Chapter

Global Prevalence of Malnutrition: Evidence from Literature

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Abstract

Malnutrition is a widespread problem, affecting the global population at some life stage. This public health epidemic targets everyone, but the most vulnerable groups are poverty-stricken people, young children, adolescents, older people, those who are with illness and have a compromised immune system, as well as lactating and pregnant women. Malnutrition includes both undernutrition (wasting, stunting, underweight, and mineral- and vitamin-related malnutrition) and overnutrition (overweight, obesity, and diet-related noncommunicable diseases). In combating malnutrition, healthcare costs increase, productivity is reduced, and economic growth is staggered, thus perpetuating the cycle of ill health and poverty. The best-targeted age for addressing malnutrition is the first 1000 days of life as this window period is ideal for intervention implementation and tracking for the improvement of child growth and development. There is an unprecedented opportunity to address the various forms of malnutrition, especially the 2016–2025 Decade of Action on Nutrition set by the United Nation. This aims to achieve the relevant targets of the Sustainable Development Goals that aim to end hunger and improve nutrition, as well as promote well-being and ensure healthy lives.

Keywords: malnutrition, children, wasting, stunting, obesity

1. Introduction

Malnutrition is a universal public health problem in both children and adults globally [1]. It is not only a public health concern but it is an impediment to global poverty eradication, productivity and economic growth. By eliminating malnutrition, it is estimated that 32% of the global disease burden would be removed [2]. As a widespread serious problem affecting children in developing countries, progress towards tackling the different forms of malnutrition remains relatively slow [3]. Malnutrition occurs due to an imbalance in the body, whereby the nutrients required by the body and the amount used by the body do not balance [1]. There are several forms of malnutrition and these include two broad categories namely undernutrition and over nutrition. Undernutrition manifests as wasting or low weight for height (acute malnutrition), stunting or low height for age (chronic malnutrition), underweight or low weight for age, and mineral and vitamin deficiencies or excessiveness. Over nutrition includes overweight, obesity and diet-related non-communicable diseases (NCDs) such as diabetes mellitus, heart disease, some forms of cancer and stroke [1]. Malnutrition is an important global issue

currently, as it affects all people despite the geography, socio-economic status, sex and gender, overlapping households, communities and countries. Anyone can experience malnutrition but the most vulnerable groups affected are children, adolescents, women, as well as people who are immune-compromised, or facing the challenges of poverty [3].

According to the World Health Organization (WHO), 462 million adults are underweight, while 1.9 billion adults are overweight and/or obese. In children under 5 years of age, 155 million are stunted, 52 million are wasted, 17 million are severely wasted and 41 million are overweight and/or obese [1]. The manifestation of malnutrition is multifold, but the paths to addressing prevention are key and include exclusive breastfeeding for the first 2 years of life, diverse and nutritious foods during childhood, healthy environments, access to basic services such as water, hygiene, health and sanitation, as well as pregnant and lactating women having proper maternal nutrition before, during and after the respective phases (levels and trends) [3].

It is vital that malnutrition is addressed in children as malnutrition manifestations and symptoms begin to appear in the first 2 years of life [4]. Coinciding with the mental development and growth periods in children, protein energy malnutrition (PEM) is said to be a problem at ages 6 months to 2 years. Thus, this age period is considered a window period during which it is essential to prevent and/or manage acute and chronic malnutrition manifestations [4–6]. Child and maternal malnutrition together have contributed to 3.5 million annual deaths. Furthermore, children less than 5 years of age have a disease burden of 35% [7]. In 2008, 8.8 million global deaths in children less than 5 years old were due to underweight, of which 93% occurred in Africa and Asia. Approximately one in every seven children faces mortality before their fifth birthday in sub Saharan Africa (SSA) due to malnutrition [8].

Young malnourished children are affected by compromised immune systems by succumbing to infectious diseases and are prone to cognitive development delays, damaging long term psychological and intellectual development effects, as well as mental and physical development that is compromised due to stunting [7, 9–11]. A malnutrition cycle exists in populations experiencing chronic undernutrition and in this cycle, the nutritional requirements are not met in pregnant women. Thus, infants born to these mothers are of low birth weight, are unable to reach their full growth potential and may therefore be stunted, susceptible to infections, illness, and mortality early in life. The cycle is aggravated when low birth weight females grow into malnourished children and adults, and are therefore more likely to give birth to infants of low birth weight as well [9]. Malnutrition is not just a health issue but also affects the global burden of malnutrition socially, economically, developmentally and medically, affecting individuals, their families and communities with serious and long lasting consequences [1].

Studies in Sudan, Ethiopia, Bangladesh, and Haiti have indicated that the causes of malnutrition are multi-faceted, with both environmental and dietary factors contributing to malnutrition risk in young children [12]. Diet and disease have been identified as primary immediate determinants; with household food security, access to health facilities, healthy environment, and childcare practices influenced by socio-economic conditions [13]. Mother's antenatal visit and body mass index were also identified as risk factors for malnutrition [14]. In children under 3 years of age some of the main factors included poor nutrition, feeding practices, education and occupation of parent/caregiver, residence, household income, nutrition knowledge of mother [15]. These studies have suggested that nutrition education for the mother is important, as it is a resource that mothers can utilize for better care of their children. It can also provide the necessary skills required for childcare,

improvement of her feeding practices, enable her to make choices and have preference of health facilities available, increase her nutritional needs awareness, and give her the chance of changing her beliefs regarding medicine and disease [16]. Some of the nutritional interventions that have had some success in addressing malnutrition include exclusive breastfeeding for the first 6 months of life, vitamin A supplementation, deworming, zinc treatment and rehydration salts for diarrhea, food fortification, and folic acid/iron for lactating and pregnant women, improvement of access to piped water and hygiene [17]. These interventions have positively influenced the development, growth and survival of children [18]. Malnutrition is not a uniform condition and therefore groups and areas that experience high risk of malnutrition must be identified and targeted interventions available to assist [17].

To determine both over and undernutrition, assessment of the nutritional status is important. This identifies those individuals who are vulnerable and at risk, and how to guide a response [19]. In determining the nutritional status of a child, it must be referenced in comparison to a healthy child [20]. Most of the anthropometric indices are used with reference tables such as that of the National Center for Health Statistics (NCHS) and the currently widely recommended and used 2006 WHO child growth standards [21]. In expressing anthropometric indices relative to a reference population, the measurements are developed using the median and standard deviations of the reference populations, which are known as Z scores [22–24]. The Z score classification system interprets weight for age (W/A), weight for height (W/H) and height for age (H/A). Z scores describe a child's mid upper arm circumference (MUAC)/weight/height in comparison to the median and the mid upper arm circumference (MUAC)/weight/height of the child relative to the reference population [25]. The anthropometric value is expressed by the two score system as "a number of standard deviations or Z scores below or above the reference mean or median value" [26]. Thus, the Z score is calculated as follows:

$$\text{Z score} = \frac{\text{observed value} - \text{median value of the reference population}}{\text{standard deviation value of reference population}} \quad (1)$$

2. Classification of malnutrition

As previously mentioned malnutrition consists of both over and undernutrition (**Table 1**).

2.1 Undernutrition

Undernutrition does not only affect the health of individuals but impacts greatly on the growth of the economy and productivity, as well as the eradication of poverty. To support their growth and development, infants and young children have increased nutritional needs and therefore are most affected by undernutrition [27, 28]. Prolonged malnourished status in children can lead to the development of

Classification	Z score values
Adequately nourished	$-2 <$ Z-score $< +1$
Moderately malnourished	$-3 <$ Z-score < -2
Severely malnourished	Z-score < -3

Table 1.
Malnutrition classification of children based on Z scores [20].

motor function and physical growth delays, lack of social skills, and low infection resistance, thus making them susceptible to common ailments and infections [28, 29]. Additionally, due to frequent infection, susceptible children become engaged in a negative cycle whereby infections lead to growth delays and their learning abilities are hindered, and infections in malnourished children may lead to childhood mortality [30].

Undernutrition is subdivided into two categories that include micronutrient malnutrition and growth failure. To differentiate between acute or chronic malnutrition, the nutritional status of an individual is assessed by using anthropometry [27]. According to Zere and McIntyre [31], anthropometry is advantageous over biochemical evaluation, as it is less invasive and cost effective; hence, in addressing child survival nutritional status anthropometry is one of the favored predictors [32]. To assess the growth status of children the most common indices used in anthropometry include low weight for height or wasting, stunting or low height for age, underweight or a low weight for age and waist/arm circumference.

2.2 Undernutrition/protein energy malnutrition (PEM)

In PEM the condition is characterized by the individual being susceptible to infection due to long-term consumption of protein and energy that is insufficient to meet the body's needs. While the body may first attempt to utilize the nutrients to meet the energy demands, if there is insufficient intake of energy then the consumed protein is used to meet the energy demands and does not address the functions of the protein in the body, hence leading to PEM. While PEM requires the measuring of growth parameters such as height and weight as it is not immediately obvious, in severe PEM children present with marasmus and kwashiorkor [33, 34]. Marasmus is characterized by a lack of protein and energy in the diet, while an inadequate intake of protein causes kwashiorkor. Marasmus or severe wasting (below −3SD) presents with a MUAC less than 115 mm in children under age five. Children with marasmus present with an "old man" appearance and are very thin [33]. In kwashiorkor, a child does not necessarily appear as undernourished but there is the presence of oedema. The children present with hair that is discolored and skin that is shiny and very tight. The weight for height is greater than or equal to −2SD. In marasmic-kwashiorkor bilateral oedema is present, with a weight for height less than −2SD [33–35].

2.3 Underweight (weight for age or W/A)

A common presentation of PEM in children is underweight. Underweight is seen as children having a weight for age with a Z score of −2SD, with severe underweight at −3SD [36, 37]. Since proteins and/or energy are insufficient in a diet, there is weight loss or failure to gain weight. This can be accompanied by a decline in linear height [38]. While the children may present with normal body proportions such as weight to height ratios, they will be undersized and underweight [39]. Through regular monitoring of growth indices such as height and weight, underweight can be identified at an early stage [26–39]. In 2013, 99 million children less than 5 years of age were underweight. Of this figure, one third of the children were from Africa and two-thirds present in Asia. An estimated 14.6% of newborns were with low birth weight in 2015, and approximately nine out of 10 of the newborns were from low and middle income countries (LMICs). Approximately 45% of deaths in LMICs in children under age five is due to underweight. In adolescent girls the underweight prevalence increased from 5.5% in 2000 to 5.7% in 2016 [40].

2.4 Stunting (height for age or H/A)

Stunting is a major public health concern that begins in intrauterine life although children are only classified as stunted at approximately age 2 years. The detrimental effects of stunting include intrauterine growth retardation, as well as inadequate nutrition required for growth and development of children [41]. High frequency of infection and decreased disease resistance such as diarrhea and pneumonia are influenced by stunting. Childhood stunting may also lead to increased mortality, poor recovery from disease and is also an obesity risk factor in adulthood [41, 42]. Stunting causes growth impairment during childhood that is associated with increased cardio-metabolic disease and obesity risk and cognitive development delay in adulthood [43]. This creates both short and long term effects that indicate the importance of stunting being identified and monitored in early life [42].

In children the initial 1000 days of life are an important window period for intervention implementation and tracking for the improvement of child growth and development [7–44]. Often stunting is correlated with poor socio-economic status, as well as environmental conditions surveys in South Africa (SA) have identified an increased stunting prevalence in black people compared to their Indian or white counterparts [31]. Some surveys looked at a wider age range of children (0–14 years) and higher stunting prevalence was found in children living informal settlements within urban and rural areas [36–45].

In stunting or low height for age the Z score is below 2 standard deviations [21]. It is prevalent usually in infants and children younger than 5 years [36], who are susceptible to infection and have an insufficient intake of nutrients over the long term. Low height for age is seen as the failure of an individual to reach full linear growth and if stunting occurs before age two then irreversible poor cognitive and motor developments may occur [41]. Severe stunting is indicated by a height for age that is lesser than the median by 85% to represent a standard deviation of −3SD [46]. In 2013 in children under 5 years of age, 161 million were identified as stunted globally. The trend of global decrease were evident from the period 2000–2013, during which figures declined from 199 million to 161 million (33–25%). However, one third of stunted children were still found in Africa [47]. During 2000–2018 the number and proportion of stunted children under age five rose by 6.5 million in Central and Western Africa and by 1.4 million in Southern and Eastern Africa. Thus, the stunting burden continues to escalate in Africa, creating serious human capital development complications [40].

2.5 Overweight and obesity

In the last five decades overweight and obesity appears to be reaching epidemic levels in both developing and developed countries [48, 49]. Eclipsing infectious disease and under-nutrition as a significant mortality and ill-health contributor, overweight and obesity have presented as the most prevalent global nutritional problem over the last two decades. Globally an estimated 1 billion adults are overweight, with 300 million of them being obese [49]. An estimated 155 million obese children contribute to this epidemic [50]. Obese children tend to become obese adults. Obesity-related health problems occur in early years of life and progress into adulthood [51]. Several chronic disease conditions in later life are associated with childhood obesity. These chronic diseases include diabetes, stroke, high blood pressure, cancers and heart disease [52]. Despite the increased prevalence of overweight and obesity in children, research evaluating treatment in these age groups is minimal. Middle-income countries such as South Africa (SA), Brazil and China have increased overweight and obesity rates across all age groups and economic levels [49].

However, over the last few years overweight has increased in every continent. It has been postulated that the number of overweight children under age five will rise from over 40 million to approximately 43 million by 2025 [53]. As of 2018, approximately half of the overweight under five children were in Asia, with a quarter in Africa. Between 2000 and 2018 in Africa, the number of overweight under five children rose by just under 44%. In children and adolescents aged 5–19 years old, the proportion of overweight in 2000 rose from one in 10 (10.3%) to just under one in five (18.4%) in 2016 [40].

2.6 Stunting versus overweight/obesity

Some developing countries such as SA are currently facing a nutrition transition with the dual burden of over and undernutrition. This nutrition transition is the replacement of traditional home cooked balanced diet meals by energy-dense foods, as well as sedentary lifestyles due to technology and urbanization. A review study highlighted the dual burden in SA in children aged 0–20 years. The prevalence of wasting and stunting was higher in younger male children and predominant in rural areas, whereas overweight/obesity prevalence was highest in females and children in urban settings. It is important for tracking of over and undernutrition in children at a district level that can also be used to prioritize, monitor and evaluate government policies regarding malnutrition [54]. More recent years have seen the double burden of malnutrition being accompanied by a triple burden of malnutrition, affecting families, communities and countries. In countries such as India and Egypt, the problem is increasing and therefore highlights the urgent need to consider child malnutrition in the greater familial and household contexts [40–55]. A study in Ghana addressed the concurrent occurrence of obesity and stunting in children aged under 5 years, providing data for the first time on such an occurrence. The study reported a stunting prevalence of 27.5%, overweight prevalence of 2.4% and an overall concurrent stunting and overweight prevalence of 1.2% [56]. A study in South Africa, with children aged 6–12 years old, reported that 9.1% were stunted, while 14.9% were overweight/obese [57]. This highlights the need for urgent targeted interventions in children to address this double burden to prevent these malnutrition issues as they transition into adulthood.

2.7 Wasting (weight for length/height or W/H)

In wasting or low weight for height the Z score is below 2 standard deviations [21]. Wasting is reflective of a body mass that is low in comparison to the age and may be due to disease or starvation. Weight loss and retardation of growth occur due to inadequate intake of food and long term it leads to wasting and becomes more severe with emaciation [58]. A child falls behind another child who is growing actively when his/her own growth is affected acutely [38], and the body height and weight become less than ideal for the age of the child [59]. Severe wasting occurs when the weight for height is less than the median by 70% to represent a standard deviation of −3SD [46]. According to the national Department of Health (DoH) height measurements in all children should be conducted at least every 3 months [60]. In measuring overall growth to compare growth standards, both height and weight measurements are essential. Globally, in 2013, in children less than 5 years of age, 51 million were wasted and 17 million severely wasted. Global wasting prevalence in 2013 approximated 8%, of which 3% accounted for severe wasting. A postulated third of wasted children were present in Africa and an estimate of the children severely wasted in Africa followed the same trend [61]. As of 2018–2019 52 million children are wasted, with an estimated 16.6 suffering from severe wasting in

2018 [62]. Children left untreated with severe acute malnutrition (SAM) are at least 12 times more likely to die than healthy children [63]. South Asia is the global wasting epicenter as 15.2% of children under five are wasted. Together with other hotspots such as Oceania, Southeast Asia and SSA, improvements regarding wasting are minimal [64] (**Table 2**).

Country	Year of last survey	Wasting	Overweight	Stunting	Underweight
Angola	2015–2016	4.9	3.4	37.6	19.0
Benin	2017–2018	5.0	1.9	32.2	16.8
Botswana	2007–2008	7.2	11.2	31.4	11.2
Burkina Faso	2017	8.6	1.7	21.1	16.2
Burundi	2016–2017	5.1	1.4	55.9	29.3
Cabo Verde	1994	6.9	—	21.4	11.8
Cameroon	2014	5.2	6.7	31.7	14.8
Central African Republic	2012	7.6	1.9	39.6	24.6
Chad	2014–2015	13.3	2.8	39.8	29.4
Comoros	2012	11.3	10.6	31.1	16.9
The Congo	2014–2015	8.2	5.9	21.2	12.3
Cote d'Ivoire	2016	6.1	1.5	21.6	12.8
Democratic Republic of Congo	2013–2014	8.1	4.4	42.7	23.4
Djibouti	2012	21.6	8.1	33.5	29.9
Equatorial Guinea	2011	3.1	9.7	26.2	5.6
Eritrea	2010	15.3	2.0	52.0	39.4
Eswatini (former Swaziland)	2014	2.0	9.0	25.5	5.8
Ethiopia	2016	10.0	2.9	38.4	23.6
Gabon	2012	3.4	7.7	17.0	6.4
The Gambia	2013	11.0	3.2	24.6	16.5
Ghana	2014	4.7	2.6	18.8	11.2
Guinea	2016	8.1	4.0	32.4	18.3
Guinea—Bissau	2014	6.0	2.3	27.6	17.0
Kenya	2014	4.2	4.1	26.2	11.2
Lesotho	2014	2.8	7.5	33.4	10.5
Liberia	2013	5.6	3.2	32.1	15.3
Madagascar	2012–2013	7.9	1.1	48.9	32.9
Malawi	2015–2016	2.8	4.6	37.4	11.8
Mali	2015	13.5	1.9	30.4	25.0
Mauritania	2015	14.8	1.3	27.9	24.9
Mauritius	1995	15.7	6.5	13.6	13.0
Mozambique	2011	6.1	7.8	42.9	15.6
Namibia	2013	7.1	4.0	22.7	13.2

Country	Year of last survey	Wasting	Overweight	Stunting	Underweight
Niger	2016	10.1	1.1	40.6	31.4
Nigeria	2016–2017	10.8	1.5	43.6	31.5
Rwanda	2014–2015	2.3	7.9	38.2	9.6
Sao Tome and Principe	2014	4.0	2.4	17.2	8.8
Senegal	2017	9.0	0.9	16.5	14.4
Seychelles	2012	4.3	10.2	7.9	3.6
Sierra Leone	2013	9.5	8.8	37.8	18.2
Somalia	2009	15.0	3.0	25.3	23.0
South Africa	2016	2.5	13.3	27.4	5.9
South Sudan	2010	24.3	5.8	31.3	29.1
Togo	2013–2014	6.6	2.0	27.6	16.1
Uganda	2016	3.5	3.7	28.9	10.4
United Republic of Tanzania	2015–16	4.5	3.7	34.5	13.7
Zambia	2013–14	6.2	6.2	40.0	14.9
Zimbabwe	2015	3.3	5.6	27.1	8.5

Table 2.
Joint malnutrition country estimates of anthropometric indicators in children aged 0–59 months [65].

3. Malnutrition in South Africa

As a developing or middle-income country, SA is still undergoing major transitions socially, economically and in the population's health. The country is currently facing a quadruple disease burden, with non-communicable diseases linked to diet and lifestyle; the burden of Human Immunodeficiency Virus/Acquired immunodeficiency syndrome (HIV/AIDS); infectious diseases and poverty linked to under nutrition; and deaths due to injuries [66]. As a developing country SA is in a nutrition transition where both over and undernutrition coexist [67]. The first 2 years of life are a vulnerable time frame as it is during this period that malnutrition begins. According to Faber and Wenhold [68], chronic malnutrition or stunting is more prevalent in children in SA compared to wasting. Since the post-apartheid era in 1994, SA has faced great challenges in addressing the nutritional status of infants, young children and adults [69]. However, large-scale nationwide surveys were conducted to trace the progress, failures and successes in addressing malnutrition. In 1994 the South African Vitamin A Consultative Group (SAVACG) conducted a national survey on the nutritional status of children aged 6–71 months [70]. Anthropometric results revealed that approximately 10% or 660,000 children were underweight, with one in every four children (1.5 million) affected by stunting. Severe wasting was only recorded in 0.4% of children. KwaZulu-Natal (KZN), Eastern Cape and Northern Province revealed the greatest prevalence of malnutrition [70]. In 1999 the National Food Consumption Survey (NFCS) was conducted in children aged 1–9 years [71], collecting a larger set of data in comparison to the SAVACG survey. The NFCS reported 10% underweight in children, with 20% affected by stunting and 17.1% as overweight and/or obese. The NFCS secondary analysis, focusing on children aged 1–5 years, reported underweight at 6.8%, stunting at 20.1%, overweight at 20.6% and obesity at 9.5% [69]. In 2005, the

National Food Consumption Survey-Fortification Baseline (NFCS-FB) reported that of children aged 1–9 years old, 20% were affected by stunting, 9.3% were underweight, wasting was found in 4.5%, and 14% were overweight or obese [72]. The South African National Health and Nutrition Examination Survey (SANHANES) conducted in 2012 reported that in children aged 0–14 years stunting prevalence was 15.4%, with 3.8% having severe stunting. Wasting was reported at 2.9%, with severe wasting at 0.8%. Underweight was reported at 5.8%, with severe underweight at 1.1%. Regarding over nutrition, SANHANES identified 18.1% of children as overweight and 4.6% as obese [36]. The prevalence of overweight and obesity was significantly greater in females (25% and 40.1%) compared to males (19.6% and 11.6%) respectively. Underweight was significantly higher in males (13.1%) in comparison to females (4.0%) [36]. Thus, it is evident that SA is facing the malnutrition epidemic at a young age and context-specific and targeted interventions are required to prevent child malnutrition before it progresses into adulthood.

4. Conclusion

During 2012–2013, WHO member states recognized the seriousness of malnutrition and its effect on global health [3]. Thus, at the United Nation's General Assembly in 2016, the United Nations Decade of Action on Nutrition 2016–2025 was announced. This set a time frame for all forms of malnutrition to be addressed and for diet-related and nutrition targets to be met by 2025. This also set the time frame for the Sustainable Development Goals (SGDs) to be achieved before 2030, particularly SDG 2 that aims to improve nutrition, achieve food security and end hunger, as well as SDG 3 that aims to ensure healthy living and promote well-being for all [1]. To tackle the malnutrition epidemic food fortification is important to ensure that children with good weight do not risk becoming overweight or obese [73]. All malnutrition indicators must be included in interventions, and more importantly treated together rather than stand-alone issues [74]. As part of the health system strengthening and with the goal of combatting malnutrition, existing policies on child malnutrition must be evaluated. The coexistence of stunting and overweight/obesity remains a challenge in LMICs that requires multi-sectoral action. During infancy and early childhood optimal nutrition is vital to ensure that, development and rapid growth demands are met. In the efforts to tackle the nutrition disparities, the first 1000 days of life are an important window period, presenting the opportunity to prevent both stunting and overweight/obesity [75]. Interventions must be inclusive of both linear growth and appropriate weight, beginning in early life and preferably during this important window period. To further tackle the double and triple burdens of malnutrition, early screening and identification of at risk children, including those already with malnutrition, is essential at healthcare facilities [76]. Thus, a more holistic, context-specific approach is required, whereby interventions not only take into consideration the risk factors, but also consider the inclusion of nutritionists and educating mothers on self and childcare regarding nutrition [77]. Furthermore, child malnutrition research and interventions must be up-scaled from community level to provincial and national levels so that it informs policy on the intervention strategies that can address the burden of child malnutrition. This is vital as children left untreated transition into malnourished adulthood, increasing the healthcare costs and needs, weakening the healthcare systems, and perpetuating the vicious malnutrition cycle.

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