

Food Security

A free lunch or a walk back home? The school food environment and dietary behaviours among children and adolescents in Ghana --Manuscript Draft--

Manuscript Number:	FOSE-D-15-00373R3	
Full Title:	A free lunch or a walk back home? The school food environment and dietary behaviours among children and adolescents in Ghana	
Article Type:	Original Article	
Keywords:	Food environments; Food Access; Dietary quality; School meals; Children and adolescents	
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Funding Information:	Bill and Melinda Gates Foundation (US)	Not applicable
	Dubai Cares	Not applicable
Abstract:	<p>Food environments can play an important role in shaping nutrition and health outcomes. One such environment that has potential to affect youth is the school food environment. In contrast to higher-income countries, however, there is a critical evidence gap on the role of school food environments on children and adolescents in low- and middle-income countries. This mixed-methods study contributes to filling this gap by investigating the role of school food environments on dietary behaviours of children and adolescents in Ghana. It draws on data from household and school questionnaires as well as focus group discussions collected as part of the baseline for an impact evaluation of the Ghana School Feeding Programme (GSFP). Multi-level regression models were fit with random intercepts at the individual, household and community levels. Excerpts from the focus group discussions provided a deeper understanding of quantitative findings. Children and adolescents who received free school meals provided by the GSFP or who lived further away from school were less likely to go home for lunch. More than half of sampled schools offered foods for sale by independent vendors, the most common being meals followed by confectionery, fruit and sugar-sweetened beverages. Predictors of bringing money to school to buy food included non-receipt of free school meals, adolescence, greater commuting distance from home, household asset score, and urban location. Policy efforts focusing on the school food environment may contribute to healthy dietary behaviours for children and adolescents with positive impacts over the lifecourse.</p>	
Response to Reviewers:	The authors thank the reviewers for the close attention and useful comments on the paper. Overall, the revisions were focused on improving the readability of the paper. The specific comments were addressed as well.	

Reviewer #2: This manuscript is much improved and only needs minor revision at this point. My comments are below.

Line 97: Briefly describe some of the findings in these studies

A sentence was added. Please see lines 107-108.

Lines 103-105: Explain why bringing money to school matters

Please see lines 114-116 in the revision for the added text.

Beginning of methods section: You have many, many variables and measurements which makes the study difficult to comprehend. Add a figure that includes the study variables being measured, how they are measured, and the populations that are measured.

The methods section has been reorganized and hopefully reads more clearly now. A new table was added (see Table 1, which lists all the variables in the quantitative analysis) while a previous one was deleted.

Lines 158-168: This text describes the participants, not the study setting. Create new section titled Population or Participants

A new section header was added. Please see line 176.

Line 209: Tables 1 and 2 should be introduced in the first paragraph of measures section

The methods section has been reorganized substantially. The new Table 1 is introduced in the first paragraph. See line 246.

Line 323: Clarify which sample this is - focus group, survey, both?

This section has been revised to improved clarity. For this specific point, please see line 316-317. Several other revisions were made through the results section to clarify where the results come from (survey or focus group)

Reviewer #3: Line 79: Consider including limitations of school food environments (e.g., inability to change BMI/nutrition outcomes, cost, inconsistent messages with what children access/consume at home etc.).

Thank you for this point. We agree it is important, but that it is too much for the first paragraph of the paper. The paper tries to be clear that the school food environment is just one factor that may influence food choices.

Line 118: Can you be more specific about what aspects of Herforth and Ahmed's framework you adapted? Was it the tiers of the Social Ecological Model, or something specific to school food environments from their article?

The study uses the definition of the food environment put forth by Herforth and Ahmed. The text has been revised to clarify this. See lines 132-134 and lines 144-146.

Lines 123-129: You have a lot of great information and I think your paper's content is important. However, I struggle to identify a clear research question and/or purpose. Is the goal for your study to characterize and describe school environment/s in Ghana, and then propose a more contextually-relevant framework? Or, using an existing framework, to identify the behavior, environmental and others barriers to children in Ghana using the school feeding program? If possible to articulate your study goal a little more bluntly, that would be helpful to reader and may help you re-organize some of the manuscript's sections to improve clarity.

Thank you for this comment. Lines 81-86 have been rewritten to clarify the objectives of the study, as well as moved up to the front of the introduction section. In addition,

the methods section was reorganized and some sentences were added to the results to improve the readability of the paper.

Lines 139-149: Can this section be reworked to briefly describe the components of the school food environmental analytical framework you are using? You provide different factors that have been shown to affect children's food decision-making, but it's not clear how these inform an analytical framework or will be used in your study.

The referenced section is about the theory and not the data used for the study. The text has been reduced and clarified to note this.

Lines 158-168: Do you have any nutrition data for your study populations?

Yes – the nutrition data was reported in the baseline study (Gelli et al 2015). The findings from this study are noted in lines 188-189. The estimates of obesity and stunting are not reported, as they are part of another paper in preparation. However the estimates are comparable to the others noted in the section.

Line 171: The background about the HGSP programme is very helpful and interesting. Could you create a separate and brief paragraph describing the HGSP (e.g., its goals, aims, target audience, and how it fits into Ghana's national nutrition strategy)? To me, the sentences you have about the HGSP don't fit under the "Survey Methods" section, where they currently are placed.

Thank you for this point. The HGSP has been expanded and moved to the study context section. See lines 157-164.

Lines 193-195: If this study is part of an overall impact evaluation, do you have any data to estimate child nutrition measures in this study population (i.e., prevalence of stunting/underweight and overweight/obesity)? That would be interesting to include in Table 4, if available. This would be helpful to characterize the population and help the reader understand what kind/s of nutrition challenges your study population is faced with.

Nutrition data is not included in this study, as it was reported in the baseline study (Gelli et al 2015). At the sample level, the prevalence of underweight and overweight are comparable to the estimates in lines 188-189.

Line 257: Why did you select these four dependent variables?

These were the variables available in the data. The text has been clarified in lines 260-262 to make this point.

Line 203: "Several schools were already implementing school feeding." What does "school feeding" mean in your study? Is it a lunchtime meal? Morning/afternoon snack? How frequently is it offered to children?

School feeding references school meals. The Ghana School Feeding Program seeks to offer children in select schools daily hot meals. Please see lines 159-164 for more details.

Line 360: In this section, you emphasize eating behaviors. But - correct me if I'm wrong - the Herforth and Ahmed framework you reference emphasizes the social ecological model. I wonder if you want to restructure your findings to emphasize the different individual, household, institutional, and cultural factors or include information about why your qualitative analysis emphasizes behavior changes when your analytical framework emphasizes ecological levels. Apologies if you did include this and I missed it.

The paper has been revised in several places to clarify that the Herforth and Ahmed reference is to the definition of food environment. The quantitative analysis primarily provides evidence on availability and affordability while the qualitative analysis provides insights into the other two dimensions (desirability and convenience). See lines 128-133. These four dimensions are relevant for each of the dietary behaviours

studied.

Title: A free lunch or a walk back home? The school food environment and dietary behaviours among children and adolescents in Ghana

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Running head: School food environments and dietary behaviours in Ghana

ABSTRACT

Food environments can play an important roles in shaping nutrition and health outcomes. One such environment that has potential to affect youth is the school food environment. In contrast to higher-income countries, however, there is a critical evidence gap on the role of school food environments on children and adolescents in low- and middle-income countries. This mixed-methods study contributes to filling this gap by investigating the role of school food environments on dietary behaviours of children and adolescents in Ghana. It draws on data from household and school questionnaires as well as focus group discussions collected as part of the baseline for an impact evaluation of the Ghana School Feeding Programme (GSFP).

Multi-level regression models were fitted with random intercepts at the individual, household and community levels. Excerpts from the focus group discussions provided a deeper understanding of quantitative findings. Children and adolescents who received free school meals provided by the GSFP or who lived further away from school were less likely to go home for lunch. More than half of sampled schools reported offering foods for sale by independent vendors, the most common being meals followed by confectionery, fruit and sugar-sweetened beverages. Predictors of bringing money to school to buy food included non-receipt of free school meals, adolescence, greater commuting distance from home, household asset score, and urban location. Policy efforts focusing on the school food environment may contribute to healthy dietary behaviours for children and adolescents with positive impacts over the lifecourse.

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20 **ABSTRACT**

21 Food environments can play an important roles in shaping nutrition and health outcomes. One such
22 environment that has potential to affect youth is the school food environment. In contrast to higher-income
23 countries, however, there is a critical evidence gap on the role of school food environments on children and
24 adolescents in low- and middle-income countries. This mixed-methods study contributes to filling this gap by
25 investigating the role of school food environments on dietary behaviours of children and adolescents in Ghana. It
26 draws on data from household and school questionnaires as well as focus group discussions collected as part of the
27 baseline for an impact evaluation of the Ghana School Feeding Programme (GSFP).

28 Multi-level regression models were fitted with random intercepts at the individual, household and
29 community levels. Excerpts from the focus group discussions provided a deeper understanding of quantitative
30 findings. Children and adolescents who received free school meals provided by the GSFP or who lived further away
31 from school were less likely to go home for lunch. More than half of sampled schools reported offering foods for
32 sale by independent vendors, the most common being meals followed by confectionery, fruit and sugar-sweetened
33 beverages. Predictors of bringing money to school to buy food included non-receipt of free school meals,
34 adolescence, greater commuting distance from home, household asset score, and urban location. Policy efforts
35 focusing on the school food environment may contribute to healthy dietary behaviours for children and adolescents
36 with positive impacts over the lifecourse.

37

38 **1. INTRODUCTION**

39 Food choices are mediated by a wide range of individual and environmental factors that include food
40 availability and accessibility, social and peer influences, and tastes and preferences (Herforth and Ahmed 2015). The
41 confluence of environmental factors in settings such as the home, community, school and workplace can define
42 distinct food environments (Story et al. 2008). Interventions and policies that shape food environments hold promise
43 for promoting healthy diets (CDC 1996; Hawkes et al. 2015). The school food environment has been recognized as
44 an entry point to support healthy food choices among children (De Villiers & Fabier 2015).

45 The present study investigates the role of the school food environment on dietary behaviours among
46 children and adolescents in the context of Ghana, a country undergoing the nutrition transition. In doing so it seeks
47 to follow the definition of food environment presented by Herforth and Ahmed (2015). Quantitative data from
48 national survey data primarily shed light on how availability and affordability might shape behaviours. The
49 qualitative data from focus group discussions provide insights into these dimensions as well as convenience and
50 desirability.

51 The national school feeding programme, which provides free meals to selected schools, is a defining
52 feature of the school food environment in Ghana and many other countries in the world (Bundy et al. 2009). The
53 findings related to school meals may be especially relevant for the prevention of malnutrition and diet-related
54 diseases over the lifecourse (Bundy et al. 2009).

55

56 **1.1 School food environments in high-, middle- and low-income countries**

57 Research from high-income countries indicates that schools are an important food environment for children
58 and adolescents (Kubik et al. 2003; Wechsler et al. 2000). In particular, school feeding programmes, which provide
59 food to children in schools on a regular basis, can contribute to improved diets and health (USDA, 2012; Story et al.
60 2002). Food advertising and placement, nutrition and health education, sales of meals and snacks by independent
61 vendors and peer influences may also play a role (Story et al. 2002).

62 Less is known about school food environments in low- and middle-income countries, especially in sub-
63 Saharan Africa. The bulk of evidence has been generated in South Africa (Claasen et al. 2016; Faber et al 2014;
64 Jacobs et al. 2013; Meko et al 2015; Oosthuizen et al, 2011). For example, one study highlighted a number of issues
65 in the school food environment such as the low content of fruits and vegetables in school meals, that about a quarter
66 of the students did not eat breakfast, and the wide consumption of unhealthy food items bought in nearby tuck shops
67 and by vendors located in the schools (Faber et al 2014). One study presents a qualitative conceptual framework for
68 healthy eating among adolescents in Ecuador (Vepsalainen et al 2015). Studies investigating the impact of school-
69 based interventions on dietary behaviours have been undertaken in Brazil (Gaglianone et al. 2006; Sichieri et al.
70 2009; Vargas et al. 2011), Thailand (Banchonhattakit et al. 2009), Trinidad and Tobago (Francis et al. 2010). The
71 measures of dietary behaviours employed in these studies primarily included knowledge and attitudes about healthy
72 eating, as well as consumption of energy-dense foods such as soft drinks and fast-food.

73 The bulk of the literature from low- and middle-income countries regarding the school food environment
74 focuses on how the provision of school feeding may impact intra-household food reallocation (Greenhalgh et al.
75 2007). The provisions of food may represent a significant transfer to households and the evidence suggests that
76 households do not respond by providing the child with less food at home, a finding known as the ‘flypaper effect’
77 (Greenhalgh et al. 2007). Fewer studies have investigated other dietary behaviours such as bringing money to school
78 to buy food and the types of foods purchased. This behaviour may be associated with the consumption of less
79 healthy foods and worsen overall dietary quality, especially with the widespread shift from under- to over-nutrition
80 and related non-communicable diseases known as the nutrition transition (Popkin 1998). In one study from Jamaica,
81 children who received school meals were as likely to bring money to school as children who did not receive school
82 meals, however purchase patterns were not analysed (Powell et al. 1998). More broadly, several reviews of the
83 literature find that school feeding can contribute to nutrition, health and educational outcomes for children and
84 adolescents (Snilstveit et al 2015; Kristjansson et al, 2015).

85 More research in low- and middle-income countries is merited as the school food environment may offer
86 promising policy levers to counteract the nutrition transition (Popkin 1998). Studies have documented increasing
87 rates of overweight and obesity among children and adolescents in many countries alongside a persistently high
88 prevalence of undernutrition and micronutrient deficiencies (Ng et al. 2014; De Onis et al. 2010). The overall shift
89 from under-to over-nutrition may be driven in part by altered dietary behaviours, which may be developed during
90 adolescence and endure over the lifecourse (Popkin 1998; Dunn et al. 2000; Mikkilä et al. 2005; Aurino et al. 2016).

91

92 **1.2 The school food environment analytical framework**

93 Our multi-methods study was guided by the framework set by Herforth and Ahmed (2015), which defines
94 food environments as the “availability, affordability, convenience, and desirability of various foods.” For children
95 and adolescents who attend schools, the school food environment may wield significant influence as has been
96 demonstrated in high-income countries (Wechsler, 2000). Previous studies have established approaches to define,
97 measure and analyse these dimensions using ecological models and social cognitive theory (Glanz 2005; Lytle 2009;
98 Story et al. 2008).

99 Food supplied by school feeding programmes and independent vendors reflect the availability dimension,
100 which may depend on community characteristics such as urbanicity. Affordability is reflected in the cost of these
101 foods in relation to the household income of children and adolescents. Convenience is also likely to influence
102 decision-making, especially for children who live further away from school. Lastly, desirability may be enhanced by
103 factors shaping preferences such as cultural norms that may be established by food consumption patterns in the
104 community and by peers, as well as nutrition education and advertising. Herforth and Ahmed (2015) note that
105 existing quantitative measures relate to the availability and affordability dimensions of the food environment. There
106 is a need to consider approaches for measurement that reflect all four dimensions. Previous studies have highlighted
107 that taste, habit strength and self-efficacy are important factors for children and adolescents in some contexts
108 (Verstraeten et al. 2014).

109

110 **2. METHODS**

111 This mixed methods study draws on quantitative and qualitative data from surveys and focus groups. The
112 data collection took place during 2013 and 2014 as part of the baseline for an impact evaluation of the Ghana HGSF
113 programme that sought to assess the effect of the programme on a wide range of child and community outcomes,
114 including education, nutrition and agriculture (Gelli et al, 2016).

115

116 **2.1 Study context**

117 Ghana was a lower-middle income country at the time the study was conducted. The population includes
118 more than nine major tribes or ethnic groups with over 100 sub-groups. Members of the various ethnic groups share
119 a common cultural heritage, history, language, and origin. The 10 regions of Ghana correlate to some degree with
120 ethnic groups, and can generally be grouped into the North (Upper East, Upper West and Northern regions), which
121 is generally less economically developed than the South (anywhere from the Brong Ahafo Region southwards).
122 Ghana launched a school feeding programme in 2005 that sought to provide a daily, hot meal to children attending
123 selected schools. In 2012, it was estimated that one in three children attending public, primary schools benefited
124 from the programme. The model is known as home-grown school feeding (HGSF) as foods are procured from the
125 community with the objective of promoting the incomes of local smallholder farmers, as well as the nutrition of
126 children. The meals, which typically include a locally produced staple such as rice, cassava, or yam with a local side
127 dish such as *groundnut* soup or *okro* stew¹, are intended to be well-balanced and appeal to local tastes and

¹ Groundnut is the Ghanaian word for peanuts. Similarly, okro in other countries may be known as okra or lady's fingers.

[Type here]

128 preferences (Parish and Gelli, 2015). In 2012, the Ghana School Feeding Programme (GSFP) was retargeted to
129 districts with the highest levels of food insecurity and poverty (Gelli A. et al. 2016).

130

131 **2.2 Study population**

132 Nutrition indicators among children and adolescents are poor in Ghana, reflecting the triple burden of
133 malnutrition. In addition, there is significant regional variation, particularly between the South and North (Agbozo et
134 al 2016; Prince and Laar 2014; Owusu et al. 2014). About one out of five school-age children in Ghana were
135 estimated to be moderately or severely stunted (Manyanga et al. 2014). On the other hand, overweight is on the rise,
136 especially among urban children attending private schools, although the exact figures are not clear (Agbozo et al
137 2016). Some studies suggest that the prevalence of obesity in the population is about one to four percent (Abiba et
138 al. 2012; Muthuri et al. 2014). Another study from secondary school students found a prevalence of overweight and
139 obesity of 13.3 percent among girls and 6.7 percent among boys (Manyanga et al. 2014). Micronutrient deficiencies
140 are widespread as well. Among rural schoolchildren in Northern Ghana the prevalence of anaemia was estimated to
141 be 64 percent (Abizari et al 2012). Another study reported that 44 percent of adolescent girls suffered from anaemia
142 (UNICEF 2012). Another investigation using the data from the present study found that average BMI-for-age z-
143 score was -0.592 while the average height-for-age z-score was -0.925 (Gelli A. et al. 2015).

144

145 **2.3 Study sample**

146 The sample for the study was based on an impact evaluation (Gelli A. et al, 2016). From a set of 60 of the
147 total of 216 districts in Ghana, two comparable public primary schools and the surrounding communities in each
148 district were selected.² Household listings were compiled in each enumeration area (EA) by the survey team
149 supervisors assisted by community leaders. Maps were obtained for most of the EAs from the Ghana Statistical
150 Service. The EA maps made it possible to identify all dwelling structures within a geographical space with a well-
151 defined boundary. All dwelling/housing structures within each EA were serially numbered to facilitate the complete
152 listing of households. The list of all households with a child aged five to 17 years of age in each EA constituted the
153 sampling frame from which participating households were selected at random for the household questionnaire.
154 About 20 to 25 households were selected from each community for the survey. The school questionnaire was
155 administered in each of the selected schools. Household and school questionnaires were administered by teams of
156 enumerators from the University of Ghana in the local language. Questionnaire responses were input and cleaned at
157 the University of Ghana.

158 In addition to the household and school survey, focus group discussions were undertaken in nine
159 communities (nine focus groups in total) between March and April 2014. The focus groups were moderated by four
160 trained and experienced data collectors who had no established relationship with participants prior to the study. The
161 discussions were conducted in the predominant language of the community. Interviews, each of which lasted about
162 an hour and a half on average, were audio recorded and transcribed verbatim into English upon return from the field.

² Data from the Ghana Education Service is available from the website: <http://www.ghanaeducationdata.com/> (link downloaded November 28, 2015).

163 While the intention for the impact evaluation was to field the questionnaire prior to the introduction of the
164 GSFP, the data indicated that several schools had already started to provide school meals. Although this constituted
165 a challenge for the impact evaluation, it is a feature of the data that was exploited for the present study.

166

167 **2.4 Household and school questionnaires**

168 The household and school questionnaires were based on tools previously used in country or in a similar impact
169 evaluation developed in Mali (Masset and Gelli, 2013). The school questionnaire was adapted to Ghana with the
170 support of the GSFP monitoring and evaluation team. Household agriculture, food consumption and expenditure
171 modules were based on the Living Standard Measurement Study (LSMS) undertaken in Ghana, as were the
172 education participation modules (LSMS, 2009-2010). TABLE 1 presents the variables from the household and
173 school questionnaires that were used for the quantitative analysis. ANNEX TABLE 1 presents the wording from the
174 questionnaires of the school food environment questions.

175

176 [INSERT TABLE 1 and ANNEX TABLE 1]

177

178 The respondent to the household questionnaire was the head of household or caregiver. As the measures of
179 dietary behaviours were not reported by the children and adolescents themselves, the responses were considered as
180 perceptions. In the school questionnaire, head teachers or caterers reported whether or not the school was in the
181 GSFP, and the availability of certain foods for sale at the school by independent food vendors. The types of food
182 reported for sale were meals, confectionery, fruit and sugar-sweetened beverages.

183 The household questionnaire included a number of modules. In the education module, the respondent
184 reported the dietary behaviours of the child or adolescent during the past week. If the child or adolescent attended
185 school, the respondent was asked if he/she received free meals at school. If the response was positive, she/he was
186 asked how many days a meal was received by the child or adolescent in the past week and whether they consumed
187 less food at home on the days on which they received a free meal at school. The household head was also asked to
188 report the number of days in the past week that the four dietary behaviors were exhibited, as well as the amount of
189 money spent on food at or near school. The number of days the dietary behavior occurred during the past week
190 ranged between zero and five days. With regards to money taken to school, a few extreme values greater than 20
191 Ghana cedis (GHS) (equivalent to about \$10 at the time of the survey) were noted and recoded as missing.
192 Caregivers also reported if the child or adolescent received free meals at school.

193 The set of variables also included other individual, household and community characteristics that may be
194 important determinants of dietary behaviours such as age and gender (Glanz 2005; Aurino et al 2016). For some
195 studies, childhood and adolescence were defined in terms of biological growth and puberty onset, while for others
196 the definition was in terms of psychosocial growth transitioning to adulthood (Dehne and Riedner 2001; Kroger
197 2003). The latter definition was used for the study and corresponds to the age-appropriate thresholds for basic
198 education or primary school, junior high school and senior high school in Ghana (Akyeampong et al. 2007). Those

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199 aged five to 10 years of age were classified as children, while those between 11 and 14 were classified as young
200 adolescents, and 15 to 17 years olds were classified as older adolescents.

201 Several variables reflect household socio-economic status (SES), which may also be an important
202 determinant of dietary behaviours (Aurino et al 2016; Vepsalainen et al 2015). These variables include the gender
203 and education level of the household head, as well as household asset score. An asset-based index, based on
204 ownership of durables and access to services, was constructed using principal components analysis and quintiles
205 (Filmer and Pritchett, 2001). This measure relates to the affordability dimension of the school food environment, as
206 do household size and the presence of a sibling less than five years of age, which may reflect increased demands on
207 household resources.

208 The time and distance to travel to and from school was also reported in the household questionnaire.
209 Children and adolescents who live further away from school may benefit more from having free school meals or
210 foods offered for sale than children who live closer and who can go home more easily for lunch, reflecting the
211 convenience dimension of food environments. Commuting time was chosen for the analysis as it was expected to
212 play a stronger role in shaping these dietary behaviours. Distance in kilometers, which was also reported in the
213 survey, was tested in the sensitivity analysis. Values that exceeded four hours were recoded as missing. Households
214 were classified as living in urban areas according to enumeration maps (Ghana Statistical Service 2012). Urban
215 areas included the national capital Accra as well as some district capitals, and may relate to all dimensions of the
216 food environment. Following the Herforth and Ahmed (2015) framework, TABLE 2 presents an overview of the
217 dimensions of the school food environment and related individual and household characteristics. Variables
218 represented in the present analysis are noted.

219

220 **2.5 Survey analysis**

221 The quantitative analysis used multi-level models with random effects at the household, school and district
222 levels to explore how factors at different levels of influence including the school food environment shaped
223 individual child and adolescent dietary behaviours (Sniders and Bosker, 1999).³ Drawing from the available
224 measures in the household questionnaire, the dependent variables in the analysis were: (1) having breakfast at home;
225 (2) going home for lunch; (3) bringing food to school; and (4) spending money on food at or near school. The
226 receipt of free school meals reported in the household questionnaire was a key independent variable. The presence
227 of GSFP in the school as reported in the school questionnaire was excluded from the list of independent variables in
228 the estimations due to multicollinearity, while the availability of foods for sale by independent vendors as reported
229 in the school survey was included in the list of independent variables. In addition, the model controlled for
230 moderating individual and household factors at the different levels through the addition of fixed effects. The
231 inclusion of fixed effects in the models was tested with the log-likelihood ratio test. Several sensitivity analyses
232 were undertaken for the multivariate findings. Binary constructions of the outcome variables were also tested which
233 noted if the diet behavior occurred at least once in the past week. In addition, alternative age groupings for
234 childhood and adolescence were tested to investigate the robustness of findings.

³ School food environment measures were effectively at the community level as there was one school per community in the data.

235 The analytic sample was defined as follows. First, the sample was limited to youth aged five to 17 years
236 who reported still being in school and attended kindergarten up to sixth grade in a primary or public school at least
237 one day in the previous week. The sample was then restricted to children and adolescents who reported whether or
238 not they received a free school meal at least once in the previous week as well as other dietary behaviours.
239 Respondents with missing information were more likely to be from urban areas, but otherwise did not significantly
240 differ from non-respondents. Observations with missing values for other variables from the household and school
241 survey were also excluded.

242 In total, the analytic sample included 4,258 children ages five to 17 years from 1,951 households located in
243 111 communities that corresponded with 111 schools sampled in the school survey. Almost all children and
244 adolescents in the analytic sample (99 percent) attended full-day school without separate morning and afternoon
245 shifts, and of these, 97 percent attended school four or five days of the previous week.

246

247 **Focus group methods**

248 The focus groups were conducted using standard procedures (Tong et al. 2015). The interview guide for the
249 discussions was adapted from a Focused Ethnographic Study tool developed by the Nutrition Department, NMIMR,
250 Ghana and Cornell University and previously used in Ghana (Pelto et al. 2013). The guide is framed within the
251 social-ecological model for the determinants of nutrition. Some of the modules were retained while some areas of
252 investigation were added.

253 All caregivers of child and adolescent study participants (who had been previously selected from the
254 communities for the baseline survey for the impact evaluation) were invited to participate in the focus group
255 discussions. The discussions took place in a quiet area outside on the school premises where distractions were
256 minimal. On average, there were eight to ten participants per focus group discussion and included both males and
257 females. No limitations were noted for the joint participation of men and women in the same focus group discussion.
258 The experiences and views of caregivers were solicited regarding the implementation of a complex intervention with
259 a focus on health and diets. Discussions around specific questions continued until no new information arose. Each
260 participant was given two cakes of soap in appreciation for their time.

261

262 **2.6 Transcript analysis**

263 Four main themes were constructed by a qualitative researcher using basic content analyses through a
264 deductive approach. Responses to specific questions were grouped and analyzed for emerging themes and sub-
265 themes. Similarities and differences across the groups were noted. The researcher coded the transcripts using NVivo
266 software, ensuring consistency across the various transcripts. TABLE 2 presents the themes and sub-themes of the
267 focus group discussion. The data was written up under the defined themes and sub-themes making full and
268 appropriate use of quotations that illustrated the nature of the interactions observed. Two themes – (1) Feeding
269 strategies to keep children healthy; and (2) Household feeding – were the focus of the present study.

270 Findings for these two themes were reviewed against findings from the quantitative analysis, similar to
271 Morrow et al. (2014) and Aurino and Morrow (2015). To the degree possible, some excerpts from the focus group

[Type here]

272 discussions were used to shed light on possible reasons behind findings from the quantitative analysis. Participant
273 quotations were used to note findings from the focus group discussions. The community where the participant
274 quotations were gathered were noted, while no individual identifying information is given.

275

276 3. RESULTS

277

278 3.1 Descriptive statistics from the surveys

279 TABLE 3 presents descriptive statistics of the children and adolescents sampled from the household
280 survey. These variables served as covariates in the subsequent multivariate analysis. About half of the sample was
281 female while about 40 percent were adolescents (aged 11 to 17 years). The distribution of the sample by region
282 reflects the sampling strategy of the impact evaluation, which concentrated in the north where food insecurity and
283 poverty rates were higher. The three main ethnic groups were Gurma (36 percent), Akan (21 percent) and Mole-
284 Dagbani (24 percent). Average household size was seven people while about 60 percent had at least one sibling less
285 than five years of age. About three percent of children lived in urban areas while the average commuting time to and
286 from school was 16 minutes. About 20 percent of children and adolescents received a free school meal in the past
287 week, 94 percent of whom received free meals four or all five of the school days in the past week.

288

289 [INSERT TABLE 3]

290

291 TABLE 4 presents descriptive statistics of reported dietary behaviours during the past week from the
292 household survey. Most children and adolescents (91 percent) had breakfast at home most of the days of the past
293 week, while a lower but still substantial share of children and adolescents had lunch at home (62 percent). Some
294 reported bringing food to school (about five percent) although it was more common to spend money on food at or
295 near school (40 percent). These children and adolescents brought an average of GHS 4.40 (\$2.20) to school the past
296 week, with 45 percent bringing more than the weekly equivalent of the GSFP subsidy of GHS 2.50 (\$1.75).

297

298 [INSERT TABLE 4]

299

300 FIGURE 1 presents characteristics of the school food environment based on responses from the school
301 questionnaire. Independent vendors offered foods for sale in more than half (53 percent) of schools. Availability of
302 foods for sale through vendors appeared to be more common in schools without the GSFP (57 versus 39 percent),
303 however, these differences were not statistically significant, perhaps due to a limited sample size.

304 The most common foods sold were meals (48 percent), followed by confectionery (26 percent), fruit (21
305 percent), and sugar-sweetened beverages (11 percent). An estimated 19 percent of schools reported vendors selling
306 one option, the most common being meals, while 18 percent sold two items, the most common being meals and
307 snacks or meals and fruit, and 14 percent sold three items, the most common being meals, confectionery and fruit.

308 Just two schools reported vendors selling all four options – meals, confectionery, fruit and sugar-sweetened
309 beverages – one of which was located in Greater Accra.

310

311 [INSERT FIGURE 1]

312

313 3.2 Multi-method analysis findings

314 This section presents the joint findings from the multi-level regression analysis as well as the analysis of
315 the focus group transcripts. The findings are organized by dietary behaviour. Full results from the multi-level
316 regression analysis can be found in TABLES 5 and 6. The estimated Intra-Class Correlations (ICCs) from these
317 models indicated significant clustering at the district, school and household levels, with the greatest level of
318 clustering at the household level ranging from 0.51 to 0.72. The fit of the models did not increase substantially with
319 the inclusion of fixed effects, although it did improve relative to the empty models as indicated by log-likelihood
320 ratio values.

321

322 3.2.1 Dietary behaviours – breakfast at home

323

324 TABLE 5 indicates that the receipt of free school meals was not predictive of having breakfast before school,
325 nor was the availability of foods offered for sale. In the focus group discussions, caregivers noted that children and
326 adolescents typically had breakfast porridges prepared from cereals such as rice, maize and millet prepared by
327 caregivers before leaving for school. Other foods mentioned include tea, rice, yam slices, beans and stew, which
328 may be left over from the previous evening’s meal. For example,

329 *‘Before they go to school, I give them porridge.’ (Caregiver from Ashanti Region); and*

330 *‘In the morning if there is no food in the house, I will buy porridge and bread. This can keep them*
331 *till midday.’ (Caregiver from Central Region)*

332

333 3.2.2 Dietary behaviours – going home for lunch

334

335 The receipt of free school meals, however, was associated with having lunch at home less frequently (coeff=-
336 0.04, $p < 0.001$). The focus group discussions suggest that children and adolescents in Ghana may have three or four
337 meals a day, depending on whether the free school meals substituted for a meal prepared at home:

338 *‘Some parents feed their wards three times a day...the children sometimes take lunch at home*
339 *apart from the school meal (making four meals a day)’ (Caregiver from Volta Region).*

340 Children and adolescents who received free school meals may come home less frequently at break time, but may
341 still have food upon return from school at the end of the school day. While this was not ascertained in the
342 questionnaire, it was raised in the focus group discussions. For example,

343 *‘[The school meals programme] has a lot of benefits... the children used to come home to eat*
344 *during break, and after eating, they will go and be hanging around the community, whilst we*

[Type here]

345 *thought he or she has gone to school. You will come out later and find him or her still hanging*
346 *around our homes instead of going back to school. Now that the children do not come home*
347 *during break time to eat, we do not find them sitting or roaming at home when they are supposed*
348 *to be in school (Caregiver from Northern Region).*

349 The provision of free school meals may also reduce the practice of leaving school to search for food from
350 other sources in the communities. For example,

351 *'Pupils no longer go to the market or bush looking for shea fruits and other wild fruits in the name*
352 *of hunger. They know that they have food at school and if they are not there, they will not be*
353 *served and so they are always ready with their bowls and spoons waiting to be served.'* (Caregiver
354 *from Northern Region).*

355

356 3.2.3 *Dietary behaviours – eat less at home*

357

358 Among those who received free school meals at school as reported in the household survey, an estimated
359 17 percent reported eating less at home. Discussions with the focus groups highlighted possible reasons for this
360 finding, which included financial difficulties and that children were less hungry as they had eaten in school. This is
361 shown in the quotes below:

362 *'[Children] used to eat lunch at home every afternoon but now that is no longer the case... [this]*
363 *helps parents... feed their families because the afternoon meals are shifted to evening. We don't*
364 *consume as much food like we used to do in the past'* (Caregiver from Upper East Region); and

365 *'[Food preparation at home] has reduced. I used to cook for instance five pieces of yam, but now*
366 *I cook just three, since the child is not hungry. There is no need to cook more'* (Caregiver from
367 *Ashanti Region); and*

368 *'The truth is that because we don't have money, the small [amount] that we have is what we cook*
369 *at home for all our school children... if they come and are not satisfied at school, we eat together*
370 *but if they are satisfied, we enjoy our home meal alone'* (Caregiver from Northern Region).

371 More than 80 percent of recipients of free school meals from the survey sample, however, continued to eat
372 the same amount of food at home. A range of reasons were provided in the focus group discussions to explain this
373 result. Some caregivers cited parental responsibility to feed their children, while others expressed concern that
374 school meals might be not sufficient to “carry” them until the evening. Some also wanted to ensure that their
375 children were provided with a balanced diet, especially if children found the food given them at school to be
376 “boring”. For example,

377 *'This feeding programme is to encourage the children to come to school so that does not mean*
378 *that it should become the opportunity for parents to neglect the children so for that matter we still*
379 *have to prepare food for them because that food will not be sufficient for them to take them*
380 *throughout the whole day'* (Caregiver from Northern Region); and

381 *'We also serve them our food to vary the food they eat because sometimes they can come and eat*
382 *rice in the school here so when they get back home we prepare [meals] to vary the food and make*
383 *it balanced' (Caregiver from Northern Region).*

384 Other predictors of having breakfast and lunch at home were identified in the quantitative analysis. The
385 convenience dimension of the school food environment as reflected by commuting distance to and from school was
386 a significant and positive predictor of having meals at home as hypothesized ($p < 0.001$) and as shown in TABLE 4.
387 The importance of this factor in dietary behaviours was also highlighted by a caregiver in the focus group
388 discussions:

389 *'Some of the children, on their way home, they get scorched by the burning sun to the extent that*
390 *when they reach home, they may be extremely tired and hungry, and some may even sleep and*
391 *wake up later to eat' (Caregiver from Duna, Northern Region).*

392 TABLE 5 shows that adolescents were also less likely to have meals at home (coeff=-0.08, $p < 0.01$).
393 Furthermore, compared to southern Ghana, children and adolescents from northern Ghana were generally more
394 likely to have breakfast before school or lunch at home, which may reflect more traditional values. Household size
395 was negatively associated with the frequency in going home for lunch.

396
397 [INSERT TABLE 5]

398 399 3.2.4 *Dietary behaviours – taking food to school*

400
401 TABLE 6 presents the multi-level regression results for taking food to school. Older adolescents
402 were less likely (coeff=-0.03, $p < 0.05$) to take food to school while children and adolescents in urban areas
403 were substantially more likely to bring food (coeff=0.49, $p < 0.001$).

404 405 3.2.5 *Dietary behaviours - spending money on food at or near school.*

406
407 TABLE 6 also presents the findings from the regression model investigating factors associated with the
408 amount of money brought to school. This analysis was restricted to the sub-sample of children and
409 adolescents who reported bringing money to school at least once in the past week. The results indicate that
410 free school meal receipt was negatively associated with bringing money to school (coeff=-0.07, $p < 0.001$) as
411 well as the amount of money brought to school (coeff=-0.08, $p < 0.01$) In the focus group discussions,
412 caregivers reported giving amounts of money ranging between 20 pesewas and one cedi to their children
413 every school day. In line with the findings from the regression analysis, some caregivers reported giving
414 less money to their children on account of the provision of free school meals, thereby making financial
415 savings. For example,

416 *'I have reduced the money I give to my children in the morning from one Ghana cedis to*
417 *fifty Ghana pesewas' (Caregiver from Volta region); and*

[Type here]

418 *'Yes, it has helped financially. Previously we had to give them money to buy something*
419 *when it is getting to midday but because the feeding is now free, we are able to save some*
420 *money. We would be liars if we said it hasn't benefited us in any way' (Caregiver from*
421 *Central Region).*

422 Others reported that less obligation was felt to give money to children if household resources were limited as
423 illustrated by the quote below:

424 *'Before the school feeding programme, you had to go and borrow money if you didn't*
425 *have for the child to buy something, but now the programme has reduced the burden such*
426 *that even when there is no money, the child can fall back on what will be served in*
427 *school' (Caregiver from Volta region).*

428 Other caregivers reported that they still gave the same amount of pocket money after the provision of the free school
429 meals while acknowledging that the children's needs were better ensured. For example,

430 *'Before the school feeding programme, I could give them money and it still wouldn't be*
431 *enough. But now, everything seems to be going smoothly' (Caregiver from Central*
432 *Region); and*

433 *'I still give each [child] one cedi. They tell me they buy pencil and other things in school,*
434 *reducing the amount will not be enough for them to buy all the daily items they need.*
435 *(Caregiver from Volta Region).*

436 The discussions with the caregivers suggested that supplementing breakfast could be one reason for the continued
437 provision of money to children and adolescents. For example,

438 *'In the morning, my children also normally take porridge. I also give them money when*
439 *they are going to school so that they can buy something else to eat when they are hungry'*
440 *(Caregiver from Central Region); and*

441 *'In the morning... after they take porridge, you get them either 10 or 20 pesewas for them*
442 *to buy something in the school so that they can learn properly, and when they come*
443 *home, we then cook for them to eat. But now... with [school feeding], we have stopped*
444 *giving them money to go to school' (Caregiver from Northern Region).*

445 The availability of foods for sale, in particular meals ($p < 0.001$) and sugar-sweetened beverages ($p < 0.05$),
446 was also positively associated with bringing money to school in the regression analysis (see TABLE 5). Caregivers
447 of children who received free school meals gave some indication in the focus group discussions that their children
448 bought snacks and sweets rather than proper meals. For example,

449 *'I give 50 pesewas to each one of my children. But it impossible to tell exactly what they buy...*
450 *sometimes when try to find out how they spent the money, they give you conflicting responses. As*
451 *one says he/she bought water and kanfer⁴, the other exposes that they buy ice cream or toffee'*
452 *(Caregiver from Volta Region).*

⁴ Kanfer is similar to abolo, which is ground, soaked corn flour with sugar that is steamed or baked on leaves.

453 The survey analysis uncovered differences in expenditures by age. For example, older adolescents (aged 15
454 to 17 years) spent on average GHS 0.65 (\$0.33) more than children (aged 5-10 years) in the past week ($p<0.001$).
455 Children and adolescents from urban areas were more likely than rural children and adolescents to bring food or
456 money to school, and the amount of money spent was greater ($p<0.05$). The multi-level regression results also
457 indicate that household asset score was predictive of bringing money to school, as was being in the southern and
458 wealthier districts of the country.

459

460 [INSERT TABLE 6]

461

462 Child gender and having a younger sibling less than five years of age did not emerge as significant in any
463 of the regression models, nor did interactions between child gender and age. In the focus group discussions,
464 however, some caregivers noted that older or bigger children received more food, and a pro-boy bias when
465 distributing food within the household. Alternative thresholds for the age groups of children, young adolescents and
466 older adolescents did not alter the statistical significance and sign of the results presented in TABLES 5 and 6. The
467 use of distance to school reduced the sample size considerably, but did not change the sign and statistical
468 significance of findings except for money brought to school. Binary constructions of the dietary behavior measures
469 did not affect the statistical significance of findings.

470 4. DISCUSSION

471 The study contributes to a presently small evidence base on school food environments and dietary
472 behaviours in low- and middle-income countries. Ghana provides an interesting case as it was a low-income country
473 at the time of the study undergoing the nutrition transition. The school food environment is largely defined by the
474 school feeding programme, which seeks to procure nutritious, locally grown foods. The programme's sustainability
475 is protected by a School Feeding Policy, which was launched in 2016. This policy can provide a platform for
476 enhancing the school food environment resulting in the promotion of healthy food choices among children and
477 adolescents (de Villiers and Faber 2016).

478 Some results are consistent with previous evidence. For example, findings related to skipping breakfast or
479 buying unhealthy foods from vendors echo the South African studies mentioned earlier (Faber et al 2014; Claasen et
480 al 2016; van der Berg and Meko 2016). In addition, this study found that more than half of the sampled schools in
481 Ghana offered foods for sale such as sugar-sweetened beverages by independent vendors. Private vendors may be
482 crowded out due to a reduced competitive edge in the presence of the GSFP or a lower demand or desirability
483 demonstrated by children and adolescents, following, for instance, nutrition education programmes. The availability
484 of these foods may offset the benefits of free school meals for children and adolescents attending schools that
485 participate in the GSFP, especially if they continue to bring pocket money to school to buy food. The amount of
486 money brought to school was low in comparison with findings from another study reporting that mean daily
487 expenditure of adolescents on ready to eat foods was GHS 2.18 (\$1.09) in the Brong Ahafo Region, and GHS 1.43

[Type here]

488 (\$0.72) in the Northern Region, translating to an estimated GHS 10.90 and GHS 7.15 per week respectively (Armar-
489 Klemesu, M et al, 2014). Out-of-home consumption is an established risk factor for higher energy and fat intake,
490 and low micronutrient intake (Lachat et al. 2012).

491 Regularity in the provision of school meals is also critical for establishing healthy and consistent dietary
492 behaviours (Bundy et al. 2009). In Ghana, the current per-meal subsidy of 50 pesewas (\$0.25) is low relative to the
493 cost of food, which may lead to irregular provision, or meals of lower quality and quantity, especially if the currency
494 value fluctuates significantly (Parish and Gelli 2015). Children and adolescents may respond to irregular meal
495 provision by going home for lunch or spending money on food at or near school.

496 Household income is also important, reflecting the affordability dimension of the school food environment.
497 The provision of free meals at school may be especially important for households from lower socioeconomic strata
498 in rural areas. The targeting of the GSFP to the poorest and most vulnerable households may strengthen the role of
499 the school food environment for those in greatest need, and introducing cost recovery mechanisms can support the
500 financial sustainability of the programme (Alderman and Bundy 2012).

501 Commuting time to and from school was significantly associated with the frequency in going home for
502 lunch and spending money on food at or near school. Other factors related to convenience such as product placement
503 and food environments around schools, particularly in urban settings, could affect the diet quality of youth as has
504 been investigated in some high-income countries (Hirschman and Chiriqui 2013; Adamson et al. 2013). Thus, the
505 school food environment may contribute not only to school-based behaviours, but also in its vicinity, as argued by
506 Van Der Berg and Meko (2016).

507 School-based nutrition education or behavioural change communication could promote internal and
508 external factors related to the desirability of school meals and promote lifelong healthy eating (Silveira et al. 2011).
509 This is especially important for adolescents, who have more autonomy regarding food purchase and consumption
510 decisions and who may be differentially targeted or impacted by factors such as social norms and advertising
511 (Mallick et al. 2014; Cusatis and Shannon 1996). This study indicates that adolescents were less likely to have
512 breakfast or lunch at home, while they were more likely to bring money to school to buy food. Household SES and
513 age may influence the desirability of foods for sale, resulting in more money spent on food at or near school.

514

515 **4.1 Limitations**

516 There were several limitations to the study. The focus was on the availability dimension of food
517 environments due to the information available from the data, and were based on perceptions not observation. The
518 other three dimensions – affordability, convenience and desirability – which may be more easily explored through
519 qualitative studies can hold significant influence on child and adolescent dietary behaviours as well (Verstraeten et
520 al. 2014). Furthermore, information on child and adolescent dietary behaviours was not collected directly at the child
521 or adolescent level, but reported by the head of household.

522 As the household questionnaire was conducted at the homes of respondents in the community, some of the
523 children and adolescents in these households may not have been pupils at the schools sampled in the school
524 questionnaire. An analysis of the 2011-2012 EMIS data noted an average of 1.4 schools per community suggesting

525 that in most cases the sampled children and adolescents did in fact attend the sampled school. In comparing
526 responses from the household and school surveys, a high correlation ($r=0.77$) was noted between school
527 participation in GSFP as reported in the school survey and household reporting of free school receipt in the
528 household survey. Differences in reporting may also be due to the regularity in the provision of meals through the
529 GSFP. Schools may indeed be part of the GSFP but not providing meals due to delays in payments to caterers,
530 which was a significant concern at the time of the data collection.⁵

531 While the survey data was not nationally representative, the sample drew from all 10 regions of Ghana.
532 Due to the targeting of the GSFP to more food insecure areas, in particular the north and rural areas of Ghana, it is
533 likely that children and adolescents who attended schools that offered GSFP were from households of lower SES
534 than children and adolescents who attended schools without GSFP. The focus group discussions concentrated on the
535 northern regions of Ghana, and may not fully reflect the range of household responses to the school feeding
536 programme and dietary behaviours exhibited by the child or adolescent.

537 Furthermore, the cross-sectional nature of the survey data limits causal interpretations. The availability of
538 foods for sale at school, as well as the types of foods available, may reflect market demand from children and
539 adolescents who attend the school or vice versa. Analysis of both the baseline and endline of the impact evaluation
540 in Ghana, as well as other studies that employ rigorous methods can provide more conclusive evidence.

541

542 **5. CONCLUSIONS**

543 The school food environment can provide policy avenues to promote nutritional outcomes for children and
544 adolescents. Refining the concept of food environments and measurement approaches for different target
545 populations such as children and adolescents is an important area for future work to inform effective policy design.
546 The developing evidence base on nutrition value chains, which relate to both supply and demand pathways, can be
547 useful for this purpose (Gelli et al, 2015). In addition, a food environments framework could be leveraged to other
548 critical issues in school nutrition in low- and middle-income countries such as food safety. More investigation is also
549 needed on how nutrition education and behavioural change communication delivered through schools can enhance
550 diet quality. Promoting a healthy school food environment may be more effective in communities where norms
551 already support healthy diets and before nutrition transitions have taken place (Herforth and Ahmed, 2015).

552

553

554 **Acknowledgements**

555 This work was financially supported by the Bill and Melinda Gates Foundation and Dubai Cares. The authors
556 acknowledge the Ghana School Feeding Programme and a number of individuals. The contributions of Lesley
557 Drake, Kwabena Bosompem, Felix Asante, Irene Ayi, Daniel Kojo Arhinful, and Edoardo Masset are acknowledged
558 for leading the overall impact evaluation. Tony Kusi provided field supervision and data analysis support. Rosanna

⁵ Newspaper articles have reported on delays and eventual releases of payments. For example, the Ghana Business News, July 2013: <https://www.ghanabusinessnews.com/2013/07/26/gsfpc-confirms-owing-caterers/> (link downloaded April 7 2015), and Ghana web, March 2014: <http://www.ghanaweb.com/GhanaHomePage/regional/artikel.php?ID=303945> (link downloaded April 7, 2015).

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559 Agble provided guidance on nutrition. Edoardo Masset contributed to the design of the household survey and Eric
560 Ockrah developed the school questionnaire. Daniel Mumuni contributed to the implementation of the survey, liaised
561 with the GSFP and provided feedback on the manuscript at various sages. Individuals at the Ghana School Feeding
562 Programme who were instrumental in the study design and in the provision of valuable technical support include the
563 National Coordinator, Mr. S.P Adamu, Mrs. Susan Torson, Nutrition Programme Manager, and Mrs. Kate Quarshie
564 of the Ghana Health Service. The Partnership for Child Development Ghana team also provided a critical role in the
565 implementation of the impact evaluation and liaising with the Ghana School Feeding Programme. These individuals
566 include Getrude Anase-Baiden, Abigail Bondzie, Fred Amese and Lutuf Abdul-Rahman.

567

568 **Conflict of Interest**

569 The authors report no conflicts of interest.

570

571 **Authorship**

572 All authors made substantial contributions to the conception and design, data acquisition, data analysis,
573 interpretation of analysis results and the drafting of the manuscript. MF developed the concept and led the
574 quantitative analysis and writing of the manuscript, while EA contributed the use of food environments as a guiding
575 framework and the mixed methods approach as well as significant contributions to the manuscript text. GF provided
576 critical inputs to the conduct of the survey and conducted the qualitative analysis of the focus group transcripts. GF
577 also contributed to the construction of variables, reviewed analysis output for the quantitative analysis and
578 contributed to the writing of the manuscript. AG designed the household questionnaire and identified the sampling
579 approach. In addition, he provided overall guidance on the analytic approach for the quantitative analysis, sample
580 definition and the variable construction.

581

582 **Ethical Standards Disclosure**

583 The household and school surveys were conducted according to the guidelines laid down in the Declaration of
584 Helsinki and all procedures involving human subjects were approved by the University of Ghana Noguchi Memorial
585 Institute for Medical Research (NMIMR) Institutional Review Board. Consent to voluntarily participate in the study
586 was sought from respondents after giving them general information about the study, details of data to be collected,
587 risks and discomforts, benefits, confidentiality and their right to leave the research at any point in time. They were
588 also given contact details of one researcher for further information. Participants signed a consent form to indicate
589 such, or made a cross to indicate consent if they could not sign.

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744 **FIGURES**

745

746 FIGURE 1: Availability of foods for sale in schools (N=111)

747

748 N=111 schools. School administrator reported if independent vendors sold any foods on the school premises. Foods
749 included meals, confectionery, fruits and sugar-sweetened beverages. Chi-square tests assessed differences between
750 schools with GSFP and schools without GSFP; No differences were statistically significant for $\alpha < 0.05$.

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753

754 **TABLES**

755

756 TABLE 1. Variables used in the quantitative analysis

Household questionnaire	
Child/adolescent dietary behaviours:	Had breakfast at home Went home for lunch Took food home from school Received free meal at school Brought food from home Brought money from home Spent money at or near school
Child/adolescent characteristics:	Age Gender Ethnicity Traveling time to school
Household characteristics:	Household size At least one sibling less than 5 years of age Asset score Education level, head of household Gender, head of household
Community characteristics:	Rural/urban Region
School questionnaire	
Food environment:	Participation in the GSFP Types of foods sold in school

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759 TABLE 2. Themes and sub-themes of focus group discussions

Main theme	Sub-themes
Strategies families use to keep children healthy	Education, healthcare, hygiene and nutrition.
Feeding strategies used to keep children healthy	Various food groupings and their health benefits for children; Food hygiene; Provision of meals at home to ensure children eat well, as opposed to buying street food, parental responsibility.
Household feeding	Factors influencing food allocation such as age, gender, monetary contribution, and health status; Advantages and disadvantages of the school feeding programme from the perspective of the children and caregivers; How school feeding may have influenced mode of feeding at home or not.
Vitamins and food fortification	Awareness of food sources of vitamins; Access and barriers to these foods, and their roles in the diet; Familiarity with commercially packaged vitamin supplements, the concept of food fortification and openness to the concept of the use of MNPs in school meals.

760 Note: Main themes were defined before the data collection while sub-themes emerged after review of the transcripts.

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763 TABLE 3. Descriptive statistics of analytic sample from the household survey (N=4,258)

Categorical variables:		%	Obs (n)
Age group ^a	5-10 years old	61.2	2,607
	11-14 years old	32.4	1,358
	15-17 years old	6.4	273
Female		46.9	1,997
Ethnic group	Akan	20.7	881
	Ga-Dange	1.9	79
	Ewe	7.6	325
	Guan	1.4	61
	Gurma	35.6	1,515
	Mole Dagbani	24.1	1,027
	Grusi	3.5	148
	Mande	1.6	67
	Other	3.6	155
	Region	Western	3.4
Central		3.3	158
Greater Accra		0.7	31
Volta		8.9	414
Eastern		4.8	221
Ashanti		11.2	523
Brong Ahafo		11.8	566
Northern		27.7	1,291
Upper East		15.6	727
Upper West		12.1	564
Urban		2.8	118
Education level of household head ^b	Some or no formal schooling	64.7	2,755
	Some secondary school	32.4	1,381
	Vocational education or college	2.9	122
Female head of household		16.8	716
At least one sibling less than 5 years of age ^c		62.1	2,646
Received free school meal	At least once in past week	22.3	950
	Number of days in the past week	4.6	950
Continuous variables:		Mean	Range
Commuting time to and from school (min) ^d		16.0	1-240
Household asset score ^e		-0.1	-1.1-5.1
Household size		6.9	2-20

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- 766 ^a Reference group is children ages 5 to 10 years of age. Young adolescents are 11 to 14 years old and older
767 adolescents are 15 to 17 years old.
- 768 ^b A sibling 5 years of age or less.
- 769 ^c Commuting distance to and from school in minutes.
- 770 ^d Household respondent reported level of education achieved of each household member including household head.
771 Reference group is none or some formal schooling.
- 772 ^e Estimated household assets. Calculated using principal components analysis based on reported ownership of
773 durables and access to services.
774

School food environments and dietary behaviours in Ghana

TABLE 4. Dietary behaviour patterns reported by children and adolescents (N=4,258)

	At least once in past week ^a		Average number of days in past week ^b	
	%	Obs (n)	Mean	Obs(n)
Had breakfast at home	90.6	3,857	4.5	3,857
Went home for lunch	62.4	2,655	4.5	2,655
Took food to school	4.8	203	3.2	203
Took money to school	39.5	1,683	4.4	1,683

N/A = not applicable. Obs (N) = number of observations reporting in the affirmative.

^a Reference period is past week. ^b Average number of days ranges from 0 to 5 days; ^c Question posed only to children and adolescents who reported receiving school meals at least once in the past week. The frequency of its occurrence was not reported.

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TABLE 5. Multi-level regression results testing the associations between the school food environment and dietary behaviours (n=4,258)

	Days had breakfast at home ^a		Days went home for lunch ^a		
	Coeff	(SE)	Coeff	(SE)	
Days free school meal received at school ^b	-0.01	(0.01)	-0.04	(0.01)	***
Foods offered for sale in school ^c :					
Meals	0.07	(0.13)	-0.10	(0.20)	
Confectionery	-0.18	(0.13)	-0.14	(0.21)	
Soft drinks	-0.01	(0.17)	-0.53	(0.27)	*
Fruit	-0.13	(0.17)	-0.32	(0.27)	
Female	0.01	(0.01)	0.03	(0.02)	
Age ^d :					
Young adolescent	-0.03	(0.01)	-0.08	(0.02)	***
Older adolescent	-0.08	(0.03)	-0.08	(0.04)	**
Ethnic group (ref=Akan)					
Ga-Dange	0.22	(0.27)	0.69	(0.39)	
Ewe	0.16	(0.16)	0.28	(0.24)	
Guan	0.11	(0.28)	0.05	(0.41)	
Gurma	0.22	(0.15)	-0.06	(0.22)	
Mole Dagbani	0.23	(0.15)	-0.21	(0.22)	
Grusi	0.50	(0.25)	0.04	(0.37)	*
Mande	-0.30	(0.28)	0.13	(0.41)	
Other	0.19	(0.21)	0.11	(0.31)	
Household size	-0.02	(0.01)	-0.01	(0.02)	***
Young sibling ^e	0.06	(0.07)	-0.06	(0.10)	
Commuting time to school ^f	-0.00	(0.00)	-0.01	(0.00)	***
Household head level of education ^g :					
Some secondary school	-0.08	(0.08)	-0.02	(0.11)	
Vocational education or college	-0.03	(0.18)	-0.71	(0.26)	**
Female head of household	-0.10	(0.09)	-0.12	(0.13)	
Household asset score ^h	0.05	(0.03)	0.00	(0.04)	
North (ref = South)	0.56	(0.17)	0.69	(0.31)	*
Urban (ref = Rural)	0.04	(0.25)	-0.33	(0.40)	
Constant	3.61	(0.19)	2.98	(0.31)	***
Random effects					
District ICC:	0.11	(0.03)	0.20	(0.04)	
Community ICC:	0.01	(0.01)	0.02	(0.01)	
Household ICC:	0.83	(0.03)	0.74	(0.04)	
LL with fixed effects:	-4680		-6056		
LL from empty model:	-4723		-6171		

N=4,258 for all regressions. Statistically significant coefficients noted as follows: *p<0.05, **p<0.01, ***p<0.001. Coeff = coefficient; SE= standard error; LL= Log-likelihood ICC=Intra-class correlation.

School food environments and dietary behaviours in Ghana

^a Dependent variables range from 0 to 5 days and reference period is previous week

^b Reported in household survey. Ranges from 0 to 5 days and reference period is previous week.

^c School food environment variables reported in the school survey.

^d Reference group is children aged 5 to 10 years. Young adolescents are 11 to 14 years old and older adolescents are 15 to 17 years old.

^e A sibling 5 years of age or less.

^f Commuting distance to and from school in minutes.

^g Household respondent reported level of education achieved of each household member including household head. Reference group is none or some formal schooling.

^h Estimated household assets. Calculated using principal components analysis based on reported ownership of durables and access to services.

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TABLE 6. Multi-level regression results testing the associations between the school food environment and dietary behaviours (cont'd)

	Days brought food to school ^a (n=4,258)		Days brought money to school ^a (n=4,258)		Amount of money (GHS) brought per week (n=1,604)				
	Coeff	(SE)	Coeff	(SE)	Coeff	(SE)			
Days free school meal received at school ^b	-0.00	(0.01)	-0.07	(0.02)	***	-0.08	(0.03)	**	
Foods offered for sale in school ^c :									
Meals	0.04	(0.08)	0.79	(0.10)	***	-0.18	(0.29)		
Confectionery	-0.10	(0.08)	-0.24	(0.20)		-0.17	(0.27)		
Soft drinks	0.04	(0.11)	0.63	(0.26)	*	-0.11	(0.33)		
Fruit	0.01	(0.09)	0.40	(0.25)		0.07	(0.32)		
Female	0.00	(0.01)	-0.01	(0.02)		-0.05	(0.04)		
Age ^d :									
Young adolescent	-0.01	(0.01)	0.04	(0.02)		0.22	(0.04)	***	
Older adolescent	-0.03	(0.01)	*	0.15	(0.04)	***	0.65	(0.08)	***
Ethnic group (ref=Akan)									
Ga-Dange	-0.18	(0.15)	-0.75	(0.35)		0.70	(0.58)		
Ewe	-0.03	(0.10)	-0.28	(0.22)		-0.61	(0.33)	*	
Guan	0.02	(0.16)	-0.29	(0.37)		-0.25	(0.60)		
Gurma	0.13	(0.08)	-0.47	(0.20)		-0.40	(0.31)		
Mole Dagbani	0.15	(0.08)	-0.05	(0.20)		-0.30	(0.30)		
Grusi	0.11	(0.14)	-0.92	(0.33)	**	-1.21	(0.62)	*	
Mande	0.02	(0.16)	0.34	(0.36)		0.68	(0.51)		
Other	0.16	(0.12)	-0.19	(0.28)		0.36	(0.43)		
Household size	-0.00	(0.01)	-0.03	(0.02)		0.10	(0.04)	**	
Young sibling ^e	0.05	(0.04)	-0.01	(0.09)		-0.09	(0.14)		
Commuting time to school ^f	0.00	(0.00)	0.01	(0.00)	***	0.00	(0.00)	***	
Household head level of education ^g :									
Some secondary school	0.01	(0.05)	0.13	(0.10)		-0.11	(0.17)		
Vocational education or college	-0.13	(0.11)	0.40	(0.24)	*	0.53	(0.36)		
Female head of household	0.09	(0.05)	0.25	(0.12)		0.35	(0.18)	*	
Household asset score ^h	0.02	(0.02)	0.16	(0.04)	***	0.17	(0.06)	**	
North (ref = South)	-0.06	(0.08)	-0.84	(0.25)	***	-1.00	(0.34)	***	
Urban (ref = Rural)	0.49	(0.15)	***	0.62	(0.36)	*	1.18	(0.46)	*
Constant	0.02	(0.10)	1.65	(0.27)	***	2.79	(0.41)	***	
Random effects									
District ICC:	0.00	(0.00)	0.14	(0.03)		0.15	(0.05)		
School ICC:	0.09	(0.02)	0.03	(0.02)		0.04	(0.04)		
Household ICC:	0.86	(0.00)	0.77	(0.03)		0.74	(0.04)		
LL with fixed effects:	-2081		-6054			-2592			
LL from empty model:	-2096		-6196			-2732			

Statistically significant coefficients noted as follows: * p<0.05, ** p<0.01, ***, p<0.001. Coeff = coefficient; SE= standard error; LL= Log-likelihood; ICC=Intra-class correlation; GHS = Ghana cedis.

^a Dependent variables range from 0 to 5 days and reference period is previous week

^b Reported in household survey. Ranges from 0 to 5 days and reference period is previous week.

^c School food environment variables reported in the school survey.

^d Reference group is children ages 5 to 10 years of age. Young adolescents are 11 to 14 years old and older adolescents are 15 to 17 years old.

School food environments and dietary behaviours in Ghana

^e A sibling 5 years of age or less.

^f Commuting distance to and from school in minutes.

^g Household respondent reported level of education achieved of each household member including household head. Reference group is none or some formal schooling.

^h Estimated household assets. Calculated using principal components analysis based on reported ownership of durables and access to service.

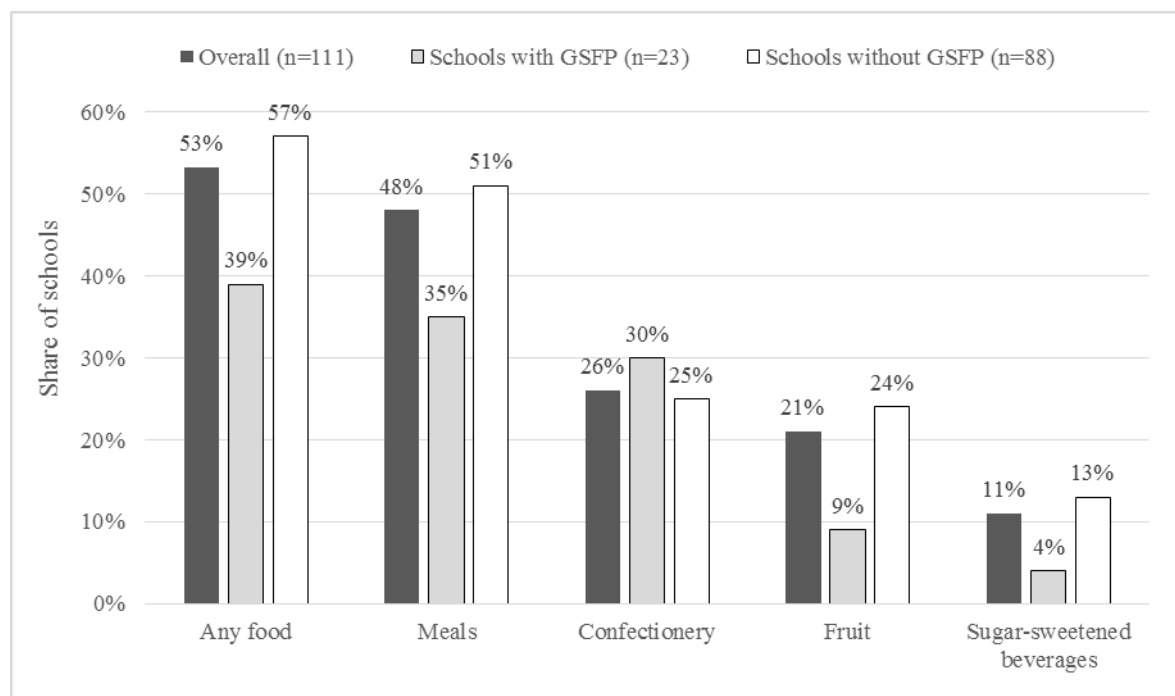
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ANNEX

Table A.1: Questions about the school food environment and dietary behaviours from the household and school questionnaires

Household Questionnaire	
Question	Response Options
Does [NAME] receive free meals at school?	1= Yes 2= No
<i>If response = 'yes', then continue with the following questions:</i>	
For how many of the past 7 days has [NAME] received a free meal or snack at school?	0-5 (Only include days from Monday to Friday)
Does [NAME] eat less food at home on days (he / she) eats a free meal or snack at school?	1= Yes 2= No
Does [NAME] ever bring food home from the free meal for other household members?	1= Yes 2= No
For how many of the past 7 days did [NAME] eat breakfast before school?	0-5 (Only include days from Monday to Friday)
For how many of the past 7 days did [NAME] take food to school for lunch and / or snacks?	0-5 (Only include days from Monday to Friday)
For how many of the past 7 days did [NAME] come home to eat for lunch?	0-5 (Only include days from Monday to Friday)
For how many of the past 7 days did [NAME] spend money on food at or near school? Include any money given to the school administration to buy food for [NAME] excluding school feeding.	0-5 (Only include days from Monday to Friday)
How much money did [NAME] spend on food at or near school in the last 7 days?	Ghc (only include days from Monday to Friday)
School Questionnaire	
Question	Response Options
What types of foods are currently sold in your school?	[multiple responses are applicable] Prepared meals Confectionery (Biscuits ,pastries, etc) Sugar sweetened beverages Fruits Other (please specify)
Is this school currently part of the Ghana School Feeding Programme?	Yes/No

FIGURE 1: Availability of foods for sale in schools (N=111)



Meenakshi Fernandes, PhD



Meenakshi Fernandes is a Senior Research Advisor at the Partnership for Child Development, based at Imperial College London, where her role is to support research activities related to improving the quality and effectiveness of school health and nutrition programmes in low- and middle-income countries. She has previously worked on food security and nutrition at the United Nations World Food Programme based in Rome, Italy and Abt Associates based in Cambridge, USA. She holds a Ph.D. in Policy Analysis from the Pardee RAND Graduate School and a B.A. in Economics from the University of Chicago.

Gloria Nelson, PhD



Gloria Folson, PhD is a researcher in the Nutrition Department at Noguchi Memorial Institute for Medical Research, based in Accra, Ghana. She is an expert in the collection and analysis of nutrition data, including blood spots, for haemoglobin analysis and dietary recall. Her work spans public health, nutrition, including infant feeding, and breastfeeding. She has a PhD in Nutrition from the University of Ghana.

Elisabetta Aurino, PhD



Elisabetta Aurino is Research Fellow in the School of Public Health at Imperial College London and Research Associate at the Department of International Development, University of Oxford. Her research focuses on evaluating the impact of school-based interventions to enhance child development outcomes; nutrition, diets and food systems in low- and middle-income countries; and the measurement of food security. Elisabetta holds a PhD in Development Economics from University of Roma Tre.

Aulo Gelli, PhD



Aulo Gelli is a Research Fellow in the Poverty Health and Nutrition Division at IFPRI. His work focuses on the evaluation of integrated agriculture and nutrition interventions, including cluster randomized controlled trials on the impact of school and pre-school meals linked to smallholder agriculture, with studies in Ghana, Malawi and Mali. He holds a Ph.D. in epidemiology from Imperial College London, an MA in development economics from the University of Roma Tre, an MSc in neural networks from Kings College London and a BSc in physics from Imperial College London.