Review

Effect of the Ghana School Feeding Programme on Nutrient Intake, Nutritional Status and Education of Children: A Review

Edem M. A. Tette[1], Juliana Yartey Enos[2*]

[1] *Department of Community Health, University of Ghana Medical School, College of Health Sciences, University of Ghana.*
[2] *Noguchi Memorial Institute for Medical Research, College of Health Sciences, University of Ghana, Legon*

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ABSTRACT The Ghana School Feeding Programme (GSFP) was initiated by the Government in 2005 to reduce hunger and malnutrition, and increase school enrolment, attendance and retention. It was also intended to boost domestic food production in deprived communities by increasing demand for farm produce to service the programme. This review was carried out to determine whether the GSFP had achieved the objectives related to nutrition and education. A desk review of 22 peer-reviewed publications emanating from studies of the GSFP over a ten-year period (2010 to 2019) was undertaken. Outcomes measured included dietary adequacy, nutritional status and educational enrolment, retention and performance of children. Assessment of the effect of the GSFP on nutritional outcomes showed mixed results. Some studies reported improved nutritional status of pupils in GSFP schools compared to non-GSFP schools. While under-nutrition and anaemia remained prevalent in several schools with and without the GSFP, there was evidence that the GSFP offered protection from hunger for some children and had a greater effect on the nutritional status of children from poorer communities. School-based program evaluation studies consistently reported increased enrolment with partial increases in attendance, retention and punctuality. Better targeting of beneficiaries, reliable funding and comprehensive approaches to addressing the nutritional needs of all school-age children, including inculcation of positive nutrition-related behaviors in children for long-term impact are recommended. Additionally, further studies which employ robust methodology to assess the impact of the GSFP on nutrition and education outcomes are needed.

Keywords: Ghana, school feeding program, nutrient intake, nutritional status

INTRODUCTION

School feeding programs provide an opportunity to improve the nutritional status of children, encourage school enrolment, improve performance and mitigate the effects of poverty globally (1,2,3,4). They involve providing meals such as breakfast, lunch or snacks to children in school (2). The meals are either prepared in schools or by a centralized kitchen or assigned caterer, often using ingredients obtained from local farms and thereby impacting the local economy (1,2). Over time, school feeding programs have been shown to offer a regular source of nutrients to vulnerable children, build human capital and provide savings of up to 10% of the household income of poor families (1). According to the World Food Program (WFP), about 0.25 USD is needed for a meal per child and studies have shown that each US dollar invested in school feeding yields a 3-10 USD return on the investment resulting from improved health, education and productivity (2).

* Corresponding Author: jyartey@gmail.com

The Ghana School Feeding Program (GSFP) was established in 2005 as a social protection intervention to provide children in selected schools in deprived communities with one nutritious meal in a day, using locally grown foods and caterers in their locality (5,6,7). The program was instituted as part of the government's efforts to achieve the Millennium Development Goals (MDGs) 1, 2 and 3 to reduce poverty, provide food security, increase school enrolment at basic level and to promote gender equality by providing an incentive to attract girls to school. Currently, it contributes directly to the Sustainable Development Goals (SDGs) 2, 4 and 5 which aim at achieving zero hunger, quality education and gender equality respectively, and indirectly to goals to 1, 8 and 10 which aim at ending poverty, providing decent work and economic growth as well as reducing inequalities (8). The program began as part of the Comprehensive African Agricultural Development Program (CAADP) with initial pilots carried out in ten [10] basic schools, mainly primary and kindergarten, in the most deprived areas of the country (6). The GSFP was extended to cover 1695 public schools with 656,624 pupils nation-wide by the end of 2009 and cost over US$200 million for 4 years (7). By 2015, the program had reached a total of 1,728,681 pupils (6).

The GSFP was initially implemented by the Ministry of Local Government and Rural Development (MLGRD) until 2015 when oversight responsibility for the programme was transferred to the Ministry of Gender, Children and Social Protection (MoGCSP) (*5,6*). Currently, the Programme operates under the supervision of a Multi-Sectoral Technical Advisory Committee (MTAC) of the MoGCSP, with representatives from the Ministries of Finance, Education, Health, Food and Agriculture, Trade and Industry, and Local Government and Rural Development (*5*) with the support of Development partners (*9*).

Ghana's school feeding programme has been in operation for 14 years, during which period there have been several studies and reports on its impact. The objective of this review is to examine the effect of the Ghana School Feeding Programme (GSFP) on child nutritional status, school enrolment, attendance and retention.

METHODS

A desk review was carried out which involved the collection, assessment, analyses and synthesis of information from published literature. The review was structured to examine the effects of the GSFP on specific measurable nutrition and education outcomes. Computerised bibliographic medical databases were searched for relevant articles from 2010-2019. These databases included MEDLINE (Pubmed version), the Cochrane Central Register of Controlled Trials, Google, Google scholar, Hinarii, Scopus and Science Direct. Key words used to identify the relevant articles were Ghana, school feeding programme, school meals, school feeding policy, impact, effects, education, attendance, enrolment, nutrition and nutritional status. Abstracts of the identified studies were retrieved and studied. Irrelevant articles were excluded and full text of the remaining articles obtained.

The reference lists of these articles were also reviewed and relevant articles identified in the lists were obtained. The Bibliography from reports of UN agencies such as the World Health Organization (WHO), UNICEF, World Food Programme (WFP) and Food and Agriculture Organization (FAO) were also searched for relevant articles.

The inclusion criteria for studies included in this review were as follows: quantitative, mixed designs or evaluation studies with measurable outcomes collected in sufficient detail to allow assessment of a change in status or effect size to assess the effects of the GSFP on nutrition and education; comparative studies involving schools with and without school feeding programmes reporting an outcome measure of interest; studies with measures of growth that were made at least 8 weeks or more from the time of intervention were included; children aged ≤17 years were included since recipients of the GSFP were pre-school and school-aged children aged 3 -17 years. This review also included studies in which school meals were assessed for their nutritional value. Studies which failed to meet the inclusion criteria as well as the following exclusion criteria were excluded; unpublished studies such as student dissertations and thesis; studies with a school feeding programme that was less than a year; and those with a sample size of less than 10 subjects.

The outcome measures assessed were as follows: 1) Nutrition outcomes such as i) Nutrient content and adequacy of meals served in the GSFP and nutrient intake of school children participating in the GSFP; ii) Nutritional status of children using anthropometric measures for assessing growth such as weight (wt), height (ht), weight for age z score (WAZ), height for age z score (HAZ), weight for height z score (WHZ), BMI for Age z score (BAZ) and mean weight gain (MWG); and biochemical indices such as measures of haemoglobin (Hb) and soluble transferrin receptor (sTfR) if reported in the articles reviewed. 2) Outcome measures related to education were changes in school enrolment, female enrolment, school attendance, retention, drop-out rates and school performance. These outcome measures are listed in Table 1.

Table 1. Nutrition and Education Outcomes and Measures

Outcome	Outcome Measures
1) Nutrition Outcomes	
i. Dietary Adequacy	Nutrient content and Probability of Adequacy (PA) for selected nutrients, Nutrient intake, percentage of Recommended Dietary Intake (RDI), Recommended Nutrient Intake (RNI)
ii. Nutritional Status: Anthropometric and Biochemical Indices	Weight (wt), height (ht), height-for-age z-score (HAZ), weight-for-age z-score (WAZ), Weight for Height z score (WHZ), BMI for Age z score (BAZ), mean weight gain (MWG), haemoglobin (Hb) and soluble transferrin receptor (sTfR).
2) Education Outcomes	School enrolment, female enrolment, attendance, retention, drop-out rates and school performance.

RESULTS

A total of 50 articles and reports on the Ghana School Feeding Programme were obtained, of which 28 papers were excluded, guided by the exclusion criteria, resulting in a total of 22 publications being included in this review. These included a Randomised Controlled Trial (RCT), descriptive and cross-sectional studies, mixed designs with quantitative and qualitative components, case studies, evaluation studies, quasi-experimental designs and modelling.

Dietary Adequacy and Nutritional Status of Children

Nutrient Intake and Adequacy of Meals

A study by Danquah et al (2012) at Atwima-Nwabiagya found that the meals served in the GSFP did not provide the expected one-third RNI of 720 kcal from school meals, but rather an average weekly intake of

460.4 kcal (64%), with a mean intake range of 59% – 68%, which was attributed to the small amounts of meals served *(10)*. Even though the meals had excess carbohydrates from staples such as rice, corn and cassava, energy requirements were not met. Additionally, the school meals provided more than two-thirds (11.4 +/- 0.9 g) of the recommended protein intakes (14g) in GSFP schools, with significantly higher intakes in schools which consumed cowpeas and groundnuts (P<0.05). But there was limited use of animal protein. The mean weekly intake of thiamine was 0.3 mg in all schools which corresponded to 75% of the RNI from the school lunch. This was also attributed to the intake of cowpeas. Observed adequate iron intakes were also attributed to the use of legumes such as cowpea in the diet. However, riboflavin, calcium and vitamin C intakes were inadequate. Zinc requirements were also not met, but the diet supplied two-thirds (2.1 +/- 0.2mg) of the recommended intake of 3.0mg. With respect to Vitamin A intake, all the meals in the three schools supplied an average of 628.3 +/- 85.2 ug RE, which is more than the one-third of the RNI requirement of 200 ug RE, possible due to the use of palm oil in the meals. Vitamin C in the school menus was derived mainly from pulses and seeds such as cowpeas and groundnuts, which supplied 59.4% of the RNI on average.

A cross-sectional survey of 383 school children aged 5-13 years in the Tolon-Kumbungu district of the Northern Region compared nutrient intake among children participating in the GSFP with those who did not *(11)*. They found that children in the GSFP had significantly higher energy intakes (2397kj; P<0.001). The proportion of children whose energy intake were below requirement was 4·7% in GSFP schools compared to 21·8% in non-GSFP schools (P< 0·001). Protein intake was adequate in both schools (median = 19.0g). However, intake of animal sources of protein was higher in GSFP pupils (5% vs 3%; P<0·001). The probability of adequacy (PA) for Fe, Zn, Ca and vitamins A, C and folate was also significantly higher in GSFP schools (mean PA 0·61 (SD 0·13) vs 0·18 (SD 0·11) P<0·001). The use of a cereal-based multiple-micronutrient-fortified corn soya blend was found to be a key contributor to micronutrient adequacy in the GSFP group. However, the GSFP pupils had a smaller median portion size of meals taken at home than pupils in the non-GSFP group (456 vs 1037 g; P<0·001) *(11)*. A similar observation was made in a nationwide study by Gelli & Aurino (2019), which found that 4% of children in the GSFP reported meal sharing with siblings at home and 23% reported receiving less food at home on days in which they had school meals *(12)*.

Parish et. al. (2015) analysed 170 meals from the school feeding programme in 34 districts of 7 regions in Ghana *(13)*. The adequacy of the diet in relation to nutrient content and cost of the meals were determined through a linear modelling analysis of menus obtained from the 34 districts using the Government's allocated budget of GHC 0.40 (USD $0.26) per child per meal and prices of commodities from markets in Accra (southern Ghana) and Tamale (northern Ghana). They found the dietary protein and fat content of the meals to be adequate, providing 30% of the Recommended Dietary Intake. However, vitamin A (3.08%) and iron contents (18.97%) were inadequate. The caloric content was considered adequate only if meals were procured at the prices in the Northern Region.

A study in the La Nkwatanang-Madina District of the Greater Accra Region compared the nutrient intakes of children in a GSFP school with those in a private school feeding programme *(14)*. The study found higher intakes of energy (2413 ± 626 kcal vs. 1988 ± 627 kcal; P<0.001), protein (63 ± 17 g vs. 53 ± 19 g; P<0.001), and zinc (10 ± 3 mg vs. 9 ± 3 mg; P=0.004) in the private feeding programme compared to the GSFP. Intakes of iron, vitamin C and A were similar in the two feeding programmes. However, although calcium intakes were low in both programmes, they were higher in the private feeding programme.

In a study at La Nkwatanang in the Greater Accra Region using meal observations, the average weights of a week's meal were converted to energy and nutrient equivalence and compared among the GSFP and a private school feeding programme by Prembaf, a non-governmental organisation *(15)*. The private school feeding programme was found to have higher nutrient content and met the energy (776 ± 427 kcal vs 315 ± 24 kcal; P=0.042), protein (20 ± 14g vs 8 ± 2g; P=0.087), and fat (17± 8g versus 6 ± 2; P=0.019) recommendations provided by the World Food Programme, but the GSFP did not. There were no significant differences in the micronutrient content of meals in both schools; even though the portion sizes from the private school were larger (416 ± 96 g vs. 243 ± 50g, P=0.007) and at a higher cost per meal/child - 70 pesewas ($0.36 in 2013) vs 40 pesewas ($0.21in 2013) than the GSFP.

Goldsmith et. al. (2019) determined the nutrient composition of a serving of rice and tomato stew - a common menu of the GSFP in the Tamale metropolis of the Northern Region, in which the serving size ranged from 232 - 273g with an average of 254g *(16)*. Although they found significant variation in the macro and micronutrients content of the food served, probably due to caterers' discretion and methods used to prepare the same meal for children aged 4-8 years, the tomato stew met 46% of their carbohydrate requirements; 68 % of sodium requirement, 32% of protein requirement, 31% of vitamin D requirement, more than 20% of Vitamin B6, B12 and E requirements and only 7% of iron and 2% of calcium requirements. For children aged 9 - 13 years, it only provided 18% of their protein requirement. They recommended the use of soy flour as a substitute for locally produced protein to increase the protein content and lower cost.

A study by Bigson et. al. (2019) investigated the nutrient content of school meals in 20 GSFP schools, 12 in Wa and 8 in Cape Coast municipalities in the Upper West and the Central regions, respectively *(17)*. Findings on the nutritional quality of meals served in upper primary schools revealed that the meals in both Municipal schools did not meet the FAO/WHO (2004) nutrient recommendations. With the exception of carbohydrates (90.6 ± 6.3g vs 69.3 ± 5.2g) and Vitamin A (726.4 ± 85.2 vs 548.2 ± 75.1ug RE) which far exceeded the reference limits, levels of calories, protein, calcium, vitamin C, thiamine, riboflavin, iron and zinc in the diets were less than one-third of RNI values and therefore considered inadequate *(16)*.

Agbozo et. al. (2018) examined the nutrient content of school lunches prepared by GSFP schools compared to private school meals in the Hohoe Municipality and found the nutritional value of the meals to be similar *(18)*. Meals of the GSFP schools compared to private schools had 420.6 vs 462.2 kcal of energy, 6.8 vs 6.8 g of protein, 23.8 vs 27.7 g of fat, 3.0 vs 2.8 mg of iron, 417.3 vs 280.8 µg retinol equivalent of vitamin A, 25.1 vs 16.5 mg of vitamin C, 1.3 vs 1.2 mg of zinc, and 62.6 vs 61.4 mg of calcium. Only the requirements for fat, vitamin A, C and iron were fully met.

Nutritional Status of Children: Anthropometric and Biochemical Indices

The Ghana School Feeding Programme is reported to have improved the nutritional status of children in implementing schools *(4,9,19)*. A longitudinal cluster randomized control trial by Gelli and Aurino (2019), involving 2869 children aged 5-15 years nationwide reported that the GSFP meals had no effect on the nutritional status (HAZ and BAZ) of children 5-15 years old in the program *(12)*. However, in sub-group analyses, the school feeding intervention was associated with increased HAZ in children aged 5-8 years (effect size 0.12SDs); increased BAZ in boys aged 5-8 years (effect size 0.19 SDs); and increased HAZ in girls (effect size 0.12SDs), especially girls aged 5-8 years living in the northern regions of Ghana (effect size: ~0.3 SDs). Also, the GSFP was found to be associated with increased HAZ in children aged 5-8 years from households living below the poverty line (effect size 0.22SDs) *(12)*.

In contrast, a cross-sectional study at Denkyembour in the Eastern Region of Ghana comparing the nutritional status of 359 children aged 5-12 years attending GSFP and those non-GSFP schools found a higher prevalence of overweight ((BAZ) 1.9% vs 0.0%) among pupils in GSFP compared to non-GSFP schools. The prevalence of thinness (WHZ) was two times higher (9.3%) among pupils in GSFP compared to non-GSFP schools (4.6%) (p=0.028). They also observed more stunting among pupils from non-GSFP schools (HAZ) 17.2% vs 16.2%; ($p = 0.284$)), but the difference was not statistically significant *(20)*. The authors suggested that the mixed outcome may be related to operational issues associated with the GSFP.

A study in the Hohoe Municipality of the Volta Region compared the nutritional status of 417 pupils in GSFP and non-GSFP schools and found no significant differences among the two groups as follows: underweight, 12.4% vs 16.8%; stunting, 13.3% vs 8.6%; thinness 1.8% vs 5.3%; and overweight 3.5% vs 5.6%, respectively *(21)*. However, the observed differences were not statistically significant. Furthermore, logistic regression revealed that being a GSFP beneficiary did not significantly reduce the odds of being underweight, stunted, thin or overweight. They also found that the odds of being underweight was significantly higher in pupils in lower primary aged 5 to 9 years (AOR; 3.0, 95% CI; 1.4-6.6, P=0.006), while children from rural areas were five times more likely to be stunted (AOR; 5.3, 95%CI; 1.3-21.6, P=0.021).

A cross-sectional study in the Atwima-Nwabiagya district of the Ashanti Region involving 234 pupils between the ages of 9 and 17 years, comprising of 114 pupils from three GSFP schools and 120 pupils from three schools without GSFP found a significant difference between the mean heights of the pupils in GSFP vs non-GSFP schools (147.4cm SD 8.9) and (144.6 SD 8.6) (P=0.016), but attributed it to the higher ages of children in the GSFP schools (15-17 years) (mean ages 13 vs 12 years) *(10)*. Comparing GSFP schools with non-GSFP schools, the study found 47.4% vs 56.6% of stunting, 48.2% vs 45.0% underweight, 4.4% vs 2.4% of thinness, 4.4% vs 5.0% overweight, and 0% vs 4.2% obese pupils. Although less stunting was observed among pupils in GSFP schools. Overall, they found no statistically significant difference in the nutritional status of children in the two groups and concluded that there was no association between having a school lunch and nutritional status.

In the cross-sectional survey of 383 school children in the Tolon-Kumbungu district comparing the nutritional status of children participating in the GSFP with those who did not, no significant differences in the prevalence of stunting (HAZ) (23·3 vs 28·9; P=0.09), underweight (WAZ) (16·3 vs 14·4; P=0.76) and thinness (11·9 vs 5·6; P=0.25) were found among the two groups of children *(11)*. The mean Hb was found to be 100 (SD16) g/l but levels were significantly higher in the school feeding group by 6g/l (P<0·001). The GSFP group had significantly lower soluble transferrin receptor (sTfR) levels (11.2 vs 124 mg/l; P=0.04). However, there was no significant difference in the prevalence of iron deficiency anaemia (62·7g/l vs 69·4 g/l; P=0.56).

In the La Nkwatanang-Madina District of the Greater Accra Region, malnutrition was prevalent in both GSFP and Private school feeding program schools *(14)*. Altogether, 48% were stunted (HAZ), 35% had low BMI-for-Age or were thin, and two thirds (67%) had one of these abnormal values. In addition, 1% were overweight (BAZ). Also, 28% of the pupils were found to be anaemic with low Hb levels. Comparison of the nutritional status of pupils in the GSFP (n=113) and the private school feeding programme (n=216) in the Hohoe Municipality by Agbozo et al. (2018) revealed that the nutritional status of the children in the two groups were similar. The prevalence of stunting was estimated at 8.9% vs 7.9%, underweight at 3.6% vs 5.7%, thinness at 1.8% vs 3.7% and overweight/obesity at 3.5% vs 4.2% *(18)*.

Education: Enrolment, attendance, retention and performance.

A mixed methods study comprising 21 schools in Bawku West and Upper East Regions showed that the GSFP resulted in over 100% increased enrolment over a 12-year period, from 4,013 in 2004/2005 to 10,589 in 2016/2017 *(22)*. However, the study also showed that the increase in enrolment began before the programme was introduced, though majority of parents and teachers attributed the increase to the programme. Another mixed methods study of a basic school in Nyoglo in the Savelugu-Nanton Municipality of the Northern region found an increase in school attendance from 22% before initiation of the GSFP to 65.4% after the programme was implemented *(23)*. In addition, school enrolment increased from 35.8% to 64.2% after programme initiation, while the school dropout rate reduced from 73.8% to 26.2% (X_2 =29.767, df=4, P=0.000), based on a records review.

Similarly, a study in the Asikuma-Odoben-Brakwa district of the Central region also demonstrated an increase in school enrolment with implementation of the GSFP and a decrease in non-GSFP schools *(24)*. The study also found significant association between the GSFP and improved academic performance of pupils in GSFP when compared with non-GSFP schools (Partial Eta Squared value 0.399, P=0.000), an association with attentiveness in class (Partial Eta Squared value 0.735, P=0.000) and an association with enrolment in school (Partial Eta Squared value 0.752, p=0.000), after a multivariate analysis. However, the association between school attendance and the GSFP was not statistically significant (Partial Eta Squared value 0.001, P=0.746). A comparative study between 10 primary schools with GSFP and 10 primary schools without GSFP in the Weweso circuit of Kumasi Metropolitan area in the Ashanti region found that school feeding had a significant impact on school enrolment, attendance and retention *(25)*. The study reported that a 100% increase in school feeding programme results, an increase in

enrolment by about 4 percentage points, an increase in attendance by 98% and an increase in retention by 99%.

A study of 5 schools in the Kwaebibirim District in the Eastern region reported that there had been a gradual increase in enrolment prior to the introduction of the GSFP from the capitation grant, awareness creation through education, provision of school uniforms, books, materials and infrastructure *(26)*. However, enrolment increased soon after the introduction of the GSFP in the schools, with the greatest increases occurring within the 2006/2007 to 2008/2009 academic years. The observed increases were varied, ranging from 3.1%, 10% and 52%, through to 66.2% increase in some schools. Thereafter, a general decrease of 9.2% was observed in the 2009/2010 academic year, followed by a small rise of about 2.2% in the subsequent year. A major incident associated with the observed decrease in enrolment was the establishment of an Islamic school in a predominantly Moslem community causing a movement of Moslem pupils to the Islamic school. The increase in enrolment generally favoured males. However, two schools reported the contrary with male to female increases in enrolment of 49% vs 89.6% and 0.5% vs 5%. The study also showed only modest improvements in school attendance by 1% - 15 % in the schools studied, while the dropout rate remained low at 4%. Only 26.3% of pupils relied solely on the GSFP for lunch.

A descriptive study at Asebu Kwamankese District in the Central Region found that the GSFP increased enrolment, attendance and retention in schools *(27)*. It also improved school performance in terms of pass mark, thinking ability, understanding, concentration and discipline, and had some effect on nutritional status, but no effect on Body mass index (BMI) and the heights of pupils *(27)*.

A study with a quasi-experimental design at Garu-Tampene community of the Upper East Region examined 360 pupils consisting of 180 pupils in GSFP schools and 180 pupils in non-GSFP schools and found a correlation between GSFP and performance in core subjects *(28,29)*. The performance of girls and boys in the GSFP schools was better compared to the non-GSFP schools and were as follows: English Language (63.3% and 63.6%) vs (55.9% and 55.2%), Mathematics (62.0% and 69.7%) vs (57.0% and 56.3%) and Integrated Science (68.4% and 66.6%) vs (59.1% and 56.1%), respectively. In addition, an increase in gross enrolment rate by about 24% was also observed in GSFP schools from 2008-2012, while a decrease in enrolment of 7% occurred in non-GSFP schools *(29)*. The increase was mostly in males in both settings.

A case study of three GSFP schools in the Ga East Municipality showed an increase in school attendance in all three schools between 2004/2005 academic year and 2006/2007 academic year from 68.4% to 94.3%; 83.9% to 92.5%; and 86.5% to 91.9% respectively *(30)*. Furthermore, an interview of stakeholders revealed, that while some students did not need or eat the school meals, others attended school without breakfast. Hence, the school meal was their first and main meal for the day.

A descriptive study of 4 schools in Talensi, Upper East region showed that prior to establishing the GSFP, the level of enrolment was 1,951 for the 2010/2011 academic year which increased by 10.9% to 2,164 in 2012/2013 academic year after it was established *(31)*. Retention rates also increased from 93.0% in the 2010/2011 academic year to 99.3% in the 2012/2013 academic year with corresponding dropout rates of 6.98% and 0.7% respectively. A qualitative study carried out concurrently suggests that the GSFP had contributed to these changes. A case study of the effect of the GSFP on school enrolment in the Tamale metropolis of the Northern Region reported that after its introduction in 2006/2007 academic year, enrolment rose steadily until the 2009/2010 academic year when it declined and increased again thereafter from 34.98 per ten thousand population in 2010/2011 academic year to 40 per ten thousand population in 2013/2014 academic year *(32)*.

DISCUSSION

Current evidence shows that school feeding programmes improve nutritional status, school enrolment and attendance in several settings globally *(1,4,11,33)*. The outcome of this review demonstrates mixed results on the effect of the GSFP on the nutritional status of Ghanaian school children. While a positive effect on nutritional status was demonstrated by an RCT, the effect did not cut across all ages or settings. Children aged 5-8 years, mostly girls living in poverty, had the most positive response *(12)*. A Cochrane review of school health programmes comprising 18 studies with nine from higher income countries and nine from low income countries showed an average weight gain of 0.39 kg over 19 months in children from low income countries who were fed at school compared to controls using RCT's alone. In other studies that were not RCTs, the gain was 0.71kg over an 11.3-month period *(4)*. Our findings are similar to the findings of another extensive review, which found that although school feeding programmes were effective in improving energy and micronutrient intakes, their effect on nutritional status was mixed and less conclusive *(33)*. While some of the GSFP schools demonstrated a positive effect on nutritional status, this was not consistent. Poor nutritional status was prevalent in both GSFP and non-GSFP schools *(20,21,10,11)*.

Interactions between Poverty and the Ghana School Feeding Programme

The observed height gain reported in this review by Gelli et al (2019), was more pronounced in children living in poverty (effect size 0.22) *(12)*. We also noted that overweight and obesity were generally uncommon in GSFP participating schools, except in the RCT and another study which showed that children living in poverty benefitted most from the GSFP *(10,12,21)*. An important observation that reflects the interaction between poverty and the GSFP is that some children on the GSFP received less food at home, and for others, the school meal served as their main meal for the day. Some studies also reported that a small proportion of the children shared some of their meal with siblings; *(11,12,30)*. These observations support the perceived notion that there are children who really need the school meals for reducing hunger, even if the gain in nutritional status is not as pronounced *(33)*. For this reason, effective targeting of the GSFP is necessary to cover all needy children. To this end, needy children can be better defined, identified and targeted, so that schools with needy pupils can be prioritized and solely funded by government, while others are funded by government with support from parents, communities or development partners as occurs in Kenya, Cote D'Ivoire and other countries *(9,34)*. In Cote D'Ivoire, communities contribute to the programme through food stamps, salaries of canteen managers, perishables, cooking fuel and agricultural supports *(9)*. A similar arrangement involving the creation of self-financing school feeding programmes with external support has been tried in cocoa growing areas in Ghana with promising results *(35)*. Thus, better engagement with the community is

critical to improving the impact of the GSFP on nutrition and education outcomes.

Nutrient Intake and Dietary Adequacy of School Meals

Menu compositions of GSFP meals generally vary across the country and change with the time of year *(36)*. Dietary adequacy of school meals was reported in some of the studies reviewed, but this did not necessarily translate into improved nutritional status among the children *(10,11,14)*. This observation suggests that there are other factors, other than the school diet, influencing nutrient intake and nutritional status. The best results, in terms of dietary adequacy, were from schools that used cowpeas, which reported improved iron, protein and thiamine intake; the addition of a multiple-micronutrient-fortified corn soya blend to the food served by the GSFP; and a private school feeding programme which provided larger portions at an additional cost *(10,11,15)*. Due to the difficulties with achieving dietary adequacy, particularly in the micronutrient composition of some school feeding programmes, suggestions have been made to introduce fortification programmes and to increase the diversity of foods provided *(13)*. In addition to this approach, careful meal planning to improve the micronutrient status of school children has been suggested, as well as the development of National Guidelines and Standards (NGS), which are currently in progress *(3,13,36)*. To this end, a school meal planner has been introduced in schools in 42 districts to facilitate the provision of locally sourced nutritious food to school children in Ghana *(37)* It is important that these guidelines address both underweight and overweight holistically since these conditions occur in both GSFP and non-GSFP, and in private schools *(3,10,20,21,36,38)*

Insufficient iron in the diet and anaemia is a major problem of school-aged children in Ghana *(11,13,14,39)*. A study in India showed that multiple micronutrient drinks were effective in improving iron deficiency, iron deficiency anaemia, vitamin C and vitamin B12 status in school children *(40)*. Such an intervention can also be applied to the school feeding programme in Ghana. Additionally, research in Ghana that has demonstrated that the use of Cowpea fortified with NaFe EDTA or in other forms was effective in reducing anaemia in school-aged children, can also be applied *(10,41)*. Increasing the dietary diversity of school meals can be a useful way of enhancing adequate nutrient intake and improving iron status *(18,42,43,44)*. Rations of a corn-soy blend porridge have also been used to improve reversal learning and catch-up growth in lean muscle mass of Malawian school children *(45)*. A low intake of calcium which was observed in some schools can be combated by introducing dairy foods such as milk. Since school meals provide only a third of nutrient requirements, parents need to be supported to provide adequate nourishment for their children and provided access to other social protection interventions to support this effort, where necessary.

Education

An increase in school enrolment and attendance in response to school meals has been reported globally *(1,4)*. The studies reviewed consistently reported an increase in enrolment of children in schools with a feeding programme *(22,23,24,25,26,27)*. Some schools also demonstrated an increase in attendance and retention or reductions in dropout rates *(23,25)*. In addition, better performance and punctuality were reported *(26,27,28,29,46)*. However, the lack of analytic studies and RCT's, as well as the presence of several confounding factors make it too simplistic to attribute these observations solely to the GSFP as some of the studies have done. Most of the studies were cross-sectional with a comparison group. Though these studies provide useful information, cross sectional studies do not determine causality. Nonetheless, the studies which explored further analysis still found statistically significant relationships between increased school enrolment and the GSFP *(22,25,27)*. This observation is similar to findings from Kristjansson et. al.'s RCT, which showed that children who were fed in school attended school at rate of about 4 to 6 days more frequently, made more gains on mathematical tasks and on some short-term cognitive tasks than controls *(4)*. The study concluded that school meals may have small physical and psychosocial benefits for disadvantaged school children which have been shown by some of these studies *(12)*.

There was limited data on the effect of the GSFP on female enrolment in schools. The studies which reported an effect on gender showed that, overall, males were favoured, unlike a study in Burkina Faso, which found an increase in the enrolment rate of girls by 3.2 percentage points *(47)*. Further studies with more rigorous designs are needed to demonstrate the effect of the GSFP on education-related gender outcomes.

CONCLUSION

The findings of this review are similar to that of a systematic review, which examined the nutrition and educational outcomes of the school feeding programme in Ghana *(48)*. The effect of the GSFP on nutrient intake and nutritional status showed mixed results. While some GSFP schools demonstrated a positive effect on the nutritional status of school children, others showed no difference. Insufficient funding and delayed payments to caterers seem to have negatively impacted the gains in nutrition as some studies reported that children on the GSFP received small portion sizes and lower quality of food as a result of inadequate funding *(7,10,15)*. It seems reasonable to conclude, that although the GSFP reduces hunger in some children and complements household food intake, especially for poor families, it might not be adequate to impact nutritional status for several reasons including funding and logistics.

This review found that studies on the impact of the GSFP on education consistently report increases in enrolment, attendance, retention and punctuality. However, without gains in nutritional outcomes, it is unlikely that the GSFP would improve cognition and academic performance of school children significantly, despite impressive documented effects on other indicators.

Resolution of the pervasive funding problem is needed to provide the necessary infrastructure and resources to improve programme implementation and yield better nutrition and education outcomes. Better management and monitoring of the programme, targeting of beneficiaries and exploration of alternate models of school feeding are needed. In addition, comprehensive approaches to addressing the nutritional needs of all school children, including inculcating positive values that influence nutrition-related behaviours *(48)* and promote healthy development of the minds and bodies of school children are recommended. Further studies which employ robust methodology as well as the collection of baseline and routine monitoring

data to inform program performance and evaluation are also needed.

STRENGTHS AND LIMITATIONS

This desk review differs from the systematic review by Awojobi, 2019 *(49)* as the studies included in this review were limited to articles from peer reviewed journals and therefore did not include student dissertations or theses. Additionally, our review included articles and papers on nutrient adequacy and intake and reported measurable outcomes; One (1) randomized controlled trial provided the highest level of evidence. Assessment of dietary intakes was performed using different tools and reference standards which may have affected comparisons across studies. Furthermore, since schools implementing the GSFP tend to be in deprived areas with higher risk of nutritional deficiency, it is possible that children in these schools are nutritionally deprived at baseline than the comparison groups in other schools. Longitudinal studies examining the progress of individual children and community characteristics would have provided useful objective information

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