Addis Ababa University

College of Development Studies

Center for Food Security Studies

Food Security and Development Studies
PhD Program

Dissertation

Title

The School Feeding Program in Public Schools in Addis Ababa: its Impact on Nutritional Status and Educational Performance of Schoolchildren, Food Safety Knowledge and Practice of Kitchen Workers, and, other Socioeconomic Outcomes

By:

Zelalem Destaw

Supervisors:

Mogessie Ashenafi, Ph.D., Professor of Food Microbiology

Eshetu Wencheko, Ph.D., Professor of Statistics

Submitted to the Center for Food Security Studies in fulfillment of the requirements of the Degree of Doctor of Philosophy (PhD) in Food Security and Development Studies

September, 2021
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Approved by The Board of Examiners

This is to certify that the dissertation written by Zelalem Destaw Bayleyegn entitled "*The School Feeding Program in Public Schools in Addis Ababa: its Impact on Nutritional Status and Educational Performance of Schoolchildren, Food Safety Knowledge and Practice of Kitchen Workers, and, other Socioeconomic Outcomes"* and submitted in fulfilment of the requirements for the degree of Doctor of Philosophy (PhD) in Food Security and Development Studies complies with the regulations of the University and meets the accepted standards with respect to originality and quality.

Professor Mogessie Ashenafi		
Professor Eshetu Wencheko		
Supervisors	Signature	Date
Examiner	Signature	Date
Examiner	Signature	Date
Chairman	Signature	Date

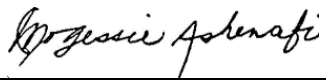
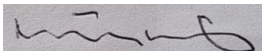
DECLARATION

I, the undersigned, declare that this dissertation entitled "The School Feeding Programs in Public Schools in Addis Ababa: its Impact on Nutritional Status and Educational Performance of Schoolchildren, Food Safety KAP of Kitchen Workers, and, other Socioeconomic Outcomes" is my original work and has not been presented for degrees in any other University, and that all sources of materials used for the study have been duly acknowledged.

Zelalem Destaw Bayleyegn

***Date of submission**: September 3, 2021*

This dissertation has been submitted for examination with our approval as a university supervisor.

Supervisors	Signature
Professor Mogessie Ashenafi	
Professor Eshetu Wencheko	

ACKNOWLEDGEMENT

It gives me great pleasure to express my deepest thankfulness to Prof. Mogessie Ashenafi, who was not only a supervisor to this research study, but also devoted his time, attention, and efforts relentlessly to raise me to the level of an independent researcher. I also thank him for his efforts to approach the Addis Ababa Mayor's Office to support this study. It is without overstatement that the quality and depth of the study was attributed to his motivation, fatherly encouragement and unreserved and relentless supervision from the conception to the completion of the research.

My honored thankfulness also goes to Prof. Eshetu Wencheko, who has not only guided me to strengthen and maintain the quality and robustness of the study design and statistical analyses of the research, but also devoted his unreserved efforts and time for the review of the whole volume of this dissertation.

This research study benefitted from the support of several institutions and individuals. I kindly acknowledge the following institutions and individuals for their financial and technical support.

Center for Food Security Studies (CFSS), Addis Ababa University, for writing support letters to Addis Ababa Education Office for funding and to other laboratories for technical support;

The College of Development Studies (CoDS), Addis Ababa University, for officially partnering with the Addis Ababa Health Bureau;

The Addis Ababa Mayor's Office for discussing our proposal with us, acknowledging its relevance, and encouraging the Addis Ababa Health Bureau for technical and financial assistances;

The Addis Ababa Health Bureau (AAHB) for funding the baseline stage, assigning health experts for data collection, supervising technical activities during fieldwork throughout all stages and securing funding from the Ministry of Health (MoH–Ethiopia) for subsequent stages;

The Ministry of Health (MoH–Ethiopia) for funding the subsequent stages of the study;

The Addis Ababa Education Bureau (AAEB) for writing support letter to sub city school departments and the target schools and facilitating data collection in the schools;

The Food Science and Nutrition Research Directorate (FSNRD) of the Ethiopian Public Health Institute (EPHI) for providing food scale to weigh food samples;

The Institute of Biotechnology (CNCS, AAU) for allowing moisture content determination of school meal samples in its laboratory.

I am thankful to Mrs. Askale Teklu and Mr. Mesfin Mekuria, of the World Food Program, Ethiopia Country Office (WFP–Ethiopia), for providing me with the relevant documents and information that helped conceptualize this research.

I am grateful to Dr. Mesay Mulugeta (CFSS/AAU), Dr. Meskerem Abi (CFSS/AAU), and Bichaye Tesfaye (CFSS/AAU) for writing support letters whenever required. I express my deepest gratitude to Dr. Dilu Shaleka (dean, CoDS/AAU), for institutionalizing the research agreement between the AAHB and the CoDS, AAU.

I am also grateful to Dr. Yohannes Challa (Head, AAHB) for accepting our proposal enthusiastically and giving directions for a successful collection of the required data.

My wonderful appreciation and thankfulness go to Dr. Samuel Zemenfeskidus (Deputy Head, AAHB), for fully acknowledging the importance of the research, working during the implementation of the research, searching for additional fund from the Ministry of Health, and commenting on the research implementation and reports.

I would like to thank Mr. Melkamu Tiruneh (AAHB) for resolving technical and procedural activities at the Addis Health Bureau that were vital in implementing the fieldwork.

I also provide my sincere appreciation to Mr. Zelalem Mulatu (Head, AAEB), for receiving positively our call to the AAEB to technically support the implementation of the research.

I thank Mr. Nebyou Baye (AAU) for helping to bring the research idea to the attention of the Addis Ababa Mayor's Office during the time of search for fund.

My special thanks go to Ms. Meti Tamrat (AAEB), coordinator of the Addis Ababa School Feeding Program, for helping immensely at the beginning by providing invaluable information and clarifications about the Addis Ababa SFP, and assisting in technical issues that were backbone for the fieldwork. She was enthusiastic about the implementation of this research and believed that the results of the research would inform the program for an effective implementation and sustainability.

I am also very grateful to Mr. Ephrem Lemma (AAEB) for his technical assistances at the Addis Ababa Education Bureau for effective communications among the sub cities and target schools.

I sincerely thank Mr. Mekuanent Dagnew, from the Emergency School Feeding Program of the Ministry of Education – Ethiopia (MoE/WFP), for his guidance and provision of materials that were relevant to conceptualize this research.

My great appreciations go to the Addis Ababa Sub-cities' Health Offices, Addis Ababa Sub-cities' Education Offices, medical directors of health centers, school directors and teachers, women cooperatives or the kitchen workers, and parents and schoolchildren who gave consents to participate whenever required and others who contributed for the successful deliberation of the data collection without hesitation.

Lastly, I would like to express my heartfelt thanks to the health experts who regularly participated in data collection throughout the two-year long cohort study.

Zelalem Destaw Bayleyegn
Addis Ababa University
Addis Ababa, Ethiopia
September, 2021

Dedicated to my mother, Mrs. Yamrot Endayehu.

I did it that you wanted see me do it!

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Acronyms

AUC	African Union Commission
BAZ	BMI-for-age Z score
BMI	Body Mass Index
EiE	Education in Emergency
ESFP	Emergency School Feeding Program
FFE	Food for Education
FGD	Focus Group Discussion
GoE	Government of Ethiopia
HACCP	Hazard Analysis Critical Control Point
HAZ	Height-for-age Z score
HGSF	Home Grown School Feeding
KII	Key Informant Interview
MoE	Ministry of Education
MUAC	Mid Upper Arm Circumference
MUACZ	MUAC-for-age Z score
NDRMC	National Disaster Risks Management Commission
NGO	Nongovernmental Organization
NSA	Nutrition Sensitive Agriculture
NSAS	Nutrition Sensitive Agriculture Strategy
NSHNS	National School Health and Nutrition Strategy
RNI	Recommended Nutrients Intake
SDG	Sustainable Development Goal
SFP	School Feeding Program
SHN	School Health and Nutrition
SNNPR	Southern Nations Nationalities and Peoples Region
UNECA	United Nations Economic Commission for Africa
WASH	Water, Sanitation and Hygiene
WAZ	Weight-for-age Z score
WFP	World Food Program

List of publications

Articles accepted

1. Destaw, Z., Wencheko, E., Kidane, S., Endale, M., Challa, Y., Tiruneh, M., . . . Ashenafi, M. (2022). Impact of School Meals on Educational Outcomes in Addis Ababa, Ethiopia. *Public Health Nutrition*, 1-31. https://doi:10.1017/S1368980022000799.
2. Destaw, Z., Wencheko, E., Kidane, S., Endale, M., Challa, Y., Tiruneh, M., . . . Ashenafi, M. (2022). School feeding contributed valuable dietary energy and nutrients despite suboptimal supply to school-age children and adolescents, in primary schools in Addis Ababa, Ethiopia. *Nutrition* (Accepted).
3. Destaw, Z., Wencheko, E., Zemenfeskidus, S. et al. Use of modified composite index of anthropometric failure and MUAC-for-age to assess prevalence of malnutrition among school-age children and adolescents involved in the school feeding program in Addis Ababa, Ethiopia. *BMC Nutr* **7**, 81 (2021). https://doi.org/10.1186/s40795-021-00471-x.
4. COVID-19 and the Addis Ababa School Feeding Program: Socioeconomic effects on schoolchildren and school kitchen workers (*Journal of Environmental Science and Public Health*).

Submitted Articles

1. Study protocol: The School Feeding Program in Public Schools in Addis Ababa – Impact on Nutritional Status and Educational Performance of Schoolchildren, Food Safety Knowledge and Practice of Kitchen Workers, and, other Socioeconomic Outcomes (*MethodsX*)
2. Effect of School Meals on nutritional status of schoolchildren: Empirical evidence from longitudinal anthropometric measurement (*Journal of Nutrition*)
3. COVID-19 and school feeding: prevalence of acute malnutrition among schoolchildren based on longitudinal analysis of MUAC-for-age Z-scores and qualitative findings (*Journal of Public Health*).

Summary

Food-insecure schoolchildren in low-income countries lose school days due to malnutrition, common viral and gastrointestinal diseases, anemia and hunger. School Feeding Programs (SFP) have been a social protection strategy that mainly target food insecure primary schoolchildren to alleviate problems related to malnutrition and improve educational outcomes, cognitive skill and nutritional status. The Addis Ababa SFP was established on February 2019, to alleviate hunger in schoolchildren for better nutritional and educational outcomes. To evaluate the impact of the program on nutritional status and school performance of schoolchildren, a baseline assessment was required at the initiation of the program with which comparisons will be made through repeated measurement during the implementation of the program. Thus, changes in nutritional and educational outcomes can be captured and the socioeconomic implications of the program, the dietary quality and adequacy of meals, as well as school water, sanitation and hygiene (WASH) and food safety issues will be understood.

The main objective of this study was to investigate the impact of the Addis Ababa SFP on nutritional and educational outcomes, the school WASH and food safety knowledge and practice of kitchen workers, and other socio-economic implications. A single-group repeated measurement/longitudinal study design was employed to follow up randomly selected 4500 students in 50 schools in all sub-cities. Multistage stratified sampling was used. Statistical methods – repeated measures ANOVA, random effects GLS regression, mixed effects regression, Confirmatory Factor Analysis, and Structural Equation models and others were employed where relevant.

Robust evidence was established that the school feeding intervention has achieved medium to large scale effects on nutritional status (effect size, η^2, of 0.02–0.12) and educational outcomes with effect sizes (η^2) of academic scores (boys = 0.023, girls = 0.04) and enrollment (girls = 0.001 and boys = 0.05), and attendance (Cramer's V = 0.2). On average, schoolchildren were served 883 calories of energy, daily, which was about 48% or 34% of the daily Recommended Nutrient Intake (RNI) for early adolescent schoolchildren of age 7–12 years or late adolescents of age 13–17 years, respectively. However, the meals provided below the RNI of energy. Daily RNI of macronutrients such as protein (46–66.3%), carbohydrate (including fiber) (48.3–68.1%), fats (20.5–25.7%), and fiber (68.4%) were below the WFP's recommendations. Micronutrients such as Thiamine (60.9% RNI), Riboflavin (43.5% RNI), Niacin (21.7% RNI), and Phosphorous (50.7% RNI) were served below daily recommendations. Calcium (82.5% RNI) and Iron (151% RNI) were served above the daily recommended level. Poor food safety knowledge (52.3%) and attitude (47.2%) resulted in poor food safety practice (36.2%) among kitchen workers. Basic services of drinking water, sanitation, and hygiene were delivered in 36 (73.5%), 14 (28%), and 31 (64.6%) of the schools surveyed for school WASH, respectively. Food safety practice in school kitchens and overall basic school drinking water, sanitation and hygiene services (school WASH) were low. Economic and psychosocial effects were grand socioeconomic effects of the SFP whereby negative psychosocial effects linked with economic inequalities were mitigated. The long school-, summer or semester-breaks, led schoolchildren to miss school meals which significantly compromised nutritional outcomes. Disruption of school meals due to COVID-19 shutdown increased malnutrition among the schoolchildren; largely reduced income of kitchen workers that could worsen the food insecurity situation in their households.

The Addis Ababa SFP has substantial contribution to the physical growth, educational, and socioeconomic benefits, while more effort is required to improve nutritional quality and adequacy.

Chapter I: General Introduction

Introduction

Background

Childhood malnutrition is associated with poor dietary consumption and unsafe food due to improper food handling, poor personal hygiene and inadequate sanitation (Jukes et al., 2007). According to Jukes *et al.* (2007), schoolchildren in low-income countries lose school days due to malnutrition, common microbial infections, worm infections, iron deficiency, hunger and others. Children of food insecure families suffer from hunger in school (Drake et al., 2020; Jukes et al., 2007). They attend class with empty stomach resulting in less or no attention and active participation in the classroom. Less enrollment, less attendance in class and high dropout rates are commonly observed as a result of food insecurity. School Feeding Program (SFP) has been an important intervention in order to protect children from hunger during school days (Drake et al., 2020).

In order to overcome loss in school days due to common health problems such as microbial and parasitic infections, anemia and hunger, several countries implement SFP as intervention (Bundy et al., 2009). In addition, worldwide, SFPs are aimed to focus on nutritional values, mainly contents of diet such as protein and energy for child body growth and maintenance, micronutrients, and vitamins that facilitate metabolic processes and prevent nutritional diseases (WFP, 2020b).

On the other hand, personal hygiene of food handlers and food handling practices during food preparation and consumption are other major concerns which, if not properly managed, may expose ready-to-eat food to contamination that will result in infection of schoolchildren with foodborne diseases. The diarrhea → malnutrition → diarrhea vicious cycle is a major factor that adversely affects child health, growth, and cognitive development (Jaffee et al., 2019; WHO, 2006a).

SFP has been a social protection strategy that mainly targets primary schoolchildren (WFP, 2019a). In some cases, secondary schoolchildren could be candidates for SFP (Babu and Hallam, 1989). Globally, there are a number of initiatives of school feeding with multi-sectoral interventions.

School feeding in the Global context

World Food Program (WFP) supports school feeding programs in 71 developing countries, of which 18.3 million children in 60 countries were directly provided with school meals (WFP, 2019a).

In 65 countries indirect support is made to school feeding programs that benefit 39 million more children. Program provisions vary in time such that some provide breakfast or lunch and some others provide both. Type of food also ranges from provision of complete meals to distribution of fortified, high-energy biscuits or nutritional snacks (WFP, 2019a). Conditional to regular school attendance of children, the program has a practice of supporting families with food and/or cash rations (Bundy et al., 2009; WFP, 2013, 2019b).

SFP was shown to contribute to social economies through local smallholder farm production and employment of youth caterers, while also ensuring community ownership through participation of local communities in different forms (WFP, 2013).

SFP is the only and largest social protection program that provides intervention for a number of benefits such as strategic objectives for education, gender equality through attracting both boys and girls to schools, food security, nutrition and health, local agriculture, and poverty alleviation (Bundy et al., 2009; Drake et al., 2017; WFP, 2013, 2019b). Its target includes minimizing school dropout rate, absenteeism, poor academic performance, cognition and learning. It is also a famous program for its double effects as a long-term social protection investment and a short-term productive safety net for schoolchildren and their families (Bundy et al., 2009; Drake et al., 2017; WFP, 2013, 2019b).

Cereal-based food baskets have been accepted and significantly provided in most of implementing countries (Bundy et al., 2009; Drake et al., 2017; WFP, 2000, 2013). It is also emphasized that calorie needs are given prior attention in order to provide children with meals having adequate energy for their daily requirements in the school. However, less attention has been given to micronutrient content of meals.

In most program implementing countries, the approaches are based on strategic focus, with education as having priority over agriculture and health (Drake et al., 2017). Moreover, the major approach of the majority of the countries is towards all children (universal) and the most vulnerable communities identified on the basis of geographic metrics (Drake et al., 2017; WFP, 2000, 2013). In the former approach, the targeting would have inevitable tradeoffs such as cost, effectiveness and equity. Whereas, in the latter case, stigmatization could be attached to those targeted individuals.

Feeding modalities vary across countries. These include, on-site feeding, take-home rations, or a mixed mode of provisions during school days (Buttenheim et al., 2011). Recently, there are practices that deliver school meals over weekends. In the United States, food insecure children receive weekend feeding which improved educational outcomes, albeit, its premier aim is to alleviate food insecurity (Fiese et al., 2020). The Addis Ababa SFP provides on-site breakfast and lunch during school days (AAEB, 2019).

In the context of global definition of food and nutrition security (FAO, 1996), it is vital to evaluate whether school feeding is a program that enables all vulnerable schoolchildren to access and consume sufficient, safe, nutritious and socially acceptable food at all times to lead an active and healthy school life.

School feeding in Ethiopia

WFP started SFP in Ethiopia since 1994 that targeted food insecure, drought-hit and conflict-affected rural areas (WFP, 2019b). Later on, Ethiopia scaled up running two national school feeding programs, regular and emergency school feeding (MoE, 2018; WFP, 2019b). The Emergency School Feeding Program (ESFP) has begun in 2015 by the Ministry of Education (MoE) and the National Disaster Risks Management Commission (NDRMC) for a number of children in need of Education in Emergency (EiE) support due to deprivations consequent to disasters such as drought (MoE, 2018; WFP, 2019b).

The Food for Education program of WFP Ethiopia country office supports the Education Sector Development Plan through a community-based education system. The system is linked with school feeding and planning and implementing school activities aimed at better education outcomes, local development, environmental sustainability, family wellbeing, and food security situations in the community (Swindale and Bilinsky, 2006).

Since 2015/16, the Government of Ethiopia (GoE) has been allocating large amount of budget in support of about 2.9 million schoolchildren in 6742 schools (2015/16); 1.4 million schoolchildren in 3024 schools (2016/17) and 2.1 million schoolchildren in 4,416 schools (2017/2018) who required EiE support (MoE, 2018; WFP, 2019b). Totally, the intervention areas of ESFP in the three consecutive years, were found in all of the Administrative Regions except Addis Ababa. Benishangul region was included in the program later in 2017/18 (MoE, 2018; WFP, 2019b) (Table 1).

Table 1: Distribution of ESFP intervention schools by year and region

No.	Region	Number of Intervention Schools by Year			Number of Targeted Schoolchildren by Year			Number of School Children Receiving Food by Year		
		2015/16	2016/17	2018	2015/16	2016/17	2018	2015/16	2016/17	2018
1	Oromia	2,112	1,093	2,120	925,782	404,969	1,015,126	976,813	469,231	504,391
2	Amhara	2,068	475	526	844,429	171,655	236,730	988,471	219,374	203,395
3	SNNPR	458	653	563	279,460	310,306	400,751	321,685	409,335	225,957
4	Somali	692	264	446	197,205	126,904	246,401	168,085	130,802	246,401
5	Tigray	675	103	176	268,831	45,375	82,277	303,509	45,876	110,435
6	Afar	653	413	540	92,983	52,828	58,665	93,904	56,217	58,665
7	Harari	46	24	19	14,358	6,811	6,200	14,497	13,345	3,400
8	Dire Dawa	38	13	13	18,397	3,707	5,353	19,076	4,364	2,400
9	Benishangul	-	-	10	-	-	2,864	-	-	3,052
10	Gambela	-	-	3	-	-	1,256	-	-	2,500
	Total	**6,742**	**3,038**	**4,416**	**2,641,445**	**1,122,555**	**2,055,623**	**2,886,040**	**1,348,544**	**1,360,596**

Source: MoE, 2018

WFP (2019b) and MoE (2018) reported that positive educational outcomes, enrollment, attendance, concentration, and dropout rates were registered as a result of the emergency interventions. According to these reports, local procurement strategies and jobs created had contributed to the local economies benefiting 40 farmer cooperative unions through aggregating, processing and supplying food. In addition, about 45,000 poor women and youth were offered job opportunities.

In general, there are Home-Grown School Feeding (HGSF), non-HGSF (or Traditional School Feeding - TDF), and Emergency School Feeding Program (ESFP) run in Ethiopia (GCNF, 2019). HGSF is a program that offers food produced by local producers by linking SFPs to local production and development (Sumberg and Sabates-Wheeler, 2011). Whereas non-HGSF (TDF) program is delivery of free school meals in kind from foreign food sources (GCNF, 2019). ESFP is a program where the MoE-Ethiopia delivers free school meals (porridge) in drought-hit rural areas, prepared from purchased domestic food commodities such as fortified grains/cereals, legumes and nuts, salt and oil (GCNF, 2019).

The regular SFP of Ethiopia has been implemented since 1994 in rural parts of all regions (MoE, 2018; WFP, 2019b). Undocumented stories tell that school feeding begun during the regime of Emperor Haile Sellassie concurrent to the introduction of modern schools in Ethiopia (Dagnew, 2015). WFP initiated the 1994 SFP by providing hot meals for about 250,000 children in forty schools (MoE, 2018; WFP, 2019b). The program has been progressively growing over the years. In 2002, take-home rations have been provided to 9734 school girls in Oromia, Afar, and Somali

regions, conditional on attendance (MoE, 2018; WFP, 2019b). A Home-Grown School Feeding (HGSF) program has been launched in 2012 in 37 pilot schools of SNNPR and later on expanded to Oromia region within 88 schools targeting about 18,000 schoolchildren in 2015. The program covered 856 schools in 2017 (MoE, 2018; WFP, 2019b).

Overall, a huge amount of investment is being devoted each year to feed food insecure schoolchildren in Ethiopia. Figure 1 and Table 2 below show summary of distribution of the program by gender and region, across years, respectively. It shows the trend of the number of beneficiary students in Afar, Amhara, Oromia, SNNPR, Somali, and Tigray for the years 2012 – 2014 and the data does not show any school participating from Amhara and Tigray regions for the rest of the years.

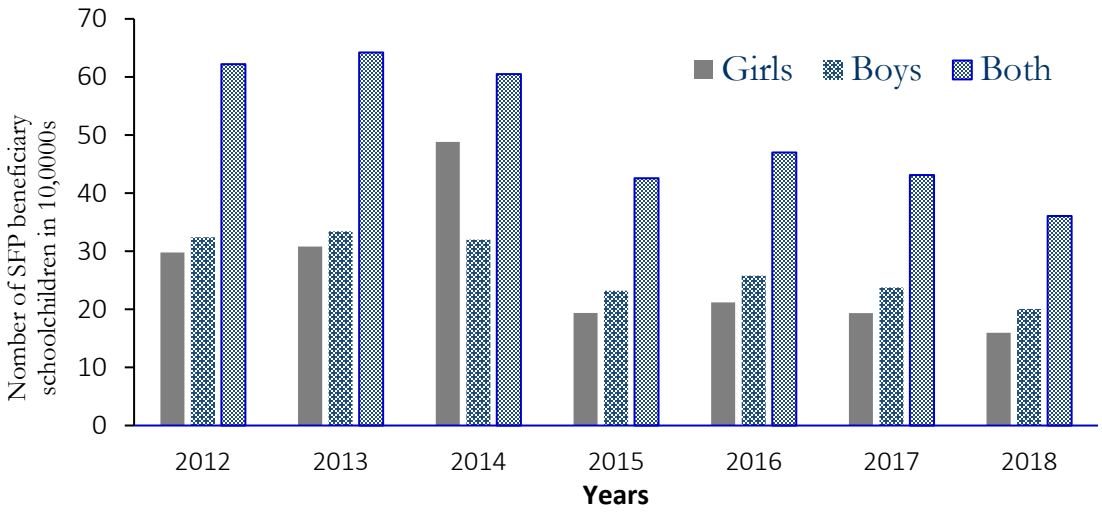

Figure 1: Number of boys and girls participated in SFP in Ethiopia each year
Source: Computed from WFP Ethiopia country office routine data.

A varying number of schoolchildren have been supported by regular SFP set by WFP Ethiopia between 2012 and 2018, (Table 2).

Table 2: Number of SFP beneficiary schools from 2012 – 2018, by region

Region	2012	2013	2014	2015	2016	2017	2018	Total
Afar	354	354	360	361	361	361	249	2,400
Amhara	124	124	79	0	0	0	0	327
Oromia	217	217	208	153	169	89	481	1,534
SNNPR	94	94	202	193	202	197	197	1,179
Somali	229	229	229	229	229	229	0	1,374
Tigray	146	146	102	0	0	0	0	394
Total	**1,164**	**1,164**	**1,180**	**936**	**961**	**876**	**927**	**7,208**

Source: Computed from WFP Ethiopia country office routine data

The WFP routine data also showed that there were HGSF, Non-HGSF/TDF and ESFP schools, where SNNPR and Oromia regions covered their major SFP using the HGSF approach. Food commodities provided by WFP (2000) for the traditional school feeding program included imported:

- Cereals: maize (whole or meal), wheat flour, bulgur wheat, sorghum or rice
- Pulses: beans, lentils or peas
- Canned fish or meat
- Vegetable oil
- Sugar
- Fortified blended foods (BF) such as Corn Soy Blend (CSB)
- Fortified biscuits.

However, WFP did not provide foods such as fresh foods and condiments, which were indispensable for meal diversity and palatability, but left to local procurement through Government funds or another alternative (WFP 2000).

There were other SFPs initiated by different NGOs and individuals. In Addis Ababa, for instance, 21,043 students have been provided with school meals by *Ye Enat Weg Charitable Association* in 210 primary schools since 2015 (Ye Enat Weg, 2018). Save the Children provided 17,800 students with SFP in Afar and Somali regions while WFP delivers the support for 9800 students in Afar region in 78 schools (MoE, 2018; WFP, 2019b). The reports also showed that many other small NGO's and individuals provide school feeding program in different places.

However, there is an immense gap and need to generate data on effect of SFP on improvement of nutritional status of schoolchildren, which consequently affects educational outcome. Moreover, information is scanty on food safety practices, which affect health and nutrition of schoolchildren, and other socioeconomical benefits that emanate from SFP.

School feeding in Addis Ababa

In Addis Ababa, different NGOs and individuals initiate SFPs. For instance, *Ye Enat Weg Charitable Association*, provide school meals for 21,043 students in 210 primary schools since 2015 (Ye Enat Weg, 2018). The Addis Ababa City Administration launched a wider school feeding program in February 2019, that was intended to alleviate hunger among poor schoolchildren, improve their attendance, minimize rates of dropout and repeaters and, ultimately, enhance educational performances of students (AAEB, 2019).

Though, previously, school meal provisions had been underway in some schools by charitable societies and other stakeholders (AAEB, 2019), the program initiated by the City government involved about 51, 689 schoolchildren, at the beginning, in 221 public schools distributed over ten sub-cities of Addis Ababa (AAEB, 2019).

However, there is little information available on the nutritional status of school-age children and adolescents involved in the Addis Ababa school feeding program.

Research problem

Nutrient contents of school meals and meal size are important issues that determine quality and quantity of nutrients a school child obtains from the meals. Nutrients provide protein energy, enhance food metabolism efficiency, and have disease prevention capacity that inhibit children's normal growth and cognitive development (FAO and PAHO, 2017).

Safety of food is determined by food handling during preparation and storage; personal hygiene of food handlers and sanitation of water used for preparation and cleaning. Proper school feeding activities avoid food contamination and protect schoolchildren from infection by foodborne diseases-causing organisms. Therefore, food safety knowledge and practice of food handlers working in school kitchen; and water, hygiene and sanitation within the school compound can protect schoolchildren from foodborne disease outbreaks that need to be assessed for an improved delivery of the food program.

The adequacy of protein, energy, minerals and vitamins, available in school meals determine diversity of food and meal size. However, their ability to satisfy nutritional requirements of schoolchildren across their age groups need to be addressed.

Hunger in schools is one of the challenges for schoolchildren in low-income countries responsible to lose school days, low enrollment, and high dropout rate (Drake et al., 2020; Jukes et al., 2007). As a result, SFP has been recognized as an important intervention in order to protect children from hunger during school days (Drake et al., 2020). Thus, educational outcomes including enrollment and performance are among the primary objectives of SFP by avoiding hunger in schools and pledge food security (Drake et al., 2017).

SFP has been acknowledged as the largest social protection intervention to fulfil some part of the socioeconomic issues in the society (Drake et al., 2017). To this effect, initiatives to make schools centers for local development through community participation in the program are implemented (Molinas and Regnault de la Moth, 2010; Swindale and Bilinsky, 2006).

Few studies reported positive impact of school feeding program on school enrolment, attendance, cognitive skill, economic benefits to community and smallholder farmers productivity (Drake et al., 2017; WFP, 2013). However, the evaluation was based on simple descriptive analysis that presented results as cross tabulations and simple graphs. In-depth analysis, using advanced impact evaluation techniques, such as comparison of means, propensity score matching, difference in

difference, instrumental variable has not been applied which would limit the validation and unbiasedness of the findings and conclusions derived from them (Babu et al., 2017; Gertler et al., 2010).

Few researchers, on the other hand, reported that worldwide, despite the huge investment and intervention, SFP has not effectively achieved its objectives. Babu and Hallam (1989) reported that SFP did not achieve significant relevance or reduction of inequality in protein intake because the food types provided were cereals; and Bundy et al. (2018) argued that, despite the benefit against hunger for schoolchildren, Feed for Education (FFE) programs lacked nutritional benefit. Babu *et al.* (2017), after reviewing several researches findings worldwide that evaluated effect of SFP in several countries, stated that there was narrow evidence in support of effective SFP in most of program implementing countries (Babu et al., 2017).

A critical assessment of evidences on school feeding in developing countries observed that studies usually suffered from methodological shortcomings which would again introduce bias in their findings and conclusions (Adelman et al., 2008). The methodological gap was mostly associated with the study design, where, for instance, studies argued for field trials to bolster findings, but did not comply with critical requirements of randomization and trial group specifications (Adelman et al., 2008).

In Ethiopia, knowledge about overall effectiveness of SFP program, the extent of coverage and its socioeconomic effect are limited and evidence that informs impacts of the program is thin. Very few comparative impact assessments are available. A study on the impact of SFP on school participation in *Sidama* zone of Southern Ethiopia, for example, reported that the impact of SFP on school enrollment, attendance, and dropout was insignificant (Dheressa, 2011).

In contrast, a study on impact of SFP in Ethiopia carried out by WFP in collaboration with the University of Mannheim covering 200 schools in four regions, showed that SFP had positive effect in enrollment and educational outcomes of boys in highland communities but did not help boys from the pastoralist's communities (Poppe et al., 2019).

Limitation of data, particularly baseline data, supportive routine data on program implementation, and midterm impact evaluation are some of the challenges to study effectiveness of SFP in Ethiopia. Specifically, Ethiopia's SFP requires "School Nutrition Data System" that supports

monitoring and program evaluation on its effect on enrollment, attendance, drop-out rates, dietary quality and adequacy, etc.

In addition, despite its being a multipurpose social protection intervention, impact of SFP has not been well investigated, is less understood and little has been known about nutritional outcomes, food diversity and meal composition and size, food safety, water, hygiene and sanitation. Its socio-economic effect is also less understood. These limitations make it difficult to, among many, identify success and failure of the program, target appropriate beneficiaries, assess nutrition and food security, evaluate job opportunities created to community and households, determine income growth and poverty reduction, and boost potentials of smallholder farmers. To effectively achieve the intended objectives of this study, a multidisciplinary approach is required to study SFP in Addis Ababa public schools. As SFP is a broad social protection program, the approach should include nutritional outcomes of SFP, food safety and knowledge and practice of food handlers, educational outcomes of schoolchildren and its socioeconomic implications to the community.

Objectives

Main objective

The main objective of the study was to assess the effect of the Addis Ababa School Feeding Program.

Specific objectives

I. Nutritional impact on schoolchildren
    a. Examine nutritional status of schoolchildren who were benefitting from the Addis Ababa School Feeding Program using anthropometric measurements based on baseline data at initiation of the program.
    b. Assess the effect of the Addis Ababa School Feeding Program on children's physical growth using longitudinal anthropometric measurements

II. Examine quality and adequacy of dietary supply in SFP
    a. Examine dietary energy and macro and micro-nutrients contents of school meals using food composition table for use in Ethiopia.

III. Impact on educational performance, attendance and enrollment
    a. Examine enrollment rates of primary schools before and after SFP has been started.
    b. Examine attendance rates of beneficiary children before and after SFP has been started.
    c. Examine short-term impact of SFP on academic performance of beneficiary children before and after SFP has been started.

IV. School WASH and Food safety in school feeding programs
    a. Knowledge, Attitudes and Practices (KAP) assessment in personal and environmental hygiene, water sanitation and food handling practices in schools

V. Impact on other socio-economic issues
    a. Examine impact of the Addis Ababa School Feeding Program on income of kitchen workers
    b. Assess socioeconomic effect of interruption of SFP due to COVID-19 pandemic.

Research Hypothesis

The hypotheses in this study were

i. School feeding program improves the nutritional status of children
ii. School meals contain the recommended daily requirement of dietary energy
iii. School feeding program has positive impact on educational outcomes
iv. Kitchen workers may have the requisite knowledge, attitude and practices on food safety measures
v. School feeding program has positive socioeconomic effects or implications for women cooperative and schoolchildren.

Significance of the study

This study would provide evidence about the effect and gaps associated with school feeding programs that would expedite performance and effectiveness of the program by maintaining provision of safe and nutritious food to schoolchildren for an active and healthy life and normal physical growth. The findings about the changes in academic performance of schoolchildren and improved income of women participating in food preparation would point out weaknesses and strengths of the program, which, in turn, will help to improve its effectiveness in the future.

Limitations and Scope of the study

Although it was attempted to consider all sub-cities of Addis Ababa, the study is limited to randomly selected five public primary schools per a sub-city and a proportion of schoolchildren therein. The scope of the study, however, comprehensively covers all issues of the pillar 'use and utilization' important to assess the contribution of Addis Ababa SFP to food and nutrition security of schoolchildren.

Outline of the dissertation

This dissertation follows the following outline. Literature review and methods of the whole research project are presented in section Two and Three of the current chapter. Chapter II presents nutritional effect of the Addis Ababa school feeding program on school-age children and adolescents. In chapter III, dietary quality and adequacy of meals provided in the Addis Ababa School Feeding Program is discussed. Chapter IV deals with Impact of School Feeding on Educational Outcomes of schoolchildren. Chapter V discusses about school WASH, Food Safety Knowledge, Attitude and Practice (KAP) among Kitchen workers of the Addis Ababa Primary Schools' Feeding Program. Chapter VI deals with Socioeconomic implications of the Addis Ababa School Feeding Program. Finally, synthesis of the research is presented and conclusion and recommendations are provided.

Literature review

Global and regional contexts

School feeding refers to providing food to schoolchildren in schools (Drake et al., 2017). Schools, initially, were thought to be convenient sites to distribute food while, later on, interest developed to maximize its impact on education and human development (Verguet et al., 2020).

Globally, good practices have been gained from multiple means of participation (Drake et al., 2017). Organizing farmers, smallholders, by providing complementary grants so as to enhance HGSF practice helped countries to improve yield, quality and safety across the food supply chain. In this case, the program benefit is spilled over to smallholders in their livelihood through acquisition of income and skill (WFP, 2013).

In Armenia, SFP contributed noticeable welfare outcome among people under extreme poverty or comparatively strong social aversion to inequality backing its social protection role (Bakhshinyan et al., 2019).

In the United Kingdom, the socioeconomic benefit of a school foods for school canteens and others is well documented (Morgan and Sonnino, 2013). In the United States, food insecure and marginally food secure children often attend schools that offer breakfasts, universal free meals, or afterschool snacks and suppers (Forrestal et al., 2021).

An assessment of multisectoral benefits of SFPs showed that multiple folds of returns can be achieved compared with returns of public health alone (Verguet et al., 2020). The assessment concludes that SFPs are potentially cost-beneficial from its multisectoral perspectives.

Households get the room to save their daily cost of meals per school-going children, and in some cases, they enable to utilize wages to other nonfood expenditures (Babu et al., 2017). In Brazil, SFP's motivated school food shopping supported by market policy resulted with socioeconomic impacts that promoted rural development (Elias et al., 2019).

Home grown School Feeding (HGSF) in Ethiopia has been on pilot in the South since 2012 (WFP, 2019b). Its target was boosting smallholder farmers' income through stimulating demand in the market under the Purchase for Progress (P4P) program that capitalizes on the existing farmers' cooperative unions (WFP, 2019b). According to the WFP, this approach has built capacity of

smallholder farmers including production diversification, bargaining power in the market, and commodity accumulation (WFP, 2019b).

Theoretical literature

Childhood nutrition

Childhood nutrition is vital for healthy physical growth and mental development of children while poor nutrition may expose children to long-term negative consequences, such as impaired health and cognitive development, economic performance, maternal reproductive outcomes, later in life (Ampaabeng and Tan, 2013; Dewey and Begum, 2011; Soliman et al., 2021). As a result, in order to maintain health and normal growth, children should get sufficient nutritious diet in order to achieve their recommended dietary requirement such as protein, carbohydrate, fats, vitamins and minerals in the required amounts. The Recommended Dietary Allowance or Amount (RDA) is a widely used reference that suggests the amount of macro- and micro-nutrients or food substances needed for a healthy childhood (Wiseman, 2003).

Nutritional status of children can be assessed in many ways. Often used assessment methods are anthropometric methods, dietary methods, laboratory methods, clinical methods, and ecological factors (Gibson, 2005).

Those measures of nutritional status can also be used as proxies of health status as they are associated with maintaining health or reduction in the risk of chronic diseases (Gibson, 2005). Detailed explanation about each of these methods and associated indices and indicators, advantages and limitations, assessments of macronutrients and micronutrients statuses, and others can be found in Gibson (2005).

This study used anthropometric and dietary methods to assess the schoolchildren's nutritional status.

Nutrition and education

Nutrition is also linked to education in different ways. For instance, child health and nutrition are strongly associated with educational achievement (Behrman, 1996), and gains in nutrition might improve educational attainment, academic achievement, and future welfare of children (Alderman and Bundy, 2012). However, associations do not necessarily indicate cause and effect relationship (Behrman, 1996).

Primary school-age children are in state of substantial mental, physical and behavioral growth and development. They need abundant energy supply from carbohydrates, other nutrients for physical growth and development from proteins, and minerals and vitamins that facilitate metabolism and disease prevention (Wiseman, 2003).

Behrman (1996) argues that claiming effect of school nutrition on children's achievement and cognitive development would be simplified if, on one hand, health status affects cognitive achievement and not that children with higher achievement take better care of their health. On the other hand, if the observed indicators such as test scores are not correlated with unobserved variables such as parental involvement that may affect achievement.

Food safety, hygiene, sanitation and food handling

Food safety refers to handling, storing and preparing food in a manner that avoids contamination of food by physical, chemical or biological contaminants. The most common and important contaminants are biological one consisting of bacteria, viruses, or parasites. Food safety measures avoid contamination of food with disease-causing organisms or eliminate them from foods altogether. Conversely, unsafe food and water imply that food has been exposed to organisms that may cause infectious diseases such as food borne diseases. Food safety and control systems have developed along with better understanding of foodborne hazards (FAO and PAHO, 2017).

Food security is attained only when diet is safe to eat. Unsafe food undermines food and nutritional security and human development (Jaffee et al., 2019). More specifically, schoolchildren highly suffer from the diarrhea-malnutrition-diarrhea vicious cycle, that usually is an outcome of contaminated food, poor sanitation, and use of unsafe water (WFP, 2000). It requires proper actions among stakeholders including farmers, food handlers and distributors, food manufacturers, food service operators, consumers, regulators, scientists, educators, and the media (Jaffee et al., 2019).

Food-borne diseases (FBDs) are among the most frequent public health problems in daily life that may occur in the different stages of the food chain: from the point of primary production to the dining table (FAO and PAHO, 2017). Lapse in food safety control at any point in the food chain could result in contamination of food with food borne disease-causing organisms.

As a result, the adequate knowledge, positive attitude and appropriate practices of handling food would generally contribute to reducing foodborne disease burden manifested as disability, death and, thus, loss of productivity and increased medical expenses (Jaffee et al., 2019).

In order to ensure food safety in school feeding program, the Food for Education (FFE) program has produced a manual that gives guidelines to schools and the community (WFP 2017). Major components of food safety management at school kitchen level include preparing a flow diagram of the food preparation process, identifying the hazards and setting control points, assigning responsibilities at each stage of the process and preparing a standard operating procedure for each stage and finally monitoring and evaluating the process. These actions should focus on food preparation stages, storage of non-food items such as food preparation utensil, cleaning and cooking water, setting up of kitchen equipment, strict adherence to personal hygiene rules by food handlers and sanitation procedures in and around the school kitchen.

Socioeconomic effect of nutrition interventions

School feeding programs attempt to feed children and reduce hunger to help them go to and stay at school; increase enrollment; reduce absenteeism; and enhance cognitive abilities. Improvement in health and nutrition is the purpose both at school and household levels. Practices that address behavioral changes, and nutrition education to schoolchildren and community alike, are considered to be part of services combined with meal provision (Drake et al., 2017; WFP, 2013). Employment opportunity is created for women and men in meal preparation in school feeding programs (Drake et al., 2017).

The school feeding program acknowledges that the prevalence and intensity of worm infections can be reduced through a systematic deworming; micronutrient status can be improved through micronutrient supplementation; access to safe drinking water and adequate sanitation can be improved through provision of potable water and sanitary latrines to schools; and awareness-raising and behavior on health, nutrition and hygiene can be improved through health, nutrition and hygiene education (WFP, 2007).

Thus, as an initiative motivated by stakeholders dealing with health, nutrition and education (WFP, 2000), an integrated school health and education approach has been designed to alleviate multifaceted malnutrition in schoolchildren. It includes elements of intervention such as (i) healthy school environment (including adequate water and sanitation facilities), (ii) comprehensive school health education, (iii) comprehensive health services for students and staff which address priority

health conditions (such as deworming campaigns), nutrition and food services (including school feeding programs), and mobilization of parents and communities.

Empirical literature

Empirical studies are very few to learn effectiveness of school feeding program both at national level and globally. There are findings that SFP is not effectively achieving its objectives (Babu *et al.* 2017). Food types provided in schools (for instance cereals only in South India) have shown insignificant relevance or reduction of inequality in protein intake (Babu *et al.* 2017). Babu and Hallam (1989) and Alderman and Bundy (2012) showed lack of nutritional benefit of Feed for Education (FFE) programs in some countries.

Nutritional impact of school feeding

Few studies justify an increasing and improved contribution on the effects of school feeding intervention on education outcomes such as enrolment, lower dropout and improved attendance. However, the effect on child health and nutrition, cognitive and physical growth, and development is not well established (Babu and Hallam 1989; WFP 2000).

In some studies, the program, except addressing temporary or short-term hunger, was not effective in addressing the nutritional value of the meal, its sufficiency and adequacy to meet dietary requirements of children (Babu and Hallam 1989).

In recent progresses, recognition has been given to health and nutrition effect of a well-designed school feeding program, for instance, by introducing micronutrient fortification of school meals; provision of nutritious food as per Recommended Dietary Allowance for energy; linking the program with the prevailing food system, namely, local food production and purchasing that it adds to the rural economies and nutritional quality of food (Drake et al., 2017; WFP, 2013).

An increase in food and nutrient consumption among school-aged children can improve weight, reduce susceptibility to infection, and increase cognitive development (Adelman et al., 2008). When fortified, school meals improve micronutrient intakes even though a meal does not contain adequate energy.

School-aged children with low food energy or micronutrient intake during their early childhood or pre-school age, could gain significant nutrition that changes their physical and mental growth in a short period of time (Adelman et al., 2008). The authors showed that randomized trials in the literature show a greater potential for SFP to improve daily energy consumption by children whose

energy consumption has been below the recommended level for their age(Adelman et al., 2008). According to these studies, iron fortification and deworming showed interactive effect, and several studies showed gains in physical growth attributed to participation in FFE programs, while gain in weight was often shown to be the case in response to the programs.

Educational outcomes of school feeding

School feeding program attracts children to school and help them to stay there. As a result, it enhances enrollment and reduces absenteeism. Therefore, it facilitates learning by avoiding hunger and enhancing cognitive abilities, supported by complementary actions, especially deworming and micronutrients provision (Bundy et al., 2009).

Confirming its benefits, Bashir et al. (2018) concluded that school feeding programs increased composite test scores more in Sub-Saharan Africa (average effect size for Kenya and Senegal = 0.26 vs. 0.14 Standard Deviations), and generally, it has been encouraging enrollment and attendance in low- and middle-income countries.

Reviews of SFPs of some countries also showed improvements in school enrolment, attendance, cognitive skill, economic benefits to community and smallholder farmers productivity through Home Grown School Feeding program (Bundy et al., 2009; Drake et al., 2017; WFP, 2013, 2019a).

Conditional on the type of food provided, the size of the food rations, and program duration, school meals improved performance and cognitive development of schoolchildren (Adelman et al., 2008). This assessment indicated that Food for Education programs had larger impacts in areas with low school participation and on children with greater initial malnutrition. However, the effect is not clear yet in schools where participation is not low. This might be because of the fact that FFE program targeted at those schools with low enrollment.

According to Behrman (1996), both experimental and socioeconomic or behavioral studies found strong positive associations between health and school achievement, but further recommended that a well-conducted, double-blind, experimental study with random assignment to treatment and control groups should be followed in order to claim conclusive effects. On the other hand, the assessment has shown that evidences were scant to show effects of school meals on primary-school enrollment rates (Adelman et al., 2008).

Regardless of limitations in coverage of study area and participants, Ethiopia's school feeding program has also been criticized for its lower effectiveness. For instance, a study in *Sidama* zone

indicated insignificant impact of school feeding on school enrollment, attendance, and dropout (Dheressa 2011).

Food safety, food handling and school feeding

There are several cross-sectional studies that assessed the sanitary-hygienic conditions of public catering establishments in different towns in Ethiopia such as in *Zeway* (Kumie et al., 2002), *Jimma* (Neme et al., 2017)and *Bahir Dar* (Kibret and Abera, 2012). Other studies have also indicated inadequate liquid waste and refuse management (Kumie et al., 2002; Mendedo et al., 2017), and poor personal hygiene of food handlers in most establishments. Only few food handlers used acceptable type of clothings while working, and sanitary conditions of food and drink establishments were poor (Kibret and Abera 2012, Kumie *et al.* 2017).

The evaluation of personal hygiene of food handlers, by Legesse *et al.* (2017) and Neme *et al.* (2017), in terms of wearing working clothings, covering hair, trimming finger nails, washing hand, training and regular medical checkup, knowledge about foodborne disease, cause and means of contamination, indicated that food handlers were poorly qualified to maintain appropriate food safety and handling practices.

Studies on substandard food establishments in *Gondar* (Gizaw et al., 2018), KAP of food handlers in traditional hotels in *Jimma* Town (Temeche et al., 2016); KAP of handlers' in *Nekemte* referral hospital, *Wollega*, (Gemeda, 2018); factors affecting food handling practices in *Dangila* town, North West Ethiopia (Tessema et al., 2014); in food and drinking establishments in *Arada* sub-city, *Addis Ababa* (Mendedo et al., 2017); in public food establishments, Northwest Ethiopia (Chekol et al., 2019); and in *Arba Minch* (Legesse et al., 2017) discussed conditions and factors that determined food safety.

Findings from such studies revealed that low levels of food safety practice were related to age, marital status, service year, monthly income, food hygiene and safety training, attitude, and depth of knowledge of food handlers (Chekol et al., 2019; Gemeda, 2018; Gizaw et al., 2018; Legesse et al., 2017; Mendedo et al., 2017; Temeche et al., 2016; Tessema et al., 2014). Similarly, absence of strict food hygiene practices was noted among meat handler in *Jigjiga* Town, Ethiopia, whereas food-handlers' knowledge and safety practices were found below acceptable level (Tegegne and Phyo, 2017). Poor food handling practice among food handlers was reported in a study at student cafeteria of Addis Ababa University (Meleko, 2015).

A review of food safety and nutrition related benefits of traditional foods and beverages showed importance of some food-borne diseases causing organisms in traditional foods such as sauces, street foods and weaning foods (Ashenafi, 2002).

Prevalence and antimicrobial susceptibility pattern of *Salmonella* isolates among food handlers at the University of Gondar, Ethiopia, showed that almost two-third of food handlers surveyed had no previous medical checkup for *Salmonella* infection; only very few of them were certified as food handlers and *Salmonella* isolates were detected from specimen collected from the food handlers (Garedew-Kifelew et al., 2014).

In general, studies ascertain that food handlers in different localities of Ethiopia do not have adequate knowledge, attitude and practices with regards to food safety, handling and preparation.

On the other hand, although schools are populated with a large number of children in different demographic compositions, there was no study conducted in school environment with respect to health and nutrition of school-aged children. As the school feeding program established by the Addis Ababa City Administration is a recent phenomenon, it is important and timely to conduct food safety and nutrition-related KAP and associated studies that may contribute to protect schoolchildren from foodborne disease which, in turn, can positively affect healthy physical growth and mental development.

Many of the previous studies on school feeding revolved around its effect mainly on educational performance, enrollment, attendance, and dropout, but rarely on cognitive development and nutrition (Babu and Hallam 1989, Alderman *et al.* 2008, Jaffee *et al.* 2019). Recently, the World Bank reported the extent to which unsafe food might reduce productivity from illness, disability and death, and increase costs, for example, due to medical expenses (Jaffee *et al.* 2019). For instance, risks and consequences of unsafe food costed low- and middle-income economies USD 110 billion each year (Jaffee *et al.* 2019). They, thus, suggested preventative measures to avoid food safety problems such as better regulatory frameworks and measures that promote behavior change. In addition, they proposed an inclusive approach to food safety management that makes food safety a shared responsibility among those in the food chain from farm to fork.

Babu and Hallam (1989) asserted that school feeding programs rarely addressed issues of food safety, food preparation and handling, source and safety of water, and sanitation in South India. Their assessment of empirical studies, Alderman *et al.* (2008) indicated that many studies dealt in

depth with the impact of school feeding programs on many of the educational and nutritional outcomes. However, little information was provided about state of the literature on food safety.

There have been huge numbers of school-age children being provided with school meals in large numbers of primary schools (ranging from 927 to 1,164) in the country, in regular school feeding programs alone. Nevertheless, there are no studies that specifically assess food safety awareness, knowledge, attitude and practices among food handlers of school feeding programs in Addis Ababa.

Socioeconomic effect of school feeding

Several school feeding programs of different countries were evaluated by WFP country offices. Evaluations focus on procedures, the depth, content and results. For instance, impact evaluations of Bangladesh and Kenya school feeding programs showed that they were mainly measured in terms of outcomes on education, nutrition and health, school management and environment, household, and Safety Net results of the School Meal (Kenya*)* (Drake et al., 2017; WFP, 2013).

Few of the reviewed SFPs were reported to achieve improvements in school enrolment, attendance, cognitive skill, economic benefits to community and smallholder farmers productivity through Home Grown School Feeding program (Drake et al., 2017; WFP, 2013)..

School feeding programs are also believed to have long term economic returns (African Union Commission et al., 2014). For instance, a USD 1 investment in school feeding is estimated to return USD 3 to 10 in health, education and productivity during adulthood.

According to Drake et al (2017), community participation had been a key characteristic of countries with the most strong and sustainable school feeding programs. It gave response to community needs, local ownership, and gained parental and community contribution through cash payment or in-kind of food donation or labor. However, support of strong policy is deemed necessary for effective coordination, accountability and sustainability of community participation.

Sustainable and successful programs are those that link the programs with community needs and participation. Linking school feeding with local agricultural production, for instance, contributed to greater economic benefit in the community (Drake et al., 2017; Gelli et al., 2007; WFP, 2013).

Empirical studies on effect of school feeding programs usually suffer from methodological shortcomings that would again introduce bias in their findings and conclusions implying that quality of most studies on the impact of school feeding is weak (Adelman et al., 2008). Moreover, the

authors argued that convincing evidence was not established yet on the effect of FFE on school enrollment and attendance for a representative sample of school-aged children from the school's service area. Conclusive empirical evidence is still shallow about effect of the program on age at entry, grade repetition, and drop-out rates.

Among all of these, a wider gap in the literature is that of the status and effect of food safety and handling on health and nutritional outcomes on children, the knowledge, attitude and practices in the community, among teachers, students, and critically among food handlers who will be mostly engaged in food preparation and service.

However, since poor food safety practices in school feeding expose foods to contamination by possible disease-causing organisms, there is the risk or occurrence of foodborne infections to schoolchildren. Repeated foodborne infection leads to loss or removal of nutrients from the body, reduces immunity, and lowers energy leaving children to severe malnutrition.

Paradigm shift in school feeding

In the current times, the conventional or traditional school feeding program has been widely shifted to a new approach, Home Grown School Feeding (HGSF) (Drake et al., 2020). In the former case, SFP serve purchased domestic or foreign sourced meals to schoolchildren primarily aimed at alleviating hunger in schools. While, the HGSF approach was proposed wider perspective of food and nutrition security, education, social protection through employment, income transfers, household food security with aim of poverty reduction, and agricultural development to develop rural economy (Bundy et al., 2017; Drake et al., 2020; WFP, 2020a).

Policy framework

Globally, 80% of countries have SF policy (WFP, 2020a). There is a growing paradigm shift from the well-established policy of the first 1000 days to the first 8000 days of investing on children. There is also an approach to expand this shift in school health and nutrition policies as schools are wider platforms to implement interventions (Drake et al., 2020; WFP, 2020b).

Ethiopia does not have any SF policy yet that could influence food safety outcomes. It raises the awareness, capabilities, and practices of those who participate in the food system from farm to fork (Jaffee *et al.* 2019).

The major criticism related to school feeding in Ethiopia is that the country has not yet established strong and direct rules and regulation that specifically ascertain the right for schoolchildren to be free from hunger. However, there are health, nutrition and food security policy frameworks that aim at enabling social protection, food security, poverty reduction, improve nutrition and health in general (FDRE, 2002; MoE, 1994, 2012; MoH, 2008).

On the other hand, school feeding policies aim at rights and sets of objectives that focus on right to food, right to education and right to health (be free from disease). The policy and legal frameworks consist of laws, policies, strategies/programs, guidelines and plans and are enabling factors or environments that maintain political will and commitment, empowerment or authorization and guide the implementation of school feeding (Drake et al. 2017).

Globally, there are attempts to establish policy framework for school feeding programs but little has been practiced though improved over time. WFP, FAO, UNICEF, and other nongovernmental organizations developed a number of policies, guidelines, manuals and provided financial and technical support to implementing countries (Drake et al. 2017).

WFP launched its ten-year School Feeding Strategy in 2020 to strengthen its global strategic role in school health and nutrition that aimed at reaching out about 73 million vulnerable children left behind (WFP, 2020a). It also planned to work for nationally owned and funded SFP transition while directly involving in fragile states, and promoting research.

School feeding is a major component of the Food for Education (FFE) program of WFP Ethiopia country office, which has been implemented since 1994. Its primary objective is to support the Education Sector Development Program (ESDP) of the Ministry of Education to improve education in the country through enhancing quality education, empowering women and vulnerable groups, and promoting schools as centers for local community development (WFP 2007).

FFE intervention assumes ownership by community through participation in planning and implementing actual school activities while schoolchildren get food for improved education outcomes such as enrolment, attendance, dropout, health and nutrition status, which gradually makes schools centers of local development (WFP 2007).

The School Health and Nutrition (SHN) strategy of Ethiopia is another strategic direction next to ESDP that aims to improve access and educational achievement of schoolchildren through health and nutrition interventions in the education system (MoE, 2015). The strategy attempts a joint

planning, designing and implementation of sustainable and quality health and nutrition intervention across the education sector and, strengthening coordination, linkage and partnership of the SHN interventions with relevant stakeholders including communities.

Furthermore, SHN strategic framework could support school feeding program by integrating strategic components such as school health- and nutrition-related policies; safe and sanitary school environments; health and nutrition education; school-based health and nutrition services; and supportive strategies with country-wide SHN capacity building and SHN planning and implementation structure (MoE, 2012).

Though there are multi-sectoral policies and regulations that maintain the national food security and nutrition interventions, school feeding program demands independent policy support that enables identification and resource allocation, facilitates program implementation, empowers responsibility and accountability. Some related policies intended to address issues of food insecurity and malnutrition, their objectives and their link to school feeding policy and legal framework are summarized in Table 3 (FDRE, 2002; MoE, 1994, 2012; MoH, 2008).

Table 3: List of policies, regulations and guidelines in the Ethiopia's Food Policy Framework

Policy/Strategies/Programs/Regulation/Guideline	Year	Major Objectives	School feeding linkage
Ethiopian Education and Training Policy	1994	- Expand education for physical and mental development - Trained citizens to maximize benefits and functionalities such as human rights, wellbeing, equality, justice, peace, democratic culture, discipline, development, technology, other private and social benefits - Cultivate cognitive, creative, productive and appreciative potential of citizens	X
Education Sector Development Program (ESDP V: 2015/16 - 2019/20)	2015	- quality education services to all students - motivate children to complete primary and secondary school and provide them with the knowledge, skills and values to become productive and responsible citizens - ensure access and equity in general education - create a learning society by providing adult and non-formal education linked to lifelong learning opportunities - Other: Technical, Vocational Education and Training, and Higher education	- School feeding programs - Improve school health through adequate supply of water and sanitation facilities
Food for Education	2008	- provide hot meal in school for students in targeted schools in rural food insecure areas to relieve a short-term hunger during school time	Functions through SFP
Food Security Strategy	2002	- ensure food security at the household level, while Agricultural Development Led Industrialization (ADLI) will focus on creating the conditions for national food self-sufficiency	X
Health Sector Transformation Plan	2015	- Broad	- Scale-up community-based nutrition (CBN) program and the first 1000 days initiative - Implement the Sequota declaration of ending child under nutrition - Scale up Community led and School led total sanitation and hygiene and sanitation - marketing
National Nutrition Program (NNP)	2016	- Nutritional Status of Adolescents Improved - Nutritional Status of Women of Reproductive Age Improved - Improved Nutritional Status of Infants and Young Children 0-23 Months - Improved Nutritional Status of Children 24-59 Months - Improved Nutritional Status of Children Ages 6-10	Strengthened Implementation of Nutrition-Sensitive Interventions in the Education Sector

Policy/Strategies/Programs/Regulation/Guideline	Year	Major Objectives	School feeding linkage
		- Improved Nutrition Service Delivery for Communicable and Non-Communicable Diseases - Healthy Lifestyles and Nutrition Promoted - Strengthened Implementation of Nutrition-Sensitive Interventions - …	An updated version of the National Nutrition Strategy, 2008.
Nutrition Sensitive Agriculture Strategy: 2017-2021	2017	- integrate nutrition information system into agriculture information system - promote nutrition in agricultural and livestock policies and strategies	- Support the education sector through its capacity building component
Productive Safety Net Program	2005	- Improve food security and stabilizing asset - increase access to safety net and disaster risk management systems, complementary livelihoods services and nutrition support for food insecure households in rural Ethiopia - improve income of targeted poor households and establish urban safety net mechanisms	X
National School Health and Nutrition Strategy	2012	- improve quality of education through creating child friendly school environments, - promote provision of safe and sanitary school environments – including well maintained clean and potable water – and with gender-segregated hygiene and sanitation facilities; - promote provision of health and nutrition services that can be readily delivered through schools and close to children's locality; - complement policies and strategies which define how health and nutrition is to be addressed in schools; - promote skills-based health and nutrition education that is delivered by trained teachers and health personnel at all levels; - ensure mechanisms are put in place for ownership and sustainability of SHN programs – thereby – - increase access and completion rates by reducing dropout and absenteeism prevalent in chronically food insecure areas of the country.	- improve access to better health and nutrition services for school-age children through strategic components such as school health- and nutrition-related policies; safe and sanitary school environments; skills-based health and nutrition education; school-based health and nutrition services - Inclusion of issues in the curriculum; diseases prevention and control; nutrition, school canteen and food policy; Water, Sanitation and Hygiene (WASH); values and life skills; special needs and disabilities; - child rights and child protection; schools' infrastructure and environmental safety; - effective community partnership; and pupil awareness and participation are

Policy/Strategies/Programs/Regulation/Guideline	Year	Major Objectives	School feeding linkage
			the major focus areas and activities of the strategy
Seqota Declaration	2015	To end stunting in children under two by 2030	- aims to transform the lives of Ethiopian children through integrated community development in agriculture, health, nutrition, education, water, sanitation and hygiene, as well as social protection (NNP II)
Social Protection Policy	2012	- Protect the poor and vulnerable individuals, households, and communities from different natural and manmade adverse effects of shocks, - Establish social insurance system and increase its scope, - Increase access to equitable and quality health, education and social welfare services to build human capital; - Expand and guarantee employment for the vulnerable to unemployment; - Enhance employment guarantee for the segments of society under social problems through promoting employment opportunities, - Ensure that the society at all levels play roles for the implementation of the policy	- Increase access to equitable and quality health, education and social welfare services to build human capital;
Food and Nutrition Policy	2018	- Ensure the availability and accessibility of adequate food to all Ethiopians at all times. - Improve accessibility, and quality of nutrition and nutrition smart health services at all stages of the life span in an equitable manner. - Improve consumption and utilization of a diversified and nutritious diet that ensures a citizen's optimal heath throughout their life cycle. - Improve the safety and quality of food throughout the value chain. - Reduce food and nutrient losses along the value chain. - Improve food and nutrition emergency risk management, preparedness and resilience systems. - Improve food and nutrition literacy of all Ethiopians	- Strengthen comprehensive and integrated nutrition services of schools, people in special circumstances and people with communicable and non-communicable diseases.

Conceptual framework

There were five hypotheses in this study that were developed to derive the concepts and analyses of inter-relations of those hypotheses with healthy nutritional status of schoolchildren. In general, SFPs are aimed to serve nutritious food to schoolchildren to achieve better nutritional conditions, improved educational outcomes, and other socioeconomic outcomes such as income to the kitchen workers.

In its primary objective, SFP is considered a vital instrument to alleviate hunger and improve the nutritional status of schoolchildren. School feeding can have net increment in children's dietary intake if the served meal is diversified enough of food stuff composed of variety of nutrients including proteins, carbohydrates, fats, vitamins, and minerals that satisfy their dietary requirement in their age. Fortified foods also increase the quality of diet increasing mineral content such as, iron, that help for functional growth of children.

As a result, schoolchildren would get macronutrients to build their body and acquire energy for learning attentively and reading. From the diversified micronutrients, their metabolic activities would be maintained to achieve a healthy life and cognitive development.

Nevertheless, schoolchildren in a school received meals from one source. Thus, since unsafe food can result in outbreaks, food safety in school kitchens and sanitation in the school environment is paramount. The assumption in this case is that SFPs should maintain safe food preparation to contribute to healthy children growth. Guidelines, trainings and monitoring of the food preparation and serving according to principles and plans would enhance knowledge, attitude and practices of kitchen workers about food safety for preparation of safe school meals. Failure to do so will expose children to foodborne diseases, and that may lead to loss of body weight, limit growth, and cause child death.

The awareness, knowledge, attitude and practices of food handlers is the major condition for the safety of the food prepared. Risks associated with unsafe food would be attributed to infection of a certain food with pathogens, expansion of infection through contamination where food infected at some point in time would largely spoil the whole food with microorganisms that grow and multiply within a short period of time.

Infected food affect children's metabolic inefficiency leading to loss of micronutrients out of their body, loss of energy, appetite, loss of body weight, chronic malnutrition, and lower resistance to other diseases.

On the other hand, unless care is taken of schoolchildren's health by deworming and cleaning, they could be exposed to diarrheal disease caused by bacteria and viruses found in food and other parasitic diseases that leads to loss of body nutrients leading to illness and risk of malnutrition. The diarrhea → malnutrition → diarrhea vicious cycle should be critically considered in school feeding programs.

Since the nutritional and health wellbeing of schoolchildren gives them the opportunity to attend school and improve cognitive development, it will result in improved outcomes of education such as performance and attendance. On the other hand, the provision of school meals by itself attracts schoolchildren to schools, and hence, enrollment and educational performance increase and dropout declines.

Another issue that the study investigates is whether school feeding program has positive socioeconomic effects or implications that may depend on women who participated in meal preparation and serving. The assumption is SFP creates job or income opportunities which would provide economic benefits to kitchen workers, that could contribute to household food security.

Thus, the proposed study follows the conceptual framework designed below in order to assess effectiveness of the Addis Ababa SFP (Figure 2).

As depicted in the conceptual framework (Figure 2), the effectiveness of school feeding program could be attributed to the change in nutritional outcomes of the schoolchildren, knowledge, attitude and practice of kitchen workers to food safety measures; and its effect in raising the income of women who participate in food preparation.

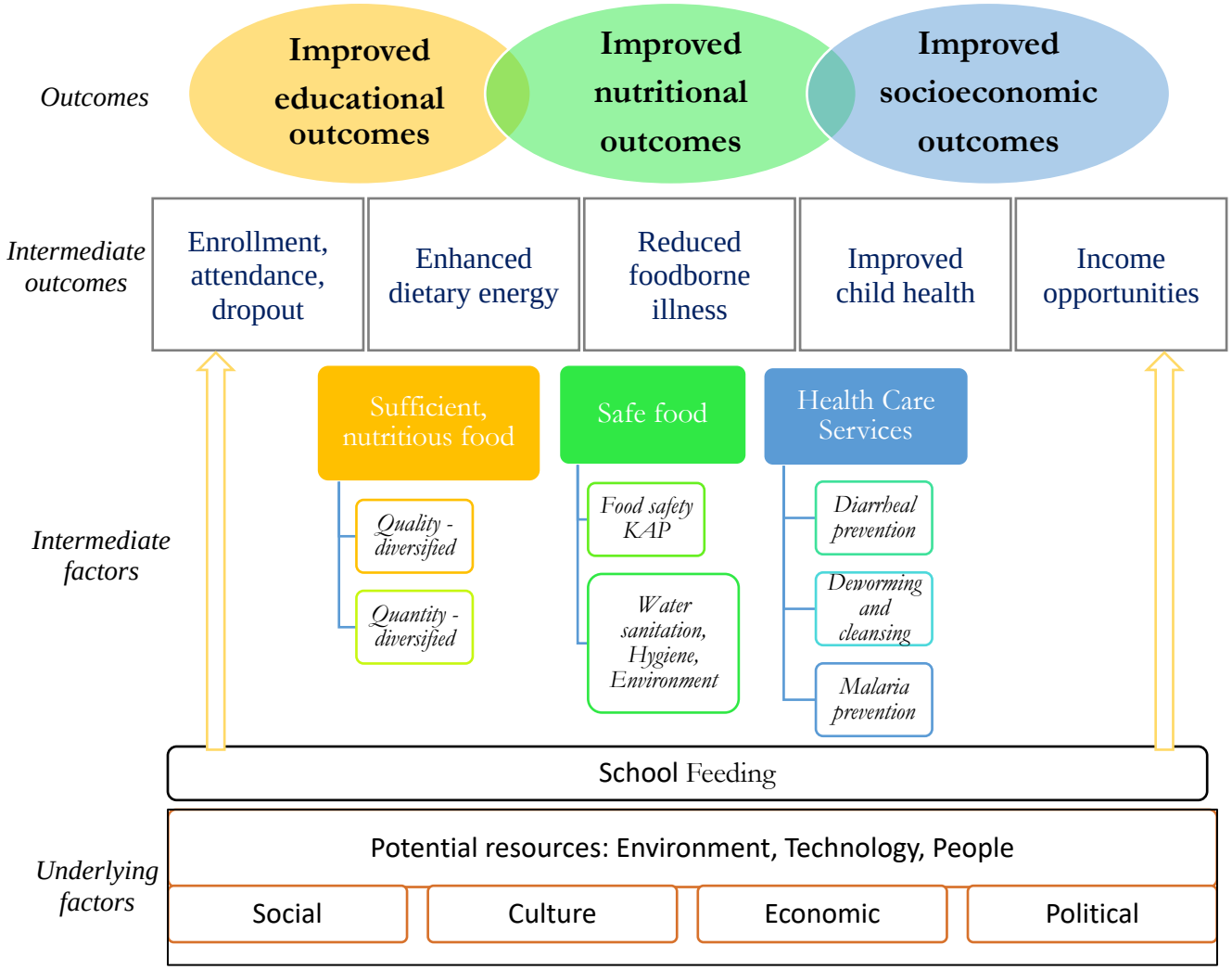

Figure 2: Conceptual framework to assess the Effect of SFP on Nutritional and educational outcomes, and its Food Safety KAP and socioeconomic implications

Own design based on literature (Bundy et al., 2009; Drake et al., 2017; WHO, 2006a)

Methods

Study design

A single-group longitudinal study design was developed in order to explore the situation we have described so far. The schoolchildren had the same status in terms of exposure to SFP since the program is universal. Thus, establishing comparative groups of schoolchildren such as benefitting versus non-benefitting was not possible. All the SFP targets were identified conditional to some administrative criteria – vulnerability to food insecurity, households' level of poverty, gender inequality, low enrollment and high dropout rates in schools.

This condition prompted use of a single group repeated measurement aimed at measuring baseline status and employ efficient measures of the effect of the intervention comparing measures of the status before the intervention and after intervention.

Study area

Primary schools in Addis Ababa were the study areas.

Study subjects

The main study subjects were schoolchildren in each school since they were major subjects of interest of school feeding program. The other subjects of interest for this study were kitchen workers benefitting from the program. All of them were selected from a school for the KAP assessment and socioeconomic implications of the SFP.

Study duration

Four rounds of data collection were undertaken. The baseline survey was employed in Mid-June 2019, followed by the other rounds by first week of October 2019, Mid-January of 2020 and first week of January, 2021. The assumption was that there would be significant nutritional effect of the intervention within three to four months intervals.

Sampling design

The Addis Ababa Bureau of Education covers all primary schools for SFP in Addis Ababa. Thus, the sampling design accounted for clustering effects of study sites across sub cities and stratification by age and sex groups.

Multistage sampling design was, therefore, used in order to account for different sources of unobserved variations across sub cities, districts, schools, age-groups, and sex.

Sampling frame

The sampling frame used to select schoolchildren was a list of schoolchildren in the primary schools where School Feeding Program started in 2019 in each sub cities (*Kifle Ketema*) in Addis Ababa.

Sample size determination

The sample size required, levels of reporting or clusters, selection and allocation procedures, number of sites, and locations of the study were the major factors determined by the study design, available resource, sampling frame as listings that contain complete information about the intervention schools, and time.

Equal sample size was determined at each school as a cluster (level of reporting) followed by a random selection of the subjects.

An important consideration of sample size determination in a repeated measurement or longitudinal studies was within subject correlation and the effect size of an intervention over time (Cohen, 1988).

Cohen (1988) defines effect size as the degree to which a certain phenomenon of interest is present in the population, or the degree to which a null hypothesis that the effect size of a treatment or an intervention is zero is false, but without intending any necessary implication of causality.

Thus, effect size on one hand is the most important determinant of power or required sample size or both, and on the other hand, it is the least familiar of the concepts surrounding statistical inference among practicing behavior scientists.

Effect sizes are assumed null at the first time point of intervention or treatment and to increase linearly to levels of 0.2, 0.5, and 0.8 standard deviation (SD) units at the last time point (Cohen, 1988).

Another important parameter of interest in sample size determination is the power of a statistical test. Power is the probability to reject a null hypothesis when it is false, i.e., the probability that it will result in the conclusion that the phenomenon exists, for instance, a positive outcome of school meals on targeted children (Diggle et al., 2002).

Therefore, using the above parameters, the sample size for a single-group repeated measurement or longitudinal study was determined using the formula:

$$\boldsymbol{n = \left(z_{\left(1-\frac{\alpha}{2}\right)} + z_{\beta}\right)^2 \times \frac{(1+(r-1)\rho)}{r\varepsilon^2}}$$

where $\boldsymbol{r}$ is the number of time points of measurement; $\boldsymbol{\rho}$ is the assumed correlation of the repeated measures; $\boldsymbol{\varepsilon}$ is effect size; $\boldsymbol{\beta}$ is the desired probability of rejection of null hypothesis; and $\boldsymbol{\alpha}$ is the desired level of significance.

Since there were no prior estimates of effect sizes and that correlations were available for the proposed study design, we adapted Cohen's classification of effect sizes of interventions assuming different levels of correlation (Cohen 1988).

Cohen's classification of average effect sizes assumes, small (0.1), medium (0.25), or large 0.4) when comparing two or more groups using ANOVA (Cohen's f), over different correlation levels of 0.1, 0.3 and 0.5 (Cohen 1988).

In order to explore an optimal sample size for the current study, the effect size was further expanded, and an adjusted sample size for design effect (*deff*), non-response rate (n_r) and for the range of values of average correlation are presented in Table 4.

Table 4: Sample size plan per school (adjusted)

Correlation (ρ)	Effect Size (ε)	r	z_α	z_β	n_0	*deff*	n_r	n
0.1	0.1	4	1.96	0.842	255	1.50	0.1	421
0.1	0.2	4	1.96	0.842	64	1.50	0.1	105
0.1	**0.3**	**4**	**1.96**	**0.842**	**28**	**1.50**	**0.1**	**47**
0.1	0.4	4	1.96	0.842	21	1.50	0.1	34
0.1	0.5	4	1.96	0.842	10	1.50	0.1	17
0.3	0.1	4	1.96	0.842	373	1.50	0.1	615
0.3	0.2	4	1.96	0.842	93	1.50	0.1	154
0.3	**0.3**	**4**	**1.96**	**0.842**	**41**	**1.50**	**0.1**	**68**
0.3	0.4	4	1.96	0.842	30	1.50	0.1	50
0.3	0.5	4	1.96	0.842	15	1.50	0.1	25
0.5	0.1	4	1.96	0.842	491	1.50	0.1	810
0.5	0.2	4	1.96	0.842	123	1.50	0.1	202
0.5	**0.3**	**4**	**1.96**	**0.842**	**55**	**1.50**	**0.1**	**90**
0.5	0.4	4	1.96	0.842	40	1.50	0.1	66
0.5	0.5	4	1.96	0.842	20	1.50	0.1	32

Thus, if an assumed medium effect size of the intervention (0.3), at 5% level of significance, 80% power, design effect of 1.5, and adjusting for 90% per cent response rate, the total minimum sample size will be 47, 68, or 90 targeted schoolchildren for correlation levels of 0.1, 0.3 or 0.5 respectively. Thus, the maximum number was considered the optimal sample size when a maximum correlation level and a medium effect size were considered. Hence, a final sample size of 90 schoolchildren per school was taken.

Sample allocation

An equal sample size of five schools and hence 450 schoolchildren were allocated for each sub city (Table 5).

Table 5: Districts, Schools and Sample size allocation

No.	District/ Kifle Ketema	Number of School selected	Allocated Number of Children selected	Boys	Girls	Number of women (Food Safety)	Number of teachers (KII)	Food items per school /week	Focus Group Discussion (FGD)
1.	Addis Ketema	5	90	50%	50%	10	-	-	-
2.	Akaky Kaliti	5	90	50%	50%	10	-	-	-
3.	Arada	5	90	50%	50%	10	-	-	-
4.	Bole	5	90	50%	50%	10	-	-	-
5.	Gullele	5	90	50%	50%	10	-	-	-
6.	Kirkos	5	90	50%	50%	10	-	-	-
7.	Kolfe Keranio	5	90	50%	50%	10	-	-	-
8.	Lideta	5	90	50%	50%	10	-	-	-
9.	Nifas Silk-Lafto	5	90	50%	50%	10	-	-	-
10.	Yeka	5	90	50%	50%	10	-	-	-
	Total	**50**	**4500**	50%	50%	**500**	**15**	**55**	**15**

In sum, a total sample of 4500 of children, 500 women, 55 meals and about 15 FGDs and 15 KIIs were determined. Table 6 shows the sampling distribution by objectives or major indicators of study and modules of study instruments.

Table 6:Sampling distribution by objectives or major indicators of study and modules of study instruments

No.	Objective	Measurement/ Assessment	Subjects or target respondents	Sample
1.	Food safety	KAP	Women/kitchen workers participating in food preparation	500
2.	Nutritional impact of SFP on school age children	Anthropometry	Beneficiary schoolchildren	4500

3.	Dietary diversity	Food composition table	Food items serviced for school/week days based on meal variation in a week	55
4.	Diet adequacy	Food composition table	Food items serviced for school days based on meal variation in a week	55
5.	Education	Enrollment, Attendance, Dropout, Academic performance	Beneficiary schoolchildren	4500
6.	Qualitative: Socio-economic implications	FGDs	Women/kitchen workers participating in food preparation	15
7.		Key Informant Interview (KII)	School directors, teachers, and program coordinators	15

Selection Procedure

At the time of data collection there were 10 sub cities in Addis Ababa. Within each sub city, there are several *Woredas*/districts within which schools are available. In order to achieve a fair distribution of the sampling across the districts, five districts were first randomly selected from each sub city. Then, five primary schools were randomly selected from each of the sampling districts. Next, sampling units, namely, schoolchildren were selected randomly. Below is a diagram that shows the flow of selection in hierarchical scheme over sub cities, districts, schools and children (Figure 3).

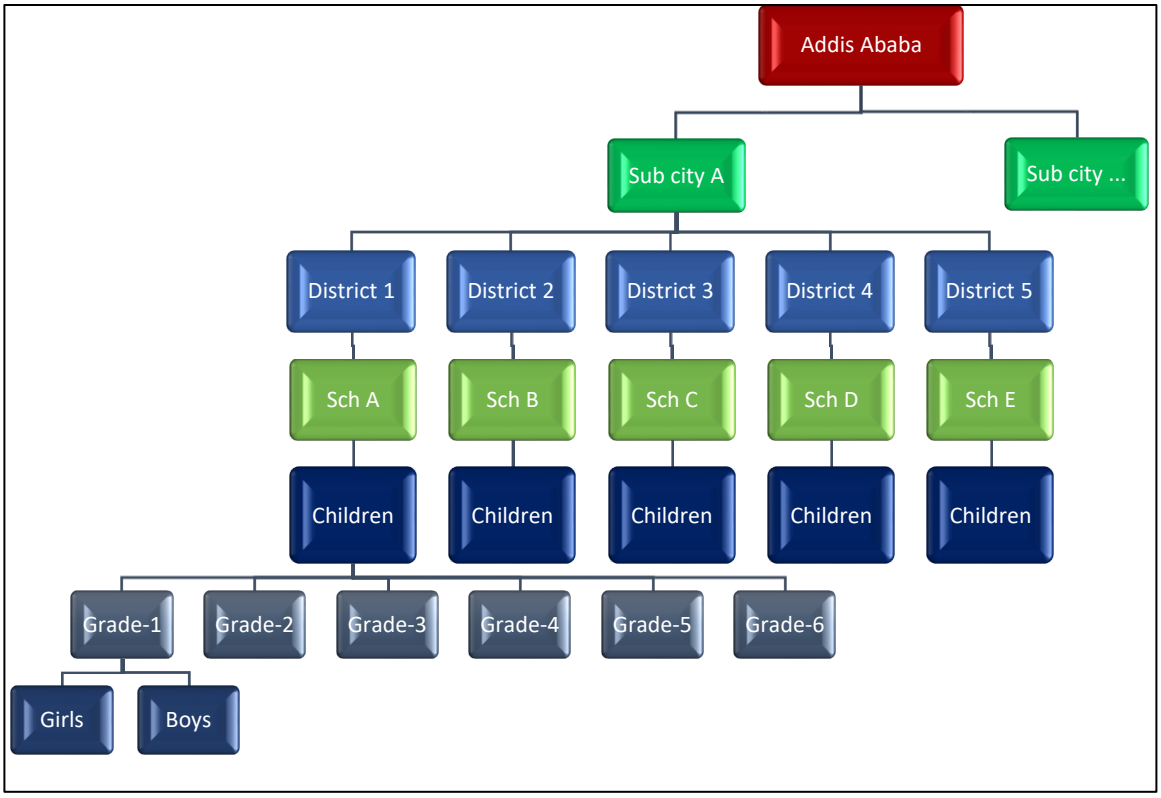

Figure 3: Hierarchical flow chart of random selection of districts, schools and children across all sub cities.

Selection of study subjects in schools

Once the schools were selected, listing of schoolchildren from grade one to grade six was done in order to employ a random selection of a total of 15 schoolchildren at each grade level, in which the number of boys and girls were equally allocated. Selection of samples from grade one to grade six maintained fair distribution of the sample across age groups of school-ages adolescents. Then, samples of kitchen workers, school directors and teachers, food menu, and key informants were also identified.

Sample size determination of food samples

The sample size for food samples was determined based on literature using the following formula(Tonkikh et al., 2019).

$$n = (\frac{Z_\alpha}{r})^2 \times (CV)^2$$

where CV is the coefficient of variation for the real population (10%); Z_α the value of the normal deviation (Z-score) corresponding to a probability (1.96); α, level of significance (0.05); and r, the relative error accepted (10%). Considering a design effect, *Deff*, of 1.25, a minimum sample of five meals per food item and a total of 55 samples from eight food items (food menu) served per week was determined.

Measurement procedures

Anthropometric measurements such as height, weight, and MUAC were taken by qualified health professionals before lunch was served to schoolchildren and within three days of start of measurement to minimize bias due to variations associated with the number of days of consumption of school meals. Measurements were taken following WHO child growth Standards (WHO, 2008).

Instruments and tools

Weight was measured using a UNISCALE (a digital scale made by UNICEF) after removing outer clothings. Height was measured using a stadiometer (height board) mounted at a right angle between a level floor and against a wall. The schoolchild removed shoes and stood upright for height measurement.

The qualitative approach used tools for Focus Group Discussion (FGD) and Key Informant Interviews (KIIs) among stakeholders, school directors and teachers and kitchen workers. Structured questionnaires were administered to capture socioeconomic and demographic characteristics of households and schoolchildren. Specifically, information about kitchen facility, school WASH, food safety KAP, dietary intake, nutrients composition in meals, anthropometry, enrollment, attendance, academic performance, and women's income were collected.

Techniques of data analysis

Overall, descriptive and analytical methods were used to measure and meet the objectives of the study. The profile of the respondents was described using sociodemographic data in terms of age, sex, literacy, education level, etc. The estimations in each round were compared against each other using panel data analysis which controls for mixed effects. Repeated measures ANOVA were employed and effect sizes were estimated for each height, weight, Body Mass Index (BMI), and Mid Upper Arm Circumference (MUAC) by age and sex categories across the four time points of measurements. The ANOVA and effect sizes were based on standardized Z-scores except for weight measure of subjects between ages 10 and 19, for whom Z-score is not applicable. Other statistical methods – random effects GLS regression, mixed effects regression, Confirmatory Factor Analysis, and Structural Equation models and others were employed where relevant.

Nutritional Status indicators

Prevalence of malnutrition is estimated using anthropometric measures and the status are compared over time. Z-scores of Weight-for-Age, Height-for-Age, BMI-for-Age, and MUAC -for-Age are computed and prevalence of undernutrition are presented based on WHO cutoffs (WHO, 2007) (Table 7). Modified Composite Index of Anthropometric Failure (mCIAF) is also used to estimate aggregate nutritional failure among schoolchildren. Measures of effect sizes are employed so as to evaluate the magnitude of the impact of the SFP on nutritional status.

Table 7: WHO Growth Reference Classification

<table>
<tr><th>Anthropometric Indicator and Condition</th><th>Age</th><th><-3</th><th>≥ -3 to < -2</th><th>≥ -2 to < -1</th><th>≥ -1 to ≤ +1</th><th>> +1 to ≤ +2</th><th>> +2 to ≤ +3</th><th>> +3</th></tr>
<tr><td>Height-for-age</td><td>5 - 19 years</td><td>Severe stunting</td><td>Moderate stunting</td><td colspan="4">Normal</td><td>Extreme tallness is not usually a nutrition issue. May indicate endocrine disorder.</td></tr>
<tr><td>Weight-for-age</td><td>5 - 9 years</td><td>Severe underweight</td><td>Moderate underweight</td><td colspan="2">Normal</td><td colspan="3">Do not use weight-for-age to determine overweight.
A child or adolescent is best assessed by BMI-for-age.</td></tr>
<tr><td>BMI-for-age</td><td>5 - 19 years</td><td>Severe thinness</td><td>Moderate thinness</td><td colspan="2">Normal</td><td>Overweight</td><td colspan="2">Obese</td></tr>
</table>

Source: 2007 WHO Growth Reference.

Dietary quality and adequacy

Analysis of food diversity and quantity of meals served are employed using a conversion factor among food groups using the Ethiopian food composition table (EHNRI, 1998).

Educational outcomes

Educational performance from academic records, attendance and enrollment rates were compared over time. Measures of effect sizes are employed so as to evaluate the magnitude of the impact of the SFP on educational outcomes.

Food safety KAP indicators

Identifying gaps in food safety- and nutrition-related Knowledge, Attitude and Practices was performed according to the FAO guideline (FAO 2014).

Indicator	Responses	Comparison
Knowledge	Correct answer(s) to a question versus incorrect answer(s)	Percentage of people who gave the correct answer(s) to a question with that of people who did not know the answer(s)
Attitude	A desired or positive response versus a negative or noncommittal response	Percentage of people who gave the desired or positive response with the percentage who gave a negative or noncommittal response
Practice	Employing an optimal or desired practice or not	Percentage of people employing an optimal or desired practice with that of people who do not

Indicators of knowledge, attitude and practices reported following the FAO guideline in terms of numbers, percentages or scores, as presented in the FAO guideline for example as below.

a. Knowledge

No.	Indicator	Number	Percent	Knowledge score, $K_i = \frac{\sum_{p=1}^{q} C_p}{n}$
1	respondents who know the correct answer to a question	n_i	%	K_i
2	respondents who do not know the correct answer to a question	n_i	%	K_i
3	respondents who know all of the correct answers to a question	n_i	%	K_i
4	respondents who know three correct answers to a question, two correct answers	n_i	%	K_i

Where K_i is score of knowledge per question, i; q number of questions; C_p correct responses given by all respondents for the p^{th} question, and n, total number of respondents.

b. Attitudes

No.	Indicator (Example)	Number	Percent	Attitude score, $A_i = \frac{\sum_{p=1}^{q} D_p}{n}$
1	respondents who think that their child is likely to become underweight (perceived susceptibility)	n_i	%	A_i
2	respondents who think that their child is not likely to become underweight (perceived susceptibility)	n_i	%	A_i
3	number of respondents who believe that oedema of both feet is a serious problem for a baby's health (perceived severity)	n_i	%	A_i
4	number of respondents who are not sure that adding fish to a baby's meal is good (perceived benefits)	n_i	%	A_i

Where A_i is score of Attitude per question, i; q number of questions; D_p desired responses given by all respondents for the p^{th} question, and n, total number of respondents.

c. Practices

Specific observable behaviors

No.	Indicator (Example)	Number	Percent	Practice score, $P_i = \frac{\sum_{p=1}^{q} E_p}{n}$
1	respondents who treat water to make it safer to drink	n_i	%	P_i
2	respondents who do not treat water to make it safer to drink	n_i	%	P_i
3	respondents who boil water to make it safer to drink	n_i	%	P_i
4	respondents who cook with less salt	n_i	%	P_i

Where P_i is score of Practice per question, i; q number of questions; E_p Employed practice/responses given by all respondents for the p^{th} question, and n, total number of respondents.

School Water, Sanitation, and Hygiene (WASH)

School WASH condition of each school was determined based on the guideline of WHO and UNICEF (WHO and UNICEF, 2018).

Socioeconomic implications

Income, job opportunity and food security conditions of women or kitchen workers were determined based on qualitative data.

Analysis plan

Table 8: Analysis plan

Objectives	Parameters	Methods	Tools and Materials
Nutritional Status	Height-for-age; Weight-for-age; BMI-for-age; MUAC-for-age	Compare changes in the indicators over time, across age and sex groups, and measure effect sizes	Anthropometric measurement, measuring scales and boards
Dietary adequacy and quality	Dietary energy Content of nutrients	Calculate meal frequencies, dietary energy, and nutrient contents	Beam balance, food menu, and meals
Food safety KAP indicators	Proportion of kitchen workers answered correctly for KAP questions	Compare percentage across sociodemographic characteristics	Food Safety KAP Questionnaire
School WASH	Proportion of basic WASH services in schools	Calculate percent of schools with basic WASH services	School WASH questionnaire
Educational outcomes	Rates of: - Enrollment - Attendance, and - Academic performance	Compare academic parameters over time and across age and sex groups	Collect academic records of children before and after SFP
Socioeconomic implications	Income and other socioeconomic issues	Qualitative assessment	Socioeconomic Questionnaire

Ethics approval and consent to participate

All methods were carried out in accordance with the Declaration of Helsinki. Permission was obtained from the Addis Ababa Education Bureau, the responsible body for the school feeding program. The study was approved by the Institutional Review Board (IRB) of the Addis Ababa Public Health Research and Emergency Management Directorate, Addis Ababa Health Bureau with Ref. No. 36552/227. The Anthropometric measurements were administered by health professionals. Informed consent was obtained from parents to take anthropometric measurements of their children. FGD and KII participants gave their consent to participate in the study and discussions to be recorded. Confidentiality of information and anonymity of participants were maintained. Informed assents were obtained from the schoolchildren.

Chapter II: Nutritional effect of the Addis Ababa school feeding program on school-age children and adolescents

Abstract

Background Malnutrition hampers educational performance of schoolchildren coming from low-income families. School feeding program was, thus, launched in public primary schools in Addis Ababa very recently. It is, thus, important to measure the initial nutritional status of participating students to see the effect of the program on their nutritional wellbeing.

Methods The first-round survey was made at the initiation of the program. A multi-stage stratified sampling from 50 schools located in the ten sub cities of Addis Ababa yielded 4500 children of ages five to 19 years. Data was collected on age, height, weight and MUAC of the school children. The nutritional status of the children was evaluated using conventional anthropometric indicators, modified Composite Index of Anthropometric Failure (mCIAF), and MUAC-for-age. Receiver operating characteristic (ROC) regression was used to examine classification of malnourishment by MUAC-for-age versus BMI-for-age and mCIAF versus MUAC-for-age. Multilevel mixed effects model was applied to investigate variations in the prevalence of malnutrition across sub cities. Repeated measures ANOVA, was employed to assess differences in the outcomes over time.

Findings The area under the ROC curves (AUC) for MUAC-for-age against BMI-for-age z-scores was 0.68 and that of mCIAF against MUAC-for-age was 0.70, respectively, indicating an overall better classification of malnourishment. Mixed effects model showed significant variations in nutritional status of schoolchildren across sub cities. Conventional measures showed that prevalence of stunting, thinness, or underweight among the sample children was 23.4%, 18.4%, and 16.5%, respectively. Assessment by mCIAF, instead, showed a higher prevalence of overall malnutrition (43.4%). MUAC-for-age indicated an acute malnutrition measurement of 33.4%. Significant differences ($p<0.0001$) in nutritional status were seen between boys and girls, and among age groups as measured by mCIAF. Robust evidence was established that the school feeding intervention has achieved medium to large scale effects on nutritional status (effect size, $\eta 2$, of 0.02–0.12).

Interpretation Conventional measures of nutritional status undermined level of malnutrition. Instead, mCIAF and MUAC-for-age gave higher estimates of the magnitude of the existing prevalence of malnutrition among school children. The school meals were associated with substantial improvement in the nutritional status of schoolchildren.

Keywords: Adolescents, BMI-for-age, mCIAF, MUAC-for-age, nutritional status, school feeding, school-aged children.

Introduction

School-age children and adolescents are characterized by a rapid and intense physiological, mental and social development with high nutritional requirement to maintain such changes (Cashin and

Oot, 2018; Spear, 2002). Poor nutrition may expose them to long-term consequences or risks of bad nutritional and health outcomes both during adolescence and adulthood (Cashin and Oot, 2018).

In order to avoid risks of unhealthy outcomes and to maintain health and normal growth, children should get sufficient nutritious food that meets their dietary requirement. However, worldwide, large number of children suffer from burdens of undernutrition attributed to risk factors such as poverty, conflicts, shocks and disaster, poor dietary intake and disease (Bundy, de Silva, Horton, Patton, et al., 2018).

In Ethiopia, at least two out of five under-five children suffer from chronic malnutrition (EPHI and ICF, 2019). Adolescent girls and boys of age 15–19 are prone to chronic energy deficiency and in Addis Ababa, of which 15% of under-five children are stunted (CSA and ICF, 2016).

The Addis Ababa City Administration launched a wider school feeding program in February 2019. However, school meal provisions had been previously underway in some schools by charitable societies and other stakeholders (AAEB, 2019). The program initiated by the City government by involving about 51, 686 pupils, in 221 public schools distributed over ten sub-cities of Addis Ababa (AAEB, 2019).

The initiative of the Addis Ababa school feeding program was intended to alleviate hunger among poor schoolchildren, improve their attendance, minimize rates of dropout and repeaters and, ultimately, enhance educational performances of students (AAEB, 2019).

There is no available information on the nutritional status of school-age children and adolescents involved in the Addis Ababa school feeding program. WHO uses growth references based on estimated Z-scores for height-for-age, weight-for-age, weight-for-height, and BMI-for-age for children of age between five and 19 years, which help to evaluate nutritional outcomes such as stunting, underweight, wasting, and thinness, respectively (de Onis et al., 2007). However, each of these standard indices may underestimate the prevalence to malnutrition since each indicates only a single nutritional outcome (Nandy et al., 2017).

Recently, an aggregate measure of prevalence of undernutrition, namely Composite Index of Anthropometric Failure (CIAF) has been suggested to assess the overall prevalence of undernourishment (Nandy and Svedberg, 2012).

The CIAF is constructed from seven components or subgroups of anthropometric failure. These are groups who suffer from (*i*) stunting only; (*ii*) wasting only; (*iii*) underweight only; (*iv*) stunting and underweight; (*v*) wasting and underweight; (*vi*) stunting, wasting and underweight; and (*vii*) those who do not suffer from any anthropometric failure (no failure). The CIAF method has been applied and validated by some studies to evaluate nutritional status of preschool children (Vollmer et al., 2017). However, both studies did not take overweight into consideration.

CIAF was implemented to evaluate anthropometric failure of pre-school and school-age children by including an additional category, namely excess weight (obesity and overweight) (Bejarano et al., 2019). This raised the number of indicators that determine CIAF from seven to nine. The extra two groups were overweight, and overweight combined with stunting (Bejarano et al., 2019; Kuiti and Bose, 2018).

However, weight-for-age does not distinguish between height and body mass for ages older than 10 years (WHO, 2009). Because, use of weight-for-age would be misleading for children older than 10 years as pubertal growth spurt may result in apparent excess weight (by weight-for-age). Thus, considering weight-for-age in hitherto CIAF computations can be applied only for children of age five to nine years. Moreover, there is no WHO reference to assess weight-for-height Z-score for school-age children and adolescents (de Onis et al., 2007; WHO, 2009). BMI-for-age is, thus, preferred over weight-for-height Z-score for school-age and adolescents as it assesses changes in weight and height by accounting for age (Flegal et al., 2002).

Another growth reference, MUAC, conventionally was not specific to sex and age. Recently, a new growth reference for sex-specific MUAC-for-age, has also been proposed for children and adolescents of age five to 19 years concurrent with the WHO growth references (Mramba et al., 2017).

The recently introduced indices, such as MUAC-for-age and CIAF, to the hitherto implemented three WHO standard indices (weight-for-age, height-for-age, and BMI-for-age), would provide a comprehensive information about the nutritional status of school-age children and adolescents.

Several studies from Addis Ababa showed that the nutritional status of school age children is far from desirable (Assemie et al., 2020; Degarege et al., 2015; Zerfu and Mekasha, 2006). As student academic performance and school attendance are influenced by nutrition, it is appropriate to assess

the nutritional status of schoolchildren at the initiation of the school feeding program to evaluate its benefits.

Objective

The objective of this chapter was to evaluate the nutritional status of the Addis Ababa School Feeding Program (SFP) on school-aged children and adolescents involved in the initial phase of school feeding program in public primary schools in Addis Ababa.

Specifically, aims at examining the baseline nutritional status of the schoolchildren and trends and effect sizes of the intervention of nutritional outcome indicators.

Methods

The data for this study were collected in June, 2019, following the initiation of the school feeding program (SFP) by the Addis Ababa Education Bureau (AAEB). The program involved 51,689 pupils, in 221 public schools distributed over ten sub-cities of Addis Ababa since February 11, 2019 (AAEB, 2019). The study focused on school-aged and adolescent children who participated in SFP in sampled primary schools in Addis Ababa.

Sample size determination was based on a repeated measurement study design of which the current work was based on the baseline data using the formula (Diggle et al., 2002):

$$\boldsymbol{n = \left(z_{\left(1-\frac{\alpha}{2}\right)} + z_{\beta}\right)^2 \times \frac{(1+(r-1)\rho)}{r\varepsilon^2}}$$

where, $\boldsymbol{r}$ is the number of time points of measurement; $\boldsymbol{\rho}$ and $\boldsymbol{\varepsilon}$ are the correlation of the repeated measures and effect size of intervention assumed (Cohen, 1988); $\boldsymbol{\beta}$ is the desired probability of rejection of null hypothesis; and $\boldsymbol{\alpha}$ is the desired level of significance. Based on this, a sample size of 90 targeted schoolchildren per school was determined at an effect size of the intervention (0.3), 0.5 correlation level, 5% level of significance, 80% power, design effect of 1.5, and adjusting for 90% response and attrition rate.

Addis Ababa is comprised of ten sub cities (called *kifle-Ketemas)*, each with an average population size of 300,727 (195,273 to 546,219) (AACA, 2021). According to a population projection until 2037, children and adolescents of age five–19 currently constitute 22% of the city population (CSA, 2013). Each sub city is further divided into 10 to 15 districts (called *Woredas*, the smallest administrative units*)*. Based on a multi-stage cluster sampling design, five districts were randomly

selected from each sub-city, followed by random selection of one primary school from each selected district. A total of 50 primary schools and 4500 schoolchildren were, thus, considered for the study. The schoolchildren at each grade level were listed and randomly selected based on proportion of their sexes.

Anthropometric measurements were taken by qualified health professionals before lunch was served to students and within three days of start of measurement. The nutritional status of the school-aged children was analyzed based on the anthropometric measurements and the status was compared by age groups and sex. Z-scores of Height-for-Age, Weight-for-Age, and BMI-for-age were computed using WHO Anthro Plus software (WHO, 2009). Prevalence rates of stunting, thinness, and overweight were reported based on the WHO Anthro Plus estimates. However, despite the fact that growth reference to compute weight-for-age Z-score is available for children younger than ten years old, the WHO Anthro Plus summarizes the prevalence rates of underweight (low weight-for-age Z-score) by considering the total sample size as the denominator, which underestimates the problem. Thus, the correct prevalence rate for underweight is separately calculated for five-to-nine-years old children only. The classification of level of malnutrition was determined based on cutoffs set in WHO Growth Reference (WHO, 2007).

In our modified CIAF (mCIAF), weight-for-age was computed only for children of age five to nine (de Onis et al., 2007). Similarly, since weight-for-height is recommended only for under-five children, BMI-for-age is used in the case of schoolchildren of five years or older (WHO, 2009). To construct the mCIAF for school-age and adolescents, we used thinness (low BMI-for-age) instead of wasting (low weight-for-height) and excess weight, in our case, was for high BMI-for-age and not for high weight-for-height.

The data was separately computed for age groups of five to nine, 10–14 and 15–19 years as the computation and interpretations, according to WHO AnthroPlus, are technically and theoretically different across the age groups.

The mCIAF assigned school age children and adolescents into "No failure" groups, when they attained normal growth status by all the three conventional indices, namely stunting, thinness, underweight/excess weight. Children who failed to attain a normal growth in, at least, one of the standard indices were categorized as "Failure". The nine groups of mCIAF, as modified from

previous works (Bejarano et al., 2019; Kuiti and Bose, 2018; Nandy and Svedberg, 2012), are given in Table 9.

Table 9: mCIAF categories adapted for children of age group 5-19

Categ -ories	Description	Stunting	Underweight	Thinness	Overweight
A	Without anthropometric failure	No	No	No	No
B	Thinness only	No	No	Yes	No
C*	Thinness and Underweight	No	Yes	Yes	No
D	Stunting, Thinness, and Underweight	Yes	Yes	Yes	No
E*	Stunting and Underweight	Yes	Yes	No	No
F	Stunting only	Yes	No	No	No
G	Overweight	No	No	No	Yes
H	Stunting and excess weight (overweight and obese)	Yes	No	No	Yes
Y*	Underweight only	No	Yes	No	No

Adatpted from others with modification for school-age and adolescents.(Bejarano et al., 2019; Kuiti and Bose, 2018).

**Only for schoolchildren of age group 5–9* (WHO, 2009).

Thus, the proportion of Anthropometric Failure is the sum of the percentages of each failure groups indicated in Table 1, except group A, and can be calculated as:

$$mCIAF = (1 - A)\%.$$

The sex-specific MUAC-for-age, as a measure of acute malnutrition of severe and moderate types, is calculated based on the reference data provided by,(Mramba et al., 2017) using the formula:

$$\mathrm{Z-score} = \frac{\left(\frac{y}{M}\right)^{L} - 1}{\mathrm{L} \times \mathrm{S}}$$

where $\boldsymbol{y}$ is observed child's MUAC measurement, M is median MUAC of the reference group, S is coefficient of variation of the reference group, and L is the skewness of the reference group.

The level of the correlation between MUAC-for-age Z-score and Z-scores of conventional anthropometric measures was examined using Pearson's product-moment correlation. ROC Curve was used to examine performance of the MUAC-for-age to correctly classify nutritional status against BMI-for-age. Similarly, the performance of mCIAF in correctly classifying anthropometric failure was compared against MUAC-for-age. Further, covariates-adjusted Receiver operating characteristic (ROC) regression was used to fit ROC curve under sex and age categories.

Outliers were excluded from the analysis. Chi-square test of association was used to examine differences in nutritional outcomes between boys and girls and among sub cities.

Multilevel Mixed effects regression model was fitted in order to evaluate the level of variations in the measures of nutritional status across levels of sub cities.

Based on repeated measures ANOVA, the effect sizes were estimated for each height, weight, Body Mass Index (BMI), and Mid Upper Arm Circumference (MUAC) by age and sex categories across the four time points of measurements. The ANOVA and effect sizes were based on standardized Z-scores except for weight measure of subjects between ages 10 and 19, for whom Z-score is not applicable.

Results and discussion

Baseline nutritional status: Modified Composite Index of Anthropometric Failure and MUAC-for-age

Data from a total of 4500 children, consisting of 46.2% girls and 53.8% boys, were analyzed after outliers were excluded. An increase in height, weight and MUAC was observed with increase in age in both sexes. Lower height and MUAC was observed than those in WHO reference in age groups 10–14 and 15–19 (Table 10).

Table 10: Median Height (cm), Weight (Kg) and MUAC (mm) measurements of children

Age	Sex	N	Height		Weight		MUAC	
			Observed (IQR)	Ref[1].	Observed (IQR)	Ref.	Observed (IQR)	Ref[3].
5–9	Girls	758	126(10)	120.9	24(5.4)	22.8	16.5(2)	18.3
	Boys	843	125.7(10)	121.6	23(5.6)	23.1	16.5(1.8)	18
10–14	Girls	1,252	142(14.5)	150.2	34(11)	NA[2]	19(3.5)	22.8
	Boys	1508	139.7(14.1)	149.8	31(8.3)	NA	18(2.5)	22.6
15–19	Girls	67	153(9.8)	162.5	48(11)	NA	22(3.7)	25.8
	Boys	67	158.1(11)	173.3	45(7.5)	NA	21(3)	28.1

IQR: Inter Quartile Range

[1] Median computed from 2007 WHO reference (de Onis et al., 2007).

[2] NA, not available

[3] Median computed from the reference group used by (Mramba et al., 2017).

Although estimation of each component of mCIAF among our study subjects ranged from 0.8% to 13.7%, overall mCIAF indicated that a much higher proportion (43.4%) of the school-age children and adolescents were affected by malnutrition (Table 11). Composite anthropometric

failure was observed in 39.8% of girls, with the highest proportion observed in age group 10 to 14 (44%). Similarly, 46.5% of all boys manifested a composite anthropometric failure, and the highest proportion (50.8%) was seen in the age group 15 to 19.

Beneficiaries of school feeding programs, during this study, were students who came from low-income households and could not get enough food to sustain them through the school day. Thus, the high prevalence (43.4%) of malnutrition, as indicated by mCIAF, was observed in a population of children targeted for school feeding program.

Table 11: Composite index anthropometric failure among school-age children and adolescents involved in school feeding program, Addis Ababa, Public Primary Schools

Modified CIAF		Girls				Boys				Overall
		5–19 n (%)	5–9 %	10–14 %	15–19 %	5–19 n (%)	5–9 %	10–14 %	15–19 %	5–19 N (%)
A	Without anthropometric failure	1251 (60.2)	67.2	56	61.2	1294 (53.5)	59.6	50.3	49.3	2545 (56.6)
B	Thinness only	196 (9.4)	6.9	11.3	4.5	305 (12.6)	7.2	15.7	11.9	501 (11.2)
C	Thinness and Underweight	48 (2.3)	6.3	-	-	74 (3.1)	8.8	-	-	122 (2.7)
D	Stunting, Thinness, and Underweight	68 (3.3)	1.5	4.4	3	136 (5.6)	2.3	7.3	10.5	204 (4.5)
E	Stunting and Underweight	22 (1.1)	2.9	-	-	57 (2.4)	6.6	-	-	79 (1.8)
F	Stunting only	272 (13.1)	4.5	18.3	13.4	343 (14.2)	3.9	19.6	22.4	615 (13.7)
G	Excess weight (overweight and obese)	122 (5.9)	7.1	4.9	10.5	118 (4.9)	6.3	4.2	3	240 (5.3)
H	Stunting and excess weight	87 (4.2)	2.2	5.2	7.5	66 (2.7)	2.4	2.9	3	153 (3.4)
Y	Underweight only	11 (0.5)	1.5	-	-	25 (1)	3	-	-	36 (0.8)
Total N (%)		2077 (100)	758 (100)	1252 (100)	67 (100)	2418 (100)	843 (100)	1508 (100)	67 (100)	4495 (100)
mCIAF	N	826	249	551	26	1124	341	749	34	1950
	%	(39.8)	32.9	44	38.8	(46.5)	40.5	49.7	50.8	(43.4)

Table 12 shows the summary of the proportion and standard deviations (SD) of school-aged and adolescents that were under aggregate anthropometric failure, stunted, underweight, and thin. It

also displays the indicators of nutritional status were significantly varying across sex at each age groups of five-nine, 10–14, and 15–19.

As seen in both the individual and composite index measures of prevalence, there have been significant differences in prevalence of malnutrition among boys and girls of school-aged and adolescents ($p<0.0001$). Similarly, boys were more affected more than girls in Eastern and North Eastern Ethiopia (Beyene et al., 2019).

Table 12: Prevalence of malnutrition by age and sex among school-age children and adolescents involved in school feeding program, Addis Ababa, Primary Schools

Indicator	Age group	Girls		Boys		Both		Sex difference χ^2-value
		n	%(SD)	n	%(SD)	n	%(SD)	
Stunting	5–9	758	10.9(1.3)	843	15.2(1.2)	1601	13.2 (1.2)	5.9*
	10–14	1252	27.9(1.3)	1508	29.8(1.2)	2760	28.9 (1.2)	1.3
	15–19	67	23.9(1.2)	67	35.8(1.1)	134	29.9 (1.2)	2.3
	Total	2077	21.6(1.3)	2418	24.9(1.3)	4495	23.4(1.3)	6.8*
Underweight†	5-9	758	12.0(1.02)	843	20.5(1.1)	1601	16.5 (1.1)	25.2***
Thinness	5–9	758	14.4(1.4)	843	18.0(1.4)	1601	16.3 (1.4)	4.3
	10–14	1252	15.4(1.4)	1508	22.7(1.4)	2760	19.4 (1.4)	27.5***
	15–19	67	7.5(1.2)	67	22.4(1.3)	134	14.9 (1.4)	9.0*
	Total	2077	14.8(1.4)	2418	21.1(1.4)	4495	18.2 (1.3)	33.9***
Excess weight	5–9	758	9.4(1.4)	843	8.7(1.4)	1601	9.0(1.4)	4.3
	10–14	1252	10.1(1.4)	1508	7.1(1.4)	2760	8.4(1.4)	27.5***
	15–19	67	17.9(1.2)	67	6.0(1.3)	134	11.9(1.3)	9.0*
	Total	2077	10.1(1.4)	2418	7.6(1.4)	4495	8.7(1.4)	33.9***
mCIAF§	5–9	758	32.9(3)	843	40.5(2.7)	1601	30.3(1.9)	9.9**
	10–14	1252	44(2.1)	1508	49.7(1.8)	2760	66.7(1.3)	8.8**
	15–19	67	38.8(9.6)	67	50.8(8.6)	134	3.1(2.2)	1.9
	Total	2077	39.8(1.7)	2418	46.5(1.5)	4495	43.4(1.1)	20.5***

Sex difference statistically significant at ***p<0.0001, **p<0.01, *p<0.05

† Weight-for-age reference data are not available beyond age 10 (WHO, 2009).

The modified aggregate measure of malnutrition, mCIAF, shows that an overall large proportion of prevalence of malnutrition among school-aged children involved in school feeding program. In contrast, the conventional indices of stunting, thinness and underweight each undermined the prevalence rates and did not describe the overall prevalence of malnutrition, independently (Table 11).

Studies on nutritional status of school-age children and adolescent in different parts of Ethiopia showed varying proportion of prevalence of malnutrition (Beyene et al., 2019; Kambarami et al., 2018). However, these studies were based only on the conventional anthropometric indicators, and did not consider a composite measure of anthropometric failure. As observed in our study, use of the composite measure would result in a higher rate of prevalence than shown by the conventional measures.

A pooled estimate of prevalence in Ethiopia showed that 21.3%, 18.2%, and 17.7% of school-age children and adolescents were stunted, underweight or thin, respectively, and the pooled prevalence of stunting in Addis Ababa was 22% (Assemie et al., 2020). These figures are similar to those found by conventional methods in our study. The Global Nutrition Report (GNR) estimates of underweight in adolescent in Ethiopia (2016) was 35.6% and 21.9% in boys and girls, respectively (GNR, 2020). However, the definition that GNR used for underweight was a Z-score of more than one standard deviation below the median BMI-for-age of the WHO growth reference. The equivalent estimate of the current study would, thus, be 45.7% boys and 37.8% girls, which is higher than that reported by GNR.

However, inconsistent findings of the level of prevalence of undernutrition were also reported at national, urban and rural levels. For instance, Ethiopia had the lowest age-standardized mean BMI for both sexes, 16.8 kg/m2 for girls and 15.5 kg/m2 for boys (MP et al., 2018). BMI-for-age in 2016, non-pregnant girls of age 15–19 is 5.7% at national level, 2.2% for urban and 6.3% of no education or primary (Kambarami et al., 2018) – and that of prevalence of thinness in boys (15–19) in 2016 was 28% national, 22.9% urban and 29.5% those with no education or primary. These may show that varying levels of the prevalence of undernutrition exist in different localities, socioeconomic statuses, and demographic characteristics.

The findings in the current study are lower than global estimates prevalence in thinness and overweight (GNR, 2020). According to this current report, globally, underweight persistently affects children and adolescents of low-income countries, while overweight and obesity are rising across all ages Global Nutrition Report (GNR). By 2016, among school-age children and adolescents worldwide, 31.6% boys and 25.9% girls of age five–19 years old were prevalent to thinness/underweight. Global prevalence to overweight was 19.2% and 17.5% among boys and girls, respectively.

The existing literature, thus far, showed prevalence of undernutrition in terms of conventional measures of anthropometric indicators. This undermines the existing burden of malnutrition among school-age children and adolescents. In addition, the existing literature is scanty and fragmented in localities, age groups, sex coverage, and publication time. As a result, there is too little and incomprehensive evidence to understand the nutritional status of the full school-age and adolescents from the existing literature.

Thus, the present study is the first of its kind to provide a more comprehensive measure of overall anthropometric failure that showed the magnitude of the prevalence of malnutrition among school-age children and adolescents in 50 randomly selected primary schools in all sub-cities of Addis Ababa. It also presented individual conventional measures (stunting, thinness, and underweight) that can be used to compare with other studies.

Prevalence of overall acute malnutrition among our study subjects ranged between 24% and 48%, with the lowest proportion seen among the age group five to nine years (Table 13). Moderate acute malnutrition was observed in all age groups of both sexes at a rate of 23% to 26%, though the rate was lower ($p<0.0001$) in age group five to nine years (18%). Severe acute malnutrition, on the other hand, was notably the highest (24%) among age group 15 to 19 years. All differences among age groups were statistically significant ($p<0.0001$).

Girls in all age groups showed lower ($p<0.0001$) prevalence of moderate acute malnutrition than boys did (Table 13). Similarly, severe acute malnutrition had higher prevalence in boys of all age groups. It is worth noting that prevalence of moderate acute malnutrition in girls and moderate and severe acute malnutrition in boys increased with age. Similarly, prevalence of overall acute malnutrition increased along with increase in age. All differences among both sexes were also statistically significant ($p<0.0001$).

Table 13: Acute malnutrition status of school-age children and adolescents based on sex-specific MUAC-for-age

Age group	Girls		Boys		Both sexes			Overall (Acute malnutrition)
	MAM (%)	SAM (%)	MAM, (%)	SAM, (%)	MAM, (%)	SAM, (%)	N	
5–9	106(14.0)	21(2.8)	180(21.4)	75(8.9)	286(17.9)	96(6.0)	1601	23.8
10–14	260(20.8)	87(7.0)	466(30.9)	238(15.8)	726(26.3)	325(11.8)	2760	38.1
15–19	10(14.9)	7(10.5)	22(32.8)	25(37.3)	32(23.9)	32(23.9)	134	47.8
Total	376(18.1)	115(5.5)	668(27.6)	338(14.0)	1044(23.2)	453(10.1)	4495	33.3

NB: Both sex and age group differences are statistically significant at p<0.0001.

SAM: Severe Acute Malnutrition with Z-score <-3SD; MAM: Moderate Acute Malnutrition with Z-score (-3SD and, -2SD) (de Onis et al., 2007; Mramba et al., 2017).

The sex- and age-specific MUAC-for-age approach used to identify acute malnutrition based on the reference group used in (Mramba et al., 2017) was, to our knowledge, a first attempt of its kind. Our finding also showed that MUAC-for-age was able to identify extent of malnutrition in school-age children and adolescents closer to that indicated by the composite index (mCIAF). This finding, therefore, agrees with that MUAC-for-age effectively assesses undernutrition as much as or beyond BMI-for-age does (Mramba et al., 2017).

MUAC-for-age is strongly correlated with weight-for-age and BMI-for-age (r = 0.64 and 0.54, respectively). Its correlation with height-for-age however is moderate (r = 0.39) (Table 14).

Table 14: Correlation between Z-score measures of anthropometry with that of MUAC-for-age

Measure	N	Correlation	95% Confidence Interval	
Height-for-age	4500	0.38	0.36	0.41
Weight-for-age	1605	0.64	0.61	0.67
BMI-for-age	4500	0.52	0.50	0.54

The Area Under the receiver operating characteristic Curves (AUC) for MUAC-for-age (classified as acute malnourished or normal) against BMI-for-age z-scores (classified as thin or normal) was 0.68 and that of mCIAF against MUAC-for-age was 0.70, respectively (Table 15).

Table 15: Area under the ROC curves for MUAC-for-age against BMI-for-age and that of mCIAF against MUAC-for-age

Reference	Classifier	ROC Area	SE	Asymptotic Normal (95% CI)	
BMI-for-age	MUAC-for-age	0.68	0.009	0.66	0.70
MUAC-for-age	mCIAF	0.70	0.008	0.69	0.72

This shows that the MUAC-for-age classification of acute malnutrition performed closely fair with BMI-for-age (Table 15, Figure 4); and fair classification of malnourishment was captured by mCIAF as compared with MUAC-for-age (Table 15, Figure 5). The area under the curve (AUC) for boys and older ages was larger than that for girls and younger ages, respectively, after sex- and age group-adjusted ROC Curve was fitted (Figure 4, Figure 5). Considerably more agreement was observed in detecting malnourishment in early- and late-adolescents in both figures. More specifically, the curves fitted at each age group for mCIAF and MUAC-for-age showing closer gap between curves. This indicated an evident overall better classification of malnourishes and was in agreement with the finding that MUAC-for-age z-score was at least as effective as BMI-for-age z-

score for assessing undernutrition among African children age of five–19 years (Mramba et al., 2017).

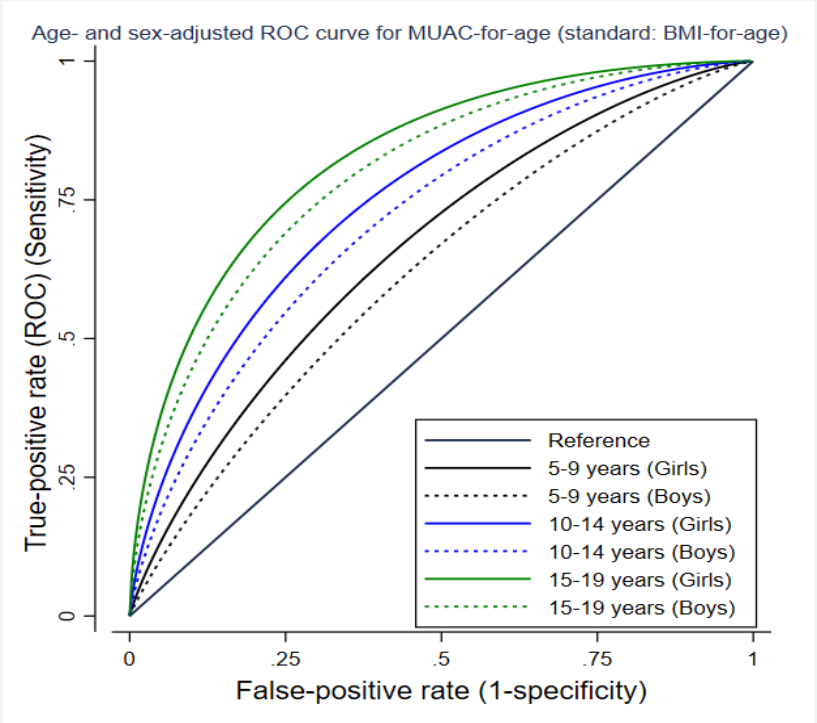

Figure 4: ROC curve for MUAC-for-age by age and sex with reference to BMI-for-age

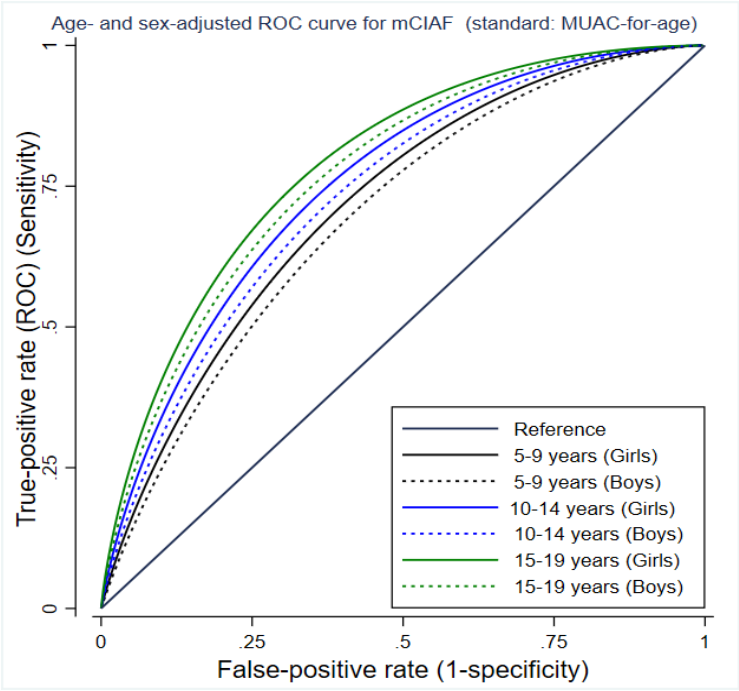

Figure 5: ROC curve for mCIAF by age and sex with reference to MUAC-for-age

MUAC for age measurements also showed that 31.4% and 18.3% of our study subjects, who suffered from anthropometric failures, also manifested moderate and severe malnutrition, respectively (Table 16). Prevalence of both moderate and severe malnutrition was significantly higher in boys than in girls in all age groups (p<0.0001).

Table 16: Prevalence of SAM and MAM among school-age and adolescent suffering from anthropometric failure

Age group	Sex	MAM, %(n)	SAM, %(n)	Normal, %(n)	Total, N	Sex Difference χ^2-value
5–9	Girls	49(19.7)	17(6.8)	183(73.5)	249	16.5***
	Boys	93(27.3)	50(14.7)	198(58.1)	341	
10–14	Girls	168(30.5)	76(13.8)	307(55.7)	551	56.7***
	Boys	290(38.7)	192(25.6)	267(35.7)	749	
15–19	Girls	5(19.2)	4(15.4)	17(65.4)	26	12.0**
	Boys	8(23.5)	18(52.9)	8(23.5)	34	
Overall (5–19)	Girls	222(26.8)	97(11.7)	507(61.4)	826	70.9***
	Boys	391(34.8)	260(23.1)	473(42.1)	1124	
	Both	613(31.4)	357(18.3)	980(50.3)	1950	

***p<0.0001, **p<0.01

The difference was much larger, however, in prevalence of severe malnutrition, particularly in the age group 15–19 years.

Prevalence of malnutrition, as measured by mCIAF, ranged between 35% and 62% among our study subjects in all sub-cities in Addis Ababa. It was the highest in Arada sub-city and lowest in Yeka sub-cities. The prevalence of acute malnutrition also ranged between 23% and 44% among the sub-cities. Prevalence of stunting followed that of acute malnutrition and was considerably high in Arada (37%), Nifas Silk/Lafto (33%) and Lideta (30%) sub-cities. The lowest prevalence (≤16%) of underweight was seen in six of the ten sub-cities (Figure 6).

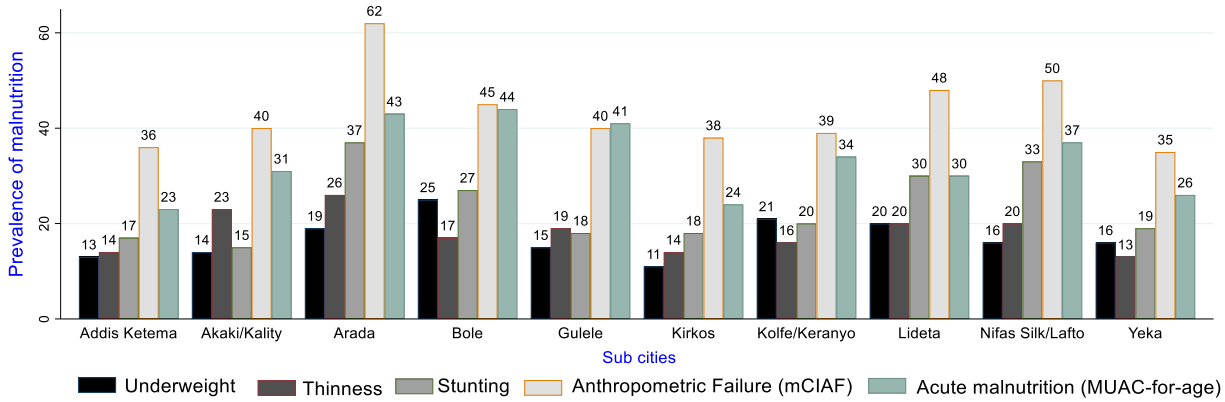

Figure 6: Prevalence of undernutrition among school-age and adolescents involved in school feeding program in each sub cities

Mixed effects regression model confirmed the result that boys were more affected than girls due to any form of malnutrition including the composite index of anthropometric failure and MUAC-for-age ($p<0.0001$). Similarly, it showed that stunting and thinness were more prevalent in early- and late-adolescent children than in middle childhood students ($p<0.0001$). This is in agreement with other reports where early adolescent age (10–14 years) in girls was significantly associated with prevalence to stunting and thinness (Arage et al., 2019; Berhe et al., 2019). It is also consistent with global higher prevalence of underweight or overweight among adolescent boys than among adolescent girls (GNR, 2020). A reason in the case of the current study might be that boys require more energy than girls (FAO/WHO/UNU, 1985). However, equal amount of meal is served in schools. This might have been reflected in the differences in the improvement of the nutritional status between boys and girls.

The variation in random effects across sub cities was significant ($p<0.0001$) in the mixed effects regression fitted for any of the anthropometric measures. The variations in prevalence of malnutrition among sub-cities in terms of the conventional measures, MUAC-for-age and the modified composite index of anthropometric failure (mCIAF) may be due to the scattered distribution of kebeles in the city which are dominantly populated by low-income households (RCN, 2020; World Bank, 2020a). Variations were also reported in poverty indices of food consumption and calorie intake among the different sub-cities of Addis Ababa (PDC, 2018).

Nutritional Impact: Longitudinal Data Analysis

In this section the impact of the Addis Ababa SFP on nutritional status of schoolchildren is presented. Summary statistics, repeated measures ANOVA and effect sizes are presented for each height, weight, Body Mass Index (BMI), and Mid Upper Arm Circumference (MUAC) by age and sex categories across the four time points of measurements. The ANOVA and effect sizes were based on standardized Z-scores except for weight measure of subjects between ages 10 and 19, for whom Z-score is not applicable. Details between children and within individuals (over time) variations are presented in Supplementary Table 22.

Overview of the study period

The baseline anthropometric data collection was held in June 2019. The second and the third phases of assessment were done in October, 2019 and January, 2020, respectively. The time interval of the measurements between the first three measurement points of assessment was three months. The duration between the first and the second measurement points was summer break, during which school meals were not served. However, school meal service resumed when school reopened in October 2019 and the third measurements were taken in January 2020. The fourth (last) measurements were planned for April 2020 to maintain the planned time interval. However, due to the pandemic caused by Coronavirus (COVID-19), schools were closed. This situation caused the last measurements to be taken in January 2021, a year after the third measurements were taken. Measurements were taken in the first week soon as schools were reopened in order to get schoolchildren's anthropometric status before the reopening of schools. It is worth noting that, during the study period, school meals were interrupted twice, during the summer break and almost a yearlong COVID-ban. These interruptions were expected to impact the nutritional conditions of the children as well as the results shown hereunder.

Trends in anthropometric measurements

The average measures of height, weight, BMI and MAUC showed an overall increase between the first, in June 2019, and the last, in January 2021 measurement points. More specifically, higher average changes were noted between the first and the third measurement (January 2020). Further, physical growth measurements increased or decreased between June, 2019 and October, 2019 and between January 2020 and January 2021, corresponding to interruptions of school meals (Table 17, Table 18, Table 19, and Table 20).

Table 17: Mean height (cm) SD, ANOVA, and Effect sizes (ANOVA based on Height-for-age Z-scores)

Age	Sex	Time I June 2019		Time II Oct 2019	Time III Jan 2020	Time IV Jan 2021		ANOVA		Effect size (η^2)
		N	Mean (SD)	Mean (SD)	Mean (SD)	N	(95% CI)	F	(df1, df2)	(95% CI)
5-9	Girls	759	126.5 (8.0)	127.3 (7.8)	129.8 (7.8)	414	131.3 (7.6)	154***	(3, 1804)	0.2 (0.17, 0.23)
	Boys	845	125.6 (7.5)	126.6 (7.4)	128.9 (7.4)	437	130.5 (7.1)	74***	(3, 1999)	0.1 (0.08, 0.12)
10-14	Girls	1251	141.7 (9.9)	143 (9.9)	145.2 (9.9)	1418	145.3 (9.9)	193***	(3, 3669)	0.14 (0.12, 0.16)
	Boys	1506	140.4 (10.2)	141.5 (10.3)	143.7 (10.3)	1718	144 (10.4)	287***	(3, 4417)	0.16 (0.14, 0.18)
15-19	Girls	67	153.3 (8.0)	153.7 (8.1)	156.1 (7.8)	245	156.1 (8.1)	103***	(3, 226)	0.58 (0.49, 0.64)
	Boys	67	157.9 (8.7)	159.2 (8.5)	160.7 (9.1)	263	159.1 (9.5)	18***	(3, 225)	0.2 (0.1, 0.28)

***p<0.001

The repeated measures ANOVA showed that the difference in the Z-scores of mean age- and sex-specific height-for-age (HAZ), weight-for-age (WAZ), BMI-for-age (BAZ), and MUAC-for-age (MUACZ) of the students at each time point of measurements were statistically significant ($p<0.0001$). This indicated that the decline in the standardized scores of heights during the first interval, the rise between the second interval and the decline during the third interval were statistically significant (Table 17–21). The mean and standard deviations of each of the Z-scores can be referred at Supplementary Table 24, and trend in the Z-scores is presented in Figure 6.

Effect sizes

The basis of the repeated measurement design that was employed in this study was to evaluate the effect of the school meals provided during each consecutive interval within the whole study period. Thus, the school meals, or in its general term, the school feeding program, was the implied intervention. The effect sizes are presented along with 95% Confidence Intervals (CI) in each table (Table 17–21). The reported effect sizes were partial Eta-Squared, which allowed the effect sizes estimated in this study, were comparable with other studies. An effect size of 0.01, 0.06, or 0.14 are considered to be small, medium or large effect, respectively (Cohen, 1988; Maher et al., 2013).

The effect sizes on height-for-age Z-scores are 0.1 for boys of age five to nine years and 0.14 or above for other age and sex groups (Table 17). The confidence intervals and the strong significance in the F values indicated that the effect sizes were significant as well. An overall ANOVA adjusted for the interaction effects of age, sex, and time also showed that significant differences among the mean height-for-age Z-scores ($F_{(3,13463)} = 507.4, p < 0.0001$) overtime with large effect size of 0.123 (0.104, 0.142). This indicated that school meals had large effect on standardized height growth. Thus, the proper provision of the school meals would result with significant growth of

children's height. Another similar study in Lao showed that SFP had an effect size of 0.29 Standard Deviations (SDs) height-for-age and 0.22 SDs weight-for-age among SFP beneficiary children of ages 3 to10 years (Bundy, de Silva, Horton, Jamison, et al., 2018).

Looking at the summary row data, mean heights of each group of age and sex (Table 17), there was an apparent increasing trend each time. However, the standardized scores showed irregular trend. It can be observed in Supplementary Table 24 that the students' standardized height had been generally stagnant during the summer break (June, 2019 to October, 2019), reached a peak by the second interval (January, 2020) but, then, generally and significantly declined during the yearlong period of school closures due to the pandemic (January, 2021).

This was indicative of compromised growth when compared with WHO standard height for their age and sex. After coming back from the summer break, students gained height in the second interval during which period school meals were served. Unfortunately, their growth was highly compromised during the lockdown period as they became food insecure from loss of significant number of school meals.

This finding was similar with an effect size of 0.12 SDs for height-for-age Z-score of children of 5–8 years old recorded in Ghana. This randomized control trial of school feeding intervention in Ghana also documented an effect size of 0.22 SDs among children of the same age groups in households below poverty line (Aurino et al., 2019).

However, unlike the current findings, a SFP in China had been reported that it did not comply with national recommendations – which as a result found that malnutrition was not declined, and the program had no statistically significant effect on BMI, while height-for-age Z scores rather went below normal (Wang et al., 2020).

However, on the other hand, medium effect sizes were observed in average weight-for-age of boys and girls of ages five to nine years. In addition, since WHO Reference group is not applicable for ages older than nine years, the ANOVA, and so the effect sizes, for these groups compared mean weights of the students over time. Thus, large effect sizes were observed on the unstandardized weigh gain/loss of both boys and girls of this age group (Table 18). Overall, significant differences among the mean weight-for-age Z-scores ($F_{[3,\ 3803]} = 74.1, p < 0.0001$) over time and a medium effect size of 0.06 (0.042, 0.07) were achieved due to school meals.

Table 18: Mean weight (kg), SD, ANOVA, and Effect sizes

Age	Sex	Time I June 2019		Time II Oct 2019	Time III Jan 2020	Time IV Jan 2021		ANOVA†		Effect size (η^2)
		N	Mean (SD)	Mean (SD)	Mean (SD)	F	(95% CI)	F	(df1, df2)	(95% CI)
5-9	Girls	759	24.3 (4.8)	24.3 (4.6)	25.9 (4.8)	414	27.2 (5.4)	33***	(3, 1804)	0.05 (0.03, 0.07)
	Boys	845	23.9 (4.3)	24.1 (4.3)	25.7 (4.5)	437	26.6 (4.6)	49***	(3, 1999)	0.07 (0.05, 0.09)
10-14	Girls	1251	34.9 (8.2)	34.8 (8.1)	36.6 (8.3)	1418	36.4 (8.6)	839***	(3, 3669)	0.41 (0.38, 0.43)
	Boys	1506	32.4 (7.1)	32.5 (6.9)	34.1 (7.1)	1718	34.5 (7.6)	1071***	(3, 4417)	0.42 (0.4, 0.44)
15-19	Girls	67	47.6 (8.2)	47.4 (7.7)	50.2 (7.9)	245	47.2 (8.1)	22***	(3, 226)	0.23 (0.13, 0.31)
	Boys	67	46.1 (7.9)	45.5 (7.3)	47.2 (8.4)	263	44.6 (8.6)	17***	(3, 225)	0.18 (0.09, 0.26)

****p<0.001* †*ANOVA based on WAZ; Age 10–19, Z-score is not applicable, weight is compared*

However, the effect size on weight-for-age is small compared with a finding in Burkina Faso where significant gains in weight-for-age (0.21 SDs) for children ages 6–10 years was reported (Bundy, de Silva, Horton, Jamison, et al., 2018).

Looking at the effects of SFP intervention on BMI-for-age it could be seen that the mean differences were significant over time, but with mixed influence (Table 19).

Table 19: Mean BMI, SD, ANOVA, and Effect sizes (ANOVA based on BAZ)

Age	Sex	Time I June 2019		Time II Oct 2019	Time III Jan 2020	Time IV Jan 2021		ANOVA		Effect size (η^2)
		N	Mean (SD)	Mean (SD)	Mean (SD)	N	Mean (SD)	F	(df1, df2)	(95% CI)
5-9	Girls	759	15.1 (2.5)	15 (2.2)	15.3 (2.2)	414	15.7 (2.4)	13***	(3, 1803)	0.02 (0.01, 0.03)
	Boys	845	15.1 (2.1)	15 (2.0)	15.4 (1.9)	437	15.6 (2.0)	22***	(3, 1994)	0.03 (0.02, 0.05)
10-14	Girls	1251	17.3 (3.2)	16.9 (3.0)	17.2 (2.9)	1418	17.1 (2.9)	38***	(3, 3663)	0.03 (0.02, 0.04)
	Boys	1506	16.3 (2.5)	16.1 (2.3)	16.4 (2.2)	1718	16.5 (2.3)	27***	(3, 4409)	0.02 (0.01, 0.03)
15-19	Girls	67	20.2 (3.3)	20 (2.9)	20.6 (2.9)	245	19.4 (3.0)	11***	(3, 226)	0.13 (0.05, 0.2)
	Boys	67	18.5 (2.8)	17.9 (2.5)	18.2 (2.5)	263	17.5 (2.5)	13***	(3, 225)	0.15 (0.07, 0.23)

***p<0.001

There was medium to large effects on boys and girls of adolescent ages, but relatively small effect sizes for younger children (Table 19). There was an overall significance of mean BMI-for-age Z-scores ($F_{[3,\ 13458]} = 66.9, p < 0.0001$) and medium effect size of 0.015 (0.01, 0.02).

Closely medium effect sizes on the Middle Upper Arm Circumference (MUAC-for-age Z-scores) were found among all age and sex groups of students, except in girls of age 15–19 years. Unlike the other groups that were strongly significant at 1% level of significance, the ANOVA for girls of this age was significant only at 10% of level of significance. This is also reflected on the effect size that lower bound of its CI is below zero, implying that effect size included zero and hence was not

significant (Table 20). There was overall significance of mean MUAC-for-age Z-scores ($F_{[3,\ 13482]} = 123.7, p < 0.0001$) and above small effect size of 0.03 (0.022, 0.032).

Table 20: Mean MUAC, SD, ANOVA, and Effect sizes (ANOVA based on MUACZ)

Age	Sex	Time I June 2019		Time II Oct 2019	Time III Jan 2020	Time IV Jan 2021		ANOVA		Effect size (η^2)
		N	Mean (SD)	Mean (SD)	Mean (SD)	N	Mean (SD)	F	(df1, df2)	(95% CI)
5-9	Girls	759	16.9 (1.8)	16.9 (1.7)	17.5 (1.9)	414	17.8 (2.1)	19***	(3, 1804)	0.03 (0.02, 0.05)
	Boys	845	16.6 (1.6)	16.7 (1.5)	17.2 (1.6)	437	17.7 (1.8)	46***	(3, 1999)	0.06 (0.04, 0.08)
10-14	Girls	1251	19.2 (2.3)	19.2 (2.3)	19.9 (2.5)	1418	19.7 (2.4)	45***	(3, 3669)	0.04 (0.02, 0.05)
	Boys	1506	18.4 (2.1)	18.5 (2.1)	19.1 (2.2)	1718	19.2 (2.3)	52***	(3, 4417)	0.03 (0.02, 0.04)
15-19	Girls	67	22.3 (2.5)	22.1 (2.4)	22.8 (2.6)	245	22.1 (2.7)	2*	(3, 226)	0.03 (-, 0.08)
	Boys	67	21 (2.4)	21 (2.4)	21.6 (2.8)	263	21.1 (2.6)	7***	(3, 225)	0.08 (0.02, 0.15)

Trends in the indicators of nutritional status of school-age children and adolescents by age groups and sex over three measurement points showed that all measures of anthropometric indicators had similar trend during the study period but girls of age 5-9 and girls of age 15-19 had shown slight increase in MUAC-for-age and Height-for-age, respectively. No changes were observed at the second phase measurement at which growth monitoring of students was done immediately after the summer break, i.e., at the beginning of the academic year. Evidently, children had not gained significant height and/or lost significant weight as a result of interruption of school meals (Figure 7).

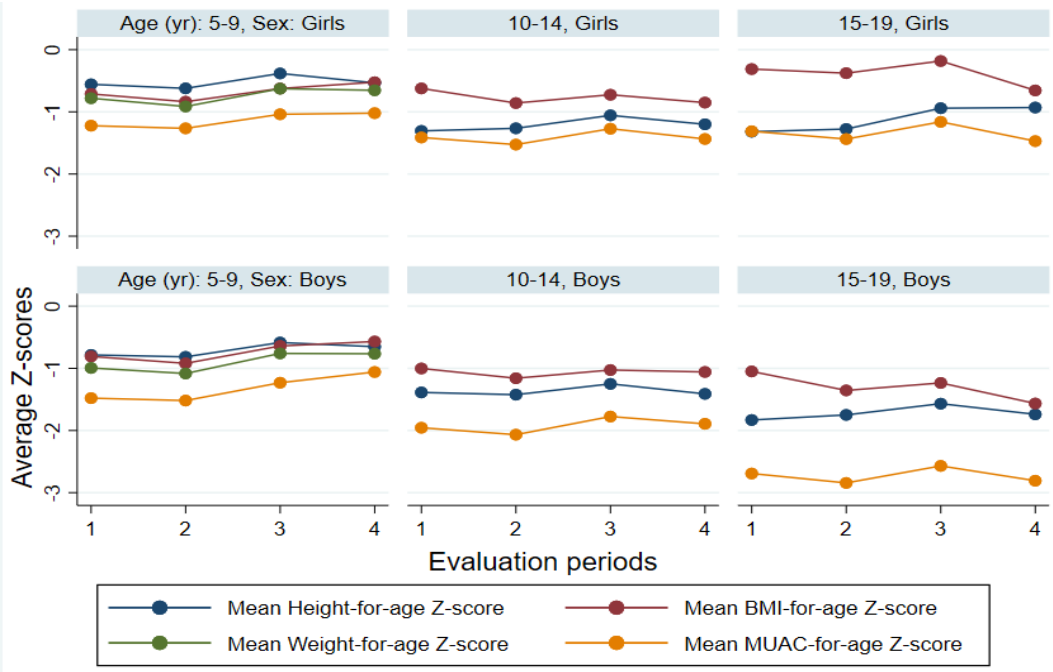

Figure 7: Trend of prevalence in different forms of malnutrition, by age, sex, time

On the other hand, increases in the various z-scores were observed at the third point of measurement, three months after school meal was resumed in October, 2019 and continued through January, 2020. However, overall, growth of schoolchildren in standardized height, weight, BMI, and MUAC was affected worse between the third and the fourth measurements point. This was a one-year interval which included the longer time school closure (March, 2019 to December, 2020) due to the COVID pandemic that, consequently resulted in the interruption of SFP (Figure 7).

The evidence base that examines the impact of SFP, essentially its effect size as an intervention, is scanty, especially in Ethiopia. Nevertheless, when compared to other findings in the existing literature (Aurino et al., 2019; Bundy, de Silva, Horton, Jamison, et al., 2018; Wang et al., 2020), the effect size of Addis Ababa SFP, as an intervention, the current study resulted in mixed findings that showed overall medium to large effects gained in physical growth among school-age children and adolescents.

However, methodological differences exist in the study designs in the existing literature. While the current one is longitudinal study with a single group of cohorts followed up to the end of the study, the previously mentioned studies had compared intervention and control groups of students using a cross-sectional study design. The repeated measurement studies usually produce robust evidence basis with good precision (Kutner et al., 2004). The fact that the universal coverage of the Addis Ababa SFP made the current study design be based on a single intervention group and not include a control group. The current study showed that children's physical growth was improved during the times of access to school meals. While physical growth stayed stagnant following the interruption of school meals during the summer break, and was highly compromised during the long school closure due to COVID-19 pandemic.

It can, however, be said that observations in this study pointed to the possible conclusion that effective school feeding programs that maintains dietary quality, quantity, diversity and safety may have significant impact on nutritional wellbeing of schoolchildren.

The study subjects were schoolchildren in varying development or growth phases such as middle childhood (five–nine years), early adolescence period (10–14 years), and late adolescent times (15–19 years). Children and adolescents of these groups achieve fast physical growth and cognitive development depending on their nutrition and health conditions (Drake et al., 2020).

Prevalence of malnutrition

Similar trends in the prevalence of different forms of malnutrition, by age, sex, and measurement time were seen in this study. Similar prevalence of stunting and underweight were observed at the first and the second measurement. Prevalence of stunting and underweight at third measurement (January, 2020), respectively, decreased by 4.6 and 5.4 percentage points from the baseline (first measurement). However, rises in prevalence but with similar magnitude was also noted between the third and fourth measurements where the fourth measurement was children's nutritional conditions had been largely compromised from loss of school meals due to COVID-19 school closure (Figure 8; Supplementary Table 24).

Similarly, thinness and acute malnutrition showed similar prevalence between the first and the second measurements. Prevalence of thinness and acute malnutrition (both severe and moderate) at third measurement had fallen, respectively, by 1.5 and 5.3 percentage points from the baseline. However, it increased by 2.7 and 6.3 percentage points, respectively at the end measurement taken after COVID-19 meal interruption (Figure 8; Supplementary Table 27).

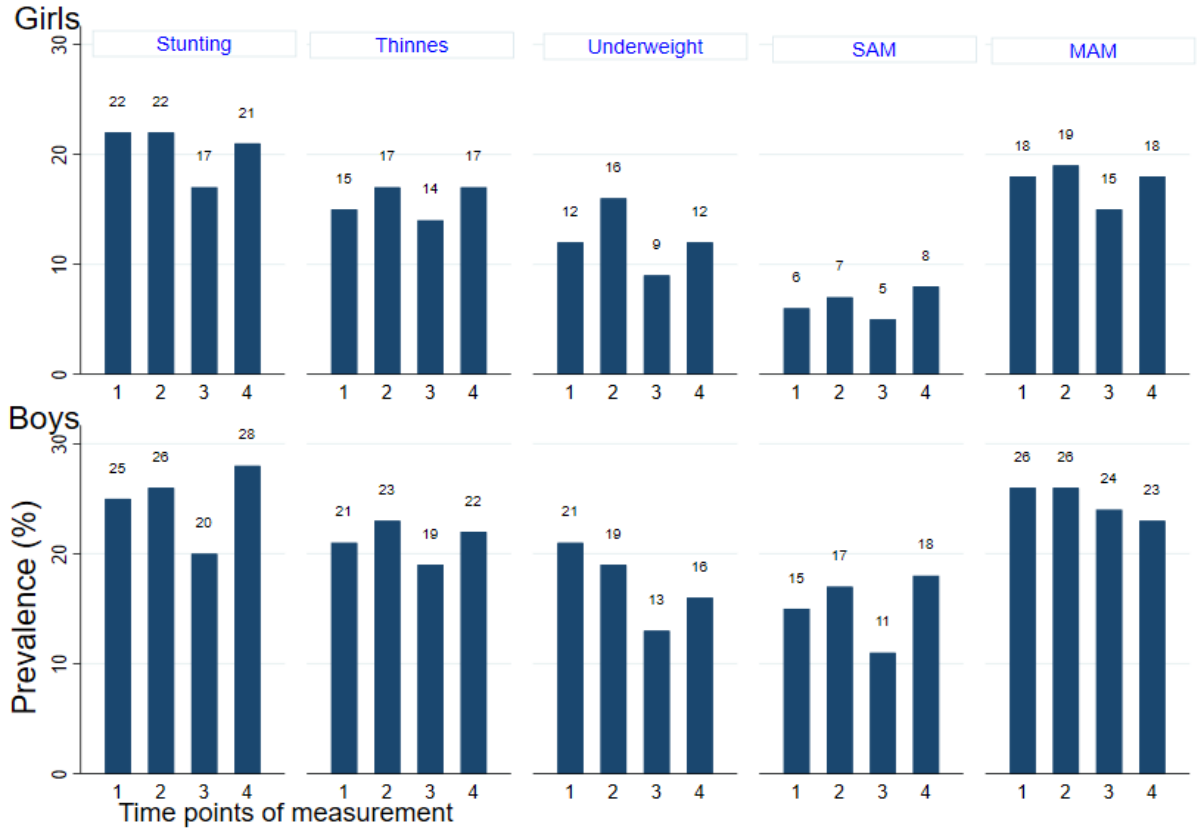

Figure 8: Overall prevalence, all ages, nutritional indicators

SAM: Severe Acute Malnutrition; MAM: Moderate Acute Malnutrition.

The prevalence of stunting and thinness, thus, at the baseline measurement and the end measurement were comparable with a finding of a national cross-sectional study among children in 142 schools in all 11 regions of Ethiopia, in which stunting of 22.3% and thinness of 23.1% were reported (Hall et al., 2008).

Modified Composite Index of Anthropometric Failure (mCIAF)

Composite index of malnutrition indicated that a difference in prevalence of malnutrition had increased slight on the second measurement. However, with reference to the baseline condition, overall, 5.6 percentage points (or 13%) reduction of prevalence from any anthropometric failure was achieved by Time III. Prevalence in all age- boys and girls had declined by 5.9 percentage points of (12.7%) and 5.2 (13.1%), respectively. Conversely, the overall all prevalence of anthropometric failure worsened back to its baseline state (Table 21). Detailed prevalence of each nutritional failure indicators can be found in Supplementary Table 25.

Table 21: Modified Composite Index of Anthropometric Failure (Prevalence of any form of nutritional failure)

Age/Sex /Time	5-9 Years			10-14 Years			15-19 Years			All ages		
	Girls	Boys	Both	Girls	Boys	Both	Girls	Boys	Both	Girls	Boys	Both
I	32.7	40.5	36.8	44.0	49.7	47.1	38.8	50.8	44.8	39.7	46.5	43.4
II	33.4	39.0	36.4	44.3	50.1	47.5	36.8	51.4	44.0	40.3	46.4	43.6
III	26.3	32.3	29.5	39.0	44.3	41.9	31.4	44.8	38.2	34.5	40.6	37.8
IV	31.6	35.7	33.7	42.8	48.0	45.6	31.0	59.7	45.9	39.2	47.0	43.4

All sex differences are significant at $p<0.0001$.

The data indicated that prevalence of any form of malnutrition has declined during the time when school meals were served. However, the prevalence increased again during the formal school break as well as after complete disruption of meals during the COVID-19 lockdown.

Conclusion

This study indicated that use of mCIAF and MUAC-for-age showed an overall similar classification of malnourishment. Mixed effects model showed significant variations in nutritional status of schoolchildren across sub cities. Assessment by mCIAF, showed a higher prevalence of overall malnutrition (43.4%) during the baseline assessment than did the separate conventional measures. The mCIAF showed significant differences ($p<0.0001$) in nutritional status between boys and girls, and among different age groups. Repeated ANOVA showed significance differences in all measurements between the four measurement time points.

SFP had medium to large effect sizes on the physical growth of school-age children and adolescents. However, the interruption of school meals during summer break and the COVID-19 lockdown compromised nutritional wellbeing of schoolchildren.

Annex

Supplementary Table 22: Between and within variations in height, weight, BMI and MUAC among girls

Age group	Variable		Mean	SD	Min	Max	Observations
5-9	Height	Overall	128.4	8.0	100.0	157.0	N = 2566
		Between		7.6	100.8	156.4	n = 759
		Within		2.8	118.7	141.8	T = 3.38076
	Weight	Overall	25.2	5.0	12.0	52.0	N = 2566
		Between		4.6	15.5	50.5	n = 759
		Within		2.3	7.4	37.1	T = 3.38076
	BMI	Overall	15.2	2.3	9.6	31.3	N = 2566
		Between		2.1	10.8	27.5	n = 759
		Within		1.1	5.8	23.4	T = 3.38076
	MUAC	Overall	17.2	1.9	8.7	27.0	N = 2566
		Between		1.6	10.4	26.0	n = 759
		Within		1.0	12.7	22.7	T = 3.38076
10-14	Height	Overall	143.9	10.0	111.9	175.0	N = 5268
		Between		9.7	113.7	172.0	n = 1596
		Within		3.0	134.3	162.8	T bar = 3.30075
	Weight	Overall	35.7	8.4	16.0	84.0	N = 5268
		Between		8.1	16.5	77.0	n = 1596
		Within		2.8	20.4	50.2	T bar = 3.30075
	BMI	Overall	17.1	3.0	9.2	34.5	N = 5268
		Between		2.8	10.4	32.9	n = 1596
		Within		1.0	10.4	25.1	T bar = 3.30075
	MUAC	Overall	19.5	2.4	11.1	36.0	N = 5268
		Between		2.2	12.8	30.4	n = 1596
		Within		1.1	13.4	25.8	T bar = 3.30075
15-19	Height	Overall	155.3	8.1	127.8	176.2	N = 474
		Between		8.1	130.0	176.2	n = 245
		Within		1.9	148.2	165.5	T bar = 1.93469
	Weight	Overall	47.8	8.1	24.0	80.8	N = 474
		Between		7.9	24.0	80.8	n = 245
		Within		1.9	41.4	57.1	T bar = 1.93469
	BMI	Overall	19.8	3.0	12.8	31.5	N = 474
		Between		2.9	13.4	31.5	n = 245
		Within		0.7	15.5	22.9	T bar = 1.93469
	MUAC	Overall	22.3	2.6	15.0	34.8	N = 474
		Between		2.6	16.0	34.8	n = 245
		Within		1.0	18.0	27.0	T bar = 1.93469

Table 23: Between and within variations in height, weight, BMI and MUAC among boys.

Age group	Variable		Mean	SD	Min	Max	Observations
5-9	Height	Overall	127.5	7.6	106.0	162.0	N = 2847
		Between		7.1	106.8	157.8	n = 845
		Within		2.9	107.4	148.4	T = 3.36923
	Weight	Overall	24.8	4.5	13.0	51.1	N = 2847
		Between		4.1	14.3	49.1	n = 845
		Within		2.1	14.0	39.4	T = 3.36923
	BMI	Overall	15.2	2.0	10.3	30.4	N = 2847
		Between		1.8	11.0	24.9	n = 845
		Within		1.0	9.5	24.3	T = 3.36923
	MUAC	Overall	17.0	1.6	11.4	27.2	N = 2847
		Between		1.4	13.8	26.4	n = 845
		Within		0.9	12.1	22.3	T = 3.36923
10-14	Height	Overall	142.5	10.4	107.0	183.5	N = 6334
		Between		10.1	110.8	180.9	n = 1914
		Within		3.3	120.3	167.4	T bar = 3.3093
	Weight	Overall	33.4	7.3	15.8	69.9	N = 6334
		Between		6.9	15.8	62.7	n = 1914
		Within		2.7	17.7	49.7	T bar = 3.3093
	BMI	Overall	16.3	2.3	9.9	31.3	N = 6334
		Between		2.2	9.9	28.0	n = 1914
		Within		1.0	10.0	26.0	T bar = 3.3093
	MUAC	Overall	18.8	2.2	8.5	30.0	N = 6334
		Between		2.0	9.5	28.5	n = 1914
		Within		1.1	10.3	27.4	T bar = 3.3093
15-19	Height	Overall	159.2	9.2	124.0	179.7	N = 491
		Between		9.3	126.0	177.5	n = 263
		Within		1.9	153.5	168.0	T bar = 1.86692
	Weight	Overall	45.4	8.3	20.0	75.0	N = 491
		Between		8.3	20.5	75.0	n = 263
		Within		2.0	37.8	56.1	T bar = 1.86692
	BMI	Overall	17.8	2.5	12.0	28.6	N = 491
		Between		2.5	12.0	28.6	n = 263
		Within		0.7	13.0	22.2	T bar = 1.86692
	MUAC	Overall	21.2	2.6	12.8	29.7	N = 491
		Between		2.4	12.8	29.7	n = 263
		Within		0.8	17.8	24.3	T bar = 1.86692

Supplementary Table 24: Mean and SD HAZ, WAZ, BAZ, and MUACZ over time, and by sex and age group

Time	Age	Sex	HAZ Mean (SD)	WAZ Mean (SD)	BAZ Mean (SD)	MUACZ Mean (SD)
Jun2019	5-9	Girls	-0.6 (1.2)	-0.8 (1.2)	-0.7 (1.4)	-1.2 (1)
		Boys	-0.8 (1.2)	-1 (1.2)	-0.8 (1.4)	-1.5 (1.1)
	15-19	Girls	-1.3 (1.2)		-0.3 (1.2)	-1.3 (1.2)
		Boys	-1.8 (1.1)		-1 (1.3)	-2.7 (1.3)
	10-14	Girls	-1.3 (1.3)		-0.6 (1.4)	-1.4 (1.1)
		Boys	-1.4 (1.2)		-1 (1.4)	-2 (1.3)
Oct2019	5-9	Girls	-0.6 (1.2)	-0.9 (1.1)	-0.8 (1.3)	-1.3 (1)
		Boys	-0.8 (1.2)	-1.1 (1.1)	-0.9 (1.4)	-1.5 (1.1)
	15-19	Girls	-1.3 (1.2)		-0.4 (1.2)	-1.4 (1.3)
		Boys	-1.7 (1.1)		-1.4 (1.2)	-2.8 (1.4)
	10-14	Girls	-1.3 (1.3)		-0.9 (1.3)	-1.5 (1.2)
		Boys	-1.4 (1.2)		-1.2 (1.3)	-2.1 (1.3)
Jan2020	5-9	Girls	-0.4 (1.2)	-0.6 (1.1)	-0.6 (1.2)	-1 (1)
		Boys	-0.6 (1.2)	-0.8 (1.1)	-0.6 (1.2)	-1.2 (1.1)
	15-19	Girls	-0.9 (1.1)		-0.2 (1.1)	-1.2 (1.2)
		Boys	-1.6 (1.2)		-1.2 (1.3)	-2.6 (1.7)
	10-14	Girls	-1.1 (1.3)		-0.7 (1.2)	-1.3 (1.1)
		Boys	-1.3 (1.2)		-1 (1.2)	-1.8 (1.2)
Jan2021	5-9	Girls	-0.5 (1.2)	-0.7 (1.2)	-0.5 (1.3)	-1 (1.1)
		Boys	-0.7 (1.2)	-0.8 (1.2)	-0.6 (1.3)	-1.1 (1.1)
	15-19	Girls	-0.9 (1.2)		-0.7 (1.2)	-1.5 (1.3)
		Boys	-1.7 (1.2)"		-1.6 (1.3)	-2.8 (1.6)
	10-14	Girls	-1.2 (1.2)		-0.9 (1.3)	-1.4 (1.2)
		Boys	-1.4 (1.2)		-1.1 (1.3)	-1.9 (1.3)

Supplementary Table 25: Modified CIAF Groups over time, by age and sex groups

5-9 Years	I			II			III			IV		
Modified CIAF	Girls	Boys	Both	Girls	Boys	Both	Girls	Boys	Both	Girls	Boys	Both
Without anthropometric failure	67.3	59.5	63.2	66.6	61.0	63.6	73.7	67.7	70.5	68.5	64.3	66.31
Thinness only	6.9	7.2	7.0	6.9	8.8	7.9	6.9	7.5	7.2	5.8	4.8	5.32
Thinness and Underweight	6.3	8.8	7.6	6.9	8.5	7.7	4.1	4.9	4.5	4.4	6.9	5.67
Stunting, Thinness, and Underweight	1.5	2.3	1.9	1.7	2.0	1.8	1.5	1.6	1.5	1.5	1.2	1.3
Stunting and Underweight	2.9	6.8	4.9	3.4	6.3	4.9	1.6	3.7	2.7	3.4	5.1	4.26
Stunting only	4.4	3.9	4.1	3.8	5.1	4.5	1.9	4.4	3.2	3.4	5.1	4.26
Overweight (overweight)	7.1	6.3	6.7	5.2	4.4	4.7	6.2	6.9	6.5	10.4	9.2	9.81
Stunting and excess weight	2.2	2.4	2.3	1.5	1.6	1.6	1.8	0.9	1.3	0.7	0.9	0.83
Underweight only	1.5	3.0	2.2	4.1	2.4	3.2	2.4	2.5	2.4	1.9	2.5	2.25
Chi-square (p-value)	25.1 (0.001)			17.4 (0.027)			17 (0.03)			7 (0.5)		
10-14 Years												
Without anthropometric failure	56.0	50.3	52.9	55.7	49.9	52.6	61.0	55.7	58.1	57.2	52.0	54.37
Thinness only	11.3	15.7	13.7	12.7	16.6	14.8	11.6	15.7	13.8	13.3	13.8	13.58
Stunting, Thinness, and Underweight	4.4	7.3	6.0	5.6	7.5	6.6	4.0	6.0	5.1	5.6	8.6	7.21
Stunting only	18.3	19.6	19.0	19.1	21.3	20.3	15.6	17.8	16.8	17.0	20.1	18.69
Overweight (overweight)	4.9	4.2	4.5	3.5	2.6	3.0	5.0	3.9	4.4	4.7	4.1	4.34
Stunting and excess weight	5.2	2.9	4.0	3.4	2.1	2.7	2.8	1.0	1.8	2.3	1.5	1.82
Chi-square (p-value)	33.7 (0)			23.4 (0)			34.4 (0)			20.8 (0.001)		
15-19 Years												
Without anthropometric failure	61.2	49.3	55.2	63.2	48.7	56.0	68.6	55.2	61.9	69.0	40.3	54.13
Thinness only	4.5	11.9	8.2	7.9	18.9	13.3	3.5	13.8	8.7	10.2	18.6	14.57
Stunting, Thinness, and Underweight	3.0	10.5	6.7	2.6	9.5	6.0	0.0	10.3	5.2	2.9	16.7	10.04
Stunting only	13.4	22.4	17.9	17.1	20.3	18.7	12.8	18.4	15.6	11.0	20.9	16.14
Overweight (overweight)	10.5	3.0	6.7	7.9	1.4	4.7	12.8	2.3	7.5	4.5	1.9	3.15
Stunting and excess weight	7.5	3.0	5.2	1.3	1.4	1.3	2.3	0.0	1.2	2.5	1.5	1.97
Chi-square (p-value)	11.5 (0.043)			11.4 (0.044)			24.7 (0)			60.7 (0)		

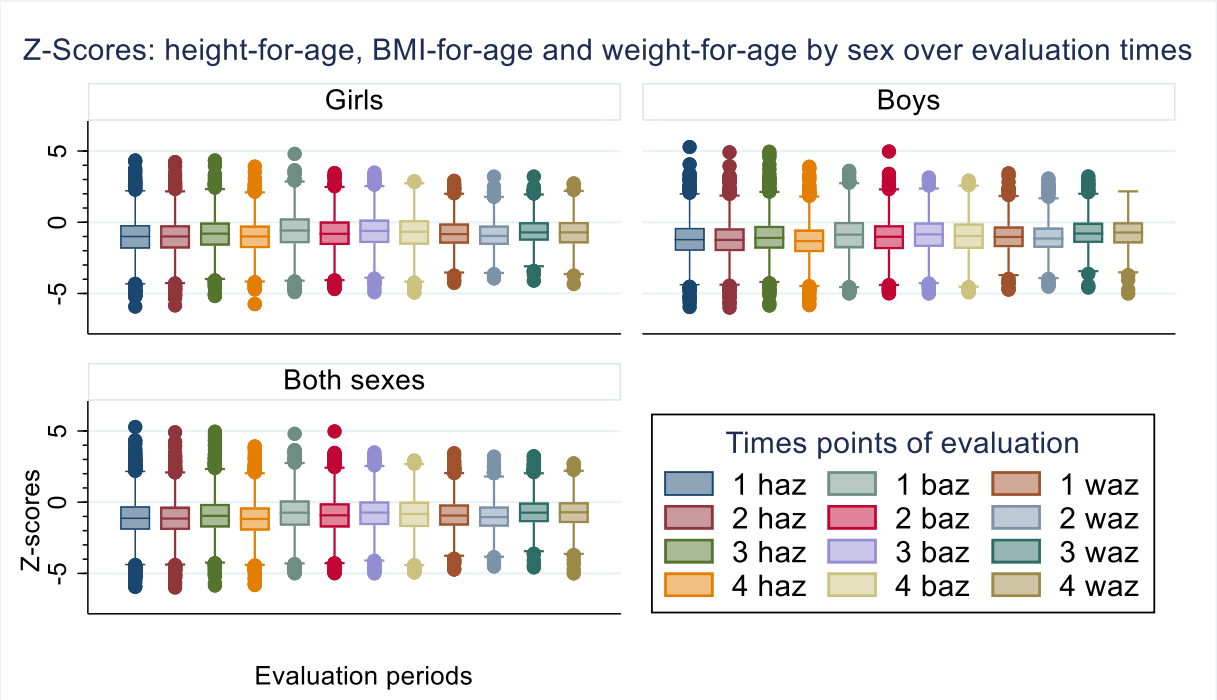

Figure 9: Box plot of Z-scores of Height-for-age, BMI-for-age, Weight-for-age, by sex over measurement times

Supplementary Table 26: Prevalence (%) of stunting and underweight by age and sex, over time

Age	Sex	Time I	Time II	Time III	Time IV
Stunting					
5-9	Girls	10.9	10.4	6.8	9.2
	Boys	15.3	15.1	10.5	12.6
	Both	13.2**	12.9**	8.8**	10.9
10-14	Girls	27.9	28.1	22.4	24.8
	Boys	29.8	30.9	24.8	30.1
	Both	28.9	29.6*	23.7	27.7***
15-19	Girls	23.9	21.1	15.1	16.3
	Boys	35.8	31.1	28.7	39.2
	Both	29.9	26.0	22.0**	28.2***
All age	Girls	21.6	21.8	17.0	20.7
	Boys	24.9	25.6	20.4	27.9
	Both	23.4**	23.9***	18.8**	24.6***
Underweight					
5-9	Girls	12.0	16.0	9.3	11.6
	Boys	20.6	19.2	12.7	16.3
	Both	16.5***	17.7*	11.1	14.0

Chi-square tests are for sex differences by age over time.
****p<0.01; **p<0.05; *p<0.1*

Supplementary Table 27: Prevalence (%) of thinness and acute malnutrition by age and sex, over time

Age	Sex	Thinness				MUAC							
		Time I	Time II	Time III	Time IV	Time I		Time II		Time III		IV	
						SAM	MAM	SAM	MAM	SAM	MAM	SAM	MAM
5-9	Girls	14.6	15.4	12.5	11.6	2.9	14.1	3.2	17.5	2.2	11.6	3.4	13.5
	Boys	18.2	19.2	14.0	12.8	9.0	21.4	7.7	20.7	4.0	20.7	6.4	11.0
	Both	16.5	17.5	13.3	12.2	6.1	18.0	5.6	19.2	3.1	16.4	4.9	12.2NS
10-14	Girls	15.7	18.3	15.6	18.9	7.0	20.6	9.7	20.6	5.8	16.9	8.7	18.7
	Boys	23.0	24.1	21.6	22.4	17.6	28.9	19.8	28.4	14.0	24.7	18.1	25.2
	Both	19.7***	21.4***	18.9***	20.8***	12.8	25.1	15.2	24.8	10.3	21.1	13.9	22.2
15-19	Girls	7.5	10.5	3.5	13.1	10.5	14.9	7.9	15.8	7.0	12.8	9.8	21.6
	Boys	22.4	28.4	24.1	35.4	35.8	34.3	48.7	25.7	25.3	40.2	38.8	31.9
	Both	14.9***	19.3***	13.9***	24.6***	23.1	24.6	28.0	20.7	16.2	26.6	24.8	27.0
All age	Girls	15.0	17.0	14.1	16.8	5.6	18.1	7.4	19.4	4.7	15.0	7.8	18.0
	Boys	21.3	22.6	19.3	22.0	15.1	26.4	16.6	25.7	11.3	24.0	18.2	23.3
	Both	18.4***	20.0***	16.9***	19.6***	10.7	22.6	12.4	22.8	8.2	19.8	13.4	20.9

Chi-square tests are for sex differences by age over time.
All MUAC prevalence are sig. at p<0.0001, except round 4 age 5-9.

Chapter III: Dietary adequacy and nutritional quality of meals provided in the Addis Ababa School Feeding Program

Abstract

Objective: This study evaluated the impact of the Addis Ababa SFP on educational outcomes.

Design: Single-group repeated measurement/longitudinal study design and multistage stratified sampling design was followed. Effect sizes estimates, repeated measures ANOVA, Chi-square, random effects GLS, and mixed effects negative binomial regression were used. Academic scores, attendance and dropout, and height and weight of schoolchildren were collected.

Setting: School Feeding Programs in Addis Ababa, Ethiopia.

Participants: Schoolchildren in primary schools, and school directors and teachers in 15 randomly selected schools for KII.

Results: Anthropometric measurements of 4500 schoolchildren were taken from 50 schools. Academic scores of 3924 schoolchildren from 46 schools, class attendance records of 1584 schoolchildren from 18 schools, and annual enrollment records of 50 schools were gathered. School meals achieved a minimum to large scale effects on educational outcomes with effect sizes ($\eta 2$) of academic scores (boys = 0.023, girls = 0.04), enrollment (girls = 0.001, boys = 0.05), and attendance (Cramer's V = 0.2). The average scores of girls were significantly higher than that of boys ($p < 0.0001$). Height-for-age ($p = 0.006$) and BMI-for-age Z-scores ($p = 0.05$) ever had significant positive relationship with average scores. Significant relation was observed between nutritional status and attendance ($p = 0.021$). KIIs showed that SFP created convenient teaching-learning environment, reduced hunger in schools, while boosting enrollment, attendance, and academic performance among the schoolchildren.

Conclusion: The Addis Ababa SFP has positively contributed to educational outcomes. Strengthening the program would enhance nutritional outcomes and diminish educational inequalities.

Keywords: Education, educational performance, food security, nutrition, school attendance, school feeding, school meals, social protection.

Introduction

School Feeding Programs (SFP) are the largest social protection programs worldwide that feed a large number of students during their stay in schools (Drake et al., 2017). Thus, SFPs contribute to the food security and wellbeing of food deprived students if the served meals maintain nutrition standards in terms of provision of safe, nutritious and adequate meals (Cohen et al., 2021; WHO, 2006b).

World Food Program (WFP) recommends 1850 calories or 2600 calories of energy for school-age children of age 7–12 or adolescents of age 13–17 years old, respectively (WFP, 2017). Daily energy requirement ranges from 1850–2850 calories for boys and 1750–2150 calories for girls (FAO/WHO/UNU, 1985). Supplementary Table 33 presents the FAO/WHO/UNU joint recommendation of energy and protein intakes.

Daily calories intake of children and adolescents is determined by their age and sex group, genetics and daily activities (Institute of Medicine, 2005). Accordingly, children are grouped as sedentary (exercise <30 min/day), moderately active (30–60 min/day), and active (60 min/day). The calorie requirements for sedentary, moderately active, and active adolescent boys of ages between 12 years and 18 years require 1800–2600 calories, 2200–2800calories, and 2400–3200 calories of energy each day, respectively. Similarly, sedentary, moderately active, and active adolescent girls of ages between 12 years and 18 years old are 1600–2000Cal, 2000–2200Cal, and 2200–2400Cal energy each day, respectively (Institute of Medicine, 2005).

As far as SFPs are concerned, in order for the school feeding programs to benefit schoolchildren, FAO (2019a) and WHO (2006b) suggest school meals to contribute at least a third or 30% of daily requirements whereas WFP suggests a full day school meal shall provide 60–75% of a schoolchild's energy and nutrients requirements (WFP, 2017).

Studies from different countries on the issue showed different results. In Nigeria, Ayogu et al. (2018) studied if school meals met one third of the Recommended Nutrient Intake (RNI) of the children. They collected food samples (20g) that constituted the school meals for five consecutive days from three schools where school lunch program was implemented. The data showed that the school meals provided over one third of the RNI for protein, vitamins A and C, and zinc but did not meet a third of the RNI for energy, calcium and iron.

In Ghana, on-site school lunch was reported less diversified with no eggs, meat, poultry or milk, or other dairy products were served during the study period (Agbozo et al., 2018). The on-site lunch was not micronutrient adequate. Requirements for proteins, carbohydrates, fat, vitamins A and C and iron were met above the FAO's recommendation.

In San Diego, USA, an observational study was conducted among students in 43 elementary schools during the 2011-2012 school years and showed that school lunch was of a higher diet quality (Au et al., 2016).

Evaluation of energy and nutrient intakes of Swedish children from school lunch showed that boys had significantly higher energy and absolute nutrient intake than girls (Persson Osowski et al., 2017). It is also reported that regular school lunch consumption was associated with a higher total intake for most nutrients, but not with a better nutrient density.

School lunches in Canada contributed lower intakes of dark green and orange vegetables, whole fruit, whole grains, and fluid milk that are rather important for health (Tugault-Lafleur and Black, 2020).

Moreover, calorie inadequacies and deficiency of micronutrients among school-age children and adolescents have been reported in different studies (Biesalski Hans and Jana, 2018).

Thus, these mixed findings indicate that it is useful to assess the nutritional content and quantity of meals served in schools. Since, SFP improves food security status of school-age children and adolescents, proper planning, implementation and assessment of the meal provision helps to maintain access to foods that ultimately benefit nutritional and health wellbeing as well as school attendance and educational performance of schoolchildren.

In its review of Nutrition in Action in Schools, WHO (WHO, 2020) suggested that parents' participation in school-based nutrition interventions, effective education on nutrition and physical activity, healthy school food environments and growth monitoring of students are crucial in nutritional related school policies.

The nutritional value and dietary adequacy of the meals served in the Addis Ababa SFP were not well known. Thus, it is important to evaluate the energy and nutrient contribution of the school meals that are served during breakfast and lunch times each school day. This study aimed at assessing the dietary quality and adequacy of the school meals served in Addis Ababa.

Objective

The main objective of this chapter was to evaluate the dietary quality and adequacy of the school meals served in schools in the Addis Ababa School feeding programs against Recommended Nutrient Intakes (RNI).

In order to achieve the evaluation, the following summary activities were followed.

A) Evaluate weight of food portion served in schools per day
B) Estimate the percentage of moisture content of meals served
C) Evaluate the amount of the total calorie, macro- and micro-nutrient content of food items served to a school-age child per school day
D) Determine proportion of energy, macro- and micro-nutrients made available by daily school meals against the Recommend Nutrient Intakes.

Methods

Sample size

The sample size was determined assuming a relative error and linking to coefficient of variation (CV) as is the case in national dietary surveys that sample size does not depend on the size of the population (Beaton et al., 1979; Becker, 2002; Welten, 2002; Tonkikh et al., 2019).

$$n = (\frac{Z_\alpha}{r})^2 \times (CV)^2$$

where CV is the coefficient of variation for the real population (10%); Z_α the value of the normal deviation (Z-score) corresponding to a probability (1.96); α, level of significance (0.05); and r, the relative error accepted (10%). Considering a design effect, *Deff*, of 1.25, a minimum sample of five meals per food item and a total of 55 samples from 11 food items (food menu) served per week was determined.

Data collection

Weight of five meals of each of 11 types of food items served during breakfast or lunch in each school days, Monday–Thursday, were measured using digital scale from 15 selected school kitchens. Sample of each food items were taken to laboratory to quantify moisture contents and weight of dry matter per 100mg food sample, and to estimate energy and nutrient contents based on the dry matter. The food menu for Friday repeats any one of the meals served in the previous four days, thus, variable depending on preference of each school kitchen. Food moisture content and weight of dry matter were determined at the Food Science and Nutrition laboratory, CNCS, AAU. Initial sample weights were recorded and dried in an oven at a temperature of 60°C to constant weight.

Data analysis

The amount of food moisture per 100gm edible portion was calculated for each meal type from the difference between the initial weight of the fresh and dried food. This was compared with the value for the same food item described in the Food Composition Table for use in Ethiopia (EHNRI, 1998)

The food energy/calories of cooked meals served was calculated, based on the dry matter, using a conversion factor adjusted for the percentage moisture differences between the cooked edible meal

and the reference food edible portions. Then the total food energy/calories of each cooked meal were converted by a factor of the adjusted food energy available in 100gm edible portions of the corresponding food type in the reference food composition table. Thus, the rate of conversion (the ratio of the dry matter from the sample meal to that of the reference meal in the FCT) was:

$$C_s = \frac{1 - r_s}{1 - r_{ref}} \times K_{ref}$$

where, C_s is the amount of the sample meal energy per 100gm edible portion; r_{ref} is the proportion of the reference food moisture; r_s is the proportion of the sample meal moisture; and K_{ref} is the amount of the reference food energy per 100gm edible portion. The weighted average daily calories/energy per breakfast, lunch or a full day were then calculated from the total number of meals served within a week accounting for the frequency of the meal types served throughout the four-week days. Similarly, the amount of nutrients available in the meals is also calculated using the same conversion factor.

Moisture for egg, marmalade and tea were taken directly from the reference food composition table without need for sample drying. The calories and nutrient contents of marmalade were taken from the factory labelling printed on the can.

Coefficient of variations were used to compare variations among school kitchens in terms of the meal weights, measured moisture of each food types, and the food energy of the sample meals.

Independent samples t-test was used to test for significant differences in the calories and nutrient contents between the school meals and the meals in the reference national food composition table. The national food composition table provides the average energy and nutrients of foods prepared in households (EHNRI, 1998). Thus, the difference from the reference energy and nutrients indicates only if the nutritional value of school meals was higher or lower than that prepared at households.

Results and discussion

The weekly menu of the school kitchens, summary of meal weight, moisture, food energy and nutrient contents of different meals served to schoolchildren under the Addis Ababa School Feeding Program is presented and discussed hereunder. According to the school menu, meal type served on Friday is anyone of the foods served in the previous four days. In general, the Addis Ababa SFP provision or serving of two school meals per day, i.e., breakfast and lunch (Table 28), was in line with WHO recommendation (WHO, 2006b).

Table 28: School meals weekly menu

Days/Time	Monday	Tuesday	Wednesday	Thursday	Friday
Breakfast	Firfir	White bread (*Difo*)	Refined bread	*Firfir*	Any of the four
	Tea	Tea	Marmalade	Tea	Any of the four
			Tea		
Lunch	Injera	Rice	Injera	Injera	Any of the four
	Lentil-based sauce	Bread	Potato-based sauce	Shiro-based	Any of the four
				Boiled egg	

Food Portion Size

Table 29 presents the summary of the cooked weight/portion size of the meals served. The names of the food items are presented according to the food composition table (EHNRI, 1998). Five samples of each of the 11 food items served within the four school/week days were considered. The coefficient of variations of each meal type showed higher variability of the portion sizes of some meals, such as *firfir, injera, lentil sauce, and potato sauce,* served per student in each of the school kitchens. Whereas, small variations were observed among other meals such as bread, egg, rice, *shiro sauce*, and white bread (*Diffo*), served by school kitchens.

However, although portion sizes of cooked rice, potato, *Shiro* (prepared from medium roasted and ground peas or beans), lentil sauces, and bread were in accordance with the WHO recommended daily portion sizes, the meals did not contain and, thus, did not comply with the recommended daily consumption of fruits, vegetables, meat, fish, poultry, milk and milk products, nuts and seeds (WHO, 2006b).

Table 29: Mean and standard deviations of food portion sizes (g) served in schools

Food item (according to FCT Ethiopia)	No. of samples	Frequency over four-week days*	Average Amount (g) served per student	Mean weight (g) ± SD	% Coefficient of Variation	Food group
Nech sinde dabo (Wheat, bread, white) – (Refined)	5	1	65.2	65.2 ± 6.8	10.5	Cereal
Inkulal, difin, yetekekele (Egg, whole, boiled)	5	1	62.4	62.4 ± 4.2	6.7	Egg
Teff dibiliq injera (*Firfir*)	5	2	184	184 ± 33.6	18.3	Cereal
Teff dibiliq injera	5	3	290.6	290.6 ± 37.4	12.9	Cereal
Misir wet, key (Lentil (split), chill, shallot, oil, salt: sauce)	5	1	210.6	210.6 ± 25.1	11.9	Legume
Marmalade	5	1	13.2	13.2 ± 0.8	0.6	Sweets
Dinich wet (Potato, shallot, chill, oil, garlic, salt: sauce)	5	1	260	260 ± 53.9	20.7	Root
Ruz, Yetekekele (Rice, whole grain, boiled)	5	1	298.4	298.4 ± 25.6	8.6	Cereal
Shiro wet (Grass pea flour (roasted), chill, sunflower extract, salt: sauce)	5	1	231.2	231.2 ± 11.2	4.8	Legume
Shay, yetefela (Tea leaves)	5	4	127.2	127.2 ± 6.8	0.5	Beverage
Nech sinde dabo (Wheat, bread, white) – (*Difo*)	5	2	127.2	127.2 ± 6.8	5.4	Cereal
Average portion size (g/day)				Breakfast Mean ± SD	Lunch Mean ± SD	Daily Mean ± SD
				275.6 ± 9.4	444.4 ± 11.1	719.9 ± 11.4

*According to the school meal menu, meal type served on Friday is anyone of the foods served in the previous four days.
The higher the CV, the greater the dispersion in the variable.

Looking at the food groups in Table 29, spices and condiments may be added during cooking, but a number of other food groups required to maintain nutrient requirements were not served. Apparently, the food items in the school meals lack milk and milk products, meat and meat products, vegetables and fruits. This indicated that the current school menu is less diversified enough to collectively provide adequate calories and micronutrients for the schoolchildren. The food composition of the Addis Ababa SFP meals is less diversified as compared with the menu served in schools in Ghana which consisted largely of energy-dense staples, some vegetables and fish, though, eggs, dairy and fruits were not served there, too (Agbozo et al., 2018).

The coefficient of variations showed no significant disparities among the weight of meals such as wheat bread, whole boiled egg, marmalade, whole grain boiled rice, *Shiro wet* (sauce based on mild roasted and ground grass pea and tea were served while little or acceptable variation in other meals such as *Injera* and *Firfir* made of mixed white and red *Teff (dibiliq)*, *Misir wet* (sauce based on split

Lentil legume), and *Dinich wet* (sauce based on cooked large potato cubes) was noted. This is partly similar to the findings in the study in Spain schools that great variation was seen both in the same school throughout the week and between the sampled four schools (Lavall et al., 2020).

Since the Addis Ababa School Feeding Program was established recently, the food portions and types of food groups, the nutritional composition as well as the calorie adequacy of meals served each day was not studied. Thus, the information would be useful to determine dietary quality of current meals and their nutritional adequacy (FAO, 2019a; McPherson et al., 2000; WFP, 2017).

Food moisture of school meals

The moisture content of each of the sampled meals is presented in Table 30. The coefficient of variations in the moisture contents was small among the meals served in the school kitchens indicating that variations in the food moisture content were negligible. The moisture of the sample meals was compared with that of the corresponding food types in the national food composition table of Ethiopian foods.

Table 30: Moisture of sampled school meals per 100gm edible portion: Averages, ranges, coefficient of variations among schools serving the meals and differences from the reference food composition tables equivalents

Food items	N	Mean	Mean moisture With range (g)	CV	Difference from reference value
Bread	5	30.7	30.7 ± 3.2	10.3	16.8***
Egg	5	74.4	74.4 ± 0.0	0.0	NA
Firfir	5	75.9	75.9 ± 3.4	4.5	NA
Injera	5	61.8	61.8 ± 3.6	5.9	0.36
Lentil	5	83.0	83.0 ± 1.9	2.3	-9.6***
Potato	5	86.3	86.3 ± 1.4	1.7	-7.5***
Rice	5	68.4	68.4 ± 2.8	4.2	3.08**
Shiro	5	89.1	89.1 ± 0.3	0.3	-13.82***
White bread (*Diffo*)	5	44.9	44.9 ± 1.4	3.0	-0.36

The samples of the food types used in the food composition table were collected from meals prepared at households (EHNRI, 1998). Thus, the difference in the moisture content between meals served in school kitchens and that of in the food composition would show the school meals condition with reference to meals prepared at household level.

Accordingly, the moisture content of bread and rice served in schools were significantly lower than the corresponding (reference) bread and rice prepared at household level (bread, $p<0.01$; rice, $p<0.05$). However, the moisture content of sauces, such as lentil, potato and *shiro,* prepared at school kitchens were significantly higher than that prepared at homes. This would imply that the

energy and nutrient content of meals served at schools would be lower than meals served at homes. No significant difference was observed between moisture of injera served at schools and at homes.

Food energy gained from each food items served in schools

The energy content/calories of each of the sample meals collected from schools were presented and the variations in calories were compared among the school kitchens (Table 31). The coefficient of variation (CV) showed that minor disparities in calories were observed for the majority of the meal types among the schools, except in tea, and potato. These energy differences were linked to the weight and moisture content of the meals served as clearly indicated in Table 29 and Table 30.

Table 31: Calories of sampled school meals: Average, SD, coefficient of variations among schools serving the meals and differences from the reference food composition tables equivalents

Food items	N	Mean	Mean calories with range (g)	CV	Difference from reference value
Bread	5	180.2	176.1 ± 13.5	7.5	-42.3***
Egg	5	95.4	95.4 ± 6.4	6.7	NA
Firfir	5	173.4	173.4 ± 19.9	11.5	NA
Injera	5	443.6	443.6 ± 88.5	19.9	-7.08
Lentil	5	136.3	136.3 ± 18.8	13.8	77.3***
Marmalade	5	28.4	28.4 ± 1.8	6.3	NA
Potato	5	134.4	134.4 ± 32.9	24.5	73.6***
Rice	5	364.9	364.9 ± 19.4	5.3	-33.97**
Shiro	5	97.8	97.8 ± 5.9	6.0	124.2***
Tea	5	199.4	199.4 ± 42.9	21.6	NA
White bread (*Diffo*)	5	280.5	280.5 ± 14.6	5.2	1.9

The calories of the sampled meals were compared with that of the corresponding reference meals prepared at households obtained from the national food composition table (Table 31). Thus, the difference from the reference food energy and nutrients indicates only that whether the nutritional value of school meals was higher or lower than that prepared at homes.

If the sampled meal weight was not adjusted for its moisture content, its calories would be similar to the calories estimated in the national food composition table. However, adjusting the sampled meal weight for its moisture helped to control for reporting inflated calories and nutrient contents. Table 31, thus, compares if the moisture adjusted calorie difference existed between sampled school meals and that of the reference food type of the same weight as the sample.

Accordingly, the calories of major sauces such as lentil, potato and *Shiro* served at school kitchens were significantly lower than the energy content of the same portion size of meals served at

households ($p<0.01$), while bread and rice served at schools had higher calories (bread, $p<0.01$; rice, $p<0.05$). In another study elsewhere, which compared calories differences between foods brought from home and those served at school meal programs showed mixed findings where home brought lunches had significantly more calories while school meals had much higher diet quality (Everitt et al., 2020).

Total calories gained from school meals

Table 32 shows the mean energy obtained from breakfast, lunch and a full day weighted average from meals served during Monday through Thursday. On Friday, children were served any one of the menus served in the previous days of the week.

Recommended Nutrients Intakes (RNI) of the nutrients and calories were derived from World Food Program (WFP, 2017), the joint FAO/WHO Recommended Nutrient Intakes (RNIs) (WHO and FAO, 1996), FAO, WHO and UNU (FAO/WHO/UNU, 1985) and Recommended Dietary Allowances by National Research Council (US) Subcommittee (Council, 1989).The daily Recommended Nutrients Intake (RNI) by WFP is 1850 calories and 2600 calories for younger children (7–12 years old) and adolescent (13–17 years old) (WFP, 2017). According to FAO/WHO joint recommendation (FAO/WHO/UNU, 1985), the daily energy requirement ranges from 1850–2850cal for boys and 1750–2150cal for girls.

According to FAO and WHO (FAO, 2019a; WHO, 2006b), school meals are required to contribute, at least, a third or 30% of daily requirements while WFP (2017) suggests that a full day school meal program shall provide 60–75% of children's energy and nutrients requirements. As the schools provide two meals per day, two–third of the daily energy and nutrients would be justified. The energy and nutrient contributions of the Addis Ababa SFPs were, thus, evaluated based on these recommendations. However, since the nutrient content estimation was based on the Ethiopia National Food Composition Table. Table 32 presents only estimates of nutrient types available in the Food Composition Table. Consequently, there are other micronutrients which were not estimated and, thus, not presented in this study.

Overall, the school meals in the Addis Ababa SFP provide an average of 882.9 Cal, which is about 48% or 34% of RNI of energy to the schoolchildren of age 7–12 years or 13–17 years old, respectively (Table 32). This is in line with guidelines of many countries school feeding programs that require provision of, at least, a third of daily requirements (FAO, 2019a).

Table 32: Mean calorie, macronutrient, mineral, vitamin content of daily meals served in the Addis Ababa SFP

Energy/ Nutrient/ Portion size	Breakfast	Lunch	Daily	RNI 7–12/13–17 years old
	Mean ± SD	Mean ± SD	Mean ± SD	
Energy (Cal/day)	363 ± 10.9	519.9 ± 16.8	882.9 ± 17	Both sexes
Percent (%) of daily requirement (7–12/ 13–17Yr.)				1850/2600[a] Adolescent girls
Both sexes	19.6/14.0	28.1/20.0	47.7/34.0	1750/2150[b]
Girls	20.7/16.9	29.7/24.2	50.5/41.1	Adolescent boys
Boys	19.6/12.7	28.1/18.2	47.7/31.0	1850/2850[b]
Macronutrients				
Protein (g)	14.9 ± 0.6	15.6 ± 0.4	30.5 ± 0.6	46–69/65–98[a]
Percent (%) of daily minimum RNI	32.4/22.9	33.9/24	66.3/46.9	
Fat (g)	3.2 ± 0.1	5.8 ± 0.1	9 ± 0.2	35–62/44–88[a]
Percent (%) of daily minimum RNI	9.1/7.2	16.6/13.2	25.7/20.5	
CHO (Inc. fiber) (g)	70.2 ± 2	102.7 ± 3.7	172.9 ± 3.6	254–347/358–488[a]
Percent (%) of daily minimum RNI	27.6/19.6	40.4/28.7	68.1/48.3	
Fiber (g)	11.7 ± 0.6	4.6 ± 0.2	16.3 ± 0.6	27–40[c]
*Percent (%) of daily minimum RNI**	119.3	32.8	68.4	
Vitamins				
β-Carotin Equiv. (RE) (mg)	1.8 ± 0.1	0.2 ± 0.01	2 ± 0.1	350-500[c]
*Percent (%) of daily minimum RNI**	0.2	0.01	0.2	
Thiamine (mg)	0.2 ± 0.01	0.5 ± 0.02	0.7 ± 0.02	0.5–0.8[c]
*Percent (%) of daily minimum RNI**	17.4	43.5	60.9	
Riboflavin (mg)	0.2 ± 0.01	0.4 ± 0.02	0.6 ± 0.02	0.6–0.9[c]
*Percent (%) of daily minimum RNI**	14.5	29	43.5	
Niacin (mg)	1.1 ± 0.04	1.8 ± 0.1	3 ± 0.1	6–10[c]
*Percent (%) of daily minimum RNI**	8	13	21.7	
Minerals				
Calcium (mg)	296.4 ± 14.6	178.1 ± 7.7	474.5 ± 15.4	250–400[c]
*Percent (%) of daily minimum RNI**	51.5	31	82.5	
Phosphorous (mg)	235 ± 6.3	373.4 ± 12	608.5 ± 11.1	800–1200[d]
*Percent (%) of daily minimum RNI**	19.6	31.2	50.7	
Iron (mg)	32 ± 1.4	37.4 ± 1.6	69.4 ± 1.9	20[c]
*Percent (%) of daily minimum RNI**	69.6	81.3	150.9	
Average portion size (g/day)	275.6 ± 9.4	444.4 ± 11.1	719.9 ± 11.4	-

[a] WFP school meals standards (WFP, 2017)
[b] FAO/WHO/UNU joint consultation FAO/WHO/UNU, 1985
[c] Nutrient density per 1000 kcal (Report of a joint FAO/WHO consultation) (WHO and FAO, 1996).
[d] The RDA for phosphorus is 800mg for children 1–10 years, 1200mg for ages 11–24 years (Council, 1989)
NB: 6 μg β-Carotene being nutritionally equivalent to 1 μg retinol
*Percentage calculated for 1000 kcal.

However, the energy obtained from the full day school meals did not comply with the WFP recommendation. As a result, since most students come from very destitute families, it is unlikely that they may get the balance from home. Thus, the schoolchildren may remain energy deficient because most may not satisfy the daily energy requirement.

School breakfasts provided about 20% and lunches about 28% of the average daily energy requirements (Table 32). These contributions did not meet a third of the RNI each. Similar studies showed that school meals contributed only 16.4–25.5% of the daily required calories in Nigeria (Ayogu et al., 2018), 20.4% in Ghana (Agbozo et al., 2018), 22.4% in Slovenian (Gregorič et al., 2015), and about 26% in Canada (Tugault-Lafleur and Black, 2020).

Girls' daily calorie requirement is relatively lower than boys (FAO/WHO/UNU, 1985), the proportion of calories they get from similar amount of school meals was higher. (Table 32). However, boys, based on their relatively higher calorie requirement, get less than a third of their daily recommended dietary energy from two meals served in schools per day. Moreover, the average daily energies provided to both sexes and age groups were nearly equivalent and above the FAO's recommendation that school meals shall provide at least a third of daily requirements (FAO, 2019a). However, available energy in school meals, by far, much lower when compared to the WFP recommendation of 60–75% of energy and nutrients requirements (WFP, 2017).

Macronutrients gained from school meals

School-age children and adolescents receive daily RNI of 46–66.3% of protein, 20.5–25.7% of fats, 48.3–68.1% of carbohydrate (including fiber), and 68.4% fiber (Table 32). These findings showed that macronutrient such as proteins and carbohydrates, but fats intake from school meals was as per the one-third Recommended Nutrients Intake (RNI) by FAO (FAO, 2019a) for school-age children. However, it was below the RNIs recommended by WFP (WFP, 2017) for adolescents (60–75%) (Table 32).

The Addis Ababa school lunch, on the other hand, contributes, at least, about 34% RNI of protein, 17% RNI of fat and 40% RNI of carbohydrates (Table 32). These findings showed that meals contributed above a third of daily recommended protein and carbohydrate, but no fats. Similar observations were made in school meals from Nigeria (Ayogu et al., 2018), Ghana (Agbozo et al., 2018), and Spain (Lavall et al., 2020). However, unlike the findings in these countries, fat content of meals in our study was below one–third of the daily requiremennts. School meals in the above

mentioned studies contained fat sources such as groundnuts, yoghurt, cow milk and other fat sources rich in oleic, linoleic, and palmitic acids (Lavall et al., 2020; MCKINLEY, 2005; Tan et al., 2014). In contrast, in Slovenian primary schools, meals did not meet minimum RNIs in carbohydrates intake (Gregorič et al., 2015).

School meals provide 68.4% of the daily required dietary fiber. This might be due to the fact that the school meals were mainly composed of whole grain and cereals which are rich in fiber. Low fiber intake might hamper smoother removal of undigested wastes from the body of schoolchildren and prevent other physiological problems (Weininger et al., 2020). Lower fiber level was also noted in school meals in Slovenia (Gregorič et al., 2015).

Micronutrients gained from the school meals

Nutrient densities of minerals and vitamins required per 1000 calories are presented in Supplementary Table 38, based on the report of a joint FAO/WHO consultation (WHO and FAO, 1996). The adequacies of such nutrients were evaluated using the energy/calorie requirements recommended for school-age children and adolescents (Table 32).

Daily β-Carotene provided by school meals was extremely below the required level (0.2%). Fruits and vegetables, such as papaya, carrots, and dark-green leafy vegetables, etc. are recommended rich sources of β-Carotin (WHO and FAO, 1996). However, as observed in the food menu in Table 28, none of these foods are served to students. β-Carotene is the most important provitamin (source of vitamin A) and its scarcity would result in blindness, poor growth, dryness and keratinization of epithelial tissues (Weininger, 2020).

Overall, the school meals provided low B vitamins such as Thiamine, Riboflavin, Niacin. They provided on average 60.9%, 43.5%, and 21.7% of the minimum daily recommended Thiamine, Riboflavin, Niacin for school-age children and adolescents, respectively. Although the meals satisfied nearly two-third of the daily required thiamine for younger schoolchildren, it was below two-third of the daily requirement for adolescents (Table 32). According to (WHO and FAO, 1996), if intake energy for adolescents is below 2000cal per day, meeting their vitamin and mineral requirements would be difficult.

Riboflavin contribution of school meals is below two-third of the daily requirements. Important foods rich in Riboflavin such as soybeans, nuts, milk, cheese, yoghurt, eggs, green leafy vegetables, and organ meats, but whole grain cereals, are mainly missing in the Addis Ababa school meals

(Table 29). School lunches in Canada also reported shortfall of Riboflavin and the school menus lacked dark green and orange vegetables, whole fruit, fruit juice, whole grains, milk and alternatives, fluid milk which made school meals poor providers of important micronutrients (Tugault-Lafleur and Black, 2020).

Niacin contribution of school meals was extremely low. Niacin rich foods such as lean meats, poultry, fish, peanuts, and enriched breads, but cereals, are apparently missing as can be seen in the school menu (Table 29). Moreover, most of the school meals are cooked at higher temperature that destroys the majority of the water-soluble vitamins available in the raw foods.

The overall lower school-based daily intake of vitamins such as Beta-Carotene, Thiamine, Riboflavin, and Niacin might be associated with the fact that school meals do not provide vitamin rich foods such as fruits and vegetables.

Iron availability in the school meals was above the recommended level. This observation is similar to that of (Agbozo et al., 2018) from Ghana but different from that of (Ayogu et al., 2018) from Nigeria. Studies showed that iron is the most critical micronutrient that is deficient worldwide among adolescents, and females lack adequate iron supply (Biesalski Hans and Jana, 2018). The reason for better iron availability in the school meals could be associated with the fact that *Injera* made of *Teff* is rich in iron as it is more frequently served in the school meals. However, this result should not mean adequate iron intake or iron bioavailability as there are several factors that hinder iron bioavailability in a body, such as phytate, polyphenols, calcium, ascorbic acid, and muscle tissue that influence iron absorption (Hurrell and Egli, 2010).

Calcium and phosphorous were lower than the recommended levels, especially for adolescents (Table 32), similar to the low availability within school lunches in Canada (Tugault-Lafleur and Black, 2020), in Nigeria (Ayogu et al., 2018), and in Slovenia (Gregorič et al., 2015). Although calcium could be obtained from legumes and pulses served in the school meals, other potential sources of calcium such as milk, cheeses, and green leaves (Gregorič et al., 2015; MCKINLEY, 2005; Tan et al., 2014) are missing in the school meals which might have compromised the daily required level of calcium intake. Similarly, except cereals, other sources of phosphorus such as milk, cheeses, and meat (MCKINLEY, 2005) are not included in the school meals served each day, thus, leading to lower intake of phosphorus. Access to adequate amount of minerals such as calcium and iron helps bones to be stronger and to prevent anemia, respectively (Weininger et al., 2020).

Considering the average portion size of meals served per day, the total weight of all of the nutrients constitutes only about 33% of the total food served for children per day from two meals, from which carbohydrate, protein, and fats constitute the higher proportions of energy, 24, 4.2, and 1.3%, respectively. In contrast fiber and micronutrients, vitamins and minerals (Beta-Carotene, thiamine, Riboflavin, Niacin, Calcium, Phosphorous, Iron and Ash), constituted of only 3.7% of the daily average portion size of the meals served (Table 32).

We noticed that school-age children and adolescents did not get adequate micronutrients from school meals to satisfy their daily requirements. However, there are opportunities and suitable environments in schools to alleviate the micronutrient deficiencies through school. For instance, studies showed that school-based micronutrient supplementation and deworming had positive effects on micronutrient status (WHO, 2020). School-based food supplementation or fortification reduced micronutrient deficiencies effectively and improved nutrition status in Sub-Saharan African countries (Kyere et al., 2020) .

In sum, macronutrients such as proteins, carbohydrates and fats are useful to build body, facilitate metabolism and supply energy. Dietary fiber is useful to reduce constipation as it absorbs water from and solidifies wastes out of a body. It is associated with lower risk for developing coronary heart diseases, diabetes, obesity and certain gastrointestinal disorders (Nirmala Prasadi and Joye, 2020). Micronutrients are important to prevent diseases and for proper functioning of the body so that proper body growth and cognitive development are maintained (Kyere et al., 2020; WHO, 2006b). Suboptimal dietary intakes leads to micronutrients deficiencies which are responsible for impaired development and mortality (Christian and Smith, 2018). Adequate daily intake of the nutrients is vital for the proper and healthy growth of school-children and adolescents.

Conclusion

Despite valuable energy and nutrients supply, the Addis Ababa SFP served school meals that contributed suboptimal daily required energy and nutrients, particularly proteins, carbohydrates, fats, minerals and vitamins. Adolescents of both sexes were more disadvantaged. Improving the nutritional quality and dietary adequacy of the school meals would boost the positive nutritional outcome of the program. Inclusion of fruits and green leafy vegetables could supplement the meals with vitamins and minerals. This may be achieved by improving diversity of diets supplied by SFP. Inclusion of animal products in school meals can improve the macronutrient and energy intakes to satisfy daily requirements.

The Addis Ababa SFP would be improved with a help of school-based dietary guidelines that describe and recommend requirements of nutrient intakes, preparation ways, safety measures, dietary values and nutritional composition.

Recommendations

Overall, the current quality and adequacy of school meals call for due consideration that:

i. revision of school menus would enhance the dietary energy and nutrient content of the school meals through including animal products such as meat, milk and addition of eggs, other protein rich food items such as tasty soya, fortification of cereals and supplementation with micronutrient powders that improve the nutrient requirement; vegetables that are rich in vitamin A; calcium-rich vegetables like moringa; while the improvement of moisture content of the meals served is equally important,
ii. the Addis Ababa SFP should have school-based dietary guidelines of requirements of nutrient intakes, that describe and recommend preparation ways, safety measures, dietary values and nutritional composition,
iii. initiating other school activities, such as preparing plots and planting vegetables on them in school compounds may contribute to better diet diversity of school meals.

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Annex

A. Daily average energy requirement and safe level of protein intake for children and adolescents aged 5–18 years **(FAO/WHO/UNU, 1985)**

Supplementary Table 33: Daily average energy requirement and safe level of protein intake for children and adolescents aged 5–18 years

Age (years)	Boys		Girls	
	Daily energy requirement	Protein (g/day)	Daily energy requirement	Protein (g/day)
5–7	1850	21	1750	21
7–10	2100	27	1800	27
10–12	2200	34	1950	36
12–14	2400	43	2100	44
14–16	2650	52	2150	46
16–18	2850	56	2150	42

B. Reference data from food composition table (used for conversion)

i. Food Energy and Moisture

Supplementary Table 34: Food Energy and Moisture

Food items served in a week	Related food item in food composition table	Food Energy (Calories)	Moisture (%)
Bread	105: Wheat, bread, black	205.3	47.5
White bread (Difo)	115: Wheat, bread, white	222	44.5
Egg	659: Egg, whole, boiled	152.9	74.4
Firfir	708: Chill, spiced, fried with fat	474.2	1
Injera	100: Teff dibiliq injera	150.2	62.2
Lentile	208: Lentile (split), chill, shallot, oil, salt: sauce	101.4	73.4
Marmalade	-	-	-
Potato	168: Potato, shallot, chill, oil, garlic, salt: sauce	80	78.8
Rice	69: Rice, whole grain, boiled	110.9	71.5
Shiro	194: Grass pea flour (roasted), chill, sunflower extract, salt: sauce	96	75.3
Tea	731: Tea leaves	119.7	70.6

ii. Macronutrients

Supplementary Table 35: Macronutrients

Related food item in food composition table	Protein (g)	Fat (g)	CHO (Inc. fiber) (g)
115: Wheat, bread, white	6.8	0.8	46.9
659: Egg, whole, boiled	11.6	10.9	2.1
708: Chill, spiced, fried with fat	7.1	26.2	51.6
100: Teff dibiliq injera	3.8	0.6	32.4
208: Lentile (split), chill, shallot, oil, salt: sauce	5.6	2.6	14.9
168: Potato, shallot, chill, oil, garlic, salt: sauce	1.6	3.9	12.1
69: Rice, whole grain, boiled	2.1	0.1	25.4
194: Grass pea flour (roasted), chill, sunflower extract, salt: sauce	6.6	2.9	11.8
731: Tea leaves	6.6	1.7	20.5

iii. Micronutrients

Supplementary Table 36: Micronutrients

Related food item in food composition table	Calcium (g)	Phosphorous (g)	Iron (g)	Beta-Carotin Equiv. (g)	Thiamine (g)	Riboflavin (g)	Niacin (g)
115: Wheat, bread, white	27	213	2.7	0.08	0.21	0.15	1.9
659: Egg, whole, boiled	51	210	4.3	0.57	0.13	0.11	0.4
708: Chill, spiced, fried with fat	250	273	3.4	131	0.23	0.44	3.4
100: Teff dibiliq injera	68	105	13.8	0.04	0.21	0.17	0.5
208: Lentile (split), chill, shallot, oil, salt: sauce	25.7	76.6	8.8		0.01	0.02	
168: Potato, shallot, chill, oil, garlic, salt: sauce	29.8	42.2	6.3		0.02	0.04	
69: Rice, whole grain, boiled	5	47	0.5	0	0.03	0.01	0.6
194: Grass pea flour (roasted), chill, sunflower extract, salt: sauce	43.6	115.7	16.8		0.03	0.04	
731: Tea leaves	168	56	16	1.19	0.02	0.01	

iv. Other nutrients

Supplementary Table 37: Other nutrients

Related food item in food composition table	Nitrogen (g)	Fiber (g)	Ash (g)
115: Wheat, bread, white	1.22	1.2	1
659: Egg, whole, boiled	1.86	0.1	1
708: Chill, spiced, fried with fat	1.13	14	13.7
100: Teff dibiliq injera	0.64	1.4	1
208: Lentile (split), chill, shallot, oil, salt: sauce	0.89	1	3.5
168: Potato, shallot, chill, oil, garlic, salt: sauce	0.25	2.5	3.6
69: Rice, whole grain, boiled	0.33	0.2	0.9
194: Grass pea flour (roasted), chill, sunflower extract, salt: sauce	1.06	1	3.4
731: Tea leaves	0.9	7	1.6

C. Recommended Nutrient Intakes

WFP_2017_Smart_School_Meals_with_Annex- use to triangulate with other SFP

Supplementary Table 38: Recommended Nutrient Intakes

Age group	Type of school	Energy (Kcal)	Carbohydrates (g) (55-75 percent of energy)	Protein (g) (10-15 percent of energy)	Fat (g) (15-30 percent of energy)	Iron (mg)	Vitamin A (Λ RE)
Primary 7-12 years	Daily RNI	1850	254-347	46-69	35-62	17,80	500
	Full day	60-75% / 1110-1390 Kcal				60-75% of RNI of MNs	60-75% of RNI of MNs
13-17 years	Daily RNI	2600	358-488	65-98	44-88	29	600
	Full day	60-75% / 1560-1950 Kcal				60-75% of RNI of MNs	60-75% of RNI of MNs

Preparation and use of food-based dietary guidelines

(FAO/WHO 1996). Report of a joint FAO/WHO consultation Nicosia, Cyprus. WHO. Geneva. www.fao.org/3/x0243e/x0243e00.htm.

Supplementary Table 39: Preparation and use of food-based dietary guidelines

Items	Nutrient density per 1000 kcal
Energy	see age, sex and activity specific recommendation
Protein	20 - 25 g
	25 - 30 g
Fats	16 -39 g (max)
Saturated	<11 g (see text)
Carbohydrates	140 -190 g
Fibre	8 -20 g
Vitamin A (retinal)	350-500 μg RE
Vitamin D	2.5-5.0 μg
Vitamin E	3.5-5.0 mg a-TE
Vitamin K	20-40 μg
Vitamin C (ascorbic acid)	2530 mg
Thiamine	0.5-0.8 mg
Riboflavin	0.6-0.9 mg
Niacin (or equivalent)	6-10 mg
Vitamin B_6	0.6-1.0 mg
Vitamin B_{12}	0.5-1.0 μg
Folate	150-200 μg
Iron	3.5, 5.5, 11 or 20 mg
Zinc	6 or 10 mg
Calcium	250-400 mg
Iodine	75 μg
Fluoride	0.5-1.0 mg (max)
Sodium as NaCl	<2.5 g

Chapter IV: Effect of School Feeding on Educational Outcomes of schoolchildren in Addis Ababa, Ethiopia

Abstract

Objective: This study investigated the nutritional quality and adequacy of the school meals served to school-age children and adolescents.

Methods: A total of 55 food samples were collected from 11 food types served for breakfast and lunch from 15 selected school kitchens. Each meal was weighed using a digital scale. The initial sample weights were recorded and dried in an oven at a temperature of 60°C to constant weight. Nutrient content and dietary energy of the meals were calculated using a conversion factor with reference to the national food composition table.

Results: On average, school meals supply 883 calories of energy per day, representing 48% or 34% of daily Recommended Nutrient Intake (RNI) for early adolescent schoolchildren of age 7–12 years or late adolescents of age 13–17 years, respectively. Late adolescent boys acquire the least (31%). Macronutrients such as protein (46–66.3%), carbohydrate (48.3–68.1%), fats (20.5–25.7%), and fiber (68.4%) were provided, which is below the daily minimum RNI expected from school meals. Micronutrients such as Thiamine (60.9%), Riboflavin (43.5%), Niacin (21.7%), and Phosphorous (50.7%) were served below daily minimum RNI out of school meals, while, Calcium (82.5%) and Iron (151%) were served.

Conclusion: Despite valuable energy and nutrients supply, the school meals contributed suboptimal RNIs to deprived school-ages and adolescents. Adolescents of both sexes were more disadvantaged. Inclusion of animal products and fruits and vegetables could improve the dietary energy and nutritional value.

Keywords: dietary energy, school meals, micronutrients, nutrition

Introduction

School Feeding Program (SFP) has become a globally recognized, institutionally rooted social protection commitment aimed at avoiding hunger in schools and pledge food security, while inducing better educational outcomes (Drake et al., 2017).

Another growing hypothesis that received attention among researchers and relevant institutions is that it is important to invest on the next 7000 days (about 19 years) of children and adolescents after the already established global intervention of 1000+ days from conception (two years after birth) (Drake et al., 2020). This paradigm shift is believed to help healthy transition of human developmental phases such as physical growth and cognitive development across the ages of preschool (two–five years), middle childhood (five–nine years), early adolescence period (10–14 years), late adolescent times (15–19 years), and young adult times until the age of 21 years. In this regard, schools are the most convenient cost-effective environments to intervene. School feeding has been recognized to be a robust intervention platform for nutritional, health, and educational intervention programs such as deworming, micronutrients fortification and supplementation, and curricular programs (Drake et al., 2020).

Actions and policy frameworks are coming towards institutionalizing these interventions. For instance, WFP (WFP, 2020b) has set its School Feeding Strategy to act in 2020–2030 based on the existing Theory of Change. The strategy aimed at "all vulnerable children have access to school feeding (…) contributing to increasing human capital and economic growth, education and learning, food systems and healthy diets".

Literatures from different country-based studies, case studies, and systematic reviews of either or both experimental and nonexperimental published articles in different times showed that SFP is effective in fulfilling many socioeconomic and educational outcomes. A systematic review of comparative studies showed the positive outcomes of energy intake, micronutrient status, enrollment, and attendance, but academic achievement among children received SFP (Jomaa et al., 2011).

School feeding in India showed that hunger has been reduced among schoolchildren, enrollment and educational outcomes have increased, and socioeconomic benefits added (Babu et al., 2017). In South Africa, SFP has significantly contributed to school attendance and academic achievement

(Mostert, 2021). Similarly, addition of a second meal enhanced educational outcomes (Devereux et al., 2018).

A retrospective cross-sectional study in 32 African countries showed that Food for Education (FFE) increased enrollment in both sexes, and, a combination of Take-Home Rations (THR) with on-site feeding showed absolute enrollment of girls sustained at 30% after the first year (Gelli et al., 2007). In countries with fast growing economy, SFPs could make marginal improvement in educational outcomes as their economic growth would have impacted education outcomes (McEwan, 2013).

SFP has been vigorously contributing to educational outcomes of schoolchildren (Drake et al., 2015). Thus, it improves education, nutrition and health, which ultimately contributes to human capital development. In connection, SFPs have also received due importance to pave the way to achieve SDGs (Morgan and Sonnino, 2013), and specifically, reduce inequalities in education (Mundy and Proulx, 2019).

The effect of school feeding program on learning outcomes has been recorded in Sub–Saharan African countries (0.13 Standard Deviations (SD)) and an average small effect in all low- and middle-income countries (0.1 SD), while closely small average effect on attendance (0.09 SD) (Bashir et al., 2018). It is also noted that as a result of eliminating hunger and raising cognition, SFP retains schoolchildren, enhances enrollment and reduces absenteeism (Bundy et al., 2009).

Some studies indicated that SFP should aim to impact educational outcomes in addition to its nutritional role (Adelman et al., 2007). In India, the cost of school meals is higher than educational inputs in a school – thus, critics from cost-benefit point of view say the mid-day meals are underperformed compared against teaching-learning costs (Chakraborty and Jayaraman, 2019). Costs of school feeding programs in Low- and Middle-Income countries (LMICs) is summarized in (Kristjansson et al., 2016) that high cost is invested for each unit of weight and/or height gain per a child.

However, the literature base in Ethiopia is thin. An earlier study in *Sidama* Zone, Southern Ethiopia, showed SFP had insignificant impact on school enrollment, attendance, and dropout (Dheressa, 2011); however, later on, in the same Zone, SFP encouraged better attendance, academic performance and less dropout (Desalegn et al., 2021). This may be associated with the improvement of the SFP through time. Comparative studies showed that SFP resulted in decreased

average number of absenteeism in *Boricha* district, Southern Ethiopia (Zenebe et al., 2018) and in Addis Ababa (Ayehu and Sahile, 2021).

Objectives

Main objective

The main objective of this chapter is to evaluate the impact of the Addis Ababa School feeding program on educational outcomes of schoolchildren.

Specific objectives

A) Examine enrollment rates of primary schools before and after SFP has been started
B) Examine attendance rates of primary schools before and after SFP has been started
C) Examine impact of SFP on academic performance of beneficiary children

Methods

The sample size for the quantitative data was determined based on a repeated measures study design discussed in Chapter One. A random sample of five schools in each sub-cities of Addis Ababa were selected that made up a total of 50 schools under consideration for the overall study. Sampling frame, complete list of schoolchildren, who were involved in the school feeding program at the beginning of this study, were first collected from all the 50 schools and digitized. Then, using the sampling frame, in each selected school, 15 schoolchildren (both sexes) were randomly selected from a population of each of first–sixth graders to maintain age and sex proportions. Thus, a subtotal of 90 schoolchildren per school and a grand sum of 4500 children involved in the Addis Ababa SFP were selected to follow up their academic outcomes.

A separate data collection tool for academic records was prepared which consisted of list of the names of study subjects along with their sex, grade and sections so that follow up and search for academic records would be simple in order to minimize errors and missing values. Using this tool, data on average semester scores and number of days a schoolchild was absent within a semester were collected at the end of three consecutive semesters or terms, namely: *Term i*) Semester I - 2011EC (January 2019); *Term ii*) Semester II – 2011 EC (June 2019); and *Term iii*) Semester I – 2012 EC (January 2020).

Since the Addis Ababa SFP was implemented as of February 2019, the data taken from the first semester/term recordings were considered to define baseline status of educational outcomes. Thus, the second and the third terms represented mid-term and end-line outcomes, respectively, during which schoolchildren had been served school meals while attending school.

In addition, enrollment statistics of boys and girls registered at the beginning of three consecutive academic years (2011 EC, 2012 EC, and 2013 EC) in each school were collected in a different questionnaire. Quantitative and qualitative data were, thus, collected and analyzed.

Summary of descriptive statistics, Chi-square, t-tests, repeated measure ANOVA, random-effects GLS regression, and mixed effects negative binomial regression models were used to analyze the data, wherever appropriate in the subtopics presented in the results section.

The qualitative data on education were collected through Key Informant Interviews (KIIs) held among school teachers and school directors. Interviews and discussions were held until a state of data saturation was reached, i.e., until information obtained from the KIIs and FGDS sufficient

to replicate the study (O'Reilly and Parker, 2013), was reached from a total of 15 randomly selected schools from among the 50 target schools selected for this study. In addition, KIIs were undertaken with the school feeding coordinator based at the Addis Ababa Education Bureau and an expert from the recently established School Feeding Agency of Addis Ababa. Information was obtained from a total of 16 KIIs.

The KIIs were communicated in Amharic, using semi-structured introductory issues about the educational benefits of the Addis Ababa school feeding program. These included, benefit of the school feeding program (SFP) to the schoolchildren and challenges and opportunities.

The KIIs were performed with school directors and teachers, who were members of school feeding program in each school, and a coordinator at the AAEB, and an expert form school feeding agency. Each key informant was interviewed separately for about 20–30 minutes. The researcher began with an introductory interview and probes with follow up questions that extracted more information on the issues raised or any other new ideas that might be raised by the interviewees. KIIs were also recorded along with notes taken.

KII recordings and notes were transcribed in English. The ideas were organized into themes and synthesized. Longer statements that gave emphasis to the issues raised under the themes were quoted, and lessons or conclusions derived out from it were highlighted.

Results and discussion

Effect of the school feeding program on educational outcomes

Academic performance

Data about semester-based average scores of a total of 3924 schoolchildren (45.7% girls) were collected from 46 schools randomly selected from all sub-cities of Addis Ababa. Average semester scores of boys and girls have increased during each semester between January 2019 and January 2020. ANOVA showed that the mean scores of girls were significantly higher than that of boys at all age groups and during each of the three semesters of the Ethiopian academic years between 2011 and 2012 (Table 40).

A repeated measures Analysis of Variances (ANOVA) was done for the overall study period to model the average scores. The Breusch-Pagan/Cook-Weisberg test for the model confirmed homoscedasticity ($\chi^2 = 0.21, p = 0.644$). Variance of Inflation of each of the covariates used in the model were 1.01–1.91 entailing covariates were moderately correlated and the model fitted the data well.

Table 40: Mean scores and standard deviations of schoolchildren by age and sex groups

Semester	Age category (years)	Girls			Boys			ANOVA[a]	
		n	Mean	SD	n	Mean	SD	Sex	Age
Jan-19	5-9	689	72.6	13.2	798	71.5	13.3	45.5*** (p<0.0001)	8.7*** (p = 0.0002)
	10-14	1051	72.3	12.5	1277	68.6	12.4		
	15-19	55	73.4	13.8	54	67.5	14.1		
	Total	1795	72.5	12.8	2129	69.7	12.8		
Jun-19	5-9	687	73.1	12.8	798	71.6	13.2	45.5*** (p<0.0001)	3.5** (p=0.03)
	10-14	1053	72.9	12.5	1277	69.1	12.2		
	15-19	55	74.4	15.4	54	67.8	14.8		
	Total	1795	73.0	12.7	2129	70.0	12.7		
Jan-20	5-9	621	74.9	12.4	718	73.5	12.5	52.4*** (p<0.0001)	4.5** (p=0.011)
	10-14	1106	74.5	12.6	1344	70.6	12.8		
	15-19	68	77.1	14.9	67	69.0	14.2		
	Total	1795	74.7	12.6	2129	71.5	12.8		

[a]ANOVA test for sex and age differences (p - values) by semester
*** p<0.01, ** p<0.05, * p<0.1

Significant differences in the average scores of the schoolchildren over time was observed ($F_{(2, 7846)} = 108.9$, p<0.0001) indicating an increasing trend or improvement in the academic performance of schoolchildren over time. The estimated average effect size (η^2) was 0.03 (boys = 0.023, girls =

0.04), indicating that the school feeding program had above a minimum but nearly a medium effect on the average academic performance of the schoolchildren. An effect size, partial Eta-Squared (η^2), of 0.01, 0.06, or 0.14 are considered to be small, medium or large effect, respectively(Cohen, 1988; Maher et al., 2013).

Effect size was minimum for boys of age 10–14 years old ($\eta^2 = 0.02$) and maximum for girls of age 15–19 years old ($\eta^2 = 0.05$) (Supplementary Table 46). Thus, the Addis Ababa SFP showed positive effect on academic performances of 10-14 boys, but the effect was more noticeable for girls of 15-19 age group.

A thorough discussion about empirical benchmarks for interpreting effect sizes of educational performances is documented in (Hill et al., 2008). Similar effect sizes, measured in terms of Cohen's f, in academic performance of school feeding programs were reported in Kenya (ε = 0.26) and Senegal (ε = 0.14) from studies on test scores (Bashir et al., 2018). An effect size (Cohen's f) of 0.1, 0.25 or 0.4 were considered to be small, medium or large effect, respectively (Cohen, 1988).

Random-effects GLS regression model was fitted controlling for covariates such as sex, age, and modified Index of Anthropometric Failure (mCIAF). Lagrange multiplier test for random effects showed that variations in the average scores over time were significant (χ^2 = 1774.2, $p < 0.0001$), thus educational performance as measured by the semester average scores of schoolchildren was confirmed across the three consecutive semesters.

Thus, the regression results also showed that the average scores of the girls were consistently significantly higher than those of boys (p = 0.01). Moreover, it was observed that schoolchildren prevalent to thinness (p = 0.063) or thinness and underweight (p = 0.051) ever had significantly lower average scores.

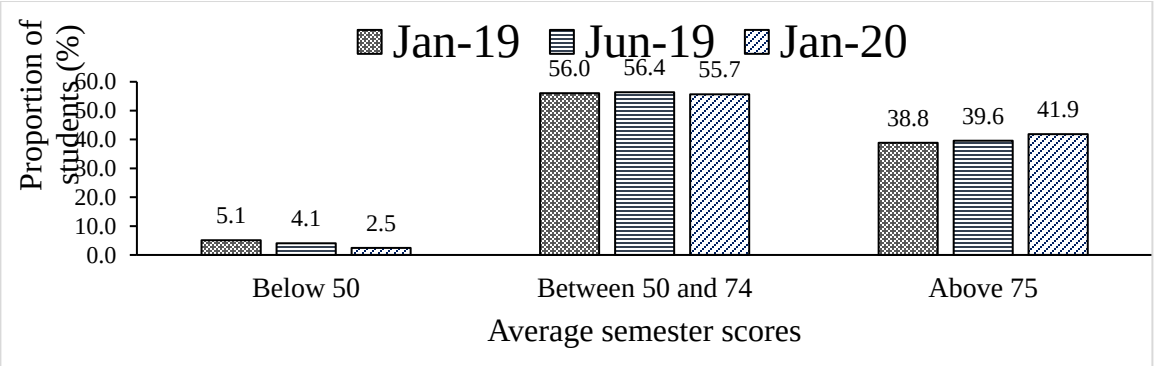

Figure 10: Proportion of schoolchildren by average scores during from Jan 2019 to Jan 2020

Among the 3924 schoolchildren followed for their average scores, the proportion of schoolchildren who scored below 50 average points decreased by half during Jan 2019 and Jan 2020, while that of those who scored 75 and above increased by about 8% (3.1 percentage points) (Figure 10).

The results here are comparable to the existing literature about the effect of school meals on academic performance. For instance, better status in height-for-age were linked to academic performance among schoolchildren in *Goba* town, South East Ethiopia (Haile et al., 2016). In another study in Ethiopia, a significant but small 2.4 percentage points increase in academic performance was observed in SFP beneficiaries (Desalegn et al., 2021). In Northwest Ethiopia, low educational performance was significantly associated with stunting, underweight and wasting (Asmare et al., 2018). Conversely, weekend feeding programs improved academic performance in the United States (Fiese et al., 2020; Kurtz et al., 2020).

Unlike the finding in this study, the impact study, by McEwan, 2013, on Chile's SFP had not shown increased scores of national mathematics and language tests. This was linked to that highest baseline enrollment in the education outcomes of Chile, and McEwan (2013) assumed the larger context of Chilean development justifies the fact that Chile's SFP had not shown increased academic scores.

There are studies that link SFP which were established long times ago might have a little or non-significance effect on educational outcomes in later times, especially, when countries are achieving progress in development, and/or, when countries have higher enrollment rate regardless of SFP intervention. A typical showcase is Chile where large-scale SFP has been installed since 1960s (McEwan, 2013).

Long term access to school meals influences positive learning achievements. The Indian midday meals is an example that resulted in robust positive effect on learning achievement in India (Chakraborty and Jayaraman, 2019). According to this Indian experience, schoolchildren who had midday meals for longer times up to five years had 18% higher reading test scores and 9% higher math test scores than those who received meals for less than a year.

Most of the reviewed studies did not provide effect size measures, but test for significances in differences appeared in their results. The conclusions of some of these agree with those found in this study. To list a few, SFP beneficiary children had better performance on national academic

assessment tests in Guyana (Ismail et al., 2014), while in Egypt, school meal improved visual memory, auditory vigilance, afternoon attentiveness and working memory (Metwally et al., 2020).

In contrast, Argentina recorded only partial improvement in school performance due to nutritional deficit of the meal (Adrogue and Orlicki, 2013). In Ghana, SFP improved academic performance and health outcomes (Awojobi, 2019) and in the United Kingdom, school meals improved educational outcomes significantly (Belot and James, 2011). Therefore, consistent with the majority of these studies, the findings in this study, that academic performance has been at least minimally boosted, would be attributed to an outstanding contribution of the School Feeding Program of Addis Ababa.

Enrollment

Data about enrollment was collected from 42 schools. The total number of boys and girls enrolled each year, the test for the mean size of classes/grade levels each year, the rate of changes from the base year enrollment (2011EC), and the tests for the mean of rates are presented in Table 41.

Table 41: Enrollment and rates of changes over years by sex

Year (EC) (GC)	Enrolled				Rate of changes			
	Boys	Girls	Both	t–value (*p*)	Boys	Girls	Both	t–value (*p*)
2011 (2018)	22,545	26,494	49,039	12.0 (<0.001)	Baseline			
2012 (2019)	23,138	26,688	49,826	11.6 (<0.001)	2.6	0.7	1.6	1.21 (0.1)
2013 (2020)	24,309	26,740	51,049	8.7 (<0.001)	7.8	0.9	4.1	4.4 (<0.001)

The number of girls enrolled was higher than boys, each year, and t-tests confirmed that the average number of boys and girls enrolled were significantly different for each of the three-years. Enrollment of boys in 2012 had increased by 2.6% of that in 2011 and 7.8% higher number of boys were enrolled in 2013.

The t-test for equality of the means of the differences between enrollments in 2012 or 2013 and that of the base year (2011) showed that significantly higher number of boys had registered each year than girls. A similar size of enrollment has been achieved in girls.

Overall, a significant increment of enrollment each year has been noted among boys in the three years considered this study. This is in agreement with the education statistics for the year 2019/2020 by the MoE–Ethiopia that the Net Intake Rate (NIR) at grade one was higher for males than females, where the national target of NIR was shown met for males (MoE, 2020). Thus, the

Addis Ababa SFP that has been going on since February 11, 2019 (*Yekatit* 2011 EC), (AAEB, 2008), might have attracted more boys for schooling.

The enrollment trend, in number, by grade level and sex groups over the three academic years (2011, 2012, 2013 EC) are presented in Figure 11.

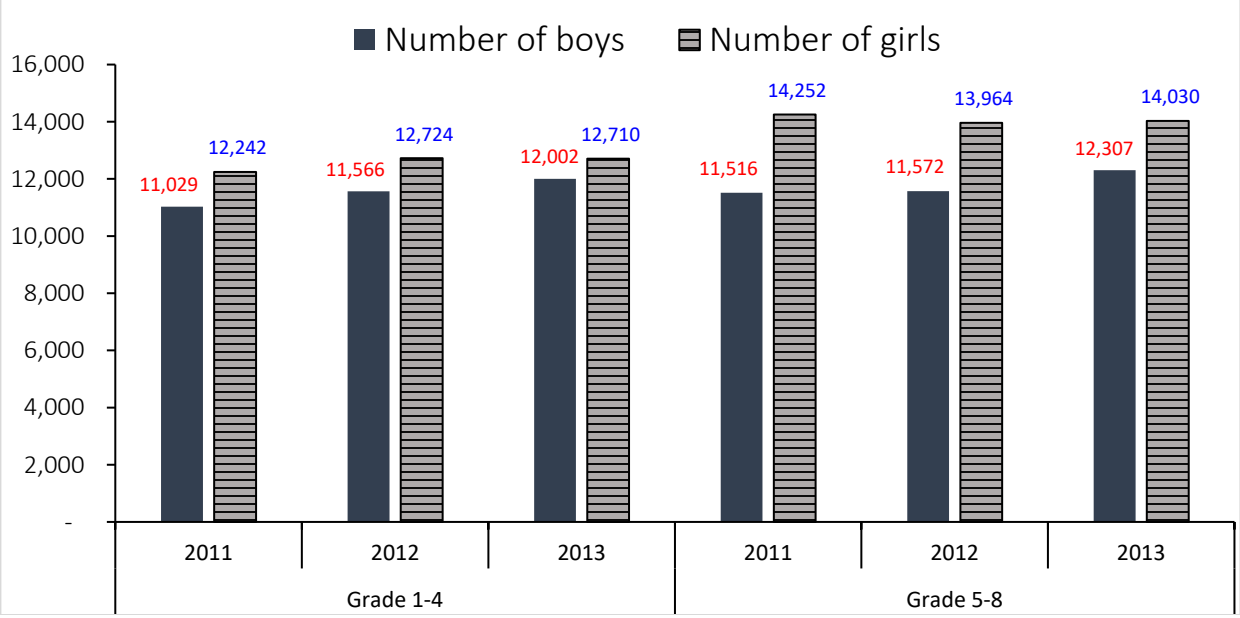

Figure 11: Enrollment by sex from 2011 to 2013 EC.

Similar to the results showed in Table 41, the enrollment of all boys and girls in grades one to eight has shown slight increment, and of these, those in grades five to eight had higher numbers. This highlights that SFP had encouraged adolescent children to come back to school. KIIs and FGDs also pointed out that SFP attracted a number of adolescents to school since their parents could send them to school instead of demanding them to work and assist in supporting the family.

Furthermore, a repeated measures ANOVA showed that the number of girls enrolled each year did not change significantly ($F_{(2,\ 654)} = 0.27$; $p = 0.76$; effect size, $\eta^2 = 0.001$), whereas statistically significantly higher number of boys had been enrolled at each of the academic years ($F_{(2,\ 654)} = 18.2$; $p < 0.0001$; effect size, $\eta^2 = 0.05$). This indicates that SFP had nearly medium effect among boys' enrollment while its effect for girls' enrollment was nil or very little.

The 7.8% increase in boys' enrollment is consistent with that in rural Bangladesh where Take Home Ration (THR) program resulted in an eight percent increase in primary school enrollment (Alderman et al., 2013).

In Ghana, a systematic review of 22 peer-reviewed SFP studies consistently reported increased enrolment (Tette and Enos, 2019). Unlike the finding in this study, SFP particularly raised girls' enrollment by 3.2 percentage points in Burkina Faso (Nikiema, 2019) which was higher when compared to that observed in this finding (0.9%). In Uganda, it helped girls to timely begin/enroll at first day of schooling (Ahmed and Ninno, 2002).

The baseline high enrollment rate of girls and lower rate of enrollment of boys might have influenced the cumulative significant difference. While the key message here might be that boys had been deprived of education earlier and might have been forced to dropout or did not enroll at all due to poverty, child labor, or hunger. Thus, it can be concluded that the recent progressive rise in the enrollment among boys is associated with the Addis Ababa SFP which avoided the need for child labor and hunger risks among boys. The KIIs employed in this study confirmed that many schoolchildren used to casually work in the streets or sell small things in local market places to generate income for themselves and their parents as well.

There is evidence that school absenteeism was linked to child labor on farms and households to generate income for family food consumption (Walingo, 2012) in Malawi. In Mali, SFP motivated child labor reduction, increased enrolment by 10 percentage points, and reduced work load and time spent on work among girls (Aurino et al., 2019).

Thus, it can be concluded that the Addis Ababa SFP contributed to significant but closely medium enrollment rate among middle- and late adolescent boys.

Attendance

Data about total number of absenteeism per semester by schoolchildren in all grades was obtained from 17 schools. The maximum number of days of absenteeism was 18 during the first semester, and 14 and eight during the second and the third semesters, respectively (Table 42).

Continuous full attendance (with no absenteeism) increased from 72.1% (baseline) to 77.9% (2nd assessment) and, finally, to 88.2% (end-line). Majority of schoolchildren were absent from school for less than five days (Table 42).

For convenient description, the number of absentee days was grouped into "No absenteeism" and "Any absence".

Table 42: Frequency of number of absent days during the three semesters, each.

Semesters/ Absentees	Jan-2019		Jun-2019		Jan-2020	
	N	%	N	%	N	%
0	1,142	72.1	1,234	77.9	1,397	88.2
1	178	11.24	125	7.89	56	3.54
2	133	8.4	111	7.01	71	4.48
3	58	3.66	46	2.9	39	2.46
4	32	2.02	22	1.39	9	0.57
5	21	1.33	18	1.14	7	0.44
6	9	0.57	6	0.38	3	0.19
7	2	0.13	6	0.38	1	0.06
8	2	0.13	5	0.32	2	0.13
9	1	0.06	4	0.25	-	-
10	3	0.19	1	0.06	-	-
11	-	-	1	0.06	-	-
12	-	-	3	0.19	-	-
13	1	0.06	1	0.06	-	-
14	1	0.06	1	0.06	-	-
18	1	0.06	-	-	-	-
Total	1584	100	1584	100	1584	100

The overall proportion of absenteeism was tabulated for the three consecutive periods/semesters of this study (Table 43). The rate of absenteeism declined from 27.9% as of January 2019 to 11.9% by January 2020 (drop off by 16 percentage points, or 57.4%). Conversely, it implies that the attendance rate raised by 16 percentage points or 57.4% during the same time of interval.

Table 43:Attendance rates and average absent days per student, over time

Attendance	Jan-19	Jun-19	Jan-20	χ_2^2
No absenteeism	1142 (72.1)	1234 (77.9)	1396 (88.1)	129.3***
Any absence	442 (27.9)	350 (22.1)	188 (11.9)	
N	1,584	1,584	1,584	
Total no. of absent days	1019	901	427	
Mean	0.64	0.57	0.27	

The differences in absenteeism over the periods was significant ($p<0.0001$) indicating that improvement in class attendance among schoolchildren. Effect sizes for Cramer's V is 0.2 which corresponds to moderate effect (Rea and Parker, 2014) in support of the Addis Ababa SFP had medium effect on attendance.

The results here mostly vary from findings reported by other studies in Ethiopia and elsewhere. In *Boricha* district, Southern Ethiopia, significantly lower average absent days were noted among SFP beneficiaries than non-beneficiaries (Zenebe et al., 2018).

The rise of attendance rate in this study is at least twice as higher as the rate gained among other 32 African countries, where school meal provision contributed for 28% and 22% rise of girls' and boys' school attendances, respectively (Gelli et al., 2007). It is also noted in Burkina Faso that Take-home rations (THRs) increased average school attendance rate for both boys and girls by 8.4 percentage points (Nikiema, 2019).

The percentage points of attendance gained in this study was higher than that found in Guyana, where 4.3% increase of attendance was noted as a result of SFP (Ismail et al., 2014). Similarly, in the United Kingdom, school meals contributed for drops in absenteeism by about 0.6 percentage points (Belot and James, 2011). In addition, in the United Kingdom, school meals were also credited for the decline of authorized absences by 14%, which may be, they argue, linked to illness and health, as well (Belot and James, 2011).

Relatively closer to the current findings is that in rural Bangladesh where THR program resulted in a 12% increase in school attendance (Alderman et al., 2013)**,** and in another study of the same program, (Ravallion and Wodon, 2000) found that the THR increased school participation by 19 percentage points for boys and 18 percentage points for girls on average.

However, a systematic review of 22 peer-reviewed SFP studies found little improvement in attendance in Ghana (Tette and Enos, 2019). Another report, SFP contributed particularly to girls' school attendance (Galaa and Saaka, 2011). On the other hand, in Uganda, THR and SFP schemes achieved large impacts on school attendance and reduced grade repetition (Ahmed and Ninno, 2002). Further, in Lao, there was minimal evidence in support of the school feeding schemes increasing enrollment (Buttenheim et al., 2011).

The discrepancy between higher impact on attendance in Addis Ababa and lower one in other studies may be associated with different reasons. The first reason goes for the difference in the study design. The findings in the other studies were mainly based on cross-sectional comparative settings between beneficiaries and non-beneficiaries. Our study, however, made repeated measurements of a single group.

The other reason may be related to socioeconomic variations between countries. For instance, in the United Kingdom wide difference in the effect size on attendance rate seems plausibly attributed to the larger difference in economic development and initial status of educational outcomes which was similar to that in Chile where insignificant effect in educational outcomes were attached to the country's progressive economic and educational development (McEwan, 2013).

Chi-square test showed that statistically significant differences in absenteeism among children of different age groups, regardless of differences in sex each year. However, the attendance rates improved over time as absenteeism of boys and girls have declined during each semester between January 2019 and January 2020. But absenteeism did not vary significantly with sex (Table 44).

Table 44: Association between attendance and age groups and sex over three semesters of SFP period

Semester	Sex	Girls[a]			Boys[a]			All ages[b]	
	Age group	5-9	10-14	15-19	5-9	10-14	15-19	Girls	Boys
	Attendance	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)
Jan-19	No absenteeism	178 (65.9)	318 (75.2)	14 (56)	194 (66)	414 (76.4)	24 (80)	510 (71)	632 (73)
	Any absence	92 (34.1)	105 (24.8)	11 (44)	100 (34)	128 (23.6)	6 (20)	208 (29)	234 (27)
	Total	270 (100)	423 (100)	25 (100)	294 (100)	542 (100)	30 (100)	718 (100)	866 (100)
Jun-19	No absenteeism	189 (70.5)	340 (80)	20 (80)	205 (69.7)	454 (83.8)	26 (86.7)	549 (76.5)	685 (79.1)
	Any absence	79 (29.5)	85 (20)	5 (20)	89 (30.3)	88 (16.2)	4 (13.3)	169 (23.5)	181 (20.9)
	Total	268 (100)	425 (100)	25 (100)	294 (100)	542 (100)	30 (100)	718 (100)	866 (100)
Jan-20	No absenteeism	216 (86.8)	398 (90.5)	29 (93.6)	227 (84.4)	508 (89.1)	27 (79.4)	641 (89.3)	756 (87.3)
	Any absence	33 (13.3)	42 (9.6)	2 (6.5)	42 (15.6)	62 (10.9)	7 (20.6)	77 (10.7)	110 (12.7)
	Total	249 (100)	440 (100)	31 (100)	269 (100)	570 (100)	34 (100)	718 (100)	866 (100)
χ^2	Jan-19	9.7*** (0.008)			11.2*** (0.004)			0.74 (0.389)	
	Jun-19	8.4** (0.015)			23.8*** (<0.0001)			1.58 (0.208)	
	Jan-20	2.9 (0.235)			5.7* (0.059)			1.55 (0.214)	

[a]Chi-square between absenteeism and age group by sex at each semester.
[b]Chi-square between absenteeism and sex at each semester.
*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Mixed effects negative binomial regression showed that the estimated effect of a unit change in height-for-age Z-scores resulted in eight percent change in the number of class attendances ($p = 0.021$). Thus, better food security conditions in schools might have reduced the frequency of absenteeism showing that reduction in absenteeism was associated the Addis Ababa SFP. The KII and FGD findings supported this empirical evidence that teachers and school directors noticed dramatic fall in absenteeism.

The impact assessment by McEwan, 2013, on Chile's SFP had shown also no evidence in favor of enrollment and attendance. The highest earliest baseline enrollment in the education outcomes of Chile and the larger context of Chilean development seem to have dominantly influenced the positive educational outcomes over the SFP. They further explained that Chile's SFP significantly influenced educational outcomes when poverty and malnutrition rates were high during which enrollment was also low. It is also reported that the overall impact of school meal interventions on education is strongest where enrolment is low and food insecurity was high (Snilstveit et al., 2016). An experimental study also claimed higher attendance as a result of SFP among lower income countries (Kristjansson et al., 2007).

In Ethiopia, poverty is among the leading factors responsible to limited school attendance. Ceasing a SFP in the rural Ethiopia resulted with 7% higher drop-out rate for girls than the control group supporting the fact that SFP in Ethiopia results in better education outcomes (Gallenbacher, 2018).

In many developing countries, primary school enrollment rates are high, but attendance is consistently low. On top of poor health and short-term hunger, poor households fail to send children to school since they need them to work on farm or give care to siblings (Adelman et al., 2007).

Findings from Key Informant Interviews

According to the school directors and teachers who participated in this study, SFP has reduced absenteeism and no student has been absent from school in connection with inability to get a lunchpack from home or take breakfast at home. A teacher shared his experience in this as follows:

> *Sometimes earlier, schoolchildren did not come to school. We asked their parents. They told us schoolchildren did not go to school because parents were not able to pack lunch for their children. But now parents send their children without any such problem.* (Teacher)

Thus, SFP solved problems that caused absenteeism. In fact, KI participants asserted that since the SFP provided both breakfast and lunch every day, schoolchildren rather came to school very early in the morning. This early arrival of the schoolchildren at the schools has now simplified even the teaching-learning process since monitoring and managing late comers and absentees were no more required.

Participants also witnessed that enrollment, attendance, dropout and academic performance of schoolchildren, and overall educational activities have been improved since the establishment of

the SFP, which has resolved multiple problems, such as hunger manifestations at schools and avoiding late coming. According to a school director:

> *A five-grader girl, about 16 years old or below, used to be late. I always saw her standing outside the classroom. I asked her homeroom teacher and he said that he was not allowing her to get in because she came to class late. I asked her why she was always late. She showed me her arms putting up her sleeves soiled with dough. I saw that she came to school after baking injera the whole night. She had to finish baking injera before she came to school. She even did not take breakfast. Now it is solved.* (School director).

Thus, number of late comers has decreased, schoolchildren attended classes regularly, and the teaching-learning process has been smoothly facilitated.

The SFP has created convenient teaching-learning environment. Teachers said that unlike the previous academic environment before the establishment of the SFP, nowadays, teachers could strictly follow up schoolchildren to attend classes actively and do their homework regularly. Teachers added that they compromised follow up of the schoolchildren earlier because they knew that schoolchildren from destitute families had to use the time out of school to work or beg along streets for their lunch or dinner, instead of doing homework and reading at home. Thus, previously, teachers and school directors had difficulty to demand a student, who was under such deprivation, for active class activity and regular homework delivery. A teacher said that:

> *I teach Biology. I have seen the difference between teaching well-fed and starved schoolchildren. I was able to read their feelings and pain when they were hungry. We observed that even clever schoolchildren could not participate actively in class activities due to the hunger effect. But now, even the so-called lazy schoolchildren actively participate.* (Teacher).

Another teacher said that:

> *The difference is visible before and after SFP was started. Dropout has declined. Teachers used to be too frustrated to give classwork, homework, etc. But now teachers teach without any frustration since they do not see any bad feeling from the schoolchildren' face as a result of hunger.* (Teacher).

Teachers and school directors also pointed out that the school feeding program has helped the schoolchildren to improve their academic performance. A school director expressed his experience that:

> *I myself have studied the problem with colleagues and found that radical enhancement of some schoolchildren in academic performance with SFP. This showed us that the schoolchildren had the capacity to perform satisfactorily but due to burden of economy and livelihood, their capacity was undermined. Thus, SFP definitely boosted performance of schoolchildren. There were schoolchildren whose parents were at low*

> *economy level but academically sound. There were many schoolchildren who had the knowledge and skill, however due to their poor livelihood they dropped out. There were schoolchildren missing from schools at lunch time before SFP. Later on in those days, we saw them along the streets in Merkato begging for money. However, when the SFP reduced their economy burden, they completely stopped disappearing from school at lunch time. They attended all class of the day with full attention and participation*. (School director).

As such, provision of school meals has a lot of merits and drives smooth delivery of education in schools.

A similar study in Ghana confirmed that teachers, caterers, parents and school administrators agreed with the fact that SFP had impact on enrollment, attendance, completion and the academic performances of primary schoolchildren, in addition to cognitive development and the reduction of hunger (Tagoe, 2018).

In general, these notable effects of the Addis Ababa SFP on educational outcomes, specifically, on enrollment, academic performance, and attendance were recorded within short period of time of the establishment of the intervention in February, 2019. Thus, clear lessons were captured that it has helped girls to attentively attend class and attracted more boys, especially in the adolescent age, to schools while removing them out of child labor or street begging. It is also noticed that SFP allowed more time to children to read and do homework attentively.

Conclusion

This study showed notable effects of the Addis Ababa SFP on educational outcomes, specifically, on enrollment, academic performance, and attendance. School feeding programs are crucial platforms to achieve the global sustainable development goals as it can reach schoolchildren through human development-related interventions including health, nutrition, and education.

Annex

Major topics of the Key Informants Interviews (KIIs) and Focus Group Discussions (FGDs)

1. Background information about women Associations'/Kitchen workers
2. Benefit of the school feeding program (SFP) to the women
3. Benefit of the school feeding program to community and community response to the SFP
4. Finance, credit and saving practices of the kitchen workers
5. Inflation and prices of meals served in schools
6. Schools' role and participation in the school feeding program
7. The role of the Addis Ababa School Feeding Agency in the school feeding program
8. Effect of school closure due to COVID-19 and the consequence of teaching in shifts
9. Challenges and opportunities.

Table 45: Qualitative data collection sites

No.	School	Sub city	FGD	KII	Date	Number of women
1.	ABT	Yeka	Yes	D/D/r	3/6/13	12
2.	EST	Addis Ketema	Yes	D/r	4/6/13	17
3.	AND	Arada	Yes	D/r, DDr, Teacher, kitchen workers representative	8/6/13	21
4.	BG	Bole	Yes	Teacher	9/6/13	20
5.	BHN	Gulele	Yes	D/r	10/6/13	23
6.	GF	Nifas silk/Lafto	Yes	Teacher	11/6/13	20
7.	TY	Kirkos	Yes	Teachers	12/6/13	12
8.	KK	Arada	Yes	Teacher	12/6/13	21
9.	AA	Arada	Yes	Teacher	16/6/13	17
10.	KM	Kolfe	Yes	D/Dr.	24/6/21	20
11.	AB	Nifas silk/Lafto	Yes	D/r.	01/7/13	14
12.	ATK	Akaki	Yes	Teacher	1/7/13	12
13.	DZD	Lideta	Yes	Teachers	25/6/21	6
14.	NKB	Yeka	Yes	Teachers	26/6/21	9
15.	ALM	Lideta	Yes	Teachers	15/6/21	16

Education outcomes

Supplementary Table 46: Effect sizes of SFP on average scores of schoolchildren

Age	Sex	F	(df1, df2)	Sphericity assumption			Epsilon-Squared	Epsilon
				Huynh-Feldt epsilon	Greenhouse-Geisser epsilon	Box's conservative epsilon		
5-9	Girls	26.39***	(2, 1306)	0.8785***	0.8765***	0.5***	0.04	0.19
	Boys	18.21***	(2, 1514)	0.8608***	0.8592***	0.5***	0.02	0.15
10-14	Girls	31.29***	(2, 2089)	0.8052***	0.8042***	0.5***	0.03	0.17
	Boys	27.07***	(2, 2539)	0.8156***	0.8148***	0.5***	0.02	0.14
15-19	Girls	3.91**	(2, 108)	0.9097**	0.8873**	0.5*	0.05	0.22
	Boys	2.98*	(2, 106)	0.7064*	0.6961*	0.5*	0.04	0.19
Overall	Girls	62.22***	(2, 3588)	0.8382***	0.8375***	0.5***	0.03	0.18
	Boys	48.44***	(2, 4256)	0.8315***	0.8309***	0.5***	0.02	0.15
	Both	108.9***	(2, 7846)	0.8343***	0.834***	0.5***	0.03	0.16

Sphericity assumption tests are significant that the variances of the differences between all pairwise combinations of groups are equal.

Supplementary Table 47: Average absenteeism and standard deviations of schoolchildren by age and sex groups

Time	agec	Girls				Boys				F-test for sex differences (p - values)	
		N	Total	Mean	SD	N	Total	Mean	SD	Age	Sex
Jan-19	5-9	249	228	0.9	1.9	274	226	0.8	1.5	8.27*** (p=0.0003)	0.06 (p=0.807)
	10-14	400	188	0.5	1.0	506	308	0.6	1.4		
	15-19	24	31	1.3	2.3	30	11	0.4	1.0		
	Total	673	447	0.7	1.5	810	545	0.7	1.5		
Jun-19	5-9	249	205	0.8	1.8	274	219	0.8	1.6	10.39*** (p<0.0001)	0.91 (p=0.341)
	10-14	400	215	0.5	1.5	506	209	0.4	1.2		
	15-19	24	18	0.8	2.0	30	8	0.3	0.7		
	Total	673	438	0.7	1.7	810	436	0.5	1.4		
Jan-20	5-9	230	69	0.3	0.8	249	104	0.4	1.1	2.70* (p=0.067)	3.32* (p=0.069)
	10-14	417	85	0.2	0.8	534	136	0.3	0.8		
	15-19	28	7	0.3	1.0	34	14	0.4	0.9		
	Total	675	161	0.2	0.8	817	254	0.3	0.9		

[a]ANCOVA test for sex and age differences (p - values).

*** p<0.01, ** p<0.05, * p<0.1

Supplementary Table 48: Association between absenteeism and SFP by age and sex groups (Alternative Presentation of Table 3)

Time		Jan-19		Jun-19		Jan-20		χ^2 (p value)	
Age Years	Attendance	Girls	Boys	Girls	Boys	Girls	Boys	Girls	Boys
		N (%)	N (%)	N (%)	N (%)	N (%)	N (%)		
5-9	No absenteeism	178 (65.9)	194 (66)	189 (70.5)	205 (69.7)	216 (86.8)	227 (84.4)	31.9***	26.7***
	Any absence	92 (34.1)	100 (34)	79 (29.5)	89 (30.3)	33 (13.3)	42 (15.6)		
	Total	270 (100)	294 (100)	268 (100)	294 (100)	249 (100)	269 (100)		
10-14	No absenteeism	318 (75.2)	414 (76.4)	340 (80)	454 (83.8)	398 (90.5)	508 (89.1)	35.9***	32.4***
	Any absence	105 (24.8)	128 (23.6)	85 (20)	88 (16.2)	42 (9.6)	62 (10.9)		
	Total	423 (100)	542 (100)	425 (100)	542 (100)	440 (100)	570 (100)		
15-19	No absenteeism	14 (56)	24 (80)	20 (80)	26 (86.7)	29 (93.6)	27 (79.4)	11.3*** (0.003)	0.68 (0.71)
	Any absence	11 (44)	6 (20)	5 (20)	4 (13.3)	2 (6.5)	7 (20.6)		
	Total	25 (100)	30 (100)	25 (100)	30 (100)	31 (100)	34 (100)		
All ages	No absenteeism	510 (71)	632 (73)	549 (76.5)	685 (79.1)	643 (89.3)	762 (87.3)	76.2***	55.6***
	Any absence	208 (29)	234 (27)	169 (23.5)	181 (20.9)	77 (10.7)	111 (12.7)		
	Total	718 (100)	866 (100)	718 (100)	866 (100)	720 (100)	873 (100)		

Chapter V: Food Safety KAP among Kitchen workers of the Addis Ababa Schools Feeding Program and School WASH

Abstract

Background: A large population of school children benefit from the school feeding programs initiated by the Addis Ababa Administration. Unsafe food can cause outbreaks of foodborne diseases which may, in turn, deplete nutrition in the long run or lead to death. Proper food safety knowledge, attitude, and practices (KAP) of the kitchen workers is, therefore, essential. However, the food safety KAP of the kitchen workers involved in the Addis Ababa School Feeding Program is unknown, at which this research was aimed.

Methods: Data was collected on food safety KAP of kitchen workers in the government sponsored school feeding program from randomly selected 50 schools in all sub-cities using a structured questionnaire. Kaiser-Meyer-Olkin (KMO) measure was used to check for sample adequacies. Cronbach's-α was used to evaluate internal consistency of the questionnaire. Spearman's sample correlation was used to assess correlations among the knowledge, attitude, and practice indices. Pearson's Chi-square and logistic regression were applied to examine variations in food safety KAP across socioeconomic status.

Findings: A total of 462 food handlers participated in the assessment. KMO values (>0.9) for all knowledge, attitude, and practice confirmed sample adequacy. Cronbach's-α values confirmed the specific questions for knowledge, attitude and practice were acceptable (0.98, 0.97, and 0.88, respectively). The correlation between knowledge and practice was high ($r = 0.8336$, $p<0.001$). The correlation between attitude and practice was substantial ($r = 0.5762$, $p<0.001$). General food safety knowledge, attitude and practice among food handlers were 35.9%, 50.4% and 47.6%, respectively. Overall food safety-KAP among all kitchen workers was 39.6%. Only 18.2% of them had medical examination before their employment. Higher educational status and training were sought significant for satisfactory food safety KAP ($p<0.001$). Food safety knowledge had significantly contributed to attitude and practice ($p<0.001$). Basic services of drinking water, sanitation, and hygiene were delivered in 36 (73.5%), 14 (28%), and 31 (64.6%) of the schools surveyed for school WASH, respectively. Food safety practice in school kitchens and overall basic school drinking water, sanitation and hygiene services (school WASH) were low.

Interpretation: The food handlers lack proper knowledge, attitude and practice to serve safe meals in schools. Risk of foodborne diseases would be inevitable. We recommend appropriate food safety training to the food handlers for proper food safety measures. Monitoring and assessing food safety practices, devising an appropriate Hazard Analysis Critical Control Point (HACCP) system for food preparation in school kitchens may minimize risks of foodborne outbreaks.

Keywords: Food safety, food safety KAP, foodborne disease, school feeding

Introduction

Access to and consumption of adequate, safe and nutritious food is among the pillars to maintain food and nutrition security (FAO, 1996). Safe food is important to food security as FAO says "there is no food security without food safety" (FAO, 2019b). Food safety is mainly concerned with proper handling, storing, and preparing food in order to prevent contamination with foodborne pathogens or eliminate them if they are found in food (WHO, 2006a). Food safety is the responsibility of all stakeholders from farm to fork including farmers, food manufacturers, distributors, retailers, food service operators, consumers, and the government as regulator (Jaffee et al., 2019).

Food becomes unsafe mainly due to exposure to pathogens that may cause mild to fatal foodborne diseases. Diarrhea is a common manifestation of foodborne diseases. Frequent acute diarrhea in children results from the diarrhea-malnutrition-diarrhea vicious cycle, which may undermine food and nutrition security (Jaffee et al., 2019; Unnevehr and Hirschhorn, 2000; WHO, 2006a). Thus, foodborne diseases are among the most frequent and rising public health concerns that seek global attention.

In many developing countries, schoolchildren from low-income and food insecure households suffer from hunger and under-nutrition which seriously affect school attendance and academic performance. The Addis Ababa City Administration, therefore, initiated a large-scale government-sponsored school feeding program in 2019 to all schoolchildren in elementary level public schools found in all sub-cities. Each school kitchen serves breakfast and lunch to a large number of schoolchildren each school day. Under the circumstances, unsafe food preparation may result in foodborne outbreaks that may affect many schoolchildren. FAO considers food safety as critical to achieve the aims of school feeding (FAO, 2019a).

Thus, school kitchen workers need to have proper knowledge, attitude, and practice of food safety principles during storing, preparing and serving meals. This requires implementation of the WHO 'five keys to safer food practices', namely, keep clean; separate raw and cooked foods; cook thoroughly; keep food at safe temperatures; and use safe water and raw materials (WHO, 2006a). Appropriate knowledge, attitude and practices of food handlers in food safety measures reduces foodborne illness, death, and loss of productivity and medical expenses (Jaffee et al., 2019; Unnevehr and Hirschhorn, 2000).

As the school feeding program is a new initiative, the level of food safety KAP of school kitchen workers is not yet evaluated. Prior studies on food handlers in food establishments in other parts of Ethiopia have shown that food handlers do not have adequate knowledge, attitude and practices with regards to food safety, liquid waste and refuse management, and personal hygiene (Kibret and Abera, 2012; Kumie et al., 2002; Mendedo et al., 2017).

Objective

This study was, thus, undertaken with the aim to assess the school Water, Sanitation and Hygiene (WASH) and the food safety KAP among the kitchen workers involved in the food preparation of the school feeding program established in Addis Ababa.

Methods

School feeding program kitchens from selected primary schools from all sub-cities were considered in this study.

Multistage cluster sampling design was applied to randomly selected five districts from each sub-city, followed by random selection of one primary school from each selected district. A total of 50 primary schools were, thus, considered for the study. Finally, information on food safety KAP was collected from each food handler, involved in food preparation in each selected school.

A structured food safety KAP questionnaire was adapted from WHO's five keys to safer foods practices (WHO, 2006a), FAO guideline for assessing nutrition-related KAP (Macías and Glasauer, 2014), and related sources (Ashenafi, 2017; Luo et al., 2019).

The questionnaire consisted of issues related to food safety in the kitchen environment. The tools were translated to Amharic in order to avoid errors due to language barrier during interview. Information on sociodemographic characteristics of the kitchen workers was also obtained. Enumerators were trained on the tools prior to data collection.

Respondents were asked several questions under the following categories to assess their knowledge of, attitude towards and practice in personal hygiene, equipment hygiene, food handling, contamination and cross-contamination, storage conditions, and foodborne illness. Averages of each category were used to calculate mean knowledge, positive attitude and appropriate practice of respondents.

The food safety Knowledge, Attitude, Practice, and overall, combined food safety KAP average scores of the kitchen workers was computed and classified using the Bloom's cut-offs for KAP studies, namely, $\geq$80% as good or positive; 60%-79% as moderate, neutral or fair; and <60% as poor or negative. Several studies used this method (Alrazeeni, 2021; Azanaw et al., 2021; Olum et al., 2020). The percentages of the average knowledge, attitude and practice were calculated as the ratio of the sum of optimal responses of the interviewees to the total expected scores if all respondents gave the optimal presumed answers to all of the KAP questions (Macías and Glasauer, 2014).

A multivariate method, Principal Component Analysis (PCA) (Gewers et al., 2021), was applied to construct standardized indices of food safety knowledge, food safety attitude, food safety practice, and an overall food safety KAP.

Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy was used to check if the sample size is adequate to warrant factor analyses for each Knowledge, Attitude, Practice indices (Kaiser, 1974). The internal consistency of the questionnaire was evaluated using scale reliability coefficient, Cronbach's-α.

Spearman's correlation (Lyerly, 1952) was used to assess the correlation among the knowledge, attitude, and practice scores. Bivariate Pearson's Chi-square (Ferguson, 2018) was used to test for significant differences in food safety KAP across socioeconomic status. Multiple logistic regression (Kutner et al., 2004) was applied to summarize the differences in each food safety knowledge, attitude, practice, and overall food safety KAP of food handlers across the significant socioeconomic status. Finally, second order Confirmatory Analysis (CFA) and Structural Equation Model (Mihalache et al., 2021; Sanlier and Baser, 2020) were employed to confirm the relationship between knowledge, attitude and practice.

Results

Sociodemographic characteristics

Food safety-KAP assessment of 462 kitchen workers from the sample schools showed that 59% had elementary school (grades 1-8) level education, 29% had secondary school (grades 9-12) level education and 13% had no education at all. About 78% were married. About 93% food handlers had one or less year of prior experience in food proportion (Table 49). The majority (76.2%) of the food handlers, had no income source before they became involved in preparing and serving meals in the school feeding program. Selection to the job was based on poverty status (Table 49).

Table 49: Food handlers involved in school feeding program food safety-KAP assessment

Socioeconomic characteristics	Total		Socioeconomic characteristics	Total	
	N	%		N	%
Education			Experience in food handling (years)		
Grade 4 and below	82	18	No experience	270	58.4
Grade 5–6	79	17	Less than five	180	39.2
Grade 7–8	109	24	Greater than five	12	2.4
Grade 9–10	88	19			
Secondary and preparatory	44	10			
No education	60	13			
Literacy			Had income source before involved in SFP		
None	51	11			
Read	10	2.2	Yes	110	23.8
Write	25	5.4	No	352	76.2
Read and write	376	81.4			
Marital status			Reason to be selected for food handler in SFP		
Married	359	77.7	Poverty/Children are involved in SFP	147	31.8
Unmarried	103	22.3	Poverty only	315	68.2
Total	462	100	Total	462	100

Average food safety KAP

Food safety knowledge

Table 50 presents the average knowledge of kitchen workers about food safety knowledge. The knowledge scores were computed on the basis of total correct answers all participant gave from the expected correct responses. Based on Bloom's cut-off point, food safety knowledge among the kitchen workers was low (52.3%). Their knowledge, particularly on safe food preparation, was generally low (39.6%).

Table 50: Food safety knowledge scores (percent of correct answers)

Food safety knowledge items	Correct (%)	Incorrect (%)
Food preparation	**39.6**	**60.4**
Reheating leftover food thoroughly eliminates food contaminants	39.4	60.6
Food has to be cooked thoroughly to be safe to eat	47.0	53.0
Fruits or raw vegetables (Cabbage, Salad, Pepper, Tomato, etc.) must be washed using clean water before eaten	50.4	49.6
Washing and cleaning	**64.5**	**35.5**
Washing and sanitizing equipment and utensils reduce food contamination	64.5	35.5
Cross-contamination	**46.5**	**53.5**
Raw meat and offal can contaminate cooked or ready-to-eat foods if stored together	46.5	53.5
Foodborne diseases	**46.0**	**54.0**
Contaminated food with fecal material can cause illness	62.1	37.9
Diarrhea can be transmitted by contaminated food and water	**62.5**	**37.6**
Hepatitis A can be transmitted by contaminated food	24.9	75.1
Typhoid fever can be transmitted by contaminated food	64.1	35.9
Personal Hygiene	**56.9**	**43.1**
Sources of contaminating microorganisms	**55.7**	**44.3**
Microorganisms are present in skin, mouth, and nose of a healthy person	43.9	56.1
Wearing personal item, ornaments such as rings, watches, necklaces during food handling can hold microorganisms, can contaminate and food	58.0	42.0
If nails are not cut short and painted, they can harbor microorganisms that	65.2	34.8
Hands can be the risk of food contamination that cause foodborne diseases	59.5	40.5
Handwashing with clean water and soap before food preparation can reduce food contamination	65.4	34.6
Actions that contaminate hands	**56.8**	**43.2**
Hands can be contaminated with microorganisms/germs during sneezing	60.0	40.0
Hands can be contaminated with microorganisms by touching raw meat	50.2	49.8
Wound cover can harbor microorganisms/germs	53.7	46.3
Hands can be contaminated during eating and drinking when preparing or serving food	40.0	60.0

Food safety knowledge items	Correct (%)	Incorrect (%)
Poor personal hygiene is among the main risks that could cause foodborne diseases	61.9	38.1
Hands can be contaminated by touching mouth, nose, hair or touching fluid	61.7	38.3
Hands can be contaminated by using towels in common during hand drying;	55.4	44.6
Hands can be contaminated when touching pets	65.4	34.6
Hands can be contaminated in toilet rooms	63.0	37.0
Overall percent knowledge	**52.3**	**47.7**

Respondents' knowledge on food preparation was generally poor. They did not have the required knowledge on the importance of thorough cooking of food, reheating of leftover food, or thoroughly washing raw vegetables and fruits to make them safe for consumption. However, they had moderate knowledge in equipment cleaning (64.5%). Respondents also had poor average knowledge on various issues pertaining to personal hygiene, although moderate knowledge was noted on crucial issues such as hand hygiene, particularly on the importance of keeping nails short and washing hands with soap and water before preparation of food (65%) (Table 50). Respondents had moderate knowledge on the common sources and types of foodborne illnesses (62-64%), although they did not consider viruses as major causes of foodborne illnesses (25%).

Food safety attitude

The food safety attitude of respondents was poor (47.1%) (Table 51). The average score in an overall positive attitude about benefit of thorough cooking and safe storage, risks of foodborne diseases, benefits of hand hygiene, and benefits of being healthy is 47.1; 42.7; 48.6; and 50%, respectively.

Table 51: Food safety attitude scores

Food safety attitude items	Agree (%)	Uncertain (%)	None (%)
Thorough cooking and storage	**47.1**	**49.3**	**3.6**
It is good to drink water after boiling to prevent diarrhea	49.8	48.5	1.7
It is good to thoroughly cook food to be safe from contamination	46.3	49.4	4.3
It is good to separately store raw food from cooked food to contamination of cooked food	47.2	48.9	3.9
Risks of foodborne diseases			
Food handlers and kitchen utensils are likely to be a risk for food contamination	**42.7**	**51.4**	**5.9**
Personal hygiene	**48.6**	**47.8**	**3.6**
Hand washing before food preparation likely prevents foodborne pathogens	49.4	47.8	2.8
Serious to have risk for health from handwashing facilities without water and soap	49.8	47.0	3.2

Food safety attitude items	Agree (%)	Uncertain (%)	None (%)
Using glove likely prevent cross-contamination	38.1	51.5	10.4
Employee health	**50.0**	**48.9**	**1.1**
It is likely that having health examination for food handlers is important to prevent food contamination			
Overall percent attitude	**47.1**	**49.4**	**3.5**

For instance, their attitude was low about drinking water after boiling which can prevent diarrhea; separately storing raw food from cooked food which prevents contamination of cooked food; hand washing before food preparation which prevents foodborne pathogens; handwashing facilities without water and soap that have risk for health; and use of glove to prevent cross-contamination.

Food safety practice

Food safety practices of respondents with regards to food preparation and kitchen sanitation was considerably poor. Poor practices included not cleaning work place routinely, not cleaning food preparation equipment with soap and water and not storing garbage in closed garbage can. On the other hand, they had good handwashing practices (82%) (Table 52). However, their practice of washing hands during the most crucial moments was poor (30-50%), although a moderate practice was observed in handwashing before starting food preparation. Other personal hygiene practices such as wearing clean uniforms, removing ornaments from one's body, as they harbor contaminants, covering hair and cutting nails short were also poor (38%).

Table 52: Food safety practice scores

Food safety practice items	Always (%)	Sometimes (%)	None (%)
Food preparation	**35.5**	**7.6**	**56.9**
detect contaminated food by smell	65.6	0.0	34.4
detect contaminated food by taste	11.7	0.0	88.3
Kitchen Sanitation	**30.6**	**7.3**	**62.1**
Floor and dinning places are cleaned after daily routine are finished	51.3	0.0	48.7
Use detergents/liquid soaps to wash equipment	36.1	55.2	8.7
Dispose the waste into a closed garbage can	21.2	0.0	78.8
Personal Hygiene	**43.5**	**35.2**	**21.3**
Handwashing	**19.6**	**0**	**80.4**
Washes hands in a bowl of water (sharing with other people	12.3	0.0	87.7
Wash hands Under running water	21.4	0.0	78.6
Use soap and water while washing hands	25.1	0.0	74.9
Moments of handwashing	**50.2**	**44.0**	**5.9**
After touching personal kits (cloth, wallets, beauty creams)	41.8	47.8	10.4

Food safety practice items	Always (%)	Sometimes (%)	None (%)
Before touching food or clean cooking utensils	57.8	40.9	1.3
Before waring glove or changing glove	33.8	44.6	21.6
Between shifting between different activities	46.8	48.1	5.2
After touching raw food items	47.6	47.0	5.4
Before preparing foods to be provided	51.5	44.2	4.3
After using toilet	59.3	38.3	2.4
After coughing, sneezing, touched mouth, nose and hair	50.2	47.0	2.8
After cleaning used dishes and utensils	52.6	42.9	4.5
Before starting food preparation	63.9	35.3	0.9
After collecting and removing waste	58.2	40.5	1.3
After using mobile, switches, or gates/windows handle	35.9	50.0	14.1
After touching pets	51.1	44.8	4.1
After touching acne fluid, mouth, nose, hair	52.2	43.9	3.9
Other personal hygiene practices (uniform, hair, nails, ornaments)	**38.0**	**31.2**	**30.7**
Wear clean uniform during food preparation	29.2	29.0	41.8
Remove ornaments such as rings, watches, necklaces off hand before food preparation	43.5	37.4	19.0
Cover hair before food preparation	59.1	34.6	6.3
Cut nails short	20.3	23.8	55.8
Overall percent practice	**36.2**	**25.1**	**39.3**

Summary of average scores of food safety KAP

Average scores for each of the food safety indicators were classified according to the Bloom's cut-off point (Table 53). It shows percentage of the average food safety knowledge, attitude or practice scores from the total expected presumed correct scores. Accordingly, the food handlers had poor food safety knowledge, food safety attitude and food safety practice.

Table 53: Average food safety knowledge, attitude and practice

Food safety KAP indicators	N	No. of items	Max Expected Score	Average scores	Status (Bloom's cut-off)	
					% of average scores	Status
Knowledge	462	29	29	15.2	52.3%	Poor
Attitude	462	19	57	26.9	47.2%	Poor
Practice	462	39	117	42.4	36.2%	Poor

Heterogeneities in food safety KAP Indicators

In order to understand variation in food safety KAP across demographic and socioeconomic characteristics, Z-scores were calculated for each respondent applying principal components

analysis (PCA). Then, the scores were categorized into good or poor conditions of food safety KAP status. Before employing PCA, sample adequacy and reliability measures were checked as below.

Sample adequacy and Reliability measures

Kaiser-Meyer-Olkin measures of sampling adequacy for each KAP index showed that the sample size was adequate to warrant factor analysis with KMO values were above 0.9 for all Knowledge and Attitude, and Practice (Table 54). Accordingly, individual variables that scored KMO value less than the threshold level of 0.5 were excluded before further computations of food safety KAP indices.

Table 54: Correlation between KAP Indices, Measure of internal consistency, and measure of sampling adequacy

Food safety KAP Indicators	Correlation			Internal consistency	Measure of sampling adequacy
	Knowledge	Attitude	Practice	Cronbach's-α	KMO statistic
Knowledge	1			0.98	0.97
Attitude	0.7337	1		0.97	0.96
Practice	0.8336	0.5762	1	0.88	0.92

All correlations are significant at $p < 0.001$.

The internal consistency of the KAP questionnaire was acceptable with Cronbach's-α for Knowledge, Attitude and Practice specific question which was 0.98, 0.97, and 0.88, respectively (Table 54), thus indicating that the questionnaire had reliably measured the food safety KAP.

Significantly positive strong correlations were observed among all pairs of Knowledge, Attitude and Practice. The Knowledge and Practice indices showed higher correlation ($r = 0.8336$). The correlation between Attitude and Practice was substantial ($r = 0.5762$). This indicates that food safety practice was more related with the food safety knowledge than that of attitude, while attitude by itself was strongly correlated with knowledge ($r = 0.7337$) (Table 54).

Food safety KAP Indicators

Overall, among the food handlers, 296 (64.1%) scored good food safety knowledge and 166 (35.9%) showed poor food safety knowledge. Similarly, 229 (49.6%) food handlers scored positive attitude towards food safety measures and 233 (50.4%) showed negative attitude (Table 55). On the other hand, 242 (52.4%) of the food handlers scored relatively good food safety practice while 220 (47.6%) of them scored poor food safety practice. The summary food safety KAP score

showed that 279 (60.4%) of food handlers scored adequate food safety-KAP and 183 (39.6%) showed insufficient one (Table 55).

Table 55: Food safety KAP Indicators

Total	Food safety **knowledge**		Food safety **attitude**		Food safety **practice**		Food safety **KAP**	
	Good	Poor	Positive	Negative	Good	Poor	Good	Poor
	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)
462	**296 (64.1)**	**166 (35.9)**	**229 (49.6)**	**233 (50.4)**	**242 (52.4)**	**220 (47.6)**	**279 (60.4)**	**183 (39.6)**

In sum, even though the majority of the food handlers had appropriate food safety KAP, many food handlers had inadequate food safety KAP. This may imply that the food prepared at schools might not be safe – that may impose children at risk of foodborne diseases.

Sociodemographic variations in food safety KAP

The variations in food safety KAP across socio-demographic characteristics is presented. Statistically significant differences in all food safety knowledge, attitude, practice and overall KAP of the food handlers were observed across the differences in educational status ($p<0.001$), literacy ($p<0.001$), and training status about food safety ($p<0.001$) ($p = 0.012$) (Table 58). The difference in food safety KAP over literacy, education and training implies that education and training might have improved food safety KAP among the food handlers involved in this particular study.

However, differences in the status of food safety knowledge, attitude, practice, and overall KAP across age group, marital status, experience in food handling, and previous source of income before involved in SFP were not found significant (Table 56 and Table 57).

Food safety Knowledge

Among food handlers who attended regular education, 281 (69.9%) scored satisfactory food safety knowledge, and 45 (75%) of food handlers who did not attend regular education scored inadequate food safety knowledge. A total of 272 (72.3%) literate food handlers who can read and write had satisfactory food knowledge score. In contrast, 39 (76.5%) of food handlers who neither read nor write scored inadequate food safety knowledge (Table 56).

A total of 135 (91.8%), of food handlers who had training about food safety training had a score of satisfactory level of food safety knowledge and it was observed that food safety training was significantly associated with food safety knowledge.

Food safety Attitude

Among the educated food handlers, 213 (53%) scored positive food safety attitude, and among the non-educated ones, 44 (73.3%) scored negative food safety attitude. A total of 205 (54.5%) literate food handlers who can read and write had positive food safety attitude score. In contrast, 39 (76.5%) of them who neither read nor write scored negative food safety attitude (Table 56).

The majority of food handlers who had training about food safety training had a positive food safety attitude.

Table 56: Socio-demographic characteristics and food safety knowledge and Attitude of food handlers

Sociodemographic characteristics	Total	Food safety **knowledge**				Food safety **attitude**			
		Satisfactory N (%)	Inadequate N (%)	χ^2	p	Positive N (%)	Negative N (%)	χ^2	p
Food handlers age group									
18-24	45 (11.3)	34 (75.6)	11 (24.4)	3.3	0.345	26 (57.8)	19 (42.2)	3.1	0.383
25-34	178 (44.5)	111 (62.4)	67 (37.6)			92 (51.7)	86 (48.3)		
35-44	141 (35.3)	95 (67.4)	46 (32.6)			74 (52.5)	67 (47.5)		
45-64	36 (9)	22 (61.1)	14 (38.9)			14 (38.9)	22 (61.1)		
Education level									
No education	60 (13)	15 (25)	45 (75)	207.3	<0.001	16 (26.7)	44 (73.3)	163	<0.001
Grade 4 and below	82 (17.7)	24 (29.3)	58 (70.7)			23 (28)	59 (72)		
Grade 5-6	79 (17.1)	29 (36.7)	50 (63.3)			30 (38)	49 (62)		
Grade 7-8	109 (23.6)	102 (93.6)	7 (6.4)			33 (30.3)	76 (69.7)		
Grade 9-10	88 (19)	86 (97.7)	2 (2.3)			85 (96.6)	3 (3.4)		
Grade 11-12	36 (7.8)	32 (88.9)	4 (11.1)			34 (94.4)	2 (5.6)		
Preparatory	8 (1.7)	8 (100)	0 (0)			8 (100)	0 (0)		
Marital Status									
Married	359 (77.7)	223 (62.1)	136 (37.9)	2.7	0.103	173 (48.2)	186 (51.8)	1.2	0.269
Unmarried	103 (22.3)	73 (70.9)	30 (29.1)			56 (54.4)	47 (45.6)		
Experience in mass food handling and serving									
Less one year	270 (58.4)	180 (66.7)	90 (33.3)	2.0	0.369	145 (53.7)	125 (46.3)	4.8	0.1
One year	161 (34.8)	98 (60.9)	63 (39.1)			69 (42.9)	92 (57.1)		
2 to 7 years	31 (6.7)	18 (58.1)	13 (41.9)			15 (48.4)	16 (51.6)		
Had source of income before involved in SFP									
Yes	110 (23.8)	69 (62.7)	41 (37.3)	0.11	0.737	54 (49.1)	56 (50.9)	0.01	0.909
No	352 (76.2)	227 (64.5)	125 (35.5)			175 (49.7)	177 (50.3)		
Had any training about food safety									
No	315 (68.2)	161 (51.1)	154 (48.9)	72.2	<0.001	90 (28.6)	225 (71.4)	175	<0.001
Yes	147 (31.8)	135 (91.8)	12 (8.2)			139 (94.6)	8 (5.4)		

differences statistically significant at ***p<0.001, **p<0.05, *p<0.1.

Food safety Practice

Among the educated food handlers (those who attended regular education), 230 (57.2%) scored good food safety practice, and among the non-educated ones, 48 (80%) scored poor food safety practice. A total of 227 (60.4%) literate food handlers who can both read and write had good food safety practice. In contrast, 43 (84.3%) who neither read nor write scored poor food safety practice. The majority of food handlers who had training about food safety training had a positive food safety practice (Table 57).

Food safety KAP

Among the educated food handlers, 264 (65.7%) scored adequate food safety KAP while 45 (75%) non-educated scored inadequate food safety KAP. A total of 255 (67.8%) literate food handlers who can read and write had adequate food safety KAP score. In contrast, 39 (76.5%) of them who neither read nor write scored inadequate food safety KAP. The majority of food handlers who had training about food safety training had adequate food safety KAP (Table 57).

Table 57: Socio-demographic characteristics and food safety Practice and overall food safety KAP

Sociodemographic characteristics	Total	Food safety **practice**		χ^2	p	Food safety **KAP**		χ^2	p
		Poor N (%)	Good N (%)			Inadequate N (%)	Adequate N (%)		
Food handlers age group									
18-24	45 (11.3)	13 (28.9)	32 (71.1)	6.2	0.103	12 (26.7)	33 (73.3)	4	0.266
25-34	178 (44.5)	84 (47.2)	94 (52.8)			70 (39.3)	108 (60.7)		
35-44	141 (35.3)	70 (49.6)	71 (50.4)			52 (36.9)	89 (63.1)		
45-64	36 (9)	17 (47.2)	19 (52.8)			17 (47.2)	19 (52.8)		
Education level									
No education	60 (13)	48 (80)	12 (20)	148.3	<0.001	45 (75)	15 (25)	173.6	<0.001
Grade 4 and below	82 (17.7)	64 (78)	18 (22)			58 (70.7)	24 (29.3)		
Grade 5-6	79 (17.1)	58 (73.4)	21 (26.6)			51 (64.6)	28 (35.4)		
Grade 7-8	109 (23.6)	22 (20.2)	87 (79.8)			26 (23.9)	83 (76.1)		
Grade 9-10	88 (19)	21 (23.9)	67 (76.1)			1 (1.1)	87 (98.9)		
Grade 11-12	36 (7.8)	7 (19.4)	29 (80.6)			2 (5.6)	34 (94.4)		
Preparatory	8 (1.7)	0 (0)	8 (100)			0 (0)	8 (100)		
Marital Status									
Married	359 (77.7)	167 (46.5)	192 (53.5)	0.8	0.376	146 (40.7)	213 (59.3)	0.8	0.385
Unmarried	103 (22.3)	53 (51.5)	50 (48.5)			37 (35.9)	66 (64.1)		
Experience in mass food handling and serving									
Less one year	270 (58.4)	117 (43.3)	153 (56.7)	5.9	0.054	99 (36.7)	171 (63.3)	2.4	0.304
One year	161 (34.8)	89 (55.3)	72 (44.7)			70 (43.5)	91 (56.5)		
2 to 7 years	31 (6.7)	14 (45.2)	17 (54.8)			14 (45.2)	17 (54.8)		

Sociodemographic characteristics	Total	Food safety **practice**		χ^2	p	Food safety **KAP**		χ^2	p
		Poor N (%)	Good N (%)			Inadequate N (%)	Adequate N (%)		
Had source of income before involved in SFP									
Yes	110 (23.8)	54 (49.1)	56 (50.9)	0.1	0.723	45 (40.9)	65 (59.1)	0.1	0.75
No	352 (76.2)	166 (47.2)	186 (52.8)			138 (39.2)	214 (60.8)		
Had training about food safety training									
No	315 (68.2)	177 (56.2)	138 (43.8)	29.2	<0.001	172 (54.6)	143 (45.4)	93	<0.001
Yes	147 (31.8)	43 (29.3)	104 (70.7)			11 (7.5)	136 (92.5)		

Regression and Structural Equation Models

Table 58 shows a summary of variations in knowledge, attitude, practice, and overall KAP in food safety over socioeconomic characteristics of the food handlers using multiple logistic regression models.

Table 58: Multiple regression of food safety KAP and socioeconomic characteristics

Socioeconomic characteristics	Knowledge		Attitude		Practice		KAP	
	AOR	(SE)	AOR	(SE)	AOR	(SE)	AOR	(SE)
Education level (Ref = no education)								
4 and below	1.39	(0.78)	0.68	(0.95)	1.18	(0.71)	1.54	(0.95)
Grade 5–8	17.97***	(9.44)	0.93	(1.19)	3.07**	(1.68)	12.54***	(7.23)
Grade 9–10	521***	(464)	1004.25***	(1544)	1.65	(1.04)	1516.9***	(1782.9)
Grade 11–12	95***	(70.53)	891.11***	(1449)	4.41**	(3.22)	288.9***	(270.9)
Any training about food safety (Ref = No)	50***	(23.97)	1448.69***	(1318)	0.89	(0.39)	79.9***	(40.73)
Food safety knowledge	-	-	4.34*	(3.39)	44.03***	(20.39)	-	-
Food safety attitude	-	-	-	-	2.09	(1.04)	-	-
Constant	0.002***	(0.002)	0.001***	(0)	0.04***	(0.04)	0.001***	(0.001)

AOR: Adjusted Odds Ratio; SE: Standard Errors; ****p<0.01, **p<0.05, *p<0.1*

Educated food handlers of Grade five and above and those trained in food safety were more likely to have adequate food safety knowledge, attitude, practice and KAP than non-educated and non-trained ones (Table 58).

Food handlers who had food safety knowledge were more likely to have positive food safety attitude. In addition, food safety practice was also significantly associated with food safety knowledge however it was not significantly associated with attitude (Table 58).

The result obtained from the Structural Equation Model (SEM) is presented in Figure 12. The SEM model was fit from second order Confirmatory Factor Analysis (CFA) where variables or K, A, and P statements were further grouped under Personal Hygiene (PH), Cross Contamination (CC), Equipment Hygiene (EH), Food Hygiene (FH), and Foodborne Disease (FD).

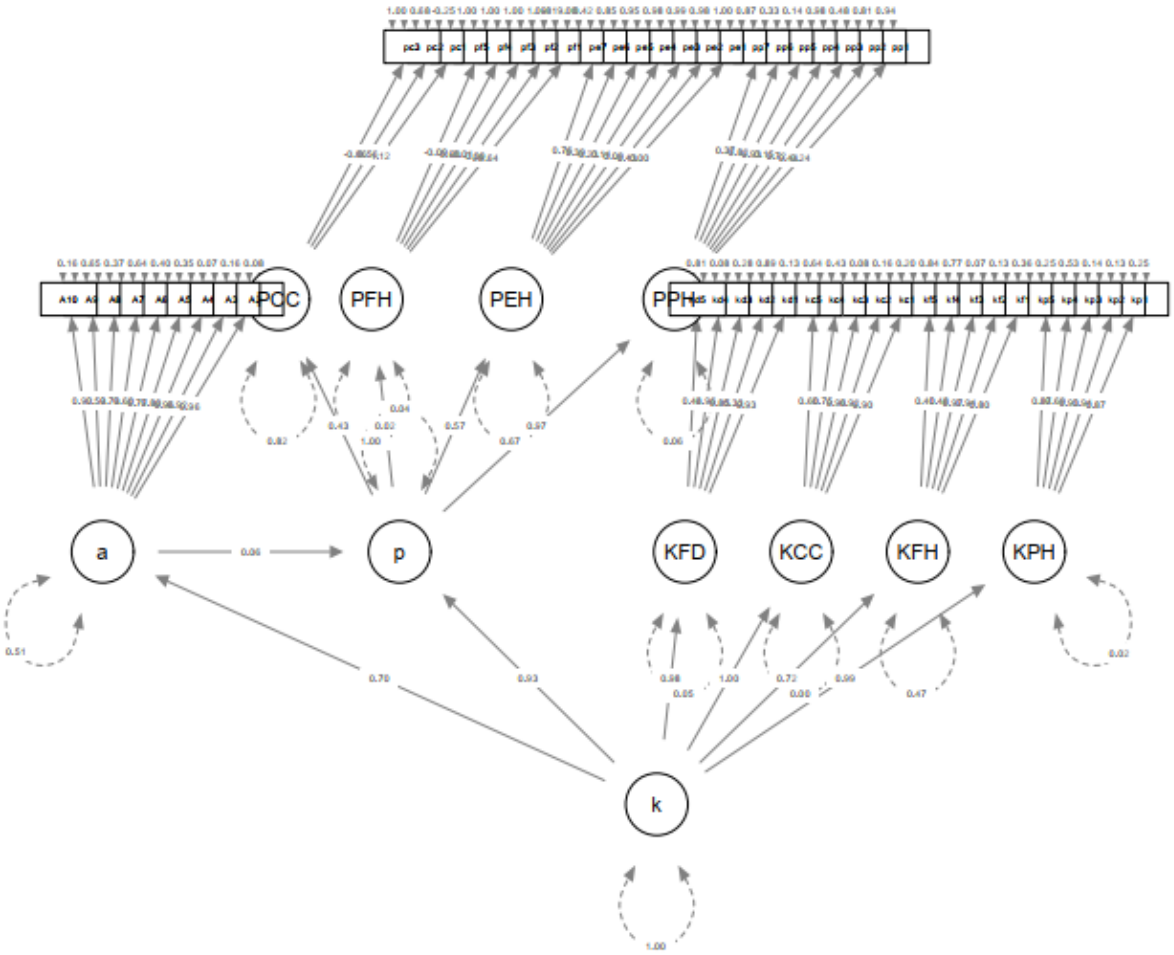

Figure 12: Structural Equation Model

The kitchen workers' knowledge of food safety KAP was almost equally associated with practicing food safety measures and their attitude towards food safety measures. But, attitude had relatively small influence on food safety practice. The evidence is in agreement with that average knowledge of 52.3%, average attitude of 47.2% and 36.2% in practice as provided in Table 53.

Food Safety KAP and Kitchen Observation

Supplementary Table 66 presented detail of items used as checklist in order to assess the food safety KAP and kitchen conditions through direct observation by the health experts. Personal hygiene, food preparation, food storage and dry storage, cleaning and sanitizing cooking and dinning utensils, garbage storage and disposal, and pest control conditions were observed. The overall lesson from this observation showed the kitchen workers overall food safety practice was low.

School WASH

SDG indicators with basic drinking water, sanitation and handwashing facilities (WASH) in schools

Table 59 presents conditions of basic drinking water, sanitation, and hygiene services delivered in schools. The definitions of basic services and calculation of the proportions were based on literature (WHO and UNICEF, 2018).

Table 59: SDG indicators with basic drinking water, sanitation and handwashing facilities (WASH) in schools

Proportion of schools with SDG indicators with basic WASH services		N	%
Water	improved drinking water source	48	96
	drinking water currently available from an improved source*	36	73.5
Sanitation	improved toilets which are usable and single-sex*	14	28
Hygiene	handwashing facilities	46	93.9
	handwashing facilities which have water and soap available*	31	64.6

*SDG indicator for "basic" service (WHO and UNICEF, 2018).

Proportion of schools with a basic drinking water service is delivered in 36 schools or 73.5% of the schools surveyed for school WASH. It is the proportion of schools with drinking water from an improved water source, such as piped, protected well/spring (including boreholes/tubewells, protected dug wells and protected springs), rainwater catchment, and packaged or delivered water, available at the school (WHO and UNICEF, 2018).

The proportion of schools with a basic sanitation service were 14 (28%), that is, the proportion of schools having toilets with flush/pour-flush toilets, pit latrines with slab, or composting toilets (WHO and UNICEF, 2018).

Proportion of schools with a basic hygiene service were 31 (64.6%) of schools which are the schools having handwashing facilities with water and soap available (WHO and UNICEF, 2018).

Availability, accessibility and quality of School WASH

Drinking water

Table 60 shows availability, accessibility and quality of drinking water in schools. It was only from 29 (59.2%) of schools that drinking water was available from the main source at the school throughout each school day, in the previous two weeks before the survey day. Similarly, it was only in 21 (42%) of the schools that drinking water from the main source was typically available throughout the school year.

Table 60: Availability, accessibility and quality of drinking water in schools

Indicators	N	%
Availability		
Drinking water was available from the main source at the school throughout each school day, in the previous two weeks	29	59.2
Drinking water from the main source was typically available throughout the school year		
Yes (always)	21	42
Mostly (unavailable ≤30 days total)	21	42
No (unavailable >30 days total)	8	16
Accessibility		
Drinking water was accessible to those with limited mobility or vision	28	59.6
Drinking water accessible to the smallest children at the school	35	71.4
Quality		
The school did anything to the water from the main source to make it safe to drink	20	40.8
If yes, treatment method is used		
Filtration	4	20
Solar disinfection (SODIS)	15	75
Chlorination	1	5
The school's main water source was compliant with national standards for drinking water	25	52.1

It was only in 28 (59.6%) of the schools that drinking water was accessible to those with limited mobility or vision. In addition, drinking water was accessible to the smallest children in 35 (71.4%) of the schools surveyed.

In terms of maintaining quality of drinking water in schools, only 20 (40.8%) of the schools did filtration, solar disinfection (SODIS), or Chlorination to the water from the main source to make it safe to drink. In addition, it was in only 25 (52%) of the surveyed school's main water source was compliant with the national standards for drinking water.

Sanitation

Table 61 presents availability, accessibility, quality and acceptability of sanitation services in schools. Use of latrine/toilets was available to schoolchildren at all times or during some specific time during school days in 64% or 36% of the schools, respectively.

Table 61: Availability, accessibility, quality and acceptability of sanitation services in schools

Indicators	N	%
Availability		
Frequency that students were permitted to use the school toilets/latrines		
At all times during the school day	32	64
During specific times during the school	18	36
Accessibility		
There was at least one usable toilet/latrine that is accessible to the smallest children at the school	40	80.0
There was at least one usable toilet/latrine that is accessible to those with limited mobility or vision	19	39.6
Locations of school toilets		
Within school building	9	18.0
Outside building, but on-premises	41	82.0
Quality		
Culturally appropriate anal cleansing materials were currently available to all students	5	10.0
There was functional lighting in the student toilets during the survey time		
All toilets	30	60.0
Some toilets	7	14.0
None	13	26.0
Latrines or septic tanks were emptied (or latrines safely covered) when they fill up	41	82.0
Acceptability		
Water and soap were available in a private space for girls to manage menstrual hygiene	10	20.0
There were covered bins for disposal of menstrual hygiene materials in girls' toilets	15	30.0
There were disposal mechanisms for menstrual hygiene waste at the school	24	48.0
Frequency per week that the student toilets are cleaned		
At least once per day	34	68.0
2-4 days/week	11	22.0
Once per week	5	10.0
In general, how clean were the student toilets		
Clean	14	28
Somewhat clean	26	52
Not clean	10	20

There was at least one usable toilet/latrine that is accessible to the smallest children in majority (80%) of schools and but only in 39.6% to those with limited mobility or vision. In about 41 (82%) of schools, location of school toilets was outside building, but on-premises.

There was less acceptable facility of water and soap that were available in a private space for girls to manage menstrual hygiene (20%) and so were covered bins for disposal of menstrual hygiene materials in girls' toilets (30%). Cleaning and cleanness of the student toilets was also seen poor.

Culturally appropriate anal cleansing materials were currently available to all students in only five (10%) of the schools. All the time available functional lighting in the student toilets during the survey time was found only in 30 (60%) of the schools, while it was available in some toilets of seven (14%) schools. Moreover, there was no functional lighting in the student toilets of 13 (26%) of the schools surveyed.

Latrines or septic tanks were emptied (or latrines safely covered) when they fill up in about 82% of schools indicating that quality sanitation services in terms of covering or emptying latrines in the schools.

Hygiene

Table 62 presents availability, accessibility and quality of hygiene services in schools. Majority of the schools (52%) provided handwashing facilities with water and soap located at the school yard. Similarly, handwashing facilities were accessible to those with limited mobility or vision and to the smallest children at 65 and 88% of the schools, respectively, indicating that existing hygiene facilities were better accessible to those groups of schoolchildren.

Table 62: Availability, accessibility and quality of hygiene services in schools

Indicators	N	%
Availability		
Handwashing facilities with water and soap were located at the school		
Toilets	6	12
Food preparation area	9	18
Food consumption area	9	18
School yard	26	52
Accessibility		
There were handwashing facilities accessible to those with limited mobility or vision	32	64
There were handwashing facilities accessible to the smallest children at the school	44	88
Quality		
Frequency that group handwashing activities were conducted for all students, per week		
At least once per school day	29	58
2-4 days/week	2	4

Indicators	N	%
Once per week	19	38
Type of menstrual hygiene management (MHM) provision that were available at the school		
MHM materials (e.g., pads)	14	28
MHM education	15	30
None	21	42
Solid waste (garbage) from the school was disposed		
Collected by municipal waste system	26	52
Burned on premises	16	32
Buried and covered on premises	5	10
Openly dumped on premises	3	6

Overall, lower frequency of group handwashing activities was conducted for all students, per week. None of menstrual hygiene management (MHM) provisions such as MHM materials (e.g., pads) and MHM education were available in majority of the schools indicating that MHM services were poor in schools. However, good solid waste (garbage) disposal practice from the schools was noted.

Discussion

This study showed that food handlers had poor knowledge, attitude and practice on food safety measures. This may imply that the food prepared at schools might not be safe – that may impose children at risk of foodborne diseases.

We found that the majority of the food handlers had poor knowledge about safer food. For instance, poor knowledge that cooking sauce thoroughly maintains safety of meals to eat. Knowledge was also found poor in that food safety might be compromised through failure to separate raw and cooked meals or cross-contamination; and hand contamination by eating or drinking during preparing or serving meals. Food handlers did not recognize that healthy person may carry microorganisms in the skin, mouth, and nose. This knowledge gap may hinder food handlers to practice major food safety precautions. Failure to maintain cooking meals at proper temperature, cross-contamination, personal and utensils' hygiene are potential sources of risk for foodborne diseases (WHO, 2006a). Similar findings were documented in other studies wherein poor knowledge on proper cleaning of equipment, cross-contamination, and foodborne diseases (Elobeid et al., 2019).

In our finding, more than 75% of the food handlers lack knowledge about that Hepatitis A can be transmitted by contaminated food (Table 50). This condition is scaring that the food handlers were poor in knowledge and practice to the key food safety measures.

It was also noticed that the majority of the food handlers had negative attitude to the majority of the attitude specific food safety questions. The weak perception of the food handlers about that a healthy food handler can be a carrier of infectious bacteria that can cause food-borne diseases (Supplementary Table 64) was found concurrent with a weak risk perception of food safety among school food handlers in Bangladesh (Machado Dr. et al., 2014).

In food safety practice, more than three-fourth of the food handlers involved in our study failed to store raw materials separately and above ground, to wear clean uniform during food preparation, cover garbage well, to keep wet drying clothes or sponges under a closed plastic, to wash hands from pipeline, to wash hands while another person assists in pouring water to another's hand, disposing the waste to garbage, to cut nails short, to use hot water while washing, and to detect contaminated food by color and by taste (Supplementary Table 65). These characteristics showed that the food handlers were behind the recommended WHO keys to safer food, namely, keep clean;

separate raw and cooked; cook thoroughly; keep food at safe temperatures; and use safe water and raw materials (WHO, 2006a).

Moreover, only 18.2% of the food handlers had held medical examination. This proportion is low as compared with the finding from a study among food handlers at the University of Gondar, Ethiopia which showed that almost two-third of food handlers surveyed had no previous medical checkup to Salmonella infection (Garedew-Kifelew et al., 2014). The same study showed, however, *Salmonella* isolates were detected in some of the food handlers. Thus, medical examination of the food handlers should be mandatory prior to engaging in food preparation and serving meals in schools.

Our finding agrees with other studies that showed knowledge is correlated with attitude and practice (Table 54) (Illés et al., 2021; Kwashie Madilo and Z. Mgqibandaba, 2020; Mihalache et al., 2021; Sanlier and Baser, 2020). However, in the current study attitude was not significantly associated with food safety practices (Table 54). The lesson, herein, is that knowledge about key food safety measures is fundamental both to raise awareness among key actors to safer food and to improve their tendency towards proper food safety practices.

The current study showed that food handlers who were educated and those trained about food safety measures had satisfactory knowledge, positive attitude, good practice, and adequate overall KAP of food safety (Table 56, Table 57). A similar finding was reported in other studies (Elobeid et al., 2019; Sibanyoni et al., 2017; Sibanyoni and Tabit, 2017). Thus, the current study signals that training the food handlers about food safety would raise and improve their knowledge, attitude and practice in preparing and serving safe meals to schoolchildren.

In other studies in Ethiopia, not related to school feeding, poor food safety practices were found related to service year, income, food hygiene and safety training, attitude, and depth of knowledge of food handlers of food and drink establishments in different towns in Ethiopia, such as Dangila (Tessema et al., 2014), Gondar (Garedew-Kifelew et al., 2014), Jimma (Temeche et al., 2016), Arba Minch (Legesse et al., 2017), Addis Ababa (Mendedo et al., 2017), Nekemte referral hospital (Gemeda, 2018), Northwest Ethiopia (Chekol et al., 2019), and meat shops of Jigjiga Town, Ethiopia (Tegegne and Phyo, 2017). Poor food handling practice was also reported among food handlers of Addis Ababa University students' cafeteria (Meleko, 2015).

Thus, food safety is of an essential concern in Ethiopia. The review food safety and nutrition related benefits of Ethiopian traditional foods and beverages showed importance of some traditional foods such as sauces, street foods and weaning foods in food-borne diseases (Ashenafi, 2002).

To the best of our knowledge, there are no studies in Ethiopia that widely assess the food safety KAP among food handlers that especially prepare and serve meals to large populations of schoolchildren. Only a few were available with regard to this issue in African school feeding programs.

Assessment of the food safety attitudes and awareness of food handlers and managers of School Feeding Programs in Mpumalanga, South Africa showed that food safety implementation was worst in informal schools in rural areas and that food service managers in some schools had little knowledge and awareness of Hazard Analysis Critical Control Point (HACCP). In addition, most food handlers had no knowledge, awareness and attitude on many important aspects of microbial food safety hazards (Sibanyoni et al., 2017; Sibanyoni and Tabit, 2017). In Kenya, knowledge was found to have contributed to attitude and practice and food handlers had fair knowledge (Illés et al., 2021). In Sewoto, South Africa, food safety knowledge and hygiene practices were found uncorrelated but education was positively correlated with knowledge and practices (Kwashie Madilo and Z. Mgqibandaba, 2020).

A large population of schoolchildren benefit from the school feeding programs initiated by the Addis Ababa Administration. Thus, if it is not safe, the food can cause outbreaks of foodborne diseases which may, in turn, deplete nutrition in the long run or lead to death (WHO, 2006a).

In the current study, it was observed that literacy and any previous training about food safety had significant association with proper food safety KAP among school kitchen workers. Food safety knowledge was significantly associated with appropriate attitude and practices among the kitchen workers. Food safety knowledge had significantly contributed to attitude and practice ($p<0.001$). Moreover, vast majority of the food handlers did not know that foodborne diseases such as Diarrhea, Typhoid, Hepatitis A can be transmitted through contaminated food.

Conclusion and recommendation

The current study on the KAP on food safety indicated that the kitchen workers lack proper knowledge, attitude and practice to serve safe meals in schools. It is likely that it may be associated with food borne diseases.

We recommend appropriate food safety training to the food handlers for proper food safety measures. Monitoring and assessing food safety practices, devising an appropriate Hazard Analysis Critical Control Point (HACCP) system for food preparation in school kitchens may minimize risks of foodborne outbreaks.

The food safety practice exercised in the school kitchens was low and overall basic school drinking water, sanitation and hygiene services (school WASH) was low.

Annex

Supplementary Table 63: Food handlers' knowledge on food safety

Rank	Indicator/ group	knowledge statement	Correct	Score	
			N (%)	Mean	SD
1.	Personal Hygiene	Hands can be contaminated when touching pets	302 (65.4)	0.654	0.043
2.		If nails are not cut short and painted, it can contain microorganisms that can be risk of food contamination	301 (65.2)	0.652	0.043
3.		Hands can be contaminated in toilet rooms	291 (63)	0.63	0.043
4.		Poor personal hygiene is among the main risks that could cause foodborne diseases	286 (61.9)	0.619	0.045
5.		Hands can be contaminated by touching mouth, nose, hair or touching fluid from acne	285 (61.7)	0.617	0.045
6.		Hands can be contaminated with microorganisms/germs during sneezing or touching face	277 (60)	0.6	0.045
7.		Wearing personal item, ornaments such as rings, watches, necklaces during food handling can hold microorganisms, can contaminate the food	268 (58)	0.58	0.045
8.		Hands can be contaminated by using towels in common during hand drying; touching utensils and cooking materials.	256 (55.4)	0.554	0.045
9.		Wound cover can hide microorganisms/germs	248 (53.7)	0.537	0.045
10.		Hands can be contaminated with microorganisms by touching raw meats	232 (50.2)	0.502	0.045
11.		Microorganisms can be available in skin, mouth, and nose of a healthy person	203 (43.9)	0.439	0.045
12.		Hands can be contaminated during eating and drinking when preparing or serving food	185 (40)	0.4	0.045
1.	Equipment hygiene	Washing and sanitizing equipment and utensils reduce food contamination	298 (64.5)	0.645	0.043
1.	Food hygiene	Fruits or raw vegetables (Cabbage, Salad, Pepper, Tomato, etc.) must be washed using clean water before eaten	233 (50.4)	0.504	0.045
2.		Using glove can reduce food contamination	232 (50.2)	0.502	0.045
3.		Cooking sauce thoroughly makes the food safe to eat	217 (47)	0.47	0.045
4.		Know a sauce is cooked thoroughly	182 (39.4)	0.394	0.045
5.		Failure reheating thoroughly could be a risk of food contamination	150 (32.5)	0.325	0.043
1.	Cross-contamination	Handwashing with clean water and soap before food preparation can reduce food contamination	302 (65.4)	0.654	0.043
2.		Food can be poisoned from contamination by human or animal faeces	287 (62.1)	0.621	0.045
3.		Hands can be the risk of food contamination that cause foodborne diseases	275 (59.5)	0.595	0.045
4.		Eating or drinking during preparing food or around clean food serving equipment could increase the risk of food contamination	235 (50.9)	0.509	0.045
5.		Know about cross-contamination	182 (39.4)	0.394	0.045
1.	Storage conditions	Animal source raw meats, internals such as stomach, small intestine, liver, kidney, heart, can be contaminated if stored together with other cooked or ready-to-eat foods	215 (46.5)	0.465	0.045
1.	Foodborne diseases	Diarrhea can be transmitted by contaminated water	303 (65.6)	0.656	0.043
2.		Typhoid can be transmitted by contaminated food	296 (64.1)	0.641	0.043
3.		Diarrhoea can be transmitted by contaminated food	274 (59.3)	0.593	0.045
4.		Hepatitis A can be transmitted by contaminated food	115 (24.9)	0.249	0.039

Supplementary Table 64: Food handlers' food safety attitudes

Rank	Indicator/group	Attitude statement	Agree	Score	
			N (%)	Mean	SE
1	Cross-contamination	Eating or drinking in places where food is prepared and around places where food serving equipment are cleaned can be the risk of food contamination	163 (35.3)	2.262	0.029
2		Using glove can prevent cross-contamination	176 (38.1)	2.277	0.03
3		Thoroughly cooked food is safe from contamination	214 (46.3)	2.42	0.027
4		If raw foods are contacted with prepared foods or stored together, food contamination could occur	218 (47.2)	2.433	0.026
5	Equipment Hygiene	Cleaning food preparing equipment and dinning dishes keep food safety	236 (51.1)	2.496	0.025
6	Food Bornedisease	A healthy food handler can be a carrier of infectious bacteria that can cause food-borne diseases	141 (30.5)	2.145	0.031
7		Workers participating in food preparation can be a risk for foodborne diseases	161 (34.8)	2.236	0.03
8		Leftovers on a plate can be a risk for foodborne diseases if provided to another consumer	209 (45.2)	2.405	0.027
9		Having yearly medical examination for food handlers is important	224 (48.5)	2.448	0.026
10		Any failure for handwashing before food preparation can be a risk for abdominal disease/diarrhoea on you or any other consumers	228 (49.4)	2.465	0.026
11		Drinking water after boiling can prevent diarrhoea	230 (49.8)	2.481	0.025
12		Think that any failure on hand washing instruments can lead to a risk for health	230 (49.8)	2.465	0.026
13		Having medical examination for food handlers is important	231 (50)	2.489	0.024
14		Contaminated food serving utensils can be a risk for foodborne diseases	234 (50.6)	2.502	0.024
15	Food Hygiene	Water used for washing materials and cleaning floor can be a risk for food contamination if disposed anywhere in a compound	201 (43.5)	2.379	0.027
16		The water available for food preparation in the school requires water treatment	227 (49.1)	2.463	0.026
17	Personal Hygiene	Food handlers who are sick due to foodborne diseases and have bad personal hygiene can be a risk for food outbreak	215 (46.5)	2.418	0.027
18		Food handlers need to have health certificate	202 (43.7)	2.351	0.029
19		I need safe food preparation training	229 (49.6)	2.478	0.025

Supplementary Table 65: Food handlers' food safety practice

Rank	Indicator/ group	Practice statement	Correct	Score	
			N (%)	Mean	SD
1	Personal Hygiene	Wash hands before starting food preparation	295 (63.9)	2.63	0.045
2		Wash hands after collecting and removing waste	269 (58.2)	2.569	0.047
3		Wash hands after using toilet	274 (59.3)	2.569	0.049
4		Wash hands before touching food or clean cooking utensils	267 (57.8)	2.565	0.047
5		Cover hair before food preparation	273 (59.1)	2.528	0.057
6		Wash hands after touching acne fluid, mouth, nose, hair	241 (52.2)	2.483	0.053
7		Wash hands after cleaning used dishes and utensils	243 (52.6)	2.481	0.053
8		Wash hands after coughing, sneezing, touched mouth, nose and hair	232 (50.2)	2.474	0.051
9		Wash hands before preparing foods to be provided	238 (51.5)	2.472	0.053
10		Wash hands after touching pets	236 (51.1)	2.47	0.053
11		Wash hands after touching raw food items	220 (47.6)	2.422	0.055
12		Wash hands between shifting between different activities	216 (46.8)	2.416	0.053
13		Wash hands after touching personal kits (cloth, wallets, beauty creams)	193 (41.8)	2.314	0.059
14		Remove ornaments such as rings, watches, necklaces off hand before food preparation	201 (43.5)	2.245	0.069
15		Wash hands after using mobile, switches, or gates/windows handle	166 (35.9)	2.219	0.061
16		Wash hands before waring glove or changing glove	156 (33.8)	2.121	0.067
17		Wear clean uniform during food preparation	135 (29.2)	1.874	0.076
18		Use soap and water while washing hands	190 (41.1)	1.823	0.090
19		Cut nails short	94 (20.3)	1.645	0.073
20		Wash hands from pipeline	116 (25.1)	1.502	0.078
21		Wash hands while another person assists in pouring water to my hand	99 (21.4)	1.429	0.074
22		Have held medical examination	84 (18.2)	1.364	0.071
23		Put hands in a container and wash hands together with others	57 (12.3)	1.247	0.061
1	Equipment Hygiene	Use soap or liquid soap while cleaning utensils	297 (64.3)	2.286	0.088
2		Use detergents/liquid soaps to wash equipment	167 (36.1)	2.275	0.055
3		Floor and dinning places are cleaned after daily routine are finished	237 (51.3)	2.026	0.092
4		Wet drying clothes or sponges are kept under a closed plastic	119 (25.8)	1.89	0.071
5		Garbages have covers that close very well	122 (26.4)	1.528	0.080
6		Dispose the waste to garbage	98 (21.2)	1.424	0.074
7		Use hot water while washing	44 (9.5)	1.19	0.053
1	Cross–contamination	Use one towel to dry hands	223 (48.3)	2.071	0.086
2		Store fruits and raw vegetables separately	135 (29.2)	1.812	0.078
3		Store fruits and raw vegetables above ground	105 (22.7)	1.747	0.073
1	Storage conditions	Store other food items purchased from market in a separate storage	244 (52.8)	2.411	0.063
1	Food hygiene	Wait for sauce to be cooked thoroughly	180 (39)	2.383	0.045
2		Detect contaminated food by smell	303 (65.6)	2.312	0.086
3		Leftover is disposed to garbage	293 (63.4)	2.268	0.088
4		Detect contaminated food by color	71 (15.4)	1.307	0.067
5		Detect contaminated food by taste	54 (11.7)	1.234	0.059

Supplementary Table 66: Food safety KAP and Kitchen observations

No.	Observation checklist	Yes		None		Few people only	
	Hygiene	N	%	N	%	N	%
1.	All kitchen workers wore clean and proper uniform including shoes	8	16.0	30	60.0	12	24.0
2.	All kitchen workers properly worn effective hair restraints	27	54.0	10	20.0	13	26.0
3.	All kitchen workers cut fingernails short, unpolished, and clean and no artificial nails	25	50.0	7	14.0	18	36.0
4.	All kitchen workers did not use						
	Jewelry except wedding ban	18	36.0	18	36.0	14	28.0
	Watch	10	20.0	28	56.0	12	24.0
	Bracelets	10	20.0	37	74.0	3	6.0
5.	All kitchen workers washed hands properly, frequently, and at appropriate times	21	42.0	17	34.0	12	24.0
6.	Kitchen workers with burns, wounds, sores or scabs, or splints and water-proof bandages on hands were observed	2	4.0	47	94.0	1	2.0
7.	Burns, wounds, sores or scabs, or splints and water-proof bandages on hands are bandaged and completely covered with a foodservice glove while handling food	8	16.0	42	84.0		
8.	The following were observed during food preparation, service, storage, and ware washing areas						
	• Eject saliva forcibly	1	2.0	47	94.0	2	4.0
	• Eating, drinking, chewing gum, smoking	9	18.0	37	74.0	4	8.0
	• Random or unprotected coughing or sneezing	6	12.0	39	78.0	5	10.0
9.	Kitchen workers used disposable tissues when coughing or sneezing, or touching nose or hair and then immediately wash hands	28	56.0	19	38.0	3	6.0
10.	Kitchen workers cover their mouth and nose during sneezing or coughing	20	40.0	22	44.0	8	16.0
11.	Kitchen workers wash hands immediately when coughing or sneezing	15	30.0	34	68.0	1	2.0
12.	Unobstructed, operational, and clean hand sinks were available	8	16.0	41	82.0	1	2.0
13.	Hand sinks are stocked with soap, disposable towels, and warm water	7	14.0	41	82.0	2	4.0
14.	A handwashing reminder sign is posted	24	48.0	24	48.0	2	4.0
15.	Employee restrooms are operational and clean	21	42.0	25	50.0	4	8.0
16.	Reminder sign, handwashing places, and soap were available in restrooms						
17.	There was enough clean water in the school kitchen	20	40.0	26	52.0	4	8.0

18.	There was enough dining room in the school						
19.	There was proper handwashing facility for students used before or after eating food						
	Food Preparation						
1.	All utensils and kitchen materials that are contaminated with food were properly and timely washed	35	70.0	10	20.0	5	10.0
2.	Washed kitchen materials were left until dried	24	48.0	25	50.0	1	2.0
3.	Washed kitchen materials were dried using towels	21	42.0	28	56.0	1	2.0
4.	Food items such as onion, condiments, raw foods were stored in conditions that avoid food contamination	26	52.0	19	38.0	5	10.0
5.	Procedure of food preparation is free from risk of cross-contamination	18	36.0	30	60.0	2	4.0
6.	Kitchen workers understand about cross-contamination	44	88.0	6	12.0		0.0
7.	There were adequate cleaning materials such as liquid soap, towel, and brushes	3	6.0	47	94.0		0.0
	Food storage and dry storage						
1.	All food items and food supplies were stored on shelves above ground	24	48.0	23	46.0	3	6.0
2.	There was no bulging or leaking canned goods	13	26.0	37	74.0		
3.	The food storage room protects food from contamination	23	46.0	22	44.0	5	10.0
4.	All food surfaces were clean	28	56.0	20	40.0	2	4.0
5.	Items such as soap or liquid soap, chemical sanitizers and pest controlling chemicals were stored separated from food items and food supplies	29	58.0	18	36.0	3	6.0
6.	There was regular cleaning schedule for all food surfaces	30	60.0	18	36.0	2	4.0
7.	Foods are stored in containers that protect food from contamination	23	46.0	23	46.0	4	8.0
	Cleaning and sanitizing cooking and dinning utensils						
1.	There was properly organized sink used to wash utensils	8	16.0	42	84.0		
2.	Water is clean and free of grease and food particles	34	68.0	15	30.0	1	2.0
3.	Oils or any other lipids used to roast food were disposed through waste disposal lines	20	40.0	30	60.0		
4.	Small equipment and utensils are washed, sanitized, and air-dried	41	82.0	8	16.0	1	2.0
5.	All small equipment and utensils, including cutting boards and knives, are cleaned and sanitized between uses	32	64.0	12	24.0	6	12.0
6.	Work surfaces are cleaned and sanitized between uses	29	58.0	20	40.0	1	2.0

7.	Drawers and racks are clean	14	28.0	32	64.0	4	8.0
	Garbage storage and disposal						
1.	Garbage cans and the environment was clean, has no smell, and far enough from the kitchen	32	64.0	16	32.0	2	4.0
2.	Kitchen garbage cans were clean and kept covered	19	38.0	30	60.0	1	2.0
3.	Garbage boxes and containers around kitchen were removed from sites frequently	36	72.0	12	24.0	2	4.0
	Pest Control						
1.	Kitchen rooms, doors and windows allow adequate light pass into the kitchen	26	52.0	21	42.0	3	6.0
2.	Doors and windows were strong that protect pests (mouse) from entering into the kitchen	13	26.0	37	74.0		
3.	Cockroaches were seen move around food storage and cocking materials	5	10.0	44	88.0	1	2.0
4.	There was a regular schedule of pest control by a licensed pest control operator.	12	24.0	36	72.0	2	4.0
5.	Any kitchen material, floor, wall, and roofs were smooth that did not sink water and easy to clean	14	28.0	35	70.0	1	2.0
6.	There was food safety control body	20	40.0	30	60.0		

Chapter VI: Socioeconomic impact of the Addis Ababa school feeding program and the effect of COVID-19 pandemic on kitchen workers and schoolchildren

Abstract

Background: School Feeding Program (SFP) is a platform to enhance education, nutrition and health, and socioeconomic benefits. The Addis Ababa SFP was launched to avoid hunger in schools among deprived schoolchildren and create income for kitchen workers.

Objective: This study assessed the socioeconomic impact of school closure and shift-based reopening of schools due to COVID-19 on schoolchildren and kitchen workers involved in the program.

Methods: Key Informant Interviews and Focus Group Discussions were held in 15 randomly selected schools throughout Addis Ababa. A total of 240 kitchen workers have participated in the discussions. School directors and teachers were key informants.

Findings: The school feeding program created income and avoided social stigma from negative psychosocial effects of economic inequalities among kitchen workers and for schoolchildren pinpointed being poor by getting meals. Disruption of school meals due to a year-long COVID-19, semester and summer breaks, weekends and holidays resulted in loss of income to kitchen workers. The shift learning system, introduced thereafter as COVID-19 precaution, reduced the number of school meals by 40% each week, which proportionally reduced income of kitchen workers.

Interpretation: Continuation of school meals during emergencies that enforce school shutdown would strengthen socioeconomic benefit of SFP while incentivizing schoolchildren for better educational performance.

Keywords: COVID-19, School Feeding Program, socioeconomic effects, school closure, school meal.

Introduction

School Feeding Program (SFP) is a social protection intervention that provides school meals to deprived schoolchildren (WFP, 2020a). In addition to its impact on education, nutrition and health, it creates employment opportunities for women and men in cooking and smallholder farmers (Drake et al., 2020; WFP, 2020a).

SFP has been inspiring poor families to send their children to schools, especially girls, who often are marginalized (Drake et al., 2015). SFPs help to achieve SDGs (Morgan and Sonnino, 2013), empower women and diminish gaps in poverty (Bakhshinyan et al., 2019; Molinas and Regnault de la Moth, 2010). The socioeconomic effect of SFP, in its social protection version, during emergencies of crisis, drought provoked hunger, and food insecurity has been highly appreciated (Drake et al., 2020).

Experiences show that SFPs appreciate local food production and market integration for smallholder farmers; and, at the same time, it promotes access to and habit for diverse nutritious diet in the community, and it also develops rural economy (WFP et al., 2020). It has stimulated employment for women smallholder farmers, jobs in school canteens, and better livelihoods for community nearby schools.

Ethiopia is among the African countries where more than 80% of children do not receive school feeding (Drake et al., 2020). While more than 85% of schoolchildren are fed in high income countries with funding from different local and international sources, the WFP led SFP feeds 16% of the Ethiopian primary schoolers (WFP, 2020a). In Ethiopia, the WFP has been delivering school meals in drought stricken, food insecure rural areas since 1994. Ministry of Education has conducted Emergency School Feeding Program (ESFP) since 2015.

Home Grown School Feeding (HGSF) in Ethiopia has been on pilot in the South since 2012 (WFP, 2019b). Its target was boosting smallholder farmers' income through stimulating demand in the market under the Purchase for Progress (P4P) program that capitalizes on the existing farmers' cooperative unions (WFP, 2019b). According to the WFP, this approach has built capacity of smallholder farmers including production diversification, bargaining power in the market, and commodity accumulation (WFP, 2019b).

There have, also, been other provisions of school meals by Charitable societies in Addis Ababa (WFP, 2019b). Currently, the Addis Ababa SFP offers on-site breakfasts and lunches for more than

400,000 children, i.e., ~2.5% of the national projected population of children and adolescents of age five–19 years (CSA, 2013) or ~66% of that of Addis Ababa (AACA, 2021).

Though there is evidence about the effectiveness and contribution of SFP, especially, on educational (Babu et al., 2017; Devereux et al., 2018; Gelli et al., 2007; Jomaa et al., 2011; McEwan, 2013; Mostert, 2021) and nutritional effects (Alderman et al., 2013; Babu et al., 2017), the evidence about its socioeconomic benefits is scanty.

Moreover, the incidence of Corona Virus Disease (COVID-19) has been public health shock that adversely jeopardized the poor families, children and kitchen workers involved in SFP. Apart from its significant influence on global economy, the pandemic forced school closure and hence interruption of SFP in schools, which, in turn, has negatively affected the nutritional wellbeing of school children, income of poor families, and that of women cooperatives that prepare and serve school meals (World Bank, 2020b). COVID lockdown and any form of school closure has been increasing school dropout to lifelong abstaining from education (Borkowski et al., 2021; World Bank, 2020b).

Nevertheless, the consequential socioeconomic crisis of lockdown of schools and interruption of school meals on schoolchildren, parents and kitchen workers was not yet well documented. Moreover, the emerging challenges brought by COVID-19 precautions after reopening of schools based on shift-based system was not well understood.

Objectives

The main objective of this chapter is to evaluate the socioeconomic benefit obtained from the Addis Ababa School feeding program by women cooperatives (kitchen workers).

Specific objectives

A) Assess the socioeconomic benefit of School Feeding Program to kitchen workers
B) Evaluate the effect of COVID-19 pandemic among schoolchildren, women cooperatives, and community during and after school closure.

Methods

The study subjects were school directors, teachers facilitating SFP activities, and school kitchen workers from 15 randomly selected schools from the ten sub cities of Addis Ababa. In addition, KIIs were undertaken with the school feeding coordinator based at the Addis Ababa Education Bureau and an expert from the recently established School Feeding Agency of Addis Ababa. Qualitative data were collected through Key Informant Interviews (KIIs) and Focus Group Discussions (FGDs). Discussion with a total of 240 participants in 15 FGDs were made and 16 KIIs were administered.

Interviews and discussions were made in Amharic, using open ended introductory questions about the socioeconomic effect of the Addis Ababa school feeding program and effects of school closure due to COVID-19. These included, background information about purpose of women cooperatives; opinion on the benefit of the school feeding program (SFP) to the cooperative members (kitchen workers), schoolchildren, and parents; and the community response to the SFP. Information was also obtained on finance, credit and saving of women cooperatives; inflation and meal price issues; schools' role and participation in SFP; role of the School Feeding Agency; effect of COVID-19 school closure; and challenges and lessons learned therefrom. Other related issues arising from the FGDs and KIIs were also noted.

The researcher facilitated the discussion, took notes and audio-recorded the discussions. Discussions focused on socioeconomic impact of the school feeding program and challenges that arose because of COVID-19 school closure. Each discussion was held for 45–60 minutes. Discussants were encouraged to freely share ideas, express feelings, and forward opinions during the discussion in order to get as much information as possible in the pertaining issues.

Key informants were interviewed separately for about 20–30 minutes. The researcher provided open ended questions such as benefit of the school feeding program (SFP) to the women, finance, credit and saving practices of the kitchen workers, inflation and prices of meals served in schools, effect of school closure due to COVID-19 and the consequence of teaching in shifts. Based on those initial discussion issues, additional information was gathered on related issues raised or any other new ideas that might be raised by the interviewees. KIIs were noted by writing and audio-recording.

FGD and KII recordings and notes were transcribed in English, organized into themes and synthesized. Longer statements that gave emphasis to the issues raised under the themes were quoted, and lessons or conclusions derived from them were highlighted.

Ethical considerations

Consents to take part in the FGDs and KIIs were granted from all the kitchen workers, school directors and teachers. Participants were informed about the recording and they gave permission to be recorded.

Findings

Sociodemographic characteristics of respondents

The majority (56.7%) of the participating kitchen worker/ women were attended primary education and about 27% of them attended secondary education while about 17% had no education. Moreover, more than 75% of the kitchen workers were married (Table 67).

A total of 15 FGDs with about 16 participants per group and 16 KIIs were administered. A total of 240 women were sat for the whole FGDs. The mean age of the FGD participants were about 33 years while the minimum and maximum ages were 20 and 63 years (Table 67).

Table 67: Background information about respondents

Age of respondents	N	Mean age (SD)
	240	33.3 (7.7)
Education and Marital Status	N	%
Education status		
No education	40	16.7
Primary (grades 1–8)	136	56.7
Secondary	64	26.7
Marital Status		
Married	181	75.4
Unmarried	59	24.6
Family size		
1-2	37	15.4
3-6	163	68
7-11	40	16.7
Total	240	100

Organization of women cooperatives

According to the KIIs made with an expert form the Addis Ababa Education Bureau, school directors and teachers, the kitchen workers in SFP were organized in such a way that meal preparation and service assignment were done at a rate of one woman for 30 schoolchildren. Thus, a ten-woman (kitchen workers) team, prepares and serves school meals for about 300 schoolchildren at one serving window. The team purchases food items, prepares the food and serves the meals. A team of kitchen workers obtains initial capital/budget by credit from a microfinance enterprise. The Addis Ababa Bureau of Women and Children Affairs organized the women as a means of job creation activity for poor women. In general, each team involved in the

school feeding program manages its finance and shared profits among members every two weeks. They got budget released from the school based on the number of schoolchildren served in the previous two weeks.

Benefit of the school feeding program to women cooperatives

The women cooperatives were housewives or household heads who, before involvement in SFP, had no means of income or did minor activities for diminutive income, such as vending small things in village outdoor markets, making and selling *Tela* (local beer) or give house-to-house services to other households, such as washing clothes, cleaning, baking *Injera* (traditional bread), or cooking during social events like feasts, wedding, mourning. During the FGDs, they described multiple benefits of the SFP. Apart from economic benefit, they believed that the program improved their self-esteem from having a job that brought income to the family. A mother (kitchen worker) who was frustrated by irregular and low wages from daily tiresome routines, said "I am happy and feel healthy when I get back home from work here". Another kitchen worker said:

> *I had been carrying heavy bundles of dried leaves and branches on my back to sell and raise my children all through my work life. Now I have a job that does not tire me much. I am healthy. It has been quite shameful, both for me and my children, to carry bundles of dried leaves and branches on the back every day as doing that job seems unworthy and lower than what a human being should do. It creates a moral pain to feel being under human being status. But now, I am feeling that I am equal to others and feeling healthy. My children are also feeling proud and no longer suffer from a stigma that their mother carries bundles until her back bent and raises them with income coming therefrom.*

It can, thus, be concluded that SFP played meaningful psychosocial role to avoid stigma among the children and the women that would arise from low socioeconomic status.

Team members explained that, currently, they felt economically safer that they were sending their children to school. For many of the FGD participants, the fact that they were coming and staying on their job each day, by itself, gave them hope and pleasure, and as a result, got mental satisfaction. A kitchen worker who was a returnee migrant said:

> *I am a returnee from a Middle East country. I used to sell small things in village outdoor market, after my return. But selling in village outdoor markets was prohibited by the government. I went to Kebele and applied to be included in the women's association being organized for this SFP. Then I got this chance. It means a lot to me!*

According to the discussants, team members also took leftover meals that were not served to schoolchildren during lunch time. They got *Injera* and *wett* (sauce) for consumption at home. They

explained that this had a significant contribution to their livelihood as they could save money or reduce financial constraint by not having to buy charcoal, oil, etc. to prepare dinner at home.

Women saved money because they had their breakfast and lunch at their workplace, and prepare coffee for own consumption at the schools; their children, for whom they were previously unable to pack lunch boxes, learned and got their meals in the school; only other family members, if any, had to get food at home; team members and their children lived in the school vicinity and did not have transport costs; members understood when one of them had to go home to resolve some social matters or handle emergencies and covered responsibilities for each other. They considered these extra benefits as incomparable with the situation they were in before they joined SFP. A woman said the following during the FGD:

> *I raise my child alone. I used to get some income from washing clothes for other families. I thank the government from my heart that has created this job for me and pulled me out of a tiresome physical work. Now my child is enrolled and attends school. He is now fed like any other child, he gets free school uniform to wear, receives educational materials such as stationaries free of charge just like other schoolchildren. Having a job by itself means a lot to me because I do not have to stay at home.*

The kitchen workers also asserted in the FGDs that they felt that they were involved in the task of feeding poor schoolchildren, a big humanitarian and charitable endeavor. As a result, they said that they got mental satisfaction. A member said, "I am so much excited than anyone else and love to serve all my life here because I get mental satisfaction when I see children eat".

FGD participants had their own concerns about the sustainability of the SFP and what they would face if the program stopped. The main concerns they raised were that "we would fall back into extreme poverty and disaster"; "it would hurt us"; "our children would suffer from hunger and deprivation"; "single mothers would be stressed"; and "households whose partners/husbands has no occupation or income sources would be in trouble". These concerns also showed that the SFP had currently reduced wide socioeconomic burdens among school kitchen workers and the community.

Similarly, school teachers and directors, who participated in the KII, believed that kitchen workers benefitted from job created for them and they were generating income from the SFP. Most of them were house-wives without income prior to being involve in the program. A school teacher explained:

> *The kitchen workers are economically benefitting. There is no reason to work here without any benefits. But I agree that the benefits may not be enough. They stayed working here for about three consecutive*

> *years. This justifies that they are benefitting from the project. Otherwise, they would leave for another job or stay at home.*

Benefit of the school feeding program to parents and the community

It was learned from the FGDs and KIIs that the community around the public schools mainly was comprised of low-income households. Many of the neighborhoods were slum areas, where, in some locations, parents and schoolchildren sell *Araki* (home-made alcoholic liquor) and, in some areas, most mothers were sex workers. Such families were sending their children to schools mainly because their children could get two meals at school. According to the FGD participants, it was hard to feed two-three children in a poor family. Thus, this SFP benefitted the parents. The following statement would show the case in point:

> *My daughter gets school meal from another school. She usually tells me 'if you give me an empty lunch box, I would bring you half of the meal I am served at school'. She tells me this because she observes that we do not have food to eat at home.* (Kitchen worker).

There were schoolchildren whose parents were beggars. A teacher shared her observation about the level of the challenge within the community to send their children to school, as follows:

> *I know two outstanding children of a mother who was a beggar. They used to stand first and second in academic performance in the class. Their mother, interrupted their schooling and sent them to serve as house maids elsewhere. I frequently urged her to bring them back to school. We even promised to buy stationaries and other facilities for them. But she insisted that they had to work because she did not have any food to give them, They, later on, started to attend evening classes. But now, thanks to the SFP, they are back to school full time.*

Prior to the SFP, poor households were usually unable to pack lunch boxes to their children. For that reason, many school children spent the school day hungry. Some parents gave their children a handful of *Qollo* (a handful of medium-roasted barley seeds) to eat at school during lunchtime. According to participants of the KIIs, after the implementation of SFP, there were schoolchildren who got their only meals at school and did not get any food at home. There were also some schoolchildren who asked for an extra meal to take home for dinner because there was no food to serve at home.

Thus, the establishment of the SFP relieved parents from several problems. There was no more distress from being unable to pack lunch box to their school going children. Economic burden to feed their children at home, if or when possible, was lessened. Teachers observed and explained that parents got great relief since the SFP started to feed their children.

The SFPs and other government/community-provided learning packages to needy school children, such as uniforms, school backpacks, books and stationaries, motivated many middle-income parents, who used to send their children to private schools, to have their children enrolled at public ones.

The SFP also encouraged schoolchildren in rural areas to leave their parents and live with relatives so that they could attend school. A teacher explained the fact as:

> *Many schoolchildren came from rural areas to live with their aunts or other relatives. They are benefitting from SFP and are attending school. But some relatives do not handle the children, they involve the children too much in household chores.* (Teacher).

There were concerns by some community members about some hygienic conditions in meal preparation. According to a school director, some community members also reflected their concern about the adequacy and nutritiousness of the meal served to their children. They questioned if appropriate food safety measures were implemented, such as kitchen sanitation and personal hygiene of food handlers; and the need for each kitchen worker to have medical examination. Moreover, the parents, the school director added, raised their concern that the price of the meal per child should be increased in order for the kitchen workers not to compromise quality and quantity of the diet.

Benefit of the school feeding program to the schoolchildren

According to the teachers and school directors, before SFP was started, schoolchildren used to lose consciousness in class and teachers used to associate it with some kind of illness. Later on, they discovered that it was due to hunger. Following the SFP, schoolchildren no longer lost consciousness in class because they were not hungry. KIs also agreed that the SFP had benefitted the children in terms of physical growth, health status, school attendance, class participation and academic performance.

It was noticed that many schoolchildren got weak due to hunger and slept in classes while lessons went on. In some schools, teachers used to feed schoolchildren from their own lunch boxes as it was distressing to see many schoolchildren without lunch box and simply saw their classmates from not so poor households ate lunch from own boxes. The two observations by teachers as stated below might show the level of the challenge schoolchildren used to face before SFP started and the benefit they received from the SFP.

> *There was one school child, a girl, who used to 'eat' cheap flavored ice. We asked her classmates why she liked ice so much? Her classmates told us that it was not because she liked ice, but she never had food for lunch. Then we started mobilizing resource among ourselves and fed some schoolchildren.*
>
> *At one time, I overheard two schoolchildren of grade eight commenting on the quality of the meal served during lunch time. One was commenting that the food served that day was not good enough. Then the other asked back 'is the food we eat at our home as good as the one we eat at school?' Then the other student was convinced that the meal served at school was even better. Then, they ate their lunch appreciating the school meal.*

The issues raised, thus far, explained the extent to which school-age children and adolescents in public schools had been suffering from hunger while in schools, and to what extent the nutritional, educational and economic benefits that schoolchildren acquired from the Addis Ababa SFP had favorably changed the situation.

It was pointed in the FGDs that many schoolchildren lived on what was served in schools during breakfast and lunch and spent the night without supper. In addition, FGD participants mentioned that, since the program was established at elementary school level, many schoolchildren in secondary and preparatory schools faced similar hunger. The kitchen workers shared their experiences that they used to get some of those students along the street who used to ask if they could give them lunch. There were times when the kitchen workers gave them money for lunch. The FGD participants recommended extension of the SFP to secondary schools and preparatory public schools as well.

Social Stigma

Kitchen workers, teachers, and school directors appreciated the current universal coverage of the Addis Ababa School Feeding Program. They explained that before the current universal SFP, only some schoolchildren in dire need of food were served meals. This had psychological effect on the beneficiary children that could make them develop social stigma because they felt that being served school meals separately from other schoolchildren clearly showed that they had no food to eat at home. In an FGD, it was said:

> *Nowadays, all poor children are psychologically undisturbed and are free from social stigma. They are no more afraid that they may be pin-pointed as being very poor by getting meals from SFP since school children who can normally come with a lunchbox from home also eat meals from SFP.* (Kitchen worker).

Thus, the universal provision of school meals was currently free of social stigma since it did not show socioeconomic disparities among children.

Economic effect of school closure and shift-based learning

During normal circumstances, before the onset of COVID-19 school closure, between 800 to 2800 schoolchildren used to be served school meals each school day. Thus, during this period, women focus group discussants said that they used to get up to ETB 800 to 2000 biweekly from profit sharing. However, this income was totally interrupted during the COVID-19 imposed school closure times.

As a result, substantial livelihood and nutritional crises were noted during two consecutive periods: (*i*) the emergency school closure due to COVID and (*ii*) at school reopening, when the shift-based learning system was introduced as a COVID-19 safety measure. According to the participants, the national universal restrictions of social distancing and other safety measures against COVID-19 (Council of Ministers, 2020), and the sudden school closure had led to socioeconomic crises both on schoolchildren and the kitchen workers. Kitchen workers were not able to serve meals, thus had remained jobless. It has also affected vulnerable households, whose children got their meals only from schools. Household resources were not enough to cover meals that were offered by the by SFP as working household members lost daily wage.

The women cooperatives expressed that, though they started working in the school kitchens under SFP, the COVID lock down threw them back in to extreme poverty and frustration making them unable to feed their children, and family in general. They explained the situation as:

> *We were under extreme economic burden, salary/income was interrupted. It was challenging time to feed our family. We received a little support from community support initiatives like one liter of cooking oil, toilet papers, 5 kg of flour, but that did not feed us longer than a month.*

Similarly, teachers observed visible economic burden on parents following the school closure. A school director explained the situation as:

> *During COVID closure, the primary concern of parents was the reopening of schools so that their children could get free meals; some parents came to us and asked to give them some food as their children were hungry.*

Teachers also observed that kitchen workers and poor people in the community surrounding schools passed through difficult times since all their income was totally spent on feeding all family members. Some kitchen workers had started searching for other means of income, such as selling vegetables and other food commodities at open outdoor village market *or* doing washing and cleaning for other households to try to feed their family with the meagre income they get therefrom.

In an FGD in one of the schools, a participant said:

> *The interruption of SFP due to COVID-19 in a district (Woreda) in Lideta sub-city, which is a known slum area, was a difficult time for the schoolchildren and their parents who lived in that district.*

FGD participants said that they would recommend not to interrupt SFP even during the pandemic because interruption led poor schoolchildren suffer from hunger. Kitchen workers said that they felt sad for the many schoolchildren who asked them when school would reopen for meals.

Due to the COVID-19 pandemic and the preventive measures, such as social distancing, out-of-job kitchen workers could not earn money by working at social events such as feasts, wedding, and other occasions as social distancing discouraged such events. For the same reason, opportunities for house-to-house paid jobs, such as washing clothes, baking *Injera*, and cooking for other households totally stopped. They stated "all alternatives to get income were blocked during the lockdown". In very rare cases, when an opportunity to wash clothes for other households appeared, the pay was inconsequential, about ETB 30 to 50 at completion of washing.

Nutrition and food security effects due to shift-based education

Gradual and partial reopening of schools was implemented in three phases as part of COVID-19 prevention strategies. Grade eight schoolchildren started school and took their regional exam at the beginning in November 2020. Then grade five to seven schoolchildren and those below grade four started education at the second and the third phases, respectively.

In addition, the arrangements of learning in shifts led half of the schoolchildren in a school to attend schools on Monday, Wednesday and Friday, while the remaining group attended on Tuesday, Thursday, and Saturday. This arrangement was intended to maintain social distancing in classrooms. It, thus, reduced the population of schoolchildren who came to school in a day by about 50%. However, it also led to feeding only half of the schoolchildren in any particular day. Thus, unlike normal schooldays during which schoolchildren used to attend school and get school meals for all five weekdays, during this pandemic, any schoolchild was served school meals only for three days during the whole week.

This condensed the total number of meals served in a school per week to about 60% compared to that was served during normal circumstances. Hence, it consequently led to about 40% reduction in income of kitchen workers. The reduced number of schoolchildren to be fed led to reduced number of meals served per day, and, extremely reduced the weekly income of kitchen workers.

Thus, the women reported, the shift-based reopening of schools had led to inconsequential biweekly income, being not more than ETB 400 to 800, highly compromised compared with their income before the pandemic.

The team members felt then that their income was not enough even to cover household expenses, and, emphatically, expressed that "saving out of it is unthinkable".

In addition, the nutritional wellbeing of schoolchildren was highly compromised as witnessed by participants of this study. Hungry schoolchildren went as far as begging for food along streets and they were noticeably frustrated during the school closure days.

According to FGD participants, many schoolchildren from destitute families resorted to begging along streets when they were off schools, for their daily bread. They suffered from deprivation and hunger. According to a school director:

> *The shift schedule, partly, has similar burden on schoolchildren as the lockdown because they face hunger during the weekdays they do not come to school. They wished they could come to school on these days just for the meal and then could go back home. But it is only the schoolchildren in their shift who can be served.*

Moreover, the kitchen workers were not able to pay back credit they got to run the school kitchens due to COVID interruption. After the reopening, they got the chance to resume saving and paying back credit. Thus, they believed that the reopening of the schools brought them moderate relief.

Stressing on the current partial school meal benefits, a kitchen worker said:

> *Not only during the COVID-19 lockdown, we also saw some grade 4 and grade 5 children begging people on streets when they missed school meals every other day due to the shift system. We also saw many schoolchildren searching for and eating food from community garbage containers, especially boys.*

Thus, schoolchildren had to go to streets for search of food instead of reading, doing their home works, or preparing for next school day, which would seriously affect school performance.

Effect of price inflation during the pandemic

The kitchen workers said that the rising inflation in all food items, ingredients, and detergents and other cleaning materials, along with the socioeconomic crisis following the COVID-19 pandemic had diminished their income and potentially threatened their livelihood.

Discussion

The findings in this study are similar with global experiences that SFPs have created income to jobless women and better nutritional outcomes (Alvi and Gupta, 2020; FAO and WFP, 2020; Saavedra, 2020). Our finding is also consistent with other's that COVID-19 impacted food and nutrition security (FAO and WFP, 2020). The school closures, interruption of school meals, and closing of public and private sectors led to job and income losses.

Globally, school shutdowns due to the pandemic led millions of poor schoolchildren to loss of daily meals (FAO and WFP, 2020; Saavedra, 2020). This global crisis proved that SFP has been the largest global social safety net for malnourished children, vulnerable, or those at risk (FAO and WFP, 2020).

Indian experience proved that the lockdown of schools due to the pandemic had clear consequence on the food security of children which might continue to have long term health and economic impacts (Alvi and Gupta, 2020). It was also reported that the times of lockdown were likely to remain much more severe for girls and children (Alvi and Gupta, 2020).

Some countries followed different ways to alleviate hunger among children during COVID-19 pandemic-driven school closure. For instance, Brazil had been distributing food kits and/or supplied food cards/vouchers (Corrê et al., 2020). In the US, the onset of the pandemic led to emergency feeding, named 'Sendai Framework for Disaster Risk Reduction' in order to combat child food insecurity. The experience of school nutrition employees that provided emergency feeding services during the COVID-19 pandemic showed that the programs demonstrated flexibility, resilience, and commitment to children during this crisis (Patten et al., 2021).

Similar to our observations, a systematic review in the United States showed that universal school meals may be associated with improved household incomes, particularly among lower-income families with children (Cohen et al., 2021).

In Armenia, SFP contributed noticeable welfare outcome among people under extreme poverty or comparatively strong social aversion to inequality backing its social protection role (Bakhshinyan et al., 2019).

Households get the room to save their daily cost of meals per school-going children, and in some cases, they enable to utilize wages to other nonfood expenditures (Babu et al., 2017). In Brazil,

SFP's motivated school food shopping supported by market policy resulted with socioeconomic impacts that promoted rural development (Elias et al., 2019).

In South Africa, SFP was an emerging income opportunity to local women cooperatives (Beesley and Ballard, 2013). In Nigeria, SFP has significantly improved cooks' income while training has improved their purchasing skills, and benefited a wide range of stakeholders (Ayoola, 2014).

Another useful point was that teachers manage classes and learning processes without hesitation or any stress that may arise from the feeling of hunger reflected out of schoolchildren face or due to sudden fainting of schoolchildren from hunger. This has numerous advantages to facilitate learning. Experience showed that SFP has contributed to substantial learning and cognitive gains for girls and the poorest schoolchildren, and it has influenced food allocation and sharing at the household level (Gelli et al., 2019).

Globally, good practices have been gained from multiple means of participation (Drake et al., 2017). Organizing farmers, smallholders, by providing complementary grants so as to enhance HGSF practice helped countries to improve yield, quality and safety across the food supply chain. In this case, the program benefit is spilled over to smallholders in their livelihood through acquisition of income and skill (WFP, 2013).

Similar to the finding in the current study, regular inflation in food prices and inadequate storage facility, increasing cost of goods, bureaucracy, insufficient technical assistance, and resistance to changes were major challenges to the effectiveness of school feeding program and school farms are believed to contribute to SFP (Azubuike and E. Mbah, 2019; Mossmann et al., 2017).

Often, the Ethiopian academic calendar of primary and secondary schools lies between mid of September and end of June. During this time, school meals are served for a maximum of 170 active school days. This implies, schoolchildren do not get meals for at least 100 days, including 72 days of weekends, 14–16 days of semester breaks, and other 10–12 holidays of school closure. In addition, the summer break takes around 95 days which covers between beginning of July and end of September, during which school meals are not served. Thus, SFP provides meals for less than half a year. Therefore, the Addis Ababa SFP, although it is considered as a social protection program (WFP, 2020a), cannot be considered as a program that intends to improve the nutritional wellbeing of schoolchildren. It only serves to keep schoolchildren in school during school days.

Similarly, it cannot be considered as a means of sustainable income source for poor women who invest and work in the school kitchens.

In addition, from this point of view, the community, more specifically families of schoolchildren get economic relief only for a cumulative extent of less than half a year. This suggests that, a full year coverage of SFP may make SFP a complete social protection program and doubles the benefit to schoolchildren, women cooperatives and parents. This may, in the long term, also result in a positive effect on human development. Though, the major objective of SFPs is to alleviate hunger in schools (Drake et al., 2020; WFP, 2020a), it is vital to consider provision of meals at homes during those breaks throughout their studentship.

Currently, the average expense to feed a schoolchild through the school days in one academic year is ETB 2720 (~USD 65 in 2020/21). This is slightly higher than the WFP's 2020 estimate of USD 55 of median cost of school feeding per child in low-income countries (WFP, 2020a). Experiences show that SFP is low costly while maintains food and nutrition security (Forrestal et al., 2021; Long et al., 2021).

The meal price in Addis Ababa (~USD 0.4), was almost equivalent to that in Ghana (USD 0.33) per meal per child per day (Aurino et al., 2020). Similar to the finding in the current study, cash transfer in Ghana's SFP is employed every two weeks. However, Ghana's SFP experience showed delayed budget reimbursements to caterers (Aurino et al., 2020) which rarely happened in the Addis Ababa SFP. Such delay in cash transfer would affect timely marketing of food items and food preparation at schools which leads to compromising the quality of the meals served.

The low price of meals per student with its dual undesirable effects of low income for kitchen workers which likely leads to compromised nutritional quality of meals, call for reconsideration of allocated budget for meals.

Provision of meals during weekends, holidays, and semester and summer breaks would keep schoolchildren food secure while women cooperatives get better income. In the United States, food insecure children receive weekend feeding programs which aimed to alleviate food insecurity (Fiese et al., 2020).

Another important issue might be the situation that there is no school feeding policy in Ethiopia which may hinder effectiveness of the SFP. The absence of clear policy on school feeding in Tanzania resulted in compromising effective delivery of the intended social protection emanating

from quality school meals (Roothaert et al., 2021). An experience from Brazil also showed the effect of policies and legal frameworks for a successful deliberation of quality school meals, including fruits, and vegetables that improved food safety, and promoted family farming (Sidaner et al., 2013). More specifically, it has been seen as an enabling factor to maximize healthy diet and eating habits, safe food production, and maximizing the returns for society (Kroth et al., 2020). The Brazilian SFP works under obligation by law to designate a minimum of 30% of the federal resource with family farmer products and is responsible to feed all Brazilian public schools (Elias et al., 2019).

Conclusion and recommendation

The findings showed that the Addis Ababa school feeding program has conclusively brought socioeconomic benefits to the women, such as source of income and psychological relief. It keeps schoolchildren effectively attend school. As schoolchildren from food insecure households are left hungry for more than half of the year, it is important to raise the program to a level of large-scale social protection program so that food insecure schoolchildren can develop into well-educated and productive citizens.

However, the interruption of the SFP due to the incidence of COVID-19 and the shift-based education system introduced thereafter hindered schoolchildren and the kitchen workers from getting optimal nutritional and economic benefits, respectively.

Local market integration of food products with farmers and wholesalers would strengthen the SFP, improves income of the women, and also promotes sustainable Home-Grown School Feeding Program.

Annex

Major topics of the Key Informants Interviews (KIIs) and Focus Group Discussions (FGDs)

1. Background information about women Associations'/Kitchen workers
2. Benefit of the school feeding program (SFP) to the women
3. Benefit of the school feeding program to community and community response to the SFP
4. Finance, credit and saving practices of the kitchen workers
5. Inflation and prices of meals served in schools
6. Schools' role and participation in the school feeding program
7. The role of the Addis Ababa School Feeding Agency in the school feeding program
8. Effect of school closure due to COVID-19 and the consequence of teaching in shifts
9. Challenges and opportunities.

Table 53: Qualitative data collection sites

No.	School	Sub city	FGD	KII	Date	Number of women
16.	ABT	Yeka	Yes	D/D/r	3/6/13	12
17.	EST	Addis Ketema	Yes	D/r	4/6/13	17
18.	AND	Arada	Yes	D/r, DDr, Teacher, kitchen workers representative	8/6/13	21
19.	BG	Bole	Yes	Teacher	9/6/13	20
20.	BHN	Gulele	Yes	D/r	10/6/13	23
21.	GF	Nifas silk/Lafto	Yes	Teacher	11/6/13	20
22.	TY	Kirkos	Yes	Teachers	12/6/13	12
23.	KK	Arada	Yes	Teacher	12/6/13	21
24.	AA	Arada	Yes	Teacher	16/6/13	17
25.	KM	Kolfe	Yes	D/Dr.	24/6/ 21	20
26.	AB	Nifas silk/Lafto	Yes	D/r.	01/7/13	14
27.	ATK	Akaki	Yes	Teacher	1/7/13	12
28.	DZD	Lideta	Yes	Teachers	25/6/21	6
29.	NKB	Yeka	Yes	Teachers	26/6/21	9
30.	ALM	Lideta	Yes	Teachers	15/6/ 21	16

Synthesis: School Feeding Program in Addis Ababa – Nutritional and Educational Effects, Food Safety KAP and School WASH conditions, and Socioeconomic Implications

Summary

The Addis Ababa School Feeding Program was established in February, 2019. As a result, this research project had the chance to carry out a baseline assessment and longitudinal study. The aim was to evaluate the impact of the SFP on nutritional and educational outcomes while also assessing school WASH and food safety KAP, and socioeconomic benefits it brought to women involved in kitchen work and to the schoolchildren.

The study evaluated the Addis Ababa School Feeding Program with regard to five major subjects. The first theme evaluated the nutritional impact of the program on schoolchildren. Secondly, the dietary quality and adequacy of the school meals were assessed to determine if the daily dietary requirement of schoolchildren of different sexes and ages is partly fulfilled by the meals. The third theme dealt with the impact of the program in academic performance of schoolchildren. The fourth one dealt with food safety issues related to food safety knowledge and practice of kitchen workers, who were considered, in this study, as kitchen workers. It also assesses conditions of school WASH services in schools. Finally socioeconomic benefits brought by the program to kitchen workers and schoolchildren were presented

Mixed methods of quantitative and qualitative studies were used. The study was mainly based on longitudinal study design that aimed at repeated follow up or growth monitoring of schoolchildren who received school meals. Appropriate sample size determination technique was applied that assumed the number of repeated measurements, effect sizes, power, level of significance, and design effects that would arise from the complexity of the study design. Sample sizes were determined at school level to finally reach a size of 90 schoolchildren per school.

Multistage-stage cluster stratified sampling was used to achieve a whole sample size of 4500 schoolchildren from randomly selected 50 schools from all sub-cities of Addis Ababa. At the first stage, list of all primary schools that serve school meals were collected from the Addis Ababa Education Bureau and organized hierarchically at their respective sub-city and woreda (district) levels. Then five distinct woredas within a sub-city were randomly selected followed by a random selection of one school within the prior selected woreda. Five schools were randomly selected from a sub-city. In the next stage, the list of names, sex, grade and sections of all schoolchildren

benefiting from school meals were collected from each target school in order to establish sampling frame. Then, list of schoolchildren was sorted out by grade and section, and sex. Finally, a random sample of 15 boys and girls were selected from each of grade one to grade six to balance sex and age groups.

Fifty health professionals were recruited and given training to employ the cohort studies. The Addis Ababa Health Bureau recruited the health experts from health centers close to the targeted schools.

Quantitative tools for anthropometric measurement and educational data were developed with lists of the target schoolchildren. Other tools included those for food safety KAP assessment, School WASH assessment, and Dietary quality assessment. Semi-structured qualitative questions were administered to collect data through Key Informant Interviews (KIIs) and Focus Group Discussions (FGDs) with school directors, teachers and women cooperatives.

The study duration was between February 2019 and January 2021, whereby the baseline and the end-line data collection were done in June 2019 and January 2021, respectively.

Descriptive and inferential statistics were employed to analyze the quantitative data. The qualitative data were analyzed through transcription of audio records and narrations.

Conclusion

The study has established several conclusive evidences.

i. Significant number of the schoolchildren were found to suffer from more than one form of anthropometric failure during the baseline assessment of their nutritional status.
ii. The dietary quality and adequacy of school meals provided satisfy at least 30% of daily requirements, which was, however, below a two–third of the recommended daily energy requirements.
iii. The school meals were not diversified enough to supply the various macronutrients and micronutrients required for healthy growth of schoolchildren.
iv. The Addis Ababa SFP improved educational outcomes as it contributed small to medium effect sizes to academic score, attendance, and enrollment.
v. The SFP has reduced hunger and associated manifestations in schoolchildren resulting in vibrant and active classroom activity which enhanced the teaching–learning environment that was valuable to improve education quality.

vi. The Addis Ababa School Feeding Program had medium to large effect sizes on the physical growth such as height, weight, BMI, and MUAC, of the benefiting schoolchildren.

vii. Food safety knowledge of kitchen workers was low, and it influenced their attitude and practice in implementing appropriate food safety measures.

viii. The food safety practice exercised in the school kitchens as observed by the health experts was low

ix. The overall basic school drinking water, sanitation and hygiene services (school WASH) was low.

x. The COVID-19 lockdown caused overwhelming crisis on the nutritional status as well as food security of schoolchildren as the consequence of the complete long interruption of the school meals because of school closure.

xi. The complete long-time interruption of school meals due to school closure during the incidence of COVID-19 imposed a complete loss of income among kitchen workers and increased economic burden on parents.

xii. The long school-breaks due to summer and semester-breaks, weekends and holidays, had led schoolchildren to miss school meals which resulted in largely compromised nutritional outcomes, income of kitchen workers, and livelihood of destitute parents.

xiii. The shift learning system introduced to maintain COVID-19 prevention precautions such as social distancing had compromised the number of school meals, that schoolchildren might get, four meals (40%) out of the total ten meals which were served in a week during normal circumstances – which also had led women to lose of the same proportion of their monthly income.

xiv. Thus, these instances of long interruption of the school meals due to COVID-19, several occasions of school-breaks, and the shift learning system could worsen the food insecurity situation of the schoolchildren, and the kitchen workers and parents in their households.

xv. The socioeconomic benefits of the Addis Ababa SFP was multifaceted.

- Kitchen workers got economic and psychosocial benefits.
- Destitute parents were able to send their children to school where they were fed, resulting in reduced household expenditure on food.

Recommendation

The Addis Ababa School Feeding Program can improve the quality of school meals through diversifying nutritious foods in the daily menu and improving food safety KAP of the kitchen workers.

With the current multifaceted socioeconomic benefits of the Addis Ababa SFP, consideration of weekends, holidays, and summer break feedings, would strengthen the position of SFP as a robust social protection program as well as an educational incentive by alleviating children's food insecurity and maintaining retention and preparedness for the next academic year.

School feeding policy is inevitable to Ethiopia to maintain efficient nutritional, educational, and socioeconomic outcomes of the SFP.

Multiple Micronutrients Supplementation (MMS) and food fortification would improve the micronutrient deficiencies.

Local market integration with farmers and wholesalers would strengthen the SFP, reduce cost and improve income of the women.

Assistance to strengthen financial management of the women cooperatives would help them efficiently manage their cost and benefit.

Future studies may consider studies whether fortification, supplementation, deworming, nutrition and food safety trainings, community participation strategies would strengthen better learning outcomes, nutritional wellbeing, and socioeconomic impacts.

Limitations

The major limitation of this study was that a comparative or control group was not established. This was because of the fact that the Addis Ababa School Feeding Program was implemented at a scale of universal coverage since the beginning that all of the schoolchildren in each school were involved in the school meal service. However, a repeated measurement cohort study at four time points for overall two years of follow up period would produce a robust data based on which the impact of the program can be assessed.

Since the incidence of COVID-19 imposed school closures before the fourth (last) round measurement was employed, it was not possible to maintain the proper time interval of measurement for the last visit. Despite our plan was to employ the fourth-round survey in April 2020, schools were closed early since March 2020 due to COVID-19 imposed national ban. As a result, we postponed the last round until the reopening of schools with an aim to assess the impact of the interruption of school meals following the school closures. The data collected during the third-round (January 2020) was, thus, used as baseline status before the incidence of COVID-19 to compare the change in nutritional status based on the data collected during the last round (January 2021) after a yearlong school meal interruption.

As the Addis Ababa SFP was initiated after February 2019 (during the second semester of the academic year) and since there are semester breaks and summer breaks in any academic year, the best possible time of taking baseline data and the optimum interval of assessment during our study period would have been better to be before a summer break, then as soon as the next academic year was begun, then before the upcoming semester break, and lastly at least three months later after the second semester was started. If the study didn't follow this possible alternative, it would have not been able to establish the baseline, and as a result we could only have collected data at two time points of measurement – which would be against the study design. As a result, our study might have suffered from low base to evaluate the effectiveness of the program without a baseline.

The opportunity that our study collected data before and after summer breaks spent without school meals and that before and after school shutdowns spent without school meals due to COVID-19 preventive measures have rather given us the chance to assess the impact of the interruption of the school feeding, on top of the fact that our study has also assessed the effect of the school meals served during normal circumstances.

The school closure due to COVID-19 created some sort of challenges in the collection on dropout and attendance over consecutive three years. In addition, rate of new entries/new enrollment was not included in this study.

The educational inputs such as teachers, books, other teaching materials and teaching learning environment were not considered, even though changes that may occur during the study period, might have effect on schoolchildren' achievements as well.

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Appendices

Questionnaires

Anthropometry, dietary adequacy and quality, education, and school WASH and Food Safety KAP

Consent Forms

የቃለ መጠይቅ ስምምነት ቅጽ /

ለርዕሳነ መምህራን

ጤና ይስጥልኝ! አቶ/ወ/ሮ፤ወ/ሪት _____። ከትምህርት ምገባ ፕሮግራም ጋር በተያያዘ፤ በምግብ ጤናማነት እና ደህንነቱ የተጠበቀ የምግብ አዘገጃጀት፣ የተመጣጠነ ምግብ፣ ፕሮግራሙ በትምህርት ላይ ስለሚያመጣው ለውጥ እና ሌሎች ማኅበራዊ ጉዳዮች ላይ ጥናት እያካሄድን ነው።

የጥናቱ ዓላማ በምግብ አዘጋጂዎችና ሌሎች በምገባ ፕሮግራሙ የሚሳተፉ አካላት የምግብ ጤናማነት እና ሥርዓተ-ምግብን በተመለከተ ያለቸውን እውቀት፣ አመለካከት ወይም አስተሳሰብ እና ልምድ መዳሰስ፤ የምግብ አቅርቦት፣ የተመጋቢ ተማሪዎችን አካላዊ ዕድገት መጠንና የትምህርት መሻሻል መለካት፤ ለምግብ አቅራቢዎች ያለውን ኢኮኖሚያዊ ፋይዳ ማጥናት፣ እንዲሁም የምገባ ፕሮግራሙን ውጤታማነት መገምገም ነው።

ስለሆነም የተመረጡ የምገባ ፕሮግራሙ ተሳታፊ ተማሪዎችን አካላዊ ዕድገት ማለትም ቁመት፣ ክብደትና የጡንቻ ዙሪያ መጠን እንለካለን። መጠይቁ 0፡07 እስከ 0፡10 ዲቂቃ ሊወስድ ይችላል። ከተማሪው የሚወሰደው መረጃና ስም ሙሉ በሙሉ ሚስጥራዊነቱ የተጠበቀ ነው። ይፋ አይደረግም። በተጨማሪም በጥናቱ መሳተፍ የማይፈልጉ ተማሪዎች ካሉ እንዲሳተፉ አይገደዱም። ወይንም በሚፈልጉበት ጊዜ ማቋረጥ ይችላሉ። እንዲሁም በእርስዎ በኩል ሊመለሱ የሚችሉ አንዳንድ ጥያቄችን እንጠይቀዎታለን፡፡

ጥናቱ የሚካሄደው የምገባ ፕሮግራሙን በመገምገም ለተማሪዎች የተሟላና ጤናማ የምግብ አገልግሎት እንዲሁም የትምህርት ሁኔታ መሻሻል የሚጠቅም መረጃ ለመሰብሰብ ሲሆን ተማሪዎችን ለመገምገም አይደለም። ስለሆነም ምዘናውን እንድናከናውን ፈቃደኛ መሆንዎን ይግለጹልን።

ፈቃደኛ ነዎት?

አዎ፡ _____ አይደለሁም፡ _____።

ስም_____

ፊርማ_____

- **መልሱ አዎ ከሆነ ወደሚቀጥለው ጥያቄ እለፍ/ፊ፤ አይደለም ከሆነ ቃለመጠይቁን አቋርጥ/ጪ።**
- **ከመጀመራችን በፊት ጥያቄ አለዎት?**
- **(ጥያቄውን መልስ/ሽ)።**
- **አሁን መጀመር እችላለሁ?**

የቃለ መጠይቅ ስምምነት ቅጽ ||

<u>ለትምህርት ቤት ምገባ ፕሮግራም ተጠቃሚ ተማሪዎች ወላጅ/አሳዳጊዎች/ተወካዮች</u>

ጤና ይስጥልኝ! የትምህርት ቤት ምገባ ፕሮግራምን በተመለከተ ለተማሪዎች ይበልጥ ጤናማ እና የተመጣጠነ ምግብ ማቅረብ የሚቻልበትን ሁኔታ ለመፍጠር ከአዲስ አበባ ዩኒቨርሲቲ፣ አዲስ አበባ ጤና ቢሮና እና ከአዲስ አበባ ትምህርት ቢሮ ጋር በመተባበር ጥናት እያካሄድን ነው።

በዚህ ጥናት የምግብ አዘጋጂዎችና ሌሎች በምገባ ፕሮግራሙ የሚሳተፉ አካላት ስለ ጤናማ እና የተመጣጠን ምግብ ያለቸውን እውቀት፣ አስተሳሰብ እና አሠራር እንገመግማለን፡፡ የምገባ ፕሮግራሙ በተመጋቢ ተማሪዎችን ላይ ያመጣውን የአካላዊ ዕድገት መጠንና የትምህርት መሻሻልን እንለካለን፡፡

በተለያዩ ክፍለ ከተማዎች በሚገኙ ትምህርት ቤቶች ከሚማሩት ተማሪዎች መካከል 4500 ተማሪዎች በዚህ ጥናት ይሳተፋሉ፡፡ የነዚህን ተማሪዎች አካላዊ ዕድገት ለመከታተል ቁመት፣ ክብደትና የጡንቻ ዙሪያ መጠናቸውን እንለካለን። እንዳስፈላጊነቱ ምስሎችንም እንወስዳለን። ከየተማሪው የሚወሰደው መረጃና ስም ሙሉ በሙሉ ምስጢራዊነቱ የተጠበቀ ነው። በተጨማሪም በጥናቱ መሳተፍ የማይፈልጉ ተማሪዎች ካሉ እንዲሳተፉ አይገደዱም። ካልፈለጉም ጀምረው ማቋረጥ ይችላሉ።

ጥናቱ የሚካሄደው የምገባ ፕሮግራሙን በመገምገም ለተማሪዎች የተመጣጠነ እና ጤናማ የምግብ አገልግሎት በሂደት ለማቅረብ እና ለትምህርት ሁኔታ መሻሻል የሚጠቅም መረጃን ለመሰብሰብ ብቻ እንጂ ተማሪዎችን ለመገምገም አይደለም።

የዚህ ጥናት ይዘት እና ውጤት ለአዲስ አበባ ትምህርት ቢሮ፣ ለጤና ቢሮ፣ እንዲሁም ለሚመለከታቸው ተቋማት ይገለጻል፡፡

ስለዚህ የልጅዎን ቁመት፣ ክብደትና የጡንቻ ዙሪያ መጠን እንድንለካ ፈቃደኛ መሆንዎን ይገልጹልን ዘንድ በአክብሮት እንጠይቃለን።

ለሚደረገው ምዘና ፈቃደኛ ነኝ፡፡

<u>የወላጅ/አሳዳጊ ስምና ፊርማ</u>

የተማሪው ስም _____

<u>የወላጅ/አሳዳጊ/</u> **ሙሉ ስም፡ _____**

ፊርማ፡ _____

ቀን፡ _____።

Anthropometry

Table 68: Schoolchildren's physical growth monitoring questionnaire

የተማሪዎች የአካል እድገት ሁኔታ መጠይቅ/ቅጽ

ቀን (ቀን/ወር/ዓ.ም) Date (dd/mm/yy)		ክፍለ ከተማ Subcity	ወረዳ District	ትምህርት ቤት School	Round

መ ለ ያ No.	ስም Name	ጸታ Sex	ክፍል Section	የትውልድ ቀን Birth date (ቀን/ወር/ዓም) Date (dd/mm/yy)			Age (Years) እድሜ (በዓመት)	ክብደት Weight (kg)	ቁመት Height (cm)	MUAC (cm)	ID
				ቀን	ወር	ዓም					
1											
2											
3											
4											
5											
6											
7											
8											
9											
10											
11											
12											
13											
14											
15											

Dietary adequacy and quality

Table 69: Dietary adequacy and quality questionnaire

የትምህርት ቤት ምገባ ፕሮግራም የምግብ ዓይነት መጠን እና ዝርዝር

1. ቁርስ/Breakfast 2. ምሳ/Lunch

ቀን (ቀን/ወር/ዓ.ም) Date (dd/mm/yy)	ክፍለ ከተማ Subcity	ወረዳ District	ትምህርት ቤት School
|___|___|/|___|___|/|___|___|___|___|		|___|___|	

Menu

Days	Name of food	Food Description	Preparation ingredients
Monday			
Tuesday			
Wednesday			
Thursday			
Friday			

Amount of items constituted in the food (gm/ml). Weight (Wt.)

Days	Name of food	Item 1	Wt.	Item 2	Wt.	Item 3	Wt.	Item 4	Wt.	Item 5	Wt.	Total Wt. (gm/ml)
Monday												
Tuesday												
Wednesday												
Thursday												
Friday												

Education: academic scores and attendance

Table 70: Semester academic scores and attendance form of schoolchildren involved in the Addis Ababa School Feeding Program

የተማሪዎች አማካይ ውጤት ከ100%፤ የቀሪ ብዛት እና ማቋረጥ በ2011 እና በ2012

Average scores of schoolchildren (100%), Attendance and Dropout in 2019 and 2020

***ካቋረጠ/ች የቀሪ ብዛት 999 ይጻፍ**
If dropout, write 999

ቀን (ቀን/ወር/ዓ.ም) Date (dd/mm/yy)	ክፍለ ከተማ Subcity	ወረዳ District	ትምህርት ቤት School

መ ለ ያ No.	ስም Name	ጾታ Sex	ክፍል Grade	2011 Sem I			2011 Sem II			2012 Sem I			2012 Sem II			ID
				40	100	ቀሪ* Att.	40	100	ቀሪ* Att	40	100.0	ቀሪ* Att.	40	100	ቀሪ* Att.	
1																
2																
3																
4																
5																
6																
7																
8																
9																
10																
11																
12																
13																
14																
15																

Education: Enrollment and dropouts

Table 71: School based enrollment and dropout

ቀን (ቀን/ወር/ዓ.ም) Date (dd/mm/yy)	ክፍለ ከተማ Subcity	ወረዳ District	ትምህርት ቤት School
|___|___|/|___|___|/|___|___|___|___|		|___|___|	

ማሳሰቢያ: የትምህርት መረጃ ከትምህርት ቤቱ መዘክር መሰብሰብ አለበት!

NB: Gather academic statistics from record office of the schools.

1. በዚህ ትምህርት ቤት ለመማር የተመዘገቡ ተማሪዎች ስንት ናቸው?
Number of students registered in the school

መስከረም 2011 ዓ.ም
September 2018

ክፍል Grade	ወንድ Boys	ሴት Girls
1		
2		
3		
4		
5		
6		
7		
8		

መስከረም 2012 ዓ.ም
September 2019

ክፍል Grade	ወንድ Boys	ሴት Girls
1		
2		
3		
4		
5		
6		
7		
8		

መስከረም 2013 ዓ.ም
September 2020

ክፍል Grade	ወንድ Boys	ሴት Girls
1		
2		
3		
4		
5		
6		
7		
8		

2. በዚህ ትምህርት ቤት ለመማር ከተመዘገቡ ተማሪዎች ውስጥ ያቋረጡ ተማሪዎች ስንት ናቸው? (Dropout)

መስከረም 2011 ዓ.ም
September 2018

ክፍል Grade	ወንድ Boys	ሴት Girls
1		
2		
3		
4		
5		
6		
7		
8		

መስከረም 2012 ዓ.ም
September 2019

ክፍል Grade	ወንድ Boys	ሴት Girls
1		
2		
3		
4		
5		
6		
7		
8		

መስከረም 2013 ዓ.ም
September 2020

ክፍል Grade	ወንድ Boys	ሴት Girls
1		
2		
3		
4		
5		
6		
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8		

School WASH and Food Safety

Consent Form

የቃለ መጠይቅ ስምምነት ቅጽ |||

<u>ለምግብ አዘጋጂዎች፣ ተሳታፊ መምህራን እና ፕሮግራም አስተባባሪዎች</u>

ጤና ይስጥልኝ! አቶ/ወ/ሮ፣ወ/ሪት _____። ከትምህርት ምገባ ፕሮግራም ጋር በተያያዘ፣ በምግብ ጤናማነት እና ደህንነቱ የተጠበቀ የምግብ አዘገጃጀት፣ የተመጣጠነ ምግብ፣ ትምህርት እና ሌሎች ማኅበራዊ ጉዳዮች ላይ ጥናት እያካሄድኩን ነው።

የጥናቱ ዓላማ በምግብ አዘጋጂዎችና ሌሎች በምገባ ፕሮግራሙ የሚሳተፉ አካላት የምግብ ጤናማነት እና ሥርዓተ-ምግብን በተመለከተ ያላለቸውን እውቀት፣ አመለካከት ወይም አስተሳሰብ እና ልምድ መዳሰስ፤ ማወቅ፤ የምግብ አቅርቦት፣ የተመጋቢ ተማሪዎችን አካላዊ ዕድገት መጠንና የትምህርት መሻሻል መለካት፤ ለምግብ አቅራቢዎች ያለውን ኢኮኖሚያዊ ፋይዳ ማጥናት፣ እንዲሁም የምገባ ፕሮግራሙን ውጤታማነት መገምገም ነው።

ስለሆነም በምገባ ፕሮግራሙ ተሳታፊ የሆኑትቱን አካላት በዚህ ዙሪያ መጠይቅ እናደርጋለን። መጠይቁ 0፡40 እስከ 0፡50 ዲቂቃ ሊወስድ ይችላል። የቃለ መጠይቁን መረጃ በበቂ ሁኔታ ለመዘገብ ያስችል ዘንድ በድምጽ እንቀዳለን፡፡ እርስዎ የሚሰጡን መረጃ ሙሉ በሙሉ ሚስጥራዊነቱ የተጠበቀ ነው። የሚሰጡት ምላሽ እና ስምዎ ይፋ አይደረግም፡፡ በተጨማሪም መመለስ የማይፈልጉት ጥያቄ ካለ ምላሽ ለመስጠት አይገደዱም። ለመጠይቁም መልስ መስጠቱን በሚፈልጉበት ጊዜ ማቋረጥ ይችላሉ።

ጥናቱ የሚካሄደው የምገባ ፕሮግራሙን በመገምገም ለተማሪዎች የተሟላና ጤናማ የምግብ አገልግሎት እንዲሁም ለየትምህርት ሁኔታ መሻሻል የሚጠቅም መረጃ ለመሰብሰብ ሲሆን እንጂ እርስዎን ለመገምገም አይደለም። ስለሆነም እባክዎ ምንም ሳይጨናነቁና ሳያፍሩ ጥያቄዎችን ለመመለስ ይሞክሩ። ትክለኛውን መልስ እንዲመልሱ አይጠበቅብዎትም። ነገር ግን በቀናነትና በትክክል የሚያውቁትን፣ የሚሰማዎትን እና ምግብ እንዴት እንደሚያዘጋጁ መልስ እንዲመልሱልኝ እወዳለሁ። እርስዎ በሚችሉት ፍጥነትና ደረጃ ሳይጨናነቁ ይመልሱልኝ።

በቃለ መጠይቁ ለመሳተፍ ፈቃደኛ ነዎት?

አዎ፡ _____ አይደለሁም፡ _____።

ስም_____

ፊርማ_____

- **መልሱ አዎ ከሆነ ወደ ሚቀጥለው ጥያቄ እለፍ/ፊ፤ አይደለም ከሆነ ቃለመጠይቁን አቋርጥ/ጪ።**

  ከመጀመራችን በፊት ጥያቄ አለዎት? (ጥያቄውን መልስ/ሽ)። አሁን መጀመር እችላለሁ?

Table 72: Food Safety KAP questionnaire

1. General Information

ኮድ፡_____ ክ/ከተማ፡____ ት/ቤት፡_____ የጤና ባለሙያ፡_____ ቀን፡_____

Code _____ Subcity _____ School _____ Health expert _____ Date_____

Instruction: This module of questions should be asked to school food providers, female teachers, and Parent-Teachers-Committee members!

1. ማኅበራዊ፣ ስነ ሕዝብ እና ኢኖሚያዊ መረጃ **Social, demographic and economic Information of Staff/food handler of School Feeding Program**		
ተ.ቁ. **No.**	**ጥያቄዎች** **Questions**	**መልሶች** **Responses**
1.	**የምግብ አዘጋጂ/አቅራቢ/ተሳታፊ ስታፍ ሙሉ ስም** Name of staff/handler	
2.	**ጾታ**/Gender	*1.* **ወንድ**/*Male* *2.* **ሴት** /*Female*
3.	**ዕድሜ**/Age	*Date of Birth* */DD/MM/YYYY/* /__ __/ /__ __/ /__ __ __ __/
4.	**ትምህርት ደረጃ**/Educational level	
4.1	**የመደበኛ ትምህርት ተምረዋል?** Have you ever attended school?	1. **አዎ**/Yes 2. **የለም**/No
4.2	***አዎ ከሆነ፣ ከፍተኛ የትምህርት ደረጃዎ ምንድን ነው?*** *If yes, w*hat is the highest level of school you attended?	1. **4ኛ ክፍልና በታች**/ *Elementary (Grade 4 and below)* *2.* **5ኛ-6ኛ ክፍል**/*Elementary (Grade 5–6)* *3.* **7ኛ-8ኛ ክፍል**/ *Elementary (Grade 7 – 8)* *4.* **9ኛ-10ኛ ክፍል**/ *Secondary (Grade 9 & 10)* *5.* **11ኛ-12ኛ ክፍል**/ *Secondary (Grade 11 & 12)* 6. **መሰናዶ I & መሰናዶ II**/ *Preparatory (Pre-I & II)* *7.* **ዲፕሎማ**/ *Diploma* *8.* **የመጀመሪያ ዲግሪ**/ *BSc/BA Degree* *9.* **ሁለተኛ ዲግሪ**/ *MSc/MA Degree*
5.	**የማንበብና መጻፍ ክህሎት (የሚችሉትን ይምረጡ)** Literacy	1. **የለኝም**/ None 2. **ማንበብ**/ Read *3.* **መጻፍ**/ Write *4.* **ማንበብና መጻፍ**/ Read and Write
6.	**የጋብቻ ሁኔታ**/Marital Status	1. **ያገባ**/Married 2. **ያላገባ**/Single
7.	**በምገባ ፕሮግራሙ ያለዎት የሥራ ድርሻ** Job type in the School Feeding Program	*1.* **መምህር**/*Teacher* *2.* **ምግብ አዘጋጅ**/*Food handler*
8.	**በሙያዉ ያለዎት የአገልግሎት ጊዜ/ዓመት** Years of service	

	How long have you been working as a food handler in food preparation in SFP?	_____
9.	Are you paid for this service in the school feeding program?	*1.* **አዎ**/Yes 2. **የለም**/No
10.	**በቀን ለስንት ተማሪዎች ምግብ ያቀርባሉ?** For how many school children do you provide meal?	_____
11.	**ለምግብ ዝግጅት የሚሆን በየወሩ ምን ያክል ገንዘብ ያወጣሉ?** How much do you expend per month, total?	_____
12.	**ለሚያቀርቡት ምግብ ከሚከፈለዎ በወር ምን ያክል ያተርፋሉ?** How much profit do you get per month, total?	_____
13.	**በምገባ ፕሮግራም መሥራት ከመጀመርዎ በፊት ሌላ የገቢ ምንጭ ወይም ሥራ ነበርዎት?** Did you have any source of income or job before the current employment?	1. **አዎ**/Yes 2. **የለም**/No
14.	**ምገባ ፕሮግራም ከመመረጥዎ በፊት አማካይ ወርሓዊ ገቢዎ ምን ያክል ነበር?** How much did you earn on average per month, before you are selected to provide meal in SFP?	
15.	**ለምገባ ፕሮረግራም ምግብ አቅራቢነት እንዴት ሊመረጡ ቻሉ?** How do you get involved in the program in this program?	*1.* ***በምግብ ዝግጅት ልምድ ስላለኝ**/Because I have experience* *2.* ***በድህነት እና ልጅ/ልጆቸ ለምገባ ስለተመረጡ**/Because I am poor and my child/ children are eligible* *3.* ***በድህነት ብቻ**/Because I am pro-poor but have no children*
16.	**የቤተሰብ ብዛት (ልጆች፣ ባል/ሚስት፣ ሌሎች አብረው የሚኖሩ ጨምሮ)** Household size including children, husband, spouse, and others living in the household. How many people live in your family including yourself?	_____
17.	**የልጆች ብዛት** How many children are there in the household	**ወንድ**/*Boys:* _____ **ሴት**/*Girls:* _____

ሥልጠና/Training

No.	Questions	Responses
18.	**ሥለ ምግብ ጤናማነትና ጤናማ አዘገጃጀት ሥልጠና ወስደው ያውቃሉ?** Have you ever attended any food safety training course	1. **አዎ**/Yes 2. **የለም**/No
	ሥልጠናው ሰርቲፊኬት ወይም የምሥክር ወረቀት አለው? Have you ever attended any food safety training course for which you have been offered a certificate	1. **አዎ**/Yes 2. **የለም**/No
19.	**የምገባ ፕሮግራም ከተመረጡ በኋላ ስለ ጤናማ የምግብ አዘገጃጀት ሥልጠና ተሰጥቶዎታል?** Has any training about safe food handling been provided to food handlers in your current food preparation facility?	1. **አዎ**/Yes 2. **የለም**/No
	አዎ ከሆነ፣ ስንት ጊዜ?	*1.* **በሴሚስተር አንድ ጊዜ**/*At least once every term* *2.* **በሴሚስተር ሁለት ጊዜ**/*At least once every year*

	If yes, how frequently is training provided?	*3.* **በዓመት አንድ ጊዜ**/*At least once every two years*
20.	**በሚከተሉት ርዕሶች ላይ ሥልጠና ወስደው ያውቃሉ?** Have you received training regarding the following? **(ሥልጠና የወሰዱትን ርዕስ በሙሉ መረጥ/ዮ)** (Choose all that apply)	1. **የግል ንጽህና አጠባበቅ**/Personal hygiene 2. **ኬሚካል ለይቶ ስለማስቀመጥ**/ Chemical storage 3. **የተባይ መከላከል**/Pest control 4. **የመገልገያ ዕቃዎች ንጽህና አጠባበቅ**/Equipment cleaning procedures 5. **የማዕድ ቤት ሥራ/አሠራር ቅደም ተከተል**/Kitchen operation procedures 6. **የመገልገያ መሣሪያዎች አያያዝ እና ጥንቃቄ**/Equipment care and maintenance program 7. **የምግብ ጤናማነት ቅድመ ጥንቃቄዎች**/Food allergy safety precautions

2. የጤናማ የምግብ አዘገጃጀት ዕውቀት/ Food Safety Knowledge

ተቁ No.	ጥያቄዎች Questions	መልሶች Answers 1.ትክክል/ Correct 2.ትክክል አይደለም/ Incorrect 3.አላውቅም/ Don't know
	ፈጥነው ስለሚበላሹ ምግቦች/Storage of perishable fresh foods	
1.	Storage conditions **ከእንስሳት የሚገኙ ያልበሰሉ ምግቦች ጥሬ ስጋ፣ የሆድ እቃ ስጋዎች (እንደ ጨጓራ፣ ወተት አንጀት፣ ጉበት፣ ኩላሊት፣ ልብ አይነት) ከሌሎች ከበሰሉ ወይም ለምግብነት ከተዘጋጁ ምግቦች ጋር ከተነካኩ ሊበከሉ ይችላሉ** Animal source raw meats, internals such as stomach, small intestine, liver, kidney, heart, can be contaminated if stored together with other cooked or ready-to-eat foods	
2.	Cooking temperature/ Food Hygiene **ወጥ ወይም በሚሰሩበት በደንብ መብሰለሉን እንዴት ያውቃሉ** ***(መልሱ ማንተክተክ ከሆነ ትክክል ነው)*** How do you know a sauce is cooked thoroughly	
3.	Cooking temperature/ Food Hygiene **ወጥ ወይም ሾርባ በሚሰሩበት ጊዜ ማንተክተክ ወይም በደንብ ማብሰል ምግቡን ጤናማ ያደርገዋል ብለው ያምናሉ** Cooking sauce thoroughly makes the food safe to eat	
4.	Food Hygiene **ፍራፍሬዎች ወይም ጥሬ አትክልቶች (እንደ ጎመን፣ ሰላጣ፣ ቆስጣ፣ ቃርያ፣ ቲማቲም ያሉትን) ለመመገብ ከመቅረባቸው በፊት በንጹህ ውሃ መታጠብ አለባቸው።።** Fruits or raw vegetables (Cabbage, Salad, Pepper, Tomato, etc.) must be washed using clean water before eaten	

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	የግል ሃይጅን/ንጽህና Personal Hygiene	
1.	እጆች ማንጠስን በማፈን ወይም ፊትን በማሻሸት በአይን በማይታዩ ጀርሞችይበከላሉ/ይቆሸሻሉ Hands can be contaminated with microorganisms/germs during sneezing or touching face	
2.	እጅ ላይ የሚደረጉ ጌጣጌጦች በአይን በማይታዩ ጀርሞችን ደብቀው ይይዛሉ፣እጅን ይበክላሉ፣ ምግብ ውስጥ ሾልከው ሊገቡ ይችላሉ Wearing personal item, ornaments such as rings, watches, necklaces during food handling can hold microorganisms, can contaminate and food	
3.	እጆች የጋራ ፎጣዎችን በመጠቀም፣ ማብሰያ እቃዎች እና መሣሪያዎችን በመያዝ በአይን በማይታዩ ጀርሞች በቀላሉ ይበከላሉ Hands can be contaminated by using towels in common during hand drying; touching utensils and cooking materials.	
4.	ያልተቆረጡ ጥፍሮች ቆሻሻ/ብክለት ወይም በአይን በማይታዩ ጀርሞች ሊይዙ ይችላሉ If nails are not cut short and painted, it can contain microorganisms that can be risk of food contamination	
5.	እጆች የቤት እንስሳትን በማሻሸት በአይን በማይታዩ ጀርሞች ይበከላሉ Hands can be contaminated when touching pets	
6.	እጆች መጸዳጃ ቤት ውስጥ በአይን በማይታዩ ጀርሞች ይበከላሉ Hands can be contaminated in toilet rooms	
7.	እጆች ጥሬ ሥጋ በመያዝ በአይን በማይታዩ ጀርሞች ይበከላሉ Hands can be contaminated with microorganisms by touching raw meats	
8.	የቁስል መሸፈኛ በአይን የማይታዩ ጀርሞች ደብቆ ይይዛል Wound cover can hide microorganisms/germs	
9.	እጆች በመመገብ (በመብላትና በመጠጣት) ጊዜ በአይን የማይታዩ ጀርሞች ይበከላሉ Hands can be contaminated during eating and drinking when preparing or serving food	
10.	እጆች ምግብ-ወለድ በሽታ ለሚፈጥር ብክለት መከሰት ዋናዎቹ ምክንያት ናቸው። Hands can be the risk of food contamination that cause foodborne diseases	
11.	ደካማ የግል ሃይጅን አጠባበቅ የምግብ ወለድ ወረርሽኝ እንዲከሰት ከሚያደርጉት ዋና ዋና ሁኔታዎች አንዱ ነው Poor personal hygiene is among the main risks that could cause foodborne diseases	
12.	እጆች አፍ፣ አፍንጫ ወይም ጸጉር ከተነካ፣ ወይም ብጉር በማፍረጥ በአይን የማይታዩ ጀርሞች ይበከላሉ Hands can be contaminated by touching mouth, nose, hair or touching fluid from acne	
13.	በጤነኛ ሰው ቆዳ፣ አፍንጫና አፍ ውስጥ በአይን የማይታዩ በሽታ አምጭ ጀርሞች ይገኛሉ Microorganisms can be available in skin, mouth, and nose of a healthy person	
	ተሸጋሪ ብክለትና የምግብ መመረዝ Cross-contamination and food poisoning	
1.	ምግብ ከሰው ወይም እንስሳት ዓይነ-ምድር ጋር በሚፈጠር ንክኪ ሊመረዝ ይችላል።	

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	Food can be poisoned from contamination by human or animal faeces	
2.	የምግብ ዝግጅት ከመጀመር በፊት እጅን በውሃና በሳሙና መታጠብ የምግብ ብክለትን ይቀንሳል Handwashing with clean water and soap before food preparation can reduce food contamination	
3.	የእጅ ጓንት/ግሎቭ መጠቀም የምግብ ብክለትን ይቀንሳል Using glove can reduce food contamination	
4.	የምግብ ዝግጅት መገልገያ ዕቃዎችን በአግባቡ ማጠብና ማጽዳት የምግብ ብክለትን ይቀንሳል Washing and sanitizing equipment and utensils reduce food contamination	
5.	ምግብ በሚዘጋጅበት እና የምግብ መገልገያዎች ታጥበው ዝግጁ በሆኑበት አካባቢ መብላት ወይም መጠጣት የምግብ ብክለትን ሊያስከትል ይችላል። Eating or drinking during preparing food or around clean food serving equipment could increase the risk of food contamination	
6.	የተዘጋጀ ምግብ እንደገና በሚሞቅበት ወቅት በሚገባ ካልተንተከተከ የምግብ ብክለትን ሊያስከትል ይችላል። Failure reheating thoroughly could be a risk of food contamination	
7.	ተሻጋሪ ብክለት ምን እንደሆነ ያውቃሉ Do you know about cross-contamination?	
	ምግብ-ወለድ በሽታዎች **Foodborne diseases**	
1.	ታይፎይድ በምግብ ብክለት ሊተላለፍ ይችላል Typhoid can be transmitted by contaminated food	
2.	የኤች. አይ. ቪ.. ኤድስ በሽታ በምግብ ብክለት ምክንያት ሊተላለፍ ይችላል HIV/AIDS can be transmitted by contaminated food	
3.	ተቅማጥ በምግብ አማካኝነት ሊተላለፍ ይችላል Diarrhoea can be transmitted by contaminated food	
4.	ተቅማጥ በተበከለ ውሃ አማካኝነት ሊተላለፍ ይችላል Diarhoea can be transmitted by contaminated water	
5.	የጉበት በሽታ (Hepatitis A) በምግብ ብክለት ሊከሰት ይችላል Hepatitis A can be transmitted by contaminated food	

3. የጤናማ የምግብ አዘገጃጀት አስተሳሰብ/ዝንባሌ/Food safety attitude

ተቁ No.	ጥያቄዎች Questions	መልሶች Answers 1. እስማማለሁ/ Agree 2. አልስማማም /Disagree 3. እርግጠኛ አይደለሁም/ Not sure
	ከምግብ ዝግጅት በፊት እጅዎን ባለመታጠብዎ የተነሳ እርስዎ ወይም ሌሎች ተመጋቢዎች ለሆድ ህመም ወይም ለተቅማጥ ሊጋለጡ ይችላሉ ብለው ያስባሉ Any failure for handwashing before food preparation can be a risk for abdominal disease/diarrhoea on you or any other consumers	
	የመገልገያ መሣሪያዎችንና የመመገቢያ ሰሀኖችን በማጠብ የምግብን ጤናማነት ለመጠበቅ ያስችላል Cleaning food preparing equipment and dinning dishes keep food safety	
	የእጅ መታጠቢያ መገልገያዎች ላይ የሚታይ ማንኛውም ጉድለት የጤና አጠባበቅ አደጋ ሊያመጣ ይችላል ብለው ያስባሉ Think that any failure on hand washing instruments can lead to a risk for health	
	የተበከለ የምግብ መገልገያ እቃ ለምግብ-ወለድ በሽታዎች መፈጠር ዋና ምክንያት ነው ብለው ያስባሉ Contaminated food serving utensils can be a risk for foodborne diseases	
	በምግብ ወለድ በሽታ የታመሙ የምግብ ሰራተኞች እና መጥፎ የግል ሃይጅን ልምዶችለምግብ-ወለድ ወረርሽኝ መከሰት ምክንያቶች ናቸው ብለው ያስባሉ Food handlers who are sick due to foodborne diseases and have bad personal hygiene can be a risk for food outbreak	
	ዕቃ የታጠበበት ፍሳሽና ለመወልወያ የዋለ ዉሃ ወደ ጓሮ በር ከተደፋ ለምግብ ብክለት ምንስኤ ሊሆን ይችላል ብለው ያስባሉ Water used for washing materials and cleaning floor can be a risk for food contamination if disposed anywhere in a compound	
	ምግብ በሚዘጋጅበት እና የምግብ መገልገያዎች በሚታጠቡበት አካባቢ መብላት ወይም መጠጣት ለምግብ ብክለት ያጋልጣል ብለው ያስባሉ። Eating or drinking in places where food is prepared and around places where food serving equipment are cleaned can be the risk of food contamination	
	ያልበሰሉ ምግቦች ከበሰለ ምግብ ጋር ከተነካኩ/አንድ ላይ ከተቀመጡ የምግብ ብክለት ለፈጠር ይችላል ብለው ያስባሉ If raw foods are contacted with prepared foods or stored together, food contamination could occur	

ተቁ No.	ጥያቄዎች Questions	መልሶች Answers 1. እስማማለሁ/ Agree 2. አልስማማም /Disagree 3. እርግጠኛ አይደለሁም/ Not sure
	ግሎቭ/ጓንት ማድረግ ተሸጋሪ ብክለትን ይከላከላል ብለው ያስባሉ Using glove can prevent cross-contamination	
	ውሃን አፍልቶ ለመጠጥ መጠቀም ተቅማጥን ይከላከላል ብለው ያስባሉ Drinking water after boiling can prevent diarrhoea	
	በደንብ የበሰለ/የተንተከተከ ምግብ ከብክለት ነጻ ነው ብለው ያስባሉ Thoroughly cooked food is safe from contamination	
	ምግብ የሚያዘጋጁ ሰዎች የጤና ምርመራ አስፈላጊ ነው ብለው ያስባሉ Having health examination for food handlers is important	
	በምግብ ዝግጅት የሚሳተፉ ሰዎች በየዓመቱ የጤና ምርመራ ያስፈልጋል ብለው ያስባሉ Having yearly health examination for food handlers is important	
	ጤናማ የምግብ ዝግጅት ትምህርት/ሥልጠና ያስፈልገኛል ብለው ያስባሉ I need safe food preparation training	
	በምግብ ዝግጅት የሚሳተፉ ሠራተኞች የምግብ-ወለድ ወረርሽኝ ምክንያት ሊሆኑ ይችላሉ ብለው ያስባሉ Workers participating in food preparation can be a risk for foodborne diseases	
	ጤነኛ የምግብ ሠራተኞች በሰውነታቸው ውስጥ ለምሳሌ (በአፍንጫ፣ አፍ፣ ቆዳ) ውስጥ በሽታ አምጭ ባክቴርያ ይገኛል ብለው ያስባሉ A healthy food handler can be a carrier of infectious bacteria that can cause food-borne diseases	
	ከተመጋቢ ፊት ተርፎ የተመለሰ ምግብ እንደገና ለሌላ ተመጋቢ መልሶ ማቅረብ ለምግብ ወለድ በሽታ ሊያጋልጥ ይችላል ብለው ያስባሉ Leftovers on a plate can be a risk for foodborne diseases if provided to another consumer	
	በምግብ ዝግጅት የሚሳተፉ ሰዎች የጤናማነት ሰርቲፊኬት ሊኖራቸው ይገባል ብለው ያምናሉ Food handlers need to have health certificate	
	በትምህርት ቤቱ ውስጥ ለምግብ ዝግጅትና ለመጠጥ የሚጠቀሙበት ውሃ መታከም ያስፈልገዋል ብለው ያስባሉ The water available for food preparation in the school requires water treatment	

4. ስለጤናማ የምግብ አዘገጃጀት አተገባበር/Food safety Practice

ተቁ No.	ጥያቄዎች Questions	መልሶች Answers
	የምግብ መብሰልና የሚበላሹ ምግቦችን መለየት **Separation of cooked food and perishable foods**	
1.	የወጥ ዝግጅት ከቁርስ ወይም ከምሳ በፊት ስንት ሰዓት ቀድመው ይጨርሳሉ Time at which breakfast or lunch is ready-to-eat	ቁርስ/Breakfast _____ ምሳ/Lunch _____
2.	ወጥ ወይም ሾርባ በሚሰሩበት ጊዜ በደንብ እስኪበስል ወይም እስኪንተከተክ ድረስ ይጠብቃሉ Wait for sauce to be cooked thoroughly	1. ምንጊዜም/Often 2. አልፎ አልፎ/Sometimes 3. የለም/Never
3.	ፍራፍሬዎች ወይም ጥሬ አትክልቶች (እንደ ጎመን፣ ሰላጣ፣ ቆስጣ፣ ቃርያ፣ ቲማቲም፣ ሽንኩርት ያሉትን) የሚያስቀምጡት በምን ሁኔታ ነው Store fruits and raw vegetables separately	1. ለየብቻ/Separately 2. ከመሬት ከፍ ብሎ/Above ground 3. መሬት ላይ ተቀላቅሎ/On ground, mixed
4.	ሌሎች ከገበያ የሚገዙ እህሎችን የሚያከማቹት/የሚያስቀምጡት እንዴት ነው Store other food items purchased from market in a separate storage	1. መጋዝን/የተለየ ቦታ 2. ከማብሰያ ቦታ ውስጥ 3. ሌላ_____
	የግል ሃይጅን/ጤና አጠባበቅ **Personal hygiene**	1. ምንጊዜም/Often 2. አልፎ አልፎ/Sometimes 3. የለም/Never
1.	በምግብ ዝግጅት ጊዜ ንጹህ ዩኒፎርም ይለብሳሉ Wear clean uniform during food preparation	
2.	የምግብ ዝግጅት ከመጀመርዎ በፊት የእጅ ጌጣጌጦችን አውልቀው ያስቀምጣሉ Remove ornaments such as rings, watches, necklaces off hand before food preparation	
3.	የምግብ ዝግጅት ከመጀመርዎ በፊት ፀጉርዎን ይሸፍናሉ Cover hair before food preparation	
4.	የምግብ አዘጋጅ እንደመሆንዎ መጠን ጥፍሮችዎን አሳጥረው ይቆርጣሉ Cut nails short	
5.	ምግብ በሚያዘጋጁበት ጊዜ እጅዎን አሁንም አሁንም ይታጠባሉ Frequently wash hands during food preparation	
6.	**እጅዎን የሚታጠቡት መቼ ነው?** **Handwashing times**	
	የምግብ ዝግጅት ስራ ከመጀመር በፊት፤ Before starting food preparation	
	ምግብ ወይም በንጽህና የተቀመጡ ማብሰያና ማቅረቢያ እቃዎችን ከመንካት በፊት Before touching food or clean cooking utensils	
	ለምግብ ዝግጅት ስራ ግሎቭ ከማድረግ በፊት፤ በመሃሉ ግሎቭ በሚቀየርበት ጊዜ Before waring glove or changing glove	
	በምግብ ዝግጅት ወቅት ከአንዱ ስራ ወደሌላው ስራ ሲተላለፉ Between shifting between different activities	
	ያልበሰሉ ምግቦችን ከያዙ በኋላ After touching raw food items	
	ሳይበስሉ ለተመጋቢ የሚቀርቡ ምግቦችን ከማዘጋጀት በፊት Before preparing foods to be provided	
	መጸዳጃ ቤት ከተጠቀሙ After using toilet	
	ካሳለ፣ ካስነጠሰ፣ አፍ፣ አፍንጫ ወይም ጸጉር ከተነካ፣	

ተቁ No.	ጥያቄዎች Questions	መልሶች Answers
	After coughing, sneezing, touched mouth, nose and hair	
	የተበላባቸው ሰሃኖችን እና ምግብ የተዘጋጀባቸው ማብሰያዎችን ካጸዱ በኋላ After cleaning used dishes and utensils	
	ቆሻሻ ከሰበሰቡ እና ካስወገዱ በኋላ After collecting and removing waste	
	ሞባይል ስልክ፣ ማብሪያ/ማጥፊያ፣ ወይም የበር/የመስኮት እጀታ ከነኩ በኋላ After using mobile, switches, or gates/windows handle	
	የቤት እንስሳትን ከነካኩ በኋላ After touching pets	
	አፍንጫ፣ አፍን፣ የራስ ጸጉርን፣ ፊትን ወይም ብጉርን ከነካኩ በኋላ After touching acne fluid, mouth, nose, hair	
	የግል መገልገያ እቃዎችን (ከስራ ውጭ የሚለበስ ልብስ፣ የገንዘብ መያዣ ቦርሳ፣ የሜጌጫ ቅባቶችና የመሳሰሉትን) ከነኩ በኋላ After touching personal kits (cloth, wallets, beauty creams)	
7.	እጅዎን ለማድረቅ የጋራ ፎጣ ይጠቀማሉ Use one towel to dry hands	
8.	ለምግብ ዝግጅትና ማጠቢያ የሚጠቀሙት ውሃ የሚያስቀምጡት በምንድን ነው Store water being used for food preparation and washing	1. በጀሪካን/Jar 2. በበርሚል/Barrel 3. ሌላ/other_____
	አካባቢን፣ የመመገቢያና የመገልገያ ማጽዳት **Environmental, dinning and equipment hygiene**	
1.	ምግብ ካዘጋጁ በኋላ የማብሰያ አካባቢው፣ ድስቶች፣ መጥበሻዎች፣ ሰሃኖች እና ሌሎች መገልገያዎች እንዴት እንደሚያጸዷቸው ሊነግሩኝ ይችላሉ? After food is prepared, how kitchen and utensils are cleaned	1. ጠራርጌ ጥራጊውን ወደ ቆሻሻ ማጠራቀሚያው እደፈዋለሁ። Dispose the waste to garbage 2. በሞቀ ውሃ አጥበዋለሁ። Use hot water while washing 3. በሳሙና (አጃክስ) ወይም በፈሳሽ ሳሙና አጥበዋለሁ Use soap or liquid soap 4. መልስ የለም No answer
2.	እጆችዎን እንዴት እንደሚታጠቡ በቅደም ተከተል ሊነግሩኝ ይችላሉ? Tell the order of washing your hands	1. እጆችን ሰሃን ውስጥ ባለ ውሃ እየነከሩ ከሌሎች ሰዎች ጋር አብሮ መታጠብ (መጥፎ ልምድ) Put hands in a container and wash hands together with others 2. ሌላ ሰው ትንሽ ንጹህ ውሃ አያንቆረቆረ መታጠብ (ትክክለኛ ልምድ) Wash hands while another person assists in pouring water to my hand 3. ቧንቧ በሚወርድ ውሃ መታጠብ (ትክክለኛ ልምድ) 4. From pipeline

ተቁ No.	ጥያቄዎች Questions	መልሶች Answers
		5.እጆችን በሳሙና እና ውሃ መታጠብ Use soap and water
3.	የተረፈ ምግብ የሚያስወግዱት እንዴት ነው Leftover is disposed to garbage	1. ተስብስቦ በቆሻሻ ማጠራቀሚያ ይጣላል/disposed in garbage 2. ሌላ/other_____
4.	ማብሰያ ወለሎችና መመገቢያ ቦታዎች የሚጸዱት መቸ ነው Floor and dinning places are cleaned after daily routine are finished	1. ጧት/Morning 2. የዕለት ስራ ሲጠናቀቅ/Every night
5.	የቆሻሻ ማጠራቀሚያዎች ግጥም ብሎ የሚዘጋ መክደኛ አላቸው Garbages have covers that close very well	1. አዎ/Yes 2. የለም/No
6.	የረጠቡ ማድረቂያ ጨርቆች ወይም ስፖንጆች ምንም ነገር በማያስገባ ፕላስቲክ ውስጥ ተቋጥረው ያድራሉ Wet drying clothes or sponges are kept under a closed plastic	1. ምንጊዜም/Often 2. አልፎ አልፎ/ Sometimes 3. የለም/Never
7.	የተበከለ ምግብን በምን መለየት ይቻላል Can detect contaminated food by:	1. በመልኩ/Color 2. በሽታው/Smell 3. በጣዕሙ/Taste 4. አላውቅም/Don't K.
8.	የመገልገያ እቃዎችን ለማጠብ ፈሳሽ ሳሙና ይጠቀማሉ Use detergents/liquid soaps to wash equipment	1. ምንጊዜም/Often 2. አልፎ አልፎ/ Sometimes 3. የለም/Never
	የጤና ምርመራ **Health examination**	
1.	የጤና ምርመራ ተድርጎልኛል Have held health examination	1. አዎ/Yes 2. የለም/No
2.	የጤና ምርመራ ማስረጃ አለኝ (ኮፒ ይያያዝ) I have certificate for health examination	1. አዎ/Yes 2. የለም/No

Table 73: Food safety practice observation checklist

የምግብ ጤናማነት መከታተያ ቅጽ

(Refer to Table 66 for English Version)

ቀን_____ክ/ከተማ_____ት/ቤት_____የጤና ባለሙያ_____

ማሳሰቢያ፡ የምግብ ማብሰያ ቤት፣ የበሰሉና ያልበሰሉ ምግቦች ማስቀመጫዎችና ማከማቻ፣ የምግብ አዘገጃጀት ሂደትና አካባቢውን በመቃኘት የሚከተለውን ቅጽ ይሙሉ፡፡

ተ.ቁ.	ዝርዝር	ምላሽ 1. አዎ 2. የለም 3. የተወሰኑ ሰዎች ብቻ
	የግል ንጽህና/ሃይጅን	
1.	ሁሉም የምግብ አዘጋጅዎች ንጹህ ዩኒፎርምና ጫማ በተገቢው ሁኔታ ለብሰዋል	
2.	ሁሉም የምግብ አዘጋጅዎች የጸጉር መሸፈኛ በአግባቡ አድርገዋል	
3.	የሁሉም የምግብ አዘጋጅዎች ጥፍር አጭር፣ ጥፍር ቀለም ያልተቀባ፣ ንጹህ ነው	
4.	ሁሉም የምግብ አዘጋጅዎች የግል ማጌጭያዎችን አላደረጉም	
	• የእጅ ጌጣጌጥ (ከጋብቻ ቀለበት ውጭ)	
	• የእጅ ሰዓት	
	• ምርፌ ቁልፍ/ስፒል	
	• ሌሎች	
5.	ሁሉም የምግብ አዘጋጅዎች በተገቢው ሰዓት፣ በተደጋጋሚና በአግባቡ እጃቸውን ይታጠባሉ	
6.	ቁስል፣ የእጅ መቆረጥ፣ የታመመ የሰውነት ክፍል፣ የቆዳ/ቁስል መላጥ ወዘተ ያጋጠማቸው የምግብ አዘጋጅዎች በምግብ ዝግጅትሥራ ላይ ታይተዋል	
7.	በምግብ ዝግጅት ወቅት ቁስል፣ የእጅ መቆረጥ፣ የታመመ የሰውነት ክፍል፣ የቆዳ/ቁስል መላጥ፣ ወዘተ በአግባቡ ዒሃ በማያስተላልፍ መሸፈኛ ተሸፍኗል	
8.	የሚከተሉት በምግብ ዝግጅት ወቅትና የመገልገያ እቃዎች ማጠቢያ ቦታዎች ዙሪያ ታይተዋል	
	• የምራቅ ወይም አክታ መትፋት (eject saliva forcibly)	
	• ማስቲካ ማኘክ፣ ምግብ መመገብ፣ መጠጣት፣ ማጨስ	
	• ያልተጠበቀ ወይም ጥንቃቄ የጎደለው ማስነጠስና ማሳል (ሲያስነጥስ ወይም ሲያስል አፍን በጨርቅ አለመሸፈን)	
9.	ምግብ አዘጋጅዎች ካሳለ፣ ካስነጠሰ፣ አፍ፣ አፍንጫ ወይም ጸጉር ከተነካ በኋላ የሚጣል ሶፍት ወይም ቆሻሻ ማስወገጃ ይጠቀማሉ	
10.	ምግብ አዘጋጅዎች በማስነጠስ በማስነጥስ ወይም በማሳል ጊዜ አፍና አፍንጫቸውን ይሸፍናሉ	
11.	ምግብ አዘጋጅዎች በማስነጠስ ወይም በማሳል ጊዜ ወዲያውኑ እጃቸውን ይታጠባሉ	
12.	ንጹኅ፣ መሰናክል የሌለበት/ወይም የሚመችና ጥቅም ላይ የሚውል የእጅ መታጠቢያ አለ	
13.	በእጅ መታጠቢያ (ካለ) ቦታው ሳሙና፣ ለአንድ ጊዜ አገልግሎት ብቻ የሚውል ፎጣ፣ እና ሙቅ ውሃ ይገኛል	
14.	የእጅ መታጠብን ማስታወሻ ምልክት ተልጥፏል	
15.	መጸዳጃ ቦታዎች ንጽህናቸው የተጠበቀ ነው	

ተ.ቁ.	ዝርዝር	ምላሽ 1. አዎ 2. የለም 3. የተወሰኑ ሰዎች ብቻ
16.	መጸዳጃ ቦታዎች መውጫ ላይ የእጅ መታጠቢያ ቦታ የእጅ መታጠቢያ ደረቅ ወይም ፈሳሽ ሳሙና፣ ሰራተኞች እጅ መታጠብ ግዴታቸው መሆኑን የሚጠቁም ምልክቶች ይገኛሉ.	
17.	በትምህርት ቤቱ የምግብ ማዘጋጃ ቦታ ውስጥ ለምግብ ዝግጅት የሚሆን በቂ የንጹህ ውሃ አቅርቦት አለ	
18.	በትምህርት ቤቱ ውስጥ በቂ የተማሪዎች መመገቢያ አዳራሽ አለ (የለም ከሆነ፣ የመመገቢያ ቦታው ይገለጽ)	
19.	ተማሪዎች ከመመገባቸው በፊት ወይም ከተመገቡ በኋላ እጃቸውን በአግባቡ የሚታጠቡበት የተሟላ የእጅ መታጠቢያ ቦታ አለ	
	ምግብ ዝግጅት	
1.	የመገልገያና ማንኛውም ከምግብ ጋር የሚነካኩ ዕቃዎች በአግባቡና በየጊዜው ይታጠባሉ፣	
2.	የታጠቡ እቃዎች በራሳቸው እንዲደርቁ ይተዋሉ.	
3.	የታጠቡ እቃዎች በጨርቅ ማድረቂያ እንዲደርቁ ይደረጋል	
4.	ለምግብ ዝግጅት የሚውሉ ግብዓቶች (ሽንኩርት፣ ቅመማ ቅመሞች፣ ያልበሰሉ/ጥሬ ምግቦች ወዘተ) ለብክለት በማያጋልጥ ሁኔታ ተቀምጠዋል	
5.	የምግብ ዝግጅት ሂደቱ ለተሻጋሪ ብክለት ተጋላጭ አይደለም	
6.	የምግብ አዘጋጆች ስለ ተሸጋሪ ብክለት ጠንቅቀው ያውቃሉ?	
7.	ለምግብ ዝግጅት የሚሆን በቂ የማጽጃ መሳሪያዎች (ፈሳሽ ሳሙና፣ መጥረጊያ፣ መወልወያ፣ የመሳሰሉት) አሉ.	
8.	ለቁሳቁሶች ንጽህና መጠበቂያ የሚውሉ ፎጣዎች ጥቅም ላይ የሚውሉት ለአንድ ጊዜ ብቻ ነው (ለእጅ፣ ለሌላ መገልገያ ዕቃዎችና ወለል ማድረቂያነት አይውሉም)	
9.	ምግብ በተገቢው ሙቀት ለተገቢው ጊዜ ይበስላል (ይህን ለመለየት በደንብ መንተክተክ አለበት)	
10.	ለተመጋቢ ሳይቀርብ የቀረ ምግብ ሌላ ጊዜ ለመበላት ፍሪጅ ውስጥ ተቀምጦ ይቆያል።	
11.	አገልግሎት ላይ የሚውል ንጹኅ ፍሪጅ/ማቀዝቀዣ አለ	
	የምግብና ደረቅ ምግብ መጋዘን	
1.	ሁሉም ምግቦች እና የምግብ አቅርቦቶች ከመሬት ከፍ ብለው መደርደሪያ ላይ ይቀመጣሉ.	
2.	ያበጠ (የተነፋ) ወይም የሚያፈስ የምግብ ማሸጊያ የለም	
3.	መጋዘኑ ምግብን ከብክለት ለመከላከል ያስችላል	
4.	የምግብ ማስቀመጫዎች ንጹህ ናቸው	
5.	ደረቅ ወይም ፈሳሽ ሳሙና፣ የንጽህና መጠበቂያ እና የተባይ ማጥፊያ ፈሳሾች በሚገባ ተለይተው ከምግብና ምግብ-ነክ አቅርቦቶች ርቀው ተቀምጠዋል	
6.	የምግብ ማስቀመጫ ቦታዎች በመደበኛ ሁኔታ ይጸዳሉ.	
7.	ምግቦች የሚቀመጡበት ዕቃ ለምግብ ማስቀመጫ አገልግሎት የሚውል ምግብን ከብክለት የሚከላከል ነው	
	የምግብ ማብሰያና መመገቢያ ዕቃዎች ንጽህናና ጽዳት	
1.	በሚገባ የተዘጋጀ የዕቃ ማጠቢያ ቦታ (sink) አለ	
2.	ውሃው ንጹህና ከቅባት እና ምግብ-ነክ ነገሮች የጸዳ ነው	

ተ.ቁ.	ዝርዝር	ምላሽ 1. አዎ 2. የለም 3. የተወሰኑ ሰዎች ብቻ
3.	ምግብ ለመጥበስ ስራ ላይ የዋለ ዘይት ወይም ማንኛውም ቅባት ፍሳሽ ማስወገጃ መስመር ውስጥ ይደፋል	
4.	የምግብ ማብሰያና መመገቢያ ዕቃዎች ከታጠቡ በኋላ በንፋስ/አየር እንዲደርቁ ይደረጋል	
5.	ሁሉም የምግብ ማብሰያና መመገቢያ ዕቃዎች (መክተፊያ፣ ቢላዋ ጨምሮ) በምግብ ዝግጅት መካከል በተደጋጋሚ ይታጠባሉ	
6.	የምግብ ማብሰያና ማዘጋጃ ቦታ በየሰዓቱ ይጸዳል	
7.	መሳቢያዎችና መደርደሪያዎች ንጽህናቸው የተጠበቀ ነው	
	የቆሻሻ ማጠራቀሚያና ማስወገጃ	
1.	የቆሻሻ ማጠራቀሚያ እና አካባቢው ከምግብ ማብሰያው በቂ ርቀት ያለው፣ ንጹህና ሽታ የሌለው ነው	
2.	በምግብ ማብሰያ አቅራቢያ የሚገኙ ጊዜያዊ የቆሻሻ ማጠራቀሚያ (Kitchen garbage cans) ንጹህና የተሸፈኑ ናቸው	
3.	በምግብ ማብሰያ አቅራቢያ የሚገኙ ጊዜያዊ የቆሻሻ ማጠራቀሚያዎች የተጠራቀመ ቆሻሻ ቶሎ ቶሎ ይወገዳል.	
	የተባይ ቁጥጥር	
1.	የምግብ ማብሰያ ክፍል በሮችና መስኮቶች ብርሃን ወደ ውስጥ ያሳልፋሉ	
2.	በሮችና መስኮቶች ጠንካራና ነፍሳትና ትንንሽ እንስሳት (አይጥ) ወደ ውስጥ አያሳልፉም	
3.	በረሮዎች በምግብ ማከማቻና ማብሰያ ቁሳቁሶችና አካባቢ ይታያሉ፣ ይንቀሳቀሳሉ	
4.	መደበኛ የተባይ ክትትልና ቁጥጥር የሚያደርግ አካል አለ	
5.	ማንኛውም የምግብ መገልገያ እቃ፣ ወለል፣ ግድግዳ እና ኮርኒስ ልሙጥ፣ ውሃ መምጠጥ የማይችል እና ለማጽዳት ቀላል ነው	
6.	በአጠቃላይ የምግብ ጤናማነት ቁጥጥር የሚያደርግ አካል አለ (ካለ በወር (ስንት)_____ ጊዜ)	

Table 74: School Water, Sanitation and Hygiene questionnaire

የትምህርት ቤት ውሃ ጤናማ አያያዝ እና ሃይጂን

ቀን_____ ክ/ከተማ_____ ት/ቤት_____

የጤና ባለሙያ_____

ተ.ቁ	ጥያቄ	የመልስ አማራጮች
	የመጠጥ ውሃን በተመለከተ ዋና ዋና ጥያቄዎች	
1.	በትምህርት ቤቱ ውስጥ መጠጥ ውሃ የሚገኘው ከየት ነው? ***ማስታወሻ***፡ ከአንድ በላይ የውሃ መገኛ ካለ የሚመረጠው በብዛት ጥቅም ላይ የሚውለው ነው። ትምህርት ቤቱ ውስጥ ውሃ ባለመኖሩ ምክንያት ተማሪዎች ከቤታቸው ውሃ ይዘው የሚመጡ ከሆነ "ውሃ የለም" የሚለው መመረጥ አለበት።	A. ከቧንቧ B. ከመሬት ውስጥ በቧንቧ ከሚወጣ C. ከተከደነ ጉድጓድ/ ምንጭ D. ከዝናብ ፈሰስ የተጠራቀመ E. ካልተከደነ ጉድጓድ/ ከተጠራቀመ ምንጭ F. ጋሪ ወይም በመኪና ላይ ከተጫነ ጋን G. ከሃይቅ/ ከወንዝ/ ወራጅ ምንጭ H. ከታሸገ ውሃ I. ውሃ የለም
2.	በት/ቤቱ ግቢ ውስጥ ከዋናው መገኛ የሚመጣ የመጠጥ ውሃ በወቅቱ አለ? ***ማስታወሻ***፡ አለ የሚባለው በጉብኝቱ ወቅት ከዋናው መገኛ የሚመጣ ወይም ከዋናው መገኛ ተቀድቶ የተጠራቀመ ውሃ ት/ቤቱ ውስጥ ሲኖር ብቻ ነው።	A. አለ B. የለም
	ዋና ዋና የፅዳት (sanitation) ጥያቄዎች	
1.	በትምህርት ቤት ውስጥ የሚገኙ የተማሪ መጸዳጃ ቤቶች ምን ዓይነት ናቸው (በብዛት የሚገኘው ዓይነት)? ***ማስታወሻ***፡ በት/ቤት ውስጥ የውሃ ጤናማ አያያዝን የሚያሟሉ፡ ዓይነ-ምድር አጥቦ የሚወስድ ውሃ ያላቸው ወይም ባለመክደኛ ጉድጓድ ያላቸው መጸዳጃ ቤቶች ናቸው። ሌሎቹ አያሟሉም።	A. ዓይነ-ምድር አጥቦ የሚወስድ ውሃ ያለው B. ባለመክደኛ ጉድጓድ ያለው C. መክደኛ የሌለው ጉድጓድ D. ከስሩ ባልዲ ያለው የመጸዳጃ መቀመጫ E. መጸዳጃ ቤት የለም
2.	በወቅቱ እያገለገሉ ያሉ እና ተደራሽ የሆኑ ስንት የተማሪ መጸዳጃ ቤቶች አሉ። --- ***ማስታወሻ***፡ የሚቆጠሩት **ጥያቄው በሚጠየቅበት ወቅት** በመማገልገል ላይ የሉ መጸዳጃ ቤቶች ብቻ ናቸው።	**<u>የሚያገለግሉ የሚባሉት</u>** ፡- (ሀ) ለተማሪ ተደራሽ የሆኑት (ያልተቆለፉ ወይም ሁል ጊዜ ቁልፍ በቀላሉ የሚገኝ) (ለ) ተማሪ ሊጠቀምበት የሚችል (የመጸዳጃ መቀመጫው ያልተሰበረ፣ የመጸዳጃው መሸለኪያ ቀዳዳ ያልተደፈነ፣ ወይም ዓይነ-ምድሩን አጥቦ ለማስኬድ በቂ ውሃ ያለበት) እና

ተ.ቁ	ጥያቄ	የመልስ አማራጮች
		(ሐ) ለአንድ ሰው ብቻ መገልገያ (ከውስጥ መቆለፍ የሚችሉ በሮች ሉት፣ ግድግዳው ላይ ትላልቅ ቀዳዳ የሌላቸው)። ከነዚህ ሶስት ሁኔታዎች አንዱ እንኳን ካልተሟ መጸዳጃ ቤቱ ተማሪ ሊጠቀምበት የሚችል ነው ማለት አይቻልም። ሆኖም ከውስጥ የሚቆለፉ መጸዳጃ ቤቶች ቅድመ መደበኛ ት/ቤቶች ውስጥ ኢንዲኖሩ አይጠበቅም)።
3.	ለሴቶች እና ለወንዶች ተማሪዎች የተለያዩ መጸዳጃ ቤቶች አሉ?	A. አለ B. የለም
	ዋና ዋና የሃይጅን ጥያቄዎች	
1.	በት/ቤቱ ውስጥ የእጅ መታጠቢያ መገልገያዎች አሉ ***ማስታወሻ***፡ የእጅ መታጠቢያ መገልገያ የሚባለው ተማሪዎች ከላይ የሚፈስ ውሃን በመጠቀም እጃቸውን በአግባቡ ለመታጠብ የሚያስችላቸው ነው። ከአንድ በላይ ተማሪዎች እጃቸውን ነክረው የሚታጠቡበት በባልዲ ወይም በሌላ ውሃ መያዣ ውስጥ የተጠራቀመ ውሃ አግባብ ላለው እጅ እጥበት ተገቢ መገልገያ አይደለም።	A. አለ B. የለም
2.	በእጅ መታጠቢያ መገልገያዎች ላይ በወቅቱ ውሃ እና ሳሙና አለ?	A. አዎ ውሃና ሳሙና አለ B. ያለው ውሃ ብቻ ነው C. ያለው ሳሙና ብቻ ነው D. ሳሙናም ውሃም የለም
3.	ት/ቤት ውስጥ ባለፉት ሁለት ሳምንታት ከዋናው መገኛ የሚመጣ የመጠጥ ውሃ በየትምህርት ቀኑ ይገኝ ነበር? ***ማስታወሻ***፡ አዎ የሚባለው ባለፉት ሁለት ሳምንታት ውስጥ በየቀኑ በማንኛውም ጊዜ ወሃ ሲገኝ የነበረ ከሆነ ብቻ ነው።	A. አዎ ይገኝ ነበር B. አይገኝም ነበር
4.	ከዋናው መገኛ የሚመጣ የመጠጥ ውሃ በትምህርት ዘመኑ ሙሉ ይገኛል? ***ማስታወሻ***፡ ውሃ የሚገኝበት በዓመት ከ30 ቀን ያነሰ ከሆነ አይገኝም ተብሎ ይመዝገብ።	A. አዎ፣ ሁልጊዜ B. ብዙ ጊዜ (የማይኖረው ከ30 ቀናት ላነሰ ጊዜ ብቻ ነው) C. አይገኝም (በድምሩ ከ30 ቀናት በላይ አይኖርም)
5.	የመንቀሳቀስ ወይም የማየት ችሎታቸው የተገደበ ተማሪዎች የመጠጥ ውሃ ወዳለበት ሳይቸገሩ መድረስ ይችላሉ? ***ማስታወሻ***፡ ሳይቸገሩ የሚደረስበት የሚባለው ወደ ውሃው የሚወስደው መንገድ መሰናክል የሌለው፣ ደረጃ የሌለው ወይም ለእድሜ የሚስማማ መወጣጫ የእጅ መያዣ ያለው፣ የቧንቧ መክፈቻው በቅምጥ የሚደረስበት ነው።	A. አዎ B. አይችሉም
6.	የመጠጥ ውሃው የት/ቤቱ ትንንሽ ልጆች በቀላሉ የሚደርሱበት ነው?	A. አዎ B. አይደለም

ተ.ቁ	ጥያቄ	የመልስ አማራጮች
7.	በት/ቤቱ ውስጥ ስንት የውሃ ቧንቧዎች አሉ? ----------	***ማስታወሻ***፡ ተማሪዎች የመጠጥ ውሃ የሚያገኙባቸውን ቦታዎች በሙሉ መቁጠር ያስፈልጋል። ይህም ቧንቧዎችን፣ ጆሳቸውን፣ ባልዲዎችን እና የመሳሰሉትን ያጠቃልላል።
8.	ከዋናው መገኛ የሚመጣው ውሃ ለመጠጥ ጤናማ እንዲሆን ት/ቤቱ የሚያደርገው ነገር አለ?	A. አዎ B. የለም
9.	መልሱ አዎ ከሆነ ምን ውሃን የማከም ዘዴ ይጠቀማል ***መስታወሻ***፡ ውሃ የተሞሉ ፕላስቲክ መያዣዎች ለተወሰኑ ሰዓቶች ለጸሃይ ብርሃን ሲጋለጡ ውሃ ውስጥ የሚገኙ ሚክሮቦች ይጠፋሉ።	A. ማጥለል B. ማፍላት C. ክሎሪን መጨመር D. ለጸሃይ ጨረር በማጋለጥ E. በልዕለ-ሃምራዊ ጨረር ሚክሮቦችን ማጥፋት
10.	በት/ቤቱ ውስጥ ያለው ዋነኛው የውሃ መገኛ ለመጠጥ ውሃ የተመደበውን ብሔራዊ የምደባ ደረጃ ያሟላል?	A. አዎ B. አያሟላም C. አላውቅም
11.	የወር አበባ ሃይጅንን ለመጠበቅ በሚያስችል መልኩ በሴት ተማሪዎች መጸዳጃ ክፍሎች ውሃ እና ሳሙና አለ?	A. አዎ፣ ውሃና ሳሙና አለ B. ውሃ እንጂ ሳሙና የለም C. ውሃ የለም
12.	በሴት ተማሪዎች መጸዳጃ ክፍሎች ውስጥ የወር አበባ ሃይጂንን ለመጠበቅ የዋለ ቁሶችን መጣያ ባለክዳን ማጠራቀሚያዎች አሉ?	A. አዎ B. የለም
13.	የወር አባባ ሃይጅንን ለመጠበቅ ያገለገሉ ቁሶችን ከት/ቤቱ የማስወገድ አሰራር አለ?	A. አዎ B. የለም
14.	የተማሪዎች መጸዳጃ ቤቶች በሳምንት ስንት ጊዜ ይጸዳሉ?	A. ቢያንስ በቀን አንድ ጊዜ B. በሳምንት ከ2 እስከ 4 ቀናት C. በሳምንት አንድ ጊዜ D. በሳምንት ከአንድ ጊዜ ያነሰ
15.	በአጠቃላይ ሲታይ የተማሪዎች መጸዳጃ ቤቶች ምን ያህል ጽዱ ናቸው? ***ማስታወሻ***፡ ጽዱ፡ ሁሉም መጸዳጃ ቤቶች መጥፎ ጠረን ወይም በርካታ ዝንቦች ወይም ትንኞች የላቸውም፣ ዓይነ-ምድር ወለል ላይ፣ ግድግዳ ላይ፣ መቀመጫው ላይ ወይም በመገልገያው አካባቢ አይታይም፤ እንደ ነገሩ ጽዱ፡ ትንሽ መጥፎ ጠረን ያለው ወይም በአንዳንድ መጸዳጃ ክፍሎች ውስጥ የዓይነ-ምድር ምልክት የሚታይበት፣ ጽዱ ያልሆነ፡ ከባድ መጥፎ ጠረን ያላቸው ወይም/እና በአብዛኛው የመጸዳጃ ክፍሎች ዓይነ-ምድር የሚታይባቸው	A. ጽዱ ናቸው B. እንደ ነገሩ ጽዱ ናቸው C. ጽዱ አይደሉም
16.	በት/ቤቱ ውስጥ ያሉት ትንንሽ ልጆች ሊደርሱበት የሚችል እና ጥቅም ላይ ሊውል የሚችል ቢያንስ አንድ የመጸዳጃ መቀመጫ ወይም ጉድጓድ አለ? ***ማስታወሻ***፡ ትንንሽ ልጆች ሊጠቀሙበት የሚችል፡ አነስ ያለ የመጸዳጃ ጉድጓድ አፍ ፣ ዝቅ ያለ መቀመጫ እና ዝቅ ያለ የበር እጀታ ያለው ነው።	A. አዎ B. የለም
17.	የማየት ወይም የመንቀሳቀስ ችግር ያለባቸው ተማሪዎች ሊጥቀሙበት የሚችል ቢያንስ አንድ መጸዳጃ ክፍል አለ?	A. አዎ B. የለም

ተ.ቁ	ጥያቄ	የመልስ አማራጮች
	ማሰታወሻ፡ ወደ መጸዳጃ ቤት የሚወስደው መንገድ ከመሰናክል ነጻ የሆነ፣ ደረጃ የሌለው ወይም ደረጃ መወጣጫ የእጅ መያዣ ያለው፣ መጸዳጃ ክፍሉ ውስጥ ለዊልቸር መንቀሳቀሻ በቂ ቦታ ያለው፤ የመጸዳጃ ቤት የበር መዝጊያ እጀታዎችም ሆኑ የመጸዳጃ መቀመጫዎች በክራንች ወይም ዊልቸር የሚንቀሳቀሱ ልጆች በቀላሉ ለደርሱባቸው የሚችሉ።	
18.	የተማሪ መጸዳጃ ቤቶች የሚገኙት የት ነው?	A. በት/ቤቱ ሕንጻ ውስጥ B. ከት/ቤቱ ሕንጻ ውጭ ግን በት/ቤቱ ግቢ ውስጥ C. ከት/ቤቱ ግቢ ውጭ
19.	ተማሪዎች የት/ቤቱን መጸዳጃ ቤቶች ለመጠቀም የሚፈቀድላቸው መቼ ነው?	A. በትምህርት ቀኑ ውስጥ በማንኛውም ጊዜ B. በትምህርት ቀኑ ውስጥ በተወሰኑ ጊዜያት C. ት/ቤቱ ውስጥ አገልግሎት ሊሰጡ የሚችሉ መጸዳጃ ቤቶች የሉም
20.	ለሁሉም ተማሪዎች ሊጠቀሙባቸው የሚችሉ ተቀባይነት ያላቸው የፊንጢጣ ማጽጃ ቁሶች በወቅቱ አሉ?	A. አዎ B. የለም
21.	ይህ ጥናት በሚካሄድበት ሰዓት በተማሪዎች መጸዳጃ ቤቶች ውስጥ ብርሃን አለ? ***ማሰታወሻ***፡ ብርሃን አስፈላጊ በሆነባቸው መጸዳጃ ቤቶች የኤሌክትሪክ አምፖል ወይም ብርሃን የሚያስገባ ህንጻ እኩል ተቀባይነት አላቸው።	A. በሁሉም መጸዳጃ ቤቶች B. በአንዳንድ መጸዳጃ ቤቶች C. ምንም የለም
22.	የመጸዳጃ ቤት ጉድጓዶች ወይም የምድር ውስጥ ማጠራቀሚያዎች (ሴፕቲክ ታንክ) ሲሞሉ ይመጠጣሉ?	A. አዎ B. አይመጠጡም
23.	የማየት ወይም የመንቀሳቀስ ችግር ያለባቸው ተማሪዎች በቀላሉ ሊደርሱባቸው የሚችሉ የእጅ እጥበት መገልገያዎች አሉ? ***ማሰታወሻ፥*** የእጅ እጥበት መገልገያ ሊደረስበት ይችላል የሚባለው ወደዚያ የሚያስኬደው መንገድ መሰናክል ወይም ደረጃዎች የሌሉት እና ከእድሜ ጋር የሚጣጣም መወጣጫ የእጅ መያዣ ሲኖረው፣ በተጨማሪ የቧንቧ መክፈቻ እና ሳሙና በቅምጥ የሚደረስባቸው፣ የቧንቧ መክፈቻውም በቀላሉ የሚከፈት ሲሆን ነው።	A. አዎ B. የለም
24.	በት/ቤቱ ውስጥ ያሉ ትንንሽ ተማሪዎች በቀላሉ ሊደርሱባቸው የሚችሉ የእጅ እጥበት መገልገያዎች አሉ? ***ማሰታወሻ፥*** የእጅ እጥበት መገልገያ ሊደረስበት ይችላል የሚባለው በት/ቤቱ ውስጥ ያሉ ትንንሽ ተማሪዎች የቧንቧ መክፈቻውን እና ሳሙናውን በቀለሉ ሊደርሱበት እና በቀላሉ መክፈት መዝጋት ሲችሉ ነው።	A. አዎ B. የለም
25.	በት/ቡቱ ውስጥ ውሃ እና ሳሙና ያለባቸው የእጅ እጥበት መገልገያዎች ያሉት የት ቦታ ነው? ***ማሰታወሻ***፡ ምልክት የሚደረገው በጉብኝቱ ወቅት ውሃ እና ሳሙና ያሉባቸውን ቦታዎች ነው።	A. መጸዳጃ ቤት ውስጥ B. ምግብ ማዘጋጃ አካባቢ C. ምግብ መመገቢያ አካባቢ D. መማሪያ ክፍል ውስጥ E. በት/ቤት ግቢ ውስጥ
26.	በት/ቤቱ ውስጥ ስንት ውሃ እና ሳሙና ያለባቸው የእጅ እጥበት መገልገያዎች አሉ?	A. የቧንቧዎች ብዛት ----------

ተ.ቁ	ጥያቄ	የመልስ አማራጮች
		B. ውሃ እና ሳሙና ያለባቸው መገልገያዎች ብዛት ----------
27.	በሳምንት ውስጥ ለሁሉም ተማሪዎች ስንት ጊዜ የቡድን እጅ እጥበት ተግባራት ይካሄዳሉ?	A. በትምህርት ቀን ቢያንስ አንድ ጊዜ B. በሳምንት ከሁለት እስከ አራት ቀናት C. በሳምንት አንድ ጊዜ D. በሳምንት ከአንድ ቀን ያነሰ
28.	ለወር አበባ ሃይጅን አጠባበቅ ከሚሆኑት ነገሮች የትኞቹ በት/ቤቱ ውስጥ ይገኛሉ? ***ማስታወሻ***፡ የመታጠቢያ ቦታዎች ከመጸዳጃ ቤት የተለዩ ናቸው። ክፍሎቹ ቢያንስ ውሃ እና ሳሙና ያላቸው ሆነው በግል ለመጠቀም እንዲቻል ከውስጥ የሚቆለፉ በሮች ያላቸው፣ ሌሎች አሬሌቀው እንዳያዩ ቀዳዳዎች ወይም ስንጥቆች፣ መስኮቶች ወይም ዝቅ ያሉ ግድግዳዎች የሌላቸው መሆን አለባቸው። መገኘት ማለት በነፃ እደላ ወይም በግዢ ማለት ነው። የወር አበባ አጠባበቅ ትምህርት አለ ማለት የሚቻለው በመደበኛነት በት/ቤቱ የትምህርት ፕሮግራም ውስጥ የተካተተ ክፍል ውስጥ የሚሰጥ ትምህርት ሲሆን ነው።	A. የመታጠቢያ ቦታዎች B. የወር አበባ ሃይጅን ቁሶች (የወር አበባ መቀበያዎች ፓዶች) C. ስለ የወር አበባ ሃይጂን አጠባበቅ ትምህርት
29.	በት/ቤቱ ውስጥ ደረቅ ቆሻሻ የሚወገደው እንዴት ነው? ***ማስታወሻ***፡ የመጀመሪያ ሶስቱ አግባብነት ያላቸው የደረቅ ቆሻሻ አወጋገድ ተብለው ይቆጠራሉ። ግቢ ውስጥ በሚታይ ሁኔታ መጣል አግባብ ያለው የቆሻሻ አወጋገድ አይደለም።	A. በማዘጋጃ ቤት በሚያቀርበው ማስወገጃ በኩል B. በት/ቤቱ ግቢ ውስጥ በማቃጠል C. በት/ቤቱ ግቢ ውስጥ ጉድጓድ ውስጥ በመጣል እና በመሸፈን D. ግቢ ውስጥ በሚታይ ሁኔታ መጣል

(Translated from English version)

SOURCE: UNICEF/WHO 2016. Core questions and indicators for monitoring WASH in Schools in the Sustainable Development Goals. WHO Press, World Health Organization, 20 Avenue Appia, 1211 Geneva 27, Switzerland

Open-ended questionnaire on socioeconomic effect of the Addis Ababa SFP

Major topics of the Key Informants Interviews (KIIs) and Focus Group Discussions (FGDs)

1. Background information about women Associations'/Kitchen workers
2. Benefit of the school feeding program (SFP) to the women
3. Benefit of the school feeding program to community and community response to the SFP
4. Finance, credit and saving practices of the kitchen workers
5. Inflation and prices of meals served in schools
6. Schools' role and participation in the school feeding program
7. The role of the Addis Ababa School Feeding Agency in the school feeding program
8. Effect of school closure due to COVID-19 and the consequence of teaching in shifts
9. Challenges and opportunities.

Listing table for sampling frame

Table 75: Listing table for sampling frame

Kifle Ketema: _____ Name of school: _____ School Director: _____ Contact (Mob): _____ Contact (Email): _____ **Is School New for SFP (Yes/No): ____**		No. of Meal Providers/Women: _____ Grade of student (|1|2|3|4|5|6|7|8|): ___ Section: ___ Room Teacher Name: _____ Contact (Mob): _____

No.	Name of targeted student		Sex	Selection criteria for SFP	Entry Status
	Student's name	Father Name	**M|F**	|1. Poverty| |2. Other|	|1. New (AABoE)| |2. Not new (Yenat Weg)| |3. Not New (Other)|
1					
2					
3					
4					
5					
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28					
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30					

Study time frame

Table 76: Study time frame

ROUND I

No.	Activities	***Effective Dates***																
		February									March							
		11	19	20	21	22	23	24	25	28	…	18	19	20	21	22	25	26
		Mon (የካ 4)	Tues	Wed	Thurs	Fri	Sat	Sun	Mon	Thurs	Sun	Mon (ሚያ 9)	Tues	Wed	Thurs	Fri	Mon	Tues
Preparation																		
1	Finalize data collection tools																	
2	Prepare measurement equipment																	
3	Identify enumerators and call for training																	
4	Identify training venue																	
5	Deliver training																	
6	Pretest and field deployment																	
Field work																		
7	Administer Anthropometry measurement																	
8	Food safety																	
9	Malnutrition and school age diet																	
10	Socio-economic implications																	
11	Food Insecurity Experience																	
12	Dietary composition																	
13	Education																	
14	Qualitative																	

ROUNDS II – IV

No.	Activities	SECOND ROUND FIELD WORK								THIRD ROUND FIELD WORK									FOURTH ROUND FIELD WORK								
		Effective Dates																									
		June								September									December								
		17	18	19	20	21	24	25	26	16	17	18	19	20	23	24	25	26	16	17	18	19	20	23	24	25	26
		Mon	Tues (ሰኔ 11)	Wed	Thurs	Fri	Mon	Tues	Wed	Mon	Tues	Wed (መስ 7)	Thurs	Fri	Mon	Tues	Wed	Thurs	Mon	Tues	Wed (ታኅ 8)	Thurs	Fri	Mon	Tues	Wed	Thurs
Preparation																											
1	Prepare data collection tools																										
2	Prepare measurement equipment																										
3	Contact and update enumerators																										
4	Identify training venue																										
5	Deliver training																										
6	Pretest and field deployment																										
Field work																											
7	Administer Anthropometry measurement																										
8	Food safety																										
9	Malnutrition and school age diet																										
10	Socio-economic implications																										
11	Food Insecurity Experience																										
12	Dietary composition																										
13	Education																										
14	Qualitative																										

Budget

Table 77: Budget

No.	Item	Cost/unit/day/ETB	Number	No. of days	Rounds	Total cost /ETB
1	Training (Tea break, Water, Lunch)	100	50	2 (pretest)	4	40,000
2	Per diem for data collectors	125	50	12	4	300,000
3	Field supervision and fuel (Lump sum)				4	57,600
4	Labor	100	10	1	4	4,000
5	Stationary	700	40	1	4	112,000
6	Tonner	1200	5			6,000
7	Binding	400	9	1		3,600
					Miscellaneous (5%)	26,160
					Total	**549,360**