AJFAND ONLINE Scholarly, Peer Reviewed ISSN 1684 5374
African Journal of Food, Agriculture, Nutrition and Development
Volume 12 No. 1
February 2012
Published by African Scholarly Science Communications Trust

PARTICIPATION IN COMMUNAL DAY CARE CENTRE FEEDING PROGRAMS IS ASSOCIATED WITH HIGHER DIET QUANTITY BUT NOT QUALITY AMONG RURAL GHANAIAN CHILDREN

[1,2]Harding KB, Marquis GS*[2], Colecraft EK[3], Lartey A[3] and O Sakyi-Dawson[4]

Kimberly Harding

*Corresponding author email: grace.marquis@mcgill.ca

[1]Micronutrient Initiative, 180 Elgin St., Ste. 1000, Ottawa, Ontario, Canada K2P 2K3.

[2]School of Dietetics and Human Nutrition, CINE Bldg., Macdonald Campus, McGill University, 21, 111 Lakeshore Rd., Ste. Anne-de-Bellevue, Quebec, Canada H9X 3V9.

[3]Dept of Nutrition and Food Science, University of Ghana, Legon, Ghana.

[4]Dept of Agricultural Extension, College of Family and Consumer Sciences, University of Ghana, Legon, Ghana.

AJFAND ONLINE Scholarly, Peer Reviewed
African Journal of Food, Agriculture, Nutrition and Development
Volume 12 No. 1
February 2012
ISSN 1684 5374
Published by African Scholarly Science Communications Trust

ABSTRACT

Communal School Feeding Programs (SFP) are based on local foods brought by children from home which are cooked and shared at school. These programs may be a sustainable food-based strategy for improving children's diets in low-resource areas. The objective of this study was to compare the dietary intakes of children who attend Day Care Centres (DCC) with communal SFP to children who do not attend any DCC or school in rural Ghana. Interviewer-administered questionnaires were used to collect dietary and other household information for 104 DCC and 89 non-DCC children aged two to five years living in two communities. In addition, the DCC lunches (ingredients and servings of each food preparation) were weighed. The Day Care Centres' lunch was higher in energy (by 64 kcal; $p<0.001$), but lower in calcium (by 18 mg; $p=0.002$), iron (by 1.3 mg; $p<0.001$) and zinc (by 0.2 mg; $p=0.046$) than the non-DCC lunch. DCC children ate more times in a day (4.2 ± 0.8 vs. 3.4 ± 0.6, $p<0.001$), had greater dietary diversity (7.2 ± 0.6 vs. 6.7 ± 1.0 food groups, $p<0.001$) and had higher daily intakes of energy (1140 ± 320 vs. 878 ± 240 kcal; $p<0.001$), calcium (282 ± 139 vs. 244 ± 118 mg; $p=0.048$), iron (12.4 ± 6.4 vs. 10.7 ± 4.7 mg; $p=0.048$) and zinc (0.40 ± 0.15 vs. 0.35 ± 0.11 mg; $p=0.019$) than non-DCC children. However, after controlling for total energy intake and other dietary, health and socio-demographic variables, daily iron and zinc intakes were lower in the DCC compared to the non-DCC group. Participation in the communal SFP was associated with higher quantity but not quality of children's diets. Communal SFP offer an opportunity to address specific population's micronutrient needs, using interventions to improve dietary quality such as point-of-use fortification, commercially fortified foods, or processed animal source food products.

Key words: School feeding, Young children, Ghana

INTRODUCTION

School Feeding Programs (SFP) offer an opportunity for improving children's diets. Existing research on SFP focuses on government or institution-supported programs which follow structured feeding guidelines, set to meet a certain proportion of children's energy and/or nutrient requirements [1-3]. However, not all SFP operate this way. Some rural Ghanaian Day Care Centres (DCC) have communal feeding programs where children bring a small amount of ingredients, and sometimes money, firewood or other resources from home. The ingredients are pooled and cooked at school and shared among all children. The money is used to purchase other food items or services. There is very little published information on these types of feeding programs. In a study of pre-school children's dietary patterns in Kenya, several participating pre-schools used this type of communal feeding program, but no data were reported on the composition of the meals or their contribution to the children's total diet [4].

Although results are equivocal, some research on government or institution-supported SFP have documented improved diet and nutritional status of participating children, in addition to increased attendance and enhanced cognitive or academic performance [1, 3, 5-10]. A systematic review and meta-analysis showed that, although the effects were small, school feeding had a positive impact on weight, attendance, mathematical achievement, short-term cognition and behaviour [11]. It is possible that similar benefits could be seen with communal SFP as well, especially those which target younger, pre-school age children. Several factors that may enhance the efficacy of SFP are actually inherent to communal SFP such as the program being developed by local teams rather than distant experts, piloting to confirm acceptability and palatability and the use of local cooking methods and ingredients [12].

The objective of this study was to determine whether children who attend DCC with communal feeding programs had different dietary intakes compared to children who did not attend any school or DCC. It was hypothesized that DCC children would have higher intakes of energy and selected nutrients than their non-DCC peers.

MATERIALS AND METHODS

Study sites

Study sites were located in the Techiman district of the Brong-Ahafo region, which is located in the Forest-Savannah Transitional zone, in mid-country Ghana. Two communities were purposefully selected because they were known to have DCC with communal feeding programs. Both sites were rural farming communities. The main sources of water for household use were boreholes or hand-dug wells and households had their own or shared latrine facilities. In Community 1, there was no electricity whereas Community 2 had electricity, although not all households were connected. Each site had one community-run DCC with a communal feeding program. At the time of data collection, both communities were part of a child nutrition intervention [13], although households participating in the intervention were not included in this study.

Participants

Because the DCC generally enrolled children between two and five years of age, participation in this study was restricted to only children in this age range. There was a fixed sample size for the DCC children group, estimated in advance at 100 children. Equal group sizes would allow for the detection of a between-group difference of 120 kcal (using 300 kcal standard deviation of a similar population, assuming Z_{α}=1.96 and Z_{β}=0.84 [14, 15]). This was considered reasonable given what was known in advance about ingredients used in the lunches, particularly energy-dense red palm oil.

Selection procedure

DCC children were randomly selected from DCC registration lists. Non-DCC children were chosen randomly from community census lists, matching the age range of the DCC children (2, 3, 4 and 5 years). Children were excluded from the study if a household member was participating in another concurrent child nutrition intervention program in the community, or if the child attended a school other than the participating DCC. If more than one child in the age range resided in a household, the child participant was randomly selected. DCC attendance was checked each day prior to study enrolment, and previous day's attendance was confirmed with the caregiver on the day of interview to ensure the dietary recall would capture a DCC day. The objectives were explained to the caregiver and they were invited to participate. Written informed consent was attained from all caregivers for their participation. This study was approved by the institutional review boards at McGill University, Iowa State University and the University of Ghana.

Data collection

The majority of data (except DCC lunch and child anthropometry and haemoglobin) were collected through face-to-face interviews with the caregivers, which generally took place in the caregivers' homes. Data collection took place in September and October, 2007, which corresponded with the post-harvest season, a time of relative food abundance.

Dietary intake

Children's food intakes were estimated with 24-hour dietary recalls on two non-consecutive days. The contribution of energy and nutrients from breast milk for those children who still breastfed was assumed to be minimal and was not included in the daily estimates reported here. The caregiver was asked to report all foods, except water, consumed by the child on the previous day. Common household units (bowls, cups, spoons) were used to estimate quantities consumed. For mixed dishes prepared by the caregiver, household units were used to estimate total ingredient quantities. During data entry, the amount of each ingredient consumed by the child was calculated from the child's portion size as a fraction of the total weight of the preparation. Local food samples were weighed to determine the weights of the estimations with household units, using a food-weighing scale to the nearest 0.1 g (Ohaus Corp., Pine Brook, USA). Water loss with cooking was taken into account during data entry, based on locally prepared recipes. The dietary recalls were completed from Tuesday through Saturday, to reflect previous weekday's intakes (Monday through Friday).

On the day prior to conducting in-home interviews, the DCC lunch was observed (for eight days in Community 1 and five days in Community 2). All ingredients in the preparation were weighed in addition to five servings of each food preparation to estimate the average serving size given to children (DCC director comments and project staff observations confirmed that the same portion size was served to all children). Data collection took place at the beginning of the school year therefore many children were new and the staff were often unable to identify them, making individual observations impossible. A month after data collection, the directors were asked about the eating habits of the participating children and asked to observe their eating habits at one lunch-time.

According to DCC director comments and project staff observations, DCC children in Community 1 generally finished the food served to them and never received extra servings. In Community 2 however, according to DCC staff, some children regularly did not finish the food served to them while others usually received an extra serving if they were still hungry (this was confirmed by project staff observations). The Community 2 DCC staff made a list of children who usually ate what was served to them (n=24), those who received an extra serving (n=13), and those who did not finish what was served to them (n=6), and estimated the proportion of serving portion consumed by the children who ate more or less than what they were originally served. For both communities, if a DCC child consumed the school lunch on the recall day (according to the caregiver and confirmed by attendance records where possible), the DCC foods served were added to the other foods reported by the caregiver on the 24-hour dietary recall.

Nutrient intakes were calculated from local food composition tables for Ghana and other West African nations as well as other published composition data [16-19]. FAO/WHO reference values were used for energy and all nutrients [20-22] with the exception of fat for which the Institute of Medicine value was used [23]. Proportions of recommended intakes were calculated on an individual level, taking into account relevant factors (sex, weight and age) as appropriate.

Dietary diversity was calculated from the dietary recalls using the following 10 food groups: cereals and grains; roots and tubers; legumes, pulses and nuts; vitamin A-rich fruits and vegetables (containing > 130 retinol equivalents (RE) per 100 g [24]); other fruits and vegetables; dairy; meat and poultry; fish; egg; and fats and oils (adapted from [25, 26]).

All eating events for the previous day reported during the 24-hour recall were later defined as meals or snacks based on the foods consumed. In accordance with the Ghanaian culture, a meal was defined as a starchy staple consumed with a sauce, such as soup or stew, regardless of time of day or amount consumed. The exception was *koko*, a thin porridge usually made from fermented maize or millet dough, which was often eaten as a morning meal. Snacks were defined as any other food consumed apart from meals. An average of the two days of intake was used for all food, energy and nutrient intake variables.

Other information

Interviewer-administered questionnaires with the caregiver were used to collect household data on demography and crop harvesting and child illnesses (symptoms of illness in the previous two weeks, including fever, cough, diarrhoea and loss of appetite). Whenever possible, child date of birth was verified with a Ghana Health Services weighing card or birth certificate. Within-community household wealth rankings for the participating households had been completed by a previous project [13]. In each community, a group of opinion leaders and other residents categorized households as belonging to low, medium or high wealth rank (based on factors such as the ability to send children to school or lend money to others). Caregivers and DCC directors were interviewed with open-ended questions regarding the DCC and their feeding programs. Child weight was measured with a digital scale (model BWB-800, Tania Corp., Tokyo, Japan) to the nearest 0.1 kg and height was measured with a vertical stadiometer (Shorr Board model, Irwin Shorr, Olney, USA) to nearest 1 mm. Both weight and height were measured in duplicate using standard methodology [27]. An average of the two values was used for data analysis. A haemoglobin photometer (HemoCue Inc, California, USA) was used to measure haemoglobin content of a capillary blood sample. The caregiver was given the results of the test and anaemic children (<11 g/dL) were referred to the nearest Ghana Health Services provider for treatment.

Analysis

SYSTAT version 12 (Systat Software, Inc., Chicago, 2007) was used for all data analysis. WHO Anthro version 2 (WHO, Geneva, 2007) and WHO AnthroPlus version 1 (WHO, Geneva, 2009) were used to calculate Z-scores for anthropometric indicators of nutritional status. For bivariate analysis between DCC and non-DCC groups, Student's *t*, Wilcoxon-Mann Whitney and chi-squared tests were used for normally distributed, non-normally distributed, and categorical data, respectively. Individual multiple linear regression analysis was used to determine if attending DCC was a determinant of energy, iron, zinc and calcium intakes, after controlling for other important factors. The number of decimal places is reported as suggested by Kelley [28]. Continuous data are presented as mean ± standard deviation (SD) and significance was set at $p<0.05$, unless otherwise indicated.

RESULTS

According to DCC registration lists there were 140 eligible DCC children in the two communities. According to community census lists, there were 226 non-DCC children (children's names cross-checked with DCC registration lists) aged two to five years living in the two communities, however it was not possible to determine eligibility until the caregiver was asked whether the child attended any other school. Caregivers of 203 children who had been randomly selected from the DCC registration lists and the community census lists, and were found during home visits, were invited to participate. All those who were invited, enrolled in the study. Ten children (DCC n=5, non-DCC n=5) were subsequently excluded, either because it was discovered after the interview that they attended another school or it was not possible to collect dietary information for them at the DCC. Data for 104 DCC and 89 non-DCC children were included in the analysis.

Household characteristics

There were no significant differences in any household, household head or caregiver characteristics between the DCC and non-DCC groups (Table 1). Slightly over half of households were considered low wealth rank within their communities. Approximately half of caregivers and two-thirds of household heads had some form of formal education; only 3% of caregivers and 16% of household heads had attended, but not necessarily completed, senior secondary school (data not shown). The most common primary occupation for household heads and caregivers was farming; over 90% of households were involved in crop farming (data not shown). Households produced an average of seven crops, the most common of which were maize, cassava, cocoyam and yam, followed by plantain, chili pepper and okra. About two-thirds of all caregivers and household heads were migrants from northern Ghana. In over 90% of cases, the caregiver was the child's biological mother.

Child characteristics

Children in the DCC group tended to be older and heavier than the non-DCC children (Table 2). There were no statistically significant group differences in the standardized anthropometric indicators of nutritional status. The non-DCC group had almost 20% more children with anaemia, but there was no statistically significant group difference in mean haemoglobin levels. There were no statistically significant differences in the proportion of children with fever, cough, diarrhoea or appetite loss between the two groups. In both groups, over two-thirds (68.3%) of children had at least one symptom of illness in the previous two weeks.

DCC feeding programs

In the Community 1 DCC, there was a three-day rotation of lunches: *gari* (ground dried cassava) and cowpea stew with red palm oil; *jollof* rice (rice cooked in a sauce made from tomato, chili pepper, onion and red palm oil); and boiled yam and *kontomire* (cocoyam leaves) stew prepared with red palm oil, ground groundnut, onion and chili pepper. Each day, children were required to bring 0.10 GH¢ (about US$ 0.10) for ingredients as well as a piece of firewood for cooking. On days when yam was served, children were also required to bring a piece of uncooked yam. In the Community 2 DCC, boiled yam and *kontomire* stew prepared with red palm oil, beans, onion, tomato and sometimes ground groundnut, *garden egg* (local eggplant) or chili pepper was served every day. There, children were required to bring a piece of uncooked yam, some uncooked *kontomire* leaves and a piece of firewood every day. Instead of food, they could bring 0.10 GH¢. They were also required to bring 0.10 GH¢ once a week to contribute to the cost of other ingredients.

The only Animal Source Food (ASF) included in the lunches was fish powder, which was used at the Community 1 DCC on half (four of eight) of the observation days. Very little was used and children received less than 2 g of fish powder per serving on each of these days. Red palm oil was included in every observed meal at both DCC; children received an average of 7 g per meal at the DCC.

Caregiver perspectives on DCC lunches

Several themes were identified in the DCC caregiver responses to a question on their thoughts about the feeding program. In both communities, caregivers said they appreciated the program because: (i) it meant they did not have to worry about what the child would eat; (ii) it reduced the child's hunger when they returned home; and (iii) the foods served were well-prepared. In Community 1 specifically, the caregivers reported that: (i) the feeding program kept the children at the DCC; (ii) it saved the caregiver time and/or money; (iii) the foods served were balanced; and (iv) without it, children may buy unhealthy foods such as toffee or biscuits with their lunch money. In Community 2, caregivers said that the foods served were good for their child's health (particularly *kontomire* and red palm oil). However, some concerns about the DCC meals were also expressed, including: (i) the quantity was not enough for their child; and (ii) there was not enough diversity in the foods served.

Caregivers were also asked how the DCC lunches compared with what was served at home. Here too, several themes were identified in both communities: (i) both the DCC and home-cooked meals were good; (ii) the children could have greater quantity of food at home and eat until they were satisfied; and (iii) the DCC meals did not include enough ingredients for all of the children or certain ingredients were not included at all (particularly ASF). In addition, Community 1 caregivers felt that home food was better (although caregivers who gave this response did not give specific reasons). Caregivers in Community 2 said; (i) there was not enough variety in the DCC meals compared to home meals; and (ii) not enough time was taken at DCC to prepare the food.

Non-DCC lunches

There was a large variety in the non-DCC lunches. Most children had a home-cooked or purchased meal consisting of a soup (e.g. peanut, palmnut, okra) or stew (e.g. tomato, *kontomire*, bean) and a starchy staple (e.g. rice, yam) - similar to foods served at the DCC. A few children ate only candy, maize porridge with sugar, bread with chocolate drink, or fried yam for lunch. Some children did not eat any lunch (n=8 on first data collection day, n=12 on second data collection day).

Published by African Scholarly Science Communications Trust
Josem Trust Place, Bunyala Road, Upper Hill, Nairobi
P.O. Box 29086-00625 Tel: +254-20-2351785 Fax: +254-20-4444030, Nairobi, KENYA
Email: oniango@iconnect.co.ke OR info@ajfand.net www.ajfand.net

Comparison of DCC and non-DCC lunches

The DCC lunch meal was higher in energy, fat, vitamin A and thiamine, but lower in calcium, iron, zinc and riboflavin than the non-DCC lunch (Table 3). DCC lunches included more red palm oil and less ASF than non-DCC lunches (data not shown).

Group comparison of overall daily dietary intakes

DCC children had, on average, greater dietary diversity (7.2 ± 0.6 vs. 6.7 ± 1.0 food groups, $p<0.001$) but consumed less ASF (30.4 ± 22.8 vs. 40.3 ± 23.6 g, $p=0.004$) than the non-DCC children. The DCC children ate more times in a day compared to their non-DCC peers (4.2 ± 0.8 vs. 3.4 ± 0.6, $p<0.001$). In the large majority (> 90%) of eating events, meal and not snack foods were consumed.

Children who attended DCC had significantly higher intakes of energy and protein than those who did not (Table 4). This difference remained when intakes were corrected for body weight (energy: 85.2 ± 22.6 vs. 68.7 ± 19.2 kcal/kg, $p<0.001$; protein: 1.92 ± 0.62 vs. 1.73 ± 0.56 g/kg, $p=0.03$). Although absolute intake of fat was higher in the DCC compared to the non-DCC children (26.6 ± 10.4 vs. 20.3 ± 9.6 g, $p<0.001$), there was no statistically significant group difference when fat intake was expressed as a percentage of energy. The DCC group had higher intakes of vitamin A, thiamine, vitamin C, calcium, iron and zinc. The DCC children's mean intakes met or exceeded recommended daily intake of energy, protein, vitamin A, thiamine, niacin, vitamin C and iron. In comparison, non-DCC children exceeded their requirements only for protein, vitamin A, and vitamin C.

Further analyses were performed on energy, as a quantitative indicator of the overall diet, and on calcium, iron and zinc, as indicators of diet quality and because these are potential micronutrients of public health significance in this population. Over 60% of energy and zinc, over 70% of iron, and over 40% of calcium intakes came from starchy staples (data not shown). Although these foods have low energy and micronutrient density, average daily intakes were considerable. Attending DCC remained a significant positive predictor of energy intake while controlling for other important variables (Table 5). However, DCC did not predict calcium intake and became a negative determinant of iron and zinc intakes when energy intake and other important variables were included in the model.

DISCUSSION

Energy intakes

The differences in energy intake between the DCC and non-DCC children are likely due to the DCC children eating more times in a day as well as the DCC lunch meals having higher energy content. The higher energy content of the DCC lunches likely came from the daily inclusion of red palm oil (the average serving was 7 g or 63 kcal, which is almost equivalent to the group difference in energy). Energy intakes among the DCC group were similar to intakes (1122 kcal) previously reported for slightly older (59 ± 10 mo), pre-school-aged rural Ghanaian children [29]. When weight and other statistically significant variables were included in the regression model for

Published by African Scholarly Science Communications Trust
Josem Trust Place, Bunyala Road, Upper Hill, Nairobi
P.O. Box 29086-00625 Tel: +254-20-2351785 Fax: +254-20-4444030, Nairobi, KENYA
Email: oniango@iconnect.co.ke OR info@ajfand.net www.ajfand.net

energy intake (age was not a predictor), DCC remained a predictor of energy intake (Table 5). After accounting for these factors, attending a DCC with a communal SFP in this setting was associated with a 230 kcal greater energy intake, which represents about 25% more than the non-DCC energy intake and over 20% of the mean energy requirement. This is slightly higher than reported differences in other SFP. A school breakfast program of cookies and an instant drink in Peru reported a 15% energy intake difference between those receiving the breakfast and the no-breakfast controls [1]. In Kenya a school snack study (including a no-snack control group, and iso-caloric snacks of vegetable stew, stew served with milk, and meat stew) showed about a 20% increase in energy intake from the baseline in the meat group, which was 10% greater than the increase in energy intake of the no-snack control group [3]. The other groups showed decreased home intakes which negated the gains from the school snack.

The dietary differences between the DCC and non-DCC groups would be expected to be reflected in anthropometric indicators of nutritional status. There were no differences; however, this may be due to the fact that data were collected within the first month of the new school year. Approximately 45% of the DCC children were returning back to school from a month-long summer break while the rest very recently started attending DCC for the first time. More time would be needed before any impact on weight, and particularly height, could be seen.

Calcium, iron and zinc intakes

For both groups, calcium intakes were slightly lower and iron and zinc intakes were similar to those reported in previous studies of other rural pre-school children in Ghana (344 mg, 11.6 mg and 5.1 mg, respectively) [29]. Calcium intakes in both groups were low, the average was around half (DCC: 54%, non-DCC: 48%) of the recommended intake. DCC children had slightly higher overall (DCC: 282 vs. non-DCC: 244 mg) daily intakes but lower intakes of calcium from the lunch meal (DCC: 42 vs. non-DCC: 60 mg). The DCC lunches contained leafy greens, which are relatively high in calcium, but were not likely to contain other important sources of calcium for this population such as rice, fish or *Tuo Zaafi (*stiff porridge made from maize or millet flour cooked with water), which contributed 16%, 15% and 15% of total calcium intake, respectively (data not shown). Although neither rice nor *Tuo Zaafi* was particularly high in calcium, they were both consumed in considerable frequencies and quantities. Non-DCC children had higher daily intakes of ASF, and fish was the most commonly consumed ASF, so the higher calcium content of the non-DCC lunch may have come from the greater fish content of that meal, or from the other important sources of calcium in this population, such as rice or *Tuo Zaafi*. Attending DCC was not a significant predictor of calcium intake when other important variables were included in the model.

The children's iron intakes were close to the recommended intake for a low iron-bioavailability diet. The non-DCC group's zinc intakes were approximately half of the recommended intake for a low bioavailability diet; while the DCC group's intakes were about one-third lower than the recommended intake. However, over 70% of iron intake and 65% of zinc intake came from starchy staples, mainly grains, which have very low bioavailability for both minerals, and may partially explain the high prevalence of anaemia.

The findings that total daily iron and zinc intakes were higher in the DCC compared to the non-DCC group were interesting considering that the non-DCC lunches contained more of both minerals than the DCC lunches. However, these differences were likely due to a greater number of meals consumed in a day by DCC children. A 'meal' by definition included a starchy staple, which was the primary source of iron and zinc. DCC lunches did not contain any foods which contributed substantially to the iron intake of this population or any iron-rich foods. *Kontomire* (cocoyam) leaves were often served, but have low iron content (1.7 mg/100 g) compared to many other leafy greens [16]. The DCC lunches often contained yam and sometimes rice, both important sources of zinc in this population (contributing 7.5% and 14.3% to overall intake, respectively).

After accounting for energy intake and other important variables, attending DCC was a negative predictor of both iron and zinc intakes. These results indicate that attending DCC did not improve the quality of the children's diets with respect to iron and zinc. Other SFP that have reported considerable increases in iron intakes have included iron-rich foods such as fortified cookies in Peru and meat in Kenya [1, 3]. The Kenyan SFP study also found that available zinc intakes increased for the meat stew group only and actually decreased for the iso-caloric vegetarian stew group, a likely reflection of enhancing and inhibiting factors in the diet.

The DCC lunch

The average energy content of the DCC lunch was around 290 kcal, which is similar to other SFP for school-aged children in India (grain and oil lunch, around 310 kcal) and Kenya (snack of vegetable stew, stew with milk or meat stew, around 250 kcal) [3, 5]. Although not designed to meet a certain proportion of the children's requirements, the lunches on average delivered almost 30% (28.3%) of the daily energy requirement, which is a reported goal for formalized school feeding programs [1, 2]. The iron, zinc and calcium content of the DCC lunch however fell short of the 30-100% goals of these feeding programs and were lower than that of the non-DCC lunches, which were generally prepared and consumed at home. Caregivers often commented that foods cooked at DCC were inferior to those at home because they did not include enough ingredients, particularly ASF. This somewhat negative evaluation may have been the reason many caregivers felt the need to serve their children another meal once the child returned home from school in the early to mid-afternoon, resulting in the DCC children eating more times in a day that the non-DCC children. This 'second lunch' suggests that no substitution (reduced home intake due to receiving food outside the home) took place in this study.

Communal school feeding programs

Anecdotal evidence shows that some other DCC in Ghana have no feeding program whatsoever. In these cases, the children either do not eat until they return home in the afternoon, or they bring food from home to eat at school, or they bring money to buy food. In the last case, children or their siblings decide what to buy, often with the same amount of money that children brought daily in Community 1, and weekly in Community 2. Several caregivers in the present study commented that they did not mind sending money to school for food because that money would otherwise be spent by their children on unhealthy foods such as candies. The Jamaican SFP study reported that most schoolchildren who do not participate in SFP buy their own food from street vendors or stores [30]. Communal feeding programs where children bring food and/or money to school, such as those seen in this study, may be an option in settings where there would otherwise be no school meal, and may be preferable to children buying foods or not eating until they return home.

It is possible however that communal SFP would not be desirable for lower income or food insecure families who would then be less likely to send their children to school because of the cost, although some government-funded SFP also require payment, for example in Jamaica [30]. In the present study, when asked about sending money, food and firewood to school, two-thirds of caregivers said they had no problem or did not mind, often stating because these goods were to be used for their children. However, one-quarter of caregivers reported that sending money on a regular basis was difficult and 5% stated that sending food and/or firewood was a challenge. All but two of the non-DCC caregivers were aware of the community DCC; when asked why they had not sent their child, 20% reported financial concerns, one quarter said their children were not ready yet (too young, could not talk yet or were still breastfeeding) and 40% claimed they were planning to send them soon. These data suggest that sending money to school for lunch may pose a problem for some families, but a large majority did not object to the practice. However, sending these items would likely pose a greater problem during periods of seasonal food scarcity.

Methodological limitations

One major limitation of the study was the different methods of dietary data collection for the lunch meal in both groups. Other SFP studies have also used a combination of dietary methods including dietary recall and weighed intake data or known nutritional content of the school meal [1, 3]. However, even if the 24-hour recall non-DCC lunches were underestimated compared to the weighed DCC lunches, the different methods could not account for all of the between-group differences because the DCC children ate more times during the day than the non-DCC children. In addition, the cross-sectional nature of the study also requires the results to be interpreted with caution. Future studies could include longitudinal designs (which could also assess feeding program limitations due to seasonal fluctuations in food availability), comparisons of DCC with communal feeding programs and those with no feeding program, or interventions that randomize DCC with no SFP into communal feeding program and control groups.

CONCLUSIONS

In the present study, children who attended DCC with communal feeding programs had higher daily intakes of energy and several micronutrients including calcium, iron and zinc. These differences were seen despite the fact that the non-DCC children's lunches were higher in calcium, iron and zinc than the DCC children's lunches.

Overall, it appears that attending DCC with a communal feeding program was associated with enhanced quantity but not quality of children's diets. Research in this area has important implications in low-resource settings where such programs could be introduced in pre-existing schools with little to no additional resources. Beyond a person to cook and a pot to cook in, these programs require no inputs other than what families provide, so could be initiated in schools with no support available for feeding programs. However, considerations of barriers to participation, such as seasonal food shortages, should be taken into account in any program design. These feeding programs also provide the opportunity, with minimal additional support and education, to address specific population's micronutrient needs. Interventions such as point-of-use fortification (e.g., multiple micronutrient powders), commercially fortified foods or processed ASF products could be used to target micronutrients of public health importance in this and similar populations, using communal SFP as a delivery mechanism. In addition, with information on the 'best buy' for local foods rich in micronutrients of concern, the meal quality could be greatly improved [31].

ACKNOWLEDGEMENTS

This publication was made possible through support provided to the Global Livestock Collaborative Research Support Program by the Office of Agriculture, Bureau for Economic Growth, Agriculture and Trade, United States Agency for International Development under terms of Grant No. PCE-G-00-98-00036-00. The opinions expressed herein are those of the author(s) and do not necessarily reflect the views of the USAID. This research was also funded by the Jim Ellis Mentorship Program for Graduate Students and a Canadian Institutes of Health Research Canada Graduate Scholarships Master's Award to KBH.

AJFAND ONLINE Scholarly, Peer Reviewed ISSN 1684 5374
African Journal of Food, Agriculture, Nutrition and Development
Volume 12 No. 1
February 2012
Published by African Scholarly Science Communications Trust

Table 1: Demographic characteristics for households with children 2 to 5 y of age in rural Ghana, by day care centre (DCC) attendance status

	DCC (n=104)		Non-DCC (n=89)		p-value[1]
	% (n)				
Low wealth rank	57.7	(60)	56.2	(50)	0.832
Household head					
Any education (n=192)	68.3	(71)	58.0	(51)	0.139
Occupation					0.340
Farming	73.1	(76)	80.9	(72)	
Salary	6.7	(7)	6.7	(6)	
Other	20.2	(21)	12.4	(11)	
Religion					0.713
Christian	50.5	(52)	48.3	(43)	
Muslim	41.7	(43)	40.4	(36)	
Traditional/none reported	7.8	(8)	11.2	(10)	
Migrant	68.0	(70)	70.8	(63)	0.672
Caregiver					
Any education	57.7	(60)	49.4	(44)	0.252
Occupation					0.424
Farming	48.1	(50)	59.6	(53)	
Trading	28.8	(30)	22.5	(20)	
Other	13.5	(14)	9.0	(8)	
None	9.6	(10)	9.0	(8)	
Marital status					0.555
Married (monogamous)	76.9	(80)	76.4	(68)	
Married (polygamous)	15.4	(16)	19.1	(17)	
Unmarried	7.7	(8)	4.5	(4)	

[1]Chi-squared test by DCC attendance group

Table 2: Demographic, anthropometric and haemoglobin characteristics and illness symptoms of Ghanaian children 2 to 5 y of age, by day care centre (DCC) attendance status

	DCC (n=104)			Non-DCC (n=89)			p-value[1]
				mean ± SD			
Age (mo)	41.1	±	10.5	38.2	±	10.3	0.051
Weight (kg)	13.49	±	1.97	12.96	±	2.12	0.075
Weight-for-height Z-score	-0.03	±	1.03	-0.22	±	1.12	0.216
Height-for-age Z-score	-1.44	±	1.14	-1.29	±	1.31	0.411
Weight-for-age Z-score	-0.84	±	0.83	-0.89	±	0.90	0.656
Haemoglobin (g/dL)	10.50	±	1.43	10.11	±	1.28	0.068
				% (n)			
Female	49.0		(51)	57.3		(51)	0.252
Still breastfed	6.7		(7)	12.4		(11)	0.180
Wasted[2]	2.9		(3)	5.6		(5)	0.342
Stunted[3]	32.4		(33)	25.6		(22)	0.309
Underweight[4]	7.8		(8)	10.5		(9)	0.532
Anaemic (haemoglobin <11 g/dL)	60.2		(53)	78.7		(59)	0.011
Illness symptoms in past 2 wk							
Fever	32.4		(33)	35.3		(30)	0.672
Cough	43.1		(44)	32.9		(28)	0.154
Diarrhoea	19.6		(20)	28.6		(24)	0.152
Appetite loss	35.3		(36)	48.2		(41)	0.073

[1]Student's t-test or chi-square test by DCC attendance group
[2]Weight-for-height Z-score < -2 standard deviations below reference median
[3]Height-for-age Z-score < -2 standard deviations below reference median
[4]Weight-for-age Z-score < -2 standard deviations below reference median

Table 3: Average energy and nutrient content of lunch meal of children 2 to 5 y of age in rural Ghana, by day care centre (DCC) status

	DCC (n=104)			Non-DCC (n=89)			p-value[1]
				mean ± SD			
Energy (kcal)	295	±	53	230	±	98	<0.001
Protein (g)	5.6	±	2.0	5.5	±	2.8	0.711
Fat (g)	8.3	±	3.6	5.7	±	4.4	<0.001
Vitamin A (RE)	444	±	124	245	±	249	<0.001
Thiamine (mg)	0.177	±	0.093	0.114	±	0.068	<0.001
Riboflavin (mg)	0.085	±	0.053	0.101	±	0.043	0.024
Niacin (mg)	1.490	±	0.59	1.34	±	0.78	0.140
Vitamin C (mg)	18.3	±	10.4	16.6	±	13.0	0.304
Calcium (mg)	42.2	±	25.7	60.4	±	53.5	0.002
Iron (mg)	1.36	±	0.47	2.70	±	2.79	<0.001
Zinc (mg)	0.99	±	0.28	1.16	±	0.81	0.046

[1]Student's t-test by DCC attendance group

Table 4: Daily and percent of recommended daily intakes of energy and selected nutrients for Ghanaian children 2 to 5 y of age, by day care centre (DCC) attendance status

	Recommended daily intake[1]	Daily intake			% of recommended daily intake		
		DCC (n=104)	Non-DCC (n=89)	p-value[2]	DCC (n=102)	Non-DCC (n=86)	p-value[2]
		mean ± SD					
Energy (kcal)	1042[3]	1140 ± 320	878 ± 240	<0.001	109.1 ± 28.7	87.2 ± 23.4	<0.001
Protein (g)	12.2[4]	25.8 ± 8.8	22.1 ± 7.0	0.002	211.8 ± 68.0	188.2 ± 59.0	0.013
Fat (% of energy)	25 - 30[5]	20.8 ± 6.2	20.7 ± 8.0	0.866	73.2 ± 22.2	69.6 ± 26.7	0.310
Vitamin A (RE)	400 - 450[6]	950 ± 410	640 ± 440	<0.001	230.8 ± 102.5	156.6 ± 109.4	<0.001
Thiamine (mg)	0.5 - 0.6[7]	0.58 ± 0.22	0.45 ± 0.20	<0.001	110.3 ± 39.6	87.9 ± 40.6	<0.001
Riboflavin (mg)	0.5 - 0.6[7]	0.38 ± 0.12	0.34 ± 0.15	0.078	73.6 ± 25.1	68.6 ± 31.3	0.226
Niacin (NE)	6 - 8[7]	6.46 ± 2.43	5.87 ± 2.47	0.100	100.4 ± 35.4	94.8 ± 40.4	0.306
Vitamin C (mg)	30[7]	67.7 ± 22.0	58.4 ± 26.3	0.008	225.7 ± 73.4	194.7 ± 87.7	0.008
Calcium (mg)	500 - 600[7]	282 ± 139	244 ± 118	0.048	54.1 ± 25.7	48.0 ± 22.2	0.089
Iron (mg)	11.6 - 12.6[7,8]	12.4 ± 6.4	10.7 ± 4.7	0.048	105.1 ± 52.3	92.8 ± 39.5	0.076
Zinc (mg)	8.3 - 9.6[7,8]	4.59 ± 1.53	5.44 ± 2.14	0.002	63.4 ± 23.7	54.9± 17.9	0.006

[1]Ranges reflect requirements of different age groups
[2]Student's t-test by DCC attendance group
[3]Mean estimated requirement of group [20]
[4]Mean safe level of intake of group [21]
[5]Minimum end of Acceptable Macronutrient Distribution Range [23]
[6]Recommended safe intake [22]
[7]Recommended nutrient intake (RNI) [22]
[8]RNI based on low dietary bioavailability (5% for iron) [22]

Table 5: Multiple linear regression models[1] for energy, iron, zinc and calcium intakes for day care centre (DCC) and non-DCC children 2 to 5 y of age in rural Ghana

Variable	Energy (kcal)	Iron (mg)	Zinc (mg)	Calcium (mg)
Child				
Attends DCC	226**	-1.92**	-0.570**	
Weight (kg)	33**			
Dietary diversity (#)[2]	78**	-1.05*		
Animal source food intake (g)	3**	- 0.03*		
Fever in past 2 weeks	75*			36.8*
Energy intake (kcal)		0.01**	0.005**	0.2**
Still breastfed	-186**			
Household				
Involved in farming		-3.54**		
Caregiver				
Muslim[3]	123**	3.14**	0.692*	72.8**

*p<0.05, **p<0.01

[1]Individual multiple linear regression models - energy: n=186, adjusted R^2=0.413, p<0.001, iron: n=187, adjusted R^2=0.601, p<0.001; zinc: n=192, adjusted R^2=0.765, p<0.001; calcium: n=186, adjusted R^2= 0.417, p<0.001

[2]Score out of 10 (1 point was given for each of the following food groups: cereals and grains, roots and tubers, legumes, pulses and nuts, vitamin A-rich fruits and vegetables, other fruits and vegetables, dairy, meat and poultry, fish, egg, oils and fats)

[3]Compared to Christian, traditional and no reported religion

REFERENCES

1. **Jacoby E, Cueto S, and E Pollitt** Benefits of a school breakfast program among Andean children in Huaraz, Peru *Food Nutr. Bull.* 1996; **17**(1): 54-64.

2. **Caribbean Food and Nutrition Institute** Final Report for Reform of the Jamaica School Feeding Programme A Pilot Project, 2003.

3. **Murphy SP, Gewa C, Liang LJ, Grillenberger M, Bwibo NO, and CG Neumann** School snacks containing animal source foods improve dietary quality for children in rural Kenya. *J. Nutr.* 2003; **133**(11): 3950S-3956S.

4. **Ngatia EM, Ng'ang'a PM, Muita JG, and JK Imungi** Dietary patterns and nutritional status of pre-school children in Nairobi. *East Afr. Med. J.* 2005; **82**(10): 520-525.

5. **Rewal S**. Results of a School Lunch Programme in India. *Food Nutr. Bull.* 1981; **3**(4): 111-117.

6. **Jacoby ER, Cueto S, and E Pollitt.** When science and politics listen to each other: Good prospects from a New School Breakfast Program in Peru. *Am. J. Clin. Nutr.* 1998; **67**(4): 795S-797S.

7. **Powell CA, Walker SP, Chang SM, and SM Grantham-McGregor** Nutrition and Education: A Randomized Trial of the Effects of Breakfast in Rural Primary School Children. *Am. J. Clin. Nutr.* 1998; **68**(4): 873-879.

8. **Omwami EM, Neumann C and NO Bwibo** Effects of a school feeding intervention on school attendance rates among elementary schoolchildren in rural Kenya. *Nutrition*. 2011; **27**(2): 188-193.

9. **Rahmani K, Djazayeri A, Ibrahimhabibi M, Heidari H, Dorostimotlagh A, Pourshahriyari M and L Azadbakht** Effects of Daily milk supplementation on improving the physical and mental function as well as school performance among children: Results from a school feeding program. *JRMS*. 2011; **16**(4): 469-476.

10. **Whaley SE, Sigman M, Neumann C, Bwibo N, Guthrie D, Weiss RE, Alber S, and SP Murphy** The impact of dietary intervention of the cognitive development of Kenyan school children. *J. Nutr.* 2003; **133**: 3965S-3971S.

11. **Kristjansson B, Petticrew M, MacDonald B, Krasevec J, Janzen L, Greenhalgh T, Wells GA, MacGowan J, Farmer AP, Shea B, Mayhew A, Tugwell P, and V Welch** School feeding for improving the physical and psychosocial health of disadvantaged students. *Cochrane Database Syst. Rev.* 2007; (1) Art. No.: CD004676. DOI: 10.1002/14651858.CD004676.pub2

12. **Greenhalgh T, Kristjansson E and V Robinson** Realist review to understand the efficacy of school feeding programmes. *BMJ*. 2007; **335**(7625): 858-861.

13. **Colecraft E, Marquis GS, and R Aryeetey** Constraints on the use of animal source foods for young children in Ghana: A participatory rapid appraisal approach. *Ecol. Food Nutr.* 2006; **45**: 351-377.

14. **Colecraft E, Adjei GA, Lartey A, and GS Marquis** Contribution of animal source foods to total dietary iron intake of children in coastal Ghana. *FASEB J.* 2007; **21**: 672.6.

15. **Hulley SB, Cummings SR, Browner WS, Grady DG, and TB Newman** Designing Clinical Research. Lippincott Williams and Wilkins, Philadelphia, 2007.

16. **Eyeson K, Ankrah EK, Sundararajan AR, Karinpaa A, and JM Rudzka** Composition of foods commonly used in Ghana. Food Research Institute, Accra, 1975.

17. **Barikmo I, Ouattara F, and A Oshaug** Food Composition Table for Mali. Akershus University College, Oslo, 2004.

18. **Murphy SP, Beaton GH, and DH Calloway** INFOODS International Minilist. University of California, Berkley, 1993.

19. **Ferguson EL, Gibson RS, Opare-Obisaw C, Osei-Opare F, Stephen AM, Lehrfeld J, and L Thomson** The zinc, calcium, copper, manganese, non-starch polysaccharide and phytate content of seventy-eight locally grown and prepared African foods. *J. Food Compost. Anal.* 1993; **6**: 87-99.

20. **FAO** Human Energy Requirements. Report of a Joint FAO/WHO/UNU Expert Consultation Rome, 17–24 October 2001. FAO, Rome, 2001.

21. **WHO** Protein and amino acid requirements in human nutrition. WHO Press, Singapore, 2007.

22. **FAO/WHO** Human Vitamin and Mineral Requirements. Report of a Joint FAO/WHO Expert Consultation Bangkok, Thailand. FAO, Rome, 2001.

23. **Institute of Medicine** Dietary Reference Intakes for Energy, Carbohydrate, Fiber, Fat, Fatty Acids, Cholesterol, Protein, and Amino Acids. National Academies Press, Washington, D.C., 2005.

24. **Kennedy G and G Nantel** Basic Guidelines for Validation of a Simple Dietary Diversity Score as an Indicator of Dietary Nutrient Adequacy for Non-Breastfeeding Children 2-6 years. FAO, Rome, 2006.

25. **Arimond M and M Ruel** Dietary diversity is associated with child nutritional status: Evidence from 11 demographic and health surveys. *J. Nutr.* 2004; **134**(10): 2579-2585.

26. **Hatloy A, Torheim LE, and A Oshaug** Food variety - A good indicator of nutritional adequacy of the diet? A case study from an urban area in Mali, West Africa. *Eur. J. Clin. Nutr.* 1998; **52**(12): 891-898.

27. **United Nations** How to Weigh and Measure Children. United Nations, New York, 1986

28. **Kelley T** How many figures are significant? *Science.* 1924; **60**(1562): 524-524.

29. **Ferguson EL, Gibson RS, Opare-Obisaw C, Ounpuu S, Thompson LU, and J Lehrfeld.** The zinc nutriture of preschool children living in two African countries. *J. Nutr.* 1993; **123**(9): 1487-1496.

30. **Walker SP, Powell CA, Hutchinson SE, Chang SM, and SM Grantham-McGregor** School children's diets and participation in school feeding programmes in Jamaica. *Public Health Nutr.* 1998; **1**(1): 43-49.

31. **Creed-Kanashiro H, Respicio G, Cuba C, and B Benavides** La Mejor Compra: Una Estrategia de Educacion Nutricional para Obtener Maxima Nutricion a Menor Costo. XII Congreso Latinoamericano de Nutricion, Buenos Aires, 2000.