: Global Nutrition Report (2020)

Since 1990, overweight has increased in all WHO African regions, although the magnitude of the increase varies from region to region. In all the countries included in the sample, women have a higher prevalence of overweight than men (Agyemang et al., 2015). Amongst the 46 countries sampled, only 2 countries had an obesity rate above 10% in men. But in women, 17 countries had an obesity rate above 10% (Agyemang et al., 2015). The increased risk of overweight and obesity in Africa is related to urbanisation. Therefore, most urban populations have higher rates of overweight and obesity than rural populations (Agyemang et al., 2009; Ziraba, Fotso and Ochako, 2009; Benkeser et al., 2012; Kandala and Stranges, 2014). It was estimated that in 2008, approximately 20-50% of the urban population in Africa was overweight or obese (Ziraba, Fotso and Ochako, 2009).

3.3.2 Incidence of childhood malnutrition (globally, Africa and Southern Africa)

This section focuses on previous research findings on the rate of childhood malnutrition particularly stunting, wasting, underweight and overweight/obesity globally, in Africa at large and Southern Africa region.

3.3.2.1 Stunting

Stunting is the most common form of childhood malnutrition (De Onis and Branca, 2016). The UNICEF, WHO and WB (2012) point out that stunting affects a large number of children around the world. Based on data from 576 nationally representative surveys from 148 countries, which includes surveys since 1966, De Onis, Blössner and Borghi (2011) estimate that in 2010, nearly 171 million children under the age of five were stunted, with about 167 million living in developing countries. Global findings by De Onis, Blössner and Borghi (2011) indicate that childhood stunting significantly decreased from approximately 40% in 1990 to 27% in 2010 and approximately 26% in 2011 (UNICEF, WHO and WB, 2012; Black et al., 2013).

Additionally, the global rate of stunting within the United Nations (UN) regions decreased from 32.6% in 2000 to 22.2% in 2017 (UNICEF, WHO and WB., 2018). Looking at the global trend, it shows that stunting amongst under-five children has decreased significantly over the years. Moreover, the absolute number also decreased from 198.4 million in 2000 to 150.8 million in 2017. The study on the global trend of childhood stunting from 1990 – 2013 by De Onis and Branca (2016), also corroborate this finding. Figure 3.4 shows the global trend of stunting estimates from 1990-2019 within UN regions.

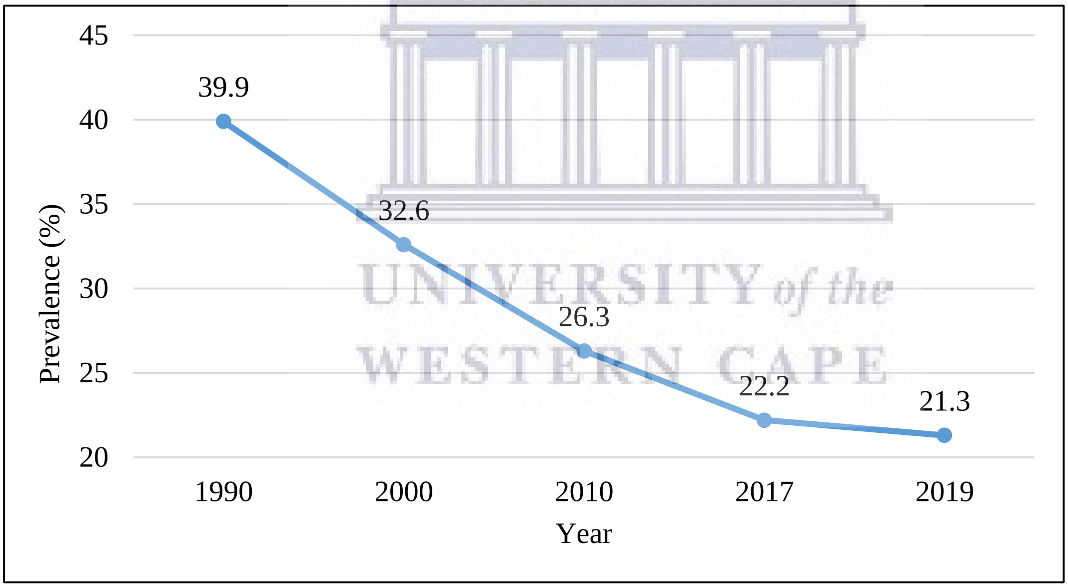


Figure 3.4: Global trend of stunting amongst children under 5 within UN regions, 1990-2019 Source: UNICEF, WHO and WB (2012, 2018, 2020)

The global trend of stunting prevalence between 1990-2019 as seen in Figure 3.4 indicate a significant decrease in stunting amongst under 5 children. Though the prevalence of stunting in developed countries has been stable at 6% since 1990 and is expected to remain at this level, that of developing countries decreased from 44.4% in 1990 to 29.2% in 2010 (De Onis, Blössner and Borghi, 2011; Stevens et al., 2012; Oruamabo, 2015). It is generally noted that stunting is associated with poverty and poor socioeconomic and environmental conditions (Keino et al., 2014; De Onis and Branca, 2016). Stunting persists in developing countries due to contaminated water supplies which leads to a cycle of enteric infections and malnutrition (Checkley et al., 2008; Smith, Stoltzfus and Prendergast, 2012).

In Africa, the prevalence of stunting in children stagnated at around 40% between 1990 and 2010 (De Onis et al., 2013). Given the population growth, this means that the number of stunted children increased from 45 million in 1990 to 60 million in (2010) According to data from UNICEF, WHO and WB (2018), the rate of stunting in the region dropped from 38.3% in 2000 to 30.3% in 2017. However, in absolute terms, the number of stunted children under 5 years of age increased from 50.6 million in 2000 to 58.7 million in 2017[18]. Within the Southern Africa region, the rate of stunting decreased from 33.1% in 2000 to 29.1% in 2017 (UNICEF, WHO and WB, 2018). Figure 3.5 presents the trend of stunting estimates within the UN African and Southern Africa region respectively from 1990-2019.

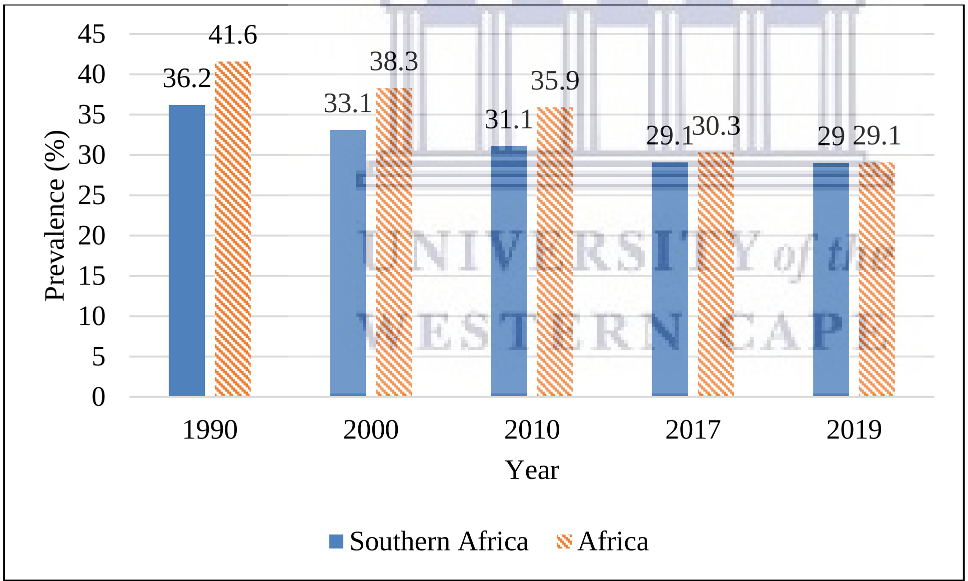


Figure 3.5: Trend of stunting amongst children under 5 in UN African and Southern Africa region, 1990-2019
Source: UNICEF, WHO and WB (2012, 2018, 2020)

[18] The stunting rate in some African countries decreased significantly. For instance, Ethiopia reduced the stunting rate from 57% in 2000 to 44% in 2011, Ghana from 34% in 1993 to 29% in 2008, and Mauritania from 55% in 1990 to 22% in 2012 (De Onis et al., 2013).

It can be seen from Figure 3.5 that in Africa the rate of stunting has decreased significantly between 1990-2019. For Southern Africa, there is a slight change between 1990-2019.

3.3.2.2 Wasting

Wasting is another critical form of malnutrition that also affects children worldwide. Based on an analysis of 388 national surveys from 139 countries for the UN regions and applying comparable methods, the global rate of wasting for 2005 was estimated to be 10% (Black et al., 2008). Globally, in the UN regions, 52 million (8%) children under five years suffered from wasting in 2011, and most of the global burden of wasting (acute undernutrition) occurred in developing countries (UNICEF, WHO and WB, 2012). The global prevalence of wasting decreased from 9.1% in 1990 (UNICEF, WHO and WB, 2012) to 7.4% in 2015 (UNICEF, WHO and WB, 2016). In 2017, approximately 50.5 million (7.5%) children under five years were wasted (UNICEF, WHO and WB, 2018). The trend estimate for wasting over the years as shown in Figure 3.6 reveals that there has been progress in the reduction of wasting though very minimal between 1990 and (2019)

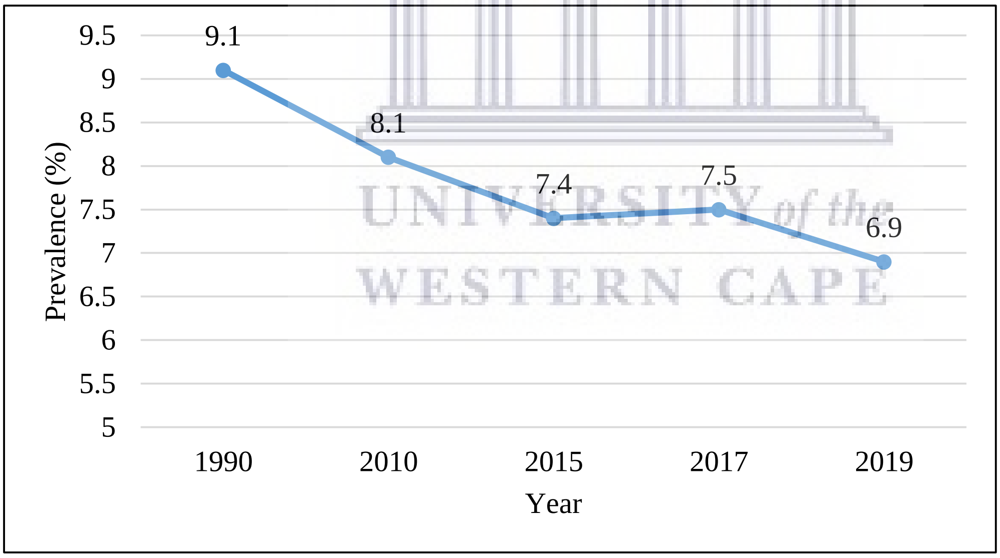


Figure 3.6: Global trend of wasting amongst under 5 children within UN regions, 1990-2019
Source: UNICEF, WHO and WB (2012, 2016, 2018, 2020)

In Africa as a whole, and the Southern Africa region, the rate of wasting decreased from 8.7% and 4.7% in 1990 (UNICEF, WHO and WB, 2012) to 7.1% and 4.0% in 2017 respectively (UNICEF, WHO and WB, 2018). Figure 3.7 presents the prevalence of wasting amongst children under 5 years of age in the UN African and Southern Africa regions in 1990-2019.

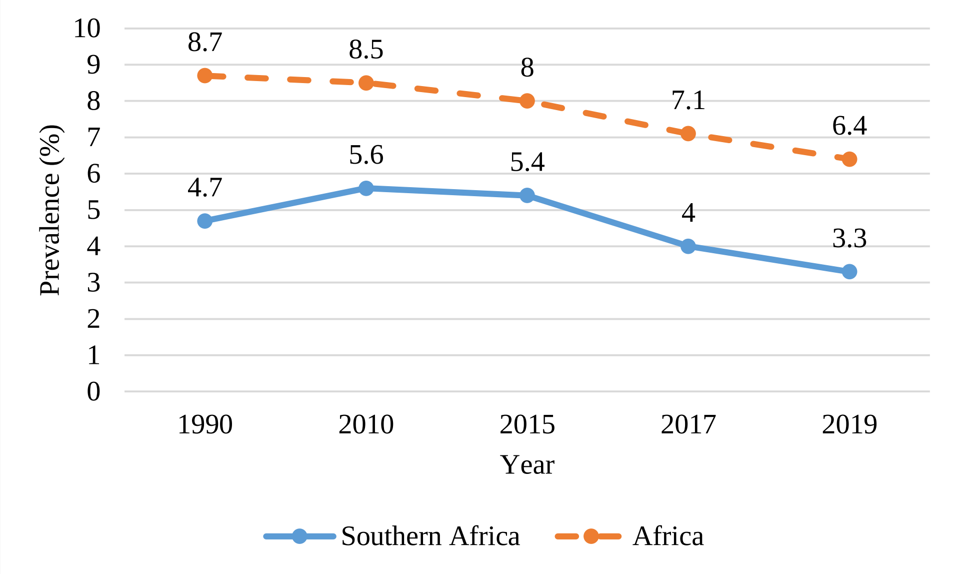


Figure 3.7: Estimates of wasting amongst children under 5 in UN African and Southern Africa region, 1990-2019
Source: UNICEF, WHO and WB (2012, 2016, 2018, 2020)

As seen in Figure 3.7, the estimates indicate a slight decrease in the rate of wasting across Africa in general and Southern Africa in particular between 1990-2019.

3.3.2.3 Underweight

Global estimates of underweight like that of stunting and wasting also decreased. According to UN estimates, in 2011, more than 100 million children under 5 years of age were underweight in the world, which is 36% less than the 159 million estimated in 1990 (Black et al., 2013). The global prevalence of underweight amongst children under 5 years of age decreased from approximately 25.1% in 1990 (UNICEF, WHO and WB, 2012) to 13.6% in 2017 (WB, 2020). The global trend of underweight from 1990-2019 is shown in Figure 3.8.

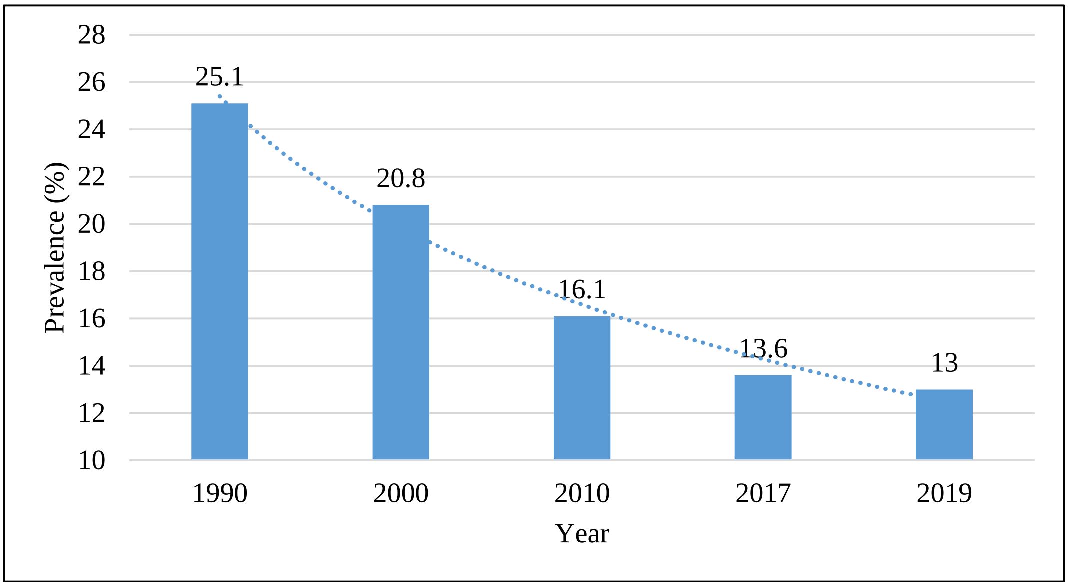


Figure 3.8: Global estimates of underweight amongst under 5 children within UN regions, 1990-2019
Source: UNICEF, WHO and WB (2012); WB (2020) and WHO (2020)

The rate of underweight also decreased within the UN Africa and Southern Africa region from 22.7% and 12.1% in 1990 (UNICEF, WHO and WB, 2012) to 14.2% and 8.2% in 2019 respectively. In Figure 3.9 the trends of underweight in Africa and Southern Africa from 1990 to 2019 are presented.

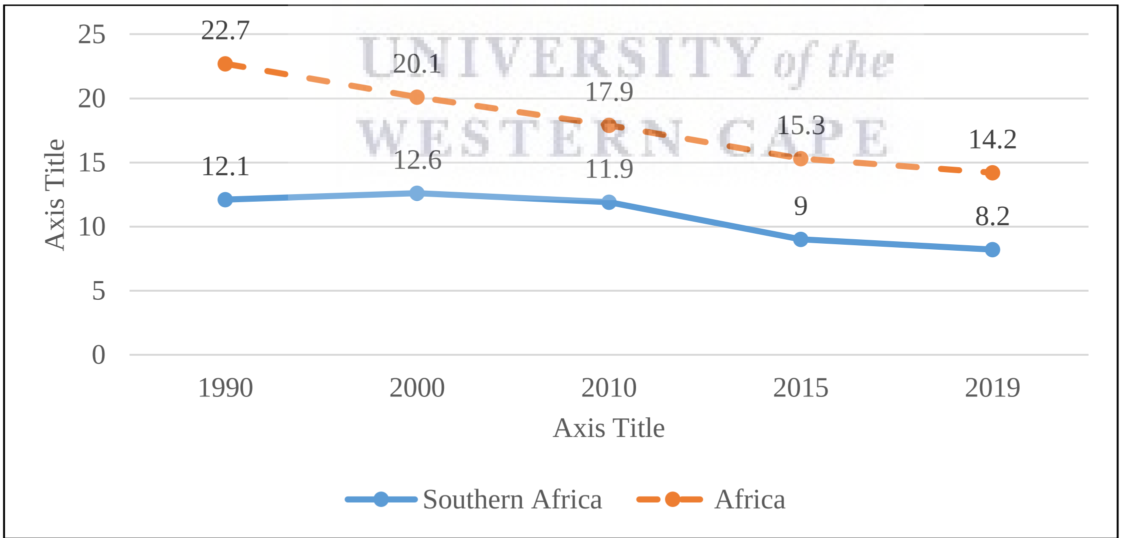


Figure 3.9: Estimates of underweight amongst children under 5 in UN African and Southern Africa region, 1990-2019
Source: UNICEF, WHO and WB (2012); and WHO (2020)

Although estimates of stunting, wasting and underweight for children under five have declined worldwide since 1990, overall progress has not been enough and millions of children remain at risk.

3.3.2.4 Overweight and obesity in children

Childhood overnutrition (overweight and obesity) associated with high-income countries is now common in low-income countries (Ziraba, Fotso and Ochako, 2009; Bhurosy and Jeewon, 2014; Biadgilign et al., 2017) and WHO considers it to be a serious public health challenge, especially in low- and middle-income countries. Globally, it is another form of childhood malnutrition that is emerging greatly (Black et al., 2013). The number of children who were overweight or obese globally nearly doubled from 5.4 million in 1990 to 10.6 million in 2014 (Biadgilign et al., 2017). The increasing trend in overweight amongst children is noticed in most parts of the world. In 2011, approximately 43 million (7%) children under 5 years were overweight globally, an increase of 54% compared with the 28 million estimated in 1990 (UNICEF, WHO and WB, 2012; Black et al., 2013). In 2000, the global rate of obesity was 4.9% which later increased to 5.6% in 2017 (UNICEF, WHO and WB, 2018). The emergence of overweight and obesity has been shaped, at least inter alia, by greater access to processed foods and industry marketing, alongside lower levels of physical activity (UNICEF, WHO and WB, 2018). Figure 3.8 presents the global trend of overweight and obesity amongst children under 5 years of age from 1990 to 2019.

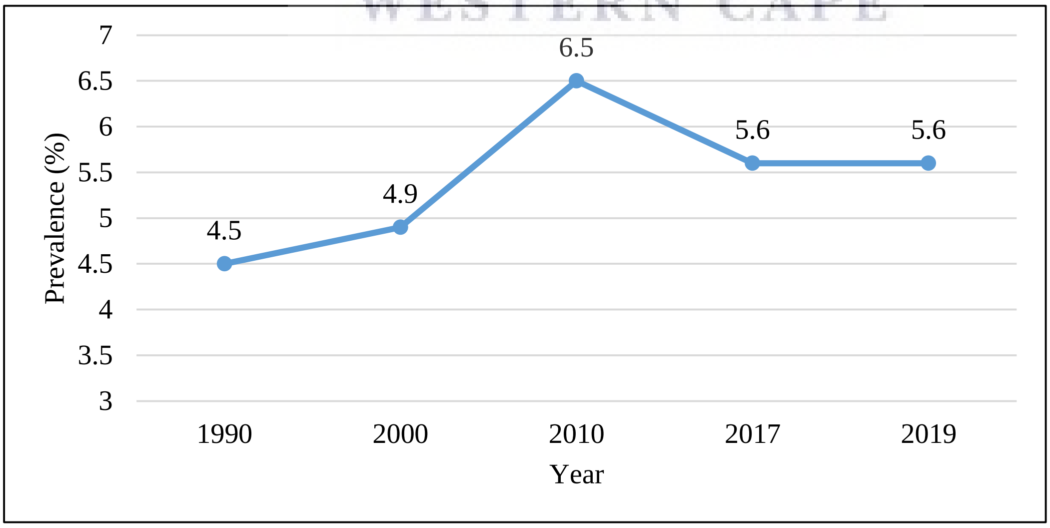


Figure 3.10: Global trend of overweight (including obese) children under 5 within UN regions, 1990-2019
Source: UNICEF, WHO and WB (2012, 2018, 2020)

In Africa, the estimated prevalence of overweight amongst children below the age of 5 increased from 4% in 1990 to 7% in 2010 (Black et al., 2013). Nevertheless, the proportion of overweight children under 5 years remained stagnant at 5% between 2000 and 2017, although the absolute number increased from 6.6million in 2000 to 9.7 million in 2017 (UNICEF, WHO and WB, 2018). In the Southern Africa region, the rate increased from 10.3% in 2000 to 13.7% in 2017. Figure 3.11 provides the trend of overweight amongst children under the age of 5 in UN African and Southern Africa region between 1990-2019.

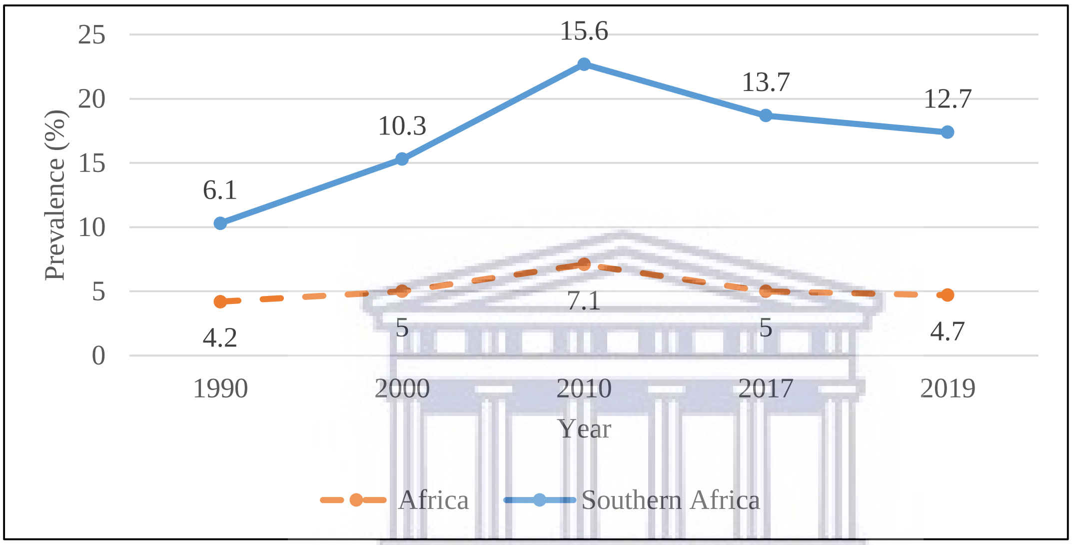


Figure 3.11: Trend of overweight (including obese) children under 5 within UN Africa and Southern Africa region, 1990-2019
Source: UNICEF, WHO and WB (2012, 2018, 2020)

Childhood overweight/obesity is increasingly becoming a global challenge. Therefore, monitoring the trend is very important. Malnutrition is caused by many factors, which are discussed in the subsequent section.

3.4 Determinants of Maternal and Child Nutritional Status

Maternal nutrition refers to the nutritional needs of women before they conceive and during antenatal and postnatal periods (Ramakrishnan et al., 2012; Shukla et al., 2014). Spreading awareness of the importance of maternal nutrition before, during and after pregnancy, and promoting lifestyle changes for women of childbearing age, in favour of healthy weight before conception is crucial (Barrett et al 2015; Cetin and Laoreti, 2015; Stephenson et al., 2018).

Globally, the causes of maternal and child malnutrition can be addressed using the framework in Figure 3.12 developed by UNICEF (Jonsson, 1993; Blössner and De Onis, 2005; Black et al., 2008; Pangaribowo, Gerber and Torero, 2013). Figure 3.12 presence the conceptual framework of malnutrition developed by UNICEF.

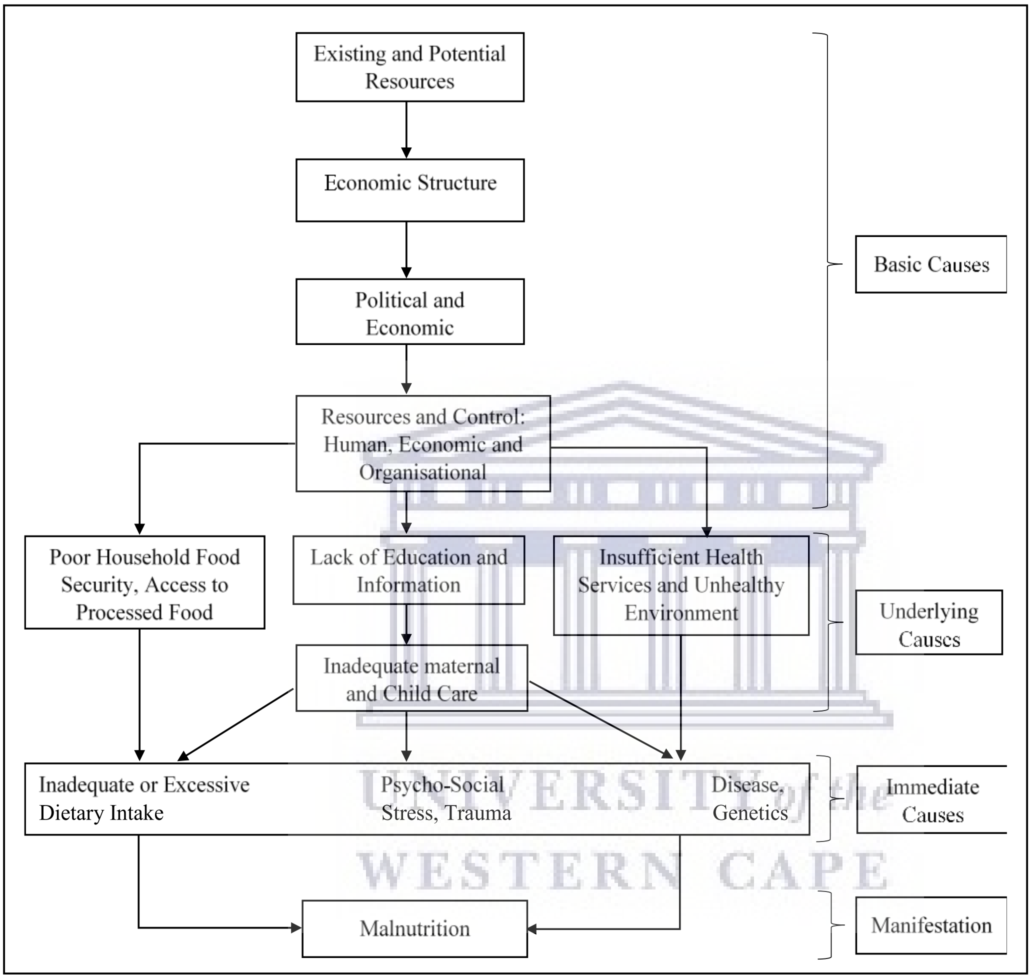


Figure 3.12: The Hierarchically Conceptual Framework of Malnutrition
Source: UNICEF (1991); Haddad, Cameron and Barnett (2015)

Pridmore and Hill (2009) underscore that this framework is important because effective intervention to address the problem of malnutrition can only be possible if the multiple causes of malnutrition are clearly understood. This framework also indicates that the causes of malnutrition are separated into three broad groups that are the basic (societal), underlying (household/community) and immediate (individual) causes (Blössner and De Onis, 2005; Burgess, 2008). These factors interrelate with each other to cause malnutrition and are complex and multidimensional (Agbozo, Atito and Abubakari, 2016).

3.4.1.1 Basic causes of malnutrition

At this level, four major factors govern society and can cause malnutrition. These are social, cultural, environmental and political factors (Ijarotimi, 2013). Social factors include income poverty which may be caused by lack of education, unemployment or low wages; environmental factors include floods, drought, and earthquakes; cultural factors include fertility practices and women's autonomy, and its impact on malnutrition depends on the ethnic groups and geographical areas (Reinhardt and Fanzo, 2014); and political factors may include policy decisions and economic situations caused by a financial crisis, war or inflation. The availability and control of potential human and economic as well as organisational resources at the household level is been determined by these factors. These factors also control the degree of social justice in communities and the status and women's autonomy (Pridmore and Hill, 2009). These basic factors lead to the underlying causes of malnutrition discussed in the next section.

3.4.1.2 Underlying causes of malnutrition

On this level, households' deficits in food security[19], inadequate access to health care and healthy environment, and poor social and care environment interact to cause malnutrition. This is summarised as "food security, health and care" factors.

***Food insecurity*:** The definition of food security already includes nutrition, but it is not sufficient (Gross et al., 2000; Pieters et al., 2013; Shetty, 2015). The need to incorporate nutrition into food security has evolved. The nutrition approach adds care practices, health services and healthy environments to the definition and concepts of food security (Pangaribowo, Gerber and Torero, 2013; El Bilali et al., 2019). This led to what is more precisely known as "nutrition security", which is defined as a situation whereby an individual or household has adequate nutritional status in terms of protein, energy, vitamins and minerals at all times (Quisumbing, 1995). Thus, in principle, it outweighs food security.

[19] According to the acceptable definition of food security, food security is achieved when at all times, people have physical and socioeconomic access to adequate, safe and nutritious food which meets their dietary needs and food preferences for an active and healthy life (Food and Agricultural Organisation, FAO, 2008; Hart, 2009).

Food is the source of micro- and macro-nutrients for humans (Lenoir-Wijnkoop et al., 2011). Although adequate intake of nutrients does not ensure an individual's nutritional status, insufficient intake does not usually mean deficiency, but it can cause problems (Nnakwe and Yegammia, 2002). Household food insecurity will affect food consumption, which in turn affects the dietary diversity and nutritional status of family members (Black et al., 2008; Mutisya et al., 2015; Jomaa et al., 2017; Chakona and Shackleton, 2018). Cook et al. (2004) add that food insecurity is experienced in its most severe form when individuals, including children, are hungry and undernourished. This may result from the unavailability of food, lack of social or economic access and/or insufficient food utilisation.

Food availability[20] in the market determines the price that an individual or household pays for food. For an individual or household that is completely dependent on food produced in their garden or field, the market availability of food and its price may not matter (Babu, Gajanan and Hallam 2016). However, for individuals or households that depend on the food market, their income levels and prices, as well as other factors such as taste, preference for certain foods, sociocultural norms and religion, can have an impact on household food availability.

Food access[21] can be hampered by poverty. Poverty is one of the reasons why some families cannot produce or buy more food (Black et al., 2008). People with low socioeconomic status are the most vulnerable to food insecurity because purchasing power is the main determinant of their ability to buy nutritious food. Households that do not have access to nutritious foods due to income poverty are mostly associated with poor diets and diseases (Govender et al., 2017; Vilar-Compte et al., 2021). Drewnowski and Specter (2004); Han and Powell (2013) and French et al. (2019) note that poor households are more likely to purchase high energy-dense foods (such as processed foods and sugar-sweetened beverages) due to their low cost.

[20] The extent of food within the reach of an individual or household in terms of sufficient quantity and quality (FAO, 2008).

[21] It is achieved when an individual/household has an opportunity to sufficient food quantity and quality to secure safe and nutritious diet (FAO, 2008)

***Inadequate social and care environment*:** Maternal and child care influence their nutrition and health (Amugsi et al., 2014; Saaka, 2014). Childcare involves timely child feeding practices, support and cognitive stimulation for children, and health-seeking behaviours. A mother's ability to supply nutrients for her baby depends on her body composition, nutritional status and body size (Adair, 2014).

Before a woman becomes pregnant, her diet helps in determining her reproductive health and importantly influences the healthy development of her infant (Martin-Gronert and Ozanne, 2006; Berti et al., 2016; Baïz et al 2019). Hence, a baby's optimal nutrition starts before conception (Bhutta et al., 2013; Prentice et al., 2013; Cetin and Laoreti, 2015). As such, an infant's optimal growth and development, health and foetal survival, is directly influenced by the mother's nutritional status. Negash et al. (2015) concur that growth and development is a key indicator of child health and nutritional status.

The nutritional status of a woman during pregnancy and lactation plays a vital role in determining her health and well-being and the short- and long-term health of her child (Abu-Saad and Fraser, 2010; Senbanjo et al., 2013; Adair, 2014; Berti et al., 2016). During pregnancy and lactation, nutritional requirements are high due to the need to support fetal growth and the secretion of breast milk (Dewey, 2016). Therefore, providing a nutritious diet to pregnant and lactating women can significantly improve the health of pregnant women and babies.

An easy way to achieve optimal infant and young child nutrition is to encourage mothers to breastfeed exclusively for the first 6 months (WHO and UNICEF, 2003; Jama et al., 2020), and then to introduce nutritionally adequate, safe, appropriate age and responsive supplementary feeding from 6 months of age (Ijarotimi, 2013). Martin, Ling and Blackburn (2016); and Hossain et al. (2018) concur that breast milk is the perfect source of nutrients for infants. Breast milk contains sufficient protein, carbohydrates and fat (Czosnykowska-Łukacka, Królak-Olejnik and Orczyk-Pawiłowicz, 2018). It also provides digestive enzymes, minerals, vitamins and hormones that infants need (Martin, Ling and Blackburn, 2016; Léké et al., 2019) and can decrease the risk of chronic diseases later in life (Gunderson, 2008; Motee and Jeewon, 2014). This poses a challenge for women in low-income settings, as their access to nutritious food is often limited (French et al., 2019).

The lack of nutrition education amongst nursing mothers or caregivers can also affect their caring capacity (Jama et al, 2020). Nutrition education can be defined as any knowledge aimed at promoting voluntary adoption of diet and nutritional behaviours that lead to a healthy lifestyle (Contento, 2008). Nutrition education empowers consumers to choose, enables women to improve the nutrition of children as well as improve the educational achievements of children (Pepino, 2014). Nutrition education, therefore, provides individuals with the knowledge needed to make the right food choices and prepare healthy meals required by them and their families to promote a healthy life. It also helps individuals to distinguish credible nutrition information from misleading commercial food advertisements.

Poor healthcare services: The health of a given population depends partially on access to health care (Kuruvilla et al., 2016), with the major determinants ranging from health services available to the quality and efficiency of professionals, and finance to access general and/or specialised care by patients (Ataguba and McIntyre, 2012). Lack of a well-resourced health system, low coverage of cost-effective health interventions, poor health information and management systems, and inefficient use of limited resources have resulted in very high preventable maternal and infant mortality, and poor social and economic conditions (Stenberg et al., 2014). This may be because families that rely on inadequate health services are more susceptible to diseases, which can lead to malnutrition.

Poor environmental conditions: Unsafe water, poor sanitation and hygiene can to malnutrition through infections (WHO, 2015; Mbuya and Humphrey, 2016; Mshida et al., 2018; Shrestha et al., 2020). Water, sanitation and hygiene (WASH) are very important for improving the nutritional status of women and children (Fink, Günther and Hill, 2011). According to Fink, Günther and Hill (2011); Smith, Stoltzfus and Prendergast (2012); and Cumming and Cairncross (2016) poor hygiene, unsafe water and poor sanitation are directly related to undernutrition in mothers and children through three key pathways: diarrhoea, intestinal worms (soil-transmitted helminths) and environmental enteric dysfunction (EED). Unwashed hands before food preparation and child feeding can cause diarrhoea pathogens (Bourne, Pilime and Behr, 2013; Nizame et al., 2013; Chidziwisano et al., 2019). Saaka (2014) note that protecting children's food and beverages from contamination can reduce the risk of infection. Also, WASH is linked to maternal and child malnutrition indirectly through the time taken to fetch water and the cost incurred to purchase water from vendors when it is not readily available at home (Stewart et al., 2013). This affects the quantity and quality of water consumed and the hygiene practices, which in turn impacts nutrition.

Climate change also contributes to malnutrition (Sheffield and Landrigan, 2011; Dietz, 2020). According to Lloyd, Kovats and Chalabi (2011); and Lake et al. (2012) there is growing concern that global climate change may be a threat to efforts geared at reducing undernutrition in the coming decades. Based on scientific assessments, global warming might have an overall negative effect on major cereal yields in low-latitude areas, though there will be an increase in yields in some high-latitude areas (Lloyd, Kovats and Chalabi, 2011). The implication of this in the low-latitude areas is the reduction of the quantity of cereal consumed by the population. Dietz (2020) note that a decrease in greenhouse gases will improve food security and preserve the protein and micronutrient content of crops.

Overpopulation with discrepancies in distribution can put further strain on the environment's ability to feed people. Overpopulation is a breakdown of the ecological balance in which the population exceeds the environment's carrying capacity (Mora and Sale, 2011). This is a challenge for food production, which leads to insufficient intake and/or consumption of non-nutritious foods, and consequently leads to malnutrition (Blössner and De Onis, 2005; Bain et al., 2013).

According to Madhavan and Townsend (2007); Sani and Kemaw (2019); and Ahmed and Abah (2014), household size which is a measure of the number of people in a household also affects the nutritional status of an individual. Populated households are expected to consume more food than less populated ones (Owoo, 2021). The greater the number of inactive people in the household, the greater the burden on the active people in providing food, which tends to increase the possibility of food insecurity (Amaza et al., 2009). This may lead to malnutrition. However, Datar (2017) ascertain that family size may have a negative relationship with childhood obesity. Children with siblings are more likely to eat with their family and less likely to eat out. Mills et al. (2017) postulate that meals prepared at home are healthier due to the method of preparation, dietary variety and/or intake of healthier food groups. The interaction of these underlying factors of malnutrition leads to the direct causes of undernutrition that are discussed in the next section.

3.4.1.3 Immediate causes of malnutrition

The immediate causes of malnutrition at the individual or household level are dietary intake and health status. At this level, inadequate dietary intake and illness, for instance, interact negatively to contribute to malnutrition (Saunders and Smith, 2010; Smith and Haddad, 2015; Babu, Gajanan and Hallam, 2016). Hence, nutrition is a function of health status and food intake, which results from the basic right through to the underlying causes of malnutrition.

Poor dietary intake: If an individual does not have an adequate diet, he/she is more likely to be malnourished. Inadequate dietary intake results from the underlying causes of malnutrition discussed above, which interact to cause this problem. For instance, an individual may have access to food but if they are not washed with clean water or cooked properly, this will eventually affect the quality of the food and may lead to undernutrition. On the other hand, excessive consumption of high energy-dense foods is likely to lead to overweight/obesity (Han and Powell, 2013; Stelmach-Mardas et al., 2016).

Genetic factors**:** Maternal malnutrition is intergenerational. This is because its effect can last beyond the generation it acts on (Annan, 2000; Martorell and Zongrone, 2012; Ntenda, 2019). For instance, undernourished mothers are more likely to give birth to children who cannot survive to 5 years or may die during childbirth (Cesani, Oyhenart and Pucciarelli, 2014). The intergenerational cycle of growth failure often indicates that girls who grow poorly, particularly stunted girls, are more likely to give birth to low-birth-weight[22] babies (De Onis and Branca, 2016; Ntenda, 2019). This is partly because maternal size has a major influence on birth weight. If these babies are girls, they are likely to continue the cycle of stunting until adulthood and so on (Prendergast and Humphrey, 2014). Teenage pregnancy also increases the risk of low birth weight (Khashan, Baker and Kenny, 2010; Guimarães et al., 2013) and it becomes difficult to break the cycle. Figure 3.13 summarises the cycle of growth failure reviewed.

[22] Low-birth-weight is defined as an absolute weight of <2500 g irrespective of gestational age (Metgud, Naik and Mallapur, 2012; Aryastami et al., 2017; Cutland et al., 2017)

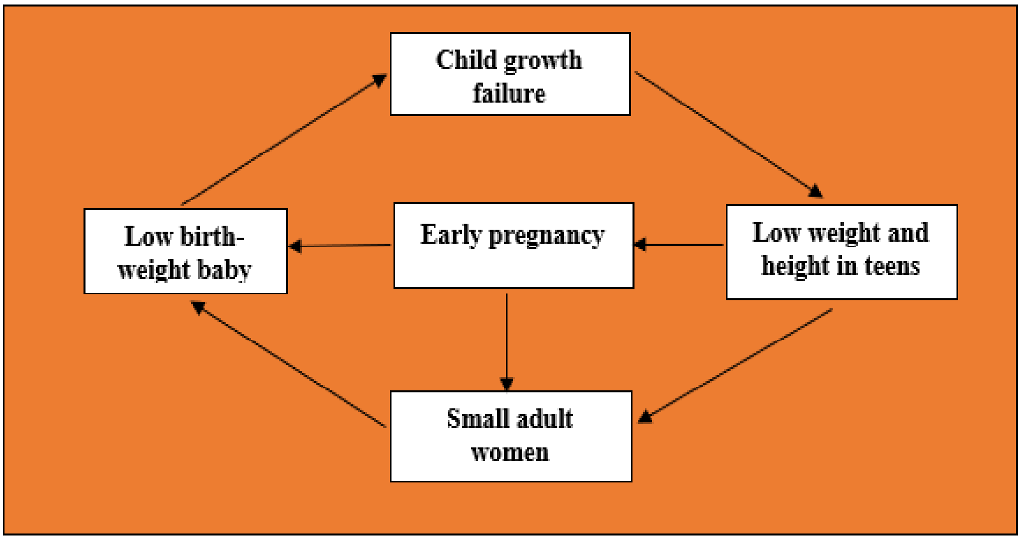


Figure 3.13: Intergenerational cycle of growth failure
Source: Adopted from Desie (2016)

In addition, overweight/obese parents are more likely to have overweight/obese children (Herrera and Lindgren, 2010; Fuemmeler et al., 2013; Thaker, 2017). However, genetic factor accounts for less than 5% of cases of childhood obesity (Sahoo et al., 2015).

Health Status: There are strong interactive relationships between health status and nutrition (Katona and Katona-Apte, 2008; Dewey and Mayers, 2011; Jones et al., 2014). Health and nutrition are closely interrelated through a "malnutrition-infection cycle" whereby malnutrition causes an individual to be more susceptible to disease and disease contributes to malnutrition (Keusch, 2003; Katona and Katona-Apte, 2008; Rodríguez, Cervantes and Ortiz, 2011; Rodriguez-Morales et al., 2016). A malnourished individual has a weak immune system and is more susceptible to infections like diarrhoea (Katona and Katona-Apte, 2008; França et al., 2009; Jones et al., 2014) and respiratory disease (Schaible and Kaufmann, 2007; Farhadi and Ovchinnikov, 2018). Infections such as AIDS, malaria, measles, respiratory infections, intestinal worms and diarrhoea, increase an individual's potential for and/or severity of undernutrition through loss of appetite and nutrients, and malabsorption of nutrients through vomiting or diarrhoea (Katona and Katona-Apte, 2008; Jones et al., 2014). If the metabolism of an individual's body is altered, the risk of malnutrition turns to be greater. In developing countries, infectious diseases such as acute respiratory infections (ARI) and diarrheal diseases (DD) account for most nutrition-related health problems (Mutua et al., 2015). The spiral of malnutrition and infection is shown in figure 3.14.

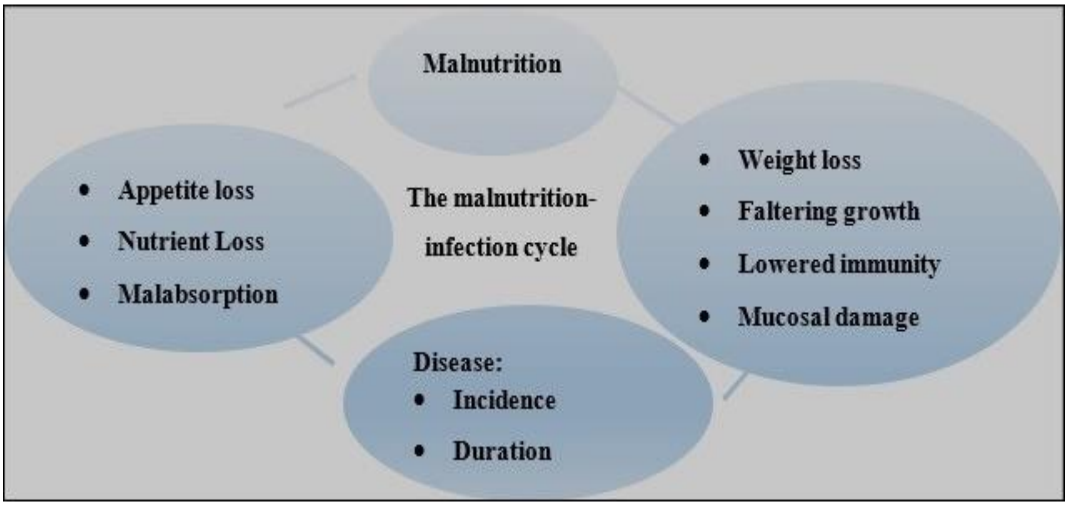


Figure 3.14. The "vicious cycle" of malnutrition and infection
Source: Katona and Katona-Apte (2008); Jones et al. (2014) and Rodriguez-Morales et al. (2016)

Apart from diseases, fertility is also a determinant of malnutrition. Inappropriate birth spacing is associated with a higher risk of childhood malnutrition particularly stunting and underweight (Starbird, Norton and Marcus, 2016; Vaivada et al., 2020; Yaya et al., 2020). This is because mothers of these children may lack the physiological recovery from the preceding birth (Yaya et al., 2020) or have not replenished the essential nutrients needed by these subsequent babies (Davis et al., 2014; Starbird, Norton and Marcus, 2016). Conversely, mothers with short inter-pregnancy intervals compared to mothers with longer inter-pregnancy intervals are more likely to be obese after childbirth because they may not have lost the weight gained in the previous pregnancy (Davis et al., 2014). Therefore, it is necessary to pay special attention to girls, whose nutritional status, cognitive development and educational level determine the quality of the next generation.

The distribution of the different causes of malnutrition in a given population will determine which and how many families are at risk of malnutrition, the severity of the problem, and the resources that may be needed to solve the problem. Malnutrition in the early stages of life is associated with an increased risk of diseases, poor cognitive and physical development, and low productivity and economic development later in life (Iversen et al., 2011).

Malnutrition is a problem at both the micro and macro levels because it places a heavy burden on the economy. At the micro-level malnutrition imposes a substantial burden on the individual. It increases an individual’s chances of mortality, morbidity, discrimination, social exclusion, sickness and under-productivity. At the macro-level there is pressure on the healthcare system; the gross domestic product (GDP) and tax revenue decreases; government expenditure on unemployment benefits increases; and businesses are faced with increased operating costs (McCormick, Stone and Corporate Analytical Team, 2007). This is the focal point of the next chapter.

3.5 Summary

This chapter examined the different forms of malnutrition which are divided into two broad categories: undernutrition and overnutrition. Concerning undernutrition, focus was on stunting, wasting, and being underweight amongst women and children, while for overnutrition both overweight and obesity amongst women and children were reviewed. It was seen that globally, in Africa and Southern Africa, the major form of malnutrition affecting children under the age of five is stunting followed by overweight and obesity. For women, the dominant form of malnutrition is overweight and obesity. Nonetheless, based on the estimated value the rate of undernutrition is declining while overnutrition is on the rise. The causes of malnutrition as seen in the literature are multidimensional and interrelated, and fall within three main levels; the basic, underlying and immediate levels. It was apparent from the review that malnutrition has devastating consequences on an individual’s health, and physical and mental development, and its effect will be largely felt in the labour market. The next chapter examines the relationship of malnutrition with labour supply.

CHAPTER FOUR

NUTRITION AND LABOUR MARKET SUCCESS

4.1 Introduction

The objective of this chapter is to review the theoretical and empirical literature on malnutrition pertinent to female labour supply. The aim is to review what others have observed. . The chapter starts with a discussion on theories that link malnutrition to labour supply. It then goes further to discuss the potential correlation between malnutrition and labour market outcomes as possible correlation makes malnutrition an endogenous variable. Other studies that have looked at the link between malnutrition and labour market outcomes are also discussed.

4.2 Theoretically linking an adult's malnutrition status and Labour Supply

There are two dominant problems an individual supplying labour may face in the labour market as a result of malnutrition (Caliendo and Lee, 2013; Mosca, 2013). First, health problems caused by malnutrition reduce labour productivity and increase absenteeism due to sick leave (Goettler, Grosse and Sonntag, 2017). Second, they may be discriminated against based on their physical attributes (Rooth, 2009; Agerström and Rooth, 2011). The negative impact of malnutrition on physical and mental development is greatly felt in the labour market (Hunt, 2005; Kelishadi, 2007; Matovu, Birungi and Sebaggala 2012). The link between the nutritional dimension of health and labour supply is dynamic, complex and underestimated.

The relationship between the nutritional dimension of health and labour supply (particularly productivity) has always been an important element in theories of economic development, particularly as expressed in the nutrition-based efficiency wages (Ghatak, 2010; Dalgaard and Strulik, 2011). Using the efficiency wage hypothesis, Leibenstein (1957) was the first to depict the relationship between employment units, health, productivity and wages. According to Leibenstein (1957), the efficiency wage hypothesis model is based on the assumption that at a low income level, there is a positive relationship between food consumption and labour productivity. Mirrlees (1975); Rodgers (1975); Stiglitz (1976) and Bliss and Stern (1978) went further to formalise and extend the model.

The pioneers of this model (Leibenstein, 1957; Mirrlees, 1975; Stiglitz, 1976; Strauss, 1986; 1975) advocate that the productivity of a worker is nonlinear with his/her nutrition and that an increase in the worker's calorie intake, generates marginal productivity gains, thereby increase wages and subsequently the LFP. From the same point of view, Stiglitz's theoretical essay (1976) describes the productivity dependence of workers on the nutritional contents of their eating habits, which suggests that eating more nutritive foods has a positive effect on productivity and then, on wages.

Bliss and Stern (1978) formalised the efficiency wage theory as depicted in figure 4.1 below. According to them, the following is the productivity-consumption relationship: a working day is based on ordinary clock hours. However, "clock hours" differ from "efficiency hours". The assumption of the "efficiency hours" is that it measures the productivity of workers' efforts. This signifies that, for a given number of clock hours, a less productive worker will be expected to generate a lower number of efficient hours of labour. Figure 4.1 depicts the nutrition-based efficiency theory.

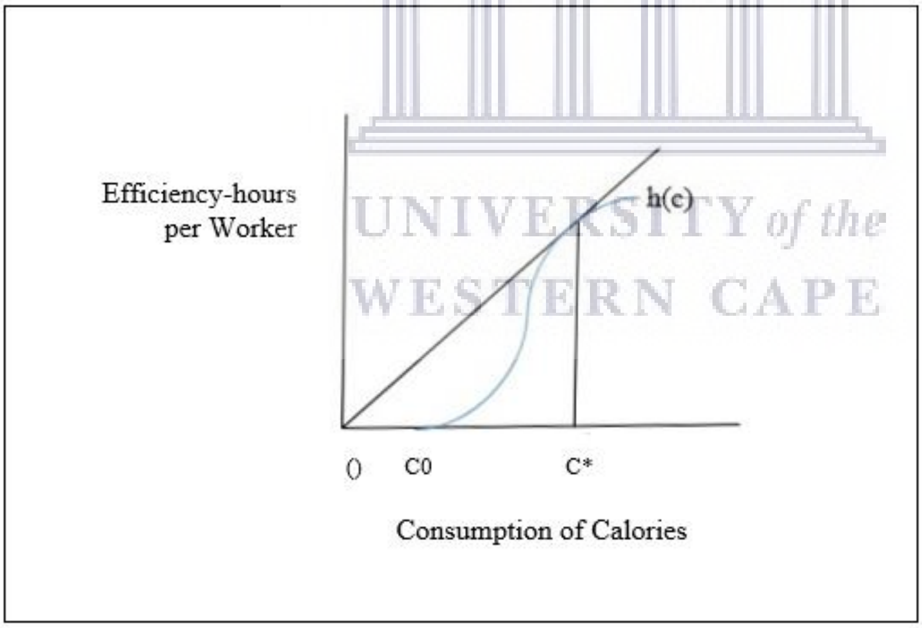


Figure 4.1: Nutrition-based efficiency wage hypothesis
Source: Aziz (1995) and Ghatak (2010)

As shown in Figure 4.1, the workers' consumption level of calories (C) determines the efficiency of labour hours, while h(c) denotes the functional relationship between efficient labour hours and consumption. Bliss and Stern (1978) assumed that

i) all workers are given the same wage w;
ii) are hired to work for the same number of clock hours and
iii) workers spend their wages on food consumption only.

As such, the relationship between efficient hours and consumption can be expressed as h(w). Let the number of clock hours worked be denoted by L, which is proportional to the number of workers hired, the number of efficient hours (y) produced is Lh(w). Therefore, $y = f[Lh(w)]$.

A certain amount of daily consumption (C_o) is required to cover the basic metabolic requirements for basic life functions. OC_o is the basic minimum requirement of food consumption per day; therefore, any amount above the OC_o level provides the energy to be spent in activities. Productivity is assumed to increase over a range of calories up to C*. In case of an additional caloric intake beyond C*, diminishing returns set. The efficiency wage hypothesis does not assert any association of wage with workers' nutritional status. It simply hypothesises that the wage paid by a cost minimising employer per efficiency-hour worked will depend on the productivity-caloric relationship. At low income levels, the technical relationship between nutrition and productivity, as assumed by the efficiency wage hypothesis, is important.

Ghatak (2010) notes that the theory does not provide a general picture because it focuses on the rural sector and the association between wages and consumption. Thus, it only applies to subsistence economies with very similar socio-economic, cultural and other characteristics. However, Aziz (1995) argues that this model is of great economic importance for decision-makers who wish to improve productivity through caloric intake and nutrition. Hence, it is a tangible investment in people's human capital. Human capital theory, which goes beyond the nutrition-based productivity wage hypothesis, considers health as a component of human capital in the process of human and economic development. Based on this theory, health has a pervasive effect on participation, hours worked, wages, job turnover, earnings, retirement and benefits packages. The effect of health on productivity determines the economic value of health.

Previous studies (Gross et al., 2000; Faber and Wenhold, 2007; Greve, 2008; Pieters, Guariso and Vandeplas, 2013) have shown that when an individual is malnourished, it negatively affects their health. As one of the components of human capital, malnutrition can be regarded as an integral input to productivity, similar to other orthodox inputs such as labour and physical capital (Weil, 2007, 2013; Amiri and Gerdtham 2013; Mahadea, 2013; Strittmatter and Sunde, 2013). Martins et al. (2011) acknowledged this by noting that health is frequently regarded as a substantial factor in the labour supply decision of an individual. This is not just because health is a form of human capital that both employers and employees value (Becker, 1964; Grossman, 1972), but also because the preferences between work and leisure by an individual may change as a result of health shocks (Anderson and Grossman, 2009; Cai, 2010; Martins et al., 2011).

Hunt (2005); Kelishadi (2007); Matovu, Birungi and Sebaggala (2012); and Goettler et al. (2017) also note that healthier workers are more physically and mentally energetic and robust, productive and tend to earn higher wages; and are less likely to be absent from work due to health problems. Powell-Jackson and Hoque (2012); and Onarheim, Iversen and Bloom (2016) argue that low productivity resulting from poor health (malnutrition), may lead to lost income for the malnourished and their families, thus perpetuating poverty and delaying national economic development (Martins et al., 2011, Arthur et al., 2015). As such, increase the opportunity cost of participating in the labour market, thereby enhancing the willingness to leisure (Cai and Kalb, 2006). Malnutrition, particularly obesity, might decrease an individual's performance in the labour market (Caliendo and Gehrsitz, 2016) through its impact on certain characteristics such as lower reservation wage (Caliendo and Lee, 2013; Proestakis and Brañas-Garza, 2016) and lower self-esteem (Cawley, 2007; Mocan and Tekin, 2011).

Malnutrition may be associated with LFP through its effect on life expectancy. From a life-cycle standpoint, malnutrition can influence life expectancy (Zheng et al., 2014; Uchendu, 2018) and, subsequently, may change the time horizon over which labour supply decisions are made (Cai and Kalb, 2006). A decrease in life expectancy reduces the timeframe for an individual to make economic decisions, as the individual needs fewer resources to finance his/her retirement age (Bloom, Canning and Graham, 2003; Van Solinge and Henkens, 2010). Consequently, this may attract an earlier labour market exit than when the individual knows they will experience a longer life span (Van Solinge and Henkens, 2010).

An individual supplying labour may be discriminated against by employers leading to unemployment (Kinge, 2016). This may be for three possible reasons; First, employers' preconceptions reflect their aversion for overweight/obese employees and the psychological costs of dealing with them (McLean and Moon, 1980; Morris, 2007); second, employers may discriminate against malnourished individuals because they believe that overweight/obese individuals are less productive (Norton and Han, 2008; Caliendo and Lee, 2013); and third, uncertainty or a lack of knowledge about an overweight/obese worker's productivity may lead to discrimination (Flint et al., 2016). Discrimination by employers may worsen as overweight/obese individuals are perceived to have high discount rates and thereby, they are less likely to invest in human capital (Norton and Han, 2008; Larose et al.2016). In certain occupations, physical appearance is a requirement (Puhl and Brownell, 2001) and excess weight may be viewed as an undesirable feature (Harkonen, Rasanen and Nasi, 2011).

The labour supply decision of individuals may be affected by malnutrition due to changes in their preferences between market and non-market time. As such, how these individuals value time away from work can be affected. This will change the relative utility between income and non-market time. Valuation of non-market time by a malnourished individual may result from the fact that the time is used to seek health care. Nevertheless, the labour supply can increase as a result of poor nutrition. The increase in labour supply may result from the need to compensate for lost earnings due to low productivity or the cost of seeking medical care, especially when the cost is linked to direct financial costs (Cai and Kalb, 2006).

4.3 Theoretically linking child malnutrition status and maternal labour supply

As in Chapter Three, malnutrition is an indicator of a child's poor health. Child health provides direct and indirect utility because it is an important input into many household production processes. Child health problems often require families to adjust time and resources, which can have long-term psychological and economic effects for all household members, which is the focus of this section.

Child health is an important part of socio-economic growth and poverty reduction because it determines current and future human capital and livelihood prospects. Malnutrition in childhood particularly stunting, can affect a child's schooling through late enrolment in school, missed school days, grade repetition and poor school achievement (Khanam, Nghiem and

Rahman, 2011; Hoddinott et al., 2013; Sunny et al., 2018). As a result, malnourished children are more likely to have lower human capital (both in terms of health and education), which negatively affects their future productivity, earnings and economic growth, and leads to intergenerational poverty transmission (Tette, Sifah and Nartey, 2015). Good health in childhood not only affects a child's physical and mental growth, and the risk of morbidity and mortality later in life; it also relief households from medical expenditures and give adult household members more time to take advantage of labour market opportunities (Tambi, 2017).

Powers (2003) notes that the presence of a healthy child in a household reduces demand for childcare and thus encourage their mothers to stay in the labour force. This is because poor child health reduces the labour supply of their caregivers (particularly their mother) as a result of higher caring needs for the child (Spiess and Dunkelberg, 2009; Fotso, 2017). If the cost of childcare depends on the characteristics of the child, caregivers with higher childcare costs and therefore higher reservation wages, are less likely to work (Powers, 1999). In such situations, the responsibility of the female household members, especially mothers, decrease due to powerful cultural norms that assign women the primary responsibility of caring for sick members in the household (Spiess and Dunkelberg, 2009).

Life-threatening child injuries or illnesses can significantly affect both parent and child psychological wellbeing (Landolt et al., 2012; McCarthy et al., 2012; Muscara et al., 2015; Woolf et al., 2016). Some parents whose children have been diagnosed with such conditions are likely to develop post-traumatic stress symptoms (Bronner et al., 2010; Le Brocque, Hendrikz and Kenardy, 2010), including post-traumatic stress disorder (PTSD), which can seriously affect daily functioning. PTSD sufferers experience cognitive impairments and disability in daily tasks (Kaye et al., 2014). As such, they are likely to face significant difficulties in maintaining family and social relations, increased absenteeism and problems in their careers leading to a loss of productivity (Wilson, Guliani and Boichev, 2016).

Gould (2004) and Frijters et al. (2009) note that having a sick child at home will also have an opposite effect on the work activities of the caregiver. Due to the child's medical care requirements, caregivers face additional financial burdens and therefore, may choose to enter the LF or increase their working hours. This may result from the fact that there might be a long-term income effect as a result of increased financial costs of medication and caring duties or the family income available for consumption has decreased, which leads to an increase in labour supply (Cidav, Marcus and Mandell, 2012). Although labour supply may increase, the additional cost is incurred in the form of forgone leisure time or home production.

4.4 Empirical literature on the link between malnutrition and labour supply

This section seeks to present related studies on the relationship between malnutrition with labour supply. It starts with a review on the endogeneity of malnutrition, followed by other studies that have looked at the impact of malnutrition on labour market outcomes.

4.4.1 Endogeneity of Malnutrition

Investigating the impact of malnutrition on labour supply is complicated by the potential endogeneity problem. At least two sources of endogeneity are commonly known and can cause bias estimates:

i) Reverse causality.
ii) Omitted variables.

It should be noted that omitted variables that are not observable for instance time preference are referred to as unobserved heterogeneity[23]. Reverse causality occurs when LFP is the cause of malnutrition and malnutrition is the cause of non-LFP. In this case, the impact can be positive or negative. Endogeneity problems may also occur in situations of omitted variables that could influence the link between malnutrition and LFP. This shows ambiguity in the relationship and as such remains an empirical problem.

4.4.1.1 The effect of labour force participation on an adult's nutritional status

LFP can affect an individual's nutritional outcomes in many ways. According to Dalgaard and Strulik (2011), LFP may enable a worker to buy more nutritious food, thus becoming healthier. Healthier, non-fattening foods, are generally expensive than fattening foods, as such those with low income or who are poor are more likely to purchase fattening foods (Laraia et al., 2017;

[23]Heterogeneity refers to differences across the units being studied.

French et al., 2019). Rao et al. (2013) carried out a systematic review and meta-analysis to establish if healthier foods are more expensive than less healthy foods. The findings show that on average, healthier dietary patterns were more expensive than less healthy patterns, whether based on actual daily intake or per 2, 000kcal. The price difference of approximately $1.50/day is the price difference per person for consuming a much healthier diet compared with an unhealthy diet.

Cawley, Moran and Simon (2010) argue that income could either decrease or increase weight. If food and a sedentary lifestyle are normal goods, then income may lead to weight gain. Appearance and good health could also be normal goods, as such an individual may invest more time and money in slimness as income rises. Kpelitse, Devlin and Sarma (2014) used five biennial confidential master files (2000/01-2009/10) from the Canadian Community Health Survey to study the causal effects of income on BMI and obesity of adults. The findings reveal that for an individual of average height, a 1% increase in income, the weight of women and men decreased by 0.300kg and 0.084 kg, respectively. Also, for a 1% increase in household income, the probability of being obese for women and men decreased by 0.76% and 0.27%, respectively.

Given changes in work practices and the need for 24-hour service in some institutions, some employees are therefore required to work more 'unconventional hours' or on shifts (Eberly and Feldman, 2010). An increase in working hours can also contribute to weight gain (Au, Hauck and Hollingsworth, 2013; Nobrega et al., 2016; Yarborough et al., 2018). Eberly and Feldman (2010) research on "does shift work make a significant contribution to the risk of obesity?" ascertain that shift workers have the highest incidence of obesity compare to those who work exclusively during the normal daytime working hours. Antunes et al. (2010) and Shrestha et al. (2016) also found similar evidence on shift work and weight gain.

Choi et al. (2010), Owen et al. (2010), Ding et al. (2011), and Keadle et al. (2017) establish that the nature and intensity of work have changed shifting from a labour-intensive manual work that breaks down excessive calories to more sedentary activities, such as service roles like sitting and typing on a computer, that expend very few calories. If calories consumed is held constant this shift would increase weight and thus, overweight/obesity. Reason being that those doing sedentary occupations might not have time to engage in physical activities (Welch et al., 2009; Proper et al., 2011; Henderson, 2015; Nobrega et al., 2016). Lin et al. (2015) used data from a large prospective cohort of American men and women from 2002 to 2010 to determine the association between time spent sitting at work and BMI. The results show that for the overall sample and men, sedentary time is associated with a higher BMI. A 1% increase in sitting time led to a 5% and 9% probability of an increase in BMI for the overall sample and men respectively. For women, there was a statistically significant relationship. Shrestha et al. (2016) and Yarborough et al. (2018) found that there is no relationship between sedentary work and obesity. Nonetheless, for those actively seeking employment, this can serve as an exercise that may cause them to lose weight.

4.4.1.2 The effect of maternal labour force participation on a child's nutritional status

The participation of mothers in the LF also affects the nutritional status of their children. Many studies (Cawley and Liu, 2012; Datar, Nicosia and Shier, 2014; Eshete et al., 2017) that investigated child nutrition and female labour supply looked at it from the angle of maternal work impacting on child nutrition.

An increase in market work for women reduces the time and energy available for household production, thus giving household members the incentives to consume foods that are convenient like fast food, restaurant meals or frozen food (Mutlu and Gracia, 2006; Gomis-Porqueras et al., 2011) and school meal programs for their children's meals (Datar and Nicosia, 2012) which may impact negatively on their diet quality and results in large amounts of calories consumed in a meal. Rashad and Sharaf, (2019) observe that maternal employment can increase family income and improve family well-being, thus freeing the family from the threat of poverty and food insecurity. Therefore, for working mothers, the higher the income, the better the nutritional status of their children (Negash et al., 2015).

Nankinga, Kwagala, and Walakira (2019) used data from the 2016 Uganda Demographic and Health Survey (UDHS) to study the relationship between maternal employment and nutritional status of children under 5 years old born to Ugandan working women aged 15-49 years. This relationship was examined using the Chi-square tests and multivariate logistic regressions. The results show that, compared with mothers who perform professional jobs, mothers who perform agricultural and manual work had a higher odds ratio to have a stunted child. Additionally, compared with mothers employed by family members, mothers employed by non-family members had a higher odds ratio of having wasted and underweight children. This indicates that in Uganda, maternal employment plays an important role in determining the nutritional status of children.

Garti, Ali and Garti (2018) studied the relationship between maternal working hours and child nutritional status in northern Ghana. The study compared children whose mothers are in the public service and work more than 6 hours a day to those whose mothers work for a few hours a day and who are farmers. The results show that the stunting rate of children whose mothers are farmers was approximately 22.1%, while that of public service mothers was about 12.8%. This was attributed to the fact that mothers working in public services may have higher incomes, more spending on food, food supply at home and sociocultural factors, such as older siblings or other extended family members, childcare and food preparation by grandparents that reduced the probability of stunting in their children. Willey et al. (2009) using South African data from Birth to Twenty (Bt20) also found that maternal employment is linked with a lower probability of having a stunted. Eshete et al. (2017) postulate that compared with unemployed mothers, there is no statistically significant difference in the overall nutritional status of the children of working mothers.

Cawley and Liu (2012) used the American Time Use Survey pooled data from 2003-2009 and ordinary least squares (OLS) to estimate the relationship between maternal employment and her allocation of time to activities related to children's diet and physical activity. The sample included female respondents who had at least one child under 18 years of age. The findings indicate that the time spent per day with children decreased by 127 minutes for mothers who are working. Notwithstanding, men offset 15% of the time reduction associated with maternal employment. This is important because more working hours will result in children having more unattended time, which in turn will increase unhealthy behaviours of these children, such as snacking and sedentary activities, such as watching television (Fertig, Glomm and Tchernis, 2009). Datar, Nicosia and Shier (2014) in their study on the impact of mothers' employment on the diet, activity and obesity of fifth and eighth-grade children in the United States also found that mothers' working hours are positively associated with children's BMI and obesity, particularly amongst high-socioeconomic families.

Apart from genetic factors, malnutrition outcomes are endogenous because the choices of an individual/household partly affect his/her state of being malnourished or other household members. In technical terms, using malnutrition particularly for an adult as a regressor is not orthogonal to the unobserved characteristics in the error terms in models of LFP because unobserved individual heterogeneity will affect both LFP and malnutrition outcomes. An individual with a high discount rate for the future is less likely to invest in his/her human capital such as education, which will be related to his/her wage income. This individual is unlikely to avoid risky health behaviours such as the consumption of fattening foods. The discount rate affects both malnutrition status and labour market outcomes. Consequently, malnutrition is an endogenous regressor in the econometric sense.

An individual's lifestyle for instance smoking can also affect their nutritional status. Tobacco use imposes economic burdens on the society and an individual via increased medical care costs resulting from poor health, premature death and lower productivity (Chiolero et al., 2008; Bockerman, Hyytinen and Kaprio, 2015). Individuals who are overweight/obese smoke for weight loss on the basis that it could reduce appetite and increase energy expenditure (Cawley, Markowitz and Tauras, 2004; Mackay, Gray and Pell, 2013). On the other hand, heavy smokers tend to weigh more than light smokers (Chiolero et al, 2008). This indicates that smoking and obesity have a bi-directional relationship. Those who cease smoking are also more likely to gain weight (Gordon et al., 1975; Clark et al., 2006; Bush et al., 2016).

Smoking can negatively affect a child's outcomes due to its well-known adverse health effects. Smoking during pregnancy is associated with adverse childhood outcomes. Mothers who smoke are more likely to give birth to premature and low-birth-weight babies (Lawder et al., 2019) as well as have obese children (Gorog et al., 2011; Harris, Willett and Michels, 2013; Wang, Mamudu and Wu, 2013) and children with low cognitive functioning (Wehby et al., 2011). Thus, the overall effect of malnutrition on LFP is, a priori, ambiguous. As such, predicting the relationship between maternal and child malnutrition, and MLFP is not obvious, because the net effect of malnutrition will depend on the dominant effect.

People's nutritional status may be influenced by the neighbourhood they reside in. The risk of overweight/obesity is higher in socioeconomically disadvantaged neighbourhoods with lower-income and less-educated populations (Powell-Wiley et al., 2014; Wong et al., 2018).

According to Pampel, Krueger and Denney (2010), this may result from inequality, other social pressures and a lack of incentives and resources to achieve health goals. Disadvantaged neighbourhoods are less likely to have a health-promoting infrastructure in place, such as healthy food stores (Wallace et al., 2021). This promotes unhealthy eating (Algert, Agrawal and Lewis, 2006; Hilmers, Hilmers and Dave, 2012), as it may be difficult for households to buy healthy food at a convenient and affordable price (Corfe, 2018). As seen in chapter 3, poor dietary intake is one of the immediate causes of malnutrition.

In a labour supply/LFP model, this bi-directional relationship between malnutrition and LFP or omitted variables are likely to lead to the endogeneity of malnutrition. Abdallah, Goergen and O'Sullivan (2015) and Zaefarian et al. (2017) note that in research, failure to correct for endogeneity may lead to biased and wrong results about the cause and effect relationships between variables under investigation. To control for the endogeneity problem valid instruments are needed to obtain consistent and useable estimates of the model. Generally, two conditions are required for an instrument to be valid: (i) the instrument must be correlated with the suspected endogenous variable (the explanatory variable) and (ii) the instrument must be uncorrelated with the error term of the structural model, that is, the instrument must be uncorrelated with the dependent variable (Wooldridge, 2010). There is more discussion about this in Chapter 5 on methodology.

4.5 Existing evidence on the relationship between an adult's malnutrition status and labour supply

Many studies particularly in developed countries have investigated the effect of the nutritional dimension of health most especially obesity and labour supply. The evidence is mixed and results vary across socio-economic groups and countries. LFP and employment probability are the main labour supply outcomes often researched and are not solely determined by factors relating to supply. Demand factors, for instance, job availability as well as the economic conditions of a country are also important determinants and are particularly significant in a country like SA with high female unemployment rates (Statistics SA, 2019, 2020).

Ricci and Chee (2005) in a cross-sectional study examined the health-related lost productive time (LPT) in overweight and obese workers using data from a national telephone survey of the United States of America (USA) workforce. The sample consisted of adult's aged 18-65 years, excluding underweight and pregnant women. LPT in hours and dollars was compared amongst the three BMI groups, that is, normal weight, overweight and obese employees. The findings indicate that obese workers (42.3%) were significantly ($P < 0.0001$) more likely to report LPT than normal-weight (36.4%) or overweight workers (34.7%). Health status facilitated the association of obesity with LPT. Obese employees cost approximately $42.29 billion in LPT, an excess of $11.70 billion when compared with normal-weight employees. Presenteeism accounted for 67.8% of the cost. Comparatively, overweight employees were not a significant source of excess LPT.

Morris (2007) using pooled data from two rounds of the Health Survey (1997 and 1998) for England to investigate the impact of obesity on employment found that in England there is a strong negative effect of obesity on employment status for both males and females. Using the prevalence of obesity in the local area[24] in which the participant lives as an instrumental variable (IV), an IV model was estimated. The results indicated that obese women had a 0.213 lower probability of employment compared with those who were not obese. The result was statistically insignificant for men. Even though cross-sectional data were used in this analysis, Morris (2007) argued that area-level obesity effectively controlled for the unobserved individual differences and in turn controlled for omitted variable bias.

Greve (2008) used the Danish panel survey from 1995 to 2000 together with administrative registers covering 8000 individuals to investigate the relationship between BMI and employment status and wages in Denmark for both men and women. In this study, an individual was considered obese if his/her BMI was $\geq 30kg/m^2$. Using a probit model, Greve (2008) reported that for both genders, obesity had a significant effect on employment, but the impact is felt more by women than men. Greve (2008) observed that being obese reduces the probability of being employed by 2.8% and 8.5% for men and women respectively at 6% significant level than healthy weight men or women respectively. To control for potential unobserved heterogeneity and endogeneity bias, mothers' and fathers' prescriptions for

[24] Prevalence of obesity in the local area is a measure of environmental factors that affect obesity; it is a summary measure of physical activity and food intake characteristics of the local populace (Morris, 2007).

different diseases related to obesity were used as an instrument. The instrument turned out to be weakly associated with bodyweight, particularly for women. However, using the information on whether the mother has been prescribed anti-obesity drugs as an IV was more valid. The instrument was positive and significantly related to BMI and the t-statistic was 2.93, implying that this instrument is relatively strong and a good predictor of women's obesity.

Cawley, Han and Norton (2009) analysed the association between body weight and labour market outcomes amongst legal immigrants to the USA from developing countries using the New Immigrant Survey of 2003 (NIS-2003), which was the first nationally representative survey of legal immigrants in the USA. The logistic regression showed that women with higher body weight who have been in the USA for less than a year or less than 5 years were less likely to be employed than healthy women. The marginal effect for female immigrants who were obese was -0.183 ($p = 0.05$) relative to female immigrants with normal weight who were new to the U. S. This implies that amongst female immigrants, obese women had a lower probability of being employed. For men, BMI was positively associated with employment. However, this study had several limitations such as a lack of valid instruments and a failure to account for possible endogeneity of obesity

Mora (2010) carried out a study in Spain on individuals living in the same district or who have attained the same level of education. An IV probit regression model was estimated using the difference between an individual's BMI score and the average BMI score of those living in the same district or have the same educational level by gender as instrumental variables. The results also revealed that at a 5% statistically significant level, there is a negative relationship between BMI and women's employment status especially for those up to 45 years.

In a study by Lindeboom, Lundborg and Van der Klaauw (2010), the British National Child Development Study (NCDS), which is a longitudinal study from 1958-2004 was used to assess the impact of obesity on labour market outcomes. The ordinary least square (OLS) results when using only obesity (BMI is $\geq 30 kg/m^2$) of the respondents as a covariate showed that, for both males and females, obesity significantly lowered their employment probabilities. At age 42, being obese was associated with a 4.9% points decrease in the probability of employment for females and a 2.3% point's reduction for males. The outcome was stronger at age 33, with the obesity penalty increasing by about 20% for females and doubling for males. Using the respondent's parent's obesity as an IV to control for the endogeneity of obesity the result showed that there is no strong causal effect of obesity on employment. This was also confirmed when panel data regressions on first differences in employment and obesity were performed.

Harvey et al. (2010) researched the association of obesity with short-term and long-term absence from ill-health. Cross-sectional and prospective analyses were conducted on staff from London Underground Ltd. All operational staff who worked full-time between 1 April 2005 and 31 March 2007 were eligible for the study. The results signify that for both cross-sectional and prospective analyses there was a positive linear association of employees' BMI with the number of workdays missed resulting from sickness absence ($P < 0.001$). Obesity was a risk factor for both short- and long-term sickness absence. Every year, it was observed that obese individuals typically took additional 4 days of sick leave. Co-morbidity chronic medical conditions were seen to be the major increasing risk factor for the long-term sickness absence as opposed to the excess short-term sickness absence. Howard and Potter (2014) used the 2000 and 2010 USA National Health Interview Survey to assess the association between overweight and obesity, related chronic health conditions and worker absenteeism. The findings also suggest that obesity is related to higher rates of worker illness absence and that the presence of diabetes positively moderates this within the severely obese population.

Harkonen, Rasanen and Nasi (2011) looked at the influence of obesity on unemployment in Finland using data consisting of the last four waves (from 1998 to 2001) from the Finnish European Community Household Panel (ECHP) survey. In analysing the effect of obesity on unemployment, the random effect (RE) logistic regression model was used. Based on their analysis, it was observed that the risk of unemployment amongst obese women was significantly higher than that of non-obese women, even after adjusting for the effects of age, education, marital status, number of children and their age, region of residence, health and the year of data collection. Similar results were not observed for men. Male obesity did not influence the risk of unemployment. This indicates gender bias in the Finnish labour market. Using panel data and appropriate IVs, Huffman and Rizov (2014) also observed a similar effect. They observed a linear positive impact of BMI on the likelihood of being employed for men and a negative effect for women in post-Soviet Russia.

A study by Some, Rashied and Ohonba (2014) in SA, used cross-sectional data obtained from the NIDS (2008) and a recursive bivariate probability model to estimate the impact of obesity on employment. IVs such as the respondent's degree of exercise per week; has been diagnosed or treated for obesity-related diseases such as diabetes, high blood pressure and stroke; and the obesity status of the head of the household was used to control for endogeneity of obesity. These instruments were strong and had significant explanatory power on obesity for the combined effect and in men. In women, however, the results showed that obesity was exogenous. Based on the findings, the combined effect shows that, on average, obese individuals are less likely to be employed than non-obese individuals. The average marginal effect of obesity on employment was -0.37 and was statistically significant at a 1% significant level. However, after disaggregating the regression by sex, no significant effect of obesity was observed for women, while the average marginal effect was -0.36 for men and was statistically significant at a 1% level.

Andreyeva, Luedicke and Wang (2014) researched obesity-attributable costs of absenteeism amongst working adults in the USA. The National Health and Nutrition Examination Survey (NHANES) for 1998–2008 and the Behavioral Risk Factor Surveillance System (BRFSS) for 2012 data were examined. The sample population consists of full or part-time working adults aged 18 and over, excluding pregnant women and persons classified as underweight (BMI<18.5). The model used for estimation was the negative binomial model and the outcome variable was obesity-attributable workdays missed in the previous year as a result of health issues, and their costs to states. The results reveal that being obese is linked with a significant increase in absent workdays, from 1.1 to 1.7 extra days missed annually compared with normal-weight workers. Obesity-attributable absenteeism amongst American employees costs the country roughly $8.65 billion per year. Obesity imposes tremendous financial burdens on governments, accounting for 6.5%–12.6% of the overall cost of absenteeism in the workplace. State legislatures and employers should explore innovative ways to minimise these costs. Hammond and Levine (2010) in their analysis on the economic implications of obesity in the USA also observed that obesity places a significant financial burden on the country.

Nigatu et al. (2016) investigated the effect of overweight and obesity on employees in meeting their work demands for example work schedule, outputs, physical and mental-interpersonal demands, using the Dutch version Work Role Functioning Questionnaire. Participants were classified into three BMI categories according to the standard international classification: normal weight (BMI < 25 kg/m^2), overweight (BMI 25.0-29.99 kg/m^2), and obese (BMI ≥30.0 kg/m^2). The findings reveal that work functioning (defined as the ability to meet work demands) total score was significantly lower amongst obese employees compared with normal weight or overweight employees. Physical and output demand scores were significantly lower among obese employees compared with normal weight or overweight employees. This implies that a physical disability that could arise as a result of obesity such as joint, motion and posture problems, may affect the ability to perform these work tasks. Nonetheless, it was seen that mental and social demand scores were not significantly different between normal, overweight and obese workers.

Larose et al. (2016) investigated the association between obesity, and employment and earnings amongst working-age adults in Canada using nationally representative longitudinal data from 2000/2001–2010/2011 National Population Health Survey. The findings revealed that obesity is not significantly associated with employment, after controlling for time-invariant individual heterogeneity, lifestyle factors and demographic and socioeconomic characteristics. But observed that obesity is related to a decrease in hourly wage rate and annual income amongst women by approximately 4% and 4.5% respectively. For men, at a 10% level of significance, obesity is linked with roughly a 2% decrease in wage rate and income.

Goettler, Grosse and Sonntag (2017) conducted a systematic review of the relationship between productivity and indirect costs[25] loss because of overweight and obesity at work. The results showed that although the average costs of presenteeism and absenteeism differed between studies, most of the studies revealed that compared with normal weight employees, overweight and obese employees were less productive and missed more working hours (short-term and long-term), which leads to higher indirect costs. Kudel, Huang and Ganguly (2018) used two administrations (2014 and 2015) of the USA National Health and Wellness Survey and also found significant disparities in work productivity impairment and indirect costs between obese

[25]Shrestha et al. (2016) note that indirect costs are non-medical costs to society that include morbidity-related costs (disability, absenteeism, presenteeism, early retirement) and mortality-related costs (premature death)

and normal-weight employees. Work productivity impairment and indirect cost were positively associated with increases in BMI class.

Lee et al. (2019) examined the relationship between obesity and the job market using data for over four years from the Korean Education and Employment Panel (from 2010 to 2013) on high school students. The study focused on young adults in the early stages of their careers, taking into account gender and job qualifications. The study used conditional logistic regression and OLS models to control for individual-level fixed effects. Overweight and obese men are found to be 1.46 times more likely than normal-weight men to be placed in professional jobs and their monthly wages were 13.9% higher. In contrast, compared with normal-weight women, overweight and obese women were 0.33 times less likely to have service jobs, earned 9.0% lower monthly wages, and half as likely to have jobs with bonuses. This occurred only when these women do not possess the assessed job market qualifications. The next section reviews the relevant literature on child health and maternal labour supply.

4.6 Review of literature on child malnutrition and Maternal Labour Supply

As seen in Chapter 3, malnutrition is an indicator of a child's poor health. Several empirical studies (Salkever, 1982; Powers, 1999, 2001; Porterfield, 2002; Frijters et al., 2009; Spiess and Dunkelberg, 2009; Yamauchi, 2012) have analysed the effects of child health on maternal labour supply, some of which are reviewed in this section.

Salkever (1982) one of the first researchers to examine the effect of child health on maternal labour supply, used the 1976 USA Survey of Income and Education (SIE) data to estimate the effect of child disability on parental labour supply and earnings. The data contained information on children aged 3-17 years with reported disabilities. Salkever (1982), used a probit model for the maternal regression and an OLS for the paternal regression estimates. After controlling for parental and household characteristics, the result indicates that there is a significantly strong negative association of child chronic health problems particularly school-related disabilities and mobility limitations with maternal labour supply and earnings than that of fathers. This could be attributed to the fact that the production of child health is more maternal-time intensive. The probit and OLS models might have produced biased estimates due to the potential endogeneity of the child disability variable which was not controlled in these analyses.

Norberg (1998) investigated the effect of newborn health and infant development and temperament on the mother's re-entry to the LF up to five years after childbirth using the 1994 National Longitudinal Survey of Youth (NLSY) and fix-effects model. She found a negatively significant effect of poor child health, as well as of the mother's poor state of health, on the time of re-entry to the LF. Mothers of children with birth defects, intrauterine growth failure and long hospitalisation at birth start working much later compared with those without. Mothers with high-risk infants were 55% less likely to have worked in the first five years after the child was born. Mothers of healthy premature babies were approximately 33% more likely to have worked, mothers of more problematic infants were about 23% more likely to have worked, and mothers of infants with very poor developmental scores were about 19% less likely to have worked in the first five years.

Powers (1999) used data from the USA October 1992 Child Supplement Module of the Current Population Survey to investigate the impact of child disability on LFP decisions for single and married mothers. A two-stage probit model was used to control for unobserved characteristics that may bias the estimate of the relationship between child health and maternal labour supply. Nevertheless, the endogeneity of the child disability variable was not strongly supported by the data. As such, the analyses were robust for a variety of specification changes. The findings indicate that for married mothers the probability to participate in the LF decreased by approximately 6.1% and 11.3% for single mothers. For wives, the effect was comparable to the average decrease in LFP associated with an additional child. For single mothers, the effect was comparable to having a baby.

Porterfield (2002) used a sample of single and married mothers with children under the age of 20 drawn from the 1992 and 1993 Survey of Income and Program Participation panel data to examine the impact of childhood disability on the choice of mothers to work or not. Porterfield (2002) also found that single mothers of a disabled child aged less than 6years old did not engage in paid work. However, married mothers were likely to work part-time. This could be attributed to the fact that compared with single mothers, the partners of married mothers assist them with childcare.

Corman, Noonan and Reichman (2005) examined the association of children aged 1 year in poor health with their mother’s labour supply. They used the Fragile Families and Child

Wellbeing Study which follows a cohort of new parents and their children in 20 USA cities (in 15 states) from 1998-2000. For the LFP equations, a bivariate probit model was used since the outcome measures are binary. A Tobit model was used for the number of hours worked. Two instruments, that is, the number of adoption agencies per 10, 000 women in the city of childbirth; and if the hospital in which the child was delivered had a Level III neonatal intensive care, were used to account for the endogeneity of child health.

However, they observed that child disability is exogenous to maternal labour supply and therefore, used a single-equation estimation for the analysis. The result indicates that the probability of working for mothers with children having poor health decreased by 8% and hours of work reduced by three per week when she is employed.

Zimmer (2007) investigated the effect of child health on maternal employment using data from the USA 1996, 2000, and 2001 waves of the Medical Expenditure Panel Survey (MEP). The sample consists of women aged 19-64 years with at least one child younger than 16 years. Child self-reported physical and mental health were used as measures for child health. Two maternal dependent variables were used, that is, employed and the number of work hours per week to reflect her labour supply decision. For the employed model, an IV-linear probability model (IV-LPM) was used, while a Tobit model was used for the hours worked model. The IVs used in this study were access to care variables determined by the degree of difficulty a mother has in contacting and obtaining care from her normal source of care. Zimmer (2007) under the assumption that child health is predetermined, observed that the presence of an unhealthy child decreases a mother's probability of working as well as her number of hours. After controlling for unobserved heterogeneity, child health had no significant effect on either the probability of employment or working hours. This suggests that a child's health might not be an important determinant of maternal employment activity.

Frijters et al. (2009) examined the impact of early childhood development on MLFP using the first wave of the Longitudinal Study of Australian Children collected in 2004. The study tracked children less than 12 months until they reached 7 years of age and children aged between 4-5 years until they reached 10 or 11 years. Data was collected on one child in each household from their parents and the child's pre-school or kindergarten teacher. To overcome the potential endogeneity problem that may arise between child development and MLFP two-stage least squares (2SLS) and IV probit models were used. Child left-handedness and mixed-handedness were used as IVs. The 2SLS, which captured the IVs, showed that at a 5% level of statistical significance, a 1% increase in poor child development decreases MLFP by approximately 11%. This was similar to the 12% observed using the IV probit model.

Spiess and Dunkelberg (2009) investigate the impact of maternal and child health indicators on FLFP using the German Socio-Economic Panel. The sample consists of mothers with very young children from the 2003 to 2005 waves. Spiess and Dunkelberg (2009) used ordered probit models and the standard maximum likelihood methods and established that that mothers of children with severe health problems are approximately 6% less likely to work in the first year after the birth of their children than mothers with healthy children. The likelihood of a mother to start working in the second year of her child's life and the intention to work in the future as dependent variables were not statistically associated with the child's health. Conversely, the preferred number of working hours in the future as a dependent variable was statistically associated with a child's severe health problems. Mothers with children who are severely sick had a 15% higher probability of preferring full-time work. Spiess and Dunkelberg (2009) further note that these differences may have been because mothers with disabled children consider their child's condition as an obstacle to employment during the child's early life, but choose to work more afterwards to make up for their prolonged duration outside the workforce, or need for full-time work to cover for higher child care costs.

Yamauchi (2012) investigated the effect of long-term child's physical or mental health problems on parental labour supply using 2004, 2006, and 2008 Longitudinal Study of Australian Children (LSAC). The children sampled were those aged 0-5 years who were interviewed from 2004 right to (2008). A separate regression model was estimated for those aged 0-1 years and 4-5 years. To eliminate the effect of omitted variable bias mother-level fixed-effects model was applied. The results of the individual fixed-effect model showed that mothers of children aged 0 years in 2004, decreased their labour supply once their children start to show long-term health complications. In addition, their household income drops by 8%, once their partners' shift from permanent to fixed-term employment. Parents with 4-year-old children in 2004 showed no changes in these outcomes related to the onset of the child's long-term health problems.

Tambi and Nkwelle (2013) used cross-sectional primary data and chi-square (Chi^2) method to evaluate the socio-economic effects of child health on maternal labour supply in Tombel, Cameroon. The calculated Chi^2 value (6.68) was greater than the Chi^2 critical value (3.841). This led to the rejection of the null hypothesis that there is no significant association between child health and maternal labour supply. Therefore, there is a strong correlation between child health and MLFP. This indicates that improved child health decreases the child's medical expenditure and the mother's psychological trauma resulting from staying at home to care for the child. Thus, the mother has more time to participate in the labour market. The time the mother spends seeking medical care for the child is an important contribution to the nutritional status of the infant or child. The extra time available to mothers can be plough into productive activities that can procure extra income for the purchase of household goods (Angrist and Evans, 1998).

The most similar research to this study by Tambi (2017) used the economic model of the family developed by Becker (1965) as the conceptual basis for his analysis on the effect of child health on MLFP. The data analysed were obtained from the 2011 Cameroon Demographic and Health Survey on children aged 0-59 months born to female respondents aged 15-49 years. Due to the problem of endogeneity that may arise between child health and maternal employment, to avoid biased estimates a 2SLS regression analysis was used. The anthropometric measure of child health used was weight-for-age z-score (WAZ) and the IV applied was large child size at birth. The 2SLS result which captured the impact of large child size on MLFP indicated that at a statistically significant level of 1% an increase in child health has a 0.169 probability effect to increase MLP. However, the results from these studies are contradictory and did not interrogate specifically on the effect of a child's nutritional status (stunting) on maternal labour supply which motivates the purpose of this research.

4.7 Summary

This chapter focused on the theoretical and empirical literature on the link between malnutrition and labour supply. Both the nutrition wage hypothesis and human capital theories suggested that malnutrition harms an individual's labour force participation. In addition, caring for a child with poor health also affects the caregiver's labour supply decision. This chapter further revealed that there is reverse causality between malnutrition and labour supply which must be controlled for in a malnutrition-labour force model by use of instrumental variables. Studies that have investigated the link between obesity and child health on an individual or caregiver's labour supply had contradictory results. Some studies found that being obese had a negative and significant relationship with labour supply, while others found no significant association. A similar conclusion was arrived at in the literature on maternal children with poor health and their labour supply. Overall, most of the results showed that obesity or poor child health diminished labour supply. The next chapter will discuss the methodology applied in this dissertation to address the research objectives. The analytical framework will be an extension of the objectives and hypotheses presented in Chapter One and will be linked to some theories and gaps in the literature.

CHAPTER FIVE

RESEARCH METHODOLOGY

5.1 Introduction

This chapter aims at providing the method used in determining the levels of maternal and child malnutrition and MLFP, as well as the relationship between maternal and child malnutrition, and maternal labour supply in SA. This chapter begins with an explanation of the research design, followed by a brief overview of the study area, data and the statistical methods used to address the research objectives.

5.2 Research Design

This research used the quantitative research design. According to Cooper and Schindler (2013), quantitative research is a systematic scientific investigation of quantitative properties and phenomena, and their relationship. This design was used mainly because of the nature of the research problem. The study aimed at determining the prevalence and trend of maternal and child malnutrition, and then, investigate the association of maternal obesity and childhood stunting on maternal labour supply. As such, motivates the need to use this research design. Quantitative research methodology focal point is on numerical representation. It allows for observations to be manipulated and controlled to explain and describe the phenomenon these observations reflect. The quantitative research method was vital to this research since it made it possible for variables such as labour force participation, obesity, overweight, stunting, wasting, underweight amongst others to be manipulated against time to observe the patterns these manipulations create. In this study, the research design enumerates the research methodology adopted, the focus area and tools of data collection, data analysis and the statistical model.

5.3 Brief overview of the Study Area (South Africa)

SA moved from an exclusive racial system of apartheid to a democratic society in 1994 (Van der Berg, 2010). During apartheid, some racial groups[26] were excluded from equal participation in almost all aspects of the economy in favour of Whites, all as part of a deliberate attempt to retard their QoL (Brook, 1996; Liebenberg, 2000). This section provides background information on SA about key issues that are considered critical contributing factors of malnutrition. The discussion focuses on SA's socio-economic background, touching on issues such as demographic, economic status and social indicators with a specific focus on health and nutrition. Thereafter, historical background of the post-apartheid labour market is provided, particularly for key issues examined in this thesis.

5.3.1 Demography and Socio-Economic Status

5.3.1.1 Population of women of reproductive age and children

The total population of SA in mid-2019 was projected to be 59.6 million people, of which 16.1 million were women of reproductive age (15-49 years) and 5.7 million were children under the age of five. Women aged 15-49 years and children under the age of five account for roughly 27% and 10% of the total population, respectively (Statistics SA, 2020b). Concerning the apartheid-era racial categories, 83% and 86% of the women and children are African, 8% are Coloured, 2% Indian and 6% and 4% White, respectively.

5.3.1.2 Economy

SA is one of the eight African countries classified as an upper-middle-income country. The economic growth of the country before the global financial crisis of 2007/2008 was impressive (Marumoagae, 2014). Just before the crisis, the annual real GDP growth was 5.6% in 2006. And then decreased to 5.4% in 2007 (Statistics SA, 2017a). The crisis has had an austere impact on SA. The country's economy entered recession in 2008/09, the first time in 19 years. The GDP growth rate dropped to 1.8% in the last quarter of 2008, then to -6.4% in the first quarter

[26] There are four racial groups in South Africa: Africans (indigenous blacks), Coloureds (mixed ancestry), Asians/Indians (Indian ancestry) and Whites (Statistics SA, 2019).

of 2009, and to -3.2% in the second quarter (Padayachee, 2010). After the crisis, annual growth recovered to approximately 3% between 2010–2011 (Statistics SA, 2017a). The growth rate then decreased to 1.8% in 2013 (South African National Treasury, SANT, 2014). The GDP growth slowed from 1.3% in 2017 to approximately 0.7% in 2018 (SANT, 2019). This low rate was attributed to a weak global environment, drought conditions, electricity shortages, disruptive industrial actions, low commodity prices and rising policy uncertainty.

In 2019, the world's human development indicators show that SA was ranked 114 out of 189 nations with a Human Development Index (HDI)[27] of approximately 0.709 (Human Development Report, HDR, 2020). This shows an increase from 0.62 in 1990 to 0.709 in 2019 (HDR 2020) and thus placing the country in the category of high human development. However, the index is lower than the average of 0.753 for countries in this category. Figure 5.1 shows the trend of HDI from 1990-2019.

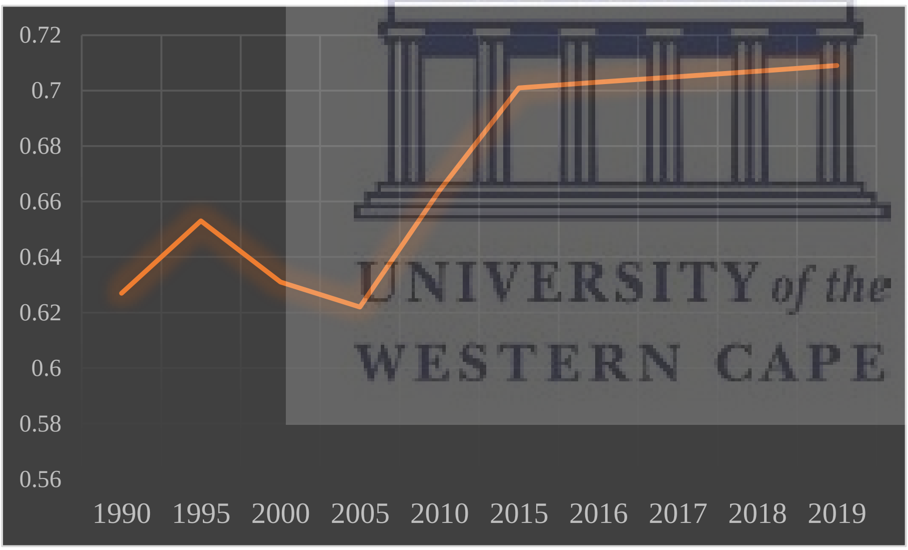


Figure 5.1 HDI value of South Africa, 1990-2019
Source: HDR (2020)

[27] HDI is an index that measures the key dimensions of human development. The three key dimensions are: 1.) Long and healthy life – measured by life expectancy. 2.) Access to education – measured by mean years of schooling of the adult population and expected years of schooling of children at school going age and 3.) Decent standard of living – measured by Gross National Income per capita adjusted for the price level of the country (Noorbakhsh, 1998; Ranis, Stewart and Samman, 2006).

5.3.1.3 Access to education

Education is a fundamental socio-economic right, necessary for lifelong learning and economic opportunities, as well as for individuals to determine the right food choices for themselves and their families. All South Africans have the right to receive basic education. The Bill of Rights requires the government to put measures that increasingly make education available and accessible. According to Statistics SA (2020b), based on data from the General Household Survey (GHS, 2019), the proportion of the population aged 7 to 24 enrolled in an educational institution increased from 73.1% in 2002 to 75.6% in (2019) Hall (2020) note that this is primarily due to a small but real increase in reported attendance rates for African and Coloured children. The main reasons amongst children of school-going age for non-attendance relate to failed systems (including exclusions and quality problems); financial barriers; and illness or disability.

Statistics from the GHS (2019) show that since 2002, the percentage of people aged 20 years and above who have at least matric (Grade 12) increased consistently from 30.7% in 2002 to 46.7% in 2019. The proportion of individuals with some post-school education increased from 9.2% in 2002 to 15.4% in 2019. In addition, the percentage of persons without education decreased by more than half, that is, from 11.4% in 2002 to 3.7% in 2019 (Statistics SA, 2020b). In SA, learners are allowed to leave school when they complete Grade 9 (final year of the senior phase) or are 15 years old, depending on which comes first. However, literacy rates can be used as a key social indicator of development, because those capable of reading and writing can find formal employment, differentiate between nutritious and non-nutritious food.

Given the difficulty in measuring literacy, initially, the GHS measured the literacy rates of adults based on an individual's functional literacy. That is, whether they have completed Grade 7 or not. Since this may not be a good reflection of someone's literacy ability, in 2009, a question that directly measures literacy was introduced. This question requires respondents to specify if they have "no difficulty", "some difficulty", "a lot of difficulty" or are "unable to" to read books, magazines and newspapers in at least one language; or write a letter in at least one language. The result indicated that the literacy rate amongst those aged 20 years and above increased from 91.9% in 2010 to 94.6% in 2019 (Statistics SA, 2020b). Figure 5.2 presents the literacy rate amongst males and females aged 15 and above in SA.

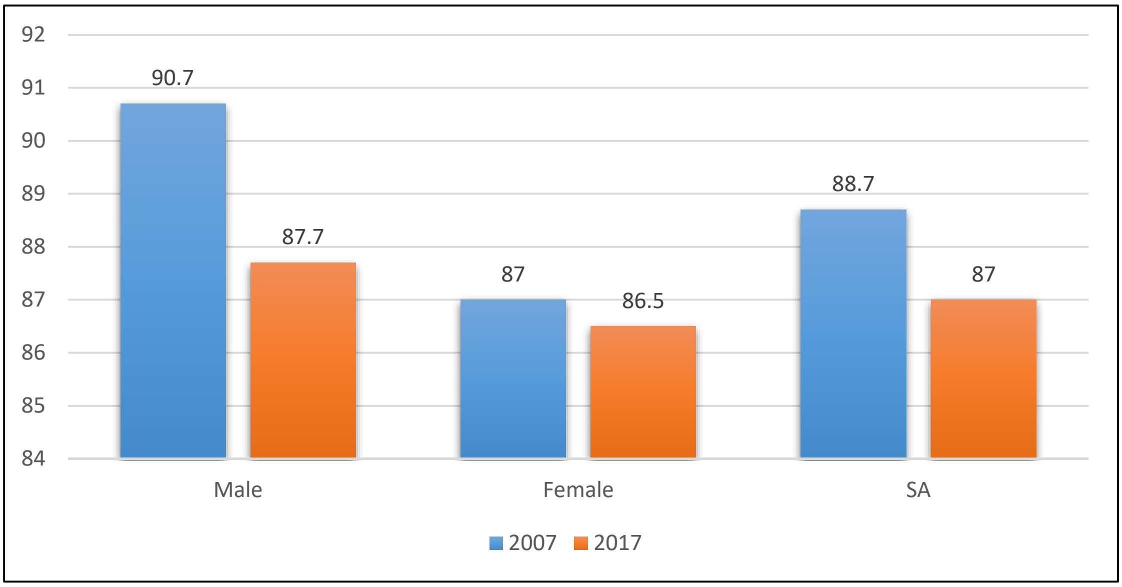


Figure 5.2 Literacy rate by sex amongst those aged 15 years and above, 2007-2017
Source: World Bank (2021)

Figure 5.2 indicates that nationally and gender-wise the literacy rate amongst those aged 15 years and above decreased between 2007 -2017. For women, the rate is less than the national average.

5.3.1.4 Access to housing

The type of dwelling an individual lives plays a very significant role in their socio-economic status. In SA, these dwellings are divided into three categories which are:

i) Formal housing a proxy for adequate housing and consists of: dwellings or brick structures on separate stands; flats or apartments; town/cluster/semi-detached houses; units in retirement villages; rooms or flatlets on larger properties provided they are built with sturdy materials;

ii) informal housing consists of: informal dwellings or shacks in backyards or informal settlements; dwellings or houses/flats/rooms in backyards built of iron, wood or other non-durable materials; and caravans or tents; and

iii) traditional housing is defined as a "traditional dwelling/hut/structure made of traditional materials" situated in a rural area. According to Statistics SA (2020b), approximately 81.9% of South African households lived in formal dwellings in 2019, followed by 12.7% in informal dwellings and 5.1% in traditional dwellings.

Households or families play a critical role in people's physical, social and economic well-being, and survival. Most people consider their family or household as the most significant social institution and reference group. Even though the traditional family structure is changing, it remains very significant in SA, where a large percentage of the populace suffers from devastating poverty and unemployment, and institutional support is inadequate (Staistics SA, 2020). In most cases, individual living arrangements are defined according to the individual's marital status and the household's composition. Table 5.1 presents the marital status of individuals aged 18-59 years in 2019.

Table 5.1: Marital status for women aged 18 -59 years in 2019

Marital Status	18-34 years	35-59 years
Single	89.6	45.1
Widowed	0.0	6.0
Divorced/separated	0.1	4.0
Living together	6.9	12.6
Legally married	3.5	32.2

Source: Statistics SA (2020b) General Household Survey (2019)

Table 5.1 reveals that the majority of women aged 18-59 years are single, with the majority in the age group 18-34 years. On the contrary, the majority of those married or living with their partners are within the age group 35-59 years. In Table 5.2, the percentage of family size is presented by area of residence (urban and rural).

Table 5.2: Percentage of households of different sizes by rural/urban status in 2019

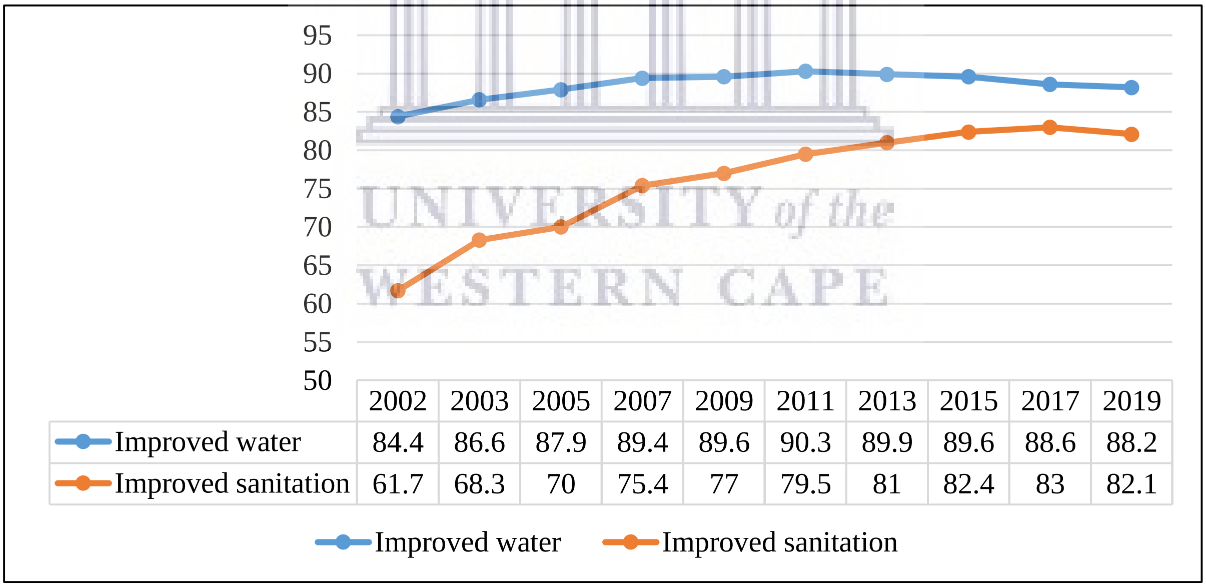
Marital Status	Urban	Rural	SA
6+	11.3	20.6	14.2
4-5	24.7	26.0	25.1
2-3	40.0	31.3	37.3
1	24.0	22.2	23.4

Source: Statistics SA (2020b) General Household Survey 2019

Table 5.2 shows that large family sizes (6+) are more common in the rural (20.6% - higher than the total rate of 14.2%) than urban (11.3%) areas. While households with less than four persons are common in the urban areas (64% - higher than the total SA rate of 60.7%) than the rural areas (53%). In addition, families or households are also crucial aspects of a child's emotional, and cognitive growth, and parents can play a key role in this development. The importance of staying with biological parents depend on the quality of care they can offer, but most often, children are cared for by other relatives such as their grandparents. According to the 2019 GHS, roughly 21.3% of children did not live with their parents, while about 32.7% did. Most of the children lived solely with their mothers (42.0%), while a smaller percentage (4.0%) lived solely with their fathers (Statistics SA, 2020b). These statistics indicate that biological fathers are not present in the homes of a significant number of children.

5.3.1.5 Access to basic services

As seen in Chapter Three, WASH is an important determinant of malnutrition. Figure 5.3 reveals the proportion of households in the country that have access to improved water amenities. These amenities are defined as access to pipe or tap water in their dwellings, off-site or on-site. Nationally, the proportion of households with access to improved water increased from 84.4% in 2002 to 88.2% in 2019. This shows little improvement in household's access to water over the past 17 years. The percentage of households with access to improved water and sanitation is presented in Figure 5.3.



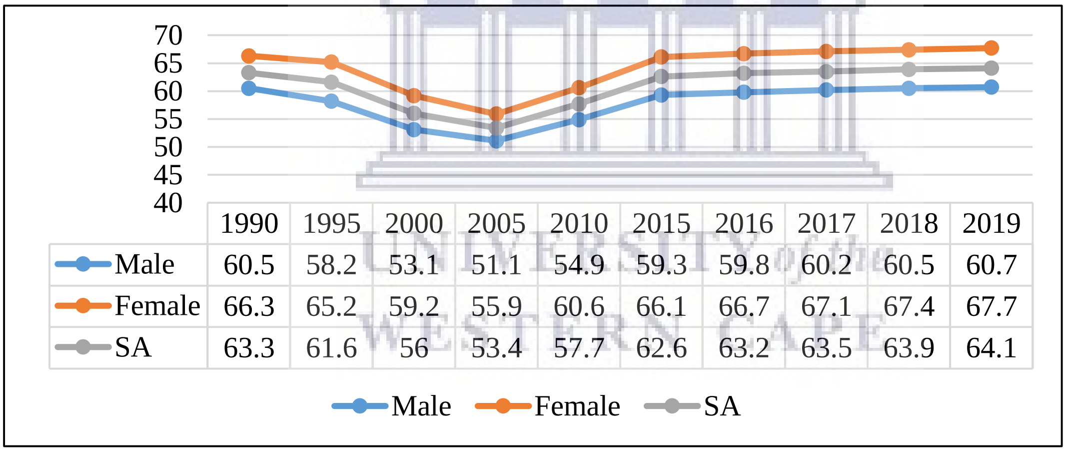
	2002	2003	2005	2007	2009	2011	2013	2015	2017	2019
Improved water	84.4	86.6	87.9	89.4	89.6	90.3	89.9	89.6	88.6	88.2
Improved sanitation	61.7	68.3	70	75.4	77	79.5	81	82.4	83	82.1

Figure 5.3: Percentage of households with access to improved water and sanitation, 2002–2019
Source: Statistics SA (2020b) General Household Survey (2019)

Figure 5.3 also identifies the proportion of households with access to improved sanitation facilities in the country. These facilities are defined as flush toilets connected to a public sewerage system or a septic tank, or a pit toilet with a ventilation pipe. Nationally, the percentage of households with access to improved sanitation increased from 61.7% in 2002 to 82.1% in 2019. This indicates that household's access to improved sanitation has greatly improved over the past 17 years.

5.3.1.6 Health

Life expectancy[28] at birth decreased by 4.4years between 1990 and 2015 (United Nations Development Programme, UNDP 2016). Initially, the decline in life expectancy was mostly attributed to Human Immune Deficiency Virus (HIV)/Acquired Immune Deficiency Syndrome (AIDS) pandemic (Ataguba and McIntyre, 2012). Nonetheless, despite an increase in life expectancy in 2019 by 0.8 years (HDR, 2020), SA faces the burden of infectious diseases alongside other NCDs such as cancer, diabetes and hypertension (Mayosi et al., 2009, Tathiah et al., 2013). NCDs accounted for the highest rate of death (43.4%), while TB and HIV/AIDS accounted for roughly 33.6% of deaths in 2012 (Pillay-van Wyk et al., 2016). Figure 5.4 presents the trend of life expectancy at birth by sex from 1990-2019.



	1990	1995	2000	2005	2010	2015	2016	2017	2018	2019
Male	60.5	58.2	53.1	51.1	54.9	59.3	59.8	60.2	60.5	60.7
Female	66.3	65.2	59.2	55.9	60.6	66.1	66.7	67.1	67.4	67.7
SA	63.3	61.6	56	53.4	57.7	62.6	63.2	63.5	63.9	64.1

Figure 5.4: Life expectancy at birth by sex over time, 1990–2019.
Source: World Bank (2021)

Infants and under-five mortality rates are important indicators of child health and development. This is because they are linked with a broad range of bio-demographic, environmental and health factors which are not only key determinants of child health but are also informative

[28] In this case, life expectancy at birth refers to how many years a new-born baby can live if the mortality rate at birth remains the same throughout the baby's life.

about the health status of the broader population. Table 5.3 shows child mortality in SA, 2012-2018.

Table 5.3: Child mortality indicators, rapid mortality surveillance, 2012-2018

Indicator		2012	2013	2014	2015	2016	2017	2018
Under-five mortality rate (U5MR)		42	43	42	39	36	33	34
Infant mortality rate (IMR)	28	29	29	28	26		23	25
Neonatal mortality rate	11	11	12	12	12		12	11

Source: Dorrington et al. (2020)

Table 5.3 reveals that between 2012 and 2018, U5MR and IMR have improved, though very slow. NMR refers to the probability of dying within the first 28 days of life per 1, 000 live births (Dorrington et al., 2020). In 2018, NMR was 11 deaths per 1, 000 live births, though it had been stagnant at 12 deaths per 1, 000 live births from 2014. Nevertheless, between 2012 and 2018, the rate is stalled at 11 deaths per 1, 000 live births. Estimates of NMR were obtained directly from vital registration data, that is, registered deaths and births without adjustment for incompleteness up to 2013. From 2013 onwards, the estimates were derived directly from neonatal deaths and live births recorded in the District Health Information System.

5.3.1.7 Food and Nutrition Security

Vulnerability to hunger: Hunger is one of the subjective indicators of food security. To determine the proportion of the population or households that are food insecure, from 2002 to 2008, the GHS asked households to specify whether and how often adults and children went hungry due to insufficient food in the household (Statistics SA, 2020b). This question was discontinued in 2009 but reinstated in the 2010 questionnaire and since then, it is asked annually. The trend analysis in Figure 5.5 reveals that the proportion of households and persons vulnerable to hunger was cut in half, decreasing from 24.2% and 29, 3% in 2002 to 10.8% and 13.8% in 2007 respectively. This indicates that in the early 2000s, the prevalence of hunger dropped significantly.

Between 2007 and 2011, the proportion of households vulnerable to hunger increased regrettably, which coincided with the global financial crisis and its aftermath. Notwithstanding, since 2011, progress in reducing hunger both at household and individual levels have been very slow and has since stalled up till 2015, remaining at just above 11% and 13, 0%. In 2019, the proportion of households and individuals vulnerable to hunger were 10.3% and 11.1%, respectively. This signifies that, compared with the 2002 rate, the percentage of households and individuals that suffer from hunger has decreased significantly. In Figure 5.5, the trend of households and individuals vulnerable to hunger for the period 2002-2019 are presented.

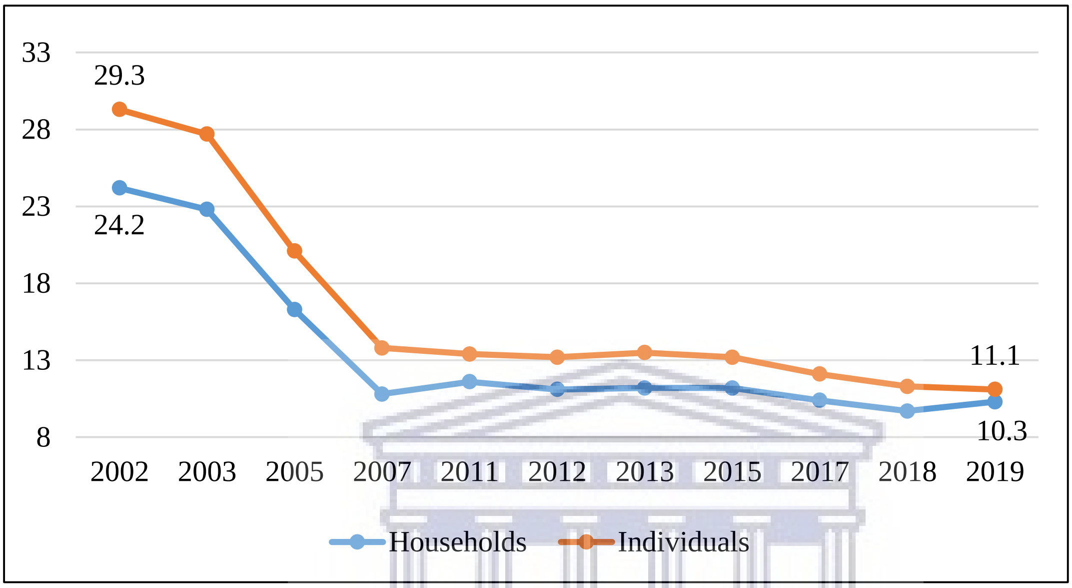


Figure 5.5: Vulnerability to hunger, 2002–2019
Source: Statistics SA (2020b) General Household Survey (2019)

SA is faced with rapid urbanisation with approximately 60% of its population currently living in urban areas (Cohen, 2006). This has resulted in a nutrition transition (Schönfeldt, Pretorius and Hall, 2013). This transition has led to a double burden of malnutrition, with persistently high rates of undernutrition and increasing rates of overnutrition (Martins et al., 2011; Kimani-Murage, 2013; Tydeman-Edwards, Van Rooyen and Walsh, 2018). Bourne, Lambert, and Steyn (2002); and Bradshaw et al. (2006) note that the double burden of malnutrition extends to a double burden of disease, in which there is a high prevalence of both infectious diseases related to under-nutrition and of NCDs related to over-nutrition in the country.

Malnutrition amongst women: In SA, the prevalence of underweight was significantly higher in males (12.8%) than females (4.2%), as well as lower for the younger group when compared with the older group (Shisana et al., 2013). The National Department of Health (NDoH), Statistics SA, South African Medical Research Council (SAMRC), and ICF (2019) reported a similar result using the South African Demographic and Health Survey (SADHS) data of 2016.

The BMI results for all men and women aged 15 years and older indicated that about 3% of women were underweight, while approximately 10% of men were underweight (NDoH, Statistics SA, SAMRC and ICF, 2019).

SA like other parts of the world is faced with overnutrition, which is most common amongst women. Shisana et al. (2013) using the South African National Health and Nutrition Examination Survey (SANHANES, 2012) found that the prevalence of overweight and obesity were significantly higher in females (24.8% and 39.2%) compared with males (20.1% and 10.6%) respectively. NDoH, Statistics SA, SAMRC and ICF (2019) also observed that in 2016, roughly 68% of women and 31% of men aged 15 years and above were overweight/obese respectively. For those 15-49 years old, the rate of overweight/obesity was about 62% for women and 25% for men. This indicates that women than men are more prone to overweight/obesity. Shisana et al. (2013) further point out that for females, the BMI increases with age and later decreases from 65 years and older.

Malnutrition amongst children: In SA, stunting is considered a major nutritional disorder, especially amongst children under the age of 5, and more than one-fifth of the country's children are affected (Labadarios et al., 2008). Shisana et al. (2013) compared the National Food Consumption Survey-Fortification Baseline (NFCS-FB-I) of 2005 to the SANHANES (2012) of children aged 1-3 years, 4-6 years, found that stunting increased from 23.5% (2005) to 26.5% (2012) amongst children aged one to three years and decreased from 16.4% (2005) to 11.9% (2012) amongst children aged four to six years respectively. Also, based on a report by the NDoH, Statistics SA, SAMRC and ICF (2019) using the SADHS data of 2016, of all the children below 5 years roughly 27.4% were stunted with a general increase amongst children aged between 1 and 3 years. The highest rate of stunting was prevalent in male children (29.8%) than female children (25%). Contrarily, Devereux, Jonah and May (2019) in their study on child malnutrition of children aged 6-59 months, note that for most of the surveys, the confidence intervals were wide and in most instances overlap each other in a way that there was no statistically significant difference between the majority of the stunting estimates and decline in the prevalence of stunting between 1993 and 2016.

Underweight is also one of the common forms of malnutrition affecting South African children (Labadarios et al., 2008). Approximately 11% of children between the age of 1 and 3 years were underweight compared with 8.6% and 7.6% of those aged between 4 and 6, and 7 and 9 years respectively using the NFCS of 2005 (Shisana et al., 2013). Comparing these results with SANHANES (2012), for these age groups, it was seen that underweight decreased to 6.1%, 4.5% and 6.6% respectively. Based on the report by the NDoH, Statistics SA, SAMRC and ICF (2019) using the SADHS data of 2016, of all the children below 5 years, roughly 6% were underweight. In general, children aged between 1 and 3 years had the highest prevalence of about 10% (NDoH, Statistics SA, SAMRC and ICF, 2019).

Shisana et al. (2013) using the NFCS of 2005 argue that nationally the prevalence of wasting was approximately 5.1% amongst children between 1 and 3 years old, compared with 5% and 3% of those aged between 4 and 6 years respectively. Comparing these results with SANHANES (2012), Shinana et al. (2013) noted that for the aforementioned age groups, wasting decreased to 2.2% and 2.0% respectively. Moreover, the NDoH, Statistics SA, SAMRC and ICF (2019) report using the SADHS data of 2016, found that of all the children below 5 years, roughly 3% were wasted. This indicates that the rate of wasting amongst those below five years of age is very low. May and Timaeus (2014) argue that all the different forms of anthropometric deficit (stunting, wasting and underweight) decreased over the period 1993 to (2008). Devereux and Waidler (2017) in their study found that child nutritional status was stagnant or slightly improved. PEM in children aged 0-4 years in 2000, was estimated to account for approximately 44.7% of the total disease burden (Nannan et al., 2007).

Rossouw, Grant and Viljoen (2012) note that in SA, overweight and obesity in children increased significantly from 1994 to 2004, but the prevalence varied with gender, racial group and age. However, according to WB (2020), the rate of overweight was 17.2% in 2004, while a report by the NDoH, Statistics SA, SAMRC and ICF (2019) revealed that in 2016, approximately 13% of children below the age of 5 years were overweight. Comparing the two, this signifies that the rate of overweight decreased between 2004-2016. Being overweight was seen to be highest in children aged 1-3 years compared with those aged 4-6 years (Steyn et al., 2006). Compared with boys, girls have a much higher prevalence of overweight and obesity (Armstrong et al., 2006; Shisana et al., 2013; Otitoola, Oldewage-Theron and Egal, 2020) and overall prevalence was higher amongst children in the urban areas (Steyn et al., 2006; Labadarios et al., 2008; Monyeki et al., 2015). The WHO emphasises the prevention of childhood obesity and this is linked to the frequency distribution of a child's meal throughout the day (Maffeis et al., 2000), adult and parental meals provided to children (Lifshitz and Tarim, 1996) and quantity of food consumed have an impact on obesity (Smiciklas-Wright et al., 2003; Livingstone and Pourshahidi, 2014).

5.3.1.8 Income distribution

Due to the skewed nature of income distribution within SA, SA has been listed amongst the most unequal countries in the world (Ntuli, 2009; Bhorat and Van der Westhuizen, 2012. The Gini coefficient, which is an index of income inequality, seems to be passed from generation to generation. This implies that income inequality has barely changed over time. Over the long term the Gini coefficient has increased from 64% in 1995 (Bhorat and Van der Westhuizen, 2012) to 68% in 2015 (Statistics SA, 2017b). Looking at a short period income inequality decreased between 2006 and 2015 from about 72% in 2006 to 68% in 2015 (Statistics SA, 2017b). Variations in the GINI coefficient still exist amongst the different population groups (Statistics SA, 2017b). This persistent high-income inequality is mainly due to differences in labour market outcomes (Van der Berg, 2010; Leibbrandt, Finn and Woolard, 2012; Anand, Kothari and Kumar, 2016).

5.3.1.9 Labour market outcomes

The South African labour market plays an important role in the country's economic development. In the pre-democratic regime, before 1994, it was used as a mechanism to segregate society (Festus et al, 2016). Segregation was achieved through different legislations, which segmented the labour market along racial lines, to the disadvantage of Africans. Africans, particularly women, were severely discriminated against and their full integration into the labour market was hindered (Seekings and Nattrass, 2008). In 1994, SA moved from apartheid to a democratic government. The democratic government carried out fundamental constitutional reforms to increase women's access to the labour market (Yakubu, 2010).

As a result of the apartheid policies and practices, laws such as the Employment Equity Act (EEA) of 1998 and the Skills Development Act (SDA) of 1998 were introduced by the democratic government to correct gender and racial imbalances created in the labour market and to achieve equity in the workplace (Horwitz and Jain, 2002; Clarke, 2004). The SDA was intended to provide a framework for institutions to design and implement national, sectoral and workplace strategies for the development and improvement of skills in the country's entire workforce by providing “learner-ships” for young people and the unemployed (Flowerday, Rankin and Schöer, 2016). The EEA encouraged affirmative action, which results in the employment of more African workers to reduce societal inequalities (Clarke, 2004; Festus et al, 2016; Flowerday, Rankin and Schöer, 2016). The SDA and EEA have helped to promote the process of women’s better integration into the labour market. The EEA bears the greatest significance for increased gender equality in the workplace (Burger and Jafta, 2010; Horwitz and Jain, 2011).

Since the abolition of apartheid, SA's FLFPR has significantly increased (Casale and Posel, 2002; Yu, 2008; Ackermann and Velelo, 2013). Casale and Posel (2002) using the first available nationally representative and detailed household survey data (October Household Survey - OHS) in their study of the continuous feminisation of the South African LF, found an increase in FLFP particularly amongst Africans in both the broad and strict LFPR over the period 1995 to 1999. But it was argued by Yu (2008) using the Labour Force Survey (LFS) that between 2000 and 2006 there is no evidence of the feminisation of the LF, though he found similar changes as Casale and Posel (2002) when using the OHS (1995 to 1999).

According to Oosthuizen and Bhorat (2005); and Leibbrandt et al. (2010), the South African labour market experienced a sharp increase in labour supply, which can be attributed to the increase in women’s participation in the labour market. The increase in LFP is quite noticeable for women than men. While the participation rate for men rose by 10% between 1993 and 2008 that of women rose by 38% (Leibbrandt et al., 2010). Many factors may account for the feminisation of the South African LF. This includes, amongst others, the increased female educational levels, loss of male employment, low birth rates as well as a greater number of female-headed households (Kabeer, 2012). The increase can also be attributed to the Affirmative Action policies (Festus et al., 2016). As seen in Table 5.4, for both males and females, there have been fluctuations in the LF characteristics from 2018 Quarter 1 to 2020 Quarter 1. However, men dominate in terms of LFP and employment rates across the periods. Table 5.4 shows the labour market outcomes for both men and women in SA.

Table 5.4: Labour force characteristics by sex, 2018-2020

Labour force Characteristics	January-March 2018		January-March 2019		January-March 2020	
Rate (%)	Men	Women	Men	Women	Men	Women
Labour participation rate	65.6	53.2	65.0	52.5	66.3	54.5
Employment rate	49.1	37.9	48.0	37.2	47.5	36.9
Unemployment rate	25.1	28.8	26.1	29.3	28.3	32.4

Source: Statistics SA 2019; 2020) Quarterly Labour Force Survey: Quarter 1(2019, 2020)

5.4 Data

This study used secondary data from NIDS. NIDS is the first nationally representative South African household panel dataset designed to track changes in South African's welfare over time (Chinhema et al., 2016). The NIDS is implemented by the Southern Africa Labour and Development Research Unit (SALDRU) at the University of Cape Town and commissioned by the office of the president. The data was employed as cross-sectional data because the research involved assessing prevalence and trends at a certain point in time. This dataset was used on the basis that, other South African national datasets are rich in either labour market (for instance the Quarterly Labour Force Surveys) or nutrition/health (examples the South African National Health and Nutrition Examination Survey and the South African Demographic and Health Survey) outcomes only.

Conversely, the census data lack detailed socio-economic indicators necessary for the study. Consequently, NIDS was exclusively used since it collects a wide range of information from respondents such as their labour market activities, education, health, anthropometric measures, demographic characteristics and other socioeconomic indicators. Another key quality of NIDS is that, contrary to other standard household survey methods, each member of a given household is interviewed separately. For the analysis, four years of NIDS were used: 2008, 2012, 2014/15 and 2017. The 2010 dataset was not analysed due to some irregularities that can negatively affect results as documented by Cichello, Leibbrandt, and Woolard (2012).

Sampling Design: Presently, five waves of data are available spanning over nine years from 2008 to 2017 with 2008 being the baseline of the study. In sampling households that need to be included in the base year, a stratified two-stage cluster sample design was used (Leibbrandt, Woolard and de Villiers, 2009).

Data Collection: In 2008, it began with a nationally representative sample of over 28, 000 individuals in 7, 300 households (Leibbrandt, Woolard and de Villiers, 2009; Brophy et al., 2018). The second, third, fourth and fifth waves were collected in 2010/2011, 2012, 2014/2015 and 2017 respectively, with a gap of approximately two years (Brophy et al., 2018). The NIDS data also contains both continuous sampling members (CSM) - same household members interviewed every two years and temporary sampling members (TSM) – members who become part of the household who were interviewed but are not followed across the waves (Chinhema et al., 2016). Both CSMs and TSMs were used in the analysis. As a result of the high attrition rate of Asian, White and high-income respondents (Branson and Wittenberg, 2019), to maintain the representativeness of the sample a Top-Up sample of 2775 CSMs were added in 2017 (Brophy et al., 2018). The reason for attrition includes refusal, non-contact and deceased. Table 5.5 presents the wave on wave attrition rate by race.

Table 5.5: Wave on wave attrition rate by race

Population Group	2012	2014/15	2017
African	13.4	11.2	11.8
Coloured	18.3	16.8	18.7
Indian	36.4	43.7	44.8
Whites	50.1	54.4	62.7
Total	15.9	14.0	14.8

Source: Brophy et al. (2018)

Information at the household and individual levels were collected by administering household and individual questionnaires. The individual adult questionnaires were administered to persons 15 years and above on the interview day. The household questionnaires were administered to the oldest woman in the household. Information about a child (0-14 years) was collected using a child questionnaire, which was administered to either the mother or the caregiver of the child. When the relevant individual (aged 15+) is not present during the interview period a household member (aged 18+) who is knowledgeable about the members of the household, spending and living arrangements is administered a proxy questionnaire.

***Weighting*:** Two sets of weights are provided for the NIDS data set; the design and post-stratification weights. Different methods were used in designing these weights and both have implications when used (Leibbrandt, Woolard and de Villiers, 2009; Wittenberg, 2009).

In deriving the design weights, the information provided to NIDS by Statistics SA about the two-stage sampling process from the master sample served as the basis for calculation. In computing the design weights, two sets of calculations were required. The probability of sampling a PSU was first calculated, then in step two, the probability of including a household in each PSU in the NIDS sample was calculated. This corrects for household nonresponse (Leibbrandt, Woolard and de Villiers, 2009).

Post-stratification weights involve calibrating the weights of a survey so that when applied both the sample size and population look the same (Wittenberg, 2009). The design weights are adjusted by these weights so that the marginal age-sex-race totals in the NIDS data correspond to the population estimates generated by Statistics SA for the 2008 mid-year population estimates. When calculating the post-stratified weights, several constraints are imposed which include: first, there must be a corresponding population distribution by provinces with that released in the Statistics SA population estimates; and second, the total weights must be equivalent to the estimated population size of 48, 687, 000; and finally, weights should be constant within households (Leibbrandt, Woolard and de Villiers, 2009; Wittenberg, 2009).

Study Domain: The objectives of this dissertation required a target population of women and children. The sample for the analysis was limited to women of the reproductive age, that is, those aged between 15-49 years (WHO, 2006a; Loaiza and Blake, 2010), who have 0-59 months old children and are their primary caregivers[29]. The analysis also focused on these children. The sample was also restricted to these groups because women in this age group are more likely to have a 0-59 months old child in their care and this group of children are the focus of WHO growth reference charts. In addition, women of reproductive age and children under 5 years are more vulnerable to malnutrition (Yasmin, 2016). The presence of a child in a household according to Linné et al. (2004), is highly correlated with an increase in adipose tissue, and hence a higher BMI. This may be due to behavioural aspects that are ignored when providing childcare, such as a decrease in physical activities.

[29] Caregivers as used in NIDS refers to the person taking care of the child.

In the 2014/15 dataset, there were no observations for women aged either 15 years or 49 years who were caring for their child. Due to the lack of data for these two age groups in 2014/15 and the small sample size of mothers aged above 45 years who are the primary caregivers of their child, the sample size was further limited to biological mothers aged between 16-45 years. It should be noted that some mothers had more than one child under 5 years. To avoid duplication of mothers' characteristics the youngest child under her care was controlled for and duplicates were dropped. As such, the analysis was restricted to one mother/one child pair and the youngest child was selected.

5.5 Statistical Analysis

For each of the main explanatory variables of interest (maternal and child nutritional status), a separate analysis was done to estimate their different effects on MLFP. The different statistical analysis performed in this dissertation includes;

Descriptive Cross-Sectional analysis was used to obtain information on maternal and child nutritional status, maternal labour supply, and the other variables used to describe "what exists" for these variables under investigation. The cross-sectional analysis in this research employed the post-stratification weights which are used to account for initial non-response and survey design (Baigrie and Eyal, 2014). The prevalence of malnutrition and labour market outcomes were calculated as percentages and presented alongside their 95% confidence intervals (CIs). A trend analysis was also conducted. Central tendency, the mean, were also used to generate summary statistics of the datasets.

It is worth noting that when using cross-sectional data to analyse trends, it is only possible to pick up overall changes that have occurred. Any mixing that had taken place cannot be identified. For instance, a large number of mothers or children may have left the survey over the period, while a larger number entered. An increase may be observed due to the large size of the net entrance. Therefore, one can only approximate when discussing the trends.

Explanatory analysis was used to examine whether one variable caused or determined the value of another variable. This helps to reveal the cause and effect relationship between the dependent and independent variables. For the regression analysis, the 2017 dataset was used. The reason why all waves of NIDS data were not pooled to estimate the models is based on the fact that for the child regression, the analysis as discussed above was limited to the youngest child in the household of which some were not in the previous waves. Therefore, to be consistent with the analyses, only the 2017 dataset was used.

In this research, the dependent variable was MLFP and the main explanatory variables were an obese mother and a stunted child in the household. However, selected explanatory variables that could affect the dependent variable were also used. More on this in section 5.7.

5.6 Theoretical Framework of Labour Supply

The standard participation model developed from the traditional neoclassical labour supply theory discussed in chapter two was applied in this study. The specification of the model used in this study follows ideas developed by Sprague (1994). It should be noted that the neoclassical model of labour supply originates from the Hicks (1946) consumer behaviour model. Following the Hicks formulation, maternal labour supply is derived from a general consumer demand model in which a fixed endowment of a commodity (time, T) is divided into two parts, one part for sale on the labour market and the other for direct consumption. Based on this, time (T) is divided between hours worked (h) and leisure (L), where L incorporates all non-market use of time (including home production). Thus, a woman is faced with a time constraint, T = h + L.

The model also assumes that the mother possesses a well-behaved utility function (U) that is defined over her consumption of commodities, C (it is assumed throughout the analysis that the relative price of C is constant, hence C represents a Hicksian composite commodity), vector of observed characteristics, X, and her hours of work, h. This can be expressed as,

$$U = f(C, X, h, \mu) \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (5.1)$$

where: X = individual/household characteristics (for instance, age, employed male in the household and marital status) and μ = unobserved characteristics.

The mother is also assumed to have a budget constraint, whereby the amount of money she has to spend on the consumption of commodities (C) must be equal to the sum of income she receives from labour and non-labour incomes (sum of asset and unearned income). This is expressed as,

$$pC = wh + N \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots. (5.2)$$

where: w = wage rate (assumed fixed), N = non labour income and p = price of the composite commodity.

Consumption and labour supply decisions can be thought of as complementary behaviours whereby, the mother selects C > 0 and h ≥ 0 that maximises her utility (5.1) subject to the budget constraint (5.2). The resulting first order conditions take the form;

$$\begin{matrix} U_c(C, X, h, \mu) = \lambda \\ U_h(C, X, h, \mu) \; \geq \; \lambda w \end{matrix} \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots \; (5.3)$$

where ƛ is the marginal utility of income. The marginal rate of substitution between hours of work and the consumption of commodities is the ratio of these marginal utilities in (5.3). If the inequality in equation (5.3) holds strictly then the mother is not working (h=0) and L=T.

A mother's reservation wage, w_r, is the slope of the indifference curve between the consumption of commodity and hours of work evaluated at $h = 0$. The wage, w_r, is such that $U_h, N, X, T, \mu \; \geq \; \lambda w_r$ below which she will not work and hence, the value of non-market activities. Thus, the decision rule is that a mother participates in the labour market if and only if the expected market wage offered (w_i) is greater than the reservation wage (w_r). This is shown in equation (5.4) below;

$$\begin{matrix} w_i \; \leq w_r \; = no\ participation \\ w_i > \; w_r = participation \end{matrix} \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (5.4)$$

The first wage (w_i) in (5.4) pertains to the market demand function while the second (w_r) refers to the individual's labour supply function (Killingsworth and Heckman, 1986). w_r, which reflects the marginal rate of substitution between consumption and leisure, and evaluated at full leisure, depends on non-labour income and personal characteristics such as tastes, marital status, race, age, health status, and ages and number of children (Sprague, 1994). This can be written as,

$$w_r = W^* (M_i, N_i) \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots .. (5.5)$$

where M_i is a vector of observed characteristics and N_i is an unobserved parameter representing tastes. On the other hand, the market wage offered to the mother depends on her human capital and personal characteristics such as education, work experience, her age and that of her child, and unobserved parameters reflecting innate ability (Sprague, 1994). This is written as,

$$w_i = W(Z_i, \varepsilon_i) \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots . (5.6)$$

where Z_i, is a vector of observed characteristics and ε_i the unobserved parameters reflecting innate ability. The formulation in (5.6) abstracts from institutional factors such as union membership and the industry or occupation type for the time being. This is because these factors affect wages and in the participation exercise, the wage model cannot be used since the institution the mother will work in is unknown at the time of her making the decision to participate in the labour market (Sprague, 1994). Theoretically, if we combine the explanatory variables in (5.5) and (5.6) the mother's LFP model is obtained such that, she will participate if any of these variables impact market demand and her labour supply functions according to the rule in equation (5.4). These conditions show that the relevant determinants of LFP include non-labour income as well as observed and unobserved personal and household characteristics.

This framework has been used extensively to model LFP as a function of the aforementioned characteristics. Nonetheless, the nutritional status of a mother and child can be considered as a component of the X vector given their impact on labour supply decisions. As seen in Chapter 3, a mother who is obese or caring for a stunted child may have a higher reservation wage thereby increasing the opportunity cost of work. Conversely, a mother who is not obese or caring for a stunted child is more likely to participate in the LF, thereby, increasing the opportunity cost of leisure. As such, this model can further be extended to incorporate maternal obesity and childhood stunting.

5.7 Empirical Model Specification

From the theoretical framework above, the empirical model can be specified. The linear probability model (LPM) can be used when modelling the LFP decision to estimate the coefficients. This is because it does not depend on the joint normality assumption[30] for consistency. However, the problems with this model include: the disturbance term (μ) is not normally distributed; predictions are not bound between 0 and 1; errors are highly heteroscedastic and difficult to correct (Gujarati, 2009). Due to these inadequacies of the LPM, a nonlinear model specification is more appropriate.

The different types of nonlinear probability models include; tobit, probit and logit. These models solve the problems of using the LPM by fitting a non-linear function (Gujarati, 2009). Probit and logit models are used if a dependent variable is a dummy variable; while a tobit model is applied if it is a censored variable. The advantage of these models is that they transform information about a binary dependent variable into an unbounded continuous variable by applying a link function and estimate a regular multivariate regression model (Razzaghi, 2013; Leeper, 2017). Practically, there is no main reason for choosing one over the other (Gujarati, 2009).

In modelling the relationship between health and LFP decisions, most researchers used the probit regression model (Morris, 2007; Greve, 2008; Delattre, Moussa and Sabatier, 2019; Pedron et al., 2019). The model allows the reporting of changes in the response probability, that is, marginal effects (Gujarati, 2009). Marginal effects which measure discrete changes are very useful when interpreting the result of a binary model. The marginal effect is calculated because the values of the generalised linear models such as logit and probit are not easily interpretable directly (Leeper, 2017). The coefficients of these models express the effect of the

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[30] Two random variables for instance, Y and Z are jointly normal if they can be expressed in the form

$Y = aX + bU,$

$Z = cX + dU,$

where X and U are independent normal random variables, and a, b, c, d, are some scalars.

various variables onto the latent, linear scale of the outcome and not the discrete (or probability) scale of the observed outcome (Long, 1997).

This research applied probit regression to model the relationship between maternal and child malnutrition, and MLFP. This model is suitable in this case because the dependent variable, which is MLFP, is binary and takes on two values: 1 if she participates in the labour force and 0 otherwise. MLFP was modelled on the extensive margin using the narrow definition of LFP. The narrow definition is the internationally accepted definition of LFP by the ILO and used by the South African government (Altman, 2003; Oosthuizen and Bhorat, 2005). It was used in this study for international comparability as recommended by the ILO (1995). Given that prior research (Kingdon and Knight, 2004; Oosthuizen and Bhorat, 2005) suggest that the broad definition of LFP is appropriate for SA, it was used to check for the robustness of the results. To estimate the effect of maternal and child malnutrition on MLFP, the following models were estimated.

5.7.1 Univariate probit model

Both the probit and LPM models were estimated. Despite the weaknesses of the LPM listed above, Angrist and Pischke (2009) point out that the model is quite robust and easy to implement and interpret. For both models, the dependent variable is binary. However, the LPM can be fitted by simple linear regression. To explain, let MLFP denoted as Y_i be a binary variable that takes the form 1 if the mother participates in the LF and 0 otherwise. It is possible to use the OLS given as;

$$Y_i = f(X_i, \mu_i) \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (5.7)$$

where X_i are vectors of observed characteristics that affect Y_i and μ_i is the unobserved variation also known as the error term, subject to the standard normal distribution. Equation (5.7) is called the LPM. The model assumes that, for a Bernoulli trial, Y_i, and its related vector of explanatory variables, X_i, the main concern is with the response probability given as;

$$Pr(Y_i = 1|X_i) = Pr(Y_i = 1|x_1, x_2, \dots, x_n) \dots\dots\dots\dots\dots\dots\dots\dots (5.8)$$

where $Pr(Y_i = 1|X_i)$ is the predicted probability that the mother participates in the LF, that is, $Y_i = 1$, given the values of the independent variables, X_i. A probit model assumes that though the values 0 and 1 are observed for Y_i, there is Y^* - a latent unobserved variable, which determines the value of Y (Gujarati, 2009).

$$Y_i^* = f(X_i, \mu_i) \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots (5.9)$$

where X_i are vectors of observed characteristics that affect Y_i^*. μ_i is normally distributed with mean $E[\mu_i] = 0$ and variance $var[\mu_i] = 1$ and Y_i^* is a latent variable that cannot be observed directly. Instead of observing Y_i^* the observed outcome Y_i, for individual i is defined by the sign of the latent variable, Y_i^*, as follows:

$$Y_i = \begin{cases} 1 \; if \; Y_i^* > 0 \\ 0 \; if \; Y_i^* \leq 0 \end{cases} \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots (5.10)$$

Wherever Y_i^* appears in this chapter, the same rule applies as in (5.10). Based on (5.10) a mother will participate in the LF if her underlying latent LFP index, $Y_i^* > 0$. It should be noted that although the equations mostly focused on an obese mother (OM)[31], the same procedure was followed when looking at the impact of the presence of a stunted child (CS) by replacing OM with CS.

It was seen in chapter 3 that malnutrition, particularly for the individual supplying her labour, can affect her LFP due to: (i) reduced health (ii) discrimination by employers and (iii) reduce labour market performance. Assuming Y is a linear function of the presence of both OM and other covariates. For household i, it is assumed that MLFP is given by:

$$Y_i = \beta_0 + \beta_1 OM_i + \beta_2 H_i + \beta_3 F_i + \beta_4 A_i + \mu_i \dots \dots \dots \dots \dots \dots \dots \dots \dots (5.11)$$

[31] It should be noted that women can be 1) calorie deficient (rare in SA); micro-nutrient deficient (common in SA but rarely measured); or overweight/obese (common in SA and measured in NIDS).

where i indexes of individuals, β_0 is the intercept; β_1 to β_4 is the estimation parameter, a measure of the impact of the variables on Y_i. H_i measures health status of the mother, F_i measures family variables that affect the mother's decision to participate; A_i reflects additional control variables that affect MLFP like age, education, race and location, and μ_i is the error term. A univariate probit model can be used to estimate (5.11):

$$\begin{gathered} Y_i^* = \beta_5 OM_i + \beta_6 X_i + \mu_i \\ E[\mu_i] = 0 \\ Var[\mu_i] = 1 \end{gathered} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (5.12)$$

where X_i is a vector of other observed characteristics such as H_i, F_i and A_i that affect Y_i^*. β_5, is the parameter of primary interest and measures the impact of OM on MLFP. For the univariate probit model, the empirical specification of the model (5.12) is as follows;

$$Pr(Y_i = 1 | OM_i, X_i) = \Phi(\beta_7 OM_i + \beta_8 X_i) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (5.13)$$

where Φ is the normal cumulative distribution function (CDF). Given that OM_i is a binary independent variable, the marginal effect (ME) of OM or CS on the probability of MLFP measures the sample average of the discrete change in OM_i or CS_i that is, how the predicted probability of participating changes as OM_i or CS_i changes from 0 to 1 while holding all other variables X_i at their means:

$$ME = \frac{1}{n}\sum_{i=1}^{n}[\emptyset(\beta_9 X_i + \beta_{10} OM_i | OM = 1) - \emptyset(\beta_9 X_i + \beta_{10} OM_i | OM = 0)] \ldots\ldots\ldots\ldots\ldots (5.14)$$

where $\emptyset$ is the standard normal distribution function, $\emptyset(\beta_9 X_i + \beta_{10} OM_i)$ is the marginal predicted probability of participating in the labour force, which is computed for all observations using the estimated coefficients, and n is the number of individuals in the sample. The same method is applied to evaluate the effect of childhood stunting (CS) on MLFP as follows;

$$\begin{gathered} Y_i^* = \beta_{11} CS_i + \beta_{12} X_i + \mu_i \\ E[\mu_i] = 0 \\ Var[\mu_i] = 1 \end{gathered} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (5.15)$$

where CS_i presence of a malnourished child in the household. The same application as above applies. The univariate model gives the direct effect of OM or CS on MLFP without controlling for endogeneity. However, estimating equation (5.12) or (5.15) is not straightforward given that OM or CS may not be truly random (exogenous). As such, the measure of OM or CS may be endogenous, thus causing its estimated effect on maternal labour supply to be biased.

Obesity or stunting may be endogenous in situations where obesity/stunting is correlated with the error term in (5.12) or (5.15) or when there is reverse causality between MLFP and obesity/stunting[32]. In the first instance, this implies that the vector X does not include all the important regressors that may potentially affect both obesity/stunting and the MLFP. Since it is not certain that malnutrition is exogenous, to control for endogeneity of malnutrition an IV regression model is required. The most essential contemporary use of IV is to solve the problem of omitted variables bias (Angrist and Pischke, 2009). This is discussed in the subsequent section.

5.7.2 Bivariate probit model

The bivariate probit model, although seen as the most significant way to model the effect of a binary explanatory variable on a binary outcome as the case in this study (Greene, 2003; Winkelmann, 2012; Li, Poskitt and Zhao, 2019), nevertheless compels the incorporation of the IV-LPM into the analysis since the latter does not depend on the joint normality assumption for consistency. An LPM offers two advantages over a probit model: first, the LPM permits the use of IVs analysis to account for potential endogeneity of malnutrition; and second, though to control for endogeneity and test of instruments can be done using a bivariate probit model, the IV-LPM permits a formal test of instrument validity in the presence of overidentifying restriction. As such, a recursive bivariate probit model is applied together with the IV-LPM.

[32] As seen in Chapter 4, MLFP can lead to maternal or child malnutrition since the mother may not have enough time to prepare quality food for herself or her child.

In the first stage, it is assumed that the latent nutritional status, OM_i^*, is a linear function of X_i and instruments, Z_i, necessary to identify the impact of malnutrition on MLFP, and a random error term, μ_{1i}. The model is specified as:

$$OM_i^* = \beta_{13}X_i + \beta_{14}Z_i + \mu_{1i} \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (5.16)$$

where Z_i is a vector of IVs that affect OM_i^* but are not correlated with μ_i. It is represented as a scalar in equation (5.16) above for notational simplicity. β_{14} is the coefficient of interest as it measures the impact of Z_i on OM_i^*. OM_i^* , is a latent variable that cannot be observed directly. The observed outcome OM_i, for individual i is defined by the sign of the latent variable as follows:

$$OM_i = \begin{cases} 1 \text{ if } OM_i^* > 0 \\ 0 \text{ if } OM_i^* < 0 \end{cases} \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (5.17)$$

In the second stage, unobserved latent LFP, Y_i^*, is specified as a function of a vector of exogenous variables, X_i, latent obesity, OM_i^*, and a random error term, μ_{2i}. This is specified as:

$$Y_i^* = \beta_{15}OM_i^* + \beta_{16}X_i + \mu_{2i} \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (5.18)$$

The coefficient of interest in (5.18) is β_{15}. The correlation between μ_{1i} and μ_{2i} is denoted by ρ. It should be noted that there are many potential sources of unobserved heterogeneity commonly categorised as either genetic or non-genetic, which can determine malnutrition or LFP. These associations can be modelled using a bivariate probit model, by assuming joint normality of the error terms, μ_{1i} and μ_{2i} or the two-stage least squares (2SLS) model using the IV-LPM model. For the bivariate probit model, the assumptions of the model are as follows:

$$\begin{aligned} E[\mu_{1i}] = E[\mu_{2i}] &= 0 \\ var[\mu_{1i}] = var[\mu_{2i}] &= 1 \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (5.19) \\ cov[\mu_{1i}, \mu_{2i}] &= \rho \end{aligned}$$

where ρ is the correlation between the error terms in obesity and stunting, and MLFP equations. In this framework, ρ captures the endogeneity of obesity/stunting. A formal test of doing so is by testing if ρ is statistically different from zero. If ρ is statistically significant, it indicates endogeneity of obesity or stunting. This indicates that obesity/stunting is endogenous and estimates of β using a univariate probit model are invalid. On the other hand, if it is statistically insignificant, it is evident that estimating separate MLFP and obesity/ stunting equations may not produce inconsistent estimates. Since the probit model contains a binary regressor that is assumed to be endogenous, the model is specified as follows:

$$OM_i = 1[\beta_{17}X_i + \beta_{18}Z_i + \mu_{1i} > 0] \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots (5.20)$$
$$Y_i = 1[\beta_{19}OM_i^* + \beta_{20}X_i + \mu_{2i} > 0] \dots \dots \dots \dots \dots \dots \dots \dots \dots \dots (5.21)$$

where (μ_{1i}, μ_{2i}) are independent of Z_i and distributed as bivariate normal (Wooldridge, 2010). For the bivariate probit model, the empirical specification of the model (5.16) - (5.21) is as follows;

$$Pr(OM_i = 1|X_i, Z_i) = \Phi(\beta_{21}X_i + \beta_{22}Z_i) \dots \dots \dots \dots \dots \dots \dots \dots (5.22)$$
$$Pr(Y_i = 1|X_i) = \Phi(\beta_{23}OM_i + \beta_{24}X_i) \dots \dots \dots \dots \dots \dots \dots \dots (5.23)$$

To control for the endogeneity problem using equation (5.15) valid instruments, $Z_{i,}$ for OM_i or CS_i are needed to obtain consistent and valid estimates of the model. For Z_i to be valid: (i) it must be correlated with the suspected endogenous variable, OM_i; (ii) it must be uncorrelated with μ_{2i} that is, the instrument must be uncorrelated with the dependent variable $cov[Z_i, \mu_{2i}] = 0$. Condition (ii) in this instrumental variables framework is very important for identification purposes. Also, the normal two-step technique, which would entail estimating (5.16) by a probit method in a first step and using the fitted values of obese/stunting in a second step to estimate (5.18), will yield inconsistent estimates of β. To obtain consistent estimates of the parameters, equations (5.16) and (5.18) must be jointly estimated.

The estimation of the parameters is based on the likelihood function of the joint distribution of (MLFP; OM/CS) given the exogenous variables X_i and Z_i. To simplify the notations let $Y_1 =$

$MLFP$ and $Y_2 = OM/CS$: The joint distribution of (Y_1, Y_2) conditional on X, Z can be decomposed as:

$$f(Y_1, Y_2|X, Z, \theta) = f(Y_1|Y_2, X, Z, \theta)f(Y_2|Z, \theta) \dots \dots \dots \dots \dots \dots \dots \dots (5.24)$$

where θ is the vector of all the model parameters, that is $\theta = (\beta_{13} - \beta_{16}, \rho)$. The ME is computed similarly as equation (5.14) with the difference being that in this case the endogeneity of obesity or stunting is taken into account. The same method was repeated for the CS regression.

5.7.3 Construction of Variables Used and a Priori Expectations

Having explained the model adopted to address the research problem of this thesis, this section focuses on the construction of variables used. It reviews the nature of the variables in the NIDS and how they were used in this study for analysis. Although the province has shown to be significantly associated with labour market outcomes such as LFP in SA (Ntuli and Wittenberg, 2013; Festus et al., 2016), it should be noted that the NIDS dataset cannot guarantee accurate interpretation at district and provincial levels due to the small sample size. As such, province-based analysis was not conducted (NIDS, 2013).

5.7.3.1 Derivation of the Labour Market Indicators:

With the NIDS data, at the time of the interview, those who were unemployed and were not willing or able to work, such as students, pensioners and home-makers, were classified as not economically active (NEA). Discouraged job-seekers referred to those willing to work but not working, and in the past four weeks, no active action was taken to look for work. Strictly unemployed, were those who wanted to work and had taken active steps to secure employment in the past four weeks, and those referred to as employed were persons in active service, usually to earn money. The working-age population (WAP) includes the NEA, employed, strict unemployed and discouraged job seekers. This study used the conventional definitions to calculate the different labour market status applied in this research as follows:

$$\textbf{Narrow Labour Force } (\mathbf{LF_1}) = Employed + Strict\ Unemployed \dots \dots \dots \dots \dots \dots (5.25)$$

$$\textbf{Broad Labour Force } (\mathbf{LF_2}) = LF_1 + Discouraged\ Job\ Seekers \dots \dots .. \dots \dots (5.26)$$

$$\textbf{Narrow LFPR} = \frac{LF_1}{WAP} \times 100 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (5.27)$$

$$\textbf{Broad LFPR} = \frac{LF_2}{WAP} \times 100 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (5.28)$$

$$\textbf{Employment Rate} = \frac{Employed}{WAP} \times 100 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (5.29)$$

$$\textbf{Narrow Uemployment Rate} = \frac{Strict\ Unemployed}{LF_1} \times 100 \ldots\ldots\ldots\ldots\ldots (5.30)$$

$$\textbf{Broad Uemployment Rate} = \frac{Strict\ Unemployed\ + Discouraged\ Job\ Seekers}{LF_2} \times 100 \ldots\ldots\ldots (5.31)$$

Nutritional Status Assessment: Knowledge of the current nutritional status of the country's population is an important prerequisite for developing concepts that improve nutrition (Péter et al., 2015). To determine the percentage of malnourished mothers and children in SA the anthropometric measures were used. Although these measures cannot provide a comprehensive assessment of an individual's nutritional status (Kuhlmann et al., 2007), they were used for the following reasons:

i) The information provided in the NIDS was more appropriate for this technique.
ii) Its easy application and non-invasive nature reinforced its viability as a nutritional assessment method (Bhattacharya et al., 2019).
iii) It is also an effective tool in promoting women's health and the prognosis of child health (Padilha et al., 2009).

Anthropometric measures can then be expressed as z-scores (SD-scores), percentiles or percent median. This research used the z-scores. According to Martinez-Millana et al (2018), interpreting results using the Z-scores has the following advantages:

i) The Z-score scale is linear. Consequently, a fixed interval of Z-scores has a fixed weight difference in kg or height difference in cm, for all children of the same age. For instance, on the height-for-age distribution for a 20-month-old girl, if the distance from a Z-score of -2 to a Z-score of -1 is 3.8 cm, the same result is found between a Z-score of 0 and +1 on the same distribution. This signifies that Z-scores have the same statistical relation to the distribution of the reference around the mean at all ages, making results interpretation comparable across indicators and age groups.

ii) Z-scores are sex-independent, hence permitting the assessment of children's growth status by merging age and sex groups.

iii) A group of Z-scores permit further calculation of summary statistics such as mean, standard deviation (SD) and standard error to categorise the growth status of a given population.

The anthropometry technique uses human body measurements to conclude the nutritional status of individuals and population. To carry out anthropometric analysis several variables such as age, sex, length, height and weight are used (World Food Programme, WFP, 2005). These measurements are available in the NIDS data and were used in generating measures such as height-for-age, weight-for-age, weight-for-height and body mass index (BMI). Child measures were calculated against the 2006 WHO's Child Growth Standards for children < 5 years (WHO, 2006b). The formula used to calculate Z-score is:

$$z = \frac{X - \mu}{\sigma} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (5.32)$$

where X is the observed value (child's anthropometric value), μ is the median value of the reference population of children of the same age and sex group, σ is the standard deviation of the reference population. A similar approach was done for the other child measures. The nutritional status of a child was determined from the z-scores as follows:

Stunting: Children with height/length-for-age z-score (HAZ) < -2 standard deviation (SD) below the WHO's Child Growth Standards median were categorised as stunted (WHO, 2006b; De Onis, Blössner and Borghi, 2011; Babu, Gajanan and Hallam, 2016; Rachmi et al., 2016; NDoH, Statistics SA, SAMRC and ICF, 2019; Rashad and Sharaf, 2019).

Underweight: Children with weight-for-age z-score (WAZ) < -2SD below the WHO's Child Growth Standards median were categorised as underweight (WHO 2006b; Rachmi et al., 2016; NDoH, Statistics SA, SAMRC and ICF, 2019; Rashad and Sharaf, 2019).

Wasting: Children with weight-for-height z-score (WHZ) < -2 SD below the WHO's Child Growth Standards median were categorised as wasted (WHO 2006b; Babu, Gajanan and Hallam, 2016; NDoH, Statistics SA, SAMRC and ICF, 2019; Rashad and Sharaf, 2019).

Childhood Overweight: Children with weight-for-height Z-score (WHZ) > +2SD above the WHO Child Growth Standards median were categorised as overweight (De Onis et al., 2007; De Onis, Blössner and Borghi, 2010; UNICEF, WHO and WB, 2012; Babu, Gajanan and Hallam, 2016; WHO, 2017; NDoH, Statistics SA, SAMRC and ICF, 2019; Rashad and Sharaf, 2019).

After computing the above child indices, biologically implausible values were identified and discarded using cut off points from the WHO Anthro software (version 3.2.2, 2011) for the Child Growth Standards. The following lower and upper SD limits as shown in table 5.6 below are the set flag limits for identifying any extreme or potentially incorrect z-score values for each indicator.

Table 5.6: Flags and error tracking

Indicators	Lower SD	Upper SD
HAZ	-6	+6
WAZ	-6	+5
WHZ	-5	+5

Source: WHO (version 3.2.2, 2011)

For maternal classification the terms overweight and obese are usually defined based on excess body fat. Although it is feasible to technologically determine an individual's fat composition directly, the method is extremely costly and hardly used when dealing with large samples. Indirect measure of fat composition that is BMI which is the ratio of weight in kilograms to height in meters squared is mostly used. Similar studies that have used this approach include Balarajan and Villamor (2009); Hillemeier et al. (2011); Chowdhury, Adnan and Hassan (2018); Yaya and Ghose (2019). Table 4.2 below shows the classification and interpretation of an adult's BMI. BMI values that fall outside the range of 12 Kg/m^2 -70 Kg/m^2 were flagged as biologically implausible (Li et al., 2009; Cheng et al., 2016; Bramley et al., 2017). Table 5.7 below presents the cut-off points to classify mothers according to their nutrition status.

Table 5.7: Classification of Maternal BMI

BMI Classification (Kg/m2)	Interpretation
<18.5	Underweight
18.5 - 24.9	Normal weight
25 – 29.9	Overweight
≥25	Overweight and or Obese
≥30	Obese

Source: WHO (2019); Global Nutrition Report (2020)

To determine the prevalence of malnutrition for the different anthropometric measures for each background characteristic of the mother or child the following formula was used:

$$Prevalence\ of\ malnutrition = \frac{Malnourished\ Individuals}{Total\ sample\ size} \times 100 \ldots\ldots\ldots\ldots\ldots\ldots\ldots (5.33)$$

Although these different forms of malnutrition are analysed in Chapters Six and Seven, the regression analysis in Chapter Six dealt only with the impact of maternal obesity on MLFP, while Chapter Seven concentrated on the impact of child stunting on MLFP. This is based on the fact that, according to literature, these are the prominent forms of malnutrition affecting women and children under the age of 5 in SA. The anthropometric measures reported in the subsequent chapters are the author's calculations. In addition, for descriptive purposes, cut-off values for public health significance were applied. According to De Onis et al. (2018), these values are important to map out countries based on severity levels by global actors and donors to easily identify priority countries. It also aids governments to act and target intervention programmes aimed at achieving low or very low levels. According to WHO (1995), very low and low levels are acceptable, medium is a poor situation, high is a serious situation and very high is a critical situation. The prevalence cut-off values are presented in table 5.8 below.

Table 5.8: Prevalence cut-off values for public health significance

Indicator	Cut-off values and levels	Category	Source
Stunting	<2.5%: very low 2.5 to <10%: low 10 to <20%: medium 20 to <30%: high ≥30%: very high	% of Children under 5	De Onis et al. (2018)
Wasting and Overweight	<2.5%: very low 2.5 to <5%: low 5 to <10%: medium 10 to <15%: high ≥15%: very high	% of Children under 5	De Onis et al. (2018)
Underweight	< 10%: Low 10-19%: Medium 20-29%: High ≥ 30%: Very high	% of Children under 5	WHO (1995)
Adult BMI<18.5 (underweight)	5-9%: Low 10-19%: Medium 20-39%: High ≥ 40%: Very high	% of women	WHO (1995)

Age: At different ages, women have different experiences, family responsibilities and working capabilities (Lee and Lee, 2014). The likelihood of participating in the labour market decreases with age (Sefiddashti et al., 2016) and this decrease may also result from age discrimination by employers (Riach and Rich, 2010; Ahmed, Andersson and Hammarstedt, 2012). The age of children in years was converted to age in months. For the descriptive analysis, age was constructed as a categorical variable. Two groups were created, 0-23 months and 24-59 months. Alderman and Headey (2018) note that analysis on children aged 0–23 months should be separate from older children since their nutritional status does not fully reflect (1) the influence of different postnatal nutritional insults; or (2) the benefits derived from the different postnatal protective factors. These age categories have been used in other similar studies (Akombi, et al., 2017; Bukusuba, Kaaya and Atukwase, 2017).

For mothers, age was classified into three categories that is the young age group ("youth" as defined by WHO and UN include those aged 15-24 years), 16-24 years, the middle age group, 25-34 years and the old age group, 35-45 years. This is in line with similar studies (Li et al., 2009; Hillemeier et al., 2011; Chowdhury, Adnan and Hassan, 2018; Firman et al., 2018; NDoH, Statistics SA, SAMRC and ICF, 2019; Hashan et al., 2020) that have used similar age categories. For the regression analysis, age was constructed as a continuous variable. Age squared was included to account for the potential non-linear effect of age through a quadratic relationship (the effect could increase with age up to a certain point and then decrease).

Gender: In most literature, stunting significantly affects boys than girls (Hien and Kam, 2008; Bukusuba, Kaaya and Atukwase, 2017; Cruz et al., 2017; Manggala et al., 2018). As such, the gender of the child was controlled for in the regression analysis. A dummy variable was generated with “1” if the child is a boy and “0” otherwise. The reference group is a girl. Based on *a priori* expectation having a young male child in the household will negatively affect mothers’ LFPR.

Race: The historical background of SA gives Coloureds a higher advantage in the labour market (Van der Berg, 2010). Thus, Coloureds are expected to have a higher LFP compared with Africans. The variable was derived from a four-level question regarding the population group the individual belongs to and was categorised as 1. African, 2. Coloured, 3. Asian/Indian and 4. White. Although in computing the population-level analysis the Asians and Whites were included, for the sub-analysis, the two groups were not represented and were also excluded in the regression analysis due to their small sample size as seen in the analyses in chapters 6 and 7. For the regression analysis a dummy variable was generated with “1” if the mother is Coloured and “0” otherwise. The reference group was African.

Marital Status: The marital status of a woman can either increase or decrease her LFP. For married women, LFP critically depends on the primary earnings and total income of the family and her bargaining strengths (Bourguignon and Chiappori, 1992; Agarwal, 1997; Gough and Killewald, 2011). The variable was derived from a five-level question regarding the individual’s current marital status: Possible responses were 1: Married, 2: Living with partner, 3: Divorced or Separated, 4: Widow/Widower and 5: Never Married. From these, two categories were created that is “Married” which combined 1 and 2, and “Single” which combined 3, 4 and 5, to ease analysis. For the regression analysis, a dummy variable was generated with “1” if the mother is married and “0” otherwise. The reference group was single. This variable is important because the theory of marriage and labour market participation, suggests that married women are less likely to be economically active than their single counterparts (Becker, 1981).

Rural/Urban Residence: Generally, job opportunities are more in urban areas than in rural areas. It is noted that those living in rural areas are less likely to participate in the labour market than those living in urban areas (Wittenberg, 2002; Mbatha and Roodt, 2014; Chatterjee, Murgai and Rama, 2015). As such, it is expected that living in an urban area will have a positive relationship with MLFP. This variable was derived from a four-level question regarding where the individual stays. The responses were rural, tribal, urban and urban informal areas. In this analysis, the rural and tribal areas were grouped to form one category called rural areas, while the urban and urban informal areas were jointly classified as urban areas, for simplification and international comparison. For the regression analysis, a dummy variable was generated with "1" if the mother or child lives in the urban area and "0" otherwise. The reference group was rural.

Non-Labour Income: Cash transfers like social grants can have a negative or positive effect on MLFP and this will depend on her market wage (Reynolds, Masters and Moser, 1998; Cahuc and Zylberberg, 2004; Coetzee, 2013). Grants received by a household member from the government was used as a proxy for non-labour income. A dummy variable was created taking the value of "1" when a household member receives money from the government and "0" otherwise. The reference group was a household member who did not receive money from the government.

Education: Education is expected to have a positive impact on MLFP. The completion of higher education is more likely to lead to a higher probability of LFP (Borjas, 2009; Branson et al., 2012). It is a variable derived for mothers with $\geq$ 12 years of schooling and was called Matric+. A dummy variable was generated taking the value "1" if she had Matric+ and "0" otherwise.

Household size and structure: When living in a family setting, a woman's labour supply decision depends on the net returns of the total labour supplied by household members and the family size (Sefiddashti et al., 2016). Family size would either increase or reduce income and housework burdens. For example, in a family with more adult male members working the woman may not do market work. In most cases, she might be compelled to do household production. If the family size is large, extra mouths need to be fed and if there are other members to assist with housework, she may be forced to work. For instance, in a family with three generations, the old parents might take care of children, whose mothers would be free from childcare. Being freed from such tasks decreases the woman's value of non-market time, leading to an increase in labour supply (Posadas and Vidal-Fernández, 2013; Compton and Pollak, 2014; Shen, Yan and Zeng, 2016; Garcia-Moran and Kuehn, 2017). Meanwhile, the presence of an elderly person who also needs care puts more pressure on the income and increase the opportunity costs to work for their caregivers (Ettner, 1995; Maurer-Fazio et al., 2011).

In many cases, family sizes in urban areas are much lower than those in rural areas (Chen et al., 2014). Consequently, the household sex and dependency ratios are more important than the family size. This implies that a woman from a family with a high dependency ratio or with more women is most likely to participate in the LF than someone without. Thus, the number of family members that contribute to total income as well as housework influence female labour supply decisions (Sasaki, 2002; Gough and Killewald, 2011; Maurer-Fazio et al., 2011; Cools, Markussen and Strom, 2017) and should be controlled for when doing analysis.

For the maternal obesity regression, household size was controlled for as well as the presence of an employed male in the household. Household size can have either a negative or positive effect on MLFP (Posadas and Vidal-Fernández, 2013; Compton and Pollak, 2014; Shen, Yan and Zeng, 2016; Garcia-Morán and Kuehn, 2017). It was used as a continuous variable in the maternal obese regression. The presence of at least an employed male in a household may also have a positive or negative effect on MLFP. In some cases, matching may occur between similarly employed husband and wife, while on the other hand, men with assured jobs may discourage their wives or relatives from working because they feel their income will be sufficient enough to run the house (Majumder, 2012). The variable was constructed as a continuous variable.

Given the importance of females in a household for additional childcare, the number of women aged 18-85 years who are not sick in a household was controlled for together with the presence of an employed male in the child regression analysis. Additionally, the strong correlation (0.77) between household size and the number of adult females aged between 18-85 years in the household, also motivated the use of the number of adult females in the child regression. These household size and structure variables were used as continuous variables.

Health Status: Good health is expected to positively impact on MLFP (Anderson and Grossman, 2009; Cai, 2010; Ghatak and Madheswaran, 2014). It is a variable derived from a five-level question regarding how the mother rates her health in general and was categorised as 1. Excellent, 2. very good, 3. Good, 4. Fair and 5. Poor. In this analysis, health status was then categorised into two groups, either "sick" or "healthy". The "sick" are those who responded fair or poor about their health, while the "healthy" are respondents who declared their health was excellent, very good or good. A dummy variable was generated taking the value "1" if the mother is healthy and "0" otherwise. The reference group was "sick".

Instrumental Variables: Ideally, genetics or parental factors such as biological parents' obesity status, which was observed to be correlated with obesity (Lindeboom, Lundborg and Van der Klaauw, 2010) but not with labour market outcome, would have constituted a good variable to use as IV. Such variables are difficult to find in the context of the NIDS datasets. Likewise, for child stunting finding the appropriate instrument using NIDS was difficult. Instead, the following instruments were used for obese mother and stunted child regressions respectively;

***Obese mother*:**

i) Smokes: As seen in the literature there is a negative correlation between smoking and obesity (Potter et al., 2004; Cawley, Markowitz, and Tauras, 2004; Mackay, Gray and Pell, 2013). As such, smoking passes the first condition test easily. However, if discrimination in the labour market and the indirect health effects of smoking are considered, there may be a correlation between LFP and smoking (Potter et al., 2004). Assuming no direct relationship exists between smoking and LFP, it may also pass the second condition test. The NIDS questionnaire respondents were asked if they smoke. A dummy variable was created taking the value of "1" when the mother's response was yes and "0" otherwise.
ii) **Disease:** The NIDS questionnaire asked respondents whether they have ever been diagnosed by a doctor with any of these diseases such as high blood pressure, heart

problems, diabetes or stroke. Obese mothers are likely to contract one of these cited diseases. As such, a correlation is expected between obesity and these diseases. It also assumed that being diagnosed in the past with one of these illnesses does not have a direct impact on current MLFP. A dummy variable was created taking the value of "1" when the mother's response to one of these questions is yes and "0" otherwise. Some, Rashied and Ohonba (2014) also used this variable as an IV in a similar research study.

iii) **Physical Activity:** The NIDS questionnaire respondents were asked how regularly they exercised. The degree of physical activity may easily pass the first condition of good IV. In general, it is believed that there is a negative correlation between the degree of physical activity (exercise) and obesity (Hills, Andersen and Byrne, 2011; Drake et al., 2012). Notwithstanding, there is no certainty that the level of physical activity will pass the second condition. If the level of a particular physical activity is costly, for instance, gym membership, there might be a correlation between MLFP status and the physical activity in question. Even if there are no costs involved, for instance, running or walking, it may also pass the second condition test. It is assumed in this analysis that there is no direct relationship between physical activity and MLFP. A dummy variable was created taking the value of "1" if the mother exercises three or more times in a week and "0" otherwise. This variable has been used in other similar studies (Morris, 2007; Some, Rashied and Ohonba, 2014)

***Stunted child*:**

i) **Mother's height:** Within the NIDS questionnaire the height of respondents was measured in cm. It is widely accepted that there is a positive correlation between parental short stature, particularly that of mothers and child stunting (Hernandez-Diaz et al., 1999; Kamiya et al., 2018; Berhe et al., 2019; Khan, Zaheer and Safdar, 2019). This indicates that it will pass the first condition test. Nonetheless, there is no guarantee that the height of a mother will pass the second condition test of instrument validity. If a particular job has certain criteria, for instance, modelling which requires a particular height, then LFP and maternal height might be correlated. In such situations, maternal height may pass the second condition test. In this analysis, it is assumed that there is no direct relationship between maternal height and MLFP.

Mother's height was used as a dummy variable which takes the value of "1" when the mother's height < 150cm and "0" otherwise.

ii) **Improved water source:** In the NIDS questionnaire, the main source of water for each household was asked. Some studies have found a negative relation between water source and childhood stunting (Ricci and Becker, 1996; Margai, 2007; Fink, Günther and Hill, 2011; Adekanmbi, Kayode and Uthman, 2013; Horta et al., 2013). A dummy variable was created taking the value of "1" when the household has piped tap water in the dwelling or on site or in the yard and "0" otherwise.

Given that these IVs are treated as directly affecting obesity and stunting, there is no compelling reason to include them directly in the MLFP equation that has obesity/stunting as a covariate. It is therefore assumed that they affect MLFP only indirectly through their influence on obesity/stunting.

Table 5.9: List of reference group for the regression

Variable	Reference Group
Maternal malnutrition	Not obese
Child malnutrition	Not stunted
Education	<12 years of schooling
Health	Sick
Race	African
Marital status	Single
Area of residence	Rural area
Gender of child	Girl
Household member receives	No
Smoke	No
Exercise	No
Disease	No
Improved water source	Yes
Mother' height <150cm	No

5.7.4 Treatment of missing values/data

Data values that are not stored for variables in the observations of interest are referred to as missing values (Graham, 2009). According to Kang (2013), it is important to take into account missing values as they can cause the following problems: (1) decrease the statistical power of a study; (2) produce biased point estimates, resulting in invalid conclusions; (3) decrease the representativeness of the samples and (4) complicate data analysis. To understand the nature of missing data as well as determine the treatment of variables with missing values, it is important to know and understand the codes used in a dataset to represent a missing value.

In the NIDS data set, the codes for non-response include (a) Don't know, (b) Refused, (c) Not applicable and (d) Missing. In a case where a question was supposed to have been answered but was not, "Missing" was used. When a skip pattern is enforced and no data has to be collected, a system missing (.) is used (Brophy et al., 2018). In this study, to deal with the issue of missing data two techniques were used which are listwise or case deletion and sensitivity analysis (discussed in the subsequent section). The listwise approach of dealing with missing values is to simply omit those cases with the missing data and analyse the remaining data (Kang, 2013). This method is known as the complete case (or available case) analysis or listwise deletion (Graham, 2009) and was used because there was a large enough sample.

5.7.4.1 Chapter 6 break down for: maternal malnutrition sample size

i) Based on the study domain, in 2008, 1713 mothers were interviewed of which the BMI of 1580 was available.
ii) In 2012, 1981 mothers were interviewed and the BMI information of 1964 was complete.
iii) 2374 mothers were interviewed in 2014/15 of which, the BMI of 2362 was known.
iv) In 2017, the mothers interviewed were 2532 but only 2512 had complete information about their BMI.

5.7.4.2 Maternal labour market status sample size:

i) For the study domain, in 2008, 1713 mothers were interviewed of which the labour market status of 1702 was available.
ii) In 2012, of the 1981 mothers were interviewed, 1976 had complete labour market information.
iii) 2374 mothers were interviewed in 2014/15 of which, the labour market status of 2371 was known.
iv) In 2017, the mothers interviewed were 2532 but only 2528 had complete information about their labour market status.

For the regression analysis in Chapter 6, Whites and Indians were excluded due to their small sample size. Figure 5.6 presents the flow chart of missing data for the variables used in the regression analysis.

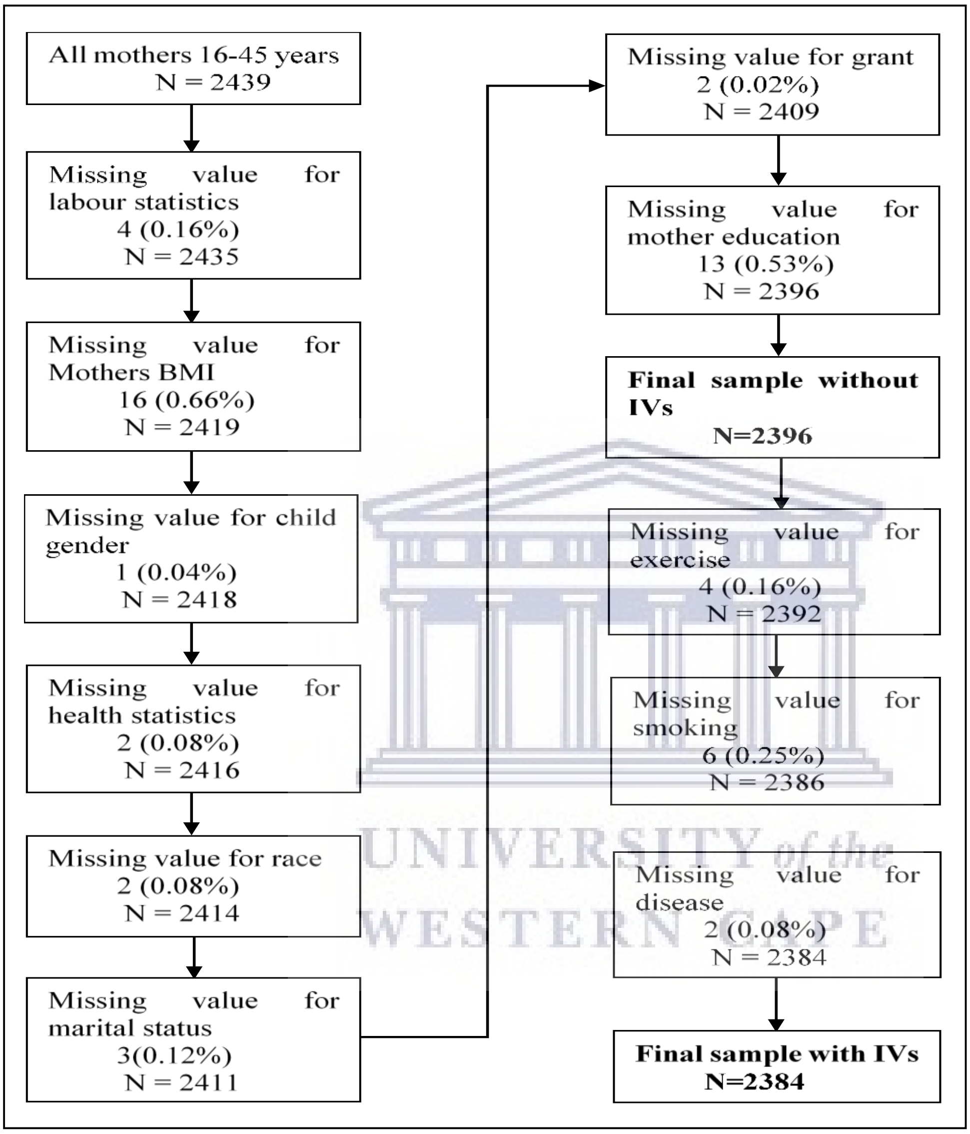

Figure 5.6: Flow chart of missing values for the maternal obese –LFP regression
Source: Own calculations using NIDS 2017

5.7.4.3 Chapter 7 break down for child malnutrition sample size

Also, based on the study domain, in 2008, 2012, 2014/15 and 2017 total number of children sampled were 3234, 3642, 4392 and 4654 respectively. Of which:

i) HAZ was computed only for 2054, 2858, 3720 and 3687 children in 2008, 2012, 2014/15 and 2017 respectively.

ii) For WAZ, it was calculated for 2088, 3080, 3785 and 3783 children in 2008, 2012, 2014/15 and 2017 respectively.

iii) With respect to WHZ, that of 1879, 2822, 3700 and 3649 children were calculated in 2008, 2012, 2014/15 and 2017 respectively.

For the regression analysis in Chapter 7, Whites and Indians were also excluded due to their small sample size. Figure 5.7 presents the flow chart of missing data for the variables used in the regression analysis.

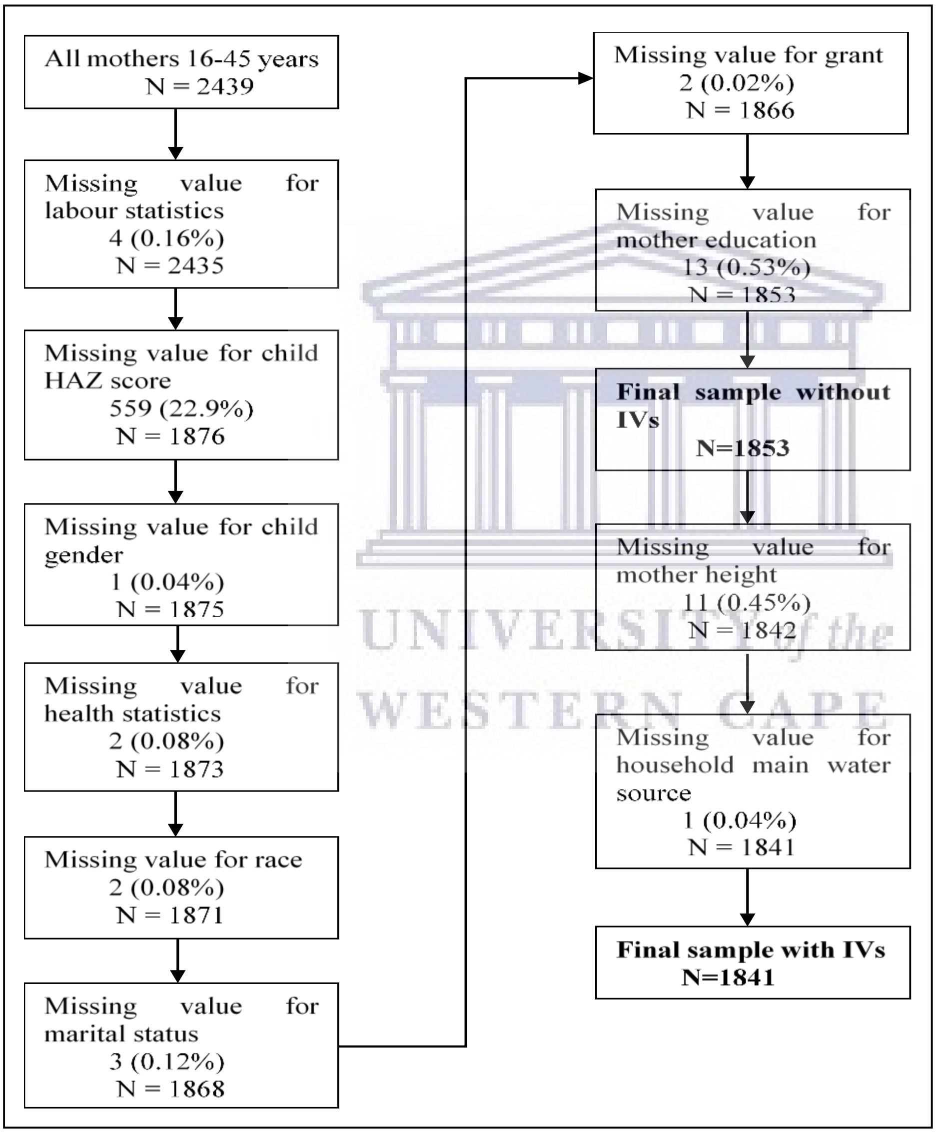

Figure 5.7: Flow chart of missing values for the childhood stunting–MLFP regression
Source: Own calculations using NIDS 2017

5.7.5 Sensitivity Analysis

Sensitivity analysis refers to the study that defines how to allocate the uncertainty in the output of a model to the different sources of uncertainty in its inputs (Kang, 2013). To establish the robustness of the estimates, the following sensitivity analyses were conducted.

5.7.5.1 Testing for exogeneity of obesity in mothers and stunted children

As seen in Chapter Four, the dominant view is that obesity or poor child health (stunting) are endogenous determinants of MLFP and therefore, necessitates the use of IVs in this study. Obesity/stunting, however, could be an exogenous determinant of MLFP in any empirical context. If this is the case, the use of IV techniques may be redundant, increasing the likelihood that the null hypothesis of no significant effect of obesity/stunting on MLFP will not be rejected. Hence, the IV estimates compared with the ordinary least square (OLS) estimates will be inefficient (Murray, 2006; Cameron and Trivedi, 2010).

When investigating the association between two variables using a bivariate probit model with suspected endogeneity, the formal test of exogeneity is the Wald test. Given the two conditions of a valid instrument above, it is easy to test the first condition using a simple Wald test of statistical significance, of the cross-equation correlation, ρ, between the MLFP and malnutrition equations. Meanwhile, the second condition cannot be tested directly and therefore, must be assumed (Morris, 2007; Wooldridge, 2010). The null hypothesis of exogeneity is given by $H_0: \rho = 0$. If $\rho = 0$, then OM/CS are exogeneous and (5.13) or (5.15) is the appropriate equation to be used. But if $\rho \neq 0$ then $\mathrm{OM/CS}$ is endogeneous, and equation (5.24) will be the appropriate model to use (Wooldridge, 2010).

Another test for endogeneity used was the Durbin-Wu-Hausman test (DWH), which is also known as the augmented regression test for endogeneity. The test was proposed by Durbin (1954), Wu (1973) and Hausman (1978). This test, sometimes described as a test for model misspecification, helps in deciding the best regression model to use, that is, whether to use an OLS or IV model, by testing the null hypothesis that the endogenous variable under consideration is actually exogenous (Tchatoka, 2012; Guo et al., 2018). The DWH test was used to detect if obesity and stunting are truly endogenous regressors in. the IV-LPM. Based on this test, obesity and stunting are considered endogenous variables if the test statistic is significant. This test was applied because the sample size in this analysis was greater than 100.

It should be noted that the efficiency of this model depends on how good the instruments used are. Nonetheless, the DWH turns to be valid even when the instruments used are weak (Guggenberger, 2010; Hahn, Ham and Moon, 2011).

5.7.5.2 Instruments validity

The regression models in this study used multiple IVs for the different endogenous variables (obese and presence of a stunted child) respectively. When a model has multiple IVs as in this study, the model is said to be over-identified (Wooldridge, 2010). To determine the validity of the instruments, the Sargan-Hansen J or Sargan's J chi-squared test of over-identifying restrictions for 2SLS regression was applied. The test was proposed by John Denis Sargan in 1958. The null hypothesis of this test is that the IVs under consideration are valid. That is, they are uncorrelated with the error term and that the excluded instruments were correctly excluded from the estimated model. The null hypothesis may be rejected if the test statistic is statistically significant at any of the conventional critical values (0.01, 0.05 or 0.10) used. As such, this casts doubt on the validity of the instruments. A rejection of the null hypothesis means that either there is a model misspecification or that the instruments are endogenous.

Hayashi (2000) notes that the Sargan test that is robust to heteroskedasticity in the errors is called the Hansen's J statistic; under the assumption of conditional homoskedasticity, the Sargan's statistic becomes the Hansen's J statistics. As such, the two statistics are sometimes referred to as the Sargan-Hansen J statistic. Both statistics are distributed as chi-squared with L-K degrees of freedom. Where L is the number of IVs, K is the number of endogeneous variables. In this study, based on the assumption of a homogenous effects model, to formally determine the validity of the instruments used for the IV-LPM, the Hansen’s J test of over-identifying restriction was reported. Table 5.9 provides the list of the different reference groups used in this study.

5.7.6 Other Statistical consideration

The NIDS data were analysed using Stata 14.0 statistical software. The Survey (‘Svy’) command which deals with complex survey designs was used. It was used to assign clustering (Wittenberg, 2013) and sampling weights (Branson and Wittenberg, 2019; Kerr, Ardington and Burger, 2020). In addition, confidence intervals (CIs) were calculated. The CI gives an estimated range of values within which the calculated parameter may fall (Andrade and

Fernández, 2016). In reporting the trends, where the CIs overlap, it was concluded that there is no statistically significant difference/change in the parameter across the years and vice versa.

5.8 Summary

This chapter discussed the methods and data used in achieving the empirical results of the thesis. It also provided a brief background of the socio-economic status of SA. This thesis applied a quantitative cross-sectional research method due to the objectives of the research. The publicly available NIDS data of 2008, 2012, 2014/15 and 2017 was used to estimate the extent and trend of maternal labour supply, and maternal and child malnutrition in SA. For the association between maternal obesity and childhood stunting, and maternal labour force participation, the 2017 dataset was used. The anthropometric method used to assess the prevalence and trend of malnutrition was explained. To investigate the relationship between maternal obesity and childhood stunting, and maternal labour force participation, the labour supply framework adopted followed Sprague (1994).

Given the assumption of endogeneity of obesity and stunting, and the binary nature of both the dependent (strict maternal labour force participation) and main explanatory variables (obese and stunted), the expected model of choice was the bivariate probit model on the basis that the instruments pass the two tests of instrument validity. Since the linear probability model provides a more formal test of instrument validity and relevance, it was used together with the probit models applied in the thesis. However, the decision to use either a two-stage least squared method or a normal linear probability model was also dependent on the validity of the instrumental variables used.

For the maternal obesity regression, the instrumental variables used were physical activity, smoking and if the mother was previously diagnosed with an obesity-related disease. The other individual and household characteristics that were deemed important to be included in the regression were: mother and child's age, gender of the child, area of residence, marital status, grants, employed male in the household, household size, and mother's education, self-assessed health and race. For the child regression model, maternal height and improved water source were used as instruments and the other covariates are similar to those in the maternal regression, except for the household size variable that was replaced with the presence of an adult female in the household. For the robustness check, sensitivity tests were carried out together with the use of the broad maternal labour force participation. The next chapter addresses objectives one to three of the study.

CHAPTER SIX

MATERNAL MALNUTRITION AND MATERNAL LABOUR MARKET PARTICIPATION IN SOUTH AFRICA: EVIDENCE FROM THE NATIONAL INCOME DYNAMICS STUDY

6.1 Introduction

In other to provide a sound understanding of maternal malnutrition and its association with maternal labour force participation, this chapter conducts and presents a statistical analysis of labour force participation and malnutrition amongst mothers aged 16-45 years caring for a child below 5 years. This analysis answers objectives one, two and three of the thesis namely: 1) explore the trend of maternal labour supply in SA; 2) determine the prevalence and trend of maternal malnutrition; and 3) investigate the relationship of obesity and MLFP in SA. This chapter begins with a presentation of maternal labour market outcomes. The discussion focuses on LFP, LFPR, employment and unemployment rates. These analyses aim to provide readers with an in-depth understanding of mothers' labour market outcomes before assessing the impact of malnutrition on MLFP. This is based on the fact that factors other than nutrition play an important role in determining labour market outcomes. It then goes further to present results and discussion of the findings on maternal malnutrition in SA, followed by an exploration of the association of maternal obesity and MLFP.

6.2 Maternal labour market outcome: evidence from the National Income Dynamics Study (cross-sectional analysis)

This section provides readers with an overview of the labour market outcomes for mothers. The purpose is to show the distribution of the LFPR, employment and unemployment rates. Table 6.1 reveals that the majority of the population are: between the ages 25-34 years, Africans, living in the urban area, single mothers (except in 2008 where the percentage is highest for married mothers) and mothers of children aged between 24-59 months. Table 6.1 presents the summary of mothers with complete labour market status based on some selected key background characteristics between 2008-2017.

Table 6.1: Summary statistics of mothers with labour market status information, 2008-2017

Variables	2008	2012	2014/15	2017
Total Number of those aged 16-45 years	1702	1976	2371	2528
Age (%)				
16-24 years	29.2	29.0	28.1	26.4
25-34 years	48.1	49.5	51.6	51.7
35-45 years	22.7	21.5	20.2	21.9
Race (%)				
African	82.2	84.9	84.1	85.8
Coloured	9.0	8.8	8.8	9.4
Indian	2.3	1.6	1.8	1.9
White	6.5	4.6	5.3	3.0
Area of Residence (%)				
Rural	41.3	40.4	40.7	40.3
Urban	58.7	59.6	59.3	59.7
Marital status (%)				
Married[33]	53.8	36.6	38.4	40.0
Single	46.2	60.4	61.6	60.0
Child's age (%)				
0-23 months	53.2	44.5	47.3	47.4
24-59months	46..8	55.5	52.7	52.6

Source: Own calculations using NIDS 2008, 2012, 2014/15, and 2017, and post-stratification weight

[33] Married as used in the entire analysis of this study refers to married/cohabiting.

6.2.1 Maternal Labour Force (MLF)

Table 6.2 presents the size of the maternal strict LF by age cohort, race, location, marital status and age of child from 2008 to 2017. The age cohort with the largest number in the LF across the years is those between 25-34 years, while the lowest number is between those age 35-45 years (except in 2017, where the age cohort 16-24 years had the lowest number). In addition, the majority of the population in the LF are Africans, live in the urban areas, are single mothers and mothers caring for children aged between 24-59 months. The variations are similar to the broad MLF presented in Table A6.1 in the appendix. Table 6.2 presents the number of mothers in the LF from 2008-2017.

Table 6.2: Strict labour force across key background characteristics, 2008-2017

Background Characteristics	2008	2012	2014/15	2017
Age Cohorts				
16-24 years	258	309	335	310
25-34 years	449	592	734	786
35-45 years	253	286	324	331
Race				
African	756	1005	1192	1173
Coloured	163	180	239	232
Area of Residence				
Rural	425	549	669	633
Urban	507	624	728	776
Marital Status				
Married	462	430	472	556
Single	486	778	956	897
Child's Age				
0-23 months	478	519	622	628
24-59months	497	687	790	825
Total	973	1214	1426	1459

Source: Own calculations using NIDS 2008, 2012, 2014/15, and 2017, and post-stratification weight
NB: Numbers were rounded up to the nearest whole number.

The estimates in Figure 6.1 indicate that the strict MLFPR is 57.2% [95% CI: 53.7-60.6] in 2008, which then increased to 61.4% [95% CI: 58.0-64.7] in (2012). It then decreased to 60.1% [95% CI: 56.7-63.5] and then further decreased to 58.3% [95% CI: 55.3-61.2] in 2017. Due to an overlap of the CIs, there is no statistically significant change over the years. These data for the periods (2008-2017) are summarised in Figure 6.1.

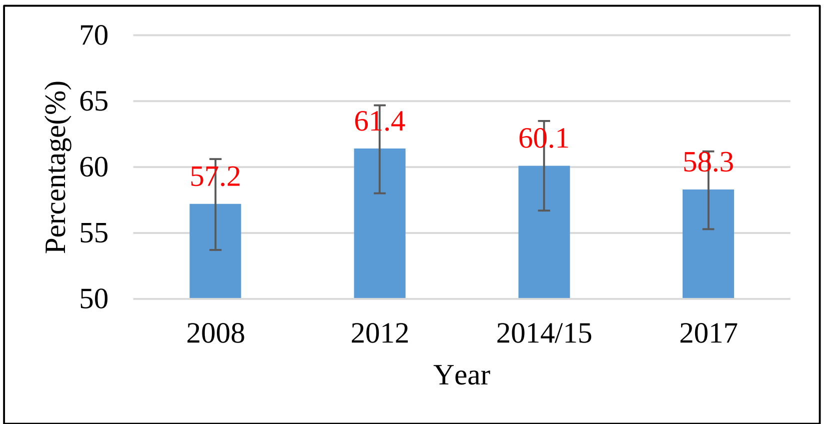

Figure 6.1: Maternal labour force participation rate, 2008-2017
Source: Own calculations using NIDS 2008, 2012, 2014/15, and 2017, and post-stratification weight

Table 6.3 reveals that the age cohort with the highest LFPR is those between the ages 35-45 years, while the least is those aged between 16-24 years. The LFPR in the age group 16-24 years decreased across the years. For those between 25-34 years and 35-45 years of age, the LFPR increased in 2012 respectively, which then decreased from 2014/17 to 2017 respectively. For the different age groups, CIs overlap. This implies there is no statistically significant change across the years for the different age cohorts respectively.

Although Africans have the highest number in the LF compared with Coloureds as seen in Table 6.2, Table 6.3 reveals that LFPR is highest amongst Coloureds than Africans over the periods. For Africans, LFPR increased between 2008 and 2012, then remained constant between 2012 and 2014/15, and then decreased between 2014/15 and 2017. Amongst Coloureds, the rate increased from 2012 to 2014/15 and then drop in 2017. The CIs within the different racial groups also overlap. Indicating there is no statistical variation within the racial groups from 2008 to 2017 respectively.

Concerning location, Table 6.3 reveals that LFPR is highest in urban areas compared with rural areas. In the urban areas, LFPR increased in 2012, then decreased in 2014/15, and later increased in 2017. While LFPR increased from 2012 to 2014/15 and then decreased between

2014/15 and 2017 in the rural areas. For both areas, there is no statistically significant difference across the period since the CIs do overlap.

As seen in Table 6.3, it can be observed that married mothers have the highest rate of LFP compared with single mothers except in 2014/15, though single mothers have the highest number in the LF. For married mothers, LFPR increased in 2012, which then decrease in 2014/15, and then an increase is observed in 2017. LFPR increased from 2012 to 2014/15 and then decreased in 2017 amongst single mothers. Considering the CIs, there is no statistically significant difference across the periods for married and single mothers due to an overlap of the CIs, except for single mothers between 2008 and 2012 where the CIs do not overlap.

Looking at a child's age, Table 6.3 shows that LFPR is highest across all the years for mothers of children aged between 24-54 months compared with mothers of children aged between 0-23 months. For mothers of children 0-23 months, LFPR increased between 2008 and 2012, which then dropped from 2014/15 right to 2017. Amongst mothers of children 24-59 months, LFPR increased from 2012 to 2014/15 and then decreased in 2017. There is no statistically significant difference in the LFPR from 2008-2017 for both groups respectively, due to an overlap of the CIs. These LFPR statistics for the period 2008 to 2017 are shown in Table 6.3.

Table 6.3: Strict labour force participation rate across key background characteristics, 2008-2017

Background Characteristics	2008 %[95% CI]	2012 %[95% CI]	2014/15 %[95% CI]	2017 %[95% CI]
Age Cohorts				
16-24 years	45.0[38.7-51.4]	44.8[38.3-51.4]	41.9[36.7-47.4]	39.0[33.6-44.6]
25-34 years	62.1[57.0-67.0]	66.4[61.3-71.1]	65.4[59.8-70.5]	65.0[60.9-68.8]
35-45 years	62.4[55.5-68.9]	72.5[66.0-78.2]	72.1[65.4-77.8]	65.8[59.6-71.4]
Race				
African	55.2[51.6-58.7]	60.2[56.7-63.6]	60.0[56.7-63.2]	57.1[53.9-60.3]
Coloured	61.8[50.2-72.1]	67.0[55.0-77.1]	68.6[59.1-76.8]	66.8[57.5-75.0]
Area of Residence				
Rural	46.1[42.0-50.3]	52.0[47.5-56.4]	54.0[49.7-58.3]	48.3[44.5-52.2]
Urban	65.0[60.0-69.7]	67.8[62.9-72.4]	64.3[59.2-69.2]	65.0[60.8-68.9]
Marital status				
Married	63.0[57.9-67.9]	64.2[58.3-69.7]	58.8[52.2-65.2]	61.3[56.7-65.8]
Single	50.4[46.0-54.7]	59.6[55.4-63.7]	60.9[57.1-64.6]	56.2[52.3-60.3]
Child's Age				
0-23 months	53.4[48.6-58.2]	55.1[50.2-60.0]	51.7[47.3-56.0]	50.8[46.4-55.1]
24-59months	61.5[56.5-66.3]	66.5[61.7-71.0]	67.7[62.4-72.7]	65.0[60.9-68.9]
Total	57.2[53.7-60.6]	61.4[58.0-64.7]	60.1[56.7-63.5]	58.3[55.3-61.2]

Source: Own calculations using NIDS 2008, 2012, 2014/15, and 2017, *and post-stratification weight*

For the broad LFPR, as seen in table A6.2 in the appendix, some differences with the strict LF definition is observed. There is a decrease in the rate of broad LFP between 2008 and 2017. Discrepancies were also observed within the key background characteristics.

6.2.2 Maternal Employment

Figure 6.2 shows that in 2008, the rate of employment is 33.4% [95% CI: 30.0-36.9], which increased to 35.1% [95% CI: 31.7-38.7] in (2012). The rate further increased to 38.7% [95% CI: 35.3-42.2] in 2014/15 but by 2017 the rate slightly decreased to 38.0% [95% CI: 35.2-41.2]. Given that the CIs overlap, it therefore implies that there is no statistical difference in employment rate over the years. The summary of the data for the periods (2008-2017) is presented in Figure 6.2

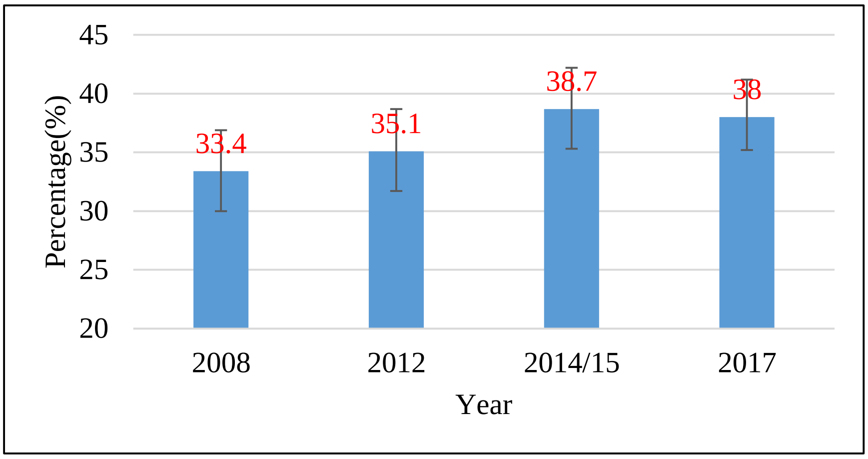

Figure 6.2: Maternal employment rate, 2008-2017
Source: Own calculations using NIDS 2008, 2012, 2014/15, and 2017, and post-stratification weight

Based on age, the estimates in Table 6.4 show that the highest rate of employment across all waves is amongst those between 35-45 years and the least rate is amongst those aged between 16-24 years. In the age group 16-24 years, it is seen that the rate of employment decreased in 2012, then increase in 2014/15 and later decreased in 2017. But within the age group 25-34 years and 35-45 years, the rate increased right to 2014/15. While it increased for those aged between 25-34 years in 2017, that of those aged between 35-45 years decreased instead. The CIs within the different age cohorts overlap each other. Hence, there is no statistically significant change in the rate of employment across the study periods respectively.

The rate of employment amongst Africans as seen in Table 6.4 is lower than that of Coloureds over the periods. Within the African population, it is observed that the employment rate increased steadily from 2012 to 2017. For Coloureds, the rate decreased in 2012, then increase in 2014/15 and later decreased in 2017. Also, the CIs for both African and Coloured mothers overlap each other across the period. Therefore, there is no statistically significant difference in the rate of employment across the study periods respectively

The estimates in Table 6.4 indicate that compared with urban areas the rate of employment in the rural areas is lower across the years. In the rural areas, the employment rate decreased in 2012, then in 2014/15 the rate increased and in 2017, the rate is approximately the same as in 2014/15. Meanwhile, in the urban areas the rate increased from 2012 to 2014/15 and then decreased in 2017. As a result of an overlap of the CIs for both the rural and urban areas, there is no statistically significant dissimilarity in the rate of employment across the study periods respectively.

For marital status, the employment rate is highest over the years amongst married mothers compared with single mothers as seen in Table 6.4. The rate of employment for both categories increased from 2012 to 2014/15. However, in 2017, the employment rate for married mothers decreased, while for single mothers, it is roughly the same as the rate in 2014/15. But when the CIs are considered, there is no statistically significant difference over the years for married and single mothers respectively due to overlap of the CIs.

Finally, it is observed in Table 6.4 that the proportion of mothers of children aged between 24-59 months who are employed is highest compared with mothers of children aged 0-23 months. For mothers of children aged 0-23 months, the employment rate decreased in 2012, which then increased in 2014/15 and 2017 respectively. Conversely, for mothers of children aged 24-59 months, the rate of employment increased from 2012 to 2014/15 and then decreased in 2017. The CIs for both groups overlap, as such, there is no statistically significant variation in the rate of employment within these groups of mothers respectively. A summary of the employment rate from 2008-2017 is provided in Table 6.4.

Table 6.4: Employment rate across key background characteristics, 2008-2017

Background Characteristics	2008 %[95% CI]	2012 %[95% CI]	2014/2015 %[95% CI]	2017 %[95% CI]
Age Cohorts				
16-24 years	18.6[13.5-25.2]	15.8[11.3-21.6]	19.2[14.9-24.3]	17.7[13.7-22.6]
25-34 years	37.0[31.9-42.4]	39.5[34.5-44.7]	42.6[37.4-48.0]	43.9[39.6-48.3]
35-45 years	44.5[37.6-51.7]	51.2[43.6-58.7]	56.0[48.9-62.9]	49.1[42.8-55.4]
Race				
African	28.6[25.3-32.0]	31.7[28.4-35.3]	36.2[33.0-39.6]	36.4[33.2-39.8]
Coloured	49.4[37.9-60.9]	48.3[36.4-60.4]	54.5[44.7-63.9]	49.5[39.8-59.2]
Area of Residence				
Rural	25.7[22.3-29.5]	23.1[19.6-27.1]	27.7[24.1-31.7]	27.5[24.2-31.1]
Urban	38.7[33.6-44.1]	43.3[38.2-48.5]	46.3[41.2-51.4]	45.3[41.0-49.7]
Marital status				
Married	39.1[33.8-44.6]	41.5[35.3-47.9]	44.7[38.5-51.1]	42.7[37.9-47.7]
Single	26.8[23.1-30.9]	31.0[27.2-35.1]	35.0[31.1-39.1]	35.1[31.4-39.0]
Child's Age				
0-23 months	28.8[24.3-33.7]	26.8[22.2-32.0]	29.8[25.8-34.2]	31.4[27.2-35.8]
24-59months	38.6[33.6-43.8]	41.8[36.9-46.9]	46.7[41.5-52.0]	44.2[40.0-48.5]
Total	33.4[30.0-36.9]	35.1[31.7-38.7]	38.7[35.3-42.2]	38.1[35.2-41.2]

Source: Own calculations using NIDS 2008, 2012, 2014/15, and 2017, and post-stratification weight

6.2.3 Maternal Unemployment

Overall, as seen in Figure 6.3 the rate of unemployment decreased across the years from 41.7% [95% CI: 37.0-48.5] in 2008 to 42.8% [95% CI: 38.2-47.6] in 2012, which further decreased to 35.6% [95% CI: 31.5-39.9] in 2014/15 and then 34.6% [95% CI: 30.8-38.6] in 2017. The CIs reveal that there is no statistically significant change in the rate of unemployment due to an overlap of the CIs over the periods of estimation. Figure 6.3 provides a summary of these results for the periods 2008-2017.

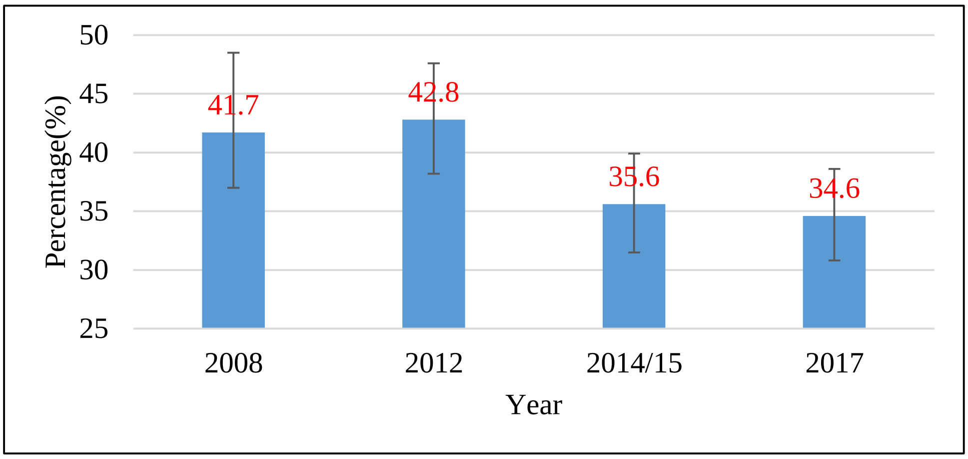

Figure 6.3: Maternal unemployment rate, 2008-2017
Source: Own calculations using NIDS 2008, 2012, 2014/15, and 2017, and post-stratification weight

The estimates in Table 6.5 show that the age cohort with the highest rate of unemployment is those between 16-24 years and the least is the age group 35-45 years. Within the different age cohorts, it can be observed that the unemployment rate increased in 2012, except for the age cohort 25-34 years where it remained constant. In 2014/15 the rate decreased for all age groups. It later increased in 2017 for those aged between 16-24 years and 35-45 years respectively. For the age group 25-34 years, the unemployment rate decreased in 2017. For the different age cohorts, there is no statistically significant change in the rate of unemployment due to an overlap of the CIs.

Racially, as seen in Table 6.5, the unemployment rate is higher amongst Africans than Coloured over the years though they have the highest population in the country. The rate of unemployment amongst Africans decreased from 2012 right to 2017. Conversely, that of Coloureds increased in 2012, then decrease in 2014/15 and in 2017 an increase is observed. Nonetheless, there is an overlap of the CIs for both racial groups indicating no statistically significant difference in the rate of unemployment across the periods.

Based on location, Table 6.5 indicates that compared with the urban areas unemployment rate is more prevalent in the rural. It can be observed that the unemployment rate in the rural areas increased between 2008 and 2012, and then steadily decreased from 2014/15 to 2017 respectively. For the urban areas, the rate decreased from 2012 to 2014/15 and then increased in 2017. There is also an overlap of the CIs for both locations. This implies that there is no statistically significant variance in the rate of unemployment across the periods.

The statistics in Table 6.5 indicate that the rate of unemployment is more prevalent amongst single mothers compared with married mothers. The rate amongst married mothers decreased from 2012 to 2014/15, and then increased in 2017. For single mothers, the unemployment rate increased in 2012, and then steadily decreased from 2014/15 to 2017. It can also be seen that there is an overlap of the CIs for both marital statuses. This signifies that there is no statistically significant change in the rate of unemployment across the periods.

Based on the child's age, it is observed in Table 6.5 that mothers of children age 0-23 months have the highest rate of unemployment compared with mothers of children age 24-59 months. Amongst mothers of children age 0-23 months, the unemployment rate increased in 2012 and then decreased in 2014/15 and 2017 respectively. For mothers of children age 24-59 months, the rate decreased in 2012 and 2014/15 respectively and then increased in 2017. For both groups there is an overlap of the CIs respectively. Therefore, there is no statistically significant change in the rate of unemployment across the periods. Table A6.3 in the appendix which presents the broad unemployment rate, a similar conclusion as the strict unemployment rate is reached. Table 6.5 presents the summary of the data on strict unemployment from 2008-2017.

Table 6.5: Strict unemployment rate across key background characteristics, 2008-2017

Background Characteristics	Wave 1 %[95% CI]	Wave 3 %[95% CI]	Wave 4 %[95% CI]	2017 %[95% CI]
Age Cohorts				
16-24 years	58.6[47.7-68.7]	64.7[53.8-74.2]	54.3[45.2-63.1]	54.5[45.1-63.6]
25-34 years	40.5[33.9-47.3]	40.5[34.5-46.9]	34.8[29.0-41.1]	32.4[27.4-38.0]
35-45 years	28.7[21.1-37.6]	29.4[21.7-38.6]	22.3[16.2-29.9]	25.4[19.1-32.9]
Race				
African	48.2[43.2-53.3]	47.3[42.4-52.3]	39.7[35.2-44.3]	36.2[32.0-40.6]
Coloured	20.1[11.4-32.8]	27.8[15.9-44.1]	20.6[13.0-31.0]	26.0[15.9-39.4]
Area of Residence				
Rural	44.2[38.3-50.3]	55.5[48.7-62.1]	48.7[42.3-55.0]	43.1[37.8-48.7]
Urban	40.4[34.2-47.0]	36.2[30.5-42.4]	28.1[23.3-33.5]	30.3[25.4-35.7]
Marital status				
Married	38.0[31.5-45.0]	35.4[28.3-43.3]	24.0[18.7-30.2]	30.3[25.0-36.3]
Single	46.8[40.7-52.9]	48.0[42.3-53.8]	42.6[37.2-48.2]	37.7[32.5-43.1]
Child's Age				
0-23 months	46.2[39.2-53.3]	51.3[44.0-58.6]	42.3[36.2-48.6]	38.2[32.1-44.7]
24-59months	37.3[31.2-43.7]	37.1[31.2-43.5]	31.1[25.7-37.0]	32.0[27.2-37.2]
Total	41.7[37.0-46.5]	42.8[38.2-47.6]	35.6[31.5-39.9]	34.6[30.8-38.6]

Source: Own calculations using NIDS 2008, 2012, 2014/15, and 2017, and post-stratification weight

6.3 Discussion of the results on MLFP

The results indicate that taking into account CIs, LFPR, employment and unemployment rates remained constant over time. This is because the confidence intervals of the different labour market outcomes overlap across the periods under investigation. The South African labour market is unique and has a complicated history. It is characterised by low rates of participation for specific groups based on demographics such as; gender, age and race. Therefore, it was vital to examine patterns of LFPR, employment and unemployment for this group of women based on age, race, area of residence, marital status and age of their child.

The descriptive analysis has shown that MLFPR is positively associated with the age of the mother and child, and more for Coloured and in the urban area. For marital status, variations are indicating that it may increase or decrease for both married and single mothers. As seen in previous chapters, malnutrition is one potential factor that can also affect an individual's decision to participate. Thus, the association between MLFPR and selected covariates as well as maternal malnutrition is further investigated in section 6.4.

Overall, the dataset reveals that employment rates increase with age. Amongst the youngest age cohort, the unemployment rate was most acute and decreased continuously as respondents got older. This may be as a result of the younger ones still finding their way into the labour market. This is similar to other studies that have investigated this issue (Altman, 2003; Leibbrandt et al., 2010). A racial decomposition of the labour market status indicates that Coloureds had the highest employment and the lowest unemployment rates compared with their African counterparts. This is similar to other studies that have investigated this issue (Altman, 2003; Leibbrandt et al., 2010). Persistent unemployment amongst African mothers may have resulted from discrimination, but it is also consistent with many other race-related factors. For instance, the historically low investments in the African population's education, still have a negative impact on the post-apartheid employment outcomes (Banerjee et al., 2008).

It has been observed that compared with urban areas, people living in rural areas are less likely to find a job (Wittenberg, 2002; Mbatha and Roodt, 2014; Chatterjee, Murgai and Rama, 2015). Generally, there are more job opportunities in urban areas compared with rural areas. Given the mainly urban apartheid job structures, the cost of job search is expected to be high for job seekers far away from cities (Banerjee et al., 2008). Therefore, compared with urban areas, the unemployment rate in rural areas tends to be higher, while the employment rate in urban areas is higher.

There are substantial differences in the incidence of employment and unemployment rates respectively, between married and single mothers. While unemployment rates were substantially high amongst single mothers compared with married mothers, the rate of employment was higher for married mothers. This might be as a result of networks. For example, a married mother may have more work-related networks than a single mother because her husband is employed (Majumder, 2012). More so, single mothers tend to be unemployed due to the opportunity cost of work resulting from the absence of fathers to take care of children (Sefiddashti et al., 2016).

It is also seen that maternal employment increases as their children age. This is similar to other findings (Lubotsky and Qureshi, 2018). The statistics also reveal that mothers of children under 24 months are faced with a high rate of unemployment compared with mothers of children aged 24 months and above. This may be because children under 24 months need more care (Kleven, Kreiner and Saez, 2009).

6.4 Maternal malnutrition in South Africa[34]

This section provides analyses on the state of maternal malnutrition that is underweight, overweight and obesity in SA. Table 6.6 presents the descriptive statistics for mothers. There are 1580, 1964, 2362 and 2512 mothers in 2008, 2012, 2014/2015 and 2017 respectively. The average height of these mothers for the four periods is approximately 1.6m, while the minimum and maximum weight is approximately 69.9kg (in 2008) and 72.3kg (in 2017) respectively. The minimum and maximum mean BMI is about 27.5kg/m^2 (in 2008) and 28.5kg/m^2 (in 2017) respectively. Overall, the largest proportion of mothers for all four years are between 25-34 years, while the lowest percentage is between 35-45 years.

Table 6.6 also reveals that the African population group is the largest compared with all other population groups in all four periods. For all the periods under investigation, the majority of mothers are in the urban areas compared with the rural areas. In 2008, there were more married mothers than single mothers, while from 2012-2017 single mothers were more than married mothers. Generally, the majority of the youngest children being taken care of are between the ages of 24 and-59 months in the respective years except in 2008 where most are between the ages 0 to 23 months. These data for the period 2008-2017 are summarised in Table 6.6.

[34] A paper will be developed from this section.

Table 6.6: Descriptive Statistics of maternal variables, 2008-2017

Variables	2008	2012	2014/15	2017
Height (mean), m	1.6	1.6	1.6	1.6
Weight (mean), kg	69.2	71.9	72.2	72.3
BMI (mean) Kg/m^2	27.5	28.0	28.4	28.5
Mother's Age (%)				
16-24 years	30.7	29.3	28.3	26.5
25-34 years	46.8	49.4	51.5	51.5
35-45 years	22.6	21.4	20.2	22.0
Race (%)				
African	84.0	85.0	84.1	86.0
Coloured	8.7	8.7	8.9	9.4
Indian	1.5	1.7	1.8	1.7
White	5.8	4.7	5.2	2.9
Area of Residence (%)				
Rural area	43.4	40.6	40.9	40.3
Urban area	56.6	59.4	59.1	59.7
Marital Status (%)				
Married	52.6	39.3	38.2	39.9
Single	47.5	60.7	61.8	60.1
Child's Age (%)				
0-23months	54.2	44.7	47.6	47.4
24-59months	45.8	55.3	52.5	52.6
N*	1580	1964	2362	2512

Source: Own calculations using NIDS 2008, 2012, 2014/15, and 2017, and post-stratification weight, *N=number of observations

The next subsequent sub-section provides estimates for maternal underweight in the country and some selected background characteristics (age, race, area of residence, marital status and child's age) together with their CIs.

6.4.1 Maternal underweight in South Africa

The estimates in Figure 6.4 reveal that in 2008 the rate of maternal underweight is 4.3% [95% CI: 3.2-5.7], which decreased to 2.8% [95% CI: 1.8-4.3] in 2012, then to 2.7% [95% CI: 1.9-3.9] in 2014/15 and later increased to 4.4% [95% CI: 3.4-5.8] in 2017. Given an overlap of the CIs, there is no statistical difference in the rate of maternal underweight across the years. Figure 6.4 presents a summary of these statistics for the periods being investigated, 2008-2017.

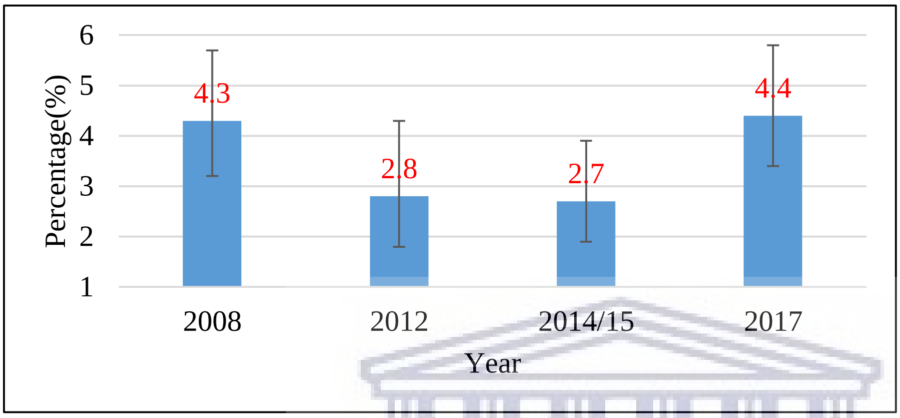

Figure 6.4: Maternal rate of underweight, 2008-2017
Source: Own calculations using NIDS 2008, 2012, 2014/15, and 2017, and post-stratification weight

Concerning age, Table 6.7 portrays that for all 4 periods, underweight is more prevalent amongst mothers between the ages of 16 and 24 years. In 2008 and 2014/15, the rate of underweight is lowest amongst those between the ages 25-34 years, while in 2012 and 2017 it is lowest between the age 35-45 years. For all the age groups, the rate of underweight decreased between 2008 and (2012). While for those aged between 16-24 years the rate increased from 2014/15 right to 2017, for those aged between 25-34 years the rate decreased in 2014/15 and then increased in 2017. Meanwhile, for those aged between 35-45 years the rate increased in 2014/15 and then decreased in 2017. When the CIs are taken into account, there is no statistical change in the rate of underweight amongst the different age groups. But in the age group 25-34 years, between 2014/15 and 2017, there is a statistically significant change in the rate of maternal underweight between the years, since the CIs do not overlap.

The estimates of the racial decomposition in Table 6.7 reveals that the rate of underweight is more prevalent amongst Coloured mothers compared with African mothers for all the years except in 2012 where both were approximately the same. For African mothers, the rate decreased between 2008 to 2014/15, which then increased in 2017, while for Coloureds, it decreased in 2012 and then increased in 2014/15 right up to 2017. Over the years, there is no statistically significant difference in the rate of maternal underweight for both African and Coloured mothers since the CIs overlap.

In terms of area of residence, the estimates in Table 6.7 signifies that except in 2012 where the rate of underweight is the same for both the urban and rural areas, underweight is high in the rural areas than urban areas in 2008 and 2014/15, while in 2017 it is high in the urban areas. For both areas, the rate decreased between 2008 and 2012. In the rural areas, the rate then increased from 2014/15 right to 2017. For the urban areas it decreased in 2014/15 and then increased in 2017. Since the CIs overlap, there is no statistically significant change in the rate of maternal underweight in both areas across the periods respectively.

The estimates for marital status in Table 6.7 indicates that underweight is more prevalent amongst single mothers across the periods than married mothers. Based on the trend, the rate of underweight decreased in 2012 for married mothers, then increased in 2014/15 and 2017. For single mothers, the rate decreased in 2012 right to 2014/15 and later increased in 2017. An overlap of the CIs for both the married and single mothers respectively, is an indication that there is no statistically significant difference in the rate of maternal underweight over the years.

Finally, based on the child's age, Table 6.7 indicates that underweight is more prevalent amongst mothers of children age 0-23 months across the periods than mothers of children age 24-59 months. The trend analysis reveals that the rate of underweight decreased in 2012 and 2014/15 and later increased in 2017 for both groups of mothers. Due to an overlap of the CIs for both groups of mothers, it therefore implies that there is no statistically significant change in the rate of maternal underweight across the periods. These data for all four years on maternal underweight are summarised in Table 6.7.

Table 6.7: Distribution of maternal underweight across key background characteristics, 2008-2017

Background Characteristics	2008 %[95% CI]	2012 %[95% CI]	2014/15 %[95% CI]	2017 %[95% CI]
Age Cohorts				
16-24 years	6.1[3.8-9.5]	4.4[2.7-7.2]	6.3[3.9-10.0]	7.2[5.1-10.3]
25-34 years	3.4[2.1-5.4]	2.7[1.3-5.7]	1.2[0.7-2.0]	4.5[3.0-6.8]
35-45 years	3.7[1.9-7.0]	0.9[0.4-2.1]	1.6[0.8-3.2]	0.8[0.3-2.2]
Race				
African	4.4[3.2-6.1]	2.9[1.8-4.6]	2.7[1.8-3.9]	4.1[3.0-5.5]
Coloured	5.7[3.2-10.0]	2.8[1.4-5.8]	5.5[2.8-10.8]	6.9[3.2-14.4]
Area of Residence				
Rural	5.0[3.5-7.2]	2.8[1.8-4.5]	3.3[2.1-5.1]	4.3[3.0-6.3]
Urban	3.7[2.3-5.9]	2.8[1.5-5.3]	2.3[1.4-4.0]	4.5[3.1-6.5]
Marital Status				
Married	2.8[1.6-4.9]	1.5[0.7-3.2]	2.0[0.9-4.6]	2.2[1.2-3.8]
Single	5.8[4.1-8.2]	3.7[2.2-6.0]	3.1[2.2-4.5]	6.0[4.4-8.1]
Child's Age				
0-23months	4.5[2.9-6.8]	3.3[2.2-5.1]	3.2[2.2-4.9]	4.7[3.3-6.6]
24-59months	4.0[2.7-5.9]	2.4[1.1-5.1]	2.3[1.2-4.1]	4.3[2.8-6.4]
Total	4.3[3.1-5.7]	2.8[1.8-4.3]	2.7[1.9-3.9]	4.4[3.4-5.8]

Source: Own calculations using NIDS 2008, 2012, 2014/15, and 2017, and post-stratification weight

In the subsequent sub-section, the estimates for maternal overweight in the country and some selected background characteristics (age, race, area of residence, marital status and child's age) together with their CIs are provided.

6.4.2 Maternal overweight in South Africa

In Figure 6.5, the estimates indicate that the rate of overweight in the country in 2008 is 27.2% [95% CI: 24.1-30.6], which increased to 29.0% [95% CI: 25.8-32.3] in (2012). However, the rate decreased to 26.7% [95% CI: 23.7-30.0] in 2014/15 and then to 25.1% [95% CI: 22.6-27.7] in 2017. Given that the CIs across the periods overlap, it can be concluded that there is no statistically significant difference in the rate of maternal overweight since 2008-2017. Figure 6.5 provides a summary of the data for the period 2008-2017.

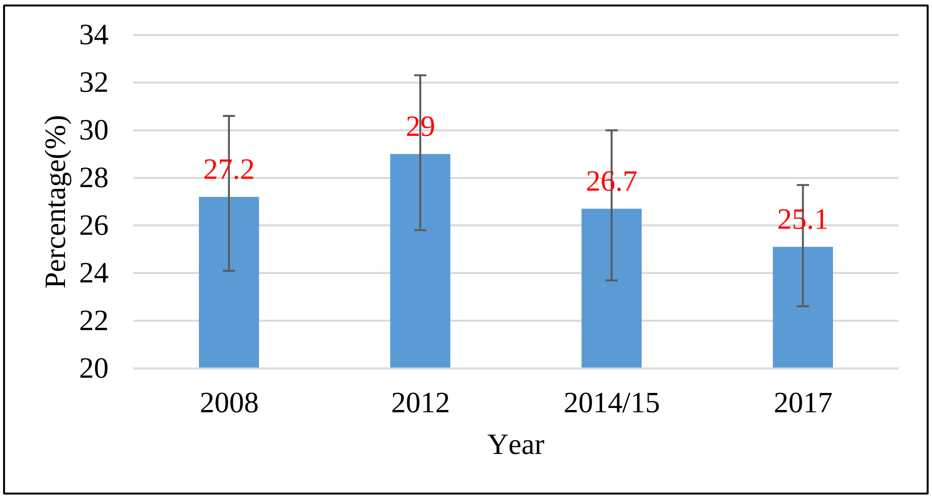

Figure 6.5: Maternal rate of overweight, 2008-2017
Source: Own calculations using NIDS 2008, 2012, 2014/15 and 2017, and post-stratification weight

The estimates in Table 6.8 show that for the age cohorts, the proportion of overweight mothers is highest amongst those in the middle age group, that is, 25-34 years across the periods except in 2017, where the rate is highest for the age cohort 35-45 years. The percentage is lowest amongst those aged 35-45 years all through, except in 2017 where the lowest rate is observed amongst those aged 16-24 years. The trend indicates that for those aged 16-24 years and 35-45 years, the rate of overweight increased between 2008 and 2012, which then decreased in 2014/15 and later increased in 2017. Meanwhile, amongst those aged 25-34 years the rate of overweight decreased across the years. When the CIs are accounted for, there is no statistically significant change in the rate of maternal overweight across the periods for all the age cohorts respectively due to an overlap of the CIs.

Racially, the estimates in Table 6.8 signifies that apart from 2008, the rate of overweight is more prevalent amongst African mothers when compared with Coloured mothers. For the African mothers, the rate increased in 2012, then decreased in 2014/15 and later in 2017. Meanwhile, for Coloureds mothers, the rate decreased in 2012 and then increased in 2014/15 and 2017 respectively. The CIs also indicate that for both racial groups, there is no statistically significant difference in maternal overweight is across the periods since the CIs overlap.

We see in Table 6.8 that the rate of overweight is more prevalent amongst those in the rural areas when compared with urban areas in all the years. In the rural areas, the rate of overweight increased in 2012, then decreased in 2014/15 and later increased in 2017. For the urban area, the rate decreased from 2012 through to 2017. For both locations, there is no statistically significant difference in the rate of overweight in mothers due to an overlap of the CIs respectively.

For marital status, Table 6.8 shows that the rate of overweight is highest amongst married mothers in 2008 and 2014/15 compared with single mothers. Then in 2012, the rate is highest for single mothers compared with married mothers. In 2017, the rate is slightly higher amongst married mothers. The CIs also reveal that across the periods, there is no statistically significant change in maternal overweight because the CIs overlap.

Finally, for mothers of children aged 24-59 months the estimates in Table 6.8 indicate that the rate of overweight is highest in this group for all periods except in 2014/15, where the rate is more prevalent amongst mothers of children age between 0-23 months. However, there is no statistically significant difference in maternal overweight across the periods for both groups due to an overlap of the CIs. Table 6.8 provides the summary on maternal overweight for all four years under review.

Table 6.8: Distribution of maternal overweight across key background characteristics, 2008-2017

Background Characteristics	2008 %[95% CI]	2012 %[95% CI]	2014/15 %[95% CI]	2017 %[95% CI]
Age Cohorts				
16-24 years	22.5[18.0-27.7]	26.2[20.7-32.7]	23.9[19.8-28.5]	24.8[20.2-30.1]
25-34 years	33.2[28.2-38.6]	31.5[27.1-36.4]	30.5[25.6-35.8]	25.0[21.6-28.8]
35-45 years	21.3[15.8-28.1]	26.7[20.1-34.6]	21.1[16.1-27.2]	25.6[20.6-31.3]
Race				
African	27.2[24.1-30.6]	30.9[27.6-34.5]	27.0[24.2-30.0]	25.6[22.9-28.5]
Coloured	27.6[16.9-41.7]	17.0[10.2-26.9]	19.1[13.3-26.7]	22.0[15.4-30.2]
Area of Residence				
Rural	27.7[24.1-31.6]	32.1[27.8-36.8]	27.9[24.2-31.8]	28.3[24.9-31.9]
Urban	26.9[22.3-32.1]	26.8[22.5-31.5]	25.9[21.6-30.8]	22.9[19.5-26.7]
Marital status				
Married	28.5[23.7-33.7]	27.0[22.0-32.7]	28.8[23.1-35.3]	25.1[21.3-29.5]
Single	26.0[22.3-30.1]	30.2[26.3-34.4]	25.5[22.2-28.9]	25.0[21.9-28.4]
Child's Age				
0-23months	25.5[21.6-29.8]	26.6[22.6-31.2]	27.8[24.0-31.9]	22.6[19.3-26.2]
24-59months	29.3[24.5-34.5]	30.8[26.3-35.8]	25.8[21.3-30.8]	27.3[23.8-31.2]
Total	27.2[24.1-30.6]	29.0[25.8-32.3]	26.7[23.7-30.0]	25.1[22.6-27.7]

Source: Own calculations using NIDS 2008, 2012, 2014/15, and 2017, and post-stratification weight

Table A6.4 in the appendix reveals that based on estimates on overweight including obesity there is an upward and downward swing in the rate over the years, but the CIs indicate that there is no statistically significant variation of maternal overweight including obesity across the periods. Overall, the rate of overweight including obesity is highest at an older age, amongst African mothers, mothers living in urban areas, married mothers and mothers of children aged 24-59 months. The following sub-section provides estimates for maternal obesity in the country and some selected background characteristics (age, race, area of residence, marital status and child's age) together with their CIs.

6.4.3 Maternal obesity in South Africa

As seen in Figure 6.6, the estimates show that the rate of maternal obesity increased across the periods. In 2008, the rate is 29.8% [95% CI: 26.6-33.3], it then increased to 32.9% [95% CI: 29.6-36.3] in 2012, then to 37.2% [95% CI: 34.0-40.5] in 2014/15. In 2017, it increased to 37.8% [95% CI: 34.8-40.9]. The rate of obesity increased from 2008-2017, which is a gap period of 9 years. Across the periods, there is an overlap of the CIs, which indicates that there is no statistically significant change in the rate of maternal obesity. But between 2008 and 2017, the CIs do not overlap, therefore, obesity has increased.

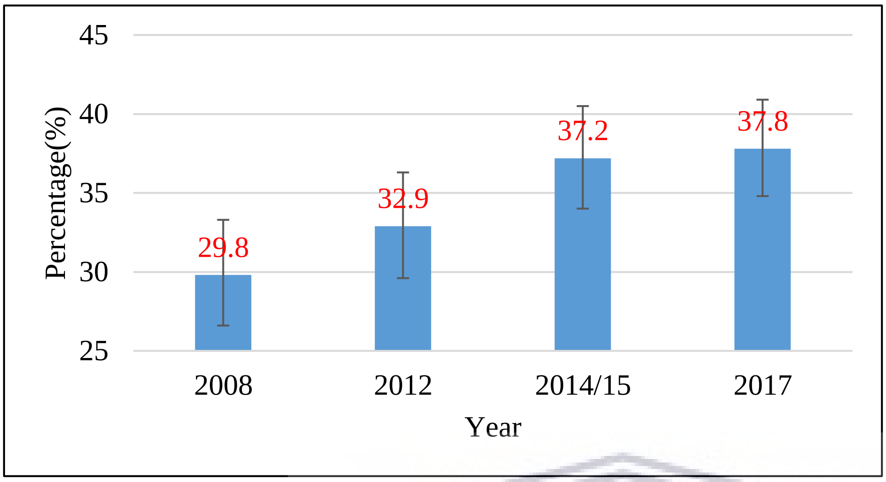

Figure 6.6: Maternal rate of obesity, 2008-2017
Source: Own calculations using NIDS 2008, 2012, 2014/15, and 2017, and post stratification weight

Based on age, in Table 6.9, the estimates of obesity suggest that the highest prevalence of obesity is amongst those between the ages 35-45 years, while the lowest rate is amongst those aged between 16-24 years. For all the age cohorts, the rate of obesity increased right up to 2014/15. For mothers aged 16-24 years and 35-45 years the rate decline in 2017, while in the same year the rate of overweight increased in the age group 25-34. The statistics also reveal that the rate of obesity increased over 9 years (2008-2017) for those aged 16-24 years and 25-34 years respectively, while a decrease is seen in the age group 35-45years. The CIs for the three age cohorts overlap across the periods except for those age 25-34 years where between 2008-2017, the CIs do not overlap. This implies that a statistically significant change in maternal obesity is observed only between 2008 and 2017 and it is amongst mothers aged between 25-34 years.

In Table 6.9, the statistics suggest that the rate of obesity is more prevalent amongst Coloured mothers than African mothers over the years, except in 2017 where the rate is slightly higher in African mothers. For both racial groups, the rate of obesity increased right up to 2014/15 and then decreased in 2017. Amongst African mothers, the CIs between 2008 and 2017 do not overlap. This indicates that there is a statistically significant change in maternal obesity within this group between 2008 and 2017.

Table 6.9 reveals that across the different years, obesity is more prevalent in urban areas than in rural areas. There is a persistent increase in the rate of obesity in the urban area across the periods, while in the rural areas the rate increases right to 2014/15 and then decreases in 2017. For both the rural and urban areas, the rate of obesity increased between 2008 and 2017. For the urban areas, the CIs over the periods overlap. As such, there is statistically no significant difference in maternal obesity in the areas. The CIs between 2008 and 2017 for the rural areas do not overlap, indicating that the rate of obesity significantly increased.

For marital status, Table 6.9 show that across the periods, the rate of obesity is more prevalent amongst married mothers compared with single mothers. There is a persistent increase in the rate of obesity for both single and married mothers across the periods. For married mothers, due to the overlap of the CIs, there is no statistically significant difference in the rate of obesity. For single mothers, since the CIs between 2008 and 2017 do not overlap, it is most likely that the rate of obesity increased.

Table 6.9 postulates that for the child's age, over the different years the rate of obesity is more common amongst mothers of children between 24-59 months, compared with mothers of children aged 0-23 months. There is a persistent increase in the rate of obesity amongst mothers of children aged 0-23 months and 24-59 months respectively. Nevertheless, in 2017, the rate of obesity amongst mothers of children aged 24-59 months decreased. For mothers of children aged 0-23 months and 24-59 months, the CIs overlap respectively over the years. Therefore, there is no statistically significant variation in the rate of maternal obesity. The summary on maternal obesity for all four years under review is provided in Table 6.9.

Table 6.9: Distribution of maternal obesity across key background characteristics, 2008-2017

Background Characteristics	2008 %[95% CI]	2012 %[95% CI]	2014/15 %[95% CI]	2017 %[95% CI]
Age Cohorts				
16-24 years	18.1[13.7-23.4]	19.2[14.8-24.4]	25.6[21.2-30.4]	20.5[16.4-25.2]
25-34 years	29.1[24.3-34.4]	33.4[28.6-38.6]	36.4[31.6-41.5]	43.0[38.6-47.5]
35-45 years	47.4[40.0-54.8]	50.6[42.9-58.2]	55.5[48.5-62.4]	46.7[40.4-53.0]
Race				
African	29.6[26.2-33.3]	32.4[29.1-35.9]	38.1[34.8-41.4]	37.9[34.7-41.2]
Coloured	37.6[26.6-50.0]	39.0[27.7-51.6]	40.2[31.0-50.2]	37.8[28.7-47.8]
Area of Residence				
Rural	24.3[20.8-28.1]	26.3[22.7-30.4]	35.1[31.2-39.2]	32.6[29.0-36.4]
Urban	34.1[29.1-39.5]	37.4[32.5-42.5]	38.6[33.9-43.6]	41.4[37.0-45.8]
Marital status				
Married	34.0[28.9-39.4]	37.7[31.9-43.9]	44.0[37.9-50.2]	44.1[39.4-49.0]
Single	25.0[21.2-29.3]	29.8[26.0-33.9]	33.0[29.4-36.9]	33.6[29.9-37.6]
Child's Age				
0-23months	27.6[23.3-32.4]	29.7[25.5-34.4]	34.5[30.3-38.8]	36.4[32.1-40.9]
24-59months	32.6[27.7-37.6]	35.4[30.7-40.5]	39.7[34.8-44.8]	39.1[35.0-43.4]
Total	29.8[26.6-33.3]	32.9[29.6-36.3]	37.2[34.0-40.5]	37.8[34.8-40.9]

Source: Own calculations using NIDS 2008, 2012, 2014/15, and 2017, and post-stratification weight

6.4.4 Discussion of the results on maternal nutritional status

The first consideration that can be drawn from the analyses above is the general trend of underweight, overweight (including obesity), overweight and obesity. The trend of underweight in this study is inconsistent with the observed global trend (Global Nutrition Report, 2020). When the estimates of overweight (including obesity) are considered, the trend between 2008 and 2017 is similar to the trend observed globally (Ng et al., 2014; Global Nutrition Report, 2020), while the trend of overweight is contrary to that observed in Africa (Agyemang et al., 2015). While estimates suggest declining trends in maternal underweight and overweight, and an increase in overweight (including obesity), when CIs are accounted for, these are not very evident and points to little or no change in these levels over the years. Though the rate of overweight is seen to be relatively stable, it is still high but less than obesity.

Concerning obesity, the increasing trend is consistent with the trend observed globally (Ng et al., 2014; Global Nutrition Report, 2020) and in Africa (Agyemang et al., 2015). The finding reveals that obesity is the most predominant form of malnutrition in the country affecting these mothers followed by overweight. This finding is consistent with the works of Ardington and Case (2009); Shisana et al. (2013) and NDoH, Statistics SA, SAMRC and ICF (2019). The high rate of overweight and obesity amongst this group of women increases their probabilities of developing NCDs (Esmailnasab, Moradi and Delaveri, 2012). As a result, chances of morbidity, mortality, social exclusion and under-productivity, thus increase (Beaglehole et al., 2011; Chaker et al., 2015). Another consideration from the findings is the disparities in the estimates across the different background characteristics.

Ageing has been found to increase the risk of weight gain (Canning et al., 2014), this has been attributed to factors such as lifestyle and physiological changes (Pérez et al., 2016). The results above confirm this, where it is observed that underweight is higher in the younger age group (16-24 years), while overweight is higher in the middle age group (25-34 years) and obesity is higher in the older age group (35-45 years). In addition, overweight (including obesity) is highest in the age group 35-45 years. Hashan et al (2020) also found a similar result in which, underweight is lower in the younger age group (15-24 years), while overweight (including obesity) is higher in the older age group (35-49 years). Several studies (Shayo and Mugusi, 2011; Masibo et al., 2013; Pobee, Owusu and Plahar, 2013) have reported a positive relationship between age and obesity. Although weight gain increases with age, it should be noted that it increases to a certain age and then declines afterwards due to biological mechanisms (Hickson, 2006; Wang et al., 2010; Jura and Kozak, 2016).

Urbanisation as seen in the literature (for instance, Agyemang et al., 2009; Ziraba, Fotso and Ochako, 2009; Benkeser, Biritwum and Hill, 2012; Kandala and Stranges, 2014) is associated with overweight and obesity. Urban living is conceived to be associated with poor eating habits and more inactive lifestyles (Martins et al., 2011; Kimani-Murage, 2013; Schönfeldt et al, 2013). This implies that living in an urban area is associated with an increased risk of malnutrition, particularly obesity. This can be attributed to an increase in access to and consumption of unhealthy foods such as fast-foods or sedentary jobs (Henderson, 2015). This may account for the low rate of undernutrition and high rate of obesity in the urban compared with the rural areas as observed in the analyses. The analyses also suggest that rural areas are gradually "catching up" with the rate of obesity. This may be due to the increasing adoption of urban lifestyles in these areas.

Early literature on marital status, generally found that being married has a positive association with body weight, while being divorced and widowed are negatively linked to body weight (Teachman, 2016). Married people are more confidant with whom they eat and as such may turn to eat more frequently, which may lead to weight gain (Averett, Sikora, and Argys, 2008; Umberson, Liu and Powers, 2009; Wilson, 2012). Alternatively, because married women are not actively seeking a partner, they are less likely to be conscious of or concerned about their body weight. Consequently, they are more likely to experience a greater increase in body weight compared with single individuals who are trying to minimise their weight gain in order to attract a mate (Carmalt, et al., 2008; Sobal, Hanson and Frongillo, 2009; Umberson, Liu and Powers, 2009; Shafer, 2010; Wilson, 2012; Averett, Argys, and Sorkin, 2013). These factors may explain why underweight is higher, and overweight and obesity are lower amongst single mothers compared with married mothers. Other studies that have found similar conclusion include Tzotzas et al., 2010; Mogre, Nyaba and Aleyira, 2014; and Teachman, 2016.

Based on the estimates, underweight and obesity are higher for Coloured than African mothers, while it is seen that overweight is higher for African than Coloured mothers. This analysis followed the same racial differences reported for SA by Senekal, Steyn and Nel (2003), but the prevalence of obesity did not follow the general trends reported for South African women by Puoane et al. (2002). In addition, mothers of children aged below 24 months are highly underweight, while mothers of children aged above 23 months are more overweight and obese.

As seen in Chapter Four, ill-health appears to be one of the impairments of labour market participation. Therefore, it is important to identify the potential role that malnutrition plays in determining MLFP. Given that maternal obesity is the prominent form of malnutrition affecting South African mothers, it is therefore important to investigate its effect on MLFP. The next section focus on the relationship between maternal obesity and MLFP.

6.5 The association between maternal obesity and maternal labour force participation[35]

Table 6.10 shows summary statistics of variables employed in the regression analysis. Of all the mothers, 57% participated in the LF. The mean age of the mothers is 29 years, while for the children is 26 months. Table 6.6 also reveals, 50.6% of the children are boys compared with girls. Most of the mothers (more than half) reported to be healthy, live in the urban areas and in a household in which a member receives a government grant. Less than half of the mothers are Coloured, married, have matric and above, live in a household with at least an employed male, smokes, exercises more often and have been diagnosed with some form of obesity-related disease. Table 6.10 provides a summary of the variables used in the regression analysis.

Table 6.10: Descriptive statistics of the variables employed in the regression analysis for mothers, 2017

Variables	N	Value
Mother's Age (years- mean)	2439	29.0
Labour force participation (%)	2435	57.4
Obese (%)	2423	37.9
Child's Age (months – mean)	2439	26.0
Boy Child (%)	2438	50.6
Healthy (%)	2437	94.9
Coloured (%)	2437	10.2
Urban (%)	2439	58.0
Married (%)	2436	37.8
Grant (%)	2437	75.6
Matric+ (%)	2426	47.9
Household Size (mean)	2439	5.5
At least one Employed Male in the Household (%)	2439	0.3
Smokes (%)	2433	6.2
Disease (%)	2437	6.5
Physical activity (%)	2435	6.1

Source: Own calculations using NIDS 2017 and post-stratification weight

[35] The fourth paper will be developed from this section.

The result in Table 6.11 shows that for both the broad and narrow definitions of MLFP there is a difference of 3% between mothers who are obese and did not participate in the labour market compared with those who did. This pre-regression analysis is presented in Table 6.11 and suggests that there is a positive relationship between better maternal weight and MLFP.

Table 6.11: Maternal Obesity-MLFP status in 2017 (row percentages sum to 100)

LFP status	Obese %[95% CI]	Not obese %[95% CI]	Row Total (N)
Strict LFP	39.3[35.2-43.7]	60.7[56.3-64.9]	1268
Strict Non-LFP	35.9[31.5-40.5]	64.1[59.5-68.5]	1151
Broad LFP	39.2[35.1-43.4]	60.8[56.6-64.9]	1333
Broad Non-LFP	36.0[31.6-40.7]	64.0[59.3-68.5]	1086

Source: Own calculations using NIDS 2017 and post-stratification weight

Table 6.12 provides preliminary evidence on the correlation between obesity and the instruments. For example, among mothers who smoke 24.8% [95% CI: 14.9-38.4] are found to be obese while 38.7% [95% CI: 35.6-42.0] of those who do not smoke are obese. A similar disparity is seen for physical activity (exercise at least 3 or more times a week) and disease (previously diagnosed by a doctor with diseases such as high blood pressure, heart problems, diabetes or stroke). These statistics are summarised in Table 6.12.

Table 6.12: Distribution of instruments across maternal obese categories

Instruments	Has condition?	Obese %[95% CI]	Not obese %[95% CI]	Row Total (N)
Physical Activity				
	Yes	33.2[22.2-46.4]	66.8[53.6-77.8]	120
	No	38.1[35.0-41.4]	61.9[58.6-65.0]	2300
Disease				
	Yes	56.9[45.9-67.3]	43.1[32.7-54.1]	188
	No	36.5[33.4-39.8]	63.5[60.2-66.7]	2235
Smokes				
	Yes	24.8[14.9-38.4]	74.6[61.1-84.6]	179
	No	38.7[35.6-42.0]	61.3[58.0-64.4]	2239

Source: Own calculations using NIDS 2017 and post-stratification weight

The above descriptive analysis shows significant scope for incorporating physical activity, disease and smoking into the determination of MLFP. It has been shown that (Table 6.11) those who did not participate in the LF were 3% likely as participants to report a worse presence of obesity. The following analysis aims to establish a maternal obesity-LFP relationship.

6.5.1 Result of models on obesity and MLFP

As seen in chapter 4 the dominant view in the literature (Morris, 2007; Lindeboom, Lundborg and Van der Klaauw, 2010; Larose et al., 2016) is that obesity is an endogenous determinant of LFP. This necessitated the use of IVs in the analyses. Conversely, some previous studies (for instance, Some, Rashied and Ohonba, 2014) could not reject the hypothesis of exogenous obesity for women. Assuming that obesity is an exogenous explanatory variable of MLFP in any empirical context, then the use of IV methods may be redundant. Given the relative inefficiency of IV estimation compared with OLS, this will increase the probability of not rejecting the null hypothesis that obesity has no significant effect meanwhile there is (Murray, 2006; Cameron and Trivedi, 2010). For these reasons, sensitivity test analyses were conducted to determine the model that best suits this study.

The results of the first stage bivariate probit model and the LPM estimation where IVs are used to control for endogeneity of obesity are presented in Table A6.5 in the appendix. Based on the bivariate probit result, the first thing done was to test the null hypothesis that maternal obesity is exogenous. That is, the hypothesis that $\rho = 0$ using a Wald test. The test results are reported in Table A6.5 (1) in the appendix. The Wald test statistic (ρ) is 0.41, with $Chi^2(1)$[36] = 1.72 and prob> Chi^2 = 0.19. The p-value is statistically insignificant using any of the conventional statistical levels of significance Therefore, the null hypothesis cannot be rejected and hence ρ is not significantly different from 0.

Also, the DWH Chi^2 tests of exogeneity of maternal obesity using the IV-LPM failed to reject the null hypothesis that maternal obesity is exogenous, even at a 10% level of statistical significance. This is because the DWH Chi^2 (1) = 1.74 and p-value is 0.19. The p-value is also statistically insignificant based on the conventional statistical levels of significance. Hence, maternal obesity is not endogenous to MLFP in this context. All these sensitivity analyses

[36] The value in bracket is the degree of freedom

imply that obesity is therefore exogenous and the results of the univariate probit model and the LPM presented in table 6.13 below are valid. Therefore, the results presented in Table A6.6 in the appendix are invalid.

For all the mothers, the results in Table 6.13 reveal that for both the univariate probit (1) and the LPM (2), holding all other variables constant, there is a positive relationship between maternal obesity and MLFP. That is being obese increases the probability of MLFP by 1%. However, these results are statistically insignificant at the conventional levels of statistical significance. As seen in Table 6.13 (1) and (2), some of the covariates conform to the a priori expectations. Age of mother and child, being Coloured (relative to African), living in an urban area (relative to the rural area) and education (matric>= 12 years of schooling) have a positive relationship with MLFP. Taking age as an example, this implies that a 1% increase in the age of the mother and child increases this increases the likelihood of MLFP by 7%-9% respectively. Also, Coloured mothers have a 13-15% chance of participating in the LF than their African counterparts, while mothers in the urban areas have a 9-10% chance of participating in the LF than rural areas. Having a matric is associated with a 17-19% likelihood of participating in the LF.

In Table 6.13 (1) and (2), it is observed that mother and child's age square respectively, being married (relative to single) and household size are negatively associated with MLFP. The negative relationship between mother and child's age square, and MFLP for example, is an indication that MLFP increases as age increases and then decreases at an older age. This indicates the quadratic effect of maternal age on MLFP. An increase in household size by 1% decreases the maternal probability of participating in the LF by 1%. On the other hand, married mothers are 5% less likely to participate in the LF than single mothers. The results also indicate that having a male child, being healthy (relative to being sick), being in a household where a member receives a grant from the government (relative to not receiving a grant) and having an employed male in the household, there is no statistically significant association with MLFP at any of the conventional statistical levels of significance. Table 6.13 presents the statistical output of the univariate probit model and the LPM.

Table 6.13: Strict MLFP determination allowing for exogeneity of obesity (marginal effects)

	(1)	(2)
Variables	Univariate probit	LPM
Obese Mother	0.01	0.01
	(0.02)	(0.02)
Mother's Age	0.09***	0.07***
	(0.01)	(0.01)
Mother's Age Square	-0.00***	-0.00***
	(0.00)	(0.00)
Child's Age	0.01***	0.01***
	(0.00)	(0.00)
Child's Age Square	-0.00***	-0.00***
	(0.00)	(0.00)
Male	0.01	0.00
	(0.02)	(0.02)
Healthy	-0.02	-0.02
	(0.05)	(0.05)
Coloured	0.15***	0.13***
	(0.03)	(0.03)
Urban	0.10***	0.09***
	(0.02)	(0.02)
Married	-0.05**	-0.05**
	(0.03)	(0.02)
Grant	0.01	0.01
	(0.03)	(0.02)
Matric	0.19***	0.17***
	(0.02)	(0.02)
Household Size	-0.01*	-0.01*
	(0.00)	(0.00)
Employed Male	-0.00	0.00
	(0.03)	(0.02)
Log pseudolikelihood	-1480.0561	
Constant		-0.92
F-stat		40.6
R^2		0.14
N	2397	2397

Source: Own calculations using NIDS 2017, robust standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1

The subsequent section provides a robust check on the analysis presented above.

6.5.2 Robustness check

Table 6.14: Broad MLFP determination allowing for exogeneity of obesity (marginal effects)

Variables	(1) Univariate probit	(2) LPM
Obese Mother	-0.00	-0.00
	(0.02)	(0.02)
Mother's Age	0.08***	0.07***
	(0.01)	(0.01)
Mother's Age Square	-0.00***	-0.00***
	(0.00)	(0.00)
Child's Age	0.02***	0.01***
	(0.00)	(0.00)
Child's Age Square	-0.00***	-0.00***
	(0.00)	(0.00)
Male	0.00	0.00
	(0.02)	(0.02)
Healthy	-0.01	-0.01
	(0.05)	(0.05)
Coloured	0.15***	0.13***
	(0.03)	(0.03)
Urban	0.08***	0.07***
	(0.02)	(0.02)
Married	-0.06***	-0.06***
	(0.03)	(0.02)
Grant	0.00	0.00
	(0.03)	(0.02)
Matric	0.17***	0.16***
	(0.02)	(0.02)
Household Size	-0.00	-0.00
	(0.00)	(0.00)
Employed Male	0.01	0.01
	(0.02)	(0.02)
Log pseudolikelihood	-1495.221	
Constant		-0.85***
		(0.17)
F-stat		33.2
R^2		0.12
N	2397	2397

Source: Own calculations using NIDS 2017, robust standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1

For the robustness of this analysis, given that the broad definition of LFP is applicable in SA, it is therefore used for the robust check of the analysis. For the broad MLFP, the results of the first stage bivariate probit model and LPM are presented in Table A6.7 and A6.5 in the appendix respectively. The same sensitivity tests performed for the strict MLFP are also applied. Both the Wald test and the DWH test presented in Table A6.7 and A6.8 in the appendix respectively were also statistically insignificant at the conventional significance levels. As such, the results in table A6.8 in the appendix are also invalid. Therefore, the single-equation models (univariate model and LPM) are valid and are presented in Table 6.14. In this case, obesity impacts negatively on MLFP using both methods, though it is statistically insignificant when any of the critical values are considered. For the covariates, the outcomes are similar to the model presented in Table 6.13 except for household size that is now irrelevant. The statistical output of the univariate probit model and the LPM using the broad MLFP are presented in Table 6.14. Other robust statistical analyses are discussed in the following section, which concentrates on the strength and validity of the selected instruments.

6.5.3 Instrument relevance and validity

The results for all mothers based on the strict MLFP in Table A6.5 (1) and the broad MLFP in Table A6.7 in the appendix show that the index coefficients of all instruments are statistically significant. The Wald test results indicate that the three IVs do not have significant explanatory power on obesity. Thus, the IVs used are weak but passed the first condition of instruments validity. Table A6.5 (2) in the appendix also reveals that each of the instruments significantly predicts the probability of being obese or not at one of the conventional levels of significance. For both models, the IVs also conformed to theoretical expectations. For instance, the more one exercises or smokes the lower the probability of being obese. On the other hand, if previously diagnosed with high blood pressure, diabetes, heart problems and/or a stroke, the probability of being obese increases. For simplicity, only the results of the IVs in Table A6.5 (2) in the appendix are presented in Table 6.15, since they are the main variables of interest in the post estimation analysis of the 2SLS regression.

To formally test if these instruments are weak, the F statistics in a joint test of the instruments was calculated and the result is 8.5 as seen in Table 6.15. This is lower than the Staiger and Stock (1997) critical F statistic of 10, which is the suggested minimum number to obtain unbiased results using the instrumented 2SLS estimation model. This implies that the instruments are weak. The identification assumption is assessed by computing the Hansen J over-identification test statistic for 2SLS. Based on the validity of the instrument, the p-value of the test of over-identifying restrictions Chi^2 as presented in Table 6.15 below is 0.20. This indicates that the null hypothesis of over-identifying restrictions cannot be rejected even at a 10% level of significance. This is because the p-value is insignificant at any of the conventional levels of significance. This indicates that the over-identifying restrictions are valid. Table 6.15 presents the formal test of IVs after a 2SLS estimation.

Table 6.15: First stage LPM estimates

Variables	Dependent variable: Pr (Obese mother = 1|X)
Disease	0.14*** (0.04)
Physical Activity	-0.08** (0.04)
Mother Smokes	-0.11*** (0.04)
N	2393
F-statistics (for joint IVs)	8.5
Hansen J test (p-value)	0.20

Source: Own calculations using NIDS 2017, robust standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1

The next section focuses on the discussion of the result on the relationship between maternal obesity and MLFP presented in Table 6.13.

6.5.4 Discussion: association between maternal obesity and MLFP

First of all, the hypothesis that maternal obesity will decrease maternal labour force participation was not supported. Including other maternal, child and household characteristics into the univariate model and LPM respectively, it is observed that there is a positive but insignificant relationship between OM and MLFP. It is not clear why this did not conform to the hypothesis. However, one possible reason could be attributed to the fact that the data could not reject the exogeneity of maternal obesity. Hence, the lack of strong instrumental variables may have caused the estimate to be biased. These results corroborate with the findings of Lindeboom, Lundborg and Van der Klaauw (2010); Some, Rashied and Ohonba (2014); and Larose et al. (2016), where they observed an insignificant association of obesity with women's employment participation.

For some of the control variables, the a priori expectations are met. For instance, the findings on maternal age for both models indicate that LFP increases up to a certain age and later decreases subsequently at an older age. These findings are similar to that observed by Ntuli and Wittenberg (2013) in their study on the determinants of black women's LFP in Post-Apartheid SA. Ntuli and Wittenberg (2013) found that those between the age group 15-19 years have a significantly higher LFP compared with those 55-59 years old. The likelihood of participating in the labour market decrease with age (Sefiddashti et al., 2016) and some researchers (Riach and Rich, 2010; Ahmed, Andersson and Hammarstedt, 2012) hypothesised that this decrease also results from age discrimination by employers.

The relationship between a child's age and MLFP indicates that when a child is younger the probability of the mother participating in the LF is low. This is in line with other similar studies (Bruce, 1978, Francesconi, 2002). The presence of a young child in a household affects LFP by reducing the time available for the caregivers to work or eliminating work (Chen et al., 2014; Dotti, Sani and Scherer, 2018). This is because, in most cases, children force their caregivers, especially their mothers, to stay at home, limiting their ability to participate in the labour market.

Racially, Coloureds are more likely to participate in LF than Africans. This means that in post-Apartheid SA, race still plays an important role in determining MLFP. This is similar to other research findings (Leibbrandt et al., 2010; Naidoo, Stanwix and Yu, 2014; Gradín, 2019). Those living in urban areas are more likely to participate in the labour market than those in rural areas. This is similar to the findings of Wittenberg, 2002; Mbatha and Roodt, 2014; and Chatterjee, Murgai and Rama, (2015)

The analyses also reveal a negative relationship between marriage and MLFP. This supports Becker's (1981) ideology regarding marriage and LFP, that single women are more likely to participate in the labour market than married women. The finding corroborates with that of Ntuli and Wittenberg (2013). It should be noted that for married women, apart from their characteristics, those of their spouses also play vital roles. As such, their LFP critically depends on the total income of the family and their bargaining strengths (Bourguignon and Chiappori, 1992; Agarwal, 1997; Gough and Killewald, 2011). In many countries, married women drop out of the LF when their husbands' income is high (Sefiddashti et al., 2016).

Having at least a matric (≥12 years of schooling) is associated with an increase in LFP. Completion of higher education is more likely to result in a higher likelihood of LFP (Borjas, 2009; Branson et al., 2012). In most instances, education is used by job seekers to signal their intrinsic productive characteristics that employers cannot observe (Kjelland, 2008). Therefore, education signals the existence of human capital, thus solving the problem of information asymmetry between employers and job seekers (Page, 2010).

The analysis also reveals that there is a negative relationship between household size and MLFP. This is consistent with Groesbeck and Israelsen (1994) findings, but contrary to that of Hafeez and Ahmad (2002). Based on the literature, the number of family members that contribute to total income as well as housework influences a mother's labour supply decisions (Sasaki, 2002; Gough and Killewald, 2011; Maurer-Fazio et al., 2011; Cools, Markussen and Strom, 2017). The negative relationship observed in this study signifies for instance that a mother in a household where more people are contributing to household income, the less likely she will do market work. Another instance of a negative relationship could occur when there is someone in the household who needs care. This will decrease MLFP.

6.6 Summary

This chapter provided statistical evidence on the state of maternal labour force participation and malnutrition and examined the relationship between maternal obesity and maternal labour force participation using the National Income Dynamic Study. Based on the analysis, the point estimates revealed that MLPR was fluctuating. The employment rate increased while the unemployment rate decreased. However, when the confidence intervals are taken into consideration it was observed that the rate of MLFP, employment and unemployment remained constant due to an overlap of the confidence intervals.

The patterns and distribution of maternal malnutrition underweight, overweight and obesity in SA were discussed using the NIDS 2008, 2012, 2014/15 and 2017. When the confidence intervals were taken into account it was observed that there was no statistically significant difference in the rate of maternal underweight and overweight in the country. Meanwhile, an increase in maternal obesity was observed. The findings also revealed that the lowest form of maternal malnutrition in the country is underweight, while obesity is the most predominant form followed by overweight.

The chapter further highlighted that maternal malnutrition is not homogenous across the different background characteristics; age, marital status, race, geographic location and age of the child being cared for. The estimates indicated that being underweight was more prevalent amongst mothers aged between 16-24 years, Coloureds, in the rural areas, single mothers and caring for a child aged between 0-23 months. Overweight was high amongst those aged between 25-34 years, Africans compared with Coloureds, in the rural areas, married and caring for a child aged between 24-59 months. For obesity, the rate was high amongst mothers; aged between 35-45 years, who are Coloureds, living in the urban areas, who are married and caring for a child aged between 24-59 months.

I used the 2017 NIDS data for the relationship between maternal obesity and MLFP. The Wald test hypothesis of exogeneity of obesity and the Durbin-Wu-Hausman test were not rejected. In addition, the F-test of joint instrumental variables also indicated that the instruments were weak. Given that the instrumental variables were weak and proven to be exogenous, the tests validated the use of the univariate and linear probability models. After controlling for maternal and children's ages, sex of the child, health and race of the mother, area of residence, marital status, whether a household member receives grants from the government, education of the mother, household size and if there is at least one employed male in the household, the results revealed that there was a positive but insignificant relationship between maternal obesity and maternal labour force participation.

For the control variables used, it was observed that the age of the mothers and the child had a quadratic effect on maternal labour force participation. Being Coloured, living in the urban area and with matric or above were linked with increased maternal labour force participation. Meanwhile, being married/cohabiting and an increase in household size was associated with a decrease in maternal labour force participation.

CHAPTER SEVEN

CHILD MALNUTRITION AND MATERNAL LABOUR MARKET PARTICIPATION IN SOUTH AFRICA: EVIDENCE FROM THE NATIONAL INCOME DYNAMICS STUDY

7.1 Introduction

This chapter aims at examining the state of child malnutrition and its association with MLFP in SA. This chapter addresses objectives four and five of the thesis: 1) examine the extent of child malnutrition, and 2) investigate the relationship between childhood stunting and MLFP. The chapter starts with a presentation of results and a discussion of the findings on child malnutrition in SA, followed by an examination of the relationship between childhood stunting and MLFP.

7.2 Child Malnutrition in South Africa[37]

This section focuses on the prevalence and trends of stunting, underweight, wasting and overweight (including obesity) amongst 0-59 months old children in SA, based on some selected background characteristics of the child: age, race, sex and location. Table 7.1 demonstrates that the average height across the periods is 88cm, the mean weight is 14.8kg, 13.7kg, 13.2% and 13.3kg respectively. Table 7.1 below provides the summary statistics on the data for all four years under review.

[37] Two papers will be developed from this section.

Table 7.1: Descriptive Statistics of children aged 0–59 months, 2008-2017

Variables	2008	2012	2014/15	2017
Height (mean in cm)	88.3	88.5	87.9	88.4
Weight (mean in kg)	14.8	13.7	13.2	13.3
HAZ (mean)	-1.1	-1.0	-1.1	-1.0
WAZ (mean)	-0.2	-0.1	-0.2	-0.1
WHZ (mean)	0.5	0.7	0.6	0.6
HAZ by:				
0-23 months (%)	30.8	24.8	31.4	29.1
24-59 months (%)	69.2	75.2	68.6	70.9
Boy (%)	51.3	51.0	49.4	49.9
Girl (%)	48.7	49.0	50.6	50.1
African (%)	87.0	87.2	85.8	87.7
Coloured (%)	7.2	7.1	7.7	8.3
Indian (%)	1.8	1.2	1.6	1.5
White (%)	3.9	4.5	4.9	2.5
Rural (%)	51.1	45.1	46.9	45.4
Urban (%)	48.9	54.9	53.1	54.6
WAZ by:				
0-23 months (%)	31.7	27.6	32.3	30.0
24-59 months (%)	68.3	72.4	67.7	70.0
Boy (%)	51.8	50.7	49.9	50.5
Girl (%)	48.2	49.3	50.1	49.6
African (%)	86.4	87.2	85.9	87.8
Coloured (%)	7.3	7.0	7.4	8.2
Indian (%)	1.8	1.2	1.8	1.5
White (%)	4.5	4.7	4.8	2.5
Rural (%)	50.7	45.2	47.1	45.5
Urban (%)	49.3	54.8	52.9	54.5
WHZ by:				
0-23 months (%)	29.8	26.1	31.7	28.6
24-59 months (%)	70.2	73.9	68.3	71.4
Boy (%)	52.0	51.1	49.5	50.3
Girl (%)	48.0	48.9	50.6	49.7
African (%)	86.9	87.1	85.8	87.8
Coloured (%)	6.9	7.0	7.6	8.3
Indian (%)	2.0	1.2	1.6	1.5
White (%)	4.2	4.6	5.0	2.4
Rural (%)	51.4	45.1	47.2	45.5
Urban (%)	48.6	54.9	52.9	54.5

Source: Own calculations using NIDS waves 1, 3, 4 and 5, and post-stratification weight

Of all the children whose HAZ was computed, Table 7.1 above reveals that the highest percentage is amongst children aged 24-59 months, African children and children living in the urban areas, except in 2008 where the proportion is highest in the rural areas. Boys have the highest rate in 2008 and 2012, while girls have the highest in 2014/15 and 2017.

In Table 7.1 above, most of the children whose WAZ was measured in 2008, 2012, 2014/15, and 2017 are between the ages of 24-59 months, African and live in the urban areas, except for 2008, where the proportion is high in rural areas. Boys have the highest percentage except in 2014/15 where the rate is slightly higher for girls.

As seen in Table 7.1, in 2008, 2012, 2014/15 and 2017 respectively, the highest percentage of children whose WHZ is known is in the age cohort 24-59 months, African, and lives in an urban area except in 2008 where the proportion is highest in the rural areas. Except in 2014/15, where the proportion of girls is slightly higher, boys have the highest percentage in the other years under investigation. The next sub-section provides estimates of stunting on some selected background characteristics of the child (age, gender, race and area of residence) together with their CIs.

7.2.1 Stunting in children aged 0 – 59 months in South Africa

Looking at the estimates in Figure 7.1 the rate of stunting is 25.7% [95% CI: 23.0-28.6] in 2008, which increases to 27.7% [95% CI: 25.1 – 30.4] in 2012, then decreased to 20.8% [95% CI: 18.9 – 22.8] in 2014/15 and remained the same in 2017 at 20.8% [95% CI: 18.7 - 23.0]. As a result of an overlap of the CIs, it therefore implies that there is no statistically significant variation in the rate of stunting between these periods. However, between 2012 and 2014/15, the rate of stunting can be said to have decreased since the CIs do not overlap. Figure 7.1 provides a summary of the data for the period under investigation, 2008-2017.

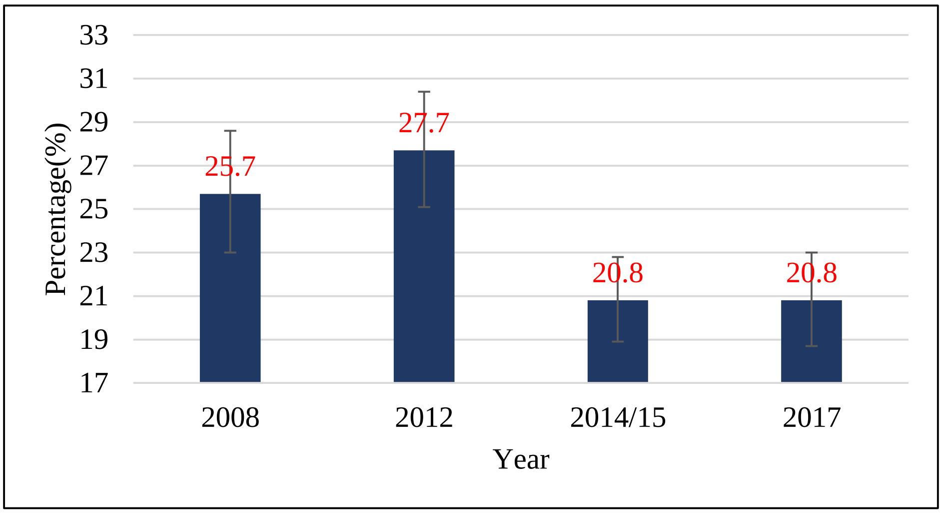

Figure 7.1: Stunting rate amongst children aged under five years, 2008-2017
Source: Own calculations using NIDS 2008, 2012, 2014/2015, and 2017, and post-stratification weight

Table 7.2 below shows that across the periods, stunting is more prevalent amongst those aged between 0-23 months when compared with those aged between 24-59 months. While the rate of stunting amongst those between the ages 24-59 months is decreasing across the years, that of those aged 0-23 months increased in 2012, then decreased in 2014/15 and later increased in 2017. The CIs reveal that there is no statistically significant difference in the rate of stunting over the years across the different age groups as a result of overlap.

Stunting across the periods as shown in Table 7.2 below is more prevalent in boys than in girls. For both boys and girls, the rate increased in 2012, which then decreased in 2014/15 and later increased in 2017. For both genders, the CIs also show that there is no statistically significant change in the rate of stunting across the periods respectively.

The estimates in Table 7.2 below also reveal that except in 2008 where the rate of stunting is more prevalent amongst Coloured than African children, it is more prevalent amongst African children in the other three periods. For African children, the rate increased in 2012, then later decreased from 2014/15 to 2017 respectively. While for Coloured children, the rate decreased from 2012 to 2014/15 respectively and later increased in 2017. Nonetheless, the CI for each race did not show statistically significant differences in the rate of stunting over the years.

The result in Table 7.2 below indicates that stunting is more prevalent in rural than urban areas. For both locations, the rate of stunting increased in 2012 and then decreased in 2014/15. While the rate in the rural areas further decreased in 2017, that of the urban areas increased instead. The CIs signify that for the rural areas, there is no statistically significant variation in the rate of stunting. But for the urban areas, there is a statistically significant decrease between 2012 and 2014/15 because the CIs do not overlap. The data on childhood stunting for all four years under review are summarised in Table 7.2.

Table 7.2: Distribution of stunting across key background characteristics, 2008-2017

Background	2008	2012	2014/15	2017
Age (in months)				
0 – 23	25.9 [21.1 – 31.2]	36.2 [31.1 – 41.5]	24.4[21.2-28.0]	26.7 [22.5 –
24 – 59	25.6 [22.5 – 29.0]	24.9 [22.1 – 27.9]	19.1[17.0-21.5]	18.3 [16.1 –
Gender				
Boys	26.3 [22.5 – 30.4]	29.9 [26.1 – 33.9]	23.2[20.3-26.3]	24.2 [21.1 –
Girls	25.0 [21.5 – 29.0]	25.4 [22.2 – 28.9]	18.5[16.1-21.1]	20.6 [15.0 –
Race				
African	26.4 [23.5 – 29.4]	29.0 [26.3 – 31.8]	22.6[20.6-24.7]	21.2 [19.0 –
Coloured	31.7 [21.0 – 44.8]	28.3 [17.1 – 41.9]	15.3[11.0-21.0]	20.6 [14.4 –
Area of Residence				
Rural Areas	28.3 [25.0-31.9]	30.8 [27.5-34.2]	25.0[22.5-27.6]	22.7 [20.1-
Urban Areas	22.9 [18.9-27.6]	25.2 [21.4-29.3]	17.1[14.5-20.2]	19.2 [16.1-
Total	25.7 [23.0 – 28.6]	27.7 [25.1 – 30.4]	20.8 [18.9 – 22.8]	20.8 [18.7 -

Source: Own calculations using NIDS 2008, 2012, 2014/2015, and 2017, and post-stratification weight

The subsequent sub-section identifies the rate of childhood underweight on some selected background characteristics of the child (age, gender, race and area of residence) together with their CIs.

7.2.2 Underweight in children aged 0 – 59 months in South Africa

The estimates in Figure 7.2 below show that the rate of underweight in 2008 is 9.1% [95% CI: 7.4 – 11.0]. In 2012, the rate slightly decreased to 9% [95% CI: 7.6 – 10.6], which then decrease in 2014/15, and in 2017, it increased to 5.7% [95% CI: 4.5 – 7.2]. Based on the CIs, there is a statistically significant change (decrease) between 2012 and 2014/15, and between 2008 and 2017 as the CIs within these periods do not overlap each other. The summary of the data for the periods under investigation is presented in Figure 7.2.

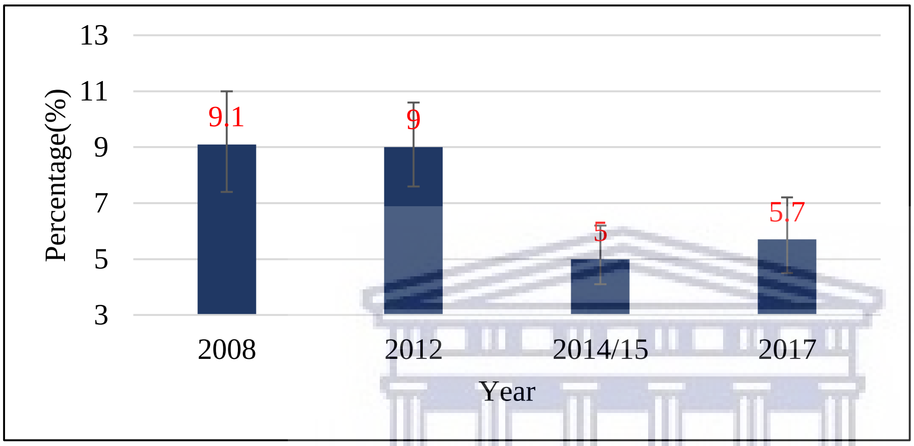

Figure 7.2: The rate of underweight amongst children aged under five years, 2008-2017
Source: Own calculations using NIDS 2008, 2012, 2014/2015, and 2017, and post-stratification weight

In Table 7.3 below, the estimates show that across the periods the rate of underweight is more prevalent amongst those aged between 24-59 months when compared with those aged between 0-23 months. While the rate of underweight amongst those between the age 0-23 months decreased across the years till 2014/15 and then remained the same in 2017 as in 2014/15, that of those aged 24-59 months increased in 2012, then decreased in 2014/15 and remained the same in 2017 as in 2014/15. Since the CIs for those in the age cohort 0-23 months do overlap, there is no statistically significant change in the rate of underweight over the years. But for those aged between 24-59 months, there is a statistically significant difference between 2012 and 2014/15.

Underweight across the years as seen in Table 7.3 below is more prevalent in boys than in girls. For boys, the rate increased in 2012, which then decreased in 2014/15 and later increased in 2017. Meanwhile, the rate decreased from 2012 right through to 2017 for girls. The CIs for boys do not overlap between 2012 and 2014/15 and for girls, between 2008 and 2017. As such, there is a statistically significant variation in the rate of underweight within these periods respectively.

The estimates in Table 7.3 below also reveal that the rate of underweight is more prevalent amongst African children than Coloured children in 2008, 2012 and 2014/15. In 2017, the rate is higher for Coloured children than for African children. For African children, the rate decreased slightly in 2012 and a further decrease is observed in 2014/15. In 2017, a slight increase is seen. For Coloured children, the rate decreased in 2012 and 2014/15 and later increased in 2017. Even so, the CIs for the respective race show that there is no statistically significant change in the rate of underweight amongst Coloured children since the CIs overlap. Meanwhile, amongst African children, there is a statistically significant difference in the rate of underweight between 2012 and 2014/15.

Table 7.3 below depicts that underweight is highly prevalent in the rural areas than urban areas from 2008 right to 2014/15. In 2017, it is more prevalent in the urban areas. In the rural areas, the rate of underweight remained constant between 2008 and 2012 and then decreased in 2014/15 and 2017 respectively. In the urban areas, the rate increased slightly in 2012, then decreased in 2014/15 and later increased in 2017. Despite that, the CIs indicate that in the rural areas, between 2012 and 2014/15, and 2008 and 2017, there is a statistically significant variation in the rate of underweight. In the urban areas, there is no statistically significant change in the rate of underweight across the periods due to an overlap of the CIs. Table 7.3 provides the summary statistics on childhood underweight for all four years under review.

Table 7.3: Distribution of underweight across key background characteristics, 2008-2017

Background Characteristics	2008 %[95% CI]	2012 %[95% CI]	2014/15 %[95% CI]	2017 %[95% CI]
Age (in months)				
0 – 23	8.8 [6.1 – 12.4]	7.9 [5.6 – 11.2]	5.2[3.6-7.3]	5.2 [3.1 – 8.7]
24 – 59	9.2 [7.3 – 11.6]	9.4 [7.7 – 11.4]	5.9[3.9-6.4]	5.9 [4.5 – 7.7]
Gender				
Boys	9.3 [7.2 – 11.9]	10.6 [8.5 – 13.2]	5.1[3.9-6.7]	7.1 [5.1 – 9.8]
Girls	8.9 [6.8 – 11.6]	7.3 [5.7 – 9.4]	5.0[3.7-6.7]	4.3 [3.1 – 5.9]
Race				
African	9.7 [7.9 – 11.8]	9.6 [8.1 – 11.5]	5.4[4.3-6.7]	5.6 [4.3 – 7.3]
Coloured	8.3 [4.0 – 16.3]	7.3 [4.5 – 11.8]	5.0[2.9-8.4]	7.5 [4.3 – 12.6]
Area of Residence				
Rural Areas	10.8 [8.7 – 13.3]	10.8 [8.9 – 13.0]	5.7[4.4-7.3]	4.9 [3.7 – 6.4]
Urban Areas	7.3 [5.2 – 10.5]	7.5 [5.6 – 10.0]	4.5[3.2-6.2]	6.4 [4.5 – 9.0]
Total	9.1 [7.4 – 11.0]	9 [7.6 – 10.6]	5.0 [4.1-6.2]	5.7 [4.5 – 7.2]

Source: Own calculations using NIDS 2008, 2012, 2014/2015, and 2017, and post-stratification weight

The following sub-section provides the extent of wasting on some selected background characteristics of the child (age, gender, race and area of residence) together with their CIs.

7.2.3 Wasting in children aged 0 – 59 months in South Africa

As shown in Figure 7.3, the results reveal that the rate of wasting in the country is 4.8% [95% CI: 3.6 – 6.4] in 2008, which increased to 5.5% [95% CI: 4.3 – 7.0] in 2012, then decreased to 3.4% [95% CI: 2.5-4.6] and remained constant at 3.4% [95% CI: 2.3 – 4.9] in 2017. Due to an overlap of the CIs over the years, there is no statistically significant change in the prevalence of wasting over the years. Figure 7.3 provides a summary of the data for the periods under investigation, 2008-2017.

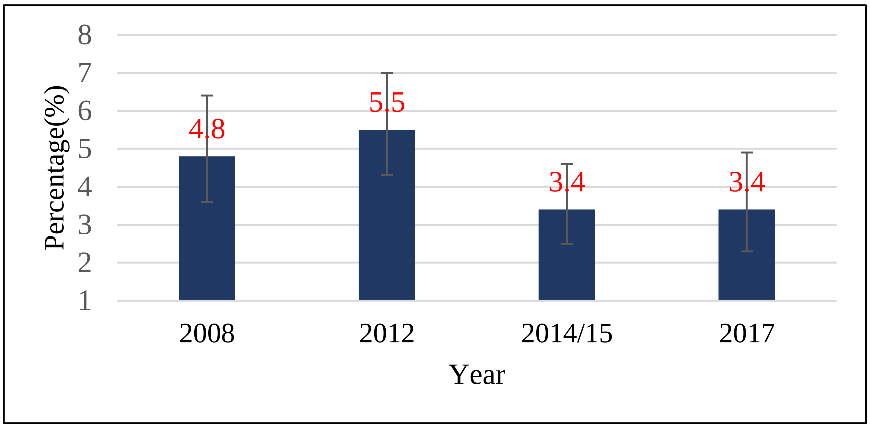

Figure 7.3: The rate of wasting amongst children aged under five years, 2008-2017
Source: Own calculations using NIDS 2008, 2012, 2014/2015, and 2017, and post-stratification weight

The statistics in Table 7.4 portrays that the rate of wasting is more prevalent amongst children aged between 0-23 months when compared with those aged between 24-59 months. The rate of wasting in both age groups increased in 2012 and later decreased in 2014/15. But in 2017, while the rate increased in the age group 0-23 months, amongst those aged 24-59 months, the rate is the same as in 2014/15. For both age cohorts, taking into account the CIs, there is no statistically significant difference in the rate of wasting across the years respectively.

The rate of wasting amongst boys and girls as presented in Table 7.4 the rate is slightly higher for girls than boys in 2008 and 2012. For both genders, the rate increased in 2012 and later decreased in 2014/15. While the rate amongst boys further decreased in 2017, that of girls increased instead. Also, for both gender, there is no statistically significant difference in the rate of wasting across the years respectively, because of an overlap of the CIs.

In Table 7.4, the findings reveal that the rate of wasting is more prevalent amongst African children than Coloured children except in 2017, where the rate is more prevalent in African children than Coloured children. For African children, the rate increased in 2012, then later decreased from 2014/15 to 2017 respectively. While amongst Coloured children, the rate decreased from 2012 to 2014/15 respectively and then increased in 2017. Nonetheless, the CIs for the respective race indicate that there is no statistically significant variation in the rate of wasting over the years due to an overlap of the CIs.

The result as shown in Table 7.4 indicates that wasting is more prevalent in the urban areas than in rural areas except in (2012). The rate of wasting increased in 2012, then decreased in 2014/15 and increased again in 2017 in the rural areas. In the urban areas, the rate remained the same as in 2008, then decreases in 2014/15 and a slight decrease is observed in 2017. There is an overlap of the CIs in both areas respectively. As such, there is no statistically significant change in the rate of wasting across the periods. The summary of these data on childhood wasting for all four years under review is presented in Table 7.4.

Table 7.4: Distribution of wasting across key background characteristics, 2008-2017

Background Characteristics	2008 %[95% CI]	2012 %[95% CI]	2014/15 %[95% CI]	2017 %[95% CI]
Age (in months)				
0 – 23	7.8 [5.1 – 11.8]	10.6 [7.2 – 15.4]	5.9[3.9-8.8]	6.2 [4.0 – 9.4]
24 – 59	3.5 [2.4 – 5.2]	3.7 [2.7 – 5.0]	2.3[1.5-3.4]	2.3 [1.4 – 3.6]
Gender				
Boys	4.6 [3.0 – 7.1]	5.2 [3.7 – 7.3]	3.9[2.6-5.9]	3.6 [2.3 - 5.5]
Girls	5.0 [3.4 – 7.2]	5.8 [4.1 – 8.2]	2.9[1.9-4.3]	3.2 [2.0 – 5.1]
Race				
African	4.9 [3.5 – 6.6]	5.8 [4.5 – 7.5]	3.6[2.6-4.9]	3.3 [2.2 – 4.9]
Coloured	3.9 [1.4 – 10.8]	3.0 [1.6 – 5.7]	2.2[1.0-5.1]	5.8 [2.7 – 12.3]
Area of Residence				
Rural Areas	4.3 [3.0 – 6.1]	5.6 [4.1 – 7.6]	2.9[1.8-4.4]	3.0 [2.1 – 4.2]
Urban Areas	5.4 [3.4 – 8.3]	5.4 [3.7 – 7.9]	3.9[2.6-5.8]	3.8 [2.2 – 6.5]
Total	4.8 [3.6 – 6.4]	5.5 [4.3 – 7.0]	3.4[2.5-4.6]	3.4 [2.3 – 4.9]

Source: Own calculations using NIDS 2008, 2012, 2014/2015, and 2017, and post stratification weight

The next sub-section focus on estimates of childhood overweight (including obesity) on some selected background characteristics of the child (age, gender, race and area of residence) together with the CIs.

7.2.4 Overweight amongst children aged 0 – 59 months in South Africa

Childhood overweight/obesity (as in adults) is difficult to reverse. It is therefore, essential to monitor the prevalence and trend of overweight/obesity using the essential statistical tools in order to evaluate the impact of policy initiatives and to plan facilities for the provision of care.

It is also important to monitor this trend if the global nutrition target for 2030 that is no increase in childhood overweight needs to be achieved.

Figure 7.4 shows that across the periods the rate of overweight is 13.2% [95% CI: 11.1-15.7] in (2008). This rate then increased to 17.1% [95% CI: 15.1 – 19.4] in 2012, which then decreased to 13.0% [95% CI: 11.2-15.1] in 2014/15 and further decreased to 11.7% [95% CI: 10.2 – 13.4] in 2017. Notwithstanding, the CIs reveal that there is no statistically significant change in the rate of overweight over the years, as a result of an overlap of the CIs. The summary of the data for the periods under investigation is presented in Figure 7.4.

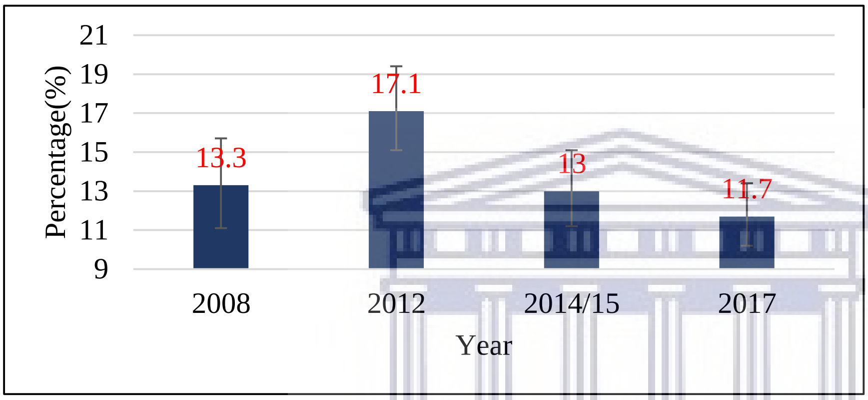

Figure 7.4: The rate of overweight amongst children aged under five years, 2008-2017
Source: Own calculations using NIDS 2008, 2012, 2014/2015, and 2017, and post-stratification weight

The estimates in Table 7.5 reveal that the rate of overweight is more prevalent amongst those aged between 0-23 months when compared with those aged between 24-59 months over the periods. For both age groups, the rate of overweight increased in 2012 and then decreased in 2014/15. For those aged 0-23 months, the rate slightly increased in 2017, while a decrease is noticed amongst those 24-59 months. For the age cohort 0-23 months, the CIs overlap, indicating that there is no statistically significant difference in the proportion of overweight over the years. For those between 24-59 months, there is a statistically significant change in the rate of overweight between 2012 and 2014/15 because the CIs do not overlap.

Overweight across the periods as seen in Table 7.5 is more prevalent in boys than in girls except in 2017 where the rate is higher for girls than boys. For both genders, the rate increased in 2012 and then decreased in 2014/15. While the rate amongst boys decreased in 2017, that of girls increased. For both gender, the CIs reveal that there is no statistically significant change in the prevalence of overweight across the years due to overlap.

Table 7.5 also reveals that compared with Coloured children, the rate of overweight is more prevalent amongst African children over the years. For both races, the rate increased in 2012 and then a decrease is observed in 2014/15. Though amongst African children the rate decreased in 2017, that of Coloured children increased instead. Nevertheless, the CIs for the respective race indicate that there is no statistically significant change in the proportion of children that are overweight over the periods because of overlap.

The findings presented in Table 7.5 indicate that overweight is more prevalent in the rural areas than urban areas in 2012 and 2017. In 2008 and 2014/15, the rate is seen to be more prevalent in the urban areas than rural areas. The rate of overweight in both areas increased in 2012, which then decreased in 2014/15 and 2017 respectively. The CIs show that for both areas, there is no statistically significant variation in the rate of overweight across the periods due to overlap, except in the rural areas where between 2012 and 2014/15 there is no overlap. These data on childhood overweight for all four years under review are summarised in Table 7.5.

Table 7.5: Distribution of childhood overweight (includes obesity) across key background characteristics, 2008-2017

Background Characteristics	2008 %[95% CI]	2012 %[95% CI]	2014/15 %[95% CI]	2017 %[95% CI]
Age (in months)				
0 – 23	18.8[14.4 – 24.1]	21.7[17.8 – 26.2]	20.6[17.2-24.6]	20.9[17.1 -25.2]
24 – 59	10.9[8.7 – 13.5]	15.5[13.2 – 18.1]	9.5[7.6-11.8]	8.7[6.7 – 9.8]
Gender				
Boys	14.5[11.5 – 18.2]	18.3[15.4 – 21.7]	14.8[11.9-18.3]	11.4[9.3 – 14.0]
Girls	11.8[9.2 – 15.1]	15.9[13.3 – 18.9]	11.3[9.4-13.5]	12.0[10.0 – 14.4]
Race				
African	13.2[11.0 – 15.8]	17.9[15.8 – 20.4]	14.1[12.2-16.3]	12.1[10.4 – 14.0]
Coloured	11.9[6.9 – 19.7]	15.1[8.6 – 25.1]	5.7[3.2-9.7]	6.7[3.2 – 13.8]
Area of Residence				
Rural Areas	11.6[9.4 – 14.2]	19.5[16.9 – 22.5]	12.6[10.6-14.9]	12.2[10.1 – 14.7]
Urban Areas	15.0[11.5 – 19.3]	15.2[12.3 – 18.5]	13.4[10.5-17.0]	11.3[9.2 – 13.8]
Total	13.2 [11.1 – 15.7]	17.1 [15.1 – 19.4]	13.0[11.2-15.1]	11.7 [10.2 – 13.4]

Source: Own calculations using NIDS 2008, 2012, 2014/2015, and 2017, and post-stratification weight

The next section deals with the discussion of the findings presented above.

7.2.5 Discussion of results on child malnutrition

SA is faced with the double burden of child malnutrition in which there is the co-existence of undernutrition (particularly stunting) and overnutrition. Stunting, as the statistics above reveal, remains the predominant form of malnutrition amongst children under 5 years of age over the years. This is similar to what was observed globally (De Onis and Branca, 2016) and within SA (Labadarios et al., 2008), in Africa and Southern Africa region (UNICEF, WHO and WB, 2020) respectively. The trend of stunting is similar to the decreasing trend observed globally (De Onis, Blössner and Borghi, 2011; UNICEF, WHO and WB, 2018); in developing countries (De Onis, Blössner and Borghi, 2011; Stevens et al., 2012; Oruamabo, 2015); in Africa (UNICEF, WHO and WB, 2018) and SA (Shisana et al., 2013; Sartorius et al., 2020) when the estimates are interpreted. When the CIs are taken into consideration there is no statistically significant difference in the rate of stunting over the years under investigation. This corroborates with the findings of Devereux, Jonah and May (2019) even after using the most recent NIDS data in this study. In addition, the rate of stunting in SA has been very high since (2008). Based on the prevalence cut-off values for public health, it is a serious situation that requires special attention. The findings also indicate that progress has not been made in the reduction of stunting in the country.

Concerning wasting, interpreting the estimates reveal a decreasing trend similar to the global trend (UNICEF, WHO and WB, 2020), Africa and Southern Africa findings (UNICEF, WHO and WB, 2020) as well as other findings on SA (Shinana et al., 2013). However, when CIs are taken into account there is no statistically significant difference in the rate of wasting over the years under investigation. For underweight, the trend is in line with global findings (UNICEF, WHO and WB, 2015) as well as findings in Africa and Southern Africa (UNICEF, WHO and WB, 2012; WHO, 2020). The estimates of underweight and wasting indicate that per the prevalence cut-off values for public health, SA has a low and acceptable rate, but requires monitoring. In addition, progress has been made in keeping the rate of wasting below 5%.

The result above also reveals that overweight is the second-highest form of malnutrition affecting children below the age of 5 years. Based on the estimates, the observed trend is contrary to what was observed in the global context (Black et al., 2013; UNICEF, WHO and WB, 2018) and within Africa and Southern Africa (UNICEF, WHO and WB, 2020). However, the recent estimate reveals that the rate of overweight is much higher than the rate observed globally and in Africa. The prevalence of overweight in children under 5 cut-off values for public health show that the rate of overweight is a serious situation. This indicates that though progress has been made in keeping the rate of overweight stable, the rate is still high.

Shisana et al. (2013) using the 2012 South African National Health and Nutrition Examination Survey (SANHANES-1) note that only 7% of children aged ≤ 6 months were exclusively breastfed. Early introduction of supplementary and mixed feeding is a common infant feeding practice in SA. Shisana et al. (2013) also pointed out that the average age of introduction of solid foods in the country in 2012 was 4.5 months. More than two-thirds (64%) of children consumed solid or semi-solid foods before the age of six months. In addition to reducing the amount of breast milk consumed by infants (Mamabolo et al., 2014), both feeding methods have high risks of infection, diarrhoea, and malnutrition (Mushaphi et al., 2008; Ijumba et al., 2014). These can explain the double burden of child malnutrition facing the country. Another important aspect observed in childhood malnutrition is the variation across the different background characteristics.

In terms of age, the findings indicate that children aged 0-23 months are more stunted than children 24-59 months. This was contrary to other studies (Glover-Amengor et al., 2016; Adhikari et al., 2019; Nshimyiryo et al., 2019), but consistent with these studies (Habimana and Biracyaza, 2019; Hall et al., 2020). However, children age 24-59 months were highly underweight than those 0-23 months old. This corroborates with other studies (Glover-Amengor et al., 2016; Adhikari et al., 2017; Kang and Kim, 2019) but contrary to Shisana et al. (2013) and Hall et al. (2020) findings. Wasting was seen to be higher amongst children aged 0-23 months than those 24-59 months old. This finding concurs with the studies of Glover-Amengor et al. (2016); and Kang and Kim (2019). Overweight amongst children age 0-23 months is observed to be higher than those 24-59 months old.

Based on gender, boys were more stunted than girls, which is consistent with other similar studies (Hien and Kam, 2008; Bukusuba, Kaaya and Atukwase, 2017; Cruz et al., 2017; Manggala et al., 2018; Habimana and Biracyaza, 2019; Nshimyiryo et al., 2019; Sartorius et al., 2020). This may be due to child feeding practices or other types of exposures (Wamani et al., 2007). The nutritional status can be explained by "biological fragility" because boys are expected to grow slightly faster than girls, and their growth may be more susceptible to nutritional deficiencies or other diseases or exposures (Condo et al., 2015). Also, boys were more underweight than girls, which is consistent with other similar studies (Hien and Kam, 2008; Glover-Amengor et al., 2016; Adhikari et al., 2017). The study also revealed that boys suffer from wasting than girls, which is in line with other studies (Hien and Kam, 2008). The high prevalence rate of overweight in boys than girls concurs with other studies (Gebremedhin, 2015).

The high rate of stunting, wasting and underweight amongst African children than Coloured in most of the years is inconsistent with the study of Shisana et al. (2013) on children age 0-14 years. African children were more overweight than Coloured and this is consistent with the findings of Shisana et al. (2013) on females aged 2-14 years.

The high rate of stunting observed in the rural areas than in the urban areas, corroborates with other similar studies (Hien and Kam, 2008; Cruz et al., 2017; Kang and Kim, 2019; Habimana and Biracyaza, 2019; Nshimyiryo et al., 2019). The findings also indicate that in the rural areas underweight is more prevalent than in the urban areas, which corroborates with other studies (Saeidlou, Babaei and Ayremlou, 2014). The high rate of wasting in the urban areas by comparison with rural areas concurs with research done by Saeidlou, Babaei and Ayremlou (2014). In addition, there were fluctuations in the rate of overweight between these areas.

Chapter four revealed that child poor health appears to be one of the impairments of MLFP. Therefore, it is important to investigate the potential role of childhood malnutrition in determining MLFP. Since childhood stunting is the main form of malnutrition that affects children, the next section will examine the relationship between stunted children in the family and MLFP.

7.3 The association of childhood malnutrition and maternal labour force participation

Table 7.6 below presents the descriptive statistics of the variables used in the childhood stunting-MLFP analysis. It can be seen that 57.4% of the mothers participated in LF and 21.1% of the children are stunted. The average age of the mother and child is 29 years and 26 months, respectively. Half of the children are boys, and less than half of the mothers are; Coloured, married, have matric and above, living in a household with at least an employed male and short. While more than half of the mothers live in urban areas, in a household in which a member receives government grant, have improved water, and are healthy. Table 7.6 shows the statistical summary of the variables used in the regression.

Table 7.6: Descriptive statistics of Table

Variables	N	Value
Mother's Age (years- mean)	2439	29.0
Labour force participation (%)	2435	57.4
Stunted child (%)	1880	21.1
Child's Age (months – mean)	2439	26.0
Boy Child (%)	2438	50.6
Healthy (%)	2437	94.9
Coloured (%)	2437	10.2
Urban (%)	2439	58.0
Married (%)	2436	37.8
Grant (%)	2437	75.6
Matric+ (%)	2426	47.9
At least one Employed Male in the Household (%)	2439	0.3
Number of adult females (mean)	2439	0.7
Mother short stature (%)	2428	6.1
Improved water source (%)	2438	72.9

Source: Own calculations using NIDS 2017 and post-stratification weight

The results in Table 7.7 show that for the narrow and broad definitions of LFP, the difference between mothers of stunted children who did not participate in the labour market and those who did is 1.0% and 0.5%, respectively. The purpose of this analysis is to perform a pre-regression diagnosis. The results indicate that there is a positive correlation between the better nutritional status of children and MLFP. The pre-regression statistics are provided in Table 7.7.

Table 7.7: Childhood stunting-MLFP status in 2017 (row percentages sum to 100)

LFP status	Child Stunted %[95% CI]	Child Not Stunted %[95% CI]	Row Total (N)
Strict LFP	20.7[17.0-24.9]	79.3[75.1-83.0]	1032
Strict Non-LFP	21.7[18.0-26.0]	78.2[74.1-82.0]	845
Broad LFP	20.9[17.3-25.0]	79.1[75.0-82.7]	1084
Broad Non-LFP	21.4[17.6-25.8]	78.6[74.2-82.4]	793

Source: Own calculations using NIDS 2017 and post-stratification weight

Table 7.8 provides preliminary evidence for the non-trivial correlation between stunting and the IVs. For example, amongst children whose mothers have normal stature only 19.5% [95% CI: 16.7-22.5] reported being stunted, while 48.0% [95% CI: 35.6-60.6] have short mothers. A similar finding was obtained for an improved water source. The summary statistics of the distribution of the instruments across the child's stunting status are presented in Table 7.8.

Table 7.8: Distribution of instruments across stunted children categories

Instruments	Has condition?	Stunted %[95% CI]	Not stunted %[95% CI]	Row Total (N)
Mother short stature				
	Yes	48.0[35.6-60.6]	52.0[39.4-64.4]	146
	No	19.5[16.7-22.5]	80.6[77.5-83.3]	1729
Improved water source				
	Yes	19.3[16.1-23.0]	80.7[77.0-83.9]	1195
	No	25.6[21.1-30.6]	74.4[69.4-78.9]	684

Source: Own calculations using NIDS 2017 and post-stratification weight

The descriptive analysis described above shows substantial evidence for including maternal short stature and improved water source in the MLFP determination. It has been shown that (in Table 7.7) non-labour force participants when compared with participants, are 1% likely to report the presence of a stunted child. Determining the childhood stunting-MLFP relationship is the focus of the subsequent analysis.

7.3.1 Result for the association between child stunting and MLFP

As seen in Chapter Four, it is expected that CS is an endogenous determinant of MLFP. Hence, the need for IV techniques. If CS is truly exogenous, then the use of IV methods as with the case of maternal obesity will be redundant. Given the relative inefficiency of IV estimation compared with OLS, this increases the likelihood of not rejecting the null hypothesis that stunting has no significant effect although it does (Murray, 2006; Cameron and Trivedi, 2010). Based on the assumption that CS is endogenous, it is expected that the Wald and Durbin-Wu-Hausman tests reject the hypothesis of the exogeneity of CS.

The results of the first stage of the bivariate probit model and LPM are shown in Table A7.1 of the Appendix. As shown in Table 7.9, the Wald test of ρ=0 is 0.39, and it is statistically significant at the 5% level of significance Chi^2 (1) = 4.25, prob> Chi^2 = 0.05. Therefore, the null hypothesis can be rejected and ρ is significantly different from 0. Also, the Durbin-Wu-Hausman tests rejected the null hypothesis of the exogeneity of CS given a p-value of 0.05. This is an indication that CS is endogenous in this context. Hence, the univariate and OLS

(LPM) models presented in Table A7.2 in the appendix are invalid. As such, the bivariate probit model and IV-LPM model are valid and the outputs are presented in Table 7.9.

The results in Table 7.9 show that the coefficient of CS range from -0.20 to -0.30 respectively, and is statistically significant at one of the conventional levels of significance. The outcome in table 7.9 (1) and (2) implies that a 1% increase in the rate of stunting while holding other factors fixed at their sample means, will decrease the probability of MLFP by 20% and 30% point respectively. However, the other control variables have the same outcome as that of Table 6.13 in Chapter Six, section 6.4.1. The variables for child's age square and being married turned out to be insignificant. The presence of an adult female in the household is seen to be positively associated with MLFP. This indicates that a 1% increase in the number of adult females in the household, increases the probability of MLFP by 2% as seen in Table 7.9 (1). Table 7.9 shows the regression result of the bivariate probit model and the IV-LPM of stunting and covariates on strict MLFP.

Table 7.9: Stunting and controls on strict MLFP probability (bivariate probit and IV-LPM)

Variables	(1) Bivariate probit	(2) IV-LPM
Stunted Child	-0.20*** (0.06)	-0.30** (0.15)
Mother's Age	0.06*** (0.01)	0.06*** (0.01)
Mother's Age Square	-0.00*** (0.00)	-0.00*** (0.00)
Child's Age	0.00* (0.00)	0.01*** (0.00)
Child's Age Square	-0.00 (0.00)	-0.00*** (0.00)
Male	-0.01 (0.02)	0.02 (0.02)
Healthy	0.00 (0.04)	-0.06 (0.06)
Coloured	0.12*** (0.03)	0.16*** (0.03)
Urban	0.08*** (0.02)	0.10*** (0.02)
Married	-0.02 (0.02)	-0.03 (0.03)
Grant	-0.00 (0.02)	0.02 (0.03)
Matric	0.16*** (0.03)	0.17*** (0.03)
Number of adult females	0.02* (0.01)	0.02 (0.01)
Employed Males	-0.00 (0.02)	-0.01 (0.02)
Rho	0.39** (0.17)	
Constant		0.80*** (0.22)
R^2		0.07
DWH Chi^2 (1)		4.28
DWH Chi^2 p-value		0.04
N	1858	1858

Source: Own calculations using NIDS 2017, robust standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1

7.3.2 Robustness check

For robustness of the analysis, the broad LFP was used and the results are presented in Table 7.10. It is also seen that there is a negative relationship between caring for a stunted child and MLFP. For the other control variables, a similar outcome is observed as in Table 7.9 except for being married that turned out to be significant to the IV-LPM model and the presence of an adult female in the house that is insignificant to the bivariate probit model.

Table 7.10: Stunting and controls on broad MLFP probability (bivariate probit and IV-LPM)

Variables	(1) Bivariate probit	(2) IV-LPM
Stunted Child	-0.18**	-0.24*
	(0.07)	(0.15)
Mother's Age	0.05***	0.06***
	(0.01)	(0.01)
Mother's Age Square	-0.00***	-0.00***
	(0.00)	(0.00)
Child's Age	0.01*	0.01***
	(0.00)	(0.00)
Child's Age Square	-0.00	-0.00***
	(0.00)	(0.00)
Male	-0.01	0.01
	(0.02)	(0.02)
Healthy	0.00	-0.05
	(0.04)	(0.06)
Coloured	0.12***	0.16***
	(0.03)	(0.03)
Urban	0.06***	0.06***
	(0.02)	(0.02)
Married	-0.04	-0.07*
	(0.02)	(0.03)
Grant	-0.00	0.03
	(0.02)	(0.03)
Matric	0.15***	0.16***
	(0.03)	(0.03)
Number of adult females	0.02	0.02
	(0.01)	(0.01)
Employed Males	0.01	0.01
	(0.02)	(0.03)
Rho	0.36*	
	(0.18)	
Constant		-0.72***
		(0.22)
R^2		0.07
DWH Chi^2 (1)		2.9
DWH Chi^2 p-value		0.09
F (for joint IVs)		24.6
Hansen J test (p-value)		0.71
N	1858	1858

Source: Own calculations using NIDS 2017, robust standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1

Other statistical analyses to test the robustness of the analyses are discussed in the next section, which involves the strength and validity of the selected instruments.

7.3.3 Instrument relevance and validity

The results in Table A7.1(1) in the appendix indicate that the index coefficients of all the instruments have a significant explanatory effect on stunting in children. The Wald test indicates that stunting is endogenous. The findings in Table A7.1(2) in the appendix for the

IV-LPM also show that the IVs are consistent with theoretical expectations and are at least statistically significant at the 10% significance level. To keep the discussion focused, only the coefficients of the instruments (outcome of the IV-LPM) in Table A7.1 (2) in the appendix are presented in table 7.11.

The positive association between maternal height and childhood stunting implies that children born of short mothers have a 29% chance of being stunted. On the other hand, the relationship between improved water source in the household and childhood stunting indicates that for children living in a household with an improved water source, the probability of being stunted decreases by 4%. The F statistic in the joint test of the instruments in all specifications is 24.6 and is greater than the Staiger and Stock (1997) critical F statistic of 10. This implies that the instruments are not weak. Table 7.11 presents the post estimation statistics after a 2SLS regression.

Table 7.11: First stage LPM estimates

Variables	Dependent variable: $\Pr$ (stunted child = $1 \mid X$)
Mother short stature	0.29***
Improved water source	-0.04*
N	1861
F (for joint IVs)	24.6
Hansen J test (p-value)	0.30

Source: Own calculations using NIDS 2017, robust standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1

The identification assumption was assessed using the Hansen J over-identification test statistic for the 2SLS model as shown in Table 7.11. Based on the validity of the instruments the p-value of the Hansen J test of over-identifying restrictions Chi^2 (1) estimate is 0.30, meaning we cannot reject the null hypothesis that the IVs used are valid even at a 10% level of significance. As such, the IVs are uncorrelated with the error term and are correctly excluded from the estimated model. For the broad MLFP, the outcomes are similar and are presented in Table A7.1(2) in the appendix. Given that some of the significant explanatory variables (age, race, area of residence and education) have been discussed in Chapter Five, the next section focuses on those (presence of a stunted child and an adult female in the household) that were not addressed in the chapter.

7.3.4 Discussion: association between child stunting and MLFP

The negative effect of caring for a stunted child on MLFP supports the hypothesis that caring for a stunted child decreases MLFP. Given that childhood stunting is an indicator of poor child health, this finding is consistent with those of Corman, Noonan and Reichman (2005); Frijters et al. (2009); Tambi and Nkwelle (2013); and Tambi (2017) who observed a negative relationship between child health and MLFP. Conversely, Zimmer (2007) observed no significant effect of child health on MLFP. Childhood stunting may negatively affect a mother's LFP because children who are sick require more attention. This may force their mothers to reduce their time at work or exit the labour market completely to care for them. These mothers are more likely to engage in activities that are more time-intensive than goods-intensive especially if within the family they are the secondary earners (Kleven, Kreiner and Saez, 2009). Based on the family setting in SA, fathers of most children are absent which puts pressure on their mothers. Hence, mothers caring for a stunted child may have high reservation wages compared with those who are not due to increase child's health costs. This too may negatively affect their decision to participate in the labour market.

The findings also reveal that the presence of another adult female aged 18-85 years in the household who is not sick, gives room for mothers to take advantage of the labour market. This is similar to the findings of Tambi (2017) who observed a positive relationship between the presence of a female sibling in the household and maternal labour supply. There is no doubt that this might be the case because a family with three generations or an adult female, the old parents or female might take care of children, whose mother would then be free from childcare. Thus, decreasing the woman's value of non-market time, leading to an increase in labour supply (Posadas and Vidal-Fernández, 2013; Compton and Pollak, 2014; Shen, Yan and Zeng, 2016; Garcia-Moran and Kuehn, 2017).

7.4 Summary

This chapter examined the extent of childhood malnutrition and the effect of childhood stunting on maternal labour force participation. Based on the findings, it was observed that SA is faced with a double burden of child malnutrition, which is characterised by the coexistence of undernutrition (particularly stunting) and overnutrition.

Child malnutrition was seen to be heterogeneous across the different selected background characteristics; the age of the child, race, geographic location and child's gender. It was observed that the rate of stunting was high amongst children aged between 0-23 months, boys, African and in the rural areas. Underweight was more prevalent amongst children aged between 24-59 months, boys, African and in the rural areas. Wasting was high amongst children aged between 0-23 months, boys, African and in the urban areas. The rate of overweight was seen to be more prevalent amongst children aged between 0-23 months, boys, African, while there were fluctuations between the rural and urban areas respectively. Based on public health significance the rate of childhood stunting and overweight are high and of public health concern.

For the presence of a stunted child regression analysis, given the assumption that childhood stunting is endogeneous, the instrumental variables used (mother's short stature and improved water source) passed both the first and second test of instrument validity. The Wald and DWH tests hypotheses of exogeneity of stunting were rejected, and the bivariate probit model and the IV-LPM were considered the valid models. The results showed that mothers of stunted children are less likely to participate in the labour force. For the covariates that were controlled for in the analysis, it was observed that the age of the mother and child had a non-linear effect on MLFP. In addition, there was a positive relationship between being Coloured, living in the urban areas, the presence of another female aged 18-85 years and having a matric+ with MLFP.

CHAPTER EIGHT

CONCLUSION AND RECOMMENDATIONS

8.1 Introduction

This thesis examined the trends in malnutrition and its association with maternal labour force participation in SA. Specific issues investigated were the prevalence and trend of maternal and child malnutrition as well as maternal labour force participation, employment and unemployment rates over four data periods. The association between maternal obesity and childhood stunting, and maternal labour force participation was investigated using various econometric methods. This chapter presents a summary of the thesis and its conclusions. The thesis is summarised with recommendations for policymakers and future research presented, outlining the contribution of the research to the body of knowledge and the limitations of the study.

8.2 Summary of the study

This study consists of eight chapters, which are summarised in this section.

8.2.1 Introduction to the study (Chapter One)

The first chapter introduced the research. It provided the background of the study, research problems, gaps in the literature and research objectives and questions. In addition, it provided a summary of the research methods as well as the research structure. The chapter revealed amongst others, that one way of increasing maternal labour force participation is by improving maternal and child nutrition. The next chapter reviewed the literature on female labour force participation.

8.2.2 Labour supply decisions (Chapter Two)

The chapter explored the state of female labour force participation around the world and some economic theories on labour supply. It was evident that globally and in Africa, women compared with men participate less in the labour market. Based on the different labour supply theories, an individual's labour supply decision is dependent on time, which is a scarce resource. The neoclassical theory of labour supply treats a household as a single and unproductive unit. In this case, time was used for either paid work or leisure. However, Becker's theory on the allocation of time extended the work-leisure framework by treating a household as comprising of other members and a productive unit with time used for market and non-market work. The unitary model assumes the household acts collectively. Concerning the sexual division of labour, in a patriarchal society, women tend to bear the responsibility of household production, whereas the sexual division of development follows a feminisation u-shape.

The collective theory identified that individuals come to an agreement based on their threat point and that members within a household can either enter a cooperative or non-cooperative agreement. In a nutshell, these theories showed that apart from individual characteristics, household characteristics are important aspects in determining maternal labour supply. The selected theories identified to be applicable in this thesis were the unitary and collective approaches. It was quite clear that female labour force participation is very complex and theoretically, there are many contradicting factors concurrently at play. One possible factor that can affect a mother's decision to work or not is her or her child's nutrition status. The next chapter focuses on the concept of malnutrition.

8.2.3 General information on malnutrition (Chapter Three)

The chapter examined the different forms of malnutrition which are divided into two broad categories: undernutrition and overnutrition. Concerning undernutrition, the focus was on stunting, wasting, and underweight amongst women and children, while for overnutrition both overweight and obesity amongst women and children were reviewed. It was seen that globally, in Africa and Southern Africa, the major form of malnutrition affecting children under the age of five is stunting followed by overweight and obesity. For women, the dominant form of malnutrition is overweight and obesity. Nonetheless, based on the estimated value the rate of undernutrition is declining while overnutrition is on the rise. The causes of malnutrition as seen in the literature are multidimensional and interrelated, and fall within three main levels; the basic, underlying and immediate levels. It was apparent from the review that malnutrition has devastating consequences on an individual's health, and physical and mental development, and its effect will be largely felt in the labour market. The next chapter examines the relationship of malnutrition with labour supply.

8.2.4 Nutrition and labour market success (Chapter Four)

The chapter focused on the theoretical and empirical literature on the link between malnutrition and labour supply. Both the nutrition wage hypothesis and human capital theories suggested that malnutrition constrains an individual's labour force participation. In addition, caring for a child with poor health also affects the caregiver's labour supply decision. This chapter further revealed that there is reverse causality between malnutrition and labour supply which must be controlled for in a malnutrition-labour force model by use of instrumental variables. Studies that have investigated the link between obesity and child health on an individual or caregiver's labour supply had contradictory results. Some studies found that being obese had a negative and significant relationship with labour supply, while others found no significant association. The literature on maternal care of children with poor health arrived at a similar conclusion regarding their labour supply. Overall, most of the results showed that obesity or poor child health had ramifications on the labour supply.

8.2.5 Research methodology (Chapter Five)

The chapter discussed the methods and data used in achieving the empirical results of the thesis. It also provided a brief background of the socio-economic status of SA. This thesis applied a quantitative cross-sectional research method due to the objectives of the research. The publicly available NIDS data of 2008, 2012, 2014/15 and 2017 was used to estimate the extent and trend of maternal labour supply, and maternal and child malnutrition in SA. For the association between maternal obesity and childhood stunting, and maternal labour force participation, the 2017 dataset was used. The anthropometric method used to assess the prevalence and trend of malnutrition was explained. To investigate the relationship between maternal obesity and childhood stunting, and maternal labour force participation, the current work adopted the labour supply framework from Sprague (1994).

Given the assumption of endogeneity of obesity and stunting, and the binary nature of both the dependent (strict maternal labour force participation) and main explanatory variables (obese and stunted), the expected model of choice was the bivariate probit model on the basis that the instruments pass the two tests of instrument validity. Since the linear probability model provides a more formal test of instrument validity and relevance, it was used together with the probit models applied in the thesis. However, the decision to use either a two-stage least squared method or a normal linear probability model was also dependent on the validity of the instrumental variables used.

For the maternal obesity regression, the instrumental variables used were physical activity, smoking and if the mother was previously diagnosed with any obesity-related disease. The other individual and household characteristics that were deemed important to be included in the regression were: mother and child's age, gender of the child, area of residence, marital status, grants, employed male in the household, household size, and mother's education, self-assessed health and race. For the child regression model, maternal height and improved water source were used as instruments and the other covariates are similar to those in the maternal regression, except for the household size variable that was replaced with the presence of an adult female in the household. For the robustness check, sensitivity tests were carried out together with the use of the broad maternal labour force participation.

8.2.6 Maternal malnutrition and maternal labour market participation in South Africa: evidence from the National Income Dynamics Study (Chapter Six)

The chapter provided statistical evidence on the state of maternal labour force participation and malnutrition and examined the relationship between maternal obesity and maternal labour force participation using the National Income Dynamic Study. Based on the analysis, the point estimates revealed that MLPR was fluctuating. The employment rate increased while the unemployment rate decreased. However, it was observed that the rate of MLFP, employment, and unemployment remained constant due to an overlap of the confidence intervals.

The patterns and distribution of maternal malnutrition underweight, overweight and obesity in SA were discussed using the NIDS 2008, 2012, 2014/15 and 2017. When the confidence intervals were taken into account it was observed that there was no statistically significant difference in the rate of maternal underweight and overweight in the country. Meanwhile, an increase in maternal obesity was observed. The findings also revealed that the lowest form of maternal malnutrition in the country is underweight, while obesity is the most predominant form followed by overweight.

The chapter further highlighted that maternal malnutrition is not homogenous across the different background characteristics; age, marital status, race, geographic location and age of the child being cared for. The estimates indicated that being underweight was more prevalent amongst mothers aged between 16-24 years, Coloureds, in the rural areas, single mothers and caring for a child aged between 0-23 months. Overweight was high amongst those aged between 25-34 years, Africans compared with Coloureds, in the rural areas, married and caring for a child aged between 24-59 months. For obesity, the rate was high amongst mothers; aged between 35-45 years, who are Coloureds, living in the urban areas, who are married and caring for a child aged between 24-59 months.

For the relationship between maternal obesity and MLFP, the 2017 NIDS dataset was used. The Wald test hypothesis of exogeneity of obesity and the Durbin-Wu-Hausman test were not rejected. In addition, the F-test of joint instrumental variables also indicated that the instruments were weak. Given that the instrumental variables were weak and proved to be exogenous, this validated the use of the univariate and linear probability models. After controlling for maternal and child's age, sex of the child, health and race of the mother, area of residence, marital status, if a household member receives grants from the government, education of the mother, household size and if there is at least one employed male in the household, the results revealed that there was a positive but insignificant relationship between maternal obesity and maternal labour force participation.

For the control variables used, it was observed that the age of the mothers and the child had a quadratic effect on maternal labour force participation. Being Coloured, living in the urban area and possession of matric or above, were linked with an increase in maternal labour force participation. Meanwhile, being married/cohabiting and an increase in household size was associated with a decrease in maternal labour force participation.

8.2.7 Child malnutrition and maternal labour market participation in South Africa: evidence from the National Income Dynamics Study (Chapter Seven)

The chapter examined the extent of childhood malnutrition and the effect of childhood stunting on maternal labour force participation. Based on the findings, it was observed that SA is faced with a double burden of child malnutrition, which is characterised by the coexistence of undernutrition (particularly stunting) and overnutrition.

Child malnutrition was seen to be heterogeneous across the different selected background characteristics; the age of the child, race, geographic location and child's gender. It was observed that the rate of stunting was high amongst children aged between 0-23 months, boys, African and in the rural areas. Underweight was more prevalent amongst children aged between 24-59 months, boys, African and in the rural areas. Wasting was high amongst children aged between 0-23 months, boys, African and in the urban areas. The rate of overweight was seen to be more prevalent amongst children aged between 0-23 months, boys, African, while there were fluctuations between the rural and urban areas respectively. Based on public health significance the rate of childhood stunting and overweight are high and of public health concern.

To evaluate the presence of a stunted child regression analysis, given the assumption that childhood stunting is endogeneous, the instrumental variables used (mother's short stature and improved water source) passed both the first and second test of instrument validity. The Wald and DWH tests hypotheses of exogeneity of stunting were rejected, and the bivariate probit model and the IV-LPM were considered the valid models. The results showed that mothers of stunted children are less likely to participate in the labour force. For the covariates that were controlled for in the analysis, it was observed that the age of the mother and child had a non-linear effect on MLFP. In addition, there was a positive relationship between being Coloured, living in the urban areas, the presence of another female aged 18-85 years and having a matric+ with MLFP.

8.3 Conclusion

Malnutrition, especially stunting and obesity has been documented as a global public health problem. In this study, I contributed to the general literature on maternal and child malnutrition by estimating the state of maternal and child malnutrition in SA from 2008 to 2017 and the causal effect of maternal obesity and childhood stunting on maternal labour force participation. Mothers who are obese or whose children are stunted may choose to stay at home to take care of themselves or the health of their children, or they may decide to enter the labour force to increase the household's budget. This thesis aimed to establish which one of these two labour market responses was empirically dominant. This was an attempt to show the centrality of maternal and child nutrition in understanding maternal labour supply for broader appreciation. Thus, the purpose of this study was to determine the extent of maternal and child malnutrition and to test the empirical hypotheses that maternal obesity and childhood stunting are important in accounting for maternal labour force participation.

This thesis concludes that SA is faced with a double burden of malnutrition, whereby there is the coexistence of a high rate of undernutrition particularly stunting in children and overnutrition (overweight/obesity) in mothers and children, which are of significant public health concerns. This double burden of malnutrition puts children at greater risk of faltering growth and communicable diseases, as well as a higher risk of developing nutrition-related non-communicable diseases such as type 2 diabetes, hypertension, and cancer as they reach adulthood. Likewise, obese mothers are also prone to these non-communicable diseases. Notwithstanding, over the years that is from 2008-2017, there has been no statistically significant variation in the rate of stunting, wasting and overweight amongst children aged 0-59 months, and underweight and overweight amongst mothers aged 16-45. To achieve the global nutrition target (as stated in section 1.4 in Chapter One), SA has made progress concerning childhood wasting and overweight including obesity, while no has advances have been made concerning stunting.

Maternal obesity had no significant effect on maternal labour force participation. This may have resulted from the fact that the data used could not reject the exogeneity of maternal obesity. However, apart from the negative health effect stunting had on children, caring for a stunted child inhibited a mother’s labour force participation. This may have resulted from the increased caring needs of the child. In addition, since women in a patriarchal society like SA are compelled to care for family members who are sick, it is no doubt that the presence of a stunted child impacts mothers who are their primary caregivers. Stunting also increases the health cost for the child, thereby increasing the mother’s reservation wage. If the reservation wage is higher than the expected wage, she is less likely to participate in the labour market.

8.4 Contributions to Knowledge

This study contributes to existing knowledge empirically, theoretically and methodologically in the fields of health and development policy and practice. This section discusses the relevance of this study to the existing literature by looking at the empirical, theoretical and methodological contributions.

8.4.1 Empirical Contributions

The main contribution of this study to the existing body of academic literature and policy is the fact that the research has provided a comprehensive empirical analysis of the state of maternal and child malnutrition as well as the effect of malnutrition on maternal labour force participation, with a specific focus on maternal obesity and childhood stunting. This is significant because there is a debate as to whether childhood malnutrition in SA has increased, decreased, or remained constant. Given the goals of the WHO member countries on the nutrition target which has been extended to 2030, this thesis helps policymakers to see the progress of both maternal and child malnutrition in the country. In addition, the effect of maternal obesity and childhood stunting on maternal labour force participation remains under-researched in the existing literature. The comprehensive empirical analyses done in this thesis were achieved by providing a detailed cross-sectional analysis of the different background characteristics of mothers and children. I am not aware of empirical research in the context of developed and developing countries which has provided an in-depth analysis of this topic.

8.4.2 Theoretical Contributions

The absence of theoretical literature on the effect of maternal obesity as well as childhood stunting on maternal labour force participation means that an effective assessment of the economic effect of malnutrition within this group remains primarily an empirical issue. Evidence from the analyses and discussions suggests that malnutrition particularly stunting has a devastating economic impact. These findings are significant if research outcomes are to provide policy recommendations that will outline practical and applicable decisions in solving the problem of female particularly mother's labour force participation. In addition, this study has extended the technique of Sprague (1994), by using an approach that included maternal obesity and caring for stunted child variables as one of the determinants of labour force participation.

8.4.3 Methodological Contribution

The main methodological contribution of the study has been the use of a recursive bivariate probit model to estimate the effect of childhood stunting on maternal labour force participation. This is important as it takes into consideration the endogeneity of stunting, which if not controlled for may bias the estimates. The study also provides univariate probit model estimates of maternal obesity on maternal labour force participation. This is also an important contribution because, in the SA context, maternal obesity might truly be exogenous in a labour supply model. In addition, I am not aware of studies that have provided these estimates on the topic as well as using the most recent NIDS dataset.

Another important contribution is based on the convenience of applying theories and theoretical concepts developed in other contexts. Due to socio-cultural disparities in economies, the applicability of several theories and research models designed for developed countries in developing countries is questioned. The successful application of these theories and models in this study aids in the explanation of case studies from emerging countries such as SA. The analyses are consistent with Becker's theory of the family, where childcare, for instance, plays a significant role in a mother's decision to participate in the labour force or not.

8.5 Policy Recommendations

First of all, given the double burden of malnutrition faced in the country, the synergies of a method to tackle several forms of malnutrition can be achieved through "double duty" actions that tackle multiple forms of malnutrition at the same time. The "double duty" approach is critical because it prevents a scenario where addressing one form of malnutrition increases the risk of another form of malnutrition. These "double duty" approaches include

i) Maternal nutrition: it is an essential aspect for both maternal health, and childhood growth and development. Therefore, policymakers need to promote healthy eating habits amongst mothers before, during and after pregnancy, as this will impact positively on their nutritional status as well as their children

ii) Encourage optimal breastfeeding: breastfeeding is also an important factor for childhood growth and development. Hence, policymakers should launch public awareness campaigns that build positive breastfeeding habits amongst breastfeeding mothers.

iii) Nutrition education: it helps mothers and caregivers to make the right food choices and prepare healthy meals required by them and their families to promote a healthy life. It will also help them to distinguish credible nutrition information from misleading commercial food advertisements. Therefore, policymakers can devise means such as television or radio or community development programmes, that can help educate these mothers or caregivers on the different ways of achieving a healthy lifestyle.

If policymakers can put in place measures that can tackle childhood stunting such as the ones listed above, this is likely to have a positive effect on maternal labour force participation. It will reduce the caring time needed by the child, thereby, giving their mothers more time to take advantage of the labour market. In addition, more flexible work arrangements that allow mothers to work from home would enable those with stunted children to engage in the labour force to some extent.

8.6 Limitations of the study and areas for future study

Although important aspects on the prevalence and trends of maternal and child malnutrition as well as the relationship between maternal and child malnutrition, and maternal labour force participation, were revealed in this study, some challenges were encountered which can also serve as areas for future research. These include:

First, most of the analyses in this thesis were limited to Africans and Coloureds since Whites and Indians were not fully represented in the data sets. This limits the generalisability of the results, particularly considering that racial groups differ in many respects due to apartheid, especially in terms of their experience in the labour market. As such, with the richness of NIDS, future analysis that includes all the racial groups may be possible with larger surveys.

The second limitation of the study was the inability to control the reverse causality of maternal obesity. The nature of the relationship between maternal obesity and maternal labour force participation is susceptible to endogenous biases. However, this study did not take to account the potential bi-directional relationship between maternal obesity and maternal labour force participation. Not participating in the workforce can be the cause of obesity. Unfortunately, NIDS does not have any suitable instrumental variables to use. In the future, research with an appropriate instrumental variable can be conducted to draw meaningful conclusions on the relationship between maternal obesity and maternal labour force participation.

Another limitation was the absence of suitable instrumental variables in the NIDS dataset to estimate the joint effect of child stunting and maternal obesity on maternal labour force participation. In the future, a richer dataset with suitable instrumental variables could be used or collected to understand this relationship, or interaction effects could be used for this purpose.

To add to the richness of the economics of malnutrition in SA, it will be interesting to investigate the effect of childhood stunting on a caregiver's reservation wage. This will provide a more detailed, empirical evidence in this regard and will therefore require a dataset that captures the caregiver's reservation wage as well as the child's nutrition measures.

For future analysis, the longitudinal dimension of data could be exploited to examine dynamic processes of nutritional change and labour force participation decisions. In addition, an interaction with stunting and healthy adult woman present could be performed to test for moderation effects. It will also be important for future analysis to consider whether there is a concern about survivor effects in the sample. In other words, the absence of mothers and children who died of causes related to malnutrition might bias the results.

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APPENDICES

Table A6. 1: Broad labour force participation across key background characteristics

Background Characteristics	2008	2012	2014/2015	2017
Age Cohorts				
16-24 years	349	353	346	335
25-34 years	516	609	752	800
35-45 years	310	299	327	341
Race				
African	933	1062	1219	1215
Coloured	207	195	247	237
Area of Residence				
Rural	553	583	692	672
Urban	595	658	739	789
Marital Status				
Married	541	456	478	568
Single	622	820	983	932
Child's Age				
0-23 months	576	561	639	654
24-59months	607	716	805	846
Total	1182	1283	1457	1506

Source: Own calculations using NIDS 2008, 2012, 2014/2015, and 2017, and post-stratification weight

NB: Numbers were round up to the nearest whole number.

Table A6. 2: Broad labour force participation rate across key background characteristics

Background Characteristics	2008 %[95% CI]	2012 %[95% CI]	2014/2015 %[95% CI]	2017 %[95% CI]
Age Cohorts				
16-24 years	60.8[54.8-66.5]	51.2[44.8-57.5]	43.3[38.1-48.8]	42[36.6-47.6]
25-34 years	71.4[66.4-75.9]	68.3[63.3-72.9]	67.0[61.4-72.1]	66.1[62.0-69.9]
35-45 years	76.5[70.5-81.7]	75.8[69.5-81.2]	72.6[66.0-78.3]	67.7[61.7-73.2]
Race				
African	68.1[64.7-71.3]	63.6[60.2-66.9]	61.3[58.1-64.5]	59.0[55.8-62.2]
Coloured	78.5[68.2-86.2]	72.5[61.7-81.2]	70.9[61.4-78.9]	68.2[58.9-76.3]
Area of Residence				
Rural	60.0[55.8-64.1]	55.2[50.8-59.5]	55.8[51.6-60.0]	51.2[47.4-55.0]
Urban	76.1[71.6-80.2]	71.6[66.8-75.9]	65.3[60.1-70.1]	66.1[62.0-70.0]
Marital Status				
Married	73.7[69.0-77.9]	68.1[62.4-73.4]	59.6[52.9-65.9]	62.6[58.0-67.0]
Single	64.5[60.2-68.6]	62.9[58.8-66.8]	62.6[58.9-66.3]	58.4[54.6-62.1]
Child's Age				
0-23 months	64.5[59.8-68.8]	59.6[54.8-64.2]	53.0[48.6-57.4]	52.8[48.5-57.0]
24-59months	75.2[70.7-79.2]	69.2[64.6-73.6]	69.1[63.7-74.0]	66.6[62.6-70.5]
Total	69.5[66.3-72.5]	64.9[61.6-68.1]	61.5[58.0-64.8]	60.1[57.2-63.0]

Source: Own calculations using NIDS 2008, 2012, 2014/2015, and 2017, and post-stratification weight

Table A6. 3: Broad unemployment rate across key background characteristics

Background Characteristics	2008 %[95% CI]	2012 %[95% CI]	2014/2015 %[95% CI]	2017 %[95% CI]
Age Cohorts				
16-24 years	69.4[60.1-77.3]	69.1[59.1-77.7]	55.8[46.9-64.4]	57.8[48.9-66.3]
25-34 years	48.2[41.9-54.4]	42.2[36.2-48.4]	36.4[30.7-42.5]	33.6[28.5-39.0]
35-45 years	41.8[33.9-50.2]	32.5[24.7-41.4]	22.9[16.7-30.5]	27.6[31.0-35.2]
Race				
African	58.1[53.6-62.4]	50.2[45.4-55.0]	41.0[36.6-45.5]	38.3[34.1-42.7]
Coloured	37.1[25.6-50.4]	33.4[20.2-49.8]	23.2[15.4-33.3]	27.5[17.4-40.5]
Area of Residence				
Rural	57.1[51.9-62.2]	58.1[51.6-64.3]	50.3[44.2-56.5]	46.3[41.0-51.7]
Urban	49.2[43.1-55.2]	39.5[33.7-45.6]	29.2[24.3-34.5]	31.5[26.5-36.9]
Marital Status				
Married	47.0[40.7-53.5]	39.1[32.0-46.8]	25.0[19.7-31.1]	31.8[26.3-37.8]
Single	58.5[53.1-63.7]	50.7[45.0-56.4]	44.2[38.8-49.6]	40.0[34.9-45.3]
Child's Age				
0-23 months	55.4[49.0-61.6]	55.0[47.8-61.9]	43.7[37.7-49.9]	40.6[34.6-46.9]
24-59months	48.7[42.8-54.6]	39.6[33.7-45.8]	32.4[27.0-38.2]	33.7[28.9-38.9]
Total	**52.0[47.6-56.3]**	**45.9[41.3-50.6]**	**37.0[32.9-41.3]**	**36.6[32.8-40.5]**

Source: Own calculations using NIDS 2008, 2012, 2014/2015, and 2017, and post-stratification weight

Table A6. 4: Distribution of maternal overweight (including obesity) across key background characteristics

Background Characteristics	2008 %[95% CI]	2012 %[95% CI]	2014/15 %[95% CI]	2017 %[95% CI]
Age Cohorts				
16-24 years	41.9[35.8-48.3]	45.5[39.1-51.9]	49.6[44.3-54.9]	45.5[40.0-51.1]
25-34 years	63.4[58.0-68.5]	65.2[59.9-70.1]	67.2[61.6-72.4]	68.6[64.5-72.4]
35-45 years	70.1[63.0-76.4]	77.3[70.6-82.8]	76.8[70.6-82.0]	73.8[67.5-79.3]
Race				
African	58.4[54.7-61.9]	63.5[60.0-66.9]	65.3[62.0-68.6]	64.2[61.0-67.3]
Coloured	65.2[53.3-75.4]	56.0[43.5-67.7]	59.7[49.4-69.3]	59.7[49.6-69.1]
Area of Residence				
Rural	52.6[48.4-56.8]	58.5[54.1-62.8]	63.2[58.8-67.5]	62.0[58.3-65.6]
Urban	62.7[57.2-68.0]	64.4[59.1-69.3]	64.8[59.7-69.6]	64.7[60.3-68.8]
Marital Status				
Married	64.6[58.9-69.9]	64.9[58.5-70.9]	73.0[66.4-78.6]	70.4[65.9-74.6]
Single	51.3[46.9-55.8]	60.1[55.9-64.2]	58.7[54.6-62.7]	59.1[55.1-62.9]
Child's Age				
0-23months	54.3[49.3-59.3]	56.7[51.6-61.7]	62.7[58.4-66.8]	59.4[55.1-63.5]
24-59months	63.1[58.0-68.0]	66.3[61.4-70.8]	65.5[59.9-70.7]	67.4[63.2-71.4]
Total	58.4[54.7-61.9]	62.0[58.5-65.4]	64.2[60.7-67.5]	63.6[60.6-66.5]

Source: Own calculations using NIDS 2008, 2012, 2014/2015, and 2017, and post stratification weight

Table A6. 5: First stage Bivariate Probit and LPM regression of obesity on covariates (strict)

Variables	(1) Bivariate probit	(2) LPM
Disease	0.36***	0.14***
	(0.11)	(0.04)
Physical Activity	-0.30**	-0.08**
	(0.13)	(0.04)
Mother Smokes	-0.34***	-0.11***
	(0.12)	(0.04)
Mother's Age	0.17***	0.04***
	(0.04)	(0.01)
Mother's Age Square	-0.00***	-0.00***
	(0.00)	(0.00)
Child's Age	0.02**	0.00**
	(0.01)	(0.00)
Child's Age Square	-0.00	-0.00
	(0.00)	(0.00)
Male	0.07	0.02
	(0.05)	(0.02)
Healthy	0.17	0.07
	(0.13)	(0.05)
Coloured	-0.04	-0.02
	(0.09)	(0.03)
Urban	0.04	0.01
	(0.06)	(0.02)
Married	0.13**	0.05**
	(0.06)	(0.02)
Grant	-0.02	-0.01
	(0.07)	(0.03)
Matric	0.18***	0.06***
	(0.07)	(0.02)
Household Size	-0.02**	-0.01**
	(0.01)	(0.00)
Employed Male	0.16**	0.06**
	(0.05)	(0.002)
Constant	-3.80***	-0.64***
	(0.56)	(0.17)
Rho	0.41	
	(0.28)	
Log pseudolikelihood	-2915.6312	
F-stat		18.9
R^2		0.09
N	2389	2393

*Source: Own calculations using NIDS wave 5, robust standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1.*

Table A6. 6: Marginal effects of obese and controls on strict MLFP probability (IV-bivariate probit and IV-LPM)

Variables	(1) Bivariate probit	(2) IV-LPM
Obese Mother	-0.22	-0.25
	(0.14)	(0.21)
Mother's Age	0.06***	0.08***
	(0.02)	(0.01)
Mother's Age Square	-0.00***	-0.00***
	(0.00)	(0.00)
Child's Age	0.01***	0.01***
	(0.00)	(0.00)
Child's Age Square	-0.00***	-0.00***
	(0.00)	(0.00)
Male	0.00	0.01
	(0.02)	(0.02)
Healthy	-0.02	-0.00
	(0.04)	(0.05)
Coloured	0.11***	0.12***
	(0.03)	(0.03)
Urban	0.08***	0.09***
	(0.02)	(0.02)
Married	-0.04**	-0.03
	(0.02)	(0.03)
Grant	0.01	0.01
	(0.02)	(0.03)
Matric	0.15***	0.19***
	(0.03)	(0.03)
Household Size	-0.00	-0.01*
	(0.00)	(0.00)
Employed Male	-0.00	0.02
	(0.02)	(0.02)
Constant		-1.07***
		(0.21)
R^2		0.07
N	2389	2389

*Source: Own calculations using NIDS wave 5, robust standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1.*

Table A6. 7: First stage Bivariate Probit regression of obesity on covariates (broad)

Variables	Bivariate probit
Disease	0.36***
	(0.11)
Physical Activity	-0.28**
	(0.13)
Mother Smokes	-0.34***
	(0.12)
Mother’s Age	0.17***
	(0.04)
Mother’s Age Square	-0.00***
	(0.00)
Child’s Age	0.01**
	(0.01)
Child’s Age Square	-0.00
	(0.00)
Male	0.07
	(0.05)
Healthy	0.17
	(0.13)
Coloured	-0.04
	(0.09)
Urban	0.04
	(0.06)
Married	0.13**
	(0.06)
Grant	-0.02
	(0.07)
Matric	0.18***
	(0.07)
Household Size	-0.02**
	(0.01)
Employed Male	0.16**
	(0.05)
Constant	-3.78***
	(0.56)
Rho	0.37
	(0.26)
Chi^2 (1)	1.69
p-value	0.19
Log pseudolikelihood	-2931.0596
N	2389

*Source: Own calculations using NIDS wave 5, robust standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1.*

Table A6. 8: Marginal effects of obese and controls on broad MLFP probability (bivariate probit and IV-LPM)

Variables	(1) Bivariate probit	(2) IV-LPM
Obese Mother	-0.20	-0.23
	(0.12)	(0.21)
Mother's Age	0.06***	0.08***
	(0.02)	(0.01)
Mother's Age Square	-0.00***	-0.00***
	(0.00)	(0.00)
Child's Age	0.01***	0.01***
	(0.00)	(0.00)
Child's Age Square	-0.00***	-0.00***
	(0.00)	(0.00)
Male	0.00	0.01
	(0.02)	(0.02)
Healthy	-0.01	0.00
	(0.04)	(0.05)
Coloured	0.12***	0.12***
	(0.03)	(0.03)
Urban	0.06***	0.07***
	(0.02)	(0.02)
Married	-0.05***	-0.04*
	(0.02)	(0.03)
Grant	0.00	0.00
	(0.02)	(0.03)
Matric	0.13***	0.17***
	(0.03)	(0.03)
Household Size	-0.00	-0.01*
	(0.00)	(0.00)
Employed Male	0.01	0.03
	(0.02)	(0.02)
Constant		-0.99***
		(0.21)
R^2		0.08
DWH Chi^2 (1)		1.30
DWH Chi^2 p-value		0.25
F (for joint IVs)		8.5
Hansen J test (p-value)		0.42
N	2389	2389

*Source: Own calculations using NIDS wave 5, robust standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1.*

TableA7. 1: First stage Stunting and controls on Strict MLFP probability (bivariate probit and LPM)

Variables	(1) Bivariate probit	(2) LPM
Mother Height	0.85***	0.29***
	(0.11)	(0.04)
Improved water	-0.14*	-0.04*
	(0.08)	(0.02)
Mother's Age	-0.05	-0.01
	(0.04)	(0.01)
Mother's Age Square	0.00	0.00
	(0.00)	(0.00)
Child's Age	0.05***	0.01***
	(0.01)	(0.00)
Child's Age Square	-0.00***	-0.00***
	(0.00)	(0.00)
Male	0.22***	0.06***
	(0.07)	(0.02)
Healthy	-0.50***	-0.16***
	(0.15)	(0.05)
Coloured	0.09	0.03
	(0.10)	(0.03)
Urban	-0.03	-0.01
	(0.08)	(0.02)
Married	-0.05	-0.02
	(0.08)	(0.02)
Grant	0.17*	0.04*
	(0.09)	(0.02)
Matric	-0.29***	-0.08***
	(0.07)	(0.02)
Number of adult females	-0.02	-0.01
	(0.04)	(0.01)
Employed Male	-0.09	-0.02
	(0.08)	(0.02)
Constant	-0.18	0.45**
	(0.67)	(0.20)
Log pseudolikelihood	-2070.374	
F-stat		11.7
R^2		0.09
N	1858	1861

*Source: Own calculations using NIDS wave 5, robust standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1.*

TableA7. 2: Strict MLFP determination allowing for exogeneity of stunting (marginal effects)

Variables	(1) Univariate probit	(2) LPM
Stunted Child	-0.02	-0.01
	(0.03)	`(0.03)
Mother's Age	0.08***	0.07***
	(0.02)	(0.01)
Mother's Age Square	-0.00***	-0.00***
	(0.00)	(0.00)
Child's Age	0.01***	0.01***
	(0.00)	(0.00)
Child's Age Square	-0.00**	-0.00**
	(0.00)	(0.00)
Male	-0.00	0.00
	(0.02)	(0.02)
Healthy	-0.00	-0.01
	(0.06)	(0.05)
Coloured	0.15***	0.14***
	(0.03)	(0.03)
Urban	0.11***	0.10***
	(0.02)	(0.02)
Married	-0.03	-0.03
	(0.03)	(0.03)
Grant	0.01	0.01
	(0.03)	(0.03)
Matric	0.21***	0.20***
	(0.02)	(0.02)
Number of adult females	0.02*	0.02*
	(0.01)	(0.01)
Employed Male	-0.01	-0.01
	(0.03)	(0.02)
Log pseudolikelihood	-1159.2969	
Constant		-0.93***
		(0.20)
F-stat		25.7
R^2		0.12
N	1863	1863

*Source: Own calculations using NIDS wave 5, robust standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1.*

TableA7. 3: Broad first stage bivariate probit model of stunting and covariates (marginal effects)

Variables	Bivariate probit
Mother height	0.85***
	(0.11)
Improved water	-0.13*
	(0.08)
Mother's Age	-0.05
	(0.04)
Mother's Age Square	0.00
	(0.00)
Child's Age	0.05***
	(0.01)
Child's Age Square	-0.00***
	(0.00)
Male	0.23***
	(0.07)
Healthy	-0.51***
	(0.14)
Coloured	0.08
	(0.10)
Urban	-0.03
	(0.08)
Married	-0.05
	(0.08)
Grant	0.17*
	(0.09)
Matric	-0.29***
	(0.07)
Number of adult females	-0.02
	(0.04)
Employed Male	-0.09
	(0.08)
Constant	-0.19
	(0.67)
Log pseudolikelihood	-2077.033
N	1858

*Source: Own calculations using NIDS wave 5, robust standard errors in parentheses: *** p<0.01, ** p<0.05, * p<0.1.*