Food and nutrition security of the unborn child: The role of maternal nutrition

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~ If we change the beginning of the story, we change the whole story. ~

The mother's role in a child's upbringing is all-encompassing. The Nurturing Care Framework recognises the central role of mothers and families in creating an environment in which children can thrive by providing good health, adequate nutrition, responsive caregiving, security and safety, and opportunities for early learning.[1, 2] Yet less emphasis has been placed on the child in the womb. It seems obvious that maternal health and nutrition during pregnancy play an important role in the health of the foetus as complex biological processes and rapid cell differentiation occur during a relatively short period. However, it was only about four decades ago that the extent of adverse foetal exposures on long-term health was highlighted. Barker and colleagues demonstrated that cardiovascular diseases in English and Welsh adults were associated with undernutrition *in utero*.[3] This sparked many retrospective and cohort studies which provided evidence in support of the hypothesis – *Developmental Origins of Health and Disease* (DOHaD).

This chapter explores the impact of maternal health on children's nutritional status, and identifies opportunities to address the double burden of malnutrition in women and children, by examining the following questions:

- How do maternal risk factors impact on their children's nutritional status?
- What is the current status of maternal and child nutrition in South Africa?
- What are the drivers of the double burden of malnutrition?
- What are the recommendations for action?

How do maternal risk factors impact on their children's nutritional status?

Epidemiological studies in natural history cohorts identified that a lower birth weight was associated with an increased risk for glucose intolerance, high cholesterol, and hypertension in adult life.[4] While maternal iron deficiency in pregnancy is associated with neurocognitive deficits in infants,[5] maternal obesity and gestational diabetes[i] increase the risk of their children developing metabolic syndrome and obesity in childhood,[6, 7] as well as obesity and insulin resistance in adulthood.[8]

A child exposed to rapid maternal weight gain during early foetal development, followed by undernutrition postnatally, may be more prone to develop abdominal obesity and non-communicable diseases (NCDs) in later life. Moreover, the offspring of an obese mother might have poor growth and development in early life.[9] These intergenerational effects have been illustrated in Figure 2 in Chapter 1.

Physical and nutritional exposures are not the only risk factors. Women with mental health disorders have an increased risk of delivering small for gestational age babies,[10] and similarly, violence during pregnancy is associated with decreased birth weight and increased rates of prematurity.[11] The adverse effects of tobacco and alcohol use during pregnancy is well known.[12, 13]

There is also growing evidence of the importance of maternal health even before conception. Recent observational studies suggest that micronutrient supplementation both at pre- and periconception may reduce the risk of adverse outcomes.[14]

Optimal preconception care can improve the health and well-being of women, couples, subsequent pregnancies, and ultimately, child health outcomes. Therefore, the health of the biological mother and father[15] have a significant intergenerational impact on their children, and optimal maternal well-being is significantly associated with the health of children.

i Where raised glucose or blood sugar levels are first identified during pregnancy.

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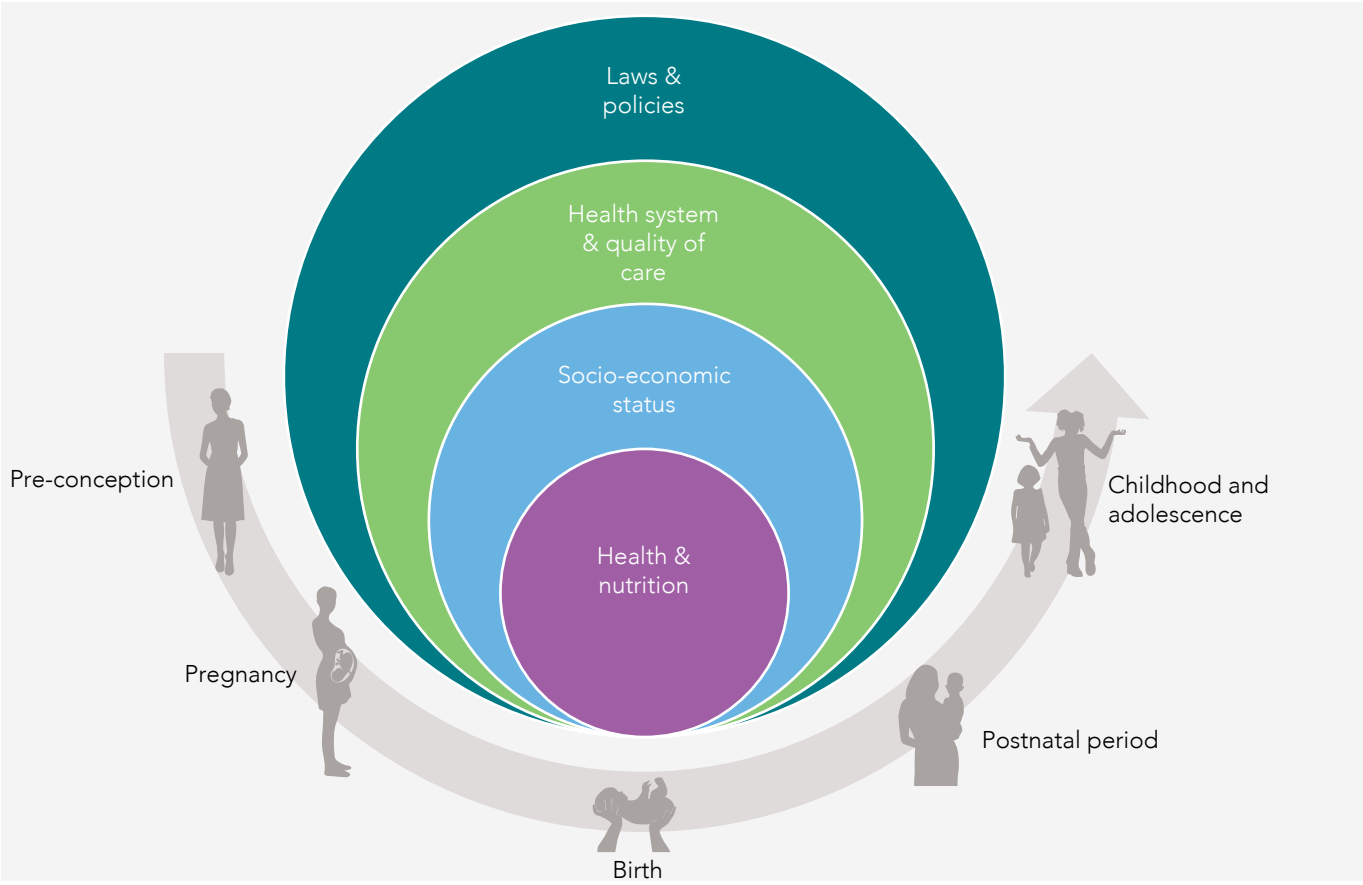
Figure 13: External drivers of maternal morbidity impact on the health and development of their children



Adapted from: Filippi V, Chou D, Barreix M, Say L, Barbour K, Cecatti JG, et al. A new conceptual framework for maternal morbidity. *International Journal of Gynecology and Obstetetrics.* 2018;141:4-9.

From maternal mortality to maternal care

Maternal health was not a topic of research, policy-making and programming until 1985.[16, 17] After a call to global agencies to prioritise maternity care, many programmes and initiatives were implemented to address maternal mortality, including the Millennium Development Goals (MDGs). In the past 20 years, maternal mortality has declined in most parts of the world, including South Africa. However, recent calls for maternal care beyond preventing death have increased.[18] There is a shift in maternal care to ensuring that mothers not only survive but thrive, as outlined in the "Survive, Thrive and Transform" agenda of the Global Strategy for Women's, Children's and Adolescents' Health (2016 – 2030).[19] In 2012, the World Health Organization (WHO) established a Maternal Morbidity Working Group to focus on maternal morbidity and "any health condition attributed to and/or complicating pregnancy and childbirth that has a negative impact on the woman's well-being and/or functioning". One outcome from the working group was the Maternal Morbidity Measurement Framework. The framework identifies several factors that require attention to optimise maternal well-being. This chapter focuses on the external drivers of maternal morbidity (and their children's health) from a nutrition perspective (Figure 13).

These external factors include the woman's economic stability, education, social and community context, health and health care, as well as neighbourhood and environment. These social and environmental determinants of health interact with the woman's reproductive health cycle and influence her risk of becoming pregnant, experiencing illness, and complications during pregnancy and childbirth.[19] The health of women and consequently, that of their children, is affected by this range of external factors which need to be addressed to enable women and their children to thrive.

What is the current status of maternal and child nutrition in South Africa?

South Africa is experiencing a double burden of malnutrition (DBM)[20] where undernutrition (i.e. micronutrient deficiency, underweight, and childhood stunting and wasting) along with overweight, obesity (and the associated diet-related NCDs) co-exist within individuals, households and populations,

throughout life.[21] At household level, DBM is defined as at least one or more members with wasting, stunting or thinness plus one or more members with overweight or obesity within the same household.[20] To further qualify as a household with a DBM, it can occur in one of four ways:

- The child is both stunted and overweight.
- The mother is overweight and one child <5 years has wasting.
- The mother is overweight and one child <5 years is stunted.
- The mother is thin and one child overweight.

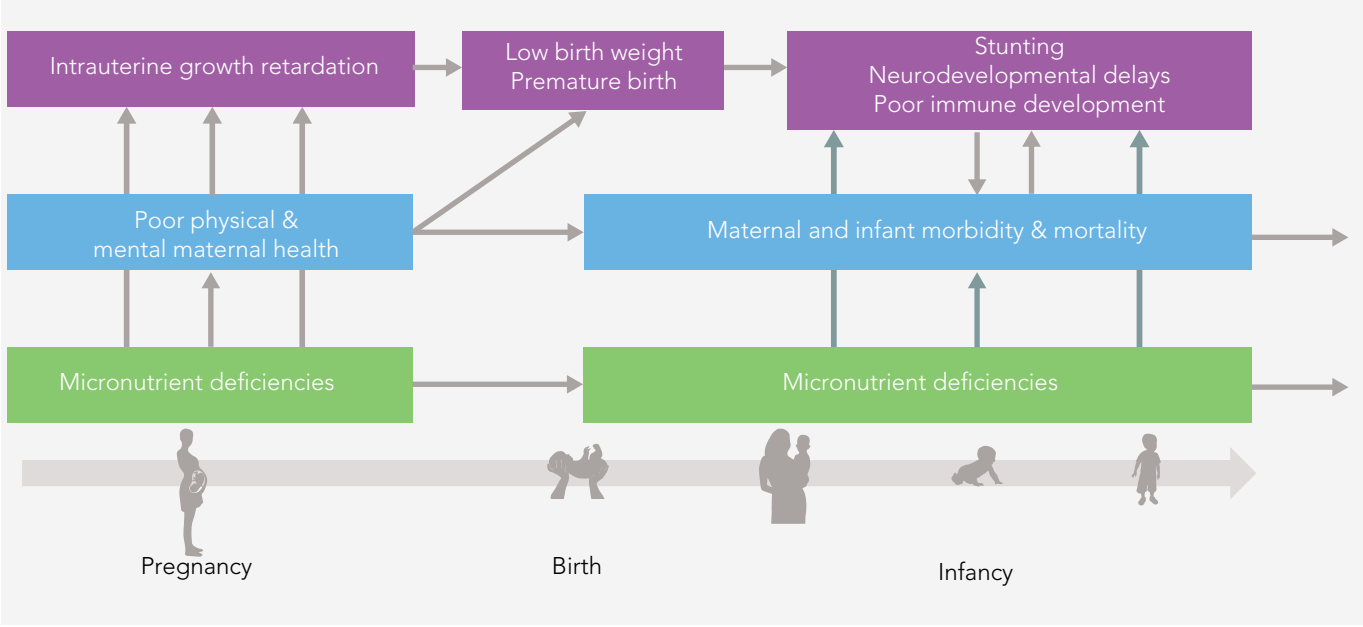
DBM at household level affects most low- and middle-income countries (LMICs) and South Africa is no exception. According to Popkin and colleagues, DBM is especially prevalent in sub-Saharan Africa, south Asia, west Asia and the Pacific.[20] In South Africa, the DBM has been shown in household surveys that indicated that overweight/obese mothers were more likely to have undernourished, specifically stunted, children.[22, 23]

A large body of evidence confirms the effect of maternal malnutrition on foetal development and the health of the child in later years. In this context, the prevalence of the DMB at an individual level, that is in the mother, is a concern. DBM that manifests during the earlier phases in the life cycle (foetal development) is particularly harmful during the sensitive periods or critical windows of development. This is when the expression of the genes and maturation of the microbiome (within the digestive system of the child) is particularly responsive to nutritional influences.[8] All these mechanisms respond to both inadequate and excessive levels of nutritional exposures in early life, which explains how crucial early nutrition and growth are for long-term health and human capital.[24, 25] Figure 14 illustrates the consequences of micronutrient deficiencies in pregnancy.

The double burden of obesity and micronutrient deficiencies in an individual woman of reproductive age may have an even worse effect on the health of her child. The burden on the unborn children of South Africa is therefore of great concern as obesity prevalence among women in South Africa is much higher than the global prevalence of 15%.[26] In 2016, 41% of women in South Africa were obese and 33% were anaemic.[27] Pregnant women are screened according to body mass index (BMI) and mid upper arm circumference during pregnancy but the Guidelines for Maternity Care in South Africa[28] provide no recommendations on nutritional advice to be given according to weight status.

Concerningly, obesity is often associated with poorer micronutrient status.[9, 29] In South Africa, obesity in women of reproductive age (WRA) was associated with iron deficiency.[30] This places an additional risk on the unborn child. Data on the micronutrient status of pregnant women in South Africa is sparse.[31] Between 2005 and 2015, no national or subnational surveys were published on the micronutrient status of apparently healthy pregnant women in South Africa (compared to 8 studies in Ethiopia and 17 in Nigeria).[31] The South African Comparative Risk Assessment group estimated that in 2000, 9 – 12% of South African pregnant women had iron deficiency anaemia, which was estimated to contribute

Figure 14: Consequences of micronutrient deficiencies in pregnancy



Adapted with permission from: Module 1 of the ImpENSA capacity building project. Accessed 30 November 2020 at: www.early-nutrition.org/impensa/

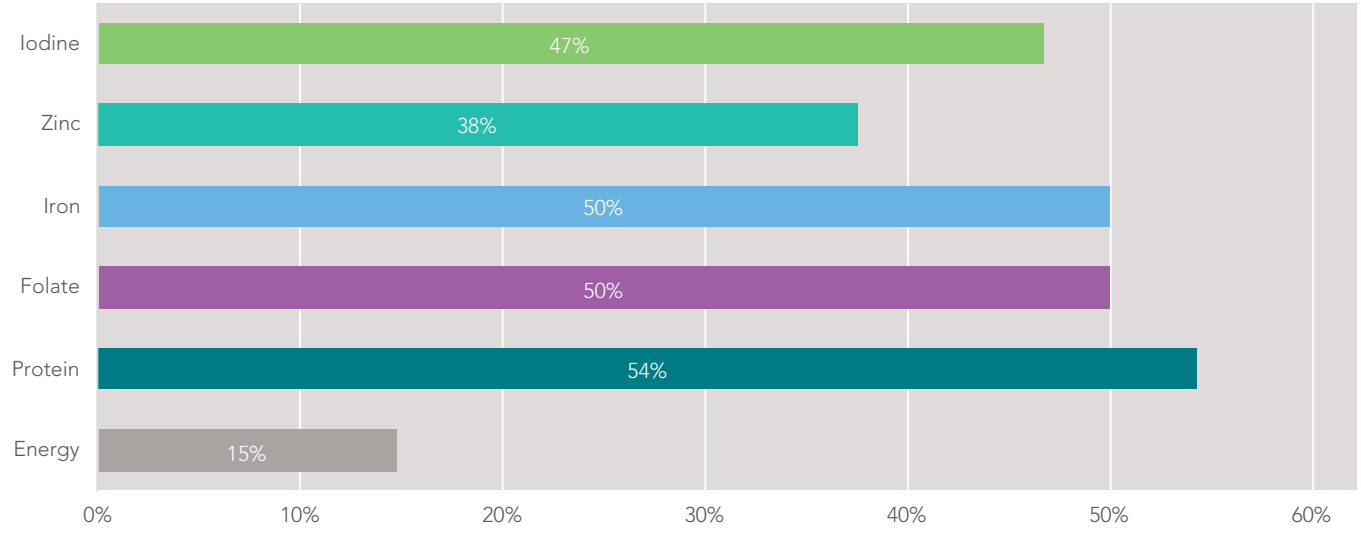
Table 8: National surveys on nutrition indicators for women in South Africa, 1998 – 2016

	SADHS 1998 15+ years	SADHS 2003 15 – 49 years	NFCS 2005 16 – 35 years	SANHANES 2012 16 – 35 years	SADHS 2016 [27] 15 – 49 years
Tobacco use during pregnancy	9% (n=198)	Not reported	Not reported	Not reported	1.6% (n=1,574)
Alcohol consumption during pregnancy	7% (n=191)	1% (n=not reported)	Not reported	Not reported	2.8% (n=1,574)
Anaemia Hb <12 g/dl in WRA Hb <11 g/dl in pregnancy	Not reported	Not reported	29% (n=2,126)	16 – 35 years: 23% (n=1,359)	Pregnant: 39.1% (n=109) 15 – 54 yrs: 32.4% (n=3,211)
Iron deficiency Fer <15 µg/L	Not reported	Not reported	45% (n=1,906)	16 – 35 years: 15% (n=1,223)	Not reported
Underweight	5.6% (n=7,970)	6.2% (n=4,481)	4.6% (n=2,403)	16 – 54 years: 4% (n=4,695)	15 – 54 years 2.9% (n=3,497)
Stunting Height <145cm	Not reported	Not reported	Not reported	Not reported	15 – 54 years 1.7% (n=3,672)
Overweight	26% (n=7,970)	28% (n=4,481)	27% (n=2,403)	16 – 54 years: 25% (n=4,695)	15 – 54 years 25.9% (n=3,497)
Obesity	30% (n=7,970)	27% (n=4,481)	25% (n=2,403)	16 – 54 years: 39% (n=4,695)	38.1% (n=3,497)
Vitamin A deficiency Retinol < 0.70 µmol/L	Not reported	Not reported	27% (n=2,450) (serum vit A <20µg/dL)	16 – 35 years: 13% (n=1,158)	Not reported
Night blindness	Not reported	0.7% (n=1,859)	Not reported	Not reported	≥15 years 12.3% (n=333)
Vitamin A supplementation received	Not reported	34.3% (n=1,859)	Not reported	Not reported	≥15 years 33.7% (n=333)

Notes: WRA: women of reproductive age; SADHS: South Africa Demographic and Health Survey; Hb: haemoglobin; Fer: ferritin; NFCS: National Food Consumption Survey; SANHANES: South African National Health and Nutrition Survey.
Sources: Department of Health, Macro International. South Africa Demographic and Health Survey 1998 [Internet]. Pretoria, South Africa; 2002. Available from: http://dhsprogram.com/pubs/pdf/FR131/FR131.pdf;
Department of Health, Medical Research Council, OrcMacro. South Africa Demographic and Health Survey 2003 [Internet]. Pretoria, South Africa; 2007. Available from: https://dhsprogram.com/publications/publication-FR206-DHS-Final-Reports.cfm;
Labadarios D, Swart R, Maunder E, Kruger H, Gericke G, Kuzwayo P, et al. Executive summary of the National Food Consumption Survey Fortifi cation Baseline (NFCS-FB-I) South Africa, 2005. South African Journal of Clinical Nutrition. 2008;21(3):245–300;
Shisana O, Labadarios D, Rehle T, Simbayi L, Zuma K, Dhansay A, et al. South African National Health and Nutrition Examination Survey, 2012 (SANHANES-1) [Internet]. 2nd ed. Cape Town: HSRC Press; 2014. Available from: http://www.hsrc.ac.za/en/research-data/view/6493; National Department of Health (NDoH), Statistics South Africa (StatsSA), South African Medical Research Council (SAMRC), ICF. South Africa Demographic and Health Survey 2016. Pretoria, South Africa and Rockville, Maryland, USA; 2019; .

to 7% of perinatal deaths and 5% of maternal deaths.[32] More recent regional studies indicate no improvement in the prevalence of iron deficiency anaemia among pregnant women. This is despite the routine high-dose iron supplements that are provided (60mg elemental iron)[28, 33] and the mandatory fortification of staples (maize meal and bread flour) which has been in place since 2003 (with eight vitamins and minerals including iron and folic acid).[34] In addition to iron supplementation, pregnant women receive high dose folic acid (5mg) and 1,000mg calcium daily during pregnancy. Even though South Africa has successfully implemented the salt iodisation policy, iodine deficiency among pregnant women in Limpopo is high (45%). Since there is limited data on pregnant women, studies on WRA are used as a proxy for the deficiency burden in pregnant women (Table 8).

Figure 15: Percentage increase in energy, protein and micronutrient requirements in the third trimester of pregnancy



Source: National Academy of Sciences. Dietary Reference Intakes (DRIs): Recommended Dietary Allowances and Adequate Intakes, total water and macronutrients. 2011. Available from: https://www.ncbi.nlm.nih.gov/books/NBK56068/table/summarytables.t4/?report=objectonly;
National Academy of Sciences. *Dietary Reference Intakes (DRIs): Recommended Dietary Allowances and Adequate Intakes, elements*. 2019. Available from: https://www.ncbi.nlm.nih.gov/books/NBK545442/table/appJ_tab3/?report=objectonly;
National Academy of Sciences. *Dietary Reference Intakes (DRIs): Recommended Dietary Allowances and Adequate Intakes, vitamins*. 2011. Available from: https://www.ncbi.nlm.nih.gov/books/NBK56068/table/summarytables.t2/?report=objectonly
Analysis by Elize Symington.

A 2017 review of micronutrient status among WRA indicates that 23% were anaemic, 16% iron deficient and 10% had iron deficiency anaemia;[ii] 22% were vitamin A deficient and 20% iodine deficient.[31] It is important to note that nutritional requirements increase during pregnancy, especially from the second trimester. When compared to pre-pregnancy requirements, energy needs only increase 11 – 15%, while the micronutrient and protein requirements increase up to 54% (Figure 15). Therefore, the emphasis on the inclusion of nutrient-dense foods and dietary diversity becomes essential to meet these micronutrient requirements without providing excessive energy.

The health effects of the DBM include an increased risk for NCDs.[38] In South Africa, NCDs are among the top causes of death, accounting for 44% of deaths in WRA in 2013.[39] NCDs are major causes of death and disability globally,[40] killing 41 million people each year (and accounting for 71% of deaths).[41] While previously more common in high-income western countries (HICs), the prevalence of NCDs is rapidly increasing in LMICs.[42, 43] From 1980 to 2014, the prevalence of diabetes remained mostly unchanged in western Europe but doubled in sub-Saharan Africa, India and China to levels that are now higher than in HICs.[40] Death rates from cardiovascular disease in many LMICs now also exceed those in HICs.[44] NCDs are occurring at younger ages and more aggressively in LMICs,[40] and are creating crippling economic, societal, and personal costs, with worse to come.

Policies, guidelines, and strategies

South Africa has several policies, guidelines and strategies in place to improve the nutritional status of the general population (including WRA) as well as pregnant women by addressing overweight and micronutrient deficiencies (see Table 2 for a summary). These interventions have tended to be fragmented and greater efforts are needed to ensure an integrated approach to the DBM across the life course. This includes a better understanding of the causes or drivers of the DBM.

What are the drivers of the double burden of malnutrition?

Many LMICs have experienced a nutrition transition due to urbanisation, income growth, expansion of the global food industry and change in household dynamics (women working outside of the home).[20] This transition has been accompanied by an increase in access to and consumption of ultra-processed foods rich in refined carbohydrates (including sugar), fat, salt and additives,[45, 46] also referred to

ii Anaemia is measured by haemoglobin status: <12 g/dL for WRA. Iron deficiency is measured by iron stores, i.e. serum ferritin: <15 ng/dL. In iron deficiency anaemia, both haemoglobin and ferritin are low.

Table 9: Summary of South African policies, guidelines and strategies addressing obesity and/or micronutrient deficiency in women of reproductive age and/or pregnant women

Document	Years of implementation	General public (incl. WRA)	PW	Obesity	Micronutrients
National Guidelines on Nutrition Counselling, Support, and Treatment for Malnourished Individuals	2015 ongoing	Yes	Yes	Yes	Yes
Food-based Dietary Guidelines	2012 ongoing	Yes	Yes	Yes	Yes
South African Food Guide	2012 ongoing	Yes	Yes	Yes	Yes
Regulations relating to the Fortification of Certain Foodstuffs	2003 ongoing	Yes	Yes	No	Yes
Regulations relating to the Mandatory Iodisation of Salt	1995 ongoing	Yes	Yes	No	Yes
Roadmap for Nutrition in South Africa	2013 – 2017	Yes	Yes	Yes	Yes
Basic Antenatal Care (BANC) Handbook	2007 ongoing	n/a	Yes	No	Yes
Standard Treatment Guidelines and Essential Medicines List for South Africa	2018 ongoing	Yes	Yes	Yes	Yes
Roadmap for the Provision of a Maternal and Child Health Package of Care for the First 1,000 Days	Draft	Yes	Yes	Yes	Yes
Guidelines for Maternity Care South Africa	2016 ongoing	n/a	Yes	Yes	Yes
Adult Primary Care Guide	2016/2017	Yes	Yes	Yes	Yes
Health Promotion Policy and Plan	2015 – 2019	Yes	Yes	Yes	No
Strategy for the prevention and control of obesity in South Africa	2015 – 2020	Yes	Yes	Yes	No
National Strategic Plan for the Prevention and Control of Non-communicable Diseases	2020 – 2025	Yes	No	Yes	No
Strategic plan for Maternal, Newborn, Child and Women's Health and Nutrition in South Africa	2012 – 2016	n/a	Yes	No	Yes

WRA: women of reproductive age; PW: pregnant women
Dark grey blocks indicate missed opportunities to address nutrition-specific matters

as obesogenic food environments. Ultra-processed foods are often more affordable, accessible and convenient than healthier foods,[45] which results in limited healthy options for those living in poverty. More than a quarter of South Africans live below the food poverty line.[47] Many women are unemployed (39%) and are not living in a union (married or living with a partner) (64%), which further contributes to the poverty of pregnant women.[27] Poverty is closely associated with food insecurity. Approximately 20% of South African households had inadequate access to food in 2017.[47] These conditions worsen in unstable situations such as with the national lockdown during the COVID-19 pandemic.[48]

While South Africa is battling household food insecurity, increased access and utilisation of processed food[49] and an increasing trend in sales of fast and processed food and sugar-sweetened beverages is evident.[20, 50, 51] High intakes of processed food are associated with obesity in Africa,[52] and ultra-processed foods are associated with cardiovascular disease and all-cause mortality in Europe.[46, 53] Apart from the physiological effect of insufficient food, eating ultra-processed foods has psychological effects too and impacts on the overall well-being of individuals.[54] Food insufficiency among pregnant women in Cape Town was associated with depressive symptoms.[55] Depressive disorders are among the most debilitating disorders worldwide and adversely affect the overall well-being of women (pre- and postnatally), compromising their capacity to care for their children and provide nurturing environments. In addition to changing food environments and high levels of food insecurity, South African women's food choices are affected by cultural beliefs. For example, pregnant women in the Eastern Cape reported avoiding nutrient-dense foods such as meat products, fish,

Case 8: Exclusive breastfeeding intentions and food insecurity of pregnant women

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Food security is imperative during the antenatal period as the physical and neurological development of the child takes place in-utero.[66] A nutritious diet during pregnancy contributes to children having a higher birth weight and a better chance of a healthy life.[67] Yet mothers in low-income households often struggle to purchase adequate nutritious food. Similarly, research indicates that decisions to exclusive breastfeed are made during the antenatal period, and these intentions predict exclusive breastfeeding outcomes.[68]

This case reports on the findings of a cross-sectional research study using self-administered closed-ended questionairres to determine the influence of household food insecurity on the exclusive breastfeeding intentions of 530 women attending an antenatal clinic in Delft, Western Cape. Seventy-two percent of the women expressed anxiety and stress due to the uncertainty of their households' food supply. Only 3% of the women's households were considered to be food secure, with 7% being mildly food insecure, 11% being moderately food insecure, and a staggering 80% being severely food insecure. Two thirds of women (66%) described living in households without sufficient quality of food, with 56% having an insufficient quantity of food. Half of the women (52%) were unemployed. This was significantly higher than the official unemployment rate of 19% or the expanded unemployment rate of 23% for the Western Cape.[69] The proportion of women having no income in this study (32%) was much higher than in the broader Delft population (17%).[70] The Child Support Grant was the only source of income for 14% of the pregnant women and they received grants for only 27% of their prior children.

Pregnant women who experience adversity such as food insecurity and stressful life events are more likely to experience mental distress that may extend into the postnatal period and impact on their capacity to care for their newborn child.[71] In addition, pregnant adolescents are more at risk than adult pregnant women to common mental disorders such as depression and anxiety.[72]

Those women who had no or limited income were 20% more likely to experience household food insecurity (aOR=0.2; Pr=0.03). However, access to the CSG had a protective effect and was associated with a five-fold increase in food security (aOR=5.5; Pr=0.00).

Seventy-three percent of the women expressed their intention to exclusively breastfeed. Reasons given included that breastmilk is healthy for the baby (34%); it is affordable (9%), and concerns about their HIV-status (1%). The primary reason given by the remaining 27% of pregnant women who did not intend to practice exclusive breastfeeding, was their need to return to work or to seek work. As reported by Witten et. al. (2020), the majority of women (72%) in this study also believed it was important for mothers to consume adequate and nutritional food in order to practice exclusive breastfeeding.[73]

While the majority of women expressed an intention to practice exclusive breastfeeding, household food insecurity may undermine pregnant women's decision to exclusively breastfeed as the Pearson's chi-squared test confirms a statistically significant association between household food insecurity and exclusive breastfeeding intention.

This study confirms the importance of household food security for pregnant women. The CSG is one of South Africa's largest social protection programmes to improve household food security. Yet, the primary caregiver can only apply for the CSG once the child has been born. *This study recommends that the Department of Social Development extend the CSG to pregnant women to improve household food security and nutrition outcomes.*

Women in low-income communities or no-income communities do not have finances to visit the South African Social Security Agency offices to apply for CSG. *The study recommends that the services provided by the mobile office for the registration of newborns at the clinics be extended to enable mothers who qualify to apply for the CSG.*

Pregnant women also experienced a lack of access to affordable and nutrient-rich food. Having little to no income makes it more challenging for these pregnant women to acquire much-needed food. *The study recommends that community-based non-profit organisations should provide nutritious meals to pregnant women to improve the nutritional health of both the mother and the unborn child. The necessary funding for the NPOs should be provided by the Department of Social Development.*

Food insecurity was one of the factors undermining women's intentions to exclusively breastfeed Providing income during the antenatal period will increase women's ability to purchase nutritious food at a critical point in children's development. This will not only improve maternal nutrition and foetal development, but also support women's intention to exclusively breastfeed as women still connect what they eat to the quality of their breastmilk.

Table 10: Summary of ten priority candidates for double-duty actions

Health systems	1. Scale up new WHO antenatal care recommendations 2. Scale up programmes to protect, promote, and support breastfeeding 3. Redesign guidance for complementary feeding practices and related indicators 4. Redesign existing growth monitoring programmes 5. Prevent undue harm from energy-dense and micronutrient-fortified foods and ready to use supplements
Societal safety nets	6. Redesign cash and food transfers, subsidies, and vouchers
Educational settings	7. Redesign school feeding programmes and devise new nutritional guidelines for food in and around educational institutions
Agriculture, food systems, and food environments	8. Scale up nutrition-sensitive agriculture programmes 9. Design new agricultural and food system policies to support healthy diets 10. Implement policies to improve food environments from the perspective of malnutrition in all its forms

Adapted from: Hawkes C, Ruel MT, Salm L, Sinclair B, Branca F. Double-duty actions: Seizing programme and policy opportunities to address malnutrition in all its forms. *Lancet*. 2020;395(10218):142-55.

potatoes, fruits, beans, eggs, butternut and pumpkin for cultural concerns about the effect on pregnancy outcome.[56]

Even though the mechanisms are not well understood, it is evident that replacing nutrient-rich foods with energy-dense foods is an emerging contributor to stunting[53, 57, 58] and that the first 1,000 days[iii] of life is a particularly sensitive period of development.[20] The DBM may also affect the health of both mother and child during childbirth. For example, an overweight mother of short stature who never reached her full height potential may have a smaller pelvis (leading to birth complications) and an increased risk of delivering a high birth weight baby or developing gestational diabetes.[59] It is due to this complex array of drivers – from food environments to social beliefs – that there is a call for comprehensive actions to address the health of women and their children. These comprehensive actions are also referred to as double-duty actions.

What are the recommendations for action?

The best window of opportunity for interventions to prevent and mitigate the DBM includes the continuum of the early life cycle: preconception, pregnancy, as well as early infancy.[8]

A call for double-duty actions

In the Lancet Series on DBM, Hawkes and colleagues explain how double-duty actions can strengthen the potential to reduce undernutrition, overweight, and diet-related NCDs.[60] A holistic approach to addressing malnutrition in all its forms is necessary as very often different forms of malnutrition are managed by separate policies, programmes, governance structures, and funding streams. As has become evident from the preceding discussions, undernutrition, obesity, and diet-related NCDs are intrinsically linked through early-life nutrition, dietary diversity, food environments, and socioeconomic factors. Therefore, double actions are needed to reduce the risk of NCD development. This is reflected in Target 2.2 of the SDGs which aims to "end all forms of malnutrition".[61] Therefore, the sooner siloed approaches in efforts to tackle malnutrition in all its forms are replaced by double-duty actions, the better off the next generation will be. Using the same platforms for shared actions to address the co-existence of both undernutrition, obesity, and diet-related NCDs is more sustainable and cost-effective. Hawkes and colleagues proposed ten strong candidates for double-duty actions across different sectors, including health services, social safety nets, educational settings, agriculture, food systems and food environments.[60] This framework has been adapted and summarised in Table 3.

However, there are very few life-course double-duty interventions that start at preconception to impact health outcomes in the child. Such interventions are essential to provide both a better understanding and an evidence base to optimise preconception health and break intergenerational trajectories of ill-health or NCDs. One such example is the Healthy Life Trajectories Initiative in Case 10. Comprehensive approaches are most probably the only solution to this multi-faceted problem and will require societal shifts in the way nutrition and public health are approached.

In South Africa, we propose a double-duty strategy with a focus on the following three elements:

- **Preconception care: Optimising women's health and nutrition:** The Lancet series on preconception health concluded that optimising preconception health could have a significant benefit for the future health of women and the prevention of intergenerational health risks. Observational evidence from several countries around

iii First 1,000 days of life: the period spanning from conception to the age of 2 years.

the world supports the conclusion that interventions that support women to optimise their health (including micronutrient status and managing their weight even before they become pregnant) may combat intergenerational obesity and NCD-risk. Since preconception clinics do not exist, the opportunities at family planning, diabetic and HIV/TB clinics should be optimised. Dietary counselling and nutritional advice should be built in as part of these services to make every contact count. This should include counselling on optimising body weight and micronutrient status within this health setting. There is motivation for the preconception micronutrient supplementation since most interventions only start after confirmation of pregnancy, in the late first trimester or even in the second trimester, and therefore miss the important processes of epigenetic change peri-conception and during early pregnancy. Additional opportunities to address preconception health are at school level. This is an early intervention to optimise the nutritional health of young women as well as the potential young fathers. Teachers should receive direct training guided by nutrition professionals and their respective bodies.

- **Perinatal care: Multifaceted interventions to address suboptimal maternal nutrition and health:** Nutrition counselling should be prioritised within ANC visits. Support for appropriate weight gain is important. Guidelines on how to address identified BMI categories should be provided in maternity care guidelines. These may include referral to a dietitian or specific dietary counselling guidelines such as portion control, nutrient density,

Case 9: Food insecurity, domestic violence and common mental disorders

Zulfa Abrahams[i]

Like many low- and middle-income countries, South Africa has a high prevalence of common mental disorders (CMDs) such as depression and anxiety during the perinatal period. It is estimated that one in every three perinatal women develop symptoms of depression,[74-77] while one in every four develop symptoms of anxiety[75,78]. Several psychosocial risk factors have been linked to the development of CMDs, including food insecurity and domestic abuse.[74, 79]

Prior to the coronavirus outbreak, more than half of all South Africans lived below the upper-bound poverty line (R1,227 per person per month),[80] in overcrowded homes with extended family members. In April and May 2020, when all non-essential services were halted during the COVID-19 lockdown, Statistics South Africa reported that the proportion of South Africans experiencing hunger increased from 4% to 7%.[81] The lockdown had the greatest impact on vulnerable groups – i.e. those who were low-skilled and less educated – as it increased the already high levels of unemployment and food insecurity.[82]

Pregnancy is a particularly vulnerable period, further marginalising already vulnerable women by reducing their income-generating potential and introducing new financial needs, such as having to improve their diet and attend regular clinic visits. In a survey of perinatal women attending public healthcare facilities across Cape Town, more than half the women reported being unemployed, 80% reported experiencing varying levels of food insecurity and 15% reported experiencing domestic abuse during the lockdown.[83] It is therefore not surprising that the proportion of perinatal women experiencing psychological distress increased from 3% prior to the lockdown to 26% during the lockdown, and that experiencing food insecurity or domestic violence significantly increased the risk of CMDs.[83]

The relationship between perinatal CMDs, poverty and food insecurity is multifaceted with several social issues interacting.[84,85] Poverty leads to food insecurity, which impacts the mental and physical well-being of the mother, and is detrimental to the care and well-being of her children.[86] Food insecurity and depression, experienced during the perinatal period, is associated with several adverse birth outcomes, including pre-term birth, low birth-weight and intra-uterine growth restriction.[87] Postpartum, it affects infant stunting as a result of early cessation of breastfeeding and insecure infant-mother attachments.[88]

It is therefore quite clear that alleviating food insecurity and providing mental health support during the perinatal period is of paramount importance for improving the physical and mental well-being of mothers, neonates, infants and young children. This can be achieved by starting the Child Support Grant during pregnancy and providing routine detection, referral and counselling services to perinatal women attending public healthcare facilities across South Africa.

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Case 10: The Healthy Life Trajectories Initiative

The Healthy Life Trajectories Initiative (HeLTI) is an initiative of the WHO and a group of funders to address the increasing burden of NCDs around the world (see: https://helti-net.org). HeLTI draws on the Developmental Origins of Health and Disease approach. The initiative recognises how environmental factors interact with genes during conception, foetal life, infancy and early childhood in ways that affect the individual's health later in life. This four-country investigation is testing a multi-faceted and integrated health and nutrition intervention that starts at preconception and continues across the life course (pregnancy, infancy and childhood). The aim is to optimise the nutritional status of undernourished women before, during and after pregnancy. This includes support to overweight or obese women to achieve a more optimal body weight and/or metabolic fitness prior to pregnancy. HeLTI should shed light on whether these interventions help improve maternal health and reduce the intergenerational risk of childhood obesity in the next generation.

The HeLTI research platform

The HeLTI programme comprises four randomised control trials in Shanghai (China), Mysore (India), Soweto (South Africa) and two provinces in Canada. Each trial is independently powered but harmonised to enable pooling of data of more than 22,000 women and more than 10,000 pregnancies. After extensive formative work, these randomised control trials are underway in China and South Africa, with India and Canada due to start in 2021. The four populations are at different points in the nutrition transition: Canadian and Shanghai are well advanced, Soweto is relatively deprived and undergoing rapid urban transition, and in rural Mysore, the transition is just beginning. A high prevalence of suboptimal nutrition characterises all sites. In India, calorie, protein and micronutrient deficiencies are frequent in pregnancy, while in Canada, China and South Africa, women often have an excessive calorie intake but also suffer from micronutrient deficiencies. To optimise nutritional status the intervention package includes nutritional counselling (with specific aims to address nutrient-density and dietary diversity); multiple micronutrient supplementation; improved social support through community health workers/nurses trained in healthy conversation skills; and motivation to improve physical activity, quality of sleep and screen time.

HeLTI outcomes: The final outcomes of the studies will evaluate the overall impact on children's nutrition and development at age five, including overweight and obesity, glucose concentration, blood pressure and neurodevelopment. A comprehensive series of measures to track maternal and child health and development including the collection of biospecimens will enable studies into the science and mechanisms of the intergenerational effect. The studies will also track a host of intermediate and process outcomes, as well as the efficacy and acceptability of the intervention package, compared with standard care.

and dietary diversity. Since micronutrient requirements increase proportionately more than energy requirements during pregnancy (Figure 3), counselling should emphasise nutrient density. Because previous single intervention trials on multiple micronutrient supplementation (MMS) have shown only modest benefits for pregnancy and child outcomes, recent work included a systematic review[62] and meta-analyses.[63, 64] These studies indicated that MMS (with more than four micronutrient components) resulted in improvements in stillbirths, small-for-gestational age and low birth weight babies when compared to iron and folic acid supplementation. Therefore, the 2020 WHO antenatal care recommendations on nutritional interventions were updated and state that "antenatal multiple micronutrient supplements that include iron and folic acid are recommended in the context of rigorous research".[65] South African guidelines should be updated according to international recommendations.

- **Behaviour change interventions:** In addition to micronutrient supplementation and fortification, population behaviour change interventions (including social grants) could be an effective method for preventing NCDs. A dual strategy should target specific groups that are actively planning a pregnancy, while improving the health of the broader population. Modern marketing techniques could be used to promote a social movement based on an emotional and symbolic connection between improved preconception, maternal health and nutrition, and offspring health. Political theory supports the development of an advocacy coalition of groups interested in preconception health, to harness the political will and leadership necessary to turn high-level policy into effective coordinated action.

Conclusion

Even though maternal mortality in South Africa has declined in the past few years, maternal well-being is of concern. The determinants and drivers contributing to the double burden of obesity and micronutrient deficiencies in pregnant women are extensive and require double-duty actions to mitigate and prevent poor intergenerational health and nutrition outcomes. A shift beyond maternal survival to optimal well-being is recommended. This will require change in the ways that healthcare services are delivered. The entire health and nutrition community needs to take ownership of such a novel approach and adopt a mindset that involves a more holistic approach to address the whole spectrum of malnutrition-related problems. Double-duty interventions are not only cost-effective but also more efficient and effective than single-duty interventions.[38]

Case 11: The discontinuation of multiple micronutrient supplements in the public health care system: The experience of KwaZulu-Natal

Lenore Spies[i]

The national health policy recommends the use of iron and folic acid (IFA) supplements to address iron-deficiency anaemia in pregnant women.[89] Yet, between 2010 and 2016, the Kwazulu-Natal Department of Health introduced a policy to provide all pregnant and breastfeeding women with a broader package of multiple micronutrient supplements (MMS) in response to the deteriorating nutrition status and immunity of clients awaiting antiretroviral therapy (ART) as well as the high levels of poverty and food insecurity in the province.[90]

In 2016, South Africa's HIV policy shifted from initiating ART based on a person's CD4 count to 'test and treat' and the provision of ART to all HIV-positive patients regardless of their CD4 count. Routine MMS was therefore discontinued based on the assumption that HIV treatment would improve women's nutritional status. And, in the absence of a national policy aligned to emerging global recommendations, the province was advised to revert to the use of IFA for pregnant women.

Particular enablers of the KZN policy directive were:

- adequate funding from both the provincial equitable share budget and the HIV/communicable diseases national conditional grant;
- a well-developed district health care system with an existing medicine procurement and distribution system that was easily able to accommodate a small delivery and storage item (MMS) within its routine systems;
- the availability of MMS on the national RT9 tender which facilitated ease of procurement;
- MMS were manufactured in-country which facilitated deliveries and reduced stockouts; and
- the review of the national infant and young child feeding guidelines, and the maternal and neonatal health guidelines, which facilitated internal discussion and consultations in order to contribute to the policy agenda.

Particular barriers that resulted in the termination of the policy directive were:

- the removal of MMS from the essential medicines list;
- the lack of international and national policy guidelines on the use of MMS in pregnant women;
- the discontinued use of MMS in the 'test and treat' HIV policy; and
- limited capacity to advocate for the continued use of MMS in the context of competing priorities.

In 2020, the World Health Organization[91] updated its antenatal care guidelines recommending the use of MMS to address multiple micronutrient deficiencies in pregnancy (especially iron deficiency anaemia), given that the dietary intake of fruit, vegetables, meat and dairy products of many pregnant women living in resource-poor contexts is often insufficient to meet increased maternal and foetal dietary needs.

Given the expected impact of the COVID-19 pandemic and the subsequent economic crisis, it would be in the interest of maternal and child health for South Africa to align its maternal and child nutrition policies and programmes to include the use and distribution of MMS. This will require decisive leadership and coordination across a hierarchy of sectors and committees to put policies in place to address the barriers listed above, and to enable implementation.

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