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REVIEW

Malnutrition intervention programmes for school children in Sub-Saharan Africa: a review

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Abstract

Developing countries are the regions whose children are at risk of malnutrition with a high rate of undernutrition and increased statistics of overnutrition leading to obesity. There have been tracked records of increased undernutrition resulting in stunted growth and development. Meanwhile, overnutrition which can lead to obesity is increasing in all age groups, with girls and women being more affected than boys and men. Factors such as low family income, changes in lifestyle, illiteracy among parents, poor environmental conditions, inadequate nutrient intake and poor health conditions predispose children to poor nutrition. Different intervention programmes have been employed to reduce the problem of malnutrition and the most prominent one adopted by government and non-governmental organizations is the school feeding programme. To reduce malnutrition, there is a need for all stakeholders to painstakingly strengthen policies, create awareness of possible solutions, and constantly evaluate the efficiencies of the intervention programmes. It is only through coordinated efforts that the reduction of malnutrition in developing countries will be reduced. This review, therefore, evaluates the malnutrition intervention programmes among school children in developing countries, especially in Sub-Saharan Africa.

1. Introduction

Children are one of the most vulnerable groups in the world due to their age and rapid development. They deserve special attention in nutrition policies to prevent malnutrition that can predispose them to serious health challenges which if not carefully managed can lead to death. The children's public health issues such as stunting, wasting with or without oedema (marasmus and Kwashiorkor) and being underweight majorly caused by malnutrition are of great concern (Govender *et al*., 2021; United Nations, 2015; Akombi *et al*., 2017). School children are regarded as children between ages 6 to 12 years between which developmental and social changes occur such as becoming competent, independent, inquisitive, making friends and developing intelligent quotients (Eccles, 1999). The developmental stage makes the school children active and there is a need for them to be fed with nutritionally dense foods such as fruits and vegetables, whole grains, lean meats, eggs, seafood and low-fat or fat-free milk products which contain healthy fats, vitamins, minerals, lean proteins and complex carbohydrate (Nekitsing *et al*., 2018; Drewnowski *et al*., 2019). In addition to the intake of required nutrients, eating breakfast every day will assist school children in maintaining adequate concentration in class (AlBashtawy, 2017). The nutritional requirements of school children at this stage increase due to developmental and social factors and the nutritional requirements of each child are affected by body size and shape, gender and genetic background (Weichselbaum and Buttriss, 2011). Lack of required nutrients in school children's diets can lead to undernutrition while the excess of certain food nutrients can result in overnutrition. Research has proven that the deficiencies of certain micronutrients such as zinc, iodine, iron and folate can harm the cognitive development of school-aged children (Black, 2003; Al Mamum and Ghani, 2017). For instance, iron and zinc deficiencies may retard growth, cause impairment of neuropsychological

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function and make children more vulnerable to infectious diseases by lowering immunity (Cho *et al*., 2019; Al Mamum and Ghani, 2017; Black, 2003). Therefore, it is expected that food for school children especially breakfast should be highly nutritious and provide a substantial part of the total daily energy requirement which should include cereal, protein-rich food such as legumes, eggs, milk and vitamin C-rich fruit. In developing countries, most school children skip breakfast which is an important meal of the day due to the nature of work of some parents who will need to resume school early or as a result of poverty which denies children access to a nutritious meal (Okafor *et al*., 2019). Those who do not skip breakfast have also been observed to be suffering from overnutrition due to poor quality of breakfast, snack choices, and empty calorie foods which contain too many high-energy and low-nutrient foods. Onyango *et al*. (2019) reported an increase in undernourishment in sub-Saharan Africa between 2010 and 2016. It was also observed that overweight and obesity kept increasing in all age groups, where girls and women are the most affected. The consequences of malnutrition can be severe if there is no timely intervention. It can, however, be prevented by eating the right types and proportions of foods. In an effort to contribute toward the United Nations' goal of ending hunger and malnutrition by 2030, there is a need to make concerted efforts through different intervention programmes such as women empowerment, the human right to adequate food, school feeding programmes and the importance of family farming which will help in achieving the goal. Several organisations and governments are also developing policies and programmes such as school feeding to reduce malnutrition problems. This study, therefore, reviews malnutrition intervention programmes in ameliorating malnutrition in Sub-Saharan Africa. The objective of this review is to critically evaluate the causes and consequences of nutrition and to critically appraise the impact of intervention programmes on malnutrition among school children.

2. Overview of malnutrition

The World Food Programme (WFP) defines malnutrition as "a condition in which an individual's physical function is weakened to the extent where bodily performance process such as physical work, pregnancy, lactation, growth and recuperating from an illness can no longer be maintained by such individual" (WFP, 2019). Malnutrition has been associated with high records of deaths in children globally; for instance, in developing countries, 54% of child deaths in 2001 were caused by malnutrition (WHO, 2013). Protein-Energy Malnutrition (PEM) is noticed mostly in developing countries and it is associated with a higher number of hospitalized and chronically ill children in the United States (Hendricks *et al.,* 2014). Overpopulation is on the increase in developing countries and it contributes to a reduction in access to healthy and nutritious foods. About 800 million people have been reported to be suffering from hunger globally where more than 204 million are from sub-Saharan Africa and the situation is getting worse in this region as years roll by (Food and Agriculture Organization of the United Nations (FAO), 2011). This could be attributed to illiteracy, poverty, ignorance, climate change, big family size, policy and corruption.

Malnutrition remains the world's most serious health problem, and it is a major cause of childhood mortality. Child malnutrition is the most fatal form of malnutrition, according to the World Health Organization (WHO) (Okafor *et al*., 2019). It is estimated that nearly 20 million children suffer from severe acute malnutrition, with the majority of them residing in South Asia and Sub -Saharan Africa (Manyike *et al*., 2014). According to Abdul Mumin and Abdulai (2020), the recent increase in the prevalence of malnutrition in Sub-Saharan African countries necessitates a critical evaluation and exploration of ways to promote food security in the sub-region. Table 1 and Table 2 indicate the global prevalence of malnutrition. In Table 1, malnutrition in Africa increased from 18.2% in 2014 to approximately 20% in 2018 where a 20.8 to 22.8 % increase was observed in sub-Saharan Africa within the same period (FAO, ECA, and AUC, 2020). FAO, ECA, and AUC (2020) estimated that there would be approximately 239 million undernourished people in the region in 2018. Nigeria, the region's most populous country, was estimated to have more than 25 million undernourished people in 2018 (Table 2), a 180 per cent increase from the previous decade (FAO, ECA, and AUC 2020).

2.1 Malnutrition among school children

Good nutrition is critical for a healthy childhood. Malnutrition occurs primarily in school-aged children because of deficiencies in one or more of the three main preconditions for good nutrition: diet, care and health (Okafor *et al*., 2019). Malnutrition results in numerous health complications and infections (Lardner *et al.*, 2015). United Nations Children's Fund (UNICEF) (2013) reported that malnutrition affects children's physical and mental growth, social skills and development. Factors such as low family income, illiteracy among parents, poor environmental conditions, inadequate nutrient intake and poor health conditions predispose children to poor nutrition. These factors affect their social, mental and physical growth and development (Okafor *et al*., 2019).

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Table 1. Prevalence of undernourishment in the world, Africa and its subregions, 2000–2018 (%).

Regions/Subregion*	2000	2010	2014	2015	2016	2017	2018	Change-between 2014-2018(%)
World	14.8	11.8	10.8	10.6	10.7	10.8	10.8	0.0
Africa	24.5	19.1	18.2	18.3	19.2	19.8	19.9	1.7
Northern Africa	6.7	5.0	7.2	6.9	7.0	7.0	7.1	-0.1
Sub-Saharan Africa	28.4	21.7	20.8	20.9	22.0	22.7	22.8	2.0
Central Africa	39.2	27.8	24.6	24.7	25.9	26.4	26.5	1.9
Eastern African	39.1	31.2	30.0	29.9	31.0	30.8	30.8	0.8
Southern African	7.3	7.1	7.5	7.8	8.5	8.3	8.0	0.5
Western Africa	15.3	10.4	11.3	11.4	12.4	14.4	14.7	3.4

Source: FAO, ECA, and AUC (2020).

*FAO uses the M49 country and regional groupings, available at https://unstats.un.org/unsd/methodology/m49. In this report, "Central Africa" refers to the M49 "Middle Africa" grouping.

Table 2. Number of undernourished (millions).

Regions/subregions/countries	2004-2006	2009-2011	2013-2015	2014-2016	2015-2017	2016-2018
Africa	196.4	200.5	212.4	221.5	233.7	246.4
Sub-Saharan Africa	177.3	181.2	196.4	205.7	217.7	229.9
Western Africa	33.2	32.0	38.3	41.3	46.3	51.6
Benin	1.2	1.1	1.0	1.0	1.1	1.1
Burkina Faso	3.3	3.3	3.5	3.6	3.7	3.8
Cabo Verde	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Cote d'ivoire	3.7	4.5	4.7	4.7	4.7	4.6
Gambia	0.2	0.2	0.2	0.2	0.2	0.2
Ghana	2.0	1.3	1.7	1.7	1.7	1.6
Guinea	2.1	1.9	1.8	1.8	1.9	2.1
Guinea-Bissau	0.3	0.3	0.4	0.5	0.5	0.5
Liberia	1.3	1.4	1.7	1.7	1.8	1.8
Mali	1.4	1.0	1.0	1.0	1.1	1.2
Mauritania	0.4	0.3	0.3	0.4	0.4	0.5
Niger	2.1	1.8	2.0	2.3	2.9	3.6
Nigeria	9.1	9.9	15.2	17.4	21.4	25.6
Senegal	2.4	1.7	1.9	1.9	1.9	1.8
Sierra Leone	2.1	1.7	1.6	1.7	1.8	1.9
Togo	1.5	1.4	1.3	1.3	1.3	1.3

Source: FAO (2019).

Malnutrition occurs in three main conditions: undernutrition (wasting, stunting or underweight); micronutrient deficiency (inadequate or excessive intake of vitamins and minerals) and overnutrition (overweight or obesity). Stunting and being underweight are two of the most common nutritional issues that school-aged children face. According to Aiga *et al*. (2019), malnutrition in children under the age of five has been monitored regularly in most countries since the WHO introduced the standard growth chart in 1978. The standard chart was used for school children and adolescents between the ages of 5 to 19 in 2007, using the prevalence of stunting, underweight, and thinness as indicators of malnutrition, as well as overweight and obesity (de Onis *et al*., 2007). Until 2007, researchers may have been discouraged from studying malnutrition among school-aged children due to a lack of long-term technical tools to evaluate all of these dimensions of malnutrition. By introducing the Human Capital Measurement Project, the World Bank has recently begun to focus on the importance of addressing malnutrition in school-aged children as a crucial investment that a country should make (World Bank Summit, 2017). As a result, a global trend toward more research on malnutrition in school-aged children is evolving.

The National Nutrition and Health Survey (NNHS) 2018 in Nigeria, reported that the occurrence of underweight among children aged 0-59 months was 19.9% (95% CI: 21.5-23.4), now at the margin of the 20% cut-off point for a critical situation that it has been since 2014, higher than the global forecast of 15% but steady with rates in the West and Central Africa region (22%). The prevalence of stunting was 32.0% and has remained the leading burden of malnutrition, with rates

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of above 30% stagnating since 2014, and many states in the northwest and northeast recording prevalence above 40% - the WHO critical levels.

Stunting is increasing sporadically globally, and this affects millions of children (de Onis and Branca, 2016). Sub-Saharan Africa and South Asia have reported the highest prevalence of stunted children. About 37% of children under 5 years living in Sub-Saharan Africa are stunted with severe and irreversible consequences. According to Aiga *et al*. (2019), it is generally difficult for stunted children to catch up between the ages of 24 and 59 months. Due to the increasing rate of food insecurity and poverty, the malnutrition status of children under the age of five is almost the same as those over the age of five. Dukhi (2020) carried out a survey among children between the age of 1–14 years and discovered a higher stunting prevalence in children living in informal settlements within urban and rural areas.

2.2 Causes and consequences of malnutrition

The United Nations Sustainable Development Goals (SDGs) 1 and 2 aimed to address human nutrition and health; these raised concerns about addressing malnutrition globally (Aiga *et al*., 2019). Malnutrition usually occurs because of inadequate dietary consumption, recurrent infections, household food insecurity, lack of proper care, social inequality, frequent and poor pregnancies, unavailability of essential health services such as safe water supply and living in an unhealthy environment (UNICEF, 2000; Abera *et al*., 2017; Berhanu *et al.*, 2018; De and Chattopadhya, 2019; Morteza *et al*., 2019). Protein-energy malnutrition is the most common malnutrition among children followed by micronutrient deficiencies (Muller and Krawinkel, 2005).

Malnutrition is a primary public health problem for most countries, especially developing countries, causing the death of 50% of children globally (Galgamuwa *et al*., 2017). In 2018, WHO reported 155 million stunted growth and 52 million wasted children below five years of age due to malnutrition (WHO, 2018; Khamis *et al*., 2019). The consequences of malnutrition on children during the first 1000 days of life usually negatively affect cognitive and brain development (Shrestha and Pathak, 2012; Leroy *et al.*, 2014; Machira and Chirwa, 2020).

There is a relationship between malnutrition and disease because the absence of some nutrients in the body may cause diseases such as diarrhoea and common childhood infections. Frequent diarrhoea in children increases the risk of stunting at age two, and stunting increases mortality risk (Checkley *et al*., 2008; Reinhardt and Fanzo, 2014). Likewise, the regular immune system is damaged through protein-calorie malnutrition (Keusch, 2003). Children with damaged immune systems cannot fight infections such as respiratory infections and malaria (Caulfield *et al*., 2004). The consequences of malnutrition call for urgent attention to human health.

2.3 Intervention programmes for malnutrition

2.3.1 Nutrition interventions and nutrition-related outcomes

Nutrition intervention has been explained to be any type of intervention for children to enhance their general nutritional status. Different types of intervention include; food fortification, supplementation, and behavioural and regulatory interventions which have an impact on nutrition outcomes (WHO, 2015). Pradhan *et al.* (2016) reviewed the primary nutrition-related outcomes such as stunting, wasting and being underweight. Children defined as stunted were those with a height-for-age Z score below−2SD from the median of the WHO reference population. Children with a weight-for-height Z score below −2SD were defined as wasted. Children defined as underweight were those with a weight-for-age Z score below −2SD (Ministry of Health and Population, 2014). Anaemia was the secondary nutrition-related outcome, and this was considered as the concentration of haemoglobin lower than 11 g/dL for children below 5 years of age (WHO, 2011). The various kinds of nutritional interventions in the included studies lasted between 6 to 13 months.

2.3.2 Nutritional planning

The effectiveness of nutritional planning programmes involves the government and non-governmental agencies. A well-planned and finished long-term project can fasten the developmental process and the benefits thereafter can be beneficial and permanent. Nutritional planning technically explains the formulation of a nutrition policy and overall lasting planning to enhance the production and supply of food, ensure its equitability in distribution, and improve the buying or purchasing power of people (Townsend *et al.,* 2015). This may involve land reforms, appropriate methods of marketing farm produce and providing aid to farmers to get better yields from their lands. To assist in improving the capacity of people to buy nutritious and healthy foods in sufficient quantity, income-rewarding operations or activities for the weaker parts of the community, and ensuring the availability of better quality foods at affordable prices through an adequate public distribution system are some of the plans for the government to implement and execute (FAO, 2014).

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2.3.3 Nutrition and health interventions

Diseases like measles, malaria, and diarrhoea are widespread in developing countries and these trigger acute malnutrition in children and infants. A better healthcare system or facility that provides immunization, periodic deworming, oral rehydration, early diagnosis and adequate treatment of prevailing illnesses can go a long way in surpassing malnutrition in developing countries (FAO, 2014). If delay in the developmental stage persists, there is a greater possibility of permanent effects and therefore intervention must take place as early as possible (WHO, 2015). Early malnutrition can be detected through a well-recorded growth chart. The growth speed is more crucial than the exact weight at a particular period. If the growth of the child is retarded or is arrested as indicated by a flat curve on the growth card, a medical practitioner should be informed and any unnoticed infection or disorder or any reason for nutritional deficiency must be assessed and taken care of. Anthropometric indices such as mid-arm circumference, height, weight and chest circumference can be measured and used for nutrition evaluation if a growth chart is not maintained (Brown and Pollit, 2016). The right diagnosis of malnutrition can assist in tackling malnutrition caused by ill-health. In view of this, there is a need to educate stakeholders on the necessity of nutrition and health interventions.

2.3.3.1 Importance of awareness creation in nutrition and health interventions

People can be educated on the nutritional quality of common foods, the importance and nutritional quality of various locally available and culturally accepted low-cost foods, and the necessity of exclusive breastfeeding for 6 months and continuation up to 2 years or beyond (UNICEF, 2019). Other areas where awareness creation is needed to minimize ill-health and malnutrition, are harm caused by unfounded beliefs and cultural practices of feeding. Increased awareness is also needed in the following areas to minimize malnutrition; the importance of adding milk, eggs, meat or pulses in sufficient quantities in the diet to improve the total dietary protein value and as recipes for producing proper weaning foods; the necessity of feeding children/adults in the period of illness and advantages of nurturing a kitchen garden (Galhena *et al*., 2013). It is also important to emphasize the importance of immunizing children and adhering to adequate sanitation procedures in their daily activities.

Enhancing the educational status of parents, most importantly mothers, on sanitation, nutrition, and common disease precautionary strategies should technically minimize malnutrition-related morbidity and mortality (El-Sayed *et al.,* 2017). It is said that "the mind of the mother is the way to the child's stomach". Quality, quantity and choices of food taken, are all the opinions of the mother or care provider.

In Sub-Saharan Africa, female children in certain communities are facing burning challenges to formal education. Poor health status, excessive disease, poverty and quality of food intake, have been directly associated with the burden of malnutrition (World Bank, 2016). The bridge between poverty and education is like a thin line and integrates into the virtual cycle of disease, ignorance and poverty. In most regions of Sub-Saharan Africa, extravagantly large family sizes could be minimized through education. A poor community of unfounded traditional beliefs might not know that having fewer children might actually assist them to manage their few resources, and also provide sufficient and quality nutrition to the family.

Likewise, Musgrove (2016) describes three ways by which malnutrition can exist ignorance and lack of education. Firstly, people may have little knowledge about essential nutrients and vitamins and refuse to even consume the less expensive and available ones. Secondly, lack of knowledge about disease causative factors and their consequences. For instance, poor hygienic conditions and lack of ability to control some intestinal parasites (Hookworms and *Ascaris lumbricoides*) show serious effects on nutrients' competition with the host, suppressing appetite and causing anaemia (Garcia, 2016).

Huge reductions have been reported in school performance amongst children infected by these parasites. Thirdly, some people may be ignorant of how their young children are to be taken care of and they may underrate healthy functions or practices such as breastfeeding and giving vitamins and foods rich in other micronutrients to their children (Musgrove, 2016). Improvement in women's education has gone a long way in contributing to 43% of the reduction in child malnutrition between 1995 and 2015 while improvement in per-individual food accessibility contributed to about 26% (Smith and Haddad, 2020).

2.3.4 Roles of school feeding in ameliorating malnutrition

In the review of the design and implementation of 14 school meal initiatives in Resource-Limited Countries, Drake *et al.* (2017) reported the addition of fruits and vegetables as a plan that has been used in some countries with positive results and which can also be beneficial if adopted by other countries. The addition of fruits and vegetables will reduce the prevalence of micronutrient deficiency also known as hidden hunger as the above

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food group is a good source of vitamins and some minerals, and promotes the absorption of some nutrients in other food groups e.g. improved absorption of iron in meat by vitamin C. Availability of iron for body use from the meals served to school meal plan beneficiaries could have been elevated if oranges given to them two times in a week with lunch was eaten by them and not taken home to be shared with younger siblings (Abizari *et al.,* 2012). Also, Drake *et al.* (2017) proposed the inclusion of school meal initiatives in the curriculum of Nutrition and Health Education. This has been practised in some countries with positive results. It further enlightens the beneficiaries on ways of eating healthy for better nutritional status.

A school meal plan allows the household to have extra income for other obligations which in the long run can lead to better nutrition for the family if the meal is regularly made available throughout the school period (Alderman and Bundy, 2011; Drake *et al.,* 2017). School feeding schemes have been reported (Aliyar *et al.,* 2015) to be of help in the reduction of starvation and micronutrient deficiency in the short term and eventually improve the nutritional status of the school children. The usual period for the planned school feeding programme is lunch, most of the school schemes make available prepared meals that extend from single dishes based on staples with added vegetables, legumes and foods from animals to meals that include a main and a side dish. Fruits are provided as part of the meal in some programmes (Wang and Fawzi, 2020).

School lunch promoted the consumption of meals from different food groups among the study population, this has been shown to cause improved meal nutrients and meal size (Abizari *et al.,* 2012). Multiple fortified corn-soy blends resulted in a notable increase in Mid-Upper Arm Circumference (MUAC) in the SFP school but did not undergo such change in the non-SFP school (Nkhoma *et al.,* 2013). Micronutrient intake also increased among the study group. Supply of the required micronutrients can be achieved by intentionally supplying micronutrient-concentrated foods (Alderman and Bundy, 2012). Consumption of fortified cowpea with some minerals called NaFecDTa lowered the incidence of iron deficiency and iron-deficiency anaemia by 30 and 40%, respectively among school children in malaria-prone areas in Northern Ghana (Abizari *et al.,* 2012.). Jomaa *et al.* (2011) stated that there was a relatively regular and definite relationship between school meals, caloric intake and micronutrient status. The addition of micronutrient-dense foods or powders may reduce the incidence of anaemia (Abizari *et al.,* 2012). In Northern Uganda, foods being given in school and take-home portions had a positive impact on anaemia prevalence in girls aged 10-13 years by 17 to 20%.

Agbozo *et al*. (2017) reported that pupils attending schools with and without SFP had different proportions of underweight (16.8% and 12.4%) and stunting (13.3% and 8.6%). MUAC ranged between 15 and 21 mm and Body Mass Index (BMI) was within the standard range recommended WHO for healthy children (Falade *et al.,* 2012). In the assessment of the nutritional status of children undergoing the National School Nutrition Programme in South Africa, Malongane and Mbhenyane (2017) reported WAZ values of 91.6% and 90.0% for female and male children, respectively. Also, 9.5% of males and 7.8% of females were underweight while 10.4% of male and 7.1% of female participants were moderately stunted (<-2 SD). Pupils were physically strong, agile and did not fall sick after the provision of chicken, egg, and non-perishable staples such as fruits and vegetables (Awojobi and Tinubu, 2020).

The inclusion of the meat group in the meal of beneficiaries resulted in a notable gain in mid-upper arm muscle circumference (MUAMC). The provision of protein-dense foods that are also rich in micronutrients increased the bioavailability of iron and zinc in children. The vitamin B_{12} status of the beneficiaries also improved when meat or milk was added to school meals in a randomized controlled trial in Kenya, as reported by Jomaa *et al*. (2011). There was a positive effect on vitamin A and iron status of children fed with fortified biscuits in South Africa as shown in Table 3. However, the effect was not sustainable after a break in consumption during the summer vacation. The biscuit provided only 50% of RDA for vitamin A in the form of carotene which is only enough to maintain day-to-day vitamin A levels but not enough for restoring very low or exhausted vitamin A stores. The dietary intake of vitamin A from meals being eaten at home during the summer months was estimated to be about 10% of RDA per day resulting in retinol value reverting to the baseline level (Jomaa *et al*., 2011).

Analysis of the nutrient composition of meals served in school was carried out by Falade *et al.* (2012), the authors reported that crude protein was between 12 and 28% and the intake of amino acids ranged between 122 and 684 mg. The vitamins ranged from 0.1 to 0.8 mg and mineral intake varied from 2.7 to 8.5 mg. The protein digestibility/amino acid score varied between 50% and 114%. These results indicated a positive impact of the feeding programme on the nutritional status of these children. However, Owusu *et al.* (2016) compared meals served by the Ghana School Feeding Programme (GSFP) and Non-Governmental School Feeding Programme

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Table 3. Some effects of school feeding on the nutritional status of school-age children in Sub-Saharan Africa.

Author	Country	Aim of the Study	Intervention	Outcome
Jomaa *et al*. (2011)	Kenya	To review the impact of school feeding programmes on children's health and educational outcome	Inclusion of either energy or milk or meat group to a local vegetable	The beneficiary group gained about 0.4 kg and increased mid-upper arm circumference (MUAC). Children in the meat group gained up to 90% in mid-upper arm muscle circumference (MUAMC). There was an improved effect of milk supplements on height in stunted children with height for age Z scores ≤1.4
Malongane and Mbhenyane (2017)	South Africa		Feeding of biscuits fortified with iron, vitamin A, and iodine at 50% RDA (Recommended Dietary Allowance)	Notable positive effect on vitamin A and iron status of the pupils. Prevalence of anaemia, vitamin A and iron deficiencies were reduced by 13%, 28% and 67% respectively.
Falade *et al*. (2012)	Nigeria	To assess the nutritional status of pupils in a selected public primary school participating in the school feeding programme	Rice and fish, porridge (mixture of yam, cowpea and palm oil), rice and cowpea, cowpea and egg, rice and fish	MUAC ranged between 15 and 21 mm, BMI was within the WHO reference standard for healthy children
Nkhoma *et al*. (2013)	Malawi	Evaluation of cognitive and anthropometric outcomes in entry-level primary school children (6-8 years)	Feeding of a daily ration of corn-soy blend porridge	There was a significant effect on MUAC due to the School Feeding Programme (SFP) which was not observed in the non-SFP school after controlling for baseline.
Neenrvoortifi *et al*. (2013)	Kenya	To evaluate the effect of an SFP on anaemic status of children living in the slums of Kenya	Rice, beef stew, supplemented millet porridge, githeria (mixture of maize and legume, mostly beans of any type), potato (boiled or fried), ndengu stew, wholemeal bread, snacks like sausage, biscuit, doughnut, banana, cocoa beverage, raw vegetable salad with oil	19% of beneficiary children were anaemic while 42% of non -beneficiary children were non-anaemic ($p = 0.001$)
Owusu *et al*. (2016)	Ghana	To compare the energy and nutrient content of meals served by the Ghana School Feeding Programme (GSFP) and Non- Governmental School Feeding Programme (NGSFP)	Carbohydrate portion which was either yam, rice, cassava or corn-based meal with a stew of vegetables and a protein source	The meals served to children in NGSFP met the World Food Programme (WFP) recommendations for energy and macronutrient, however, those in the GSFP did not. No notable differences in the micronutrient content. Iron and Zinc contents were nearly within the limit for the recommendation. Vitamin A and calcium were fairly lower than the minimum requirement of 30% for all school programmes.

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Table 3 (Cont.). Some effects of school feeding on the nutritional status of school-age children in Sub-Saharan Africa.

Author	Country	Aim of the Study	Intervention	Outcome
Agbozo *et al*. (2017)	Ghana	To assess the impact of the Ghana school feeding programme on the nutritional status of beneficiary and non-beneficiary pupils		Pupils attending schools with and without SFP had varying proportions of underweight (12.4% and 16.8% respectively) and stunting (13.3% and 8.6 %). No statistically notable differences in nutritional status indicators (underweight, stunting, thinness and overweight) between pupils attending schools with and without school feeding although differences were observed between the two groups in the prevalence of the various indicators.
Banwat *et al*. (2018)	Nigeria	To compare dietary practices and nutritional status of participating and non-participating school pupils		The prevalence of stunting among school-fed pupils was 43.3% compared with 47.5% among non-school-fed pupils ($p = 0.035$). The prevalence of overweight among school-fed and non-school-fed pupils were 1.6 and 2.5% respectively. The proportion of pupils with normal weight was slightly higher in the SFP group (78.7%) compared with 77.5% obtained for the non-SFP group. The proportion of children with normal weight for height was higher in the SFP (92.1%) than non-SFP group (84.2%) and the difference was statistically significant ($p = 0.035$)
Zenebe *et al*. (2018)	Ethiopia	To examine the effects of SFP on dietary diversity, nutrition status and class attendance of school children	Meal prepared either from wheat, corn or bran	91.7% of beneficiaries consume legumes while 8.3% of non-beneficiaries consume from the food group. Almost all children consumed cereals and tubers on the day before the study. Beneficiaries had mean stunting (HAZ) scores of -1.45±1.38 while non-beneficiaries had a mean HAZ score of -2.17±1.15

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Table 3 (Cont.). Some effects of school feeding on the nutritional status of school-age children in Sub-Saharan Africa.

Author	Country	Aim of the Study	Intervention	Outcome
Gelli *et al*. (2019)	Ghana	To evaluate the impact of a large-scale school meals programme on school-age children anthropometry indicators	Meal prepared from wheat, corn or bean	School meals improved HAZ in early primary school years; and 5-8 years (effect size ≈0.1SD) in girls from households living below the poverty line and those living in the northern region (the country's most impoverished area). There was increased BAZ in boys of early primary school age.
Awojobi and Tinubu (2020)	Nigeria	To assess the impact of NHGSFP on the health and nutritional status of elementary pupils	Provision of protein; poultry (chicken and egg), non-perishable staples such as vegetables and fruits	Pupils were physically strong, agile and did not normally fall sick

(NGSFP), and it was observed that the children served NGSFP met the World Food Programme for energy and macronutrients content however, those in the GSFP did not, thus, there was a minimal contribution of GSFP to the growth of beneficiaries.

Best *et al.* (2011) having studied ten reports on school feeding schemes stated that micronutrient blood level was impacted positively and substantially after micronutrient supplementation. In a study in Ghana, it was reported that school meal scheme beneficiaries had higher median consumption of calories, macro and micronutrients than non-beneficiaries.

The prevalence of underweight was reduced by 0.4 SD for the younger ones of the school feeding beneficiaries when compared with younger ones of non-beneficiaries (Kazianga *et al*., 2014). There was little but substantial consequence on weight gain and little but an insubstantial consequence in height gain among school-age children (Watkins *et al.,* 2015) in Low Middle-Income Countries (LMICs).

In another study, cereals and tubers were eaten by 99.3% and 91.7% of children of non-beneficiary and beneficiary households, respectively on the day before the study. Notably, 91.7% of beneficiaries consumed legumes while 8.3% of non-beneficiary of school feeding consumed food from other groups in one month of study of school children aged 10-14 years in Ethiopia (Zenebe *et al.,* 2018). Different food groups introduced into the diet resulted in a stunting (HAZ) score of -1.45±1.38 for beneficiaries and -2.17±1.15 for non-beneficiaries. Also, BMI improved notably for participating children. Kinwele *et al.* (2021) in a study of school children in Kenya reported that staple foods were eaten by all the children both beneficiaries and non-beneficiaries, 98.6% of the former ate legumes, nuts and seeds while 75.7% of the latter consumed food from other groups but foods of high vitamin contents like fruits and vegetables were poorly eaten by both groups. It was concluded that children in school feeding schemes eat foods from more groups than those not in the scheme thus they are likely to have a better nutritional outcome.

School feeding programmes interrupted by the COVID-19 pandemic resulted in reduced household food security mostly for households benefiting from the programme. Reduced food security will impact negatively on the nutritional status of the beneficiary consequently leading to undernutrition. Through well-structured school feeding initiatives, catch-up from early growth retardation is feasible (Bundy *et al.,* 2018). It was also observed that some parents feed their wards who are beneficiaries of the school meal initiative less food at home using the programme as a substitution for home feeding which will negate the objective of the initiative as it is meant to serve as an additional source of nutrients to the children and not a replacement (Aliyar *et al.,* 2015).

2.2.5 Food security and malnutrition in sub-Saharan Africa

Food security is bound to occur if people have economic and physical access at all times to safe, sufficient, and nutritious food that meets their food and dietary preferences, for a healthy and active life and this may serve as an intervention in tackling the issue of malnutrition (WFP, 2015). Food insecurity has been caused by several factors such as distribution obstacles, changes in global climate, an absence of effective local agriculture, and disinterest or an inability by local officials to act. This condition has been worsened further by disorganized and inefficient international interventions. Sufficient food aid without any urgent demand to guarantee sustainability can lead to a prolonged causative factor of malnutrition in SSA. Some

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categories of the populace are more susceptible to food insecurity, including women (especially low-income pregnant and lactating women), low-income urban dwellers, victims of conflict, migrant workers, the elderly, the ill, and children under 5 years of age (FAO, 2014). Assistance for regional and local farming, climate prediction methods, financial aid for infrastructure and development, and a more unanimous aid initiative would promote Sub-Saharan Africa towards sustainable and reliable food sources and a better secure future. As a matter of fact, these options would result in low dependency on foreign food aid and higher dependence on solutions from within SSA. The creation of appropriate functioning political and economic structures would assist in leading countries to food security, as well as help to improve the overall well-being of the people (Tunji *et al.,* 2015).

3. The way forward and conclusion

The consequences of malnutrition need to be addressed to achieve SDGs 2 and 3 by improving the nutritional status of children in countries with a high incidence of malnutrition through government intervention programmes; this will prevent deaths associated with undernutrition. There is a need for national policies to increase food security and implement agricultural policies to achieve SDGs 2 and 3 (Zero hunger and good health and well-being). Likewise, the consumption of healthy foods by both mothers and children is necessary to reduce the child mortality rate in developing nations. Government and non-governmental organisations (NGOs) can collaborate and organise nutritional programmes and policies that will educate the rural women on the importance of nutrients present in foods within their surroundings and provide basic amenities such as healthcare centres, safe drinking water, sanitation and schools. Malnutrition is prevalent among the people who live in rural areas and the government must expedite action to eradicate malnutrition amongst citizens of the country to promote economic development and prevent mortality associated with malnutrition. It has also become imperative for stakeholders involved in school feeding to be monitored and educated to ensure quality foods are given to pupils and even at the right time. Nutritionists and dietitians should be involved in the development of foods for school children to ensure balanced nutrition of meals is distributed to school children. The nutritional status of pupils in schools should be evaluated at the beginning and end of each term to monitor the efficiency of intervention programmes particularly as it concerns school feeding.

Different intervention programmes are critical to the eradication of malnutrition in developing countries, especially in SSA. The governments should intensify efforts in floating different intervention programmes to solve malnutrition problems.

Conflict of interest

The authors declare no conflict of interest.

References

Abdul Mumin, Y. and Abdulai, A. (2020). Informing food security and nutrition strategies in sub-Saharan African Countries: An overview and empirical analysis. *Applied Economic Perspectives and Policy*, 44(1), 364-393. https://doi.org/10.1002/aepp.13126

Abera, L., Dejene, T. and Laelago, T. (2017). Prevalence of malnutrition and associated factors in children aged 6–59 months among rural dwellers of Damot Gale district, South Ethiopia: a community-based cross-sectional study. *International Journal for Equity in Health*, 16, 111. https://doi.org/10.1186/ s12939-017-0608-9

Abizari, A.R., Moretti, D., Zimmermann, M.B., Amar-Klemesu, M. and Brouwer, I.D. (2012). Whole cowpea meal fortified with NaFeEDTA reduces iron deficiency among Ghanaian school children in a malaria-endemic area. *Journal of Nutrition,* 142 (10), 1836–1842. https://doi.org/10.3945/ jn.112.165753

Agbozo, F., Attito, P. and Abubakari, A. (2017). Nutritional status of pupils attending public primary schools with and without school feeding programme in ho hoe municipality, Ghana. *Journal of Food and Nutrition Research*, 5(7), 467-474. https:// doi.org/10.12691/jfnr-5-7-3

Aiga, H., Abe, K., Andrianome, V.N., Randriamampionona, E., Razafinombana, A.R., Murai, T. and Hara, M. (2019). Risk factors for malnutrition among school-aged children: a cross-sectional study in rural Madagascar. *BMC Public Health,* 19, 773. https://doi.org/10.1186/ s12889019-7013-9

Akombi, B.J., Agho, K.E., Merom, D., Renzaho, A.M. and Hall, J.J. (2017). Child malnutrition in subSaharan Africa: A meta-analysis of demographic and health surveys (2006-2016). *PloS ONE*, 12(5), e0177338. https://doi.org/10.1371/ journal.pone.01773

Al Mamum, M.A. and Ghani, R.B.A. (2017). The role of iron and zinc in the cognitive development of children. *Asian Journal of Medical and Biological Research*, 3(2), 145-151. https://doi.org/10.3329/ ajmbr.v3i2.33561

AlBashtawy, M. (2017). Breakfast eating habits among school children. *Journal of Pediatric Nursing*, 36, 118-123. https://doi.org/10.1016/j.pedn.2017.05.013

Alderman, H. and Bundy, D.A.P (2011). School feeding programmes and development: Are we framing the question correctly? *World Bank Research Observer*, 27(2), 204-221. https://doi.org/10.1093/wbro/lkr005

Aliyar, R., Gelli, A. and Hamdani, S.H (2015). A review of nutritional guidelines and menu compositions for school feeding programmes in 12 countries. *Frontiers in Public Health,* 3, 148. https://doi.org/10.3389/fpubh.2015.00148

Awojobi, O.N. and Tinubu, R.A. (2020). Impact evaluation of national home-grown school feeding programme in Nigeria: Preliminary findings from a mixed-methods approach. Retrieved from website: https://www.researchgate.net/publication/342881116_Impact_Evaluation_of_National_Home-Grown_School_Feeding_Programme_in_Nigeria_Preliminary_Findings_from_a_Mixed-Methods_Approach

Banwat, M.E., Fayenuwo, J.O., Pantok, A.O., Okorie, C.J., Okoro, L., Tagurum, Y.O., Akosu, T.J., Chingle, M.P and Zoakah, A.I. (2018). Comparing dietary practices and nutritional status of children on school feeding programme with others in Jos North Local Government Area, Plateau State. *Journal of Epidemiological Society of Nigeria*, 1(2), 59-66. https://doi.org/10.46912/jeson.24

Berhanu, G., Mekonnen, S. and Sisay, M. (2018). Prevalence of stunting and associated factors among preschool children: a community based comparative cross-sectional study in Ethiopia. *BMC Nutrition*, 4 (1), 28. https://doi.org/10.1186/s40795-018-0236-9

Best, C.N., Neufingerl, J., del Rosso, C., Transler, T., van den Briel, T. and Osendarp, S. (2011). Can multi micronutrient food fortification improve the micronutrient status, growth, health and cognition of school children? A Systematic Review. *Nutrition Reviews*, 69(4), 186-204. https://doi.org/10.1111/j.1753-4887.2011.00378.x

Black, M. (2003). Micronutrient deficiencies and cognitive functioning. *Journal of Nutrition*, 133(11), 3927S-3931S. https://doi.org/10.1093/jn/133.11.3927S

Brown, J.L. and Pollit, E. (2016). Malnutrition, poverty and intellectual development. *Scientific American*, 274(2), 38-43. https://doi.org/10.1038/scientificamerican0296-38

Bundy, D.A.P, Silva, N.D., Horton, S. Jamison, D.T. and Patton, G.C. (2018). Disease control priorities, child and adolescent health and development authors group. Investment in child and adolescent health and development: key messages from Disease Control Priorities, 3rd ed. *Lancet*, 391(10121), 687-699. https://doi.org/10.1016/S0140-6736(17)32417-0

Caulfield, L.E., de Onis, M., Blossner, M. and Black, R.E. (2004). Undernutrition as an underlying cause of child deaths associated with diarrhea, pneumonia, malaria, and measles. *American Journal of Clinical Nutrition*, 80(1), 193-198. https://doi.org/10.1093/ajcn/80.1.193

Checkley, W., Buckley, G., Gilman, R.H., Assis, A.M., Guerrant, R.L. and Morris, S.S. (2008). Multi country analysis of the effects of diarrhoea on childhood stunting. *International Journal of Epidemiology,* 37(4), 816–830. https://doi.org/10.1093/ije/dyn099

de Onis, M. and Branca, F. (2016) Childhood stunting: A global perspective. *Maternal and Child Nutrition*, 12 (S1), 12–26. https://doi.org/10.1111/mcn.12231

De, P. and Chattopadhya, N. (2019). Effects of malnutrition on child development: Evidence from a backward district of India. *Clinical Epidemiology and Global Health*, 7, 439–445. https://doi.org/10.1016/j.cegh.2019.01.014

Drake, L., Fernandes, M., Aurino, E., Kiamba, J., Giyose, B., Burbano, C., Alderman, H., Mai, L., Mitchell, A. and Gelli, A. (2017). School feeding programmes in middle childhood and adolescence. In Bundy, D.A.P., Silva, N.D., Horton, S., Jamison, D.T. and Patton, G.C. (Eds.) Disease control priorities. 3rd ed. Washington, DC, USA: The World Bank Group. https://doi.org/10.1596/978-1-4648-0423-6_ch12

Drewnowski, A., Dwyer, J., King, J.C. and Weaver, C.M. (2019). A proposed nutrient density score that includes food groups and nutrients to better align with dietary guidance. *Nutrition Review*, 77(6), 404-416. https://doi.org/10.1093/nutrit/nuz002

Dukhi, N. (2020). Global prevalence of malnutrition: Evidence from literature. In Imran, M. and Imran, A. (Eds.) IntechOpen E-Book. https://doi.org/10.5772/intechopen.92006

Eccles, J.S. (1999). The development of children ages 6 to 14. *The Future of Children*, 9(1), 30-44. https://doi.org/10.2307/1602703

El-Sayed, N., Mohamed, A.G., Nofal, L., Mahfouz, A. and Zeid, H.A. (2017). Malnutrition among pre-school children in Alexandria, Egypt. *Journal of Health Population and Nutrition*, 19(4), 275-80.

FAO, ECA, and AUC. (2020). 2019. Key Messages. Africa. Regional overview of food security and nutrition. Retrieved from FAO website: https://

www.fao.org/3/ca7704en/CA7704EN.pdf

Food and Agriculture Organization of the United Nations (FAO). (2011). The state of food insecurity in the World: How does international price volatility affect domestic economies and food security. Retrieved from FAO website: https://www.fao.org/3/i2330e/i2330e.pdf

Galgamuwa, L.S., Iddawela, D., Dharmaratne, S.D. and Galgamuwa, G.L.S. (2017). Nutritional status and correlated socio-economic factors among preschool and school children in plantation communities, Sri Lanka. *BMC Public Health,* 17, 377. https://doi.org/10.1186/s12889-017-4311-y

Galhena, D.H., Freed, R. and Maredia, K.M. (2013). Home gardens: a promising approach to enhance household food security and wellbeing. *Agriculture and Food Security*, 2, 8. https://doi.org/10.1186/2048-7010-2-8

Garcia, V. (2016). Children, Malnutrition and Horizontal Inequalities in Sub-Saharan Africa: A Focus on Contrasting Domestic Trajectories. New York, USA: United Nations Development Programme, Regional Bureau for Africa.

Gelli, A., Aurino, E., Folson, G., Arhinful, D., Adamba, C., Osei-Akoto, I., Masset E, Watkins, K., Fernandes M., Drake L. and Alderman, H.A. (2019). School meals programme implemented at scale in Ghana increases height-for-age during midchildhood in girls and in children from poor households: A Cluster Randomized Trial. *Journal of Nutrition,* 149(8), 1434-1442. https://doi.org/10.1093/jn/nxz079

Govender, I., Rangiah, S., Kaswa, R. and Nzaumvila, D. (2021). Malnutrition in children under the age of 5 years in a primary health care setting. *South African Family Practice*, 63(1), 5337. https://doi.org/10.4102/safp.v63i1.5337

Hendricks, K.M., Duggan, C. and Gallagher, L. (2014). Malnutrition in hospitalized pediatric patients. Current prevalence. *Archive of Pediatrics and Adolescent Medicine,* 149(10), 1118-1122. https://doi.org/10.1001/archpedi.1995.02170230072010

Cho, J.M., Kim, J.Y. and Yang, H.R. (2019). Effects of oral zinc supplementation on zinc status and catch-up growth during the first 2 years of life in children with non-organic failure to thrive born reterm and at term. *Pediatrics and Neonatology*, 60(2), 201-209. https://doi.org/10.1016/j.pedneo.2018.06.006

Jomaa, L.H., McDonnell, E. and Probart, C. (2011). School feeding programmes in developing countries: Impact on children's health and educational outcomes. *Nutrition Reviews*, 69(2), 83-98. https://doi.org/10.1111/j.1753-4887.2010.00369.x

Keusch, G.T. (2003). The history of nutrition: Malnutrition, infection and immunity. *Journal of Nutrition*, 133(1), 336S-340S. https://doi.org/10.1093/jn/133.1.336S

Khamis, A.G., Mwanri, A.W., Ntwenya, J.E. and Kreppel, K. (2019). The influence of dietary diversity on the nutritional status of children between 6 and 23 months of age in Tanzania, *BMC Pediatrics*, 19, 518. https://doi.org/10.1186/s12887-019-1897-5.

Kinwele, A., Ochola, S.A. and Mugambi, M. (2021). Influence of home-grown school feeding programme on dietary diversity among school children 6-13 years of age in Makueni county, Kenya. *European Journal of Health Sciences*, 6(1), 57-72. https://doi.org/10.47672/ejhs.678

Lardner, D.A., Giordano, J., Jung, M.K., Passafaro, M.D., Small, A., Haar, M. and Beria, J.S. (2015). Evaluation of nutritional status among school-aged children in rural Kwahu-Eastern Region, Ghana; anthropometric measures and environmental influences. *African Journal of Food Nutrition and Science* 15(3), 9996–10012. https://doi.org/10.18697/ajfand.70.15340

Leroy, J.L., Ruel, M., Habicht, J.P. and Frongillo, E.A. (2014). Linear growth deficit continues to accumulate beyond the first 1000 days in low-and middle-income countries: global evidence from 51 national surveys. *The Journal of Nutrition,* 144(9), 1460–1466. https://doi.org/10.3945/jn.114.191981

Machira, K. and Chirwa, T. (2020). Dietary consumption and its effect on nutrition outcome among under five children in rural Malawi. *PLoS ONE*, 15(9), e0237139. https://doi.org/10.1371/journal.pone.0237139

Malongane, F. and Mbhenyane, X.G. (2017). Nutritional Status of children in the national school nutrition programme in Capricon District, Limpopo Province, South Africa. *South African Journal of Child Health,* 11(1), 11-15. https://doi.org/10.7196/SAJCH.2017.v11i1.1124

Manyike, P.C., Chinawa, J.M., Ubesie, A., Obu H.A., Odetunde, O.I. and Chinawa, A.T. (2014). Prevalence of malnutrition among pre-school children in, South-east Nigeria. *Italian Journal of Pediatrics,* 40, 75. https://doi.org/10.1186/s13052-014-0075-5

Morteza, M., Majid, D., Fatemeh, S. and Aziz, A.P. (2019). An Investigation of the prevalence and causes of malnutrition in Iran: a review article and meta-analysis. *Clinical Nutrition Research*, 8(2), 101-118. https://doi.org/10.7762/cnr.2019.8.2.101

Muller, O. and Krawinkel, M. (2005). Malnutrition and health in developing countries. *Canadian Medical Association Journal,* 173(3), 279-286. https://doi.org/10.1503/cmaj.050342

Musgrove, P. (2016). Feeding Latin America's Children. *The World Bank's Research Observe,* 8(1), 2346. https://doi.org/10.1093/wbro/8.1.23

National Nutrition and Health Survey (NNHS). (2018). Report on the Nutrition and Health Situation in Nigeria. Retrieved from UNICEF website: https://www.unicef.org/nigeria/media/2181/file/Nigeria-NNHS-2018.pdf

Nekitsing, C., Hetherington, M.M. and Blundell-Birtill, P. (2018). Developing healthy food preferences in preschool children through taste exposure, sensory learning, and nutrition education. *Current Obesity Report,* 7, 60–67. https://doi.org/10.1007/s13679-018-0297-8

Nkhoma, O.W., Duffy, M.E., Cory-Slechta, D.A., Davidson, P.W, McSorley, E.M., Strain, J.J. and O'Brien, G.M. (2013). Early-stage primary school children attending a school in the Malawian school feeding programme (SFP) have better reversal learning and lean muscle mass growth than those attending a non-SFP school. *The Journal of Nutrition*, 143(8), 1324-1330. https://doi.org/10.3945/jn.112.171280

Okafor, A.M., Nnamani, U.E. and Onyia, U.D. (2019). Malnutrition and its associated factors among primary school children in Nsukka, Nigeria. *African Journal of Biomedical Research,* 22(3), 263-270.

de Onis, M.D., Onyango, A.W., Borghi, E., Siyam, A., Nishida, C. and Siekmann, J. (2007). Development of a WHO growth reference for school-aged children and adolescents. *Bulletin of World Health Organisation*, 85(9), 660–667. https://doi.org/10.2471/BLT.07.043497

Onyango, A.W., Jean-Baptiste, J., Samburu, B. and Mahlangud, T.L.M. (2019). Regional overview on the double burden of malnutrition and examples of programme and policy responses: African Region. *Annals of Nutrition and Metabolism*, 75(2), 127–130. https://doi.org/10.1159/000503671

Owusu, J.S., Colecraft, E.K., Aryeetey, R.N., Vaccaro, J.A. and Huffman, F.G. (2016). Comparison of two school feeding programmes in Ghana, West Africa. *West Africa International Journal ofChild Health*, 5 (2), 56-62. https://doi.org/10.6000/1929-4247.2016.05.02.2

Pradhan, M.S.P., Dhital, R. and Subhani, H. (2016). Nutrition interventions for children aged less than 5 years following natural disasters: a systematic review. *BMJ Open,* 6(9), e011238. https://doi.org/10.1136/bmjopen-2016-011238

Reinhardt, K. and Fanzo, J. (2014). Addressing chronic malnutrition through multi-sectorial, sustainable approaches: a review of the causes and consequences. *Frontiers in Nutrition,* 1, 13. https://doi.org/10.3389/fnut.2014.00013

Shrestha, I. B. and Pathak, L. R. (2012). Review of the National Health Policy 1991. Retrieved from National Health Sector Support Programme website: http://www.nhssp.org.np/health_policy/Review%20of%20 National%20Health%20Policy%201991.pdf.

Smith, C.L. and Haddad, L.J. (2020). Explaining child malnutrition in developing countries. A cross-country analysis. Retrieved from International Food Policy Research Institute (IFPRI) website: https://www.ifpri.org/cdmref/p15738coll2/id/125371/filename/125372.pdf

Townsend, M.S., Love, B., Achterberg, C. and Murphy, S. (2015). Food insecurity is positively related to overweight in women. *Journal of Nutrition*, 131(6), 1738-1745. https://doi.org/10.1093/jn/131.6.1738

Tunji, A., Djurfeldt, G., Holmen, H. and Isinika, A.C. (2015). Conclusions and a Look Ahead. In The African Food Crisis. Cambridge, United Kingdom: CABI Publishing.

United Nations Children's Fund (UNICEF). (2000). Nutrition. Retrieved from UNICEF website: https://www.unicef.org/kenya/nutrition#:~:text = Nutrition%20in%20numbers,doses%20of% 20vitamin%20A%20supplement.

United Nations Children's Fund (UNICEF). (2013) Improving Child Nutrition: The Achievable Imperative for Global Progress. Retrieved from UNICEF website: https://data.unicef.org/resources/improving-child-nutrition-the-achievable-imperative-for-global-progress/

United Nations Children's Fund (UNICEF). (2019). The State of the World's Children 2019. Children, Food and Nutrition: Growing well in a changing world. Retrieved from UNICEF website: https://www.unicef.org/reports/state-of-worlds children -2019

United Nations. (2015). The Millennium Development Goals Report 2015. Retrieved from United Nations website: https://www.un.org/millenniumgoals/2015_MDG_Report/pdf/MDG% 202015%20rev%20(J y%201).pdf

Wang, D. and Fawzi, W.W. (2020). Impacts of school feeding on educational and health outcomes of

school-age children and adolescents in low and middle-income countries: protocol for a systematic review and meta-analysis. *Systematic Reviews* 9, 55. https://doi.org/10.1186/s13643-020-01317-6

Watkins, K, Gellis, A., Hamdani, S., Masset, E., Merch, C., Nadazani, N. and Vanhees, J. (2015). Sensitive to nutrition? A literature review of school feeding effects on the child development lifecycle. Retrieved January 11, 2022 from website: https://www.imperial.ac.uk/media/imperial-college/medicine/sph/pcd/HGSF-Working-Paper-16-Sensitive-to-nutrition-lit-review-of-school-feeding-effects-in-child-development-life-cycle.pdf

Weichselbaum, E. and Buttriss, J. (2011). Nutrition, health and school children. *Nutrition Bulletin*, 36(3), 295-355. https://doi.org/10.1111/j.1467-3010.2011.01910.x

World Food Programme (WFP). (2015). World Food Programme. Rome, Italy: World Food Summit in Rome.

World Food Programme (WFP). (2019). World Food Programme (WFP). Food and Nutrition Handbook. Rome, Italy: World Food Programme.

World Health Organization (WHO). (2011). Hemoglobin concentrations for the diagnosis of anaemia and assessment of severity. Vitamin and mineral nutrition information system. Retrieved on December 28, 2021 from WHO website: http://www.who.int/vmnis/indicators/haemoglobin.pdf

World Health Organization (WHO). (2015). Nutrition interventions. e-Library of Evidence for Nutrition Actions (eLENA). Retrieved on December 28, 2021 from WHO website: http://www.who.int/elena/intervention/en/

World Health Organization (WHO). (2018). Infant and young child feeding. Retrieved on January 11, 2021 from WHO website: https://www.who.int/newsroom/factsheets/detail/infant-and-young-child-feeding.

World Bank (2016). Repositioning Nutrition as Central to Development: A Strategy for Large-Scale Action. Washington, DC, USA: World Bank.

World Bank Summit (2017). Committing to Action to Drive Economic Growth. Retrieved December 19, 2021 from website: http://www.worldbank.org/en/news/feature/2017/10/20/countries-commit-to-strong action-on-human-capital-to-drive-economicgrowth

World Health Organisation (WHO) (2013). Malnutrition-The Global Picture. Retrieved on January 11, 2021 from WHO website: http://www.who.int/home-page/

Zenebe, M., Gebremedhin, S., Henry, C.J. and Regassa, N. (2018). School feeding programme has resulted in improved diversity, nutritional status and class attendance of school children. *Italian Journal of Pediatrics* 44, 16. https://doi.org/10.1186/s13052-018-0449-1

