Double burden of malnutrition among women in South Africa: Evidence from the Demographic Health Survey

by

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DECLARATION

I, Tinotenda Gerald Geoffrey Chiwawa, hereby declare that the work on which this dissertation/thesis is based is my original work (except where acknowledgements indicate otherwise) and that neither the whole work nor any part of it has been, is being, or is to be submitted for another degree in this or any other university.

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DEDICATION

In honour of my mother and grandmother, who have influenced the person I am today, I express my heartfelt gratitude. Their unwavering support and countless sacrifices have shaped my character and guided me through life's journey.

THESIS ABSTRACT

Background: The global shifts in nutrition patterns have been associated with an increasing number of individuals experiencing multiple forms of malnutrition, collectively termed the double burden of malnutrition (DBM). It is defined as the coexistence of undernutrition and overnutrition within the same population, community, or individual. The phenomenon can manifest at individual, household, or population levels and has significant public health implications.

Methodology: The thesis includes a comprehensive literature review examining theoretical, methodological, and empirical studies on the DBM among women. The findings reviewed that the DBM is now prevalent in the poorest low- or middle-income countries, which include Sub-Saharan Africa. South Africa is one of the top five African countries with the highest prevalence of overweight and obese individuals, particularly among women (34%). Women are now at a heightened risk of experiencing the DBM. Most studies on the DBM involving women in South Africa were primarily focused on either household contexts or individual prevalence of Body Mass Index challenges. This study seeks to fill the research gap by examining socioeconomic inequalities in the DBM among non-pregnant women in South Africa and identifying the main contributing factors. The outcome variable for this study is the DBM and it was defined as the coexistence of underweight and overweight/obese non-pregnant women in South Africa. Data from the 2016 South Africa Demographic Health Survey was utilised to calculate the prevalence of the DBM among the selected women aged 15-49 years. The initial sample size was 11083 women, but due to missing data and the exclusion of pregnant women, the final sample size was reduced to 3262 non-pregnant women. The concentration curve and the concentration index were used to assess the socioeconomic inequalities. Finally, an in-depth decomposition analysis uncovered the key driving factors contributing to the observed inequalities. The data management, exploration, and analysis were done using Stata 17 statistical software.

Results: A total of 39% (1261 out of 3262) of non-pregnant women were found to experience the DBM. The prevalence varied across demographic groups, with higher rates observed among women aged 35-44 years, unemployed, Black/African, unmarried, urban residents, and those in the middle wealth quintiles. Socioeconomic inequalities related to the DBM were evident, illustrated by a pro-rich distribution in the concentration curve and a positive CI value of 0.14. Factors such as education, employment, health insurance, marital status, and watching

TV contributed positively to socioeconomic inequality, while factors like parity and place of residence exhibited negative contributions.

Conclusion: The findings of this study provide valuable insights into the DBM among non-pregnant women in South Africa. The high prevalence of the DBM, particularly among certain demographic groups, underscores the need for targeted interventions. The socioeconomic inequalities related to DBM, as evidenced by a pro-rich distribution highlight the complex interplay of numerous factors. These findings suggest that addressing the DBM in South Africa among women requires a multifaceted approach considering the socioeconomic context.

ACKNOWLEDGEMENTS

I would like to express my sincere gratitude to Dr. Olufunke Alaba, my supervisor, whose guidance and expertise were invaluable in shaping this thesis. I also appreciate the support of Akim Tafadzwa Lukwa, Denis Okova, and Marian Yaa Abrafi Edusei throughout my research journey. They all played a crucial role in the completion of my thesis.

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PART A: LITERATURE REVIEW

1.0 INTRODUCTION AND BACKGROUND

This literature review is structured into three parts. The theoretical review, the first section, is a foundational exploration of the double burden of malnutrition (DBM) and health inequality. It includes the concepts of health inequality and the DBM and delves into the various theoretical frameworks that seek to explain them. The methodological review then examines the methods used to calculate the DBM and health inequalities. The concluding section, the empirical review, aims to shed light on the available research on the health inequalities of the DBM. Looking at the findings of previous studies, and the current state of knowledge.

1.1 THEORETICAL REVIEW

1.1.1 What is the DBM?

The term DBM was initially presented in 1992 at the International Conference of Nutrition by the Food and Agriculture Organization of the United Nations (FAO) and the World Health Organisation (WHO) (Shrimpton & Rokx, 2012), and later affirmed by Jacob (2022). Over time, the DBM has been interpreted in several ways, but the overarching definition is the coexistence of multiple forms of malnutrition within the same population, community, or individual (WHO, 2016a). Malnutrition is a condition characterised by an imbalance of nutrients, which can manifest as either a deficiency or an excess (Saunders et al., 2015). The DBM has commonly been associated with low-income and middle-income countries (LMICs), which has been attributed to changes in global nutritional trends (Popkin et al., 2020; Wells et al., 2020). These shifts have been associated with food systems that make unhealthy food more affordable and widely available, and reduced physical activity linked to technological advancements in transportation, home, and workplaces (Popkin et al., 2020).

1.1.2 Levels of DBM

The DBM can occur across three different levels (WHO, 2016a)**.** At the individual level, it is observed when multiple forms of malnutrition occur throughout a person's lifetime. For example, an overweight individual who once experienced stunting during childhood (WHO, 2023). This form of the DBM is commonly found among women and children (Delisle, 2008). At the household level, it occurs when different members within the same household suffer

from various forms of malnutrition. At a population level, both undernutrition and overnutrition will coexist within the same community, region, or country (WHO, 2016a).

1.1.3 Burden of the DBM

This global burden of malnutrition affects every country, with over 1.9 billion adults worldwide estimated to be overweight and more than 600 million adults obese, while 462 million adults are underweight (WHO, 2016). This DBM presents a multifaceted challenge with significant health, economic, and developmental implications, as it is associated with some noncommunicable diseases (Anik et al., 2019; Were et al., 2020; WHO, 2016b, 2023a). The Global Panel on Agriculture and Food Systems for Nutrition estimated that the global impact of malnutrition might be as high as US$3.5 trillion annually, which is around US$500 per person. Its incidence is on the rise, particularly in the poorest LMICs, notably South and East Asia and Sub-Saharan Africa (SAA) (Agyemang et al., 2015; Popkin et al., 2020; Were et al., 2020). The DBM has been linked to several top risk factors for death in low-income countries (WHO, 2016b), additionally, it contributes to over 2.6 million deaths worldwide annually due to overweight or obesity (Añón-Hidalgo et al., 2019). Within SSA countries, South Africa stands out as the most affected country by obesity, also ranking among the top five African countries with the highest prevalence of overweight individuals (Agyemang et al., 2015). Recent studies indicate a population prevalence of underweight adults at 4.8% and 51.9% for overweight and obese adults in South Africa, with women, particularly those of childbearing age, bearing a disproportionately higher burden (Mbogori et al., 2020; Nglazi & Ataguba, 2022).

1.1.4 The DBM among women

Women are responsible for safeguarding the nutritional needs of both themselves and their families, serving as primary caregivers and often the main decision-makers in household food choices (Madzorera & Fawzi, 2020). Despite their critical role, women often face challenges in meeting their nutritional requirements, exacerbated by factors such as increased needs during pregnancy and lactation, menstrual losses, and gender inequalities, particularly within impoverished communities (Delisle, 2008; Jouanne et al., 2021; Madzorera & Fawzi, 2020). Global efforts to address women's nutritional needs have primarily focused on maternal and child health during pregnancy and early childhood, overlooking the broader spectrum of

women's health and well-being (Madzorera & Fawzi, 2020; WHO, 2016b). Acquiring additional knowledge can play a pivotal role in enhancing food security and nutrition for women, contributing to the attainment of the Sustainable Development Goals by 2030 (Clark & Wu, 2016).

1.1.5 Prevalence of the DBM

The worldwide impact of malnutrition is prevalent in all countries. The prevalence of DBM has notably risen, primarily associated with the rising incidence of individuals experiencing obesity and overweight conditions (Popkin et al., 2020). Currently, approximately one-third of individuals globally suffer from some form of malnutrition (WHO, 2016). In some studies, the prevalence of the condition was reported separately as underweight and overweight/obese.

The prevalence of the DBM emergence poses significant challenges to public health globally. Agyemang et al. (2015) highlighted the alarming rates of overweight prevalence in a study looking at 46 African nations. The countries with the most significant overweight prevalence were Seychelles, leading at 64%, followed by Mauritius at 44.8%, Cameroon at 43.9%, Botswana at 41.6%, and South Africa at 41% (Agyemang et al., 2015). Moreover, the study revealed a gender disparity, with women exhibiting a higher overweight prevalence as compared to men. Specifically, Seychelles, Lesotho, and South Africa stood out as having the highest overweight prevalence among women (Agyemang et al., 2015). Between 1998 and 2017, the prevalence of overweight South African women of reproductive age rose from 51.3% to 60.0% and 24.7% to 35.2% for obesity (Nglazi & Ataguba, 2022).

Investigations in Ghana reviewed that the prevalence of DBM was 14% among women (15-49 years), characterized by the simultaneous coexistence of anaemia and BMI challenges (underweight or overweight/obese) (Kushitor et al., 2020). Within this group of women, 41% had anaemia, 12% were classified as obese, 23% were overweight and 4% were underweight. Within a rural community in Malaysia, approximately 15.7% of mother/child pairs were found to experience household DBM (Khor & Sharif, 2003). Similarly in Haiti, among the 203 sampled households, 14% exhibited household DBM, where a malnourished child (under 10 years old) coexisted with an overweight mother (Raphaël et al., 2005).

In both Russia and China, the prevalence of household DBM was approximately 8%, whereas in Brazil, it was slightly elevated at 11% (Doak et al., 2000). Russia showed a notably higher prevalence of overweight individuals at 71%, contrasting with China's lower rate of 26%.

Conversely, China had the highest prevalence of underweight individuals at 28%, while Russia reported the lowest rate at 6% (Doak et al., 2000). In Myanmar, Pakistan, Nepal, and Bangladesh, the household-level prevalence of DBM, which was defined as the concurrent presence of an overweight mother and a stunted child, was observed as 5.54%, 3.93%, 1.54%, and 4.1%, respectively (Anik et al., 2019).

Using cross-sectional data from the demographic health survey (2000-2017), countries in the South and Southeast Asia region had an overall combined underweight prevalence of 22%, while overweight prevalence was 29% (Biswas et al., 2022). Among the countries, Bangladesh exhibited the highest underweight prevalence in 2000 at 44%, and Pakistan reported the lowest in 2017 at 7%. Conversely, Pakistan recorded the highest overweight prevalence at 67%, while Bangladesh had the lowest at 11% in 2000 (Biswas et al., 2022). Among the other included countries in the study, Nepal had their highest prevalence of underweight individuals in 2006 at 24%, Myanmar in 2016 at 15%, Timor-Leste in 2009 at 28%, Cambodia in 2005 at 20%, and India in 2016 at 22% (Biswas et al., 2022). For overweight prevalence, Nepal recorded the highest in 2016 at 33%, followed by India in 2016 at 31%, Myanmar in 2016 at 38%, Timor-Leste in 2016 at 19%, and Cambodia in 2014 at 34% (Biswas et al., 2022).

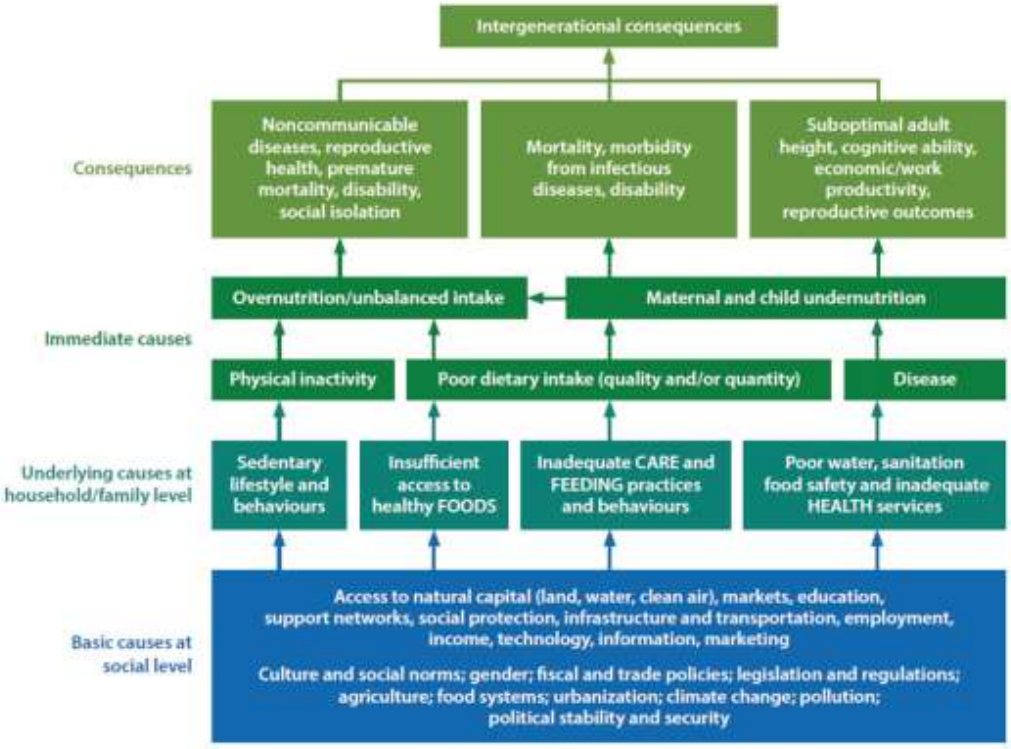
In India, significant shifts in BMI-related patterns among women were found over a decade. The prevalence of underweight women declined from 36% in 2006 to 23% in 2016 (Nguyen et al., 2021). This decline in underweight status was most prevalent among rural women, followed by urban slum dwellers, and, to a lesser extent, those residing in urban non-slum areas. In contrast, the proportion of overweight/obese women nearly doubled during the same period, rising from 13% in 2006 to 21% in 2016 (Nguyen et al., 2021).

1.1.6 Theoretical frameworks and perspective

1.1.6.1 Framework 1: Conceptual framework outlining the determinants of the DBM

Figure 1 presents a conceptual framework that outlines the determinants of the DBM, as described by the WHO in 2016. This framework emphasizes the basic, household level and immediate causes that result in intergenerational consequences. It uses overnutrition and maternal and child undernutrition as its primary outcomes. The basic causes include specific determinants such as access to natural capital, cultural and social norms (including gender dynamics), agriculture practices, food system, urbanization, climate change and pollution

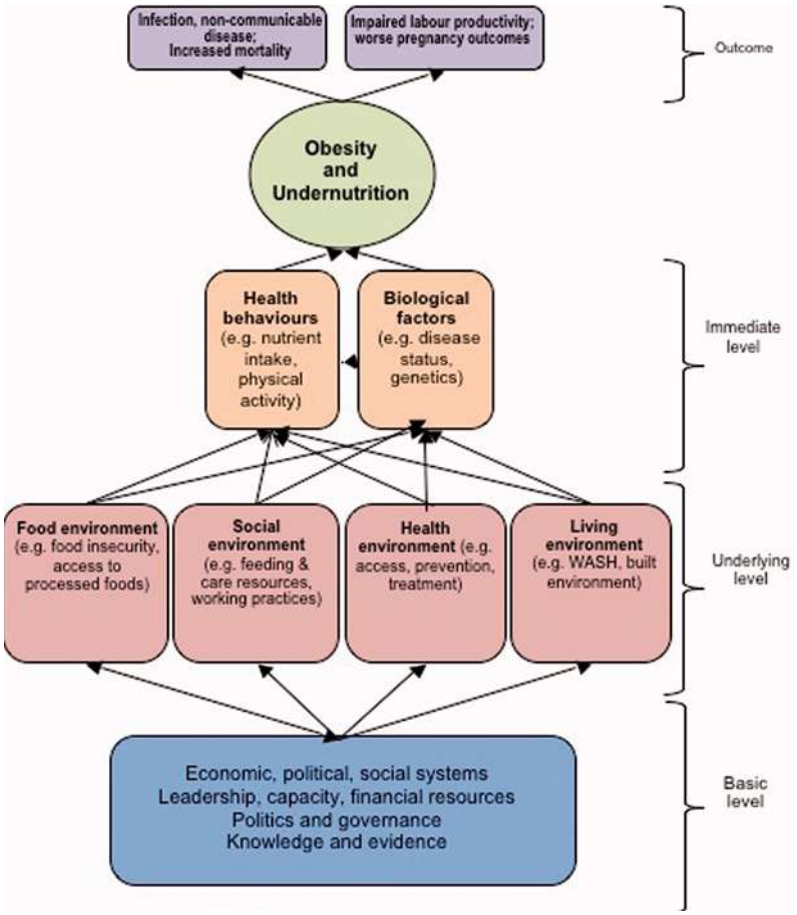
(WHO, 2016b). The framework also highlights the relevance of elements at the household or family level that are interconnected with immediate causes. At this level, several system-level factors come into play. These include sedentary lifestyles, access to nutritious food, inadequate sanitation, and concerns about water quality, among others.



Part A: Figure 1. Conceptual framework outlining the determinants of the double burden of malnutrition (WHO, 2016b).

1.1.6.2 Framework 2: Conceptual framework for determinants of malnutrition

Figure 2 presents a simple conceptual framework proposed by Haddad et al. in 2015. This framework categorises the determinants of both undernutrition and obesity into three interconnected levels. At the basic level, a variety of system-level factors such as economic structures, political systems, and social norms can act as guiding forces for the underlying level, influencing both undernutrition and obesity (Haddad et al., 2015). The underlying level is shaped by a multitude of environmental factors, which include aspects like food availability and quality, living conditions, societal influences, and healthcare access. These factors lay the groundwork for individual-level health behaviours and biological factors.

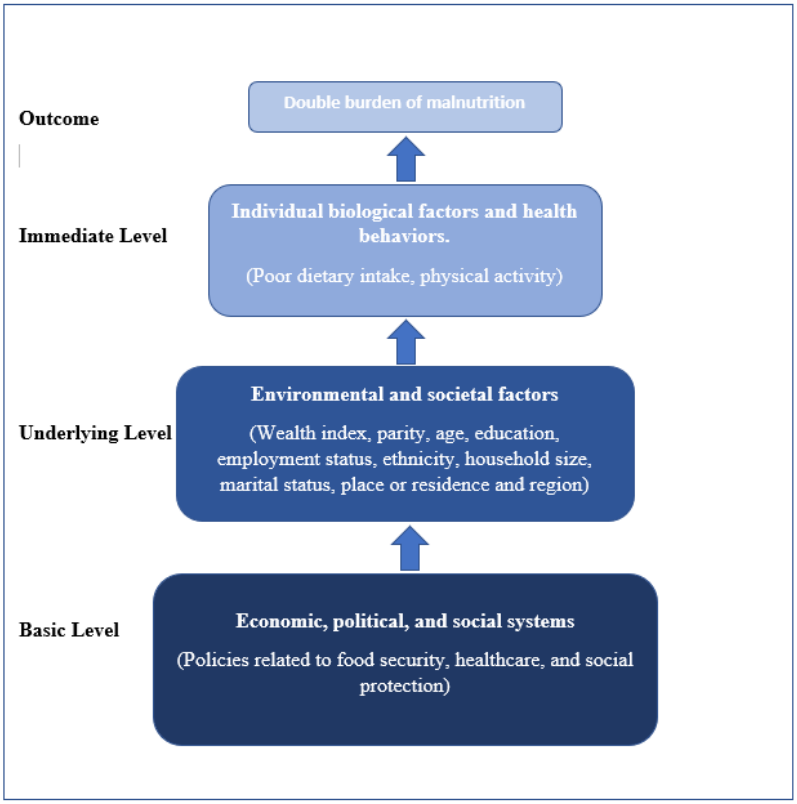


Part A: Figure 2. Conceptual framework for determinants of malnutrition by (Haddad et al., 2015).

1.1.6.3 Framework 3: Adapted conceptual framework outlining the determinants of the DBM

Figure 3 presents a conceptual framework that outlines the determinants of the DBM adapted from the 2016 WHO framework. This framework has three levels, with factors that contribute to the DBM. The basic causes encompass broader economic, political, and social systems that guide the underlying and immediate causes. These systems can include policies related to food security, healthcare, and social. The underlying level includes environmental and societal factors that influence the immediate causes. These factors include wealth index, parity, age, education, employment, ethnicity, household size, marital status, place of residence, region, and habits like watching TV. The immediate level consists of individual biological factors and health behaviours that directly influence a woman's nutritional status, such as dietary intake, physical activity, and metabolic factors. This framework emphasizes that addressing the DBM requires a comprehensive approach that considers all these interconnected factors. It also

highlights the need for targeted interventions that address the specific needs and challenges of diverse groups of women. By addressing these multiple layers of determinants, sustainable development and improved nutritional outcomes can be achieved.



Part A: Figure 3. Adapted conceptual framework outlining the determinants of the double burden of malnutrition from (WHO, 2016b).

1.1.7 Health inequality

Health inequality has been defined and understood in many different ways. McCartney, (2019) described health inequalities as "systematic, avoidable, and unfair gaps in health outcomes based on socioeconomic rank" (McCartney et al., 2019). Another author, Braveman and Gruskin (2003), defined it as the existence of systematic differences in health between social groups, with varying social hierarchies (Braveman & Gruskin, 2003). Inequality is evident in the uneven distribution of income, unequal opportunities available to individuals, and differences across various regions (IMF, 2020).

Typically, discussions on health inequality centre around health outcomes regarding social class and economic status (Smith et al., 2016). Health inequalities have been documented in every location and under diverse political and socioeconomic systems, as well as between

different social categories within the population and geographical areas within the same nation (Whitehead, 1992). It is also crucial to note that the general health of a population is frequently dependent or highly impacted by the amount of health disparities within that community. (McCartney et al., 2019). South Africa experiences some of the most extreme inequalities globally (IMF, 2020). For this study, inequalities in the DBM will be on the different socioeconomic statuses of non-pregnant women in South Africa.

1.1.8 Theories of health inequalities

People from various backgrounds, social strata, and nations experience varying degrees of health outcomes. The term health inequality refers to differences, variations, and disparities in the health or health outcomes of people and groups (Kawachi et al., 2002). The Black Report presented ideas to explain the fundamental reasons for health inequality, which were later developed; nonetheless, it was claimed that the structural theory gave the most persuasive explanation. (Black et al., 1980).

1.1.8.1 Artefact theory

The artefact theory posits that observed inequalities in health outcomes between socioeconomic groups may be attributable to methodological artefacts rather than genuine differences in health status (Black et al., 1980; McCartney et al., 2013). This means that the apparent link between being wealthy or educated and being healthier might not be true, it could just be a result of how social status was measured and classified.

1.1.8.2 Selection theory

The main hypothesis centres around reverse causality, arguing that deteriorating health creates a social selection, resulting in a link between poor health and lower social rank (McCartney et al., 2013). So, this theory argues that an individual's health determines their socioeconomic status, as opposed to socioeconomic status determining their health (Bambra, 2011). The potential for a health selection effect to account for health inequalities was thoroughly investigated and dismissed in the Black report (McCartney et al., 2013).

1.1.8.3 Cultural and behavioural theory

The theory argues that the relationship between socioeconomic status and health outcomes stems from differences in health-related behaviours, which include dietary habits and physical activity (Øversveen et al., 2017). For this theory to stand, socioeconomic factors must be the sole effect modifier within this relationship (McCartney et al., 2013). However, the findings of the Black Report highlighted that individuals' behaviours are frequently influenced by their social and economic situations, not just their cultural background. For instance, maintaining a healthy diet can be costly (Scambler, 2012).

1.1.8.4 Structural theory

The structural theory states that variations in the socioeconomic conditions of societal clusters, which include income, wealth, influence or power, environmental factors, and accessibility, throughout an individual's life, lead to health inequalities (McCartney et al., 2013). The theory links structural factors to health outcomes, but it fails to identify the root causes of health inequalities (Macintyre, 1997).

1.1.9 Socioeconomic status (SES)

SES refers to an individual's or family's financial and social position in a society. (Baker, 2014). Wealth, education, employment, household assets and characteristics are some key components commonly used to determine SES in health inequality studies (Anik et al., 2019; Biswas et al., 2022; Kushitor et al., 2020; Sarker et al., 2022). These factors are often used individually or in combination to assess SES and to understand its association with health outcomes (Antonoplis, 2023). In the South African Demographic Health Survey, SES included factors such as livestock, land, educational attainment, geographical location, specific household assets such as televisions, bicycles, vehicles, and numerous other factors (SADHS, 2019).

1.1.10 Socioeconomic-status related health inequality in DBM

Insufficient knowledge about socioeconomic inequalities within countries poses a significant obstacle to addressing issues effectively. Various researchers such as Nguyen et al. (2021) and Sarker et al. (2022) have identified a theoretical relationship between SES and the DBM. The nutritional well-being of a population is significantly influenced by both the quality and

quantity of available food resources (WHO, 2016a). Over time, there has been an increase in packaged, restaurant, and take-away snacks and meals, accompanied by a rise in the cost of fresh produce, particularly impacting LMICs reliant on food imports (WHO, 2016a). Additionally, factors such as war, violence, and climate-related events have also played a role in shaping individual or national dietary patterns (WPF, 2023). In various regions, individuals with lower SES often face challenges in affording nutritious food, thereby increasing their susceptibility to the DBM. As per the estimates provided by the World Food Programme in 2023, approximately 333 million individuals are currently facing acute levels of food insecurity (WPF, 2023).

1.2 METHODOLOGICAL REVIEW

This section looks at the various methodologies that can be utilised to assess the DBM and health inequalities, at a population level. Examining these methods serves as a critical foundation for comprehending the steps involved in assessing the variables of interest.

1.2.1 Measuring DBM

How the DBM is defined can vary depending on the objectives and aim of a particular study. For instance, in research conducted in India by Nguyen et al. (2021), the DBM was defined as the coexistence of a stunted and overweight/obese child or an underweight and overweight/obese adult. Another study conducted in Bangladesh by Sarker et al. (2022), defined the DBM as the simultaneous occurrence of an underweight mother with an overweight child or an overweight mother with a child experiencing stunting, wasting, or underweight, all within the same household. In both these studies and the South African demographic health survey, body mass index (BMI) was used to categorize adults as underweight, normal weight, overweight, and obese (Nguyen et al., 2021; SADHS, 2019; Sarker et al., 2022). BMI is a numerical measurement that utilizes an individual's weight (in kilograms) and height (in meters squared) to offer an approximation of body fat, for both males and females (Weir & Jan, 2019).

The equation for BMI:

$$\boldsymbol{BMI} = \frac{weight\ in\ kg}{(height\ in\ meters)^2}$$

According to WHO (2010), based on the participant's BMI, they will be classified as:

Underweight *if BMI <18.50*kg/m^2

Normal weight *if BMI 18.5-24.9*kg/m^2

Overweight *if BMI 25-29.9*kg/m^2

Obese *if BMI*$\geq$*30*kg/m^2

1.2.2 Measuring health inequalities

Several methodologies have been established to effectively measure health inequalities, which include the concentration curve (associated with the Concentration Index), the Slope Index of Inequality, the Relative Index of Inequality, the Index of Dissimilarity, the Gini coefficient, the Lorenz curve, and the Pseudo-Lorenz curve (Wagstaff et al., 1991).

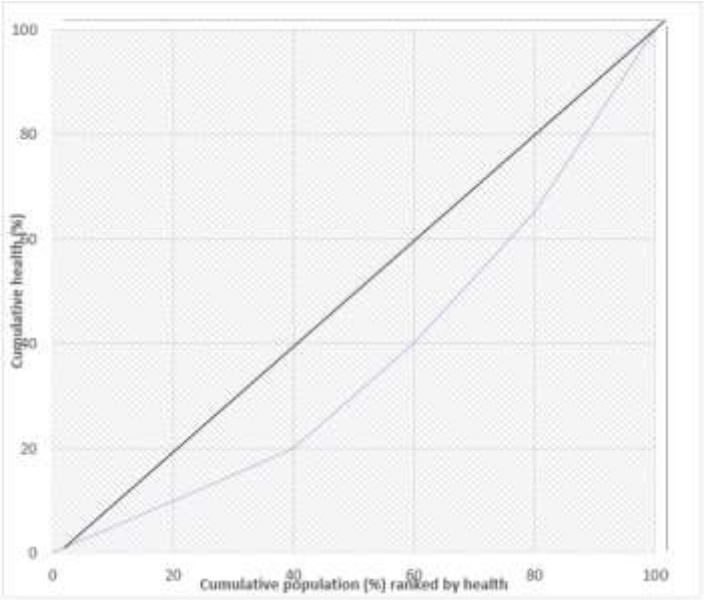
1.2.2.1 The range

This method of assessing health inequalities typically involves comparing the experiences of the top and bottom socioeconomic groups (Wagstaff et al., 1991). The comparison is expressed as the range itself or as a ratio between one extreme value and the other. While the range provides a simple measure, it may not capture the full complexity of health inequalities. The range does not fully account for what is going on within intermediate socioeconomic groups (Wagstaff et al., 1991). For example, the gap between the top and bottom groups might remain the same, but inequality among the intermediate groups might be changing. Another limitation associated with using the range is that it fails to account for the sizes of the comparison socioeconomic groups, which makes it insensitive to changes in the population distribution across the groups resulting in misleading conclusions (Wagstaff et al., 1991).

1.2.2.3 The Lorenz curve and Gini coefficient

The Lorenz curve was introduced by Max O. Lorenz in 1905 as a visual representation of income distribution. The Lorenz curve is a graphical representation of the population's distribution of a variable, such as health. It plots the cumulative proportions of the population, ranked by health, against the cumulative proportions of health. In the graph, a 45-degree diagonal line represents a lack of inequalities. If health inequalities exist, the curve deviates below the diagonal line as shown in Figure 4. The greater the deviation, the more pronounced the inequality. While the Lorenz curve captures the experiences of all individuals and is not

limited to specific social classes, it fails to account for the socioeconomic dimensions of health inequalities (Wagstaff et al., 1991).



Part A: Figure 4. The Lorenz curve for the hypothetical population

The Gini coefficient, on the other hand, quantifies the degree of inequality represented by the Lorenz curve. It is calculated as the area between the line of equality and the Lorenz curve, ranging from 0 to 1 (Wagstaff et al., 1991). It is calculated as twice the area between the Lorenz curve and the diagonal or as one minus the area under the Lorenz curve (Wagstaff et al., 1991). Both these methods yield the same result.

1.2.2.4 Slope and Relative index of inequality

The relative index of inequality (RII) and the slope index of inequality (SII) are measures that reflect the socioeconomic dimension of health inequalities (Moreno-Betancur et al., 2015). These indices calculate the mean health status of each socioeconomic group and rank them by their socioeconomic status, not by their health (Wagstaff et al., 1991). The SII is an absolute measure used to calculate the magnitude of health inequalities across multiple socioeconomic groups within a population (Renard et al., 2019; Schlotheuber & Hosseinpoor, 2022). The entire population sample is organized in ascending order from the most disadvantaged subgroup (Regidor, 2004; Schlotheuber & Hosseinpoor, 2022). As an absolute measure, the SII is sensitive to shifts in the average population health level or variations in the occurrence

of the health issue under examination (Regidor, 2004; Wagstaff et al., 1991). This sensitivity limits its applicability for evaluating inequalities in various populations over time. In terms of interpretation, the SII assumes a value of zero if there is no inequality, a negative value for inequities among the poor (pro-poor), and a positive value for inequalities concentrated among the wealthy (pro-rich) (Schlotheuber & Hosseinpoor, 2022).

The RII is frequently used to quantify how the occurrence of a health outcome varies according to socioeconomic status or another relevant background factor (Sergeant & Firth, 2006). The RII expresses the relationship between the highest SES and the lowest health outcomes. It exclusively assumes non-negative values and considers both the group's socioeconomic status and its population size (Mackenbach & Kunst, 1997). RII assumes a value of one if no inequalities are present (Schlotheuber & Hosseinpoor, 2022). A value above one indicates inequalities among the wealthy (pro-rich), and a value below one indicates inequalities concentrated among the poor (pro-poor) (Mackenbach & Kunst, 1997; Schlotheuber & Hosseinpoor, 2022).

1.2.2.5 Pseudo-Lorenz curve

The Pseudo-Gini coefficient and the Pseudo-Lorenz curve are methods used to analyse health inequalities, but they differ from the traditional Gini coefficient and Lorenz curve in that instead of using individual-level data, they use grouped data based on occupational classes, which are then ranked by mortality (Wagstaff et al., 1991). This version plots the cumulative percentage of the population, grouped into occupational classes, and ranked by health, against the cumulative percentage of deaths (Wagstaff et al., 1991). However, because the population is grouped by social class rather than health, their curve is not a true Lorenz curve. This method fails to capture the socioeconomic aspect of health inequality because the classes are arranged based on their health status (Wagstaff et al., 1991). It cannot differentiate between a situation where the sickest socioeconomic group is made up of millionaires and one where it is made up of unskilled manual workers.

1.2.2.6 Index of Dissimilarity

The Index of Dissimilarity (ID) is a measure used in health inequality studies. It is calculated for various socioeconomic groups, and it measures the absolute difference between the groups'

share of the population's health from its population share (Wagstaff et al., 1991). It implies an absolute distance concept, meaning that under complete equality, everyone's share of health would be equal to their population share (Wagstaff et al., 1991). This is shown in the equation below, ID is the difference between the population health of the group (s_j^h) and the group's population share (s_j^p), all divided by two (Wagstaff et al., 1991).

$$ID = \frac{1}{2} * \sum_j (S_j^h - S_j^p)$$

Were

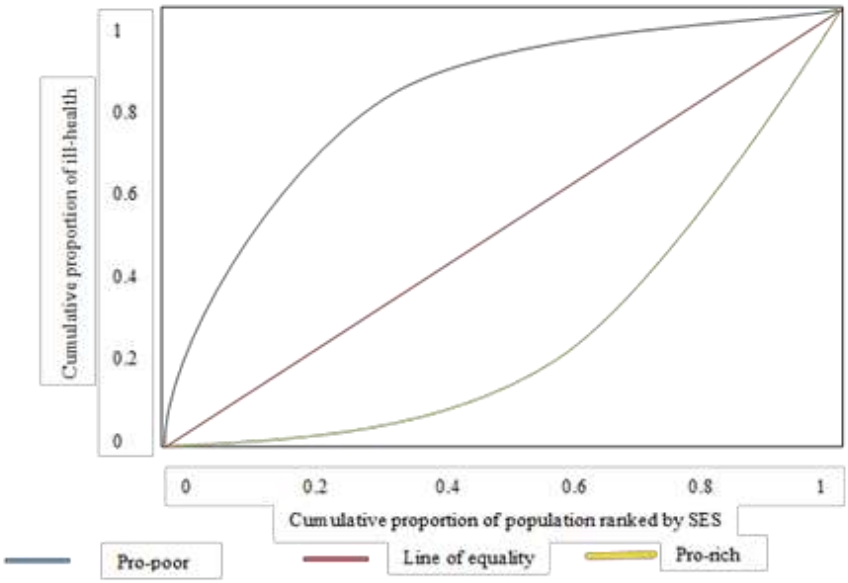
(s_j^h) is the population health of the group

(s_j^p) is the group's population share

The ID just like the pseudo-Lorenz curve fails to account for the socioeconomic dimensions of inequalities in health (Wagstaff et al., 1991). It only considers how each group's share of health compares with its population share, not how this inequality relates to the group's socioeconomic status.

1.2.2.6 Concentration Index and Curve

A concentration curve is a graphical representation where cumulative proportions of the population (arranged from the most disadvantaged to the least disadvantaged) are plotted against the cumulative proportions of health as shown in Figure 5. If there are no health inequalities the concentration curve will align with the 45-degree diagonal line (line of equality) (Wagstaff et al., 1991). If the inequality is concentrated among the poor, the concentration curve will lie below the line of equality. Conversely, if the inequality is concentrated among the rich, the concentration curve will be positioned above the line of equality. While the concentration curve can illustrate the socioeconomic inequalities associated with a health outcome, it is not suitable for quantifying the extent of the inequality (Kakwani et al., 1997).



Part A: Figure 5. Concentration curves

The Concentration Index (CI) provides a numerical measure of the socioeconomic inequalities in health (Erreygers, 2009). It quantifies the gap between the concentration curve and the equality line (Almasi-Hashiani et al., 2017).

The CI can also be computed from the equation below:

$$CI=\frac{2}{\mu}COV(y_i, R_i)$$

Were

y_i is the health variable

μ is its mean.

R_i is the fractional rank of the *i*th individual in the socioeconomic distribution (e.g., an individual's rank in the income distribution.

COV(.,.) is the covariance.

The CI is bounded between –1 and +1 (Wagstaff et al., 1991). A negative CI indicates a higher concentration of DBM inequities among the poor (pro-poor), on the other hand, a positive CI

suggests that the DBM inequalities are concentrated among the wealthy (pro-rich) (Wagstaff et al., 1991). If the CI value is zero (is on the line of equality), it indicates the absence of socioeconomic disparities. Like SII and RII, in the CI, individuals are ranked according to their socioeconomic status, starting with the most disadvantaged (Wagstaff et al., 1991). This is a widely used index for analysing health inequality because of its association with the concentration curve, its compatibility with the Gini coefficient, and its ease of decomposition (Erreygers, 2009).

1.2.2.6 Decomposition analysis

The CI and the concentration curve serve as valuable tools for indicating socioeconomic inequalities, but they are limited in explaining the factors associated with the observed inequality. The CI can be broken down into individual factors that either contribute to or are associated with health inequalities (Wagstaff et al., 2003). Decomposition analysis gives a deeper insight into the specific factors contributing to the observed inequalities, thus facilitating targeted interventions and policy measures aimed at addressing the root cause.

In decomposing the concentration index, the following steps are done

Regression of health variable against its determinates

$$\gamma_i = \alpha + \sum_k \beta_k x_{kj} + \varepsilon_i \qquad (1)$$

Where:

x_k - set of k determining variables

β_K - the coefficient

ε_i - random error term

Given the relationship between γ_i and x_{kj} as expressed in equation 1, we can formulate the CI for y as follows:

$$C = \sum_k \left(\frac{\beta_{k\bar{x}_k}}{\mu}\right) C_k + \frac{GC_\varepsilon}{\mu} \qquad (2)$$

Where:

μ - mean of γ

$\bar{x}_k$ - mean of x_k

C_k – the CI of x_k

1.3 EMPIRICAL

1.3.1 Literature search strategy

This section provides an overview of studies investigating socioeconomic inequalities within the DBM. The research sources encompassed several databases, including Google Scholar, EconLit, Scopus, PubMed, Web of Science, and BioMed Central. Additionally, studies from the WHO websites were included. To identify relevant studies, a combination of Medical Subject Headings (MeSH) terms were used: 1. Health Inequality (inequality(ies) or disparity(ies)); 2. Socioeconomic status (social class); 3. For the DBM, there was no MeSH term available, so the dual burden of malnutrition, overnutrition or undernutrition or malnutrition or overweight and underweight were used; 4. Women (mother). Some studies were excluded if access to the full article was not publicly available and studies that only included children.

1.3.2 Study Comparison

1.3.2.1 Prevalence

Research across multiple countries reveals varying prevalence rates of DBM, with some studies reporting separate rates for underweight and overweight/obesity. Notably, in Africa, studies have revealed alarmingly high prevalence rates of overweight and obesity, with Seychelles and South Africa ranking among the top five countries with the highest prevalence for both conditions (Agyemang et al., 2015). Gender disparities are evident, with women often experiencing higher rates of overweight and obesity, particularly in Seychelles, Lesotho, and South Africa (Agyemang et al., 2015). In South Africa, women of childbearing age exhibited a striking prevalence of 60% for overweight and 35.2% for obesity (Nglazi & Ataguba, 2022).

Some studies investigated household DBM. A study in Ghana revealed a 14% prevalence of the DBM among women aged 15-49 years, characterized by the coexistence of anaemia and BMI challenges (Kushitor et al., 2020). Similarly, investigations in rural Malaysia and Haiti

found household DBM prevalence rates of approximately 15.7% and 14%, respectively (Khor & Sharif, 2003; Raphaël et al., 2005). Similar findings have been reported in Malaysia, Haiti, Russia, China, Brazil, Bangladesh, Nepal, Pakistan, and Myanmar, where household-level DBM was observed (Anik et al., 2019; Biswas et al., 2022; Doak et al., 2000). In South and Southeast Asian countries like Bangladesh, Cambodia, India, Myanmar, Nepal, Pakistan, and Timor-Leste, the combined underweight prevalence was reported at 22%, while the overweight prevalence stood at 29% (Biswas et al., 2022). A study conducted in India highlighted significant shifts in BMI-related trends among women over a decade, with a notable decrease in underweight prevalence but a significant increase in overweight/obesity rates, particularly among rural and urban slum populations (Nguyen et al., 2021).

1.3.2.2 Prevalence in South Africa

In various provinces of South Africa, the DBM poses significant health challenges among women. In Limpopo Province, the DBM within households was evident, a striking prevalence of overweight (27.4%) and obesity (42.3%) was observed among mothers (Modjadji & Madiba, 2019). Similarly, in Free State Province, both rural and urban areas exhibited high rates of overweight and obesity among women, with 65.6% and 66.2% prevalence, respectively (Tydeman-Edwards et al., 2018). South Africa has demonstrated the highest GDP alongside alarming rates of overweight and obesity, particularly among children under 5 years old (13.3%) and adults over 18 years old (51.9%) (Mbogori et al., 2020). Moreover, in KwaZulu-Natal, household DBM was prevalent, with 32.1% of mothers classified as overweight and 28.4% with obesity grade 1 (Kaldenbach et al., 2022). Additionally, the country's prevalence of overweight/obesity and anaemia stands at 38.7%, the highest among 29 African countries (Santos et al., 2023). Most studies on the DBM involving women in South Africa have primarily focused on either household contexts or individual prevalence of BMI challenges.

1.3.2.3 Association of SES and DBM

Nguyen et al. (2021) conducted a study in India to examine inequalities in DBM among individuals of different age groups, considering factors such as gender, wealth, and place of residence. The researchers utilized the SII and the CI to evaluate these inequalities. Their findings revealed that inequalities among underweight women were pro-poor across various

residential areas, while inequalities among obese women were pro-rich. However, a decomposition analysis was not conducted in this study.

Sarker et al. (2022) conducted research in Bangladesh to assess the occurrence of DBM among mothers aged 15 to 49 years with children under 5 years old. Using data from the Bangladesh Demographic Health Survey, they defined DBM as the coexistence of underweight mothers with overweight children or overweight mothers with stunted, wasted, or underweight children. To assess the inequalities in the DBM across different socioeconomic groups, the researchers used the CI. The analysis of these two distinct BDM scenarios yielded different CI values. With the scenario involving overweight mothers and underweight children being characterized as pro-rich, and scenarios with underweight mothers and overweight children being identified as pro-poor.

In a research study conducted in Bangladesh by Sarker et al., (2022), the aim was to assess the occurrence of DBM among mothers aged 15 to 49 years who had children under 5 years of age. DBM was defined as the coexistence of an underweight mother with an overweight child, or an overweight mother with a stunted, wasted, or underweight child. This investigation utilized data from the Bangladesh Demographic Health Survey conducted between 2017-2018. To assess the inequalities in DBM prevalence across different socioeconomic groups, the researchers used a CI. The analysis of these two distinct BDM scenarios yielded different CI values. Specifically, the situation involving an overweight mother with stunted, wasted, or underweight children was characterized as pro-rich due to the positive CI value. In contrast, the scenario involving underweight mothers with overweight children was identified as pro-poor due to the negative CI value.

Biswas et al. (2022) examined the absolute and relative inequalities in the DBM among women across seven countries in South and Southeast Asia: Bangladesh, Cambodia, India, Myanmar, Nepal, Pakistan, and Timor-Leste. They utilized DHS data (2000-2017) and calculated CI to measure socioeconomic inequalities, defining DBM as the coexistence of underweight and overweight/obesity within each country. They combined overweight and obesity categories due to low obesity prevalence in some countries The study revealed that underweight was concentrated among poor women, while overweight/obesity was more common among rich women in all countries studied. The greatest inequality among underweight women was observed in Pakistan in 2013 (CI = -0.36) and for overweight/obese women was in Pakistan in 2000 (CI = 0.57).

Another study investigated the prevalence, socioeconomic inequalities, and association between various socio-demographic factors and the DBM in households across four specific countries: Bangladesh, Nepal, Pakistan, and Myanmar. The research utilized datasets from the DHS. In this study, DBM was defined as the coexistence of an overweight mother and stunted child in the same household, with overweight being defined as a BMI $\geq 25kg/m^2$ for the mothers. Stunting was classified as a child with a length or height of at least two standard deviations (< 2 SD) below the mean for their age. The study utilized the RII to assess inequalities. The DBM within households was pro-rich, as indicated by RII values of 1.25 for both Bangladesh and Nepal, 1.14 for Pakistan, and 1.09 for Myanmar.

In India Singh et al., (2023) investigated, the prevalence and socioeconomic inequalities of household DBM among mother–child pairs were investigated. The study utilized data from the National Family and Health Survey (NFHS-5) conducted between 2019 and 2021. In this research, DBM was defined as the coexistence of an overweight or obese mother with a stunted, wasted, or underweight child. To measure health inequalities, the researchers used the concentration curve and the CI and further did a decomposition analysis. The overall CI was positive (0.24), and the concentration curve was below the line of equality indicating that household DBM was pro-rich. Determinants used in the decomposition analysis consisted of the mother's age, education, place of residence, region, and religion among many others. Abdominal obesity was the most significant contributor to the inequality in the DBM, followed by geographical region and place of residence.

Author and year	Title of study	Country of study	Data used	How they defined DBM	SES used	Methodology	Results
Kushitor, Owusu & Kushitor (2020)	The prevalence and correlates of the double burden of malnutrition among women in Ghana.	Ghana	2014 Ghana Demographic and Health Survey.	The coexistence of anaemia and BMI challenges (underweight or overweight/obesity) among women.	Household assets and other characteristics such as drinking water, type of floor, and sanitation facility.	Logistic regression	• 13% for underweight and anaemic. • 58.6% for overweight and anaemic. • 28.4% for obese and anaemic. • Overall prevalence was 14% of women (15-49 years) who experienced DBM. • Richer households had higher odds of experiencing DBM.
Khor & Sharif, (2003)	Dual forms of malnutrition in the same households in	Malaysia	A food frequency	The coexistence of an underweight child and an overweight mother.	Household income and household		• 15.7% of mother/child pairs were found to experience the DBM.

	Malaysia – a case study among Malay rural households		questionnaire (FFQ)		income per capita per month		
Doak et al., (2000)	Overweight and underweight Coexist within Households in Brazil, China, and Russia.	Brazil, China, and Russia	Brazil (PNSN 1989), China (CHHS 1993), Russia (RLMS 1996)	The coexistence of underweight and overweight members in the same household.	Income and the value of home production expressed in per capita	Multinomial logistic regression	• In Russia and China, the DBM was observed to be approximately 8%, Brazil was slightly elevated at 11%.
Nguyen et al., (2021)	The double burden of malnutrition in India: Trends and inequalities (2006–2016)	India	National Family Health Surveys in 2005–2006 (NFHS-3) and 2015-2016 (NFHS-4)	Coexistence of child and adult undernutrition and overweight or obesity	Household ownership of 17 assets, livestock, house, and land.	SII & CI	• Underweight women-36% in 2006 to 23% in 2016. • overweight/obese women -13% in 2006 to 21% in 2016. • Pro-rich across all residential areas.
Sarker et al., (2022)	Drivers and distribution of the household-level double burden of	Bangladesh	Bangladesh Demographic and Health	Coexistence of underweight mother and overweight child or overweight mother	Household's ownership of selected assets,	CI	• 13.35% for overweight mothers with stunted, wasted, or underweight children.

	malnutrition in Bangladesh: analysis of mother-child dyads from A National Household Survey		Survey (BDHS) 2017–2018	and stunting, wasting, or underweight child in the same household.	availability of electricity supply, television, bicycle, materials used for housing construction, types of water access and sanitation facilities, use of health and other services, and health outcomes		• 7.69% for underweight mothers with overweight children. • Pro-poor for underweight mothers and overweight children. • Pro-rich for overweight mothers and stunting, wasting, or underweight children.
Biswas et al., (2022)	Geographical and socioeconomic inequalities in the double burden of malnutrition among women in Southeast	Bangladesh, Cambodia, India, Myanmar, Nepal, Pakistan, and Timor-Leste	Demographic and Health Surveys (DHS) conducted between 2001 and 2017.	Coexistence of women underweight and overweight/obesity.	Household's ownership of selected assets.	CI	• Pooled prevalence 22% for underweight women. • 29% for overweight/obese women. • The highest prevalence was for underweight

	Asia: A population-based study						women was Bangladesh with 44% in 2000 and for overweight/obese women was Pakistan with 67% in 2017. • In all countries, being underweight was pro-poor while being overweight/obese was pro-rich.
Lee et al., (2012)	Socioeconomic disparities and the familial coexistence of child stunting and maternal overweight in Guatemala	Guatemala	Guatemalan Living Standards Measurement Survey (LSMS) 2000	Coexistence of a stunted child and an overweight mother	Total household consumption per capita of food and non-food items	Concentration curve with CI and ID	• Stunted child – 47.3% • Overweight mother - 42.2% • DBM – 17% • DBM was pro-poor
Anik et al., (2019)	Double burden of malnutrition at household level: A comparative study	Bangladesh, Nepal, Pakistan, and Myanmar	Demographic and Health Survey:	Coexistence of an overweight mother and stunted child in the same household.	Assets owned by households in urban and rural areas	RII & SII	Prevalence was: • Bangladesh 4.1% • Nepal 1.54% • Pakistan 3.93%

	among Bangladesh, Nepal, Pakistan, and Myanmar		Bangladesh (2014) Nepal (2016) Pakistan (2012-13) Myanmar (2015-16)				• Myanmar 5.54% • DBM among households was pro-rich in all countries.
Singh et al., (2023)	Inequalities in the prevalence of double burden of malnutrition among mother-child dyads in India	India	National Family and Health Survey (NFHS-5) (2019-2021)	Coexistence of an overweight/obese mother with a stunted/wasted/under weight child.	Wealth index which includes goods owned by the household, ranging from television, bicycle, car, and housing Characteristics for example drinking water, toilet facilities, and flooring materials.	CI	• 17.66% of mothers were overweight/obese. • 32% of the children were stunted. • 20% of the children were wasted. • 30% of the children were underweight. • DBM among households was pro-rich in all countries.

Meller et al., (2021)	Double Burden of Malnutrition and Inequalities in the Nutritional Status of Adults: A Population-Based Study in Brazil, 2019	Brazil	Vigitel 2019 (A cross-sectional investigation utilizing information sourced from the Surveillance System of Risk and Protective Factors for Chronic Diseases through Telephone Surveys)	Coexistence of underweight and excess-weight adults	Education	SII	• 6.% women were underweight, and 54.1% had excess weight. • 3.9% of men were underweight, and 50.2% had excess weight. • Being underweight and excess weight was pro-poor.
Kumar et al., (2022)	Inequalities in overweight and obesity among reproductive age	India	National Family Health Survey (2015–16)		Based on assets owned and household characteristics	CC and CI	*Prevalence* 19% of women were underweight and 25% were overweight and obese

	group women in India: evidence from National Family Health Survey (2015–16)						*Inequality* Being overweight or obese was pro-rich
Shirisha et al., (2022)	Wealth-related inequality in women and children malnutrition in the states of Chhattisgarh and Tamil Nadu	Chhattisgarh and Tamil Nadu (in India)	National Family Health Survey-3rd (2005–06) & 4th (2015–16)	Coexistence of a stunted/wasted child or both and underweight or obese mother.	Based on assets owned and household characteristics	SII & CI	*Prevalence* overweight/obese women were 2% in 2005-6 and 6% in 2015-16 *Inequality* Undernutrition and anaemia among children and women were pro-poor Overweight /obesity was pro-rich

CC- concentration curve, CI – concentration index, RII – relative index of inequality, SII - slope index of inequality

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PART B: JOURNAL ARTICLE

Proposed journal: BMC Public Health

Title and authorship information

Double burden of malnutrition among women in South Africa: Evidence from the Demographic Health Survey

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ABSTRACT

Background

The global shifts in nutrition patterns have been associated with an increasing number of individuals experiencing multiple forms of malnutrition, resulting in what is known as the double burden of malnutrition (DBM). In 2014, WHO estimated that close to 2 billion adults aged 18 and above worldwide were overweight, 600 million adults were obese, and 462 million adults were underweight. In recent years, there has been a notable increase in the DBM among women, particularly in Southern Africa. South Africa is ranked among the top five African countries with the highest prevalence of overweight and obese individuals. Most studies on the DBM involving women in South Africa were primarily focused on either household contexts or individual prevalence of Body Mass Index challenges. This study seeks to fill the research gap by examining socioeconomic disparities in the double burden of malnutrition (DBM) among non-pregnant women in South Africa and identifying the main contributing factors.

Methods

The study only included non-pregnant women (n=3262) aged between 15-49 years. For the analysis, data from the 2016 South Africa Demographic Health Survey was utilized to calculate the prevalence of DBM (coexistence of underweight and overweight/obese non-pregnant women) and to examine the socioeconomic inequalities, using the concentration curve and the concentration index. An in-depth decomposition analysis uncovered the key driving factors contributing to the observed inequalities.

Results

A total of 39% (1261 out of 3262) of non-pregnant women were found to experience the DBM. This prevalence varied across demographics, with higher rates among women in the 35-44 age bracket, unemployed, Black/African, unmarried, urban residents, and those in the middle wealth

quintiles. Socioeconomic inequalities related to the DBM were evident, illustrated by a pro-rich distribution in the concentration curve and a positive CI value of 0.14. Factors such as education, employment, health insurance, marital status, and watching TV contributed positively to socioeconomic inequality, while factors like parity and place of residence exhibited negative contributions.

Discussion

This research offers significant insights into the DBM among South African non-pregnant women. The high prevalence, especially within certain demographic groups, highlights the urgent need for focused interventions to address these health disparities. The socioeconomic inequalities related to DBM, as evidenced by a pro-rich distribution highlight the complex interplay of numerous factors. These findings suggest that addressing DBM in South Africa requires a multifaceted approach that considers the socioeconomic context.

BACKGROUND

Malnutrition has traditionally been addressed as a separate issue, with some studies focusing on undernutrition, food insecurity, and micronutrient deficiencies, while others have concentrated on overnutrition, obesity, or overweight (Wells et al., 2020). However, due to the rapid global transition in nutrition patterns, an increasing number of individuals are now experiencing multiple forms of malnutrition, termed the double burden of malnutrition (DBM) (Wells et al., 2020). The World Health Organization (WHO) refers to the DBM as the coexistence of undernutrition and overnutrition within the same population, community, or individual (WHO, 2016a). This global burden of malnutrition affects every country. In 2014, WHO estimated that over 2 billion adults aged 18 and above worldwide were overweight, and 600 million adults were obese, while 462 million adults were underweight (WHO, 2016a). Additionally, close to 3 million individuals die each year because of being overweight or obese (Añón-Hidalgo et al., 2019).

The increase in the incidence of overweight and obesity rates has been linked to the shifts in the global food system, which have made unhealthy food more accessible and affordable. This is coupled with a decline in physical activity due to technological advancements in transportation, home, and workplace settings (Popkin et al., 2020). These transitions are more prevalent in developing or low-middle-income countries (LMICs) due to improving economic conditions (Kimani-Murage, 2013). Presently, DBM is becoming more prevalent in the poorest LMICs with significantly lower gross domestic product per capita, particularly in South and East Asia and Sub-Saharan Africa (SSA) (Agyemang et al., 2015; Popkin et al., 2020).

Within SSA, South Africa stands out as the country most affected by obesity and overweight individuals, ranking among the top five African countries with the problem (Agyemang et al., 2015). Proximity to big food retailers and fast-food restaurants has been associated with higher rates of overweight and obesity in South Africa (Otterbach et al., 2021). Recent studies indicate a population prevalence of underweight adults at 4.8% and 51.9% for overweight and obese adults

in South Africa, with women of childbearing age exhibiting a higher incidences (Mbogori et al., 2020; Nglazi & Ataguba, 2022).

In SSA, the shift towards overnutrition has occurred rapidly over the last four decades, with women being more significantly impacted compared to men (Delisle, 2008; Were et al., 2020). Women play a crucial role in ensuring nutritional needs are met for themselves and their families, yet they are disproportionately affected by nutritional disorders and chronic diseases (Delisle, 2008; Madzorera & Fawzi, 2020). Despite their increased nutritional requirements, efforts to improve women's nutritional status have often focused on maternal and child nutrition during pregnancy and early childhood (Madzorera & Fawzi, 2020). Women are at a heightened risk of experiencing the DBM. However, there is limited research on socio-economic inequalities among women in South Africa concerning the DBM. This research aims to address this gap by investigating socioeconomic inequalities in the DBM among non-pregnant women in South Africa and identifying the primary factors contributing to these inequalities.

METHODS

Data

This study utilised data from the 2016 South African Demographic and Health Survey (SADHS), a nationally representative survey that is publicly available on (https://www.dhsprogram.com/). It uses a stratified two-stage sampling design. This investigation concentrated on the women's survey within the SADHS, which had information on women aged between 15 to 49 years. The initial sample size was 11083 women, but due to missing data and the exclusion of pregnant women, the final sample size was reduced to 3262 non-pregnant women.

Outcome variable

In this study, the outcome variable is the DBM. DBM was defined as the coexistence of underweight and obese non-pregnant women in South Africa. It was assessed using Body Mass Index (BMI). BMI, also known as the Quetelet index, is one of the measurements used to assess the nutritional status of women in the demographic health surveys (SADHS, 2019). BMI was calculated using the respondent's height and weight measurements. In the SADHS surveys, weight was recorded in kilograms (kg), while the height was recorded in centimetres (cm) (SADHS, 2019).

The equation for BMI is as follows:

$$BMI = \frac{weight\ in\ kg}{(height\ in\ meters)^2}$$

According to WHO (2010), women were then classified as underweight if BMI <18.50kg/m^2 and obese if BMI≥30kg/m^2.

Socioeconomic status (SES)

The SES of the population was assessed using the SADHS wealth index. The wealth index is a scoring system used to create household wealth quintiles, considering consumer assets, such as televisions, bicycles, or cars, as well as housing attributes like the source of drinking water, toilet facilities, and flooring materials (SADHS, 2019). Households were grouped into five quantiles and ranked from poorest to richest.

Analytical Methods

The data management, exploration, and analysis were done using Stata 17 statistical software.

Socioeconomic inequalities

This paper utilised the concentration curve and the concentration index (CI) methodologies to assess the health inequalities among non-pregnant women in South Africa. The concentration curve visually depicts the cumulative proportions of the population plotted against the cumulative proportions of health, with the population ranked from the most disadvantaged to the least disadvantaged. In cases where there are no health inequalities, the concentration curve will align with the line of equality (Wagstaff et al., 1991). When inequalities are concentrated among the poor, the concentration curve falls above the line of equality, whereas if inequalities are concentrated among the rich, the curve will be situated below the line of equality. Although the concentration curve provides a graphical representation of socioeconomic inequalities related to a health outcome, it does not quantify the extent of inequality (Kakwani et al., 1997).

The CI is widely employed for analysing health inequality due to its association with the concentration curve, and its ease of decomposition (Erreygers, 2009). Bounded between -1 and +1, the CI provides the degree of inequality in health between the rich and poor (Wagstaff et al., 1991). A negative CI indicates a higher concentration of inequities among the poor (pro-poor), whereas a positive CI suggests that the inequalities are concentrated among the wealthy (pro-rich) (Wagstaff et al., 1991). A CI value of zero signifies the absence of socioeconomic inequalities.

The CI can be computed from the equation below:

$$CI=\frac{2}{\mu}COV(y_i, R_i)$$

Where y_i is the health variable, and μ is its mean. R_i is the fractional rank of the *i*th individual in the socioeconomic distribution (e.g., an individual's rank in the income distribution. *COV(.,.)* is the covariance.

Decomposition analysis

The CI and the concentration curve serve as valuable tools for indicating socioeconomic inequalities. The CI can be broken down into individual factors that either contribute to or are associated with health inequalities (Wagstaff et al., 2003). Decomposition analysis provides a deeper insight into the specific factors contributing to the observed inequalities. The CI can be expressed as the total sum of contributions from different determinants, alongside an unexplained residual component (Zere et al., 2011).

In decomposing the CI, the following steps will be done

1. Regression of health variable against its determinates

$$\gamma_i = \alpha + \sum_k \beta_k x_{kj} + \varepsilon_i \qquad (1)$$

Where:

x_k - set of k determining variables

β_K - the coefficient

ε_i - random error term

Given the relationship between γ_i and x_{kj} as expressed in equation 1, we can formulate the CI for y as follows:

$$C = \sum_k \left(\frac{\beta_{k\bar{x}_k}}{\mu}\right) C_k + \frac{GC_\varepsilon}{\mu} \qquad (2)$$

Where:

μ - mean of γ

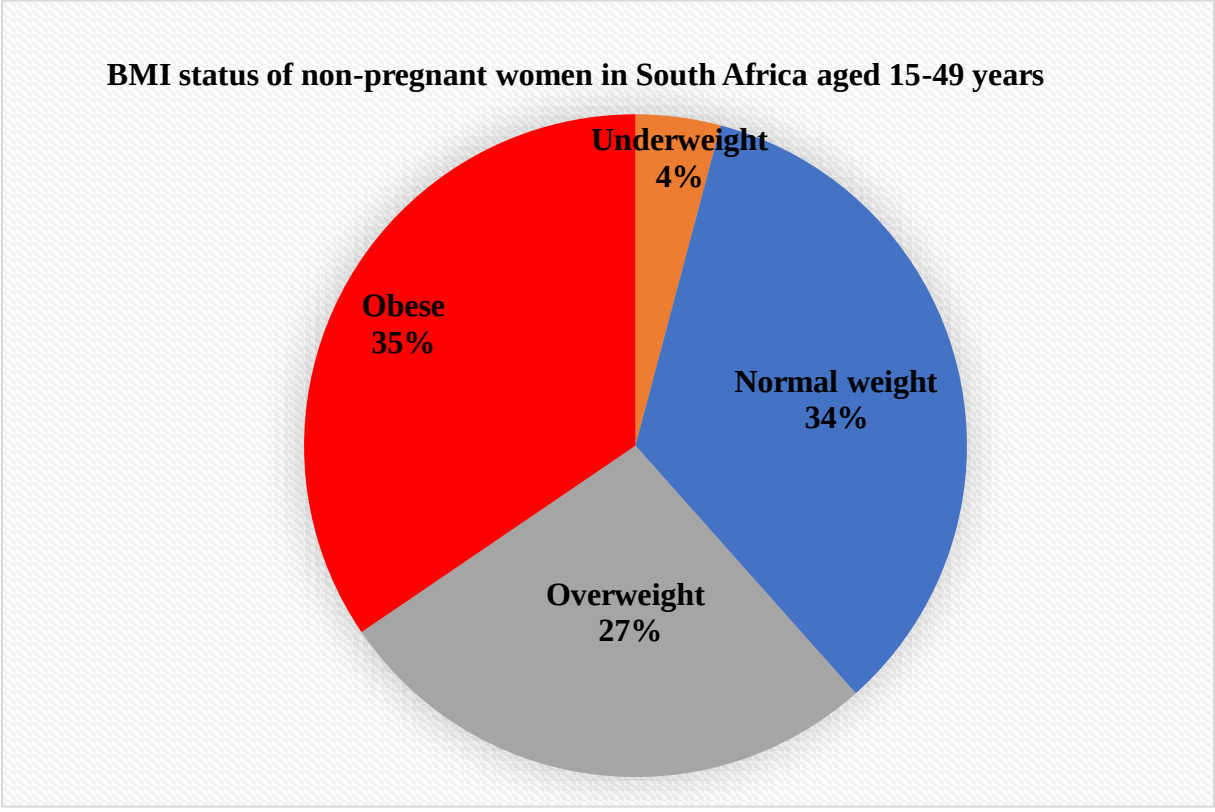
$\bar{x}_k$ - mean of x_k

C_k – the CI of x_k

RESULTS

BMI distribution among women

Figure 1 illustrates the BMI distribution among non-pregnant women in South Africa. The analysis reveals that the largest proportion of women, approximately 35% of the total sample, was within the normal weight category. Additionally, a huge portion of women are categorized as either overweight or obese, accounting for 27% and 34% of the sample, respectively. The prevalence of underweight individuals was low, comprising only 4% of the sample.



Part B: Figure 1. BMI distribution among non-pregnant women in South Africa

General characteristics

A considerable proportion of women, approximately 39% (n=1261 of 3262), experience the DBM (coexistence of both underweight and obesity). The prevalence of the DBM varied across diverse groups. Women aged 35-44 years had the highest prevalence (33%), followed by those aged 25-34 years (32%), while women aged 45-49 years had the lowest prevalence (16%). Among the different education levels, those with secondary education had the highest prevalence of 76%. Unemployed women had a slightly higher prevalence of DBM (59%) as compared to employed women (41%). Regarding ethnicity, the highest prevalence of DBM was among Black/African women (88%), followed by Coloured women (9%), White women (2%), and Indian/Asian women (1%). Unmarried women showed a higher prevalence of DBM (61%) compared to married women (39%). Urban residences exhibited a higher prevalence of DBM (56%) compared to rural areas (44%). Most women with the DBM did not have health insurance (86%). Larger households (>5 members) had a higher prevalence of DBM (47%) compared to smaller households. The prevalence of DBM also varied by wealth quintiles, with the highest prevalence observed among the poorest (17%) and poorer (20%) quintiles.

Part B: Table 1. Background characteristics of women with the DBM

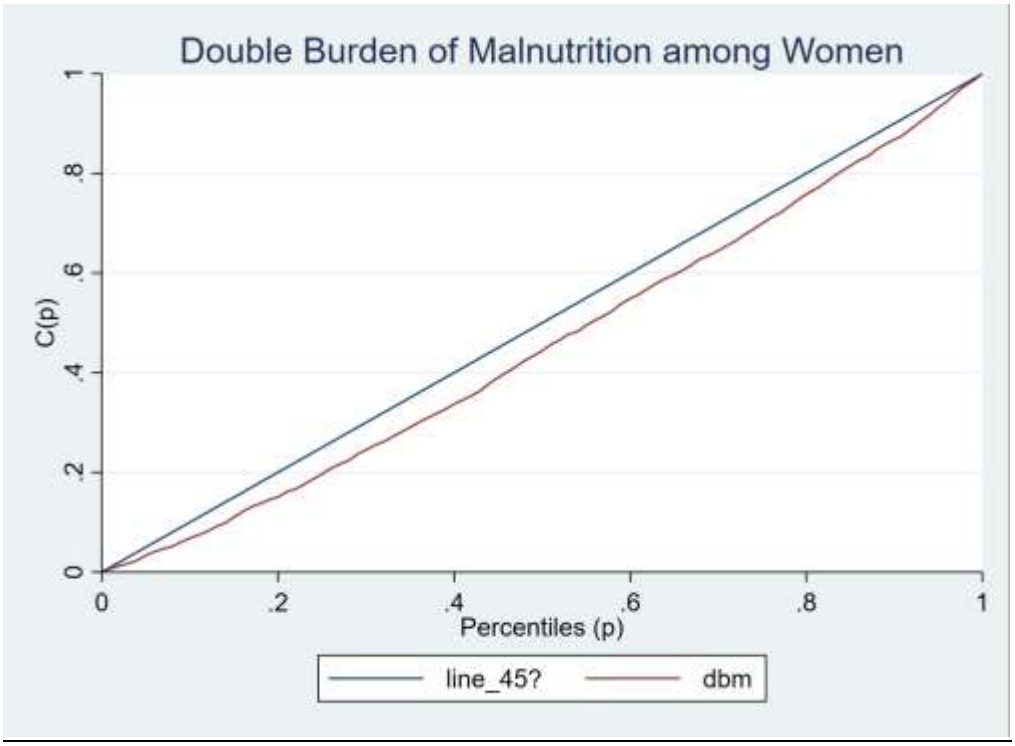
Women's characteristics	**DBM**	**p-value**
	n=1261 (39%)	
Age		**<0.001**
15-24 years	245 (19)	
25-34 years	402 (32)	
35-44 years	414 (33)	
45-49 years	200 (16)	

Education		**0.6411**
No education	34 (3)	
Primary	133 (11)	
Secondary	962 (76)	
Higher	132 (10)	
Employment status		**<0.001**
Unemployed	743 (59)	
Employed	518 (41)	
Ethnicity		**0.6020**
Black/African	1107 (88)	
White	24 (2)	
Coloured	117 (9)	
Indian/Asian	13 (1)	
Household size		**0.0154**
1-2	214 (17)	
3-5	451 (36)	
>5	596 (47)	
Health insurance		**0.0126**
No	1081 (86)	
Yes	180 (14)	
Marital status		**<0.001**
Not married	766 (61)	
Married	495 (39)	
Parity		**<0.001**
0	219 (18)	

1	283 (22)	
2	305 (24)	
>3	454 (36)	
Place of residence		**0.4083**
Urban	705 (56)	
Rural	556 (44)	
Region		**0.0998**
Western cape	75 (6)	
Eastern cape	159 (13)	
Northern cape	116 (9)	
Free state	142 (11)	
Kwazulu-Natal	201 (16)	
Northwest	145 (11)	
Gauteng	111 (9)	
Mpumalanga	150 (12)	
Limpopo	162 (13)	
Watching TV		**<0.001**
Not watching	204 (16)	
watching	1057 (84)	
Wealth index		**<0.001**
Poorest	209 (17)	
Poorer	254 (20)	
Middle	328 (26)	
Richer	282 (22)	
Richest	188 (15)	

Socioeconomic inequality

The study found that socioeconomic inequalities related to the DBM among non-pregnant women in South Africa were more prevalent among those with higher socioeconomic status, indicating a pro-rich distribution. This is illustrated in Figure 2 by the concentration curve, which fell below the line of equality. This was further supported by a positive CI value of 0.14.



Part B: Figure 2. Concentration curve for the DBM among non-pregnant women in South Africa

Table 2 illustrates the estimates of the decomposition analysis, with the individual CI and the respective contributions of numerous factors to the socio-economic inequality within the context

of the DBM among non-pregnant women in South Africa. The CI measures the degree of socio-economic inequality. The elasticity represents the sensitivity of the outcome variable to changes in the explanatory variable. The contribution signifies the degree of inequality attributable to the explanatory variable. In this analysis, factors such as education, employment, health insurance, marital status, and watching TV contribute positively to socio-economic inequality. Conversely, factors like parity and place of residence exhibit negative contributions. All factors had a positive CI besides household size, parity, and place of residence.

Part B: Table 2. Estimates from decomposition analysis

Background characteristics	Elasticity	Concentration index	Contribution
Age	0.099	0.032	0.012
Education	0.074	0.049	0.014
Employment	0.010	0.136	0.005
Ethnicity	0.001	0.442	0.001
Household size	-0.006	-0.009	0.000
Health insurance	0.006	0.507	0.013
Marital status	0.014	0.051	0.003
Parity	0.043	-0.043	-0.008
Place of residence	0.002	-0.339	-0.002
Region	-0.013	0.069	0.004

Watching TV	0.047	0.112	0.021

DISCUSSION

This study utilised the 2016 SADHS to explore socioeconomic inequalities in the DBM among non-pregnant women in South Africa, and to identify key contributing factors to this inequality. The findings highlight a significant DBM challenge faced by non-pregnant women in South Africa. A substantial proportion of women in the country were obese, with 35% experiencing this condition. This figure corresponds with the results reported by Agyemang et al. in 2015 (Agyemang et al., 2015). Additionally, 4% of women were found to be underweight. The overall prevalence of DBM among non-pregnant women was notably high at 39%, surpassing rates reported in other countries (Anik et al., 2019; Biswas et al., 2022; Doak et al., 2000; Kushitor et al., 2020). One possible explanation for this finding is the complex interplay of socioeconomic factors in South Africa, such as education, employment, and urbanization, which may contribute to both undernutrition and overnutrition. Increased urbanization, access to cheap, unhealthy food, and sedentary lifestyles could be driving factors for obesity, while economic inequality and limited access to nutritious food may contribute to underweight conditions. These findings suggest that addressing DBM among non-pregnant women in South Africa requires a comprehensive understanding of the multifaceted factors influencing both underweight and obesity.

A detailed examination of background characteristics revealed significant variations in DBM prevalence among the women. Factors such as parity, age, alcohol consumption, religion, household size, educational level, and employment status, wealth index, among others, have been associated with underweight and obesity in previous studies (Ahmed et al., 2020; Ferdausi et al., 2022; Hashan et al., 2020; Ikoona et al., 2023). The DBM prevalence increased with age, with a slight decrease observed in the 45-49 age range. The highest DBM rates were found in the 35-44

age bracket. Most affected women (76%) had secondary-level education, yet unemployment was markedly linked to higher DBM rates. Increased parity correlated with an increase in the prevalence of DBM, a finding that is consistent with some studies associating increased parity with obesity (Heliövaara & Aromaa, 1981; Li et al., 2016). Larger households and the absence of health insurance were also more common among the affected women. Notably, most affected women watched TV, and wealth distribution showed a middle-class majority. Black/African women constituted the majority of those affected by the DBM.

The socioeconomic inequality analysis confirmed a pro-rich distribution of the DBM, emphasizing the disproportionate burden on women of higher socioeconomic status. This inequality is graphically represented by the concentration curve, which lies below the equality line, corroborated by a positive CI value of 0.14. A similar study by Biswas et al. in 2022 investigated DBM inequalities among women in seven South and Southeast Asian countries—Bangladesh, Cambodia, India, Myanmar, Nepal, Pakistan, and Timor-Leste. The study found that underweight was pro-poor among the women, while overweight/obesity was pro-rich in all the countries studied (Biswas et al., 2022). Similarly, a study conducted by Nguyen et al. (2021) in India revealed that inequalities among underweight women were pro-poor across different residential areas, while inequalities among obese women were pro-rich (Nguyen et al., 2021).

The pro-rich inequality among the women in South Africa could be due to a variety of factors associated with higher socioeconomic status. Numerous factors have been associated with underweight and obesity, including parity, age, alcohol consumption, religion, household size, educational level, and employment status, among others (Ahmed et al., 2020; Ferdausi et al., 2022; Hashan et al., 2020; Ikoona et al., 2023).

In this study, a decomposition analysis was conducted, encompassing most of these factors. The analysis pinpointed key contributors to socioeconomic inequalities in the DBM. The decomposition analysis revealed that age, education, employment, health insurance, marital status,

place of residence, and television viewing all contribute positively to socioeconomic inequality, indicating a higher likelihood of DBM among wealthier women.

This study is not without limitations. The use of cross-sectional data from the 2016 SADHS may not fully capture the complexities of DBM prevalence and its contributing factors. Furthermore, the dataset used had a large proportion of missing data, which reduced the initial sample size from 11,083 women to 3,262 non-pregnant women. Missing data can reduce the representativeness of the samples, potentially limiting the generalizability of the findings. Future research should focus on addressing data completeness and consider longitudinal studies to better understand the dynamics of DBM among non-pregnant women in South Africa.

CONCLUSION

In conclusion, this study sheds light on the socioeconomic inequalities in the DBM among non-pregnant women in South Africa. The results highlight a significant challenge confronting non-pregnant women in the country, with a considerable percentage of women grappling with obesity. These insights carry substantial implications for health policies and interventions in South Africa. The high incidence of DBM among non-pregnant women, especially within specific demographic groups, underscores the necessity for targeted interventions.

DECLARATIONS

Research Ethics

Ethical approval for this study was sought from the Human Research Ethics Committee (HERC) of the University of Cape Town (970/2023).

Availability of data and materials

The data used for this study is from the 2016 South African Demographic and Health Survey, which is publicly available on (https://www.dhsprogram.com/).

Competing interests

No competing interests.

Funding

The study was self-funded by the corresponding author. No research funding was received.

Authors' contributions

Tinotenda Gerald Geoffrey Chiwawa designed the study, drafted the paper, analysed the results, reviewed the paper, and submitted it for publication.

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PART C: POLICY BRIEF

ADDRESSING SOCIOECONOMIC INEQUALITIES IN THE DOUBLE BURDEN OF MALNUTRITION AMONG NON-PREGNANT WOMEN IN SOUTH AFRICA

"Let food be thy medicine and medicine be thy food." — **Hippocrates**

BACKGROUND AND INTRODUCTION

Malnutrition is a global challenge, now involving both undernutrition and overnutrition, known as the double burden of malnutrition (DBM). South Africa, is one of the top five African countries with high overweight and obesity rates. DBM is now becoming more prevalent, especially among women. However, there's limited research on the socioeconomic factors contributing to DBM among South African women.

KEY FINDINGS

1. **High prevalence of DBM**

- The overall prevalence of DBM was 39%, surpassing rates reported in other countries.

  Obesity: 35%

  Underweight: 4%

2. The prevalence was influenced by factors including **age, education, employment status, ethnicity, household size, and wealth index.**

3. The DBM was concentrated among the wealthy.

4. Contributing factors to the inequality were **education, employment, health insurance, marital status, and television viewing.**

WHY IT MATTERS?

DBM has serious implications for individuals and society. About 3 million individuals die each year because of being overweight or obese. Underweight women may suffer from weakened immunity and increased vulnerability to infections. On the other hand, obesity is associated with chronic diseases such as diabetes, cardiovascular disorders, and certain cancers. When socioeconomic inequalities are present, it creates a cycle of disadvantage. These inequalities hinder progress toward achieving health equity and sustainable development goals.

POLICY IMPLICATIONS

- Targeted Interventions: Addressing the DBM among non-pregnant women requires tailored interventions that consider socioeconomic factors. Programs should focus on improving access to nutritious foods and promoting healthy lifestyle behaviours.
- Health Policy Integration: Health policies should integrate nutrition interventions into broader health systems. This includes integrating nutrition education into primary healthcare services and promoting collaboration between multiple health sectors.
- Community Engagement: Community-based initiatives, such as women's groups and nutrition education workshops, can promote behaviour change and empower individuals to make healthier choices.
- Research and Data Collection: Conducting further research to understand the dynamics of DBM prevalence and its determinants, particularly among vulnerable populations. Longitudinal studies can provide insights into the causal pathways and inform targeted interventions.

CONCLUSION

Addressing socioeconomic inequalities in the DBM among non-pregnant women in South Africa is crucial for improving health outcomes and promoting equity. By implementing targeted interventions, integrating nutrition into health policies, empowering women, engaging communities, and strengthening research, significant strides can be made towards reducing the double burden of malnutrition and promoting health and well-being for all.

PART D: APPENDICES

Appendix 1. ETHICAL APPROVAL

UNIVERSITY OF CAPE TOWN
Faculty of Health Sciences
Human Research Ethics Committee

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Groote Schuur Hospital
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19 December 2023

HREC REF: 970/2023

Dr Olufunke Alaba
Health Economics
Email: Olufunke.alaba@uct.ac.za
Student: Chwtin005@myuct.ac.za

Dear Dr Alaba

PROJECT TITLE: DOUBLE BURDEN OF MALNUTRITION AMONG WOMEN IN SOUTH AFRICA: EVIDENCE FROM THE DEMOGRAPHIC HEALTH SURVEY
(MASTER CANDIDATE- MR TINOTENDA GERALD GEOFFREY CHIWAWA)

Thank you for submitting your study to the Faculty of Health Economics Research Ethics Committee (HREC) for review.

It is a pleasure to inform you that the HREC has **formally approved** the above-mentioned study,

Approval is granted for one year until the 30 December 2024.

Please submit a progress form, using the standardised Annual Report Form (FHS016) or FHS017 if the study continues beyond the approval period. Please submit a Standard Closure form if the study is completed within the approval period.
(Forms can be found on our website: www.health.uct.ac.za/fhs/research/humanethics/forms)

The HREC acknowledge that the student: Mr Tinotenda Gerald Geoffrey will also be involved in this study.

Please quote HREC REF 970/2023 in all your correspondence.

Please note that the ongoing ethical conduct of the study remains the responsibility of the principal investigator.

Please note that for all studies approved by the HREC, the principal investigator **must** obtain appropriate institutional approval, where necessary, before the research may occur.

Yours sincerely

PROFESSOR M BLOCKMAN
CHAIRPERSON, FACULTY OF HEALTH SCIENCES HUMAN RESEARCH ETHICS COMMITTEE

Federal Wide Assurance Number: FWA00001637. Institutional Review Board (IRB) number: IRB00001938 NHREC-registration number: REC-210208-007
This serves to confirm that the University of Cape Town Human Research Ethics Committee complies to the Ethics Standards for Clinical Research with a new drug in patients, based on the Medical Research Council (MRC-SA), Food and Drug Administration (FDA-USA), International Council for Harmonisation of

Technical Requirements for Pharmaceuticals for Human Use: Good Clinical Practice (ICH GCP), South African Good Clinical Practice Guidelines (DoH 2020), based on the Association of the British Pharmaceutical Industry Guidelines (ABPI), and Declaration of Helsinki (2013) guidelines. The Human Research Ethics Committee granting this approval is in compliance with the ICH Harmonised Tripartite Guidelines E6: Note for Guidance on Good Clinical Practice (CPMP/ICH/135/95) and FDA Code Federal Regulation Part 50, 56 and 312.

Appendix 2. RESEARCH PROTOCOL

1.1 BACKGROUND

In the past, malnutrition has been addressed and tackled separately, with a focus on undernutrition, food insecurity, and micronutrient deficiencies, while other research has focused on overnutrition, obesity, or being overweight (Wells et al., 2020). However, as nutritional transitions occur globally at a rapid pace, an increasing number of individuals are experiencing various forms of malnutrition, termed as the double burden of malnutrition (DBM) (Wells et al., 2020). The World Health Organization (WHO) defines the DBM as the simultaneous occurrence of undernutrition and overnutrition within the same population, community, or even within individuals (WHO, 2016). The DBM has detrimental effects on societies, families, and individuals. It is observed at three different levels. At an individual level, it is seen particularly among women and children (Delisle, 2008). Within households, it is seen when several household members are affected by various forms of malnutrition, often characterized by the simultaneous presence of overweight/obese mother and child malnutrition (Delisle, 2008). The DBM is also observed at the population level, where undernourishment and overweight coexist within the same community, region, or country (WHO, 2016a).

The connection between undernutrition and overnutrition goes beyond just existing together. The global burden of malnutrition is a complex issue that now affects every country. In 2014, the WHO estimated that over 2 billion adults (18 years and older) worldwide were overweight, and more than 600 million of these adults were obese, while 462 million were underweight (WHO, 2016a). In 1990, the percentage of overweight individuals in various African regions was low, with Northern Africa at 7.5%, Southern Africa at 6.4%, Eastern Africa at 4.5%, Middle Africa at 3.7%, and Western Africa at 2.6%. However, since 1990, there has been a significant increase in the number of overweight individuals, especially in the Southern African region, where the prevalence rate averaged 21% in 2015 (Agyemang et al., 2015). The surge in the number of overweight and

obese individuals has been linked to changes in the global food system, which make unhealthy food options more affordable and widely accessible, as well as a decrease in physical activity due to technological advancements in transportation, home, and workplaces (Popkin et al., 2020).

Currently, the DBM is prevalent in the poorest low- or middle-income countries (LMICs) with significantly lower gross domestic product per capita, in South and East Asia and Sub-Saharan Africa (SSA) (Popkin et al., 2020). The countries in the lowest income quartile are now experiencing severe levels of the DBM. For many SSA countries, the DBM has become a significant challenge, due to inequalities in food insecurity (Were et al., 2020). Delisle (2008) states that malnutrition is mostly brought on by poverty, which also largely explains why it persists in poor countries. SSA has low levels on the global hunger index and accounts for 75% of the 162 million ultra-poor people (making less than US$0.50 a day) in the world (Delisle, 2008).

Children and women are identified as the two demographics most susceptible to malnutrition (Delisle, 2008). In SSA, there has been a swift transition towards overnutrition over the past forty years, with women being disproportionately affected relative to men (Were et al., 2020). Data from 1975 showed a higher proportion of women (17.4%) who were obese or overweight compared to men (7.5%) (Abarca-Gómez et al., 2017). Fast forward four decades, the percentage remained high among women (39,7%) as compared to men (22.2%) (Abarca-Gómez et al., 2017).

Women are pivotal in fulfilling not only their own nutritional needs but also those of their family members (Madzorera & Fawzi, 2020). They are disproportionately affected by nutritional disorders linked to hunger and undernourishment, as well as nutrient-related chronic diseases, such as obesity and diabetes (Delisle, 2008). Women's requirements are not sufficiently met despite their susceptibility regarding nutrition, due to their increased need for key nutrients during pregnancy and lactation as well as to make up for menstrual loss and gender inequalities within poverty (Delisle, 2008; Madzorera & Fawzi, 2020). In 2014, the WHO estimated that around 264 million women were affected by iron-amenable anaemia, but efforts to improve the nutritional

status of women have often concentrated on enhancing the outcomes of maternal and child nutrition during pregnancy and early childhood (Madzorera & Fawzi, 2020).

The occurrence of undernutrition and overnutrition may indicate an unequal distribution of resources and uneven access to healthy and nutritious food. Being underweight or overweight/obese has been linked to significantly increased chances of adverse health consequences (Bennett et al., 2016). DBM can increase the risk of chronic diseases in individuals and households and has been reported to have high incidences in obesity, diabetes, and hypertension, among many other nutrition-related non-communicable diseases (NCDs) (Were et al., 2020). Several of these risk factors are listed among the WHO 2019 top 10 risk factors leading to mortality in low-income countries. These include being underweight during childhood (7.8%), high blood pressure (7.5%), high blood glucose levels (4.9%), physical inactivity (3.8%) and high cholesterol levels (3.4%) (WHO, 2020).

1.2 PROBLEM STATEMENT

DBM has serious negative effects, which include developmental, economic, social, and medical consequences, and this can have a significant impact on both individuals and their families and communities (Anik et al., 2019). The Global Panel on Agriculture and Food Systems for Nutrition estimated that the global impact of malnutrition on the economy might be as high as US$3.5 trillion annually (US$500 per person). The DBM has also been associated with some non-communicable diseases, which include heart disease, diabetes, and certain cancers (WHO, 2024). Obese persons may also experience low self-esteem, depression, and social isolation (WHO, 2016a). These diseases are economically expensive to society due to high treatment costs, opportunity costs (e.g., lost income), and lower labour productivity.

The issue of the DBM has become a significant health concern in SSA (Reardon et al., 2021). Within SSA, South Africa is the country most affected by obesity (Otterbach et al., 2021). It has been listed among the five African nations with the most significant incidence of overweight individuals (Agyemang et al., 2015). Proximity to big food retailers and fast-food restaurants has been associated with these higher rates of overweight and obesity (Otterbach et al., 2021). According to a recent study, the population prevalence of underweight adults in South Africa was 4.8%, and 51.9% for overweight and obese adults (Mbogori et al., 2020). Men exhibited a higher incidence of underweight, whereas women had a higher incidence of overweight and obesity. The prevalence of overweight and obese women of childbearing age in South Africa rose from 51.3% to 60.0% and 24.7% to 35.2%, respectively, between 1998 and 2017 (Nglazi & Ataguba, 2022).

Each year, over 3 million people succumb to death due to complications related to obesity or being overweight (Añón-Hidalgo et al., 2019). It is important to tackle the issues around the DBM and develop health interventions that are tailored to the context, as well as to comprehend the inequalities and determinants of the DBM among women in South Africa. Bettering women's resources, towards their health, nutrition, and education is crucial, not only in terms of equity but also for the sake of future generations' health (Delisle, 2008). In rural South Africa, adolescent girls face a higher risk of obesity, a risk that escalates with age and was associated with a higher socio-economic status (Kimani-Murage et al., 2011).

Insufficient knowledge about socioeconomic inequalities of DBM within countries poses a significant obstacle to addressing this issue effectively in the region (Biswas et al., 2022). This lack of data hinders the development of effective policies and interventions. Furthermore, the complexity of the DBM requires a multifaceted approach that addresses the underlying social, economic, and environmental determinants of health. Addressing the DBM among women is not only crucial for improving health outcomes but can contribute to broader efforts to improve food

security and nutrition among women and achieve the Sustainable Development Goals by 2030 (UNSD, 2024).

2. BRIEF LITERATURE REVIEW

This literature review provides an insight into the DBM, encompassing theories, methodologies, and empirical findings. By analysing a range of scholarly articles, reports, and publications, this review aims to shed light on the DBM.

2.1 Theoretical review

2.1.1 Health inequality and socioeconomic status (SES)

In every region and under various political and social systems, inequalities in health have been observed among different social groups within the population and across different geographical areas within the same country (Whitehead, 1992). Health outcomes can significantly vary among different individuals and groups (McCartney et al., 2019). Health inequalities can be defined as variations in health outcomes among different socioeconomic groups (Whitehead, 1992). These inequalities, being a product of social factors and modifiable, are considered unjust. This study assesses the health inequality of DBM among non-pregnant women of different SES in South Africa. SES is a vital construct in health inequality research and is often measured using various indicators such as occupation, education, income, expenditure, consumer assets (e.g., televisions, bicycles, or cars), as well as housing attributes like the source of drinking water, toilet facilities (Kumar et al., 2022; Shirisha et al., 2022; Singh et al., 2023).

2.1.2 Theories of health inequalities

Individuals from diverse backgrounds, social strata, and nations experience varying degrees of health outcomes. Health inequality is the overarching term used to signify differences, variances, and discrepancies in the health or health outcomes of individuals and groups (Kawachi et al., 2002). The Black Report introduced theories to try and explain the root causes of health inequalities, which have been further developed over time. Despite the expansion of these theories, it was thought that the structure theory gives the best explanation.

2.1.2.1 Cultural and Behavioural Theory

The theory argues that the relationship between socioeconomic status and health outcomes stems from differences in health-related behaviours, which include dietary habits and physical activity (Øversveen et al., 2017). For this theory to stand, socioeconomic factors must be the sole effect modifier within this relationship (McCartney et al., 2013). However, the findings of the Black Report highlighted that individuals' behaviours are frequently influenced by their social and economic situations, not just their cultural background. For instance, maintaining a healthy diet can be costly (Scambler, 2012).

2.1.2.2 Structural theory

The structural theory states that variations in the socioeconomic conditions of societal clusters, which include income, wealth, influence or power, environmental factors, and accessibility, throughout an individual’s life, lead to health inequalities (McCartney et al., 2013). The theory links structural factors to health outcomes, but it fails to identify the root causes of health inequalities (Macintyre, 1997).

2.1.2.3 Selection theory

The main hypothesis centres around reverse causality, arguing that deteriorating health creates a social selection, resulting in a link between poor health and lower social rank (McCartney et al., 2013). So, this theory argues that an individual's health determines their socioeconomic status, as opposed to socioeconomic status determining their health (Bambra, 2011). The potential for a health selection effect to account for health inequalities was thoroughly investigated and dismissed in the Black report (McCartney et al., 2013).

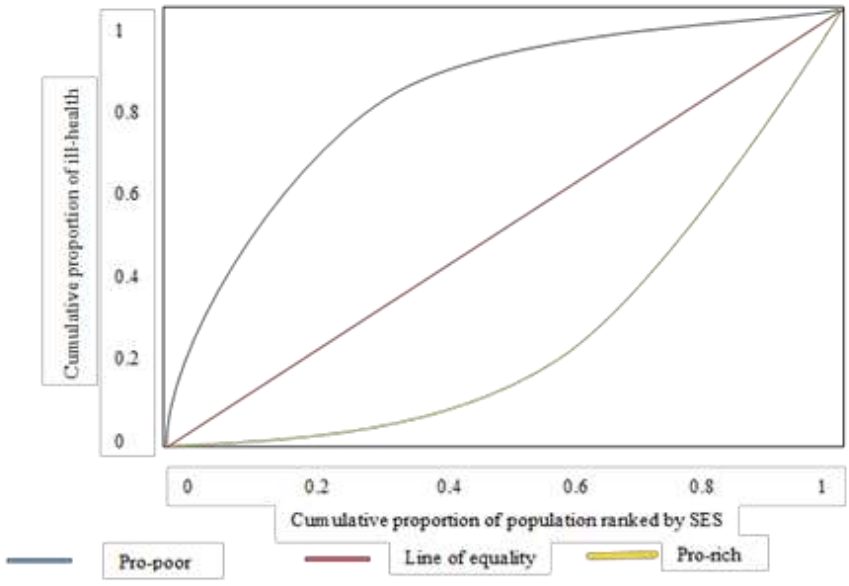
2.2 Methodological review

Several methodologies have been established to effectively measure health inequalities, which include the concentration curve (associated with the Concentration Index), the Slope Index of Inequality, the Relative Index of Inequality, the Index of Dissimilarity, the Gini coefficient, the Lorenz curve, and the Pseudo-Lorenz curve (Carr-Hill et al., 2005; Wagstaff et al., 1991).

2.2.1 Concentration Index (CI) and Curve

The concentration curve graphically represents the cumulative proportions of the population (arranged from the most disadvantaged to the least disadvantaged), plotted against the cumulative proportions of health, as shown in Figure 1. While the concentration curve can illustrate the socioeconomic inequalities associated with a health outcome, it is not suitable for quantifying the extent of the inequality (Kakwani et al., 1997). The CI provides a numerical measure of the socioeconomic inequalities of health (Erreygers, 2009). It quantifies the gap between the concentration curve and the equality line (Almasi-Hashiani et al., 2017). The CI is ranges between –1 and +1 (Wagstaff et al., 1991). A negative CI value indicates a higher concentration of inequalities among the poor (pro-poor), and a positive CI value suggests that inequality is concentrated among the wealthy (pro-rich). Similar to SII and RII, in the CI,

individuals are ranked according to their socioeconomic status, starting with the most disadvantaged (Wagstaff et al., 1991).This index is a widely used for analysing health inequality due to its association with the concentration curve, its compatibility with the Gini coefficient, and its ease of decomposition (Erreygers, 2009). This index has been used to assess inequalities of DBM in several studies (Biswas et al., 2022; Nguyen et al., 2021; Sarker et al., 2022).



Appendix: Figure 1. Concentration curves

2.2.2 Relative index of inequality (RII)

The RII is frequently used to quantify how the occurrence of a health outcome varies in relation to socioeconomic status or another relevant background factor (Sergeant & Firth, 2006). The RII exclusively assumes non-negative values and considers both the group's socioeconomic status and

its population size (Mackenbach & Kunst, 1997). The RII assumes a value of one, if no inequalities are present (Schlotheuber & Hosseinpoor, 2022). A RII value above one indicates higher levels of inequality among the wealthy (pro-rich), and a value below one indicates inequalities concentrated among the poor (pro-poor) (Mackenbach & Kunst, 1997; Schlotheuber & Hosseinpoor, 2022). This index has been used to assess inequalities of DBM in several studies (Anik et al., 2019; Hong et al., 2020).

2.2.3 Slope index of inequality (SII)

The SII is an absolute measure used to assess and quantify the magnitude of health inequalities across multiple socioeconomic groups within a population (Renard et al., 2019; Schlotheuber & Hosseinpoor, 2022). The socioeconomic groups are arranged in order based on their socioeconomic status, rather than their health status (Wagstaff et al., 1991).The entire population sample is organized in ascending order from the most disadvantaged subgroup, assigned a rank of 0, to the most advantaged subgroup, assigned a rank of 1 (Regidor, 2004; Schlotheuber & Hosseinpoor, 2022). Since it is an absolute measure, it is responsive to shifts in the average population health level or variations in the occurrence of the health issue under examination (Regidor, 2004; Wagstaff et al., 1991). Another notable characteristic of the SII is its sensitivity to the overall health status of the population's average health (Wagstaff et al., 1991). Hence, the SII's sensitivity restricts its applicability for evaluating inequalities in various populations over time. This index has been utilized in numerous studies to evaluate inequalities in DBM (Anik et al., 2019; Hong et al., 2020; Nguyen et al., 2021).

2.3 Empirical Review

A study conducted in India by Nguyen et al., (2021) (Nguyen et al., 2021) investigated the DBM inequalities among individuals of varying age groups. The study considered factors such as gender,

wealth, and place of residence (rural, urban slum and urban non-slum). The researchers used SII and the CI as to assess these inequalities. Over a decade, from 2006 to 2016, the study observed notable shifts in BMI-related trends among women. Specifically, the prevalence of underweight women decreased from 36% in 2006 to 23% in 2016, while the percentage of overweight/obese women nearly doubled during the same period, rising from 13% in 2006 to 21% in 2016 (Nguyen et al., 2021). The analysis of inequalities among underweight women across various residential areas, proved to be pro-poor, irrespective of the type of residence (Nguyen et al., 2021). This conclusion was supported by the negative values for both the CI and SII across all three types of residences for both years. Conversely, inequalities among obese women were found to be pro-rich across all residential areas (Nguyen et al., 2021). This observation was backed by the positive values of both the SII and CI.

In a research study conducted in Bangladesh, Sarker et al. (2022) aimed to assess the occurrence of DBM among mothers aged 15 to 49 years who had children under 5 years of age. DBM was defined as the simultaneous presence of an underweight mother with an overweight child, or an overweight mother with a stunted, wasted, or underweight child. The researchers utilized the CI to assess the inequalities in the DBM prevalence across different socioeconomic groups. The findings revealed that the prevalence of the DBM was 13.35% among cases involving overweight mothers with stunted, wasted, or underweight children (Sarker et al., 2022). In contrast, the prevalence was 7.69% among instances where the mother was underweight, and the child was overweight. The analysis of these two distinct BDM scenarios yielded different CI values. Specifically, the situation involving an overweight mother with stunted, wasted, or underweight children was characterized as pro-rich due to the positive CI value (Sarker et al., 2022). In contrast, the scenario involving underweight mothers with overweight children was identified as pro-poor due to the negative CI value (Sarker et al., 2022).

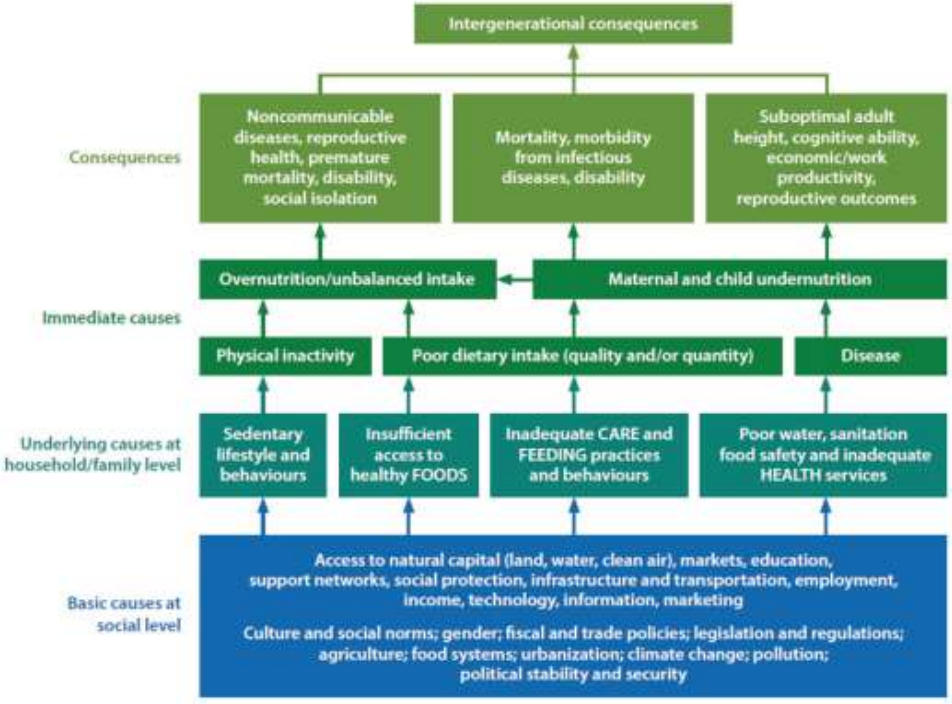
Biswas et al. (2022) examined the absolute and relative inequalities in the DBM among women across seven countries in South and Southeast Asia: Bangladesh, Cambodia, India, Myanmar, Nepal, Pakistan, and Timor-Leste. They used demographic health survey data from 2000 to 2017 and calculated the CI to measure the socioeconomic inequalities. They defined DBM as the coexistence of underweight and overweight/obesity within each country, enabling comparison. They combined overweight and obesity categories due to low obesity prevalence in some countries. The study found that the overall pooled prevalence of underweight and overweight/obese women across all countries was 22% and 29%, respectively. Notably, Bangladesh in 2017 had the highest underweight prevalence (44%) and Pakistan in 2017 had the highest overweight/obesity prevalence (67%). In all countries, underweight was pro-poor (negative CI) and overweight/obesity was pro-rich (positive CI) (Biswas et al., 2022).

2.4 CONCEPTUAL FRAMEWORK

2.4.1 Framework 1: Conceptual framework outlining the determinants of the double burden of malnutrition

Figure 2 illustrates a conceptual framework outlining the determinants of the double burden of malnutrition from WHO (2015). The framework highlights the basic, household level and immediate causes that lead to intergenerational consequences. The framework utilized overnutrition and maternal and child undernutrition as its key outcomes. The basic causes encompass specific determinants which include access to natural capital, cultural and social norms like gender dynamics, agriculture practices, food system, urbanization, climate change and pollution (WHO, 2015). The framework also emphasizes the significance of factors at the household or family level that are interconnected with immediate causes. At the household or

family level, numerous system-level factors come into play, including sedentary lifestyles, access to nutritious food, inadequate sanitation, and water quality concerns, among several others.

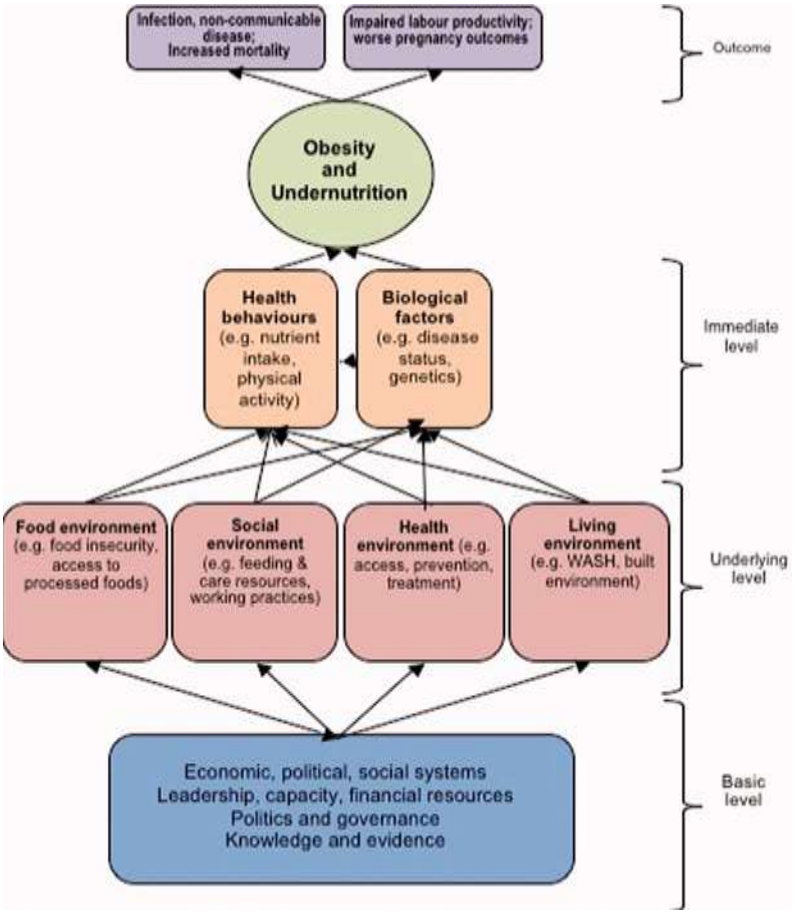


Appendix: Figure 2. Conceptual framework outlining the determinants of the DBM (World Health Organization, 2015).

2.4.2 Framework 2: Conceptual framework for determinants of malnutrition

Figure 3 illustrates a simple conceptual framework for addressing the double burden of malnutrition by Haddad et al (2015). In this framework determinants of both undernutrition and obesity were categorized into three levels, each sharing similar components: immediate, underlying, and basic. At the basic level, various system-level factors such as economic, political, and social systems can function as guiding influences for the underlying level, ultimately affecting

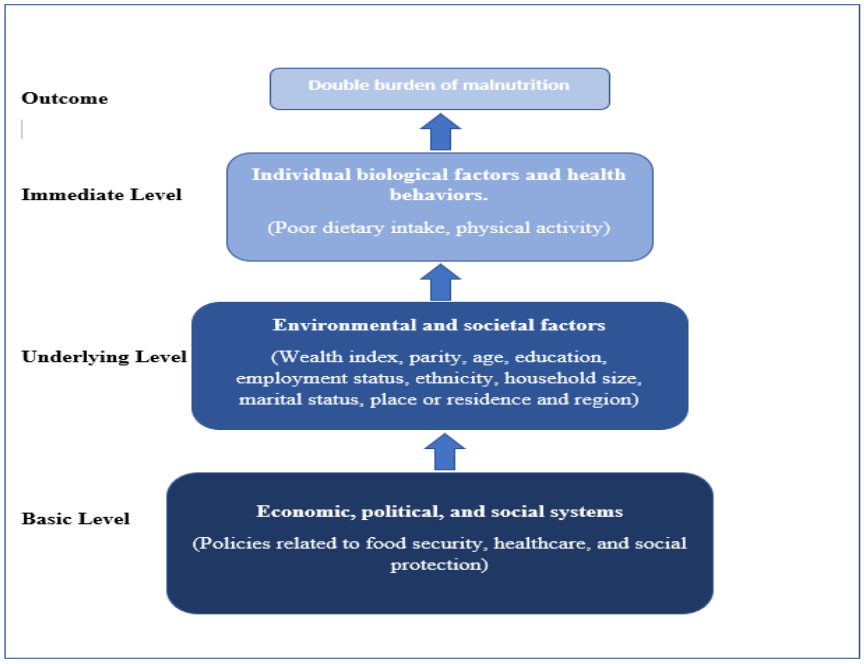
both undernutrition and obesity (Haddad et al., 2015). At the underlying level, multiple environmental determinants, encompassing aspects like food, living conditions, social factors, and healthcare settings, form the foundation for individual health behaviours and biological factors. At the underlying level, multiple environmental determinants, encompassing aspects like food, living conditions, social factors, and healthcare settings, form the foundation for individual health behaviours and biological factors.



Appendix: Figure 3. Conceptual framework for determinants of malnutrition by (Haddad et al., 2015).

2.4.3 Framework 4. Adapted conceptual framework outlining the determinants of the DBM

Figure 4 presents an adapted conceptual framework that outlines the determinants of the DBM from WHO (2016). This framework emphasizes the basic, underlying, and immediate level factors that contribute to the DBM. The basic causes encompass broader economic, political, and social systems that guide the underlying and immediate causes. These systems can include policies related to food security, healthcare, and social protection. The underlying level includes environmental and societal factors that influence the immediate causes. These factors include wealth index, parity, age, education, employment, ethnicity, household size, marital status, place of residence, region, and habits like watching TV. The immediate level consists of individual biological factors and health behaviours that directly influence a woman's nutritional status, such as dietary intake, physical activity, and metabolic factors. This framework emphasizes that addressing the DBM requires a comprehensive approach that considers all these interconnected factors. It also highlights the need for targeted interventions that address the specific needs and challenges of diverse groups of women. By addressing these multiple layers of determinants, sustainable development and improved nutritional outcomes can be achieved.



Appendix: Figure 4. Adapted conceptual framework outlining the determinants of the double burden of malnutrition (World Health Organization, 2015)

3. RESEARCH AIM

The study aims to explore the socio-economic inequalities in the DBM among women in South Africa and identify the primary factors contributing to these disparities.

4. RESEARCH OBJECTIVES

1. To determine the prevalence of the DBM among women in South Africa.
2. To assess socio-economic inequalities associated with DBM among women in South Africa.
3. To decompose the factors that contribute to the socio-economic inequalities.

5. METHODOLOGY

5.1 Dataset

The study will utilize data from the most recent data from the 2016 South African Demographic and Health Survey (SADHS), which is accessible to the public (https://www.dhsprogram.com/). The SADHS dataset provides a comprehensive overview of key findings in South Africa, employing a two-stage sampling design (SADHS, 2019).

Appendix: Table 1. SADHS survey information

Country	**Survey year**	**Total sample size (households)**
South Africa	2016	11083

5.2 Study population

The data for this analysis will be sourced from the women's survey in the SADHS. The woman's questionnaire includes data gathered from women aged between 15-49 years old.

5.3 Outcome Variable

The outcome variable for this study is the DBM, and it will be assessed using body mass index (BMI). BMI, also known as the Quetelet index, is one of the measurements used to assess the nutritional status of women in the SADHS. BMI is used to categorize adults as underweight, normal weight, overweight, and obese. BMI in the SADHS is calculated using results from the

respondent's height and weight measurements (SADHS, 2019). In the survey, weight was recorded in kilograms (kg), while the height was recorded in centimetres (cm) (SADHS, 2019).

Equation for BMI:

$$\boldsymbol{BMI} = \frac{weight\ in\ kg}{(height\ in\ meters)^2}$$

Since the DBM will be defined as the coexistence of underweight and obese women in South Africa. According to WHO (2010), based on the participant's BMI, they will be classified as:

Underweight *if BMI* $<18.50kg/m^2$

Obese *if BMI* $\geq 30kg/m^2$

5.4 Analytical Methods

This study will make use of Stata 17 statistical software, for the data management, exploration, and analysis (Stata Corp, Texas, United States).

5.4.1 Prevalence

This analytical method will be used on objective 1. Prevalence is the proportion or measure of a population who have a specific characteristic at a particular point in time or over a time period (Hunt & Kaloshin, 2010). The prevalence of the DBM among women in South Africa will be calculated by dividing the number of women suffering from the DBM by the total number of women and multiplying this result by 100.

$$Prevalence = \frac{The\ number\ of\ people\ in\ sample\ with\ characteristic}{Total\ number\ of\ people\ in\ sample}$$

5.4.2 Concentration Index and Curve

SES will be assessed using the SADHS wealth index. The wealth index is a scoring system used to create household wealth quintiles, taking into account consumer assets, such as televisions, bicycles, or cars, as well as housing attributes like the source of drinking water, toilet facilities, and flooring materials (SADHS, 2019). Households will be grouped and ranked from poorest to richest. The socioeconomic inequalities of the DBM among women will be measured using concentration curve and CI across the distinct groups. The CI is bounded between –1 and +1 and assesses the degree of inequality in the DBM between the rich and poor (Wagstaff et al., 1991). A negative CI indicates a higher concentration of DBM inequities among the poor (pro-poor), and a positive CI suggests that the DBM inequalities are concentrated among the wealthy (pro-rich) (Wagstaff et al., 1991). If the CI value is zero, it indicates the absence of socioeconomic inequalities.

The CI can also be computed from the equation below:

$$CI=\frac{2}{\mu}COV(y_i, R_i)$$

Where y_i is the health variable, and μ is its mean. R_i is the fractional rank of the *i*th individual in the socioeconomic distribution (e.g., an individual's rank in the income distribution. *COV(.,.)* is the covariance.

5.4.3 Decomposition analysis

The CI and the concentration curve serve as valuable tools for indicating socioeconomic inequalities, but they are limited in explaining the factors associated with the observed inequality. The CI can be broken down into individual factors that either contribute to or are associated with health inequalities (Wagstaff et al., 2003).

In decomposing the concentration index of the DBM among women in South Africa, the following steps will be done

Regression of health variables against its determinates

$$\gamma_i = \alpha + \sum_k \beta_k x_{kj} + \varepsilon_i \quad (1)$$

Where:

x_k - set of k determining variables

β_K - the coefficient

ε_i - random error term

Given the relationship between γ_i and x_{kj} as expressed in equation 1, we can formulate the CI for y as follows:

$$C = \sum_k \left(\frac{\beta_{k\bar{x}_k}}{\mu}\right) C_k + \frac{GC_\varepsilon}{\mu} \quad (2)$$

Where:

μ - mean of γ

$\bar{x}_k$ - mean of x_k

C_k – the CI of x_k

6. RESEARCH LIMITATIONS

This will be a cross-sectional study, as a result any links or relationships found may only be described as associations and not causal.

7. ETHICAL CONSIDERATIONS

The study would be based on the examination of secondary data, requested from the DHS program website. For all the DHS, the respondents were asked to give their informed consent before the individual interviews could begin. The ethical approval for this study will be sought from the Human Research Ethics Committee (HERC) of the University of Cape Town.

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Appendix 3. BMC Public Health - (Guide for authors)

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1. Criteria

Research articles should report on original primary research or new experimental or computational methods, tests or procedures. Manuscripts reporting results of a clinical trial must conform to CONSORT 2010 guidelines. Authors of randomized controlled trials should submit a complete CONSORT checklist alongside their manuscript, available at www.consort-statement.org. Research articles may also report on systematic reviews of published research provided they adhere to the appropriate reporting guidelines which are detailed in our editorial policies. Please note that non-commissioned pooled analyses of selected published research and bibliometric analyses will not be considered. Studies reporting descriptive results from a single institution or region will only be considered if analogous data have not been previously published in a peer reviewed journal and the conclusions provide distinct insights that are of relevance to a regional or international audience.

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2. Preparing your manuscript

The information below details the section headings that you should include in your manuscript and what information should be within each section.

Please note that your manuscript must include a 'Declarations' section including all of the subheadings (please see below for more information).

3. Title page

The title page should:

• present a title that includes, if appropriate, the study design e.g.:

o "A versus B in the treatment of C: a randomized controlled trial", "X is a risk factor for Y: a case control study", "What is the impact of factor X on subject Y: A systematic review"

o or for non-clinical or non-research studies a description of what the article reports

• list the full names and institutional addresses for all authors

o if a collaboration group should be listed as an author, please list the Group name as an author. If you would like the names of the individual members of the Group to be searchable through their individual PubMed records, please include this information in the “Acknowledgements” section in accordance with the instructions below

o Large Language Models (LLMs), such as ChatGPT, do not currently satisfy our authorship criteria. Notably an attribution of authorship carries with it accountability for the work, which cannot be effectively applied to LLMs. Use of an LLM should be properly documented in the

Methods section (and if a Methods section is not available, in a suitable alternative part) of the manuscript.

• indicate the corresponding author

4. Abstract

The Abstract should not exceed 350 words. Please minimize the use of abbreviations and do not cite references in the abstract. Reports of randomized controlled trials should follow the CONSORT extension for abstracts. The abstract must include the following separate sections:

• Background: the context and purpose of the study

• Methods: how the study was performed and statistical tests used

• Results: the main findings

• Conclusions: brief summary and potential implications

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• Trial registration: If your article reports the results of a health care intervention on human participants, it must be registered in an appropriate registry and the registration number and date of registration should be stated in this section. If it was not registered prospectively (before enrollment of the first participant), you should include the words 'retrospectively registered'. See our editorial policies for more information on trial registration

5. Keywords

Three to ten keywords representing the main content of the article.

6. Background

The Background section should explain the background to the study, its aims, a summary of the existing literature and why this study was necessary or its contribution to the field.

7. Methods

The methods section should include:

• the aim, design and setting of the study

• the characteristics of participants or description of materials

• a clear description of all processes, interventions and comparisons. Generic drug names should generally be used. When proprietary brands are used in research, include the brand names in parentheses

• the type of statistical analysis used, including a power calculation if appropriate

8. Results

This should include the findings of the study including, if appropriate, results of statistical analysis which must be included either in the text or as tables and figures.

9. Discussion

This section should discuss the implications of the findings in context of existing research and highlight limitations of the study.

10. Conclusions

This should state clearly the main conclusions and provide an explanation of the importance and relevance of the study reported.

11. List of abbreviations

If abbreviations are used in the text they should be defined in the text at first use, and a list of abbreviations should be provided.

12. Declarations

All manuscripts must contain the following sections under the heading 'Declarations':

• Ethics approval and consent to participate

• Consent for publication

• Availability of data and materials

• Competing interests

• Funding

• Authors' contributions

• Acknowledgements

• Authors' information (optional)

Please see below for details on the information to be included in these sections.

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• include the name of the ethics committee that approved the study and the committee’s reference number if appropriate

Studies involving animals must include a statement on ethics approval and for experimental studies involving client-owned animals, authors must also include a statement on informed consent from the client or owner.

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possible to share research data publicly, for instance when individual privacy could be compromised, and in such instances data availability should still be stated in the manuscript along with any conditions for access.

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• The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

• All data generated or analysed during this study are included in this published article [and its supplementary information files].

• The datasets generated and/or analysed during the current study are not publicly available due [REASON WHY DATA ARE NOT PUBLIC] but are available from the corresponding author on reasonable request.

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Hao Z, AghaKouchak A, Nakhjiri N, Farahmand A. Global integrated drought monitoring and prediction system (GIDMaPS) data sets. figshare. 2014. http://dx.doi.org/10.6084/m9.figshare.853801

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The datasets generated during and/or analysed during the current study are available in the [NAME] repository, [PERSISTENT WEB LINK TO DATASETS].[Reference number]

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Always use footnotes instead of endnotes

Appendix 4. South Africa Demographic Health Survey 2016 Questionnaire

WEIGHT, HEIGHT, WAIST, BLOOD PRESSURE, HAEMOGLOBIN MEASUREMENT, BLOOD COLLECTION FOR HBA1C AND HIV TESTING, AND RECORDING OF MEDICINES FOR WOMEN AGE 15-95

201	FROM THE LIST OF PERSONS ELIGIBLE FOR BIOMARKERS, RECORD THE LINE NUMBER, NAME, AGE, AND MARITAL STATUS FOR ALL ELIGIBLE WOMEN IN 202. WRITE THE NAME OF EACH WOMAN AT THE TOP OF THE FOLLOWING PAGES. IF THERE ARE MORE THAN THREE WOMEN, USE ADDITIONAL QUESTIONNAIRE(S).			
		WOMAN 1	WOMAN 2	WOMAN 3
202	CHECK LIST OF WOMEN ELIGIBLE FOR BIOMARKERS: RECORD LINE NUMBER, NAME, AND AGE. RECORD MARITAL STATUS.	LINE NUMBER . . . . [ ][ ] NAME ____________ AGE . . . . [ ][ ] NEVER IN UNION . . . . 1 OTHER 2	LINE NUMBER . . . . [ ][ ] NAME ____________ AGE . . . . [ ][ ] NEVER IN UNION . . . . 1 OTHER 2	LINE NUMBER . . . . [ ][ ] NAME ____________ AGE . . . . [ ][ ] NEVER IN UNION . . . . 1 OTHER 2
202A	CHECK 202: AGE	15-17 YEARS . . . . 1 18-95 YEARS . . . . 2 (SKIP TO 202C)	15-17 YEARS . . . . 1 18-95 YEARS . . . . 2 (SKIP TO 202C)	15-17 YEARS . . . . 1 18-95 YEARS . . . . 2 (SKIP TO 202C)
202B	CHECK 202: MARITAL STATUS	NEVER IN UNION . . . . 1 (SKIP TO 202E) OTHER 2	NEVER IN UNION . . . . 1 (SKIP TO 202E) OTHER 2	NEVER IN UNION . . . . 1 (SKIP TO 202E) OTHER 2
	ADULT RESPONDENT CONSENT FOR ANTHROPOMETRY			
202C	ASK CONSENT FOR ANTHROPOMETRY.	PROVIDE ADULT RESPONDENT WITH CONSENT FORM.		
202D	CIRCLE THE CODE AND SIGN YOUR NAME.	GRANTED . . . . 1 RESPONDENT REFUSED . . . 2 ____________ (SIGN AND SKIP TO 205) NOT PRESENT/OTHER . . . 3 (SKIP TO 205)	GRANTED . . . . 1 RESPONDENT REFUSED . . . 2 ____________ (SIGN AND SKIP TO 205) NOT PRESENT/OTHER . . . 3 (SKIP TO 205)	GRANTED . . . . 1 RESPONDENT REFUSED . . . 2 ____________ (SIGN AND SKIP TO 205) NOT PRESENT/OTHER . . . 3 (SKIP TO 205)
202E	RECORD NAME OF PARENT/ADULT RESPONSIBLE FOR MINOR.	NAME ____________	NAME ____________	NAME ____________
	PARENTAL/RESPONSIBLE ADULT CONSENT FOR ANTHROPOMETRY			
202F	ASK CONSENT FOR ANTHROPOMETRY.	PROVIDE PARENT/RESPONSIBLE ADULT WITH PARENTAL CONSENT FORM.		
202G	CIRCLE THE CODE AND SIGN YOUR NAME.	GRANTED . . . . 1 PARENT/OTHER RESPONSIBLE ADULT REFUSED . . . . . 2 ____________ (SIGN) (IF REFUSED, SKIP TO 205) NOT PRESENT/OTHER . . . 3 (SKIP TO 205)	GRANTED . . . . 1 PARENT/OTHER RESPONSIBLE ADULT REFUSED . . . . . 2 ____________ (SIGN) (IF REFUSED, SKIP TO 205) NOT PRESENT/OTHER . . . 3 (SKIP TO 205)	GRANTED . . . . 1 PARENT/OTHER RESPONSIBLE ADULT REFUSED . . . . . 2 ____________ (SIGN) (IF REFUSED, SKIP TO 205) NOT PRESENT/OTHER . . . 3 (SKIP TO 205)
	MINOR RESPONDENT CONSENT FOR ANTHROPOMETRY			
202H	ASK CONSENT FOR ANTHROPOMETRY.	PROVIDE MINOR RESPONDENT WITH CONSENT FORM.		
202I	CIRCLE THE CODE AND SIGN YOUR NAME.	GRANTED . . . . 1 MINOR RESPONDENT REFUSED . . . . 2 ____________ (SIGN) NOT PRESENT/OTHER . . . 3	GRANTED . . . . 1 MINOR RESPONDENT REFUSED . . . . 2 ____________ (SIGN) NOT PRESENT/OTHER . . . 3	GRANTED . . . . 1 MINOR RESPONDENT REFUSED . . . . 2 ____________ (SIGN) NOT PRESENT/OTHER . . . 3

WEIGHT, HEIGHT, WAIST, BLOOD PRESSURE, HAEMOGLOBIN MEASUREMENT, BLOOD COLLECTION FOR HBA1C AND HIV TESTING, AND RECORDING OF MEDICINES FOR WOMEN AGE 15-95

		WOMAN 1	WOMAN 2	WOMAN 3
	NAME FROM LIST.	NAME _____	NAME _____	NAME _____
205	WEIGHT IN KILOGRAMS.	KG. . . . [ ][ ][ ].[ ][0] NOT PRESENT . . . . . 99994 REFUSED . . . . . 99995 OTHER 99996	KG. . . . [ ][ ][ ].[ ][0] NOT PRESENT . . . . . 99994 REFUSED . . . . . 99995 OTHER 99996	KG. . . . [ ][ ][ ].[ ][0] NOT PRESENT . . . . . 99994 REFUSED . . . . . 99995 OTHER 99996
206	HEIGHT IN CENTIMETRES.	CM. . . . . [ ][ ][ ].[ ] NOT PRESENT . . . . . 9994 REFUSED . . . . . 9995 OTHER 9996	CM. . . . . [ ][ ][ ].[ ] NOT PRESENT . . . . . 9994 REFUSED . . . . . 9995 OTHER 9996	CM. . . . . [ ][ ][ ].[ ] NOT PRESENT . . . . . 9994 REFUSED . . . . . 9995 OTHER 9996
206A	WAIST CIRCUMFERENCE IN CENTIMETRES.	CM. . . . . [ ][ ][ ].[ ] NOT PRESENT . . . . . 9994 REFUSED . . . . . 9995 OTHER 9996	CM. . . . . [ ][ ][ ].[ ] NOT PRESENT . . . . . 9994 REFUSED . . . . . 9995 OTHER 9996	CM. . . . . [ ][ ][ ].[ ] NOT PRESENT . . . . . 9994 REFUSED . . . . . 9995 OTHER 9996
207	MEASURER: ENTER YOUR FIELDWORKER NUMBER.	[ ][ ][ ][ ] FIELDWORKER NUMBER	[ ][ ][ ][ ] FIELDWORKER NUMBER	[ ][ ][ ][ ] FIELDWORKER NUMBER
208	CHECK 202: AGE	15-17 YEARS . . . . . 1 18-95 YEARS . . . . . 2 (SKIP TO 210)	15-17 YEARS . . . . . 1 18-95 YEARS . . . . . 2 (SKIP TO 210)	15-17 YEARS . . . . . 1 18-95 YEARS . . . . . 2 (SKIP TO 210)
209	CHECK 202: MARITAL STATUS	NEVER IN UNION . . . . . 1 (SKIP TO 213) OTHER 2	NEVER IN UNION . . . . . 1 (SKIP TO 213) OTHER 2	NEVER IN UNION . . . . . 1 (SKIP TO 213) OTHER 2

FORMATTING DATE: 5 June 2016
ENGLISH LANGUAGE: 22 April 2016

2016 SOUTH AFRICA DEMOGRAPHIC AND HEALTH SURVEY
WOMAN'S QUESTIONNAIRE

IDENTIFICATION

PLACE NAME _____

NAME OF HOUSEHOLD HEAD _____

CLUSTER NUMBER .....

HOUSEHOLD NUMBER .....

NAME AND LINE NUMBER OF WOMAN _____

HOUSEHOLD SELECTED FOR MALE SURVEY AND FULL BIOMARKERS? (YES = 1; NO = 2) .....

RESPONDENT SELECTED FOR THE HOUSEHOLD RELATIONS MODULE? (YES = 1; NO = 2) .....

INTERVIEWER VISITS

	1	2	3	FINAL VISIT
DATE				DAY / MONTH / YEAR (2 0 1)
INTERVIEWER'S NAME				INT. NO.
RESULT*				RESULT*
NEXT VISIT: DATE / TIME				TOTAL NUMBER OF VISITS

*RESULT CODES: 1 COMPLETED; 2 NOT AT HOME; 3 POSTPONED; 4 REFUSED; 5 PARTLY COMPLETED; 6 INCAPACITATED; 7 OTHER _____ (SPECIFY)

LANGUAGE OF QUESTIONNAIRE** 0 1 | LANGUAGE OF INTERVIEW** | HOME LANGUAGE OF RESPONDENT** | TRANSLATOR USED (YES = 1, NO = 2)

LANGUAGE OF QUESTIONNAIRE** ENGLISH

**LANGUAGE CODES:

01 ENGLISH	05 seSOTHO	09 tshiVENDA
02 AFRIKAANS	06 seTSWANA	10 xiTSONGA
03 isiXHOSA	07 sePEDI	11 isiNDEBELE
04 isiZULU	08 siSWATI	12 OTHER

SUPERVISOR

NAME _____ NUMBER

100A	CHECK RESPONDENT'S AGE AND MARITAL STATUS IN HOUSEHOLD QUESTIONNAIRE. AGE 15-17 AND NEVER IN UNION ☐ ↓ AGE 18 AND ABOVE OR AGE 15-17 AND EVER IN UNION ☐ → 100C	

INTRODUCTION AND CONSENT (PARENT/GUARDIAN)

100B
Hello. My name is _____. I am working with Statistics South Africa. We are conducting a survey about health and other topics all over South Africa. The information we collect will help the government to plan health services. Your household was selected for the survey. I would like to talk to (NAME OF MINOR) about her health and well-being. The questions usually take about 45 to 60 minutes. All of the answers (NAME OF MINOR) gives will be confidential and will not be shared with anyone other than members of our survey team. (NAME OF MINOR) doesn't have to be in the survey, but we hope you will agree to allow (NAME OF MINOR) to answer the questions since (NAME OF MINOR)'s views are important.

In case you need more information about the survey, you may contact the person listed on the card that has already been given to your household.

Do you have any questions?
May I begin the interview with (NAME OF MINOR) now?

SIGNATURE OF INTERVIEWER _____ DATE _____

PARENT/GUARDIAN AGREES MINOR MAY BE INTERVIEWED . . 1 ↓
PARENT/GUARDIAN DOES NOT AGREE TO ALLOW MINOR TO BE INTERVIEWED . . 2 → END

INTRODUCTION AND CONSENT (RESPONDENT)

100C
Hello. My name is _____. I am working with Statistics South Africa. We are conducting a survey about health and other topics all over South Africa. The information we collect will help the government to plan health services. Your household was selected for the survey. The questions usually take about 45 to 60 minutes. All of the answers you give will be confidential and will not be shared with anyone other than members of our survey team. You don't have to be in the survey, but we hope you will agree to answer the questions since your views are important. If I ask you any question you don't want to answer, just let me know and I will go on to the next question or you can stop the interview at any time.

In case you need more information about the survey, you may contact the person listed on this information sheet.

GIVE INFORMATION SHEET.

Do you have any questions?
May I begin the interview now?

SIGNATURE OF INTERVIEWER _____ DATE _____

RESPONDENT AGREES TO BE INTERVIEWED . . 1 ↓
RESPONDENT DOES NOT AGREE TO BE INTERVIEWED . . 2 → END

SECTION 1. RESPONDENT'S BACKGROUND

NO.	QUESTIONS AND FILTERS	CODING CATEGORIES	SKIP
101	RECORD THE TIME.	HOURS ☐☐ MINUTES ☐☐	
102	How long have you been living continuously in (NAME OF CURRENT CITY, TOWN OR VILLAGE OF RESIDENCE)? IF LESS THAN ONE YEAR, RECORD '00' YEARS.	YEARS ☐☐ ALWAYS . . . 95 VISITOR . . . 96 → 105	
103	Just before you moved here, where did you live? PROBE: Is that a city, a town, a rural area, a farm, a tribal area, or an informal settlement?	CITY . . . 1 TOWN . . . 2 RURAL AREA . . . 3 FARM . . . 4 TRIBAL AREA . . . 5 INFORMAL SETTLEMENT . . . 6	
104	Before you moved here, which province did you live in?	WESTERN CAPE . . . 01 EASTERN CAPE . . . 02 NORTHERN CAPE . . . 03 FREE STATE . . . 04 KWAZULU-NATAL . . . 05 NORTH WEST . . . 06 GAUTENG . . . 07 MPUMALANGA . . . 08 LIMPOPO . . . 09 SADC COUNTRY . . . 16 OTHER COUNTRY . . . 26	

SECTION 1. RESPONDENT'S BACKGROUND

NO.	QUESTIONS AND FILTERS	CODING CATEGORIES	SKIP
105	On what day, month, and year were you born?	DAY ..... ☐☐ DON'T KNOW DAY ..... 98 MONTH ..... ☐☐ DON'T KNOW MONTH ..... 98 YEAR ..... ☐☐☐☐ DON'T KNOW YEAR 9998	
106	How old were you at your last birthday? COMPARE AND CORRECT 105 AND/OR 106 IF INCONSISTENT. IF AGE 95 OR OLDER, RECORD 95.	AGE IN COMPLETED YEARS ..... ☐☐	
106A	Which population group do you consider yourself: black, white, coloured, Indian or something else?	BLACK/AFRICAN ..... 1 WHITE ..... 2 COLOURED ..... 3 INDIAN/ASIAN ..... 4 OTHER _____ 6 (SPECIFY)	
107	Have you ever attended an educational institution?	YES ..... 1 NO 2	→ 111
108	What is the highest level you attended: primary, secondary, or higher than secondary?	PRIMARY ..... 1 SECONDARY ..... 2 HIGHER THAN SECONDARY 3	
109	What is the highest grade or form you completed at that level?	**PRIMARY SCHOOL** LESS THAN 1 YEAR COMPLETED ..... 00 GRADE 1/SUB A/CLASS 1 ..... 11 GRADE 2/SUB B/CLASS 2 ..... 12 GRADE 3/STANDARD 1/ AET 1 (KHA RI GUDE, SANLI) ..... 13 GRADE 4/STANDARD 2 ..... 14 GRADE 5/STANDARD 3/AET 2 ..... 15 GRADE 6 /STANDARD 4 ..... 16 GRADE 7/STANDARD 5/AET 3 ..... 17 **SECONDARY SCHOOL** LESS THAN 1 YEAR COMPLETED ..... 20 GRADE 8/STANDARD 6/FORM 1/NTC 1/ N1/NC (V) LEVEL 2 ..... 21 GRADE 9/STANDARD 7/FORM 2/AET 4/NTC 2/ N2/NC (V) LEVEL 3 ..... 22 GRADE 10/STANDARD 8/FORM 3/NTC 3/ N3/NC (V) LEVEL 4 ..... 23 GRADE 11/STANDARD 9/FORM 4 ..... 24 CERTIFICATE OR DIPLOMA WITH LESS THAN GRADE 12/STANDARD 10 COMPLETED .. 25 GRADE 12/STANDARD 10/FORM 5/MATRIC .. 26 N4/NTC4 ..... 27 N5/NTC5 ..... 28 N6/NTC6 ..... 29 **HIGHER EDUCATION** FURTHER STUDIES INCOMPLETE OR ONGOI 30 CERTIFICATE OR DIPLOMA WITH GRADE 12/ STANDARD 10 COMPLETED ..... 31 HIGHER DIPLOMA (TECHNIKON/ U. OF TECHNOLOGY) ..... 32 POST HIGHER DIPLOMA (TECHNIKON/ U. TECHNOLOGY MASTERS, DOCTORAL) 33 BACHELORS DEGREE/BACHELORS DEGREE AND POST GRADUATE DIPLOMA ..... 34 HONOURS DEGREE ..... 35 HIGHER DEGREE (MASTERS, DOCTORATE .. 36	
110	CHECK 108: PRIMARY OR SECONDARY ☐ ↓ HIGHER ☐		→ 113

SECTION 1. RESPONDENT'S BACKGROUND

NO.	QUESTIONS AND FILTERS	CODING CATEGORIES	SKIP
111	Now I would like you to read this sentence to me. SHOW CARD TO RESPONDENT. IF RESPONDENT CANNOT READ WHOLE SENTENCE, PROBE: Can you read any part of the sentence to me?	CANNOT READ AT ALL ..... 1 ABLE TO READ ONLY PART OF THE SENTENCE ..... 2 ABLE TO READ WHOLE SENTENCE ..... 3 NO CARD WITH REQUIRED LANGUAGE _____ 4 (SPECIFY LANGUAGE) BLIND/VISUALLY IMPAIRED 5	
112	CHECK 111: CODE '2', '3' OR '4' CIRCLED ☐ CODE '1' OR '5' CIRCLED ☐ → 114		
113	Do you read a newspaper or magazine at least once a week, less than once a week or not at all?	AT LEAST ONCE A WEEK ..... 1 LESS THAN ONCE A WEEK ..... 2 NOT AT ALL 3	
114	Do you listen to the radio at least once a week, less than once a week or not at all?	AT LEAST ONCE A WEEK ..... 1 LESS THAN ONCE A WEEK ..... 2 NOT AT ALL 3	
115	Do you watch television at least once a week, less than once a week or not at all?	AT LEAST ONCE A WEEK ..... 1 LESS THAN ONCE A WEEK ..... 2 NOT AT ALL 3	
116	Do you own a cell phone?	YES ..... 1 NO 2	→ 118
117	Do you use your cell phone for any financial transactions?	YES ..... 1 NO 2	
118	Do you have an account in a bank or other financial institution that you yourself use?	YES ..... 1 NO 2	
119	Have you ever used the Internet?	YES ..... 1 NO 2	→ 124
120	In the last 12 months, have you used the Internet? IF NECESSARY, PROBE FOR USE FROM ANY LOCATION, WITH ANY DEVICE.	YES ..... 1 NO 2	→ 124
121	During the last one month, how often did you use the Internet: almost every day, at least once a week, less than once a week, or not at all?	ALMOST EVERY DAY ..... 1 AT LEAST ONCE A WEEK ..... 2 LESS THAN ONCE A WEEK ..... 3 NOT AT ALL 4	
124	In the last 12 months, how many times have you been away from home for one or more nights?	NUMBER OF TIMES ..... ☐☐ NONE 00	→ 126
125	In the last 12 months, have you been away from home for more than one month at a time?	YES ..... 1 NO 2	
126	CHECK 106: AGE OF RESPONDENT AGE 15-49 ☐ AGE 50 AND ABOVE ☐ → 701		

SECTION 2. REPRODUCTION

NO.	QUESTIONS AND FILTERS	CODING CATEGORIES	SKIP
201	Now I would like to ask about all the births you have had during your life. Have you ever given birth?	YES ..... 1 NO 2	→ 206
202	Do you have any sons or daughters to whom you have given birth who are now living with you?	YES ..... 1 NO 2	→ 204
203	a) How many sons live with you? b) And how many daughters live with you? IF NONE, RECORD '00'.	a) SONS AT HOME ..... [ ][ ] b) DAUGHTERS AT HOME ..... [ ][ ]	
204	Do you have any sons or daughters to whom you have given birth who are alive but do not live with you?	YES ..... 1 NO 2	→ 206
205	a) How many sons are alive but do not live with you? b) And how many daughters are alive but do not live with you? IF NONE, RECORD '00'.	a) SONS ELSEWHERE ..... [ ][ ] b) DAUGHTERS ELSEWHERE ..... [ ][ ]	
206	Have you ever given birth to a boy or girl who was born alive but later died? IF NO, PROBE: Any baby who cried, who made any movement, sound, or effort to breathe, or who showed any other signs of life even if for a very short time?	YES ..... 1 NO 2	→ 208
207	a) How many boys have died? b) And how many girls have died? IF NONE, RECORD '00'.	a) BOYS DEAD ..... [ ][ ] b) GIRLS DEAD ..... [ ][ ]	
208	SUM ANSWERS TO 203, 205, AND 207, AND ENTER TOTAL. IF NONE, RECORD '00'.	TOTAL BIRTHS ..... [ ][ ]	
209	CHECK 208: Just to make sure that I have this right: you have had in TOTAL _____ births during your life. Is that correct? YES ☐ NO ☐ → PROBE AND CORRECT 201-208 AS NECESSARY.		
210	CHECK 208: ONE OR MORE BIRTHS ☐ NO BIRTHS ☐		→ 226

SECTION 2. REPRODUCTION

211 Now I would like to record the names of all your births, whether still alive or not, starting with the first one you had.
RECORD NAMES OF ALL THE BIRTHS IN 212. RECORD TWINS AND TRIPLETS ON SEPARATE ROWS. IF THERE ARE MORE THAN 6 BIRTHS, USE AN ADDITIONAL QUESTIONNAIRE, STARTING WITH THE SECOND ROW.

212	213	214	215	215A	216	217	218	219	220	220A	221
What name was given to your (first/ next) baby? RECORD NAME. BIRTH HISTORY NUMBER.	Is (NAME) a boy or a girl?	Were any of these births twins?	On what day, month, and year was (NAME) born?	IF BIRTH SINCE JANUARY 2011: How many months were you pregnant before the birth of (NAME)? ENTER '8' IN THE MONTH OF BIRTH IN THE CALENDAR. WRITE THE NAME OF THE CHILD TO THE LEFT OF THE '8' CODE. PLACE A 'P' IN EACH OF THE PRECEDING MONTHS ACCORDING TO THE DURATION OF THE PREGNANCY. (NOTE: THE NUMBER OF 'P's MUST BE ONE LESS THAN THE NUMBER OF MONTHS THAT THE PREGNANCY LASTED.) **C**	Is (NAME) still alive?	IF ALIVE: How old was (NAME) at (NAME)'s last birthday? RECORD AGE IN COMPLETED YEARS.	IF ALIVE: Is (NAME) living with you?	IF ALIVE: RECORD HOUSEHOLD LINE NUMBER OF CHILD. RECORD '00' IF CHILD NOT LISTED IN HOUSEHOLD.	IF DEAD: How old was (NAME) when (he/she) died? IF '12 MONTHS' OR '1 YR', ASK: Did (NAME) have (his/her) first birthday? THEN ASK: Exactly how many months old was (NAME) when (he/she) died? RECORD DAYS IF LESS THAN 1 MONTH; MONTHS IF LESS THAN TWO YEARS; OR YEARS.	IF DEAD: IF BIRTH SINCE JANUARY 2011: Where did (NAME) die? At a health facility, at home, or somewhere else?	Were there any other live births between (NAME OF PREVIOUS BIRTH) and (NAME), including any children who died after birth?
01	BOY 1 GIRL 2	SING 1 MULT 2	DAY MONTH YEAR	MONTHS	YES 1 NO 2 → (SKIP TO 220)	AGE IN YEARS	YES 1 NO 2	HOUSEHOLD LINE NUMBER → (NEXT BIRTH)	DAYS 1 MONTHS 2 YEARS 3	HEALTH FACILITY . . . 1 HOME . . . . . 2 ELSEWHERE . 3	
02	BOY 1 GIRL 2	SING 1 MULT 2	DAY MONTH YEAR	MONTHS	YES 1 NO 2 → (SKIP TO 220)	AGE IN YEARS	YES 1 NO 2	HOUSEHOLD LINE NUMBER → (SKIP TO 221)	DAYS 1 MONTHS 2 YEARS 3	HEALTH FACILITY . . . 1 HOME . . . . . 2 ELSEWHERE . 3	YES 1 → (ADD BIRTH) NO 2 → (NEXT BIRTH)
03	BOY 1 GIRL 2	SING 1 MULT 2	DAY MONTH YEAR	MONTHS	YES 1 NO 2 → (SKIP TO 220)	AGE IN YEARS	YES 1 NO 2	HOUSEHOLD LINE NUMBER → (SKIP TO 221)	DAYS 1 MONTHS 2 YEARS 3	HEALTH FACILITY . . . 1 HOME . . . . . 2 ELSEWHERE . 3	YES 1 → (ADD BIRTH) NO 2 → (NEXT BIRTH)
04	BOY 1 GIRL 2	SING 1 MULT 2	DAY MONTH YEAR	MONTHS	YES 1 NO 2 → (SKIP TO 220)	AGE IN YEARS	YES 1 NO 2	HOUSEHOLD LINE NUMBER → (SKIP TO 221)	DAYS 1 MONTHS 2 YEARS 3	HEALTH FACILITY . . . 1 HOME . . . . . 2 ELSEWHERE . 3	YES 1 → (ADD BIRTH) NO 2 → (NEXT BIRTH)
05	BOY 1 GIRL 2	SING 1 MULT 2	DAY MONTH YEAR	MONTHS	YES 1 NO 2 → (SKIP TO 220)	AGE IN YEARS	YES 1 NO 2	HOUSEHOLD LINE NUMBER → (SKIP TO 221)	DAYS 1 MONTHS 2 YEARS 3	HEALTH FACILITY . . . 1 HOME . . . . . 2 ELSEWHERE . 3	YES 1 → (ADD BIRTH) NO 2 → (NEXT BIRTH)
06	BOY 1 GIRL 2	SING 1 MULT 2	DAY MONTH YEAR	MONTHS	YES 1 NO 2 → (SKIP TO 220)	AGE IN YEARS	YES 1 NO 2	HOUSEHOLD LINE NUMBER → (SKIP TO 221)	DAYS 1 MONTHS 2 YEARS 3	HEALTH FACILITY . . . 1 HOME . . . . . 2 ELSEWHERE . 3	YES 1 → (ADD BIRTH) NO 2 → (NEXT BIRTH)

SECTION 2. REPRODUCTION

NO.	QUESTIONS AND FILTERS	CODING CATEGORIES	SKIP
222	Have you had any live births since the birth of (NAME OF LAST BIRTH)?	YES ..... 1 (RECORD BIRTH(S) IN TABLE) NO 2	
223	COMPARE 208 WITH NUMBER OF BIRTHS IN BIRTH HISTORY NUMBERS ARE SAME ☐ NUMBERS ARE DIFFERENT ☐ (PROBE AND RECONCILE)		
224	CHECK 215: ENTER THE NUMBER OF BIRTHS IN 2011-2016	NUMBER OF BIRTHS ..... ☐☐ NONE 0	
226	Are you pregnant now?	YES ..... 1 NO ..... 2 UNSURE 8	→ 230
227	How many months pregnant are you? RECORD NUMBER OF COMPLETED MONTHS. C ENTER 'P's IN THE CALENDAR, BEGINNING WITH THE MONTH OF INTERVIEW AND FOR THE TOTAL NUMBER OF COMPLETED MONTHS.	MONTHS ..... ☐☐	
228	When you got pregnant, did you want to get pregnant at that time?	YES ..... 1 NO 2	→ 230
229	CHECK 208: TOTAL NUMBER OF BIRTHS ONE OR MORE ☐ a) Did you want to have a baby later on or did you not want any more children? NONE ☐ b) Did you want to have a baby later on or did you not want any children?	LATER ..... 1 NO MORE/NONE 2	
230	Have you ever had a pregnancy that miscarried, was terminated, or ended in a stillbirth?	YES ..... 1 NO 2	→ 239
231	When did the last such pregnancy end?	MONTH ..... ☐☐ YEAR ..... ☐☐☐☐	
232	CHECK 231: LAST PREGNANCY ENDED IN 2011-2016 ☐ → 233A LAST PREGNANCY ENDED IN 2010 OR EARLIER ☐ → 239		

SECTION 2. REPRODUCTION

NO.	QUESTIONS AND FILTERS	CODING CATEGORIES			SKIP
LINE NO.	233 In what month and year did the preceding such pregnancy end?	233A Did that pregnancy end in a spontaneous miscarriage, an induced abortion, or a stillbirth?	234 How many months pregnant were you when that pregnancy ended?	235 Since January 2011, have you had any other pregnancies that did not result in a live birth?	
01		MISCARRIAGE 1 ABORTION 2 STILLBIRTH 3	MONTHS	YES 1 NO 2	→ NEXT LINE → 236
02	MONTH YEAR	MISCARRIAGE 1 ABORTION 2 STILLBIRTH 3	MONTHS	YES 1 NO 2	→ NEXT LINE → 236
03	MONTH YEAR	MISCARRIAGE 1 ABORTION 2 STILLBIRTH 3	MONTHS	YES 1 NO 2	→ NEXT LINE → 236
04	MONTH YEAR	MISCARRIAGE 1 ABORTION 2 STILLBIRTH 3	MONTHS	YES 1 NO 2	→ 236
236	**C** FOR EACH PREGNANCY THAT DID NOT END IN A LIVE BIRTH IN 2011-2016 OR LATER, ENTER 'C' FOR MISCARRIAGE, 'A' FOR INDUCED ABORTION, OR 'S' FOR STILLBIRTH IN THE CALENDAR IN THE MONTH THAT THE PREGNANCY TERMINATED AND 'P' FOR THE REMAINING NUMBER OF COMPLETED MONTHS OF PREGNANCY.IF THERE ARE MORE THAN FOUR PREGNANCIES THAT DID NOT END IN A LIVE BIRTH, USE AN ADDITIONAL QUESTIONNAIRE STARTING ON THE SECOND LINE.				
236A	CHECK 233A: HAD INDUCED ABORTION SINCE JANUARY 2011? YES ↓ NO → 237				
236B	The most recent time you had an induced abortion, what method was used?	SURGICAL ABORTION ..... 11 MEDICAL ABORTION ..... 21 SURGICAL AND MEDICAL ..... 31 SELF-INDUCED ..... 41 DON'T KNOW 98			→ 236D → 236E
236C	Where was the procedure done? PROBE TO IDENTIFY THE TYPE OF SOURCE. IF UNABLE TO DETERMINE IF PUBLIC OR PRIVATE SECTOR, RECORD 96 AND WRITE THE NAME OF THE PLACE.	**PUBLIC SECTOR** GOVT. HOSPITAL ..... 11 GOVT. CLINIC/COMMUNITY HEALTH CENTRE 12 OTHER PUBLIC SECTOR _____ 16 (SPECIFY) **PRIVATE MEDICAL SECTOR** PRIVATE HOSPITAL/CLINIC ..... 21 MARIE STOPES CLINIC ..... 22 PRIVATE DOCTOR ..... 23 OTHER PRIVATE MEDICAL SECTOR _____ 26 (SPECIFY) **OTHER SOURCE** BACKSTREET ABORTION ..... 31 OTHER _____ 96 (SPECIFY)		→ 236E

SECTION 2. REPRODUCTION

NO.	QUESTIONS AND FILTERS	CODING CATEGORIES	SKIP
236D	Where did you get the drug? PROBE TO IDENTIFY THE TYPE OF SOURCE. IF UNABLE TO DETERMINE IF PUBLIC OR PRIVATE SECTOR, RECORD 96 AND WRITE THE NAME OF THE PLACE.	**PUBLIC SECTOR** GOVT. HOSPITAL ..... 11 GOVT. CLINIC/COMMUNITY HEALTH CENTRE 12 COMMUNITY HEALTH WORKER ..... 13 OTHER PUBLIC SECTOR _____ 16 (SPECIFY) **PRIVATE MEDICAL SECTOR** PRIVATE HOSPITAL/CLINIC ..... 21 CHEMIST/PHARMACY ..... 22 PRIVATE DOCTOR ..... 23 OTHER PRIVATE MEDICAL SECTOR _____ 26 (SPECIFY) **OTHER SOURCE** BACKSTREET ABORTION ..... 31 TRADITIONAL HEALER ..... 32 OTHER _____ 96 (SPECIFY)	
236E	We have spoken about pregnancy losses that occurred since 2011. Did you have any miscarriages, terminations, or stillbirths that ended before 2011?	YES ..... 1 NO 2	→ 238 → 239
237	Did you have any miscarriages, terminations or stillbirths that ended before 2011?	YES ..... 1 NO 2	→ 239
238	When did the last such pregnancy that terminated before 2011 end?	MONTH ..... [ ][ ] YEAR ..... [ ][ ][ ][ ]	
239	When did your last menstrual period start? _____ (DATE, IF GIVEN)	DAYS AGO ..... 1 [ ][ ] WEEKS AGO ..... 2 [ ][ ] MONTHS AGO ..... 3 [ ][ ] YEARS AGO ..... 4 [ ][ ] IN MENOPAUSE/ HAS HAD HYSTERECTOMY ..... 994 BEFORE LAST BIRTH ..... 995 NEVER MENSTRUATED 996	
240	From one menstrual period to the next, are there certain days when a woman is more likely to become pregnant?	YES ..... 1 NO ..... 2 DON'T KNOW 8	→ 242
241	Is this time just before her period begins, during her period, right after her period has ended, or halfway between two periods?	JUST BEFORE HER PERIOD BEGINS ..... 1 DURING HER PERIOD ..... 2 RIGHT AFTER HER PERIOD HAS ENDED ..... 3 HALFWAY BETWEEN TWO PERIODS ..... 4 OTHER _____ 6 (SPECIFY) DON'T KNOW 8	
242	After the birth of a child, can a woman become pregnant before her menstrual period has returned?	YES ..... 1 NO ..... 2 DON'T KNOW 8	

SECTION 7. MARRIAGE AND SEXUAL ACTIVITY

NO.	QUESTIONS AND FILTERS	CODING CATEGORIES	SKIP
701	Are you currently married or living together with someone as if married?	YES, CURRENTLY MARRIED ..... 1 YES, LIVING WITH A PARTNER ..... 2 NO 3	→ 701B
701A	Do you have a regular boyfriend/partner or fiancé?	YES ..... 1 NO 2	→ 702
701B	Is this person a man or a woman?	MAN ..... 1 WOMAN ..... 2 INTERSEX OR TRANSGENDERED 3	
701C	CHECK 701: RESPONDENT'S CURRENT MARITAL STATUS 701 = 3 ☐ 701 = 1 OR 2 ☐		→ 703A
702	Have you ever been married or lived together with someone as if married?	YES, FORMERLY MARRIED ..... 1 YES, LIVED WITH A PARTNER ..... 2 NO 3	→ 703A
703	What is your marital status now: are you widowed, divorced, or separated?	WIDOWED ..... 1 DIVORCED ..... 2 SEPARATED 3	
703A	CHECK 106: AGE OF RESPONDENT AGE 15-49 ☐ AGE 50 AND ABOVE ☐		→ 901
703B	CHECK 701 AND 702: EVER MARRIED OR LIVED WITH A PARTNER? 702 = 1 OR 2 ☐ 701 = 1 OR 2 ☐ 701 = 3 AND 702 = 3 ☐		→ 709 → 713
704	Is your (spouse/partner) living with you now or is he/she staying elsewhere?	LIVING WITH HER ..... 1 STAYING ELSEWHERE 2	
705	RECORD THE SPOUSE'S/PARTNER'S NAME AND LINE NUMBER FROM THE HOUSEHOLD QUESTIONNAIRE. IF HE/SHE IS NOT LISTED IN THE HOUSEHOLD, RECORD '00'.	NAME _____ LINE NO. ..... ☐☐	
705A	CHECK 701B: SEX OF SPOUSE/PARTNER SPOUSE/PARTNER IS MALE (701B = 1) ☐ SPOUSE/PARTNER IS FEMALE OR INTERSEX (701B = 2 OR 3) ☐		→ 709
706	Does your (husband/partner) have other wives or does he live with other women as if married?	YES ..... 1 NO ..... 2 DON'T KNOW 8	→ 709
707	Including yourself, in total, how many wives or live-in partners does he have?	TOTAL NUMBER OF WIVES AND LIVE-IN PARTNERS ..... ☐☐ DON'T KNOW 98	
708	Are you the first, second, ... wife?	RANK ..... ☐☐	

SECTION 7. MARRIAGE AND SEXUAL ACTIVITY

NO.	QUESTIONS AND FILTERS	CODING CATEGORIES	SKIP
709	Have you been married or lived with someone only once or more than once?	ONLY ONCE ..... 1 MORE THAN ONCE 2	
710	CHECK 709: MARRIED/LIVED WITH A PARTNER ONLY ONCE → a) In what month and year did you start living with your (spouse/partner)? MARRIED/ LIVED WITH A PARTNER MORE THAN ONCE → b) Now I would like to ask about your first (spouse/partner). In what month and year did you start living with your first (spouse/partner)?	MONTH ..... [ ][ ] DON'T KNOW MONTH ..... 98 YEAR ..... [ ][ ][ ][ ] DON'T KNOW YEAR 9998	→ 712
711	How old were you when you first started living together?	AGE ..... [ ][ ]	
712	**CHECK FOR PRESENCE OF OTHERS. BEFORE CONTINUING, MAKE EVERY EFFORT TO ENSURE PRIVACY.**		
713	Now I would like to ask some questions about sexual activity in order to gain a better understanding of some important life issues. Let me assure you again that your answers are completely confidential and will not be told to anyone. If we should come to any question that you don't want to answer, just let me know and we will go to the next question. How old were you when you had sexual intercourse for the very first time?	NEVER HAD SEXUAL INTERCOURSE ..... 00 AGE IN YEARS ..... [ ][ ]	→ 731
714	I would like to ask you about your recent sexual activity. When was the last time you had sexual intercourse? IF LESS THAN 12 MONTHS, ANSWER MUST BE RECORDED IN DAYS, WEEKS OR MONTHS. IF 12 MONTHS (ONE YEAR) OR MORE, ANSWER MUST BE RECORDED IN YEARS.	DAYS AGO ..... 1 [ ][ ] WEEKS AGO ..... 2 [ ][ ] MONTHS AGO ..... 3 [ ][ ] YEARS AGO ..... 4 [ ][ ]	→ 716 → 727

		LAST SEXUAL PARTNER	SECOND-TO-LAST SEXUAL PARTNER	THIRD-TO-LAST SEXUAL PARTNER
715	When was the last time you had sexual intercourse with this person?		DAYS AGO .. 1 WEEKS AGO .. 2 MONTHS AGO .. 3	DAYS AGO .. 1 WEEKS AGO .. 2 MONTHS AGO .. 3
716	The last time you had sexual intercourse with this person, was a condom used?	YES .... 1 NO .... 2 (SKIP TO 718)	YES .... 1 NO .... 2 (SKIP TO 718)	YES .... 1 NO .... 2 (SKIP TO 718)
717	Was a condom used every time you had sexual intercourse with this person in the last 12 months?	YES .... 1 NO 2	YES .... 1 NO 2	YES .... 1 NO 2
718	What was your relationship to this person with whom you had sexual intercourse? IF BOYFRIEND/GIRLFRIEND: Were you living together as if married? IF YES, RECORD '2'. IF NO, RECORD '3'.	SPOUSE .... 1 LIVE-IN PARTNER ..... 2 BOYFRIEND/GIRLFRIEND NOT LIVING WITH RESPONDENT ..... 3 CASUAL ACQUAINTANCE .. 4 CLIENT/SEX WORKER .. 5 OTHER ______ 6 (SPECIFY)	SPOUSE .... 1 LIVE-IN PARTNER ..... 2 BOYFRIEND/GIRLFRIEND NOT LIVING WITH RESPONDENT ..... 3 CASUAL ACQUAINTANCE .. 4 CLIENT/SEX WORKER .. 5 OTHER ______ 6 (SPECIFY)	SPOUSE .... 1 LIVE-IN PARTNER ..... 2 BOYFRIEND/GIRLFRIEND NOT LIVING WITH RESPONDENT ..... 3 CASUAL ACQUAINTANCE .. 4 CLIENT/SEX WORKER .. 5 OTHER ______ 6 (SPECIFY)
719	How long ago did you first have sexual intercourse with this person?	DAYS AGO .. 1 WEEKS AGO .. 2 MONTHS AGO .. 3 YEARS AGO .. 4	DAYS AGO .. 1 WEEKS AGO .. 2 MONTHS AGO .. 3 YEARS AGO .. 4	DAYS AGO .. 1 WEEKS AGO .. 2 MONTHS AGO .. 3 YEARS AGO .. 4
720	How many times during the last 12 months did you have sexual intercourse with this person? IF NON-NUMERIC ANSWER, PROBE TO GET AN ESTIMATE. IF NUMBER OF TIMES IS 95 OR MORE, RECORD '95'.	NUMBER OF TIMES	NUMBER OF TIMES	NUMBER OF TIMES .....
721	How old is this person?	AGE OF PARTNER DON'T KNOW 98	AGE OF PARTNER DON'T KNOW 98	AGE OF PARTNER DON'T KNOW 98
722	Apart from this person, have you had sexual intercourse with any other person in the last 12 months?	YES .... 1 (GO BACK TO 715 IN NEXT COLUMN) NO .... 2 (SKIP TO 724)	YES .... 1 (GO BACK TO 715 IN NEXT COLUMN) NO .... 2 (SKIP TO 724)	
723	In total, with how many different people have you had sexual intercourse in the last 12 months? IF NON-NUMERIC ANSWER, PROBE TO GET AN ESTIMATE. IF NUMBER OF PARTNERS IS 95 OR MORE, RECORD '95'.			NUMBER OF PARTNERS LAST 12 MONTHS .. DON'T KNOW 98

SECTION 7. MARRIAGE AND SEXUAL ACTIVITY

NO.	QUESTIONS AND FILTERS	CODING CATEGORIES	SKIP
724	CHECK 106: AGE 15-24 ☐ ↓ AGE 25-49 ☐ → 727		
725	CHECK 701: NOT CURRENTLY MARRIED/ LIVING WITH A SPOUSE ☐ ↓ CURRENTLY MARRIED/ LIVING WITH A SPOUSE ☐ → 727		
726	In the past 12 months have you had sex or been sexually involved with anyone because he gave you or told you he would give you gifts, cash, or anything else?	YES ..... 1 NO 2	
727	In total, with how many different people have you had sexual intercourse in your lifetime? IF NON-NUMERIC ANSWER, PROBE TO GET AN ESTIMATE. IF NUMBER OF PARTNERS IS 95 OR MORE, RECORD '95'.	NUMBER OF PARTNERS IN LIFETIME ..... ☐☐ DON'T KNOW 98	
731	PRESENCE OF OTHERS DURING THIS SECTION.	YES NO CHILDREN <10 ..... 1 2 MALE ADULTS ..... 1 2 FEMALE ADULTS 1 2	

SECTION 9. SPOUSE'S BACKGROUND AND WOMAN'S WORK

NO.	QUESTIONS AND FILTERS	CODING CATEGORIES	SKIP
901	CHECK 701 AND 701A: CURRENTLY MARRIED/ LIVING WITH SOMEONE OR HAS A REGULAR PARTNER/BOYFRIEND ↓	NOT IN UNION OR NO REGULAR PARTNER/BOYFRIEND ☐	→ 909
902	How old was your (spouse/partner) on his/her last birthday?	AGE IN COMPLETED YEARS ..... ☐☐	
903	Did your (spouse/partner) ever attend an educational institution?	YES ..... 1 NO 2	→ 906
904	What was the highest level he/she attended: primary, secondary, or higher than secondary?	PRIMARY ..... 1 SECONDARY ..... 2 HIGHER THAN SECONDARY ..... 3 DON'T KNOW 8	→ 906
905	What was the highest grade or form he/she completed at that level?	**PRIMARY SCHOOL** LESS THAN 1 YEAR COMPLETED ..... 00 GRADE 1/SUB A/CLASS 1 ..... 11 GRADE 2/SUB B/CLASS 2 ..... 12 GRADE 3/STANDARD 1/ AET 1 (KHA RI GUDE, SANLI) ..... 13 GRADE 4/STANDARD 2 ..... 14 GRADE 5/STANDARD 3/AET 2 ..... 15 GRADE 6 /STANDARD 4 ..... 16 GRADE 7/STANDARD 5/AET 3 ..... 17 **SECONDARY SCHOOL** LESS THAN 1 YEAR COMPLETED ..... 20 GRADE 8/STANDARD 6/FORM 1/NTC 1/ N1/NC (V) LEVEL 2 ..... 21 GRADE 9/STANDARD 7/FORM 2/AET 4/NTC 2/ N2/NC (V) LEVEL 3 ..... 22 GRADE 10/STANDARD 8/FORM 3/NTC 3/ N3/NC (V) LEVEL 4 ..... 23 GRADE 11/STANDARD 9/FORM 4 ..... 24 CERTIFICATE OR DIPLOMA WITH LESS THAN GRADE 12/STANDARD 10 COMPLETED .. 25 GRADE 12/STANDARD 10/FORM 5/MATRIC .. 26 N4/NTC4 ..... 27 N5/NTC5 ..... 28 N6/NTC6 ..... 29 **HIGHER EDUCATION** FURTHER STUDIES INCOMPLETE OR ONGOING ..... 30 CERTIFICATE OR DIPLOMA WITH GRADE 12/ STANDARD 10 COMPLETED ..... 31 HIGHER DIPLOMA (TECHNIKON/ U. OF TECHNOLOGY) ..... 32 POST HIGHER DIPLOMA (TECHNIKON/ U. TECHNOLOGY MASTERS, DOCTORAL) 33 BACHELORS DEGREE/BACHELORS DEGREE AND POST GRADUATE DIPLOMA .. 34 HONOURS DEGREE ..... 35 HIGHER DEGREE (MASTERS, DOCTORATE) 36 DON'T KNOW 98	
906	Has your (spouse/partner) done any work in the last 7 days?	YES ..... 1 NO ..... 2 DON'T KNOW 8	→ 908
907	Has your (spouse/partner) done any work in the last 12 months?	YES ..... 1 NO ..... 2 DON'T KNOW 8	→ 909
908	What is your (spouse's/partner's) occupation? That is, what kind of work does he/she mainly do?	_____ _____ ☐☐☐☐	
909	Aside from your own housework, have you done any work in the last seven days?	YES ..... 1 NO 2	→ 913

SECTION 9. SPOUSE'S BACKGROUND AND WOMAN'S WORK

NO.	QUESTIONS AND FILTERS	CODING CATEGORIES	SKIP
910	As you know, some women take up jobs for which they are paid in cash or kind. Others sell things, have a small business or work on the family farm or in the family business. In the last seven days, have you done any of these things or any other work?	YES ..... 1 NO 2	→ 913
911	Although you did not work in the last seven days, do you have any job or business from which you were absent for leave, illness, vacation, maternity leave, or any other such reason?	YES ..... 1 NO 2	→ 913
912	Have you done any work in the last 12 months?	YES ..... 1 NO 2	→ 913A
913	What is your occupation? That is, what kind of work do you mainly do?	_____ _____ ☐☐☐☐	
913A	CHECK 106: AGE OF RESPONDENT AGE 15-49 ☐ ↓ AGE 50 AND ABOVE ☐		→ 1202
913B	CHECK 909, 910, 911, AND 912: ANY YES? YES ☐ ↓ NO ☐		→ 917
914	Do you do this work for a member of your family, for someone else, or are you self-employed?	FOR FAMILY MEMBER ..... 1 FOR SOMEONE ELSE ..... 2 SELF-EMPLOYED 3	
915	Do you usually work throughout the year, or do you work seasonally, or only once in a while?	THROUGHOUT THE YEAR ..... 1 SEASONALLY/PART OF THE YEAR ..... 2 ONCE IN A WHILE 3	
916	Are you paid in cash or kind for this work or are you not paid at all?	CASH ONLY ..... 1 CASH AND KIND ..... 2 IN KIND ONLY ..... 3 NOT PAID 4	
917	CHECK 701, 701A AND 701B: CURRENTLY MARRIED/ LIVING WITH A MAN, OR HAS REGULAR MALE PARTNER/BOYFRIEND ↓ NOT IN UNION OR NOT IN UNION WITH A MAN ☐		→ 925
918	CHECK 916: CODE '1' OR '2' CIRCLED ☐ ↓ OTHER ☐		→ 921
919	Who usually decides how the money you earn will be used: you, your (husband/partner), or you and your (husband/partner) jointly?	RESPONDENT ..... 1 HUSBAND/PARTNER ..... 2 RESPONDENT AND HUSBAND/PARTNER JOINTLY ..... 3 OTHER _____ 6 (SPECIFY)	
920	Would you say that the money that you earn is more than what your (husband/partner) earns, less than what he earns, or about the same?	MORE THAN HIM ..... 1 LESS THAN HIM ..... 2 ABOUT THE SAME ..... 3 HUSBAND/PARTNER HAS NO EARNINGS ..... 4 DON'T KNOW 8	→ 922
921	Who usually decides how your (husband's/partner's) earnings will be used: you, your (husband/partner), or you and your (husband/partner) jointly?	RESPONDENT ..... 1 HUSBAND/PARTNER ..... 2 RESPONDENT AND HUSBAND/PARTNER JOINTLY ..... 3 HUSBAND/PARTNER HAS NO EARNINGS ..... 4 OTHER _____ 6 (SPECIFY)	

SECTION 9. SPOUSE'S BACKGROUND AND WOMAN'S WORK

NO.	QUESTIONS AND FILTERS	CODING CATEGORIES	SKIP
922	Who usually makes decisions about health care for yourself: you, your (husband/partner), you and your (husband/partner) jointly, or someone else?	RESPONDENT ..... 1 HUSBAND/PARTNER ..... 2 RESPONDENT AND HUSBAND/PARTNER JOINTLY ..... 3 SOMEONE ELSE ..... 4 OTHER 6	
923	Who usually makes decisions about making major household purchases?	RESPONDENT ..... 1 HUSBAND/PARTNER ..... 2 RESPONDENT AND HUSBAND/PARTNER JOINTLY ..... 3 SOMEONE ELSE ..... 4 OTHER 6	
924	Who usually makes decisions about visits to your family or relatives?	RESPONDENT ..... 1 HUSBAND/PARTNER ..... 2 RESPONDENT AND HUSBAND/PARTNER JOINTLY ..... 3 SOMEONE ELSE ..... 4 OTHER 6	
925	Do you own this or any other house either alone or jointly with someone else?	ALONE ONLY ..... 1 JOINTLY ONLY ..... 2 BOTH ALONE AND JOINTLY ..... 3 DOES NOT OWN 4	→ 931
926	Do you have a title deed or documents for any house you own?	YES ..... 1 NO ..... 2 DON'T KNOW 8	→ 931
927	Is your name on the title deed or documents?	YES ..... 1 NO ..... 2 DON'T KNOW 8	
931	PRESENCE OF OTHERS AT THIS POINT (PRESENT AND LISTENING, PRESENT BUT NOT LISTENING, OR NOT PRESENT)	PRES./ LISTEN. / PRES./ NOT LISTEN. / NOT PRES. CHILDREN < 10 ..... 1 / 2 / 3 HUSBAND ..... 1 / 2 / 3 OTHER MALES ..... 1 / 2 / 3 OTHER FEMALES ..... 1 / 2 / 3	
932	In your opinion, is a husband justified in hitting or beating his wife in the following situations: a) If she goes out without telling him? b) If she neglects the children? c) If she argues with him? d) If she refuses to have sex with him? e) If she burns the food?	YES / NO / DK a) GOES OUT ..... 1 / 2 / 8 b) NEGLECTS CHILDREN .. 1 / 2 / 8 c) ARGUES ..... 1 / 2 / 8 d) REFUSES SEX ..... 1 / 2 / 8 e) BURNS FOOD ..... 1 / 2 / 8	
933	CHECK 217 AND 218: ONE OR MORE CHILDREN LESS THAN AGE 18 LIVING WITH HER ↓ NO CHILDREN OR NO CHILDREN LESS THAN AGE 18 LIVING WITH HER →		1001
934	Now I would like to ask you questions about how you discipline or punish your (child/children). In the past 12 months, have you ever: a) Hit or slapped your (child/children) with your hand to punish or discipline the child? b) Hit or beat your (child/children) using a belt, spoon, stick, shoe or any other implement to punish or discipline the child?	YES / NO a) HIT WITH HAND ..... 1 / 2 b) HIT WITH IMPLEMENT ..... 1 / 2	

SECTION11. MATERNAL MORTALITY

NO.		CODING CATEGORIES	SKIP
1101	Now I would like to ask you some questions about your brothers and sisters, that is, all of the children born to your biological mother, including those who are living with you, those living elsewhere and those who have died. How many children did your mother give birth to, including you?	NUMBER OF BIRTHS TO BIOLOGICAL MOTHER ..... ☐☐	
1102	CHECK 1101: TWO OR MORE BIRTHS ☐ ↓ ONLY ONE BIRTH (RESPONDENT ONLY) ☐ → 1201		
1103	How many births did your mother have before you were born?	NUMBER OF PRECEDING BIRTHS ..... ☐☐	

1104	What was the name given to your oldest (next oldest) brother or sister?	(1) _____	(2) _____	(3) _____	(4) _____	(5) _____	(6) _____
1105	Is (NAME) male or female?	MALE 1 FEMALE 2	MALE 1 FEMALE 2	MALE 1 FEMALE 2	MALE 1 FEMALE 2	MALE 1 FEMALE 2	MALE 1 FEMALE 2
1106	Is (NAME) still alive?	YES ... 1 NO ... 2 → GO TO 1108 DK ... 8 → GO TO (2)	YES ... 1 NO ... 2 → GO TO 1108 DK ... 8 → GO TO (3)	YES ... 1 NO ... 2 → GO TO 1108 DK ... 8 → GO TO (4)	YES ... 1 NO ... 2 → GO TO 1108 DK ... 8 → GO TO (5)	YES ... 1 NO ... 2 → GO TO 1108 DK ... 8 → GO TO (6)	YES ... 1 NO ... 2 → GO TO 1108 DK ... 8 → GO TO (7)
1107	How old is (NAME)?	☐☐ GO TO (2)	☐☐ GO TO (3)	☐☐ GO TO (4)	☐☐ GO TO (5)	☐☐ GO TO (6)	☐☐ GO TO (7)
1108	How many years ago did (NAME) die?	☐☐	☐☐	☐☐	☐☐	☐☐	☐☐
1109	How old was (NAME) when he/she died? IF DON'T KNOW, PROBE TO GET AN ESTIMATE.	☐☐ IF MALE OR DIED BEFORE 12 YEARS OF AGE GO TO 1114	☐☐ IF MALE OR DIED BEFORE 12 YEARS OF AGE GO TO 1114	☐☐ IF MALE OR DIED BEFORE 12 YEARS OF AGE GO TO 1114	☐☐ IF MALE OR DIED BEFORE 12 YEARS OF AGE GO TO 1114	☐☐ IF MALE OR DIED BEFORE 12 YEARS OF AGE GO TO 1114	☐☐ IF MALE OR DIED BEFORE 12 YEARS OF AGE GO TO 1114
1110	Was (NAME) pregnant when she died?	YES ... 1 → GO TO 1113 NO ... 2	YES ... 1 → GO TO 1113 NO ... 2	YES ... 1 → GO TO 1113 NO ... 2	YES ... 1 → GO TO 1113 NO ... 2	YES ... 1 → GO TO 1113 NO ... 2	YES ... 1 → GO TO 1113 NO ... 2
1111	Did (NAME) die during childbirth?	YES ... 1 → GO TO 1113 NO ... 2	YES ... 1 → GO TO 1113 NO ... 2	YES ... 1 → GO TO 1113 NO ... 2	YES ... 1 → GO TO 1113 NO ... 2	YES ... 1 → GO TO 1113 NO ... 2	YES ... 1 → GO TO 1113 NO ... 2
1112	Did (NAME) die within two months after the end of a pregnancy or childbirth?	YES ... 1 NO ... 2	YES ... 1 NO ... 2	YES ... 1 NO ... 2	YES ... 1 NO ... 2	YES ... 1 NO ... 2	YES ... 1 NO ... 2
1113	How many live born children did (NAME) give birth to during her lifetime?	☐☐	☐☐	☐☐	☐☐	☐☐	☐☐
1114	Was (NAME)'s death due to an accident or violence?	YES ... 1 NO ... 2	YES ... 1 NO ... 2	YES ... 1 NO ... 2	YES ... 1 NO ... 2	YES ... 1 NO ... 2	YES ... 1 NO ... 2

IF NO MORE BROTHERS OR SISTERS, GO TO NEXT SECTION.

SECTION 12. TOBACCO AND ALCOHOL

NO.	QUESTIONS AND FILTERS	CODING CATEGORIES	SKIP
1201	CHECK COVER SHEET: IS HOUSEHOLD SELECTED FOR MALE SURVEY AND BIOMARKERS OR IS RESPONDENT AGE 50 OR OLDER AND SELECTED FOR HOUSEHOLD RELATIONS MODULE? YES ☐ NO ☐ → 1501		
1202	Would you say your health is poor, average, good, or excellent?	POOR ..... 1 AVERAGE ..... 2 GOOD ..... 3 EXCELLENT 4	
1203	Do you personally think you are underweight, normal weight, overweight, or obese?	UNDERWEIGHT ..... 1 NORMAL WEIGHT ..... 2 OVERWEIGHT ..... 3 OBESE ..... 4 DON'T KNOW 8	
1204	Do you currently smoke tobacco every day, some days, or not at all?	EVERY DAY ..... 1 SOME DAYS ..... 2 NOT AT ALL 3	→ 1207 → 1206
1205	In the past, have you smoked tobacco every day?	YES ..... 1 NO 2	→ 1208
1206	In the past, have you ever smoked tobacco every day, some days, or not at all?	EVERY DAY ..... 1 SOME DAYS ..... 2 NOT AT ALL 3	→ 1209
1207	On average, how many of the following products do you currently smoke each day? Also, let me know if you use the product, but not every day. IF RESPONDENT REPORTS USING THE PRODUCT BUT NOT EVERY DAY, RECORD '888'. IF THE PRODUCT IS NOT USED AT ALL, RECORD '000'. a) Manufactured cigarettes? b) Hand-rolled cigarettes? c) Pipes full of tobacco? d) Cigars or cigarillos? e) Number of hookah, hubbly-bubbly or water pipe sessions? f) Any others? _____ (SPECIFY)	NUMBER DAILY a) MANUFACT. CIGARETTES ☐☐☐ b) HAND-ROLLED CIGARETTES ☐☐☐ c) PIPES FULL OF TOBACCO ☐☐☐ d) CIGARS OR CIGARILLOS ☐☐☐ e) WATER PIPE SESSIONS ☐☐☐ f) OTHERS ..... ☐☐☐	→ 1209

SECTION 12. TOBACCO AND ALCOHOL

NO.	QUESTIONS AND FILTERS	CODING CATEGORIES	SKIP
1208	On average, how many of the following products do you currently smoke each week? Also, let me know if you use the product, but not every week. IF RESPONDENT REPORTS USING THE PRODUCT BUT NOT EVERY WEEK, RECORD '888'. IF THE PRODUCT IS NOT USED AT ALL, RECORD '000'. a) Manufactured cigarettes? b) Hand-rolled cigarettes? c) Pipes full of tobacco? d) Cigars or cigarillos? e) Number of hookah, hubbly-bubbly or water pipe sessions? f) Any others? _____ (SPECIFY)	NUMBER WEEKLY a) MANUFACT. CIGARETTES ☐☐☐ b) HAND-ROLLED CIGARETTES ☐☐☐ c) PIPES FULL OF TOBACCO ☐☐☐ d) CIGARS OR CIGARILLOS ☐☐☐ e) WATER PIPE SESSIONS ☐☐☐ f) OTHERS ..... ☐☐☐	
1209	Do you currently use snuff, chewing tobacco or other smokeless tobacco products every day, some days, or not at all?	EVERY DAY ..... 1 SOME DAYS ..... 2 NOT AT ALL 3	→ 1211 → 1212
1210	In the past, have you used snuff, chewing tobacco or other smokeless tobacco products every day, some days, or not at all?	EVERY DAY ..... 1 SOME DAYS ..... 2 NOT AT ALL 3	→ 1213
1211	On average, how many times a day do you use the following products? Also, let me know if you use the product, but not every day. IF RESPONDENT REPORTS USING THE PRODUCT BUT NOT EVERY DAY, RECORD '888'. IF THE PRODUCT IS NOT USED AT ALL, RECORD '000'. a) Snuff, by mouth? b) Snuff, by nose? c) Chewing tobacco? d) Any others? _____ (SPECIFY)	TIMES DAILY a) SNUFF, BY MOUTH ..... ☐☐☐ b) SNUFF, BY NOSE ..... ☐☐☐ c) CHEWING TOBACCO ..... ☐☐☐ d) ANY OTHERS ..... ☐☐☐	→ 1213
1212	On average, how many times a week do you use the following products? Also, let me know if you use the product, but not every week. IF RESPONDENT REPORTS USING THE PRODUCT BUT NOT EVERY WEEK, RECORD '888'. IF THE PRODUCT IS NOT USED AT ALL, RECORD '000'. a) Snuff, by mouth? b) Snuff, by nose? c) Chewing tobacco? d) Any others? _____ (SPECIFY)	TIMES WEEKLY a) SNUFF, BY MOUTH ..... ☐☐☐ b) SNUFF, BY NOSE ..... ☐☐☐ c) CHEWING TOBACCO ..... ☐☐☐ d) ANY OTHERS ..... ☐☐☐	

SECTION 12. TOBACCO AND ALCOHOL

NO.	QUESTIONS AND FILTERS	CODING CATEGORIES	SKIP
1213	CHECK 106: AGE OF RESPONDENT AGE 15-49 ☐ ↓ AGE 50 AND ABOVE ☐ → 1220		
1214	CHECK 224: LIVE BIRTH SINCE JANUARY 2011? YES ☐ ↓ NO ☐ → 1220		
1215	CHECK 212 AND 215: _____ (NAME OF YOUNGEST CHILD) ↓		
1216	CHECK 1204 AND 1206: CURRENTLY SMOKES TOBACCO OR SMOKED IN THE PAST? YES ☐ ↓ NO ☐ → 1218		
1217	During your pregnancy with (NAME) how often did you smoke tobacco: every day, some days, or not at all?	EVERY DAY ..... 1 SOME DAYS ..... 2 NOT AT ALL 3	
1218	CHECK 1209 AND 1210: CURRENTLY USES SMOKELESS TOBACCO OR USED IN THE PAST? YES ☐ ↓ NO ☐ → 1220		
1219	During your pregnancy with (NAME) how often did you use smokeless tobacco: every day, some days, or not at all?	EVERY DAY ..... 1 SOME DAYS ..... 2 NOT AT ALL 3	
1220	Do you currently work in a job where other people smoke tobacco around you?	YES ..... 1 NO ..... 2 NOT CURRENTLY WORKING 3	
1221	Have you ever worked in a job where you were regularly exposed to smoke, dust, fumes or strong smells?	YES ..... 1 NO ..... 2 → 1223	
1222	How many years did you work at a job where you were regularly exposed to smoke, dust, fumes or strong smells? IF LESS THAN 1 YEAR, RECORD '00'.	YEARS ..... ☐☐	
1223	Do you currently use e-cigarettes every day, some days, or not at all?	EVERY DAY ..... 1 SOME DAYS ..... 2 NOT AT ALL 3	
1224	Have you ever consumed a drink that contains alcohol such as beer, wine, ciders, spirits, or sorghum beer? PROBE: Even one drink?	YES ..... 1 NO ..... 2 → 1301	
1225	Was this within the last 12 months?	YES ..... 1 NO ..... 2 → 1233	
1226	In the last 12 months, how frequently have you had at least one drink? PROBE: Five or more days a week, 1-4 days a week, 1-3 days a month, or less often than once a month?	5 OR MORE DAYS A WEEK ..... 1 1-4 DAYS PER WEEK ..... 2 1-3 DAYS A MONTH ..... 3 LESS OFTEN THAN ONCE A MONTH 4	

SECTION 12. TOBACCO AND ALCOHOL

NO.	QUESTIONS AND FILTERS	CODING CATEGORIES	SKIP
1227	During each of the last 7 days, how many standard drinks did you have? USE SHOWCARD. RECORD TOTAL NUMBER OF DRINKS CONSUMED EACH DAY STARTING WITH THE DAY BEFORE THE DAY OF THE INTERVIEW AND PROCEEDING BACKWARDS. IF NONE, RECORD '00'.	MONDAY ..... ☐☐ TUESDAY ..... ☐☐ WEDNESDAY ..... ☐☐ THURSDAY ..... ☐☐ FRIDAY ..... ☐☐ SATURDAY ..... ☐☐ SUNDAY ..... ☐☐	
1227H	During the last 7 days, how many standard home-made beers or other homemade alcohol did you have? USE SHOWCARD.	NUMBER OF HOME-MADE BEERS .. ☐☐	
1227I	CHECK 1226 AND 1227: CODE 3 OR 4 RECORDED IN 1226 AND CONSUMED 0-1 DRINKS IN THE LAST 7 DAYS IN 1227? NO ☐ ↓ YES ☐ →		1233
1228	Have you ever felt that you should cut down on your drinking?	YES ..... 1 NO 2	
1229	Have people annoyed you by criticizing your drinking?	YES ..... 1 NO 2	
1230	Have you ever felt bad or guilty about your drinking?	YES ..... 1 NO 2	
1231	Have you ever had a drink first thing in the morning to steady your nerves or get rid of a hangover?	YES ..... 1 NO 2	
1231A	CHECK 1227: FIVE OR MORE DRINKS IN ONE DAY DURING LAST 7 DAYS? NO ☐ ↓ YES ☐ →		1233
1232	In the past 30 days, have you consumed five or more standard drinks on at least one occasion?	YES ..... 1 NO 2	
1233	CHECK 106: AGE OF RESPONDENT AGE 15-49 ☐ ↓ AGE 50 AND ABOVE ☐ →		1301
1234	CHECK 224: LIVE BIRTH SINCE JANUARY 2011? YES ☐ ↓ NO ☐ →		1301
1235	CHECK 212 AND 215: _____ (NAME OF YOUNGEST CHILD) ↓		
1236	During your pregnancy with (NAME) how often did you drink alcohol: every day, some days, or not at all?	EVERY DAY ..... 1 SOME DAYS ..... 2 NOT AT ALL 3	

Appendix 5. Turnitin score for the whole document

ORIGINALITY REPORT

32%	28%	26%	16%
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