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SUPPLEMENT ARTICLE

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School health and nutrition environments: A multicountry survey in five countries of sub-Saharan Africa region—Burkina Faso, Ethiopia, South Africa, Sudan, and Tanzania

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Abstract

Schools are increasingly regarded as a key setting for promoting the health, well-being, and development of children and adolescents. In this multicountry cross-sectional survey, we describe the health, nutrition, and food environments of public primary schools in five urban settings in Africa region: Ouagadougou, Burkina Faso; Addis Ababa, Ethiopia; Durban; South Africa, Khartoum, Sudan; and, Dar es Salaam, Tanzania. We evaluated the school health and nutrition (SHN) environments in three main areas: (1) the availability of health-related policies, guidelines, and school curricula, (2) the provision of health, nutrition, and water, sanitation, and hygiene (WASH) services in schools, and (3) the school food environments and eating habits of adolescents. We used stratified random sampling to recruit 79 schools from five countries. Trained fieldworkers collected standardized questionnaire data from 79 school administrators, 765 food vendors, and 4999 in-school adolescents aged 10–15 years. In our study, 24 out of 79 school administrators were aware of their

school's health-related policies and guidelines while 30 schools had a specific SHN curriculum. In general, health, nutrition, and WASH services were inadequate. Possibly due to a lack of school kitchens, 14.4% of students bought snacks and unhealthy foods from food vendors. Our study indicates that schools' food and nutrition environments are insufficient to improve adolescent health and nutrition in the African region, including limited coverage of SHN policies, suboptimal facilities and nutrition services, and unregulated food environments. Schools in sub-Saharan Africa need to improve their health and nutrition environments.

KEYWORDS

adolescents, Africa, environment, health, nutrition, policy, schools, WASH

1 | INTRODUCTION

More than 3000 adolescents die every day, totalling 1.2 million deaths a year, largely from preventable causes such as road traffic injuries, drowning, interpersonal violence, self-harm and maternal conditions (World Health Organization [WHO], 2017). More than two-thirds of these deaths occur in low- and middle-income countries (LMICs) in sub-Saharan Africa (SSA) and South-East Asia (SEA). Undernutrition is one of the major factors in these countries that makes adolescents more vulnerable to diseases and early death in adolescence. In SSA, malnutrition (underweight, stunting, and micronutrient deficiencies) was the leading risk factor for disability-adjusted life years among surviving young adolescents (aged 10–14 years) while overweight and anaemia were among the leading causes of diseases among adolescents aged 10–19 years (Danquah et al., 2020; Darling et al., 2020; John et al., 2021; Onyango et al., 2019). Poor health during the early years also contributes to an estimated 500 million school days lost each year across the LMICs, resulting in significant school dropout rates and hindering the development of human capital (Bundy et al., 2017; The International Commission on Financing Global Education Opportunity, 2016). Without investing in adolescent health and nutrition, LMICs in SSA and SEA will not achieve the 2030 Agenda for Sustainable Development including the sustainable development goal of zero hunger (SDG 2), good health and well-being (SDG 3), quality education (SDG 4), gender equality (SDG 5), clean water and sanitation (SDG 6), 10- reduced inequality (SDG 10), and responsible consumption and production (SDG 12) (United Nations [UN], 2015; United Nations Educational, Scientific, and Cultural Organization [UNESCO], 2019, 2022).

Several evidence-based interventions have been recommended for improving the nutritional status of school-age children and adolescents and optimizing health and education outcomes with greater returns to a country's economy (Bundy et al., 2017). Globally, school enrolment has increased significantly, and given the substantial proportion of children spending their time in school—schools have become a critical platform for improving adolescent nutrition (UNESCO, 2022). School Health and Nutrition (SHN) services including school feeding, micronutrient supplementation and deworming, nutrition education, and growth monitoring among others, is a moderately effective and cost-effective strategy to address several health and nutrition problems of children and adolescents (O'Brien et al., 2021; Shinde, Wang, et al., 2023; Wang et al., 2021). However, most of these services are designed to address one form of malnutrition, either undernutrition or overweight/obesity. Significant gaps hinder the effectiveness of SHN programmes (Shinde, Wang, et al., 2023). First, food, nutrition, health, education, and other relevant interventions are rarely combined to maximize their synergies. Second, a lack of capacity exists in designing and implementing these programmes to take into account the context-specific needs of countries. Third, in many LMICs, the SHN efforts are fragmented and small-scale. Finally, in many cases, the policy implementation, collaborative mechanisms, and funding are insufficient to institutionalize effective SHN strategies at the national and sub-national levels. Consequently, there is increasing interest in integrating components addressing food and nutrition environments to address multiple forms of malnutrition and improve children's and adolescents' health and nutritional status.

Among the successful initiatives to address the multiple forms of nutrition among school-going children and adolescents is the

Key messages

- The role of schools in promoting child health, well-being, and development is increasingly recognized.
- Our study examined public primary schools in five African cities.
- We assessed three main areas in schools: the availability of health-related policies and curricula, the provision of health, nutrition, and WASH services, and the school food environment for adolescents aged 10–15 years.
- Our findings indicate inadequate awareness and access to health-related policies, suboptimal facilities, and inadequate nutrition services. In addition, unregulated food environments have been observed. Our study emphasizes the need to improve health and nutrition environments in sub-Saharan African schools.

Nutrition-Friendly School Initiative (NFSI) of the World Health Organization (WHO), which utilizes the school environment to address multiple forms of malnutrition in countries. The NFSI requires five core components, including (i) having a written school policy on nutrition, (ii) enhancing awareness and capacity building, (iii) developing a nutrition and health curriculum, (iv) creating a supportive school environment, and (v) providing supportive school nutrition and health services (WHO, 2020). To date, the NFSI framework has been implemented across 18 countries (WHO, 2020), mainly in European regions, but also in SSA including Burkina Faso and Benin (Delisle et al., 2013). A WHO review of reviews synthesized the evidence on NFSI's five components and 26 essential criteria. Several components and approaches to school nutrition, including diet, physical activity, educational interventions, and environmental changes, have been found to lead to positive weight-related, diet-related, and health behaviour outcomes among children and adolescents. However, the bulk of the evidence is from high-income countries and related to healthy diets and/or prevention of overweight/obesity (WHO, 2020).

To better understand the school environment in SSA, we undertook a cross-sectional study with school administrators, food vendors, and in-school adolescents aged 10–15 years in five countries including Burkina Faso, Ethiopia, South Africa, Sudan, and Tanzania. Motivated by the WHO's NFSI framework, we specifically focused on three components within the school environment: (1) the availability of health-related policies or implemented guidelines, (2) the provision of health, nutrition, and water, sanitation, and hygiene (WASH) services, and (3) the quality of the school food environment, including foods sold by vendors. In addition, this assessment draws on context-specific recommendations to improve the SHN environments, and sustainable scale-up of SHN interventions in developing countries.

2 | METHODS

2.1 | Study sites and design

A cross-sectional study was conducted in the urban settings of Ouagadougou, Burkina Faso; Addis Ababa, Ethiopia; Kwazulu Natal, South Africa; Khartoum, Sudan; and, Dar es Salaam, Tanzania. We sampled schools and students at each site by using a multistage cluster random sampling technique. To begin, we randomly selected districts and administrative units in the selected cities of each country. We, then, randomly selected around 10–20 primary schools per country. Approximately 60 students per school were randomly selected, resulting in a sample of nearly 1200 adolescents per country. Male and female students aged 10–14 years were invited to participate in Ethiopia, South Africa, Sudan, and Tanzania, while in Burkina Faso, male and female students aged 11–15 years were recruited (Shinde, Noor, et al., 2023). We excluded those adolescents who refused to participate, were too ill to be interviewed, or were absent during data collection. Data collection occurred between March and December 2020.

Of the schools selected for the adolescent survey, we randomly selected 10 schools for interviews with food vendors in each country. In every selected school, food vendors in and around the school were surveyed using a semistructured questionnaire. We interviewed 79 school administrators or teachers and 765 food vendors from five countries.

2.2 | Data sources and study participants

Standard protocol and questionnaire were developed and adopted in the local context across the five participating countries. Field workers were recruited and trained by the local participating institutions and selected based on demonstrated experience in social science research and data collection. After the training, the field workers visited all the sampled schools to collect information from the school administrators, food vendors, and in-school adolescents using structured questionnaires.

2.2.1 | School administrator survey

From each selected school, the field workers identified school administrators that were knowledgeable of or responsible for food and healthy environment practices/activities in the school. The survey included questions on existing health-related policies or guidelines, the provision of health and nutrition services, the delivery of a nutrition curriculum, the provision of WASH facilities and services, physical education and activities, and access to medical screening and mental health services. In case a school administrator reported about the available policy or guideline, we asked if it included a recommended package of school-based health and nutrition services.

2.2.2 | Food vendor survey

The field workers identified formal and/or informal food vendors that were in or within a 5-min walk radius of the included schools. This survey covered several topics including the food items sold by the vendors, their costs, and the proportion of sales of these foods.

2.2.3 | Adolescent survey

The field workers randomly selected approximately 60 adolescents per school, with 15 students from primary grades (equivalent to grades 5–8; aged 10–15 years). As part of a systematic development process, the questionnaire was adapted from the Global School-based Student Health Survey (WHO, 2019) and the ARISE Network community-based adolescent health survey (Darling et al., 2020). The questionnaire covered the following topics: demographic characteristics, hygiene practices, physical activity, food preferences and eating behaviours, household food insecurity, peer influences, and

mental health (Shinde, Noor, et al., 2023). The questionnaire was administered by the field workers, who assessed the dietary intake of adolescents using a locally adapted 7-day food frequency questionnaire listing 25 predefined food groups (Madzorera et al., 2023). The questionnaire also included questions seeking information on adolescents' 24-h dietary recall based on mealtime (i.e., breakfast, lunch, dinner, and snacks) listing 25 predefined food groups.

2.3 | Data analyses

Data from school administrators, food vendors, and in-school young adolescents were analysed using descriptive statistics, that is frequencies, means, and proportions as appropriate. We structured the results as per the study objectives describing: (1) the availability of health-related policies or guidelines enacted by the schools, (2) the health, nutrition, and WASH services provided in schools, and (3) the school food environment including food vendors. These objectives cover broadly three out of the four dimensions to assess the school food environment as outlined by the NFSI framework (WHO, 2020), which are the physical, economic, sociocultural, and policy environments. We used the school administrator data to assess objectives 1 and 2 and the food vendor and student data to assess objective 3. Using the triangulation of multiple sources of data, we have presented both conforming and contradictory findings. Data were analysed using Stata/IC 15.0 (StataCorp).

2.4 | Ethical considerations

The study protocol and the tools were reviewed and approved by the Institutional Review Board of the Harvard T. H. Chan School of Public Health in June 2019 (Approval no. IRB19-0822), the Ethics Committee of the Medical Faculty of the University Heidelberg in Germany in August 2019 (Approval no. S-505/2019) and of the country-specific Ethics and Institutional Review Boards. Local education authorities and schools were approached and requested their participation. For school administrators and food vendors, written informed consent was obtained. For the participating adolescents, written informed consent was obtained from a parent or guardian, and verbal assent was provided by all adolescents. The study was conducted in accordance with the guidelines of the most recent version of the ethical principles of the Declaration of Helsinki, which applies to national and international regulatory requirements. Adolescent participants who were found to have nutrition and health abnormalities were referred for care as per the standard of care in their respective countries.

3 | RESULTS

We selected a total of 79 schools for this survey including 22 in Burkina Faso, 20 in Ethiopia, 5 in South Africa, 11 in Sudan, and 21 in Tanzania. In total, 4999 adolescents from 79 schools participated in survey interviews in five countries of which 54% were girls. The mean age of the participants was 12.2 (±1.2) years. The adolescents were nearly equally distributed ranging from 21% to 25% across the participating countries except for South Africa which had fewer students (7.5%) due to COVID-19 school closure. Table 1 shows the country-wise adolescent survey samples and demographic characteristics of participants enroled in each country. In addition, our study included 79 school administrators, and 765 food vendors located within or immediately surrounding the school property.

3.1 | Availability of health-related policies, guidelines, and school curricula

Table 2 shows the number of available policies and guidelines at the country level. Nine out of 79 schools had a health-related policy or guideline. Of the 79 school administrators interviewed, 24 (30.4%) were aware of the existence of country-level recommended packages of school-based health and nutrition services. Of these 24 schools, 91.7% schools had a guideline for physical activities for students, 66.7% had a guideline on school feeding, 50% had a guideline on WASH practices, 45.8% had a guideline or regulation on food vendors (45.8%), and 37.5% had a guideline on school garden (Table 2). Most SHN packages did not include micronutrient supplementation, guidance on healthy diets, health/nutrition curricula, counselling, or referral services for nutrition.

Table 3 summarizes findings on the existence of a health and nutrition curriculum as reported by the school administrators. Only 10.4% of school administrators were aware of the existence of such curricula for their schools. Where existent, commonly included topics of school health and nutritional curricula were healthy eating practices, physical activity, and reproductive and sexual health. The least covered topics included unhealthy foods and beverages, hygiene (including oral), emotional and mental health, and violence prevention.

3.2 | Provision of health, nutrition, and WASH services by the schools

Twenty-nine out of 79 schools (36.7%) that participated in this survey had a teacher designated to provide health and/or nutrition-related services to students. Most schools do not have a clinic within the school premises. Table 4 shows various school services provided within the last 2 years as well as the frequency with which these services were provided. While the frequency of SHN services provided varies widely within and between countries, several SHN services are currently lacking, including vision, hearing, dental/oral health, and other screening services and growth and nutritional status monitoring. Only 7 out of 79 schools (8.8%) had a school clinic. Only 47 out of 79 schools had piped water while 61 schools (77.2%) had toilet facilities and 62 schools had handwashing stations for students. Only 21 schools (26.5%) had a changing room facility for girls.

Additionally, the school administrators answered questions on sports and physical activities in the school. Out of 79 schools, 65

TABLE 1 Distributions of demographic characteristics in Ethiopia, Tanzania, Sudan, South Africa, and Burkina Faso (*N* = 4999).

Variable	Burkina Faso (*N* = 1059)	Ethiopia (*N* = 1200)	South Africa (*N* = 376)	Sudan (*N* = 1107)	Tanzania (*N* = 1257)
Sex of student (%)					
Male	456 (43.1)	543 (45.2)	163 (43.8)	548 (49.8)	601 (47.8)
Female	603 (56.9)	657 (54.8)	209 (56.2)	553 (50.2)	656 (52.2)
Age (years; %)					
10–11	68 (6.4)	211 (20.8)	195 (52.4)	382 (33.7)	387 (45.1)
12–13	420 (39.7)	535 (52.6)	154 (41.4)	534 (47.5)	408 (47.6)
14–15	571 (53.9)	270 (26.6)	23 (6.2)	185 (16.8)	62 (7.2)
Mother and Father alive 9%)					
Both alive	1000 (94.4)	1027 (85.6)	308 (83.0)	1048(95.2)	1119 (89.0)
Only mother alive	43 (4.1)	127 (10.6)	43 (11.6)	40(3.6)	97 (7.7)
Only father alive	12 (1.1)	35 (2.9)	16 (4.3)	13(1.2)	31 (2.5)
Both not alive	4 (0.4)	8 (0.7)	3 (0.8)	–	10 (0.8)
Don't know	0 (0.0)	2 (0.2)	1 (0.3)	–	–
Living with (%)					
Mother	826 (78.0)	964 (80.3)	291 (77.4)	1074 (97.6)	968 (77.0)
Father	817 (77.2)	748 (62.3)	160 (42.6)	1032 (93.7)	786 (62.5)
With male guardian	48 (4.5)	39 (3.3)	43 (11.4)	8 (0.7)	93 (7.4)
With female guardian	114 (10.8)	144 (12.0)	107 (28.5)	11 (1.0)	143 (11.4)
Siblings	195 (18.4)	418 (34.8)	226 (60.1)	752 (68.3)	848 (67.5)
By myself	–	1 (0.1)	–	–	–
Education level of father/male guardian (%)					
No schooling	178 (27.4)	62 (7.9)	3 (1.5)	11 (1.1)	19 (2.2)
Primary	140 (21.5)	264 (33.7)	13 (6.6)	16 (1.5)	283 (32.2)
Secondary	183 (28.2)	237 (30.3)	85 (43.2)	159 (15.3)	114 (13.0)
Technical/Vocational	7 (1.1)	13 (1.7)	7 (3.6)	13 (1.3)	11 (1.4)
University/College	142 (21.9)	86 (11.0)	30 (15.2)	655 (63.2)	70 (8.0)
Don't know	–	121 (15.5)	59 (30.0)	183 (17.7)	381 (43.4)
Occupation of father/male guardian (%)					
Farmer	46 (7.9)	10 (1.3)	2 (0.5)	19 (1.7)	25 (2.0)
Merchant	236 (40.6)	252 (32.2)	3 (0.8)	284 (25.8)	414 (32.9)
Teacher	19 (3.3)	8 (1.0)	–	271 (24.6)	12 (1.0)
Government worker	141 (24.3)	220 (28.1)	15 (4.0)	321 (29.2)	90 (7.2)
Unemployed	19 (3.3)	46 (5.9)	23 (6.1)	20 (1.8)	35 (2.8)
Others	117 (20.1)	236 (30.1)	0 (0.0)	74 (6.7)	250 (19.9)
Education of mother/female guardian (%)					
No schooling	311 (40.3)	62 (7.9)	7 (2.0)	20 (1.9)	33 (3.0)
Primary	169 (2.9)	264 (33.7)	25 (7.2)	46 (4.3)	462 (41.7)
Secondary	212 (27.5)	237 (30.3)	169 (48.6)	306 (28.3)	159 (14.3)
Technical/Vocational	1 (0.1)	13 (1.7)	12 (3.5)	12 (1.1)	6 (0.5)

(Continues)

TABLE 1 (Continued)

Variable	Burkina Faso (*N* = 1059)	Ethiopia (*N* = 1200)	South Africa (*N* = 376)	Sudan (*N* = 1107)	Tanzania (*N* = 1257)
University/College	78 (10.1)	86 (11.)	44 (12.6)	500 (46.3)	67 (6.0)
Don't know	–	121 (15.5)	91 (26.2)	196 (18.2)	382 (34.5)
Occupation of mother/female guardian					
Farmer	3 (0.4)	4 (0.4)	5 (1.3)	4 (0.4)	22 (1.8)
Merchant	328 (40.8)	266 (24.2)	16 (4.3)	87 (7.9)	586 (44.2)
Teacher	18 (2.2)	14 (1.3)	6 (1.6)	288 (26.2)	16 (1.3)
Government worker	106 (13.2)	224 (20.4)	5 (1.3)	160 (14.5)	32 (2.6)
Unemployed	11 (1.4)	46 (4.2)	116 (30.9)	221 (20.1)	21 (1.7)
Homemaker	337 (41.9)	391 (35.6)	24 (6.4)	305 (27.7)	369 (29.4)
Others	123 (13.4)	143 (13.0)	150(39.9)	10 (0.9)	81 (6.4)
Time taken to get to school					
Less than 15 min	363 (34.3)	658 (54.8)	146 (39.5)	1058 (96.1)	290 (23.1)
15–30 min	470 (44.4)	416 (34.7)	139 (37.6)	39 (3.5)	545 (43.4)
30–45 min	138 (13.0)	78 (6.5)	33 (8.9)	4 (0.4)	210 (16.7)
45–60 min	36 (3.4)	32 (2.7)	21 (5.7)	–	165 (13.1)
More than 60 min	6 (0.6)	8 (0.7)	14 (3.8)	–	42 (3.3)
Don't know	46 (4.3)	8 (0.7)	17 (4.6)	–	5 (0.4)
Travelling to and from school					
Walk	433 (40.9)	1108 (92.3)	291 (78.7)	1037 (94.2)	964 (76.7)
Ride a bike	498 (47.0)	1 (0.1)	–	3 (0.3)	1 (0.1)
Ride a bus	1 (0.1)	9 (0.8)	3 (0.8)	38 (3.5)	231 (18.4)
Catch a ride with someone	87 (8.2)	2 (0.2)	35 (9.5)	2 (0.2)	8 (0.6)
Take a taxi	–	78 (6.5)	17 (4.6)	3 (0.3)	2 (0.2)
School bus	–	–	23 (6.2)	15 (1.4)	12 (1.0)
Other	40 (3.8)	2 (0.2)	1 (0.3)	2 (0.2)	39 (3.1)

(82.3%) provided at least one form of physical activity, and 59 (74.7%) provided access to a playground or track-and-field activities. Most schools offered sports once to twice per week. As shown in Table 5, the most common sports offered were soccer (55 schools, 69.6%) running (41 schools, 51.8%), and rope skipping (19 schools, 24%). The least commonly offered sport was tennis (3 schools, 3.7%).

3.3 | Food items available with food vendors in and around schools

Table 6 provides an overview of food items offered by vendors in and around schools in the studied countries. Peanuts, chips, and biscuits were the most popular snacks sold by food vendors across all countries (69.3%), with 98.6% of food vendors in Sudan and 78% in Burkina Faso offering these items in and around schools. Processed food items such as meat, fish, soy and avocado sandwiches, sausages and beverages like water, and sweeten-sugary beverages were the second most frequently available food items with food vendors. A few vendors sold deep-fried foods, fresh fruits, and animal products in Burkina Faso, South Africa, and Tanzania.

3.4 | School food environment and eating habits

Only 39 out of 79 schools (49.3%) had a kitchen for cooking food, 27 had cafeteria or canteen services (34.1%), and 18 had a school garden (22.7%) (Table 4). Most of the students received their meals at home

TABLE 2 Availability of health-related policies or guidelines at school-level as reported by the school administrators (%).

Health-related policies or guidelines	Burkina Faso (*N* = 22)	Ethiopia (*N* = 20)	South Africa (*N* = 5)	Sudan (*N* = 11)	Tanzania (*N* = 21)	Total (*N* = 79)
Health-related policies or guidelines	7 (32.0)	0 (0.0)	1 (20.0)	0 (0.0)	1 (4.8)	9 (11.4)
A recommended package of school-based health and nutrition services	6 (27.3)	10 (50.0)	1 (20.0)	6 (0.0)	1 (4.8)	24 (30.4)
Topics covered by the package						
Food vendor guidelines/regulations	6 (100.0)	2 (20.0)	1 (100.0)	1 (17.7)	1 (100.0)	11 (45.8)
Physical activities	5 (83.0)	9 (90.0)	1 (100.0)	6 (100)	1 (100.0)	22 (91.7)
Deworming	3 (50.0)	0 (0.0)	1 (100.0)	0 (0.0)	1 (100.0)	5 (20.8)
Use of the first-aid kit	3 (50.0)	6 (60.0)	NA	1 (17.7)	1 (100.0)	11 (45.8)
School feeding programme	2 (33.0)	9 (90.0)	1 (100.0)	3 (50.0)	1 (100.0)	16 (66.7)
School garden	1 (17.0)	4 (40.0)	1 (100.0)	2 (33.3)	1 (100.0)	9 (37.5)
WASH infrastructure/practices	1 (17.0)	10 (100.0)	NA	0 (0.0)	1 (100.0)	12 (50.0)
Dietary guidelines	0 (0.0)	4 (40.0)	1 (100.0)	1 (17.7)	0 (0.0)	6 (25.0)
Mandated health/nutrition curriculum	0 (0.0)	5 (50.0)	1 (100.0)	0 (0.0)	0 (0.0)	6 (25.0)
Counselling/referral of staff or students on health problems/behaviours, incl. mental health	0 (0.0)	9 (90.0)	1 (100.0)	0 (0.0)	1 (100.0)	11 (45.8)
Screening services: vision, hearing, height and weight measurement	0 (0.0)	3 (30.0)	NA	0 (0.0)	0 (0.0)	3 (12.5)
Medical check-up	NA	5 (50.0)	1 (100.0)	2 (33.3)	1 (100.0)	9 (37.5)
Micronutrient supplementation, e.g., iron folate girls only/all (girls and boys)	0 (0.0)	1 (10.0)	0 (0.0)	0 (0.0)	0 (0.0)	1 (4.16)

Abbreviation: NA, not applicable, question not asked.

TABLE 3 Availability of school health and nutrition curriculum as reported by the school administrators (%).

School health and nutrition curriculum	Burkina Faso (*N* = 22)	Ethiopia (*N* = 20)	South Africa (*N* = 5)	Sudan (*N* = 11)	Tanzania (*N* = 21)	Total (*N* = 79)
Number of schools with a specific school health and nutrition curriculum available	3 (16)	2 (0.0)	4 (0.0)	0 (0.0)	21 (100.0)	30 (10.4)
Topics covered by the curriculum						
Healthy eating practices	3 (100)	0 (0.0)	0 (0.0)	NA	5 (100.0)	8 (26.7)
Physical activity	2 (67)	0 (0.0)	0 (0.0)	NA	5 (100.0)	7 (23.3)
Reproductive health/sexuality education	2 (67)	0 (0.0)	0 (0.0)	NA	5 (100.0)	7 (23.3)
Unhealthy foods and beverages	1 (33)	0 (0.0)	0 (0.0)	NA	5 (100.0)	6 (20.0)
Hygiene (including oral)	1 (33)	0 (0.0)	0 (0.0)	NA	5 (100.0)	6 (20.0)
Health care-seeking/disease prevention	1 (33)	0 (0.0)	0 (0.0)	NA	5 (100.0)	6 (20.0)
General life skills	1 (33)	0 (0.0)	0 (0.0)	NA	5 (100.0)	6 (20.0)
Emotional and mental health	0 (0.0)	0 (0.0)	0 (0.0)	NA	4 (80.0)	4 (13.3)
Violence prevention	0 (0.0)	0 (0.0)	0 (0.0)	NA	5 (100.0)	5 (16.7)
Nutrition curriculum	2 (10.5)	2 (10.0)	4 (80.0)	NA	21 (100)	29 (96.7)

Abbreviation: NA, not applicable, question not asked.

TABLE 4 Available school facilities as reported by the school administrators (%).

School facility	Burkina Faso (*N* = 22)	Ethiopia (*N* = 20)	South Africa (*N* = 5)	Sudan (*N* = 11)	Tanzania (*N* = 21)	Total (*N* = 79)
Toilets	17 (77.3)	11 (55.0)	3 (60.0)	11 (100.0)	19 (90.5)	61 (77.2)
Handwashing stations	13 (59.1)	19 (95.0)	2 (40.0)	11 (100.0)	17 (80.1)	62 (78.4)
Toilets by gender	12 (54.5)	19 (95.0)	3 (60.0)	2 (18.2)	21 (100.0)	57 (72.1)
Playground/track fields	8 (36.4)	18 (90.0)	2 (66.7)	3 (27.3)	20 (95.2)	51 (64.6)
Kitchen	6 (27.3)	20 (100)	3 (60.0)	5 (45.5)	5 (23.8)	39 (49.33)
Food storage facility	6 (27.3)	2 (18.2)	1 (33.3)	2 (18.2)	3 (14.3)	14 (17.7)
School clinic	3 (13.7)	4 (20.0)	0 (0.0)	0 (0.0)	0 (0.0)	7 (8.8)
Cafeteria or canteen	3 (13.7)	15 (75.0)	0 (0.0)	4 (36.4)	5 (23.8)	27 (34.1)
School garden	2 (9.1)	5 (25.0)	1 (33.3)	1 (9.1)	9 (42.9)	18 (22.7)
Changing rooms for girls	1 (4.5)	11 (55.0)	0 (0.0)	0 (0.0)	9 (42.9)	21 (26.5)
Piped water	13 (59.1)	16 (100.0)	NA	10 (90.9)	8 (38.1)	47 (59.4)

Abbreviation: NA, not applicable, question not asked

TABLE 5 Sports services offered at school as reported by the school administrators (%).

Sports at school	Burkina Faso (*N* = 22)	Ethiopia (*N* = 20)	South Africa (*N* = 5)	Sudan (*N* = 11)	Tanzania (*N* = 21)	Total (*N* = 79)
Running (marathon, sprinting)	17 (77.2)	10 (52.6)	3 (60.0)	0 (0.0)	11 (52.4)	41 (51.8)
Soccer	13 (59.0)	18 (94.7)	3 (60.0)	3 (27.3)	18 (85.7)	55 (69.6)
Rope skipping	9 (40.9)	8 (42.1)	0 (0.0)	0 (0.0)	2 (9.5)	19 (24.0)
Basketball	4 (18.1)	4 (21.1)	0 (0.0)	1 (9.1)	3 (14.3)	12 (15.2)
Volleyball	4 (18.1)	5 (26.3)	1 (20.0)	3 (27.3)	2 (9.5)	15 (18.9)
Netball	1 (4.5)	12 (63.2)	3 (60.0)	0 (0.0)	1 (4.5)	17 (21.5)
Tennis	0 (0.0)	3 (15.8)	0 (0.0)	0 (0.0)	0 (0.0)	3 (3.7)
Other sports	10 (45.4)	0 (0.0)	3 (60.0)	0 (0.0)	10 (47.6)	23 (29.1)
Inclusion of physical activities in the local/ regional authority health policy	17 (77.2)	3 (15.0)	NA	0 (0.0)	0 (0.0)	19 (24.0)

Abbreviation: NA, not applicable, question not asked.

including 55% of students having breakfast at home, 70% having lunch at home, and 98% having dinner at home. Thirty-six per cent of the students reported that they did not have breakfast in the morning. When asked about their eating behaviours on the day of the interview, 79% of the students consumed snacks, of which 44% consumed the snacks at home, 28% self-prepared and 21% bought them from the school canteen. Among students, the majority consumed grains foods. About 14.1% participants consumed whole grains, 14% refined grains and baked goods, 9.8% liquid oils, 8.87% other vegetables (8.7%), 7.3% juices (7.3%), and 5.8% sweets and ice cream while a small percentage consumed eggs (1.7%) and fish (1.8%) (Figure 1). Adolescents in the study had a mean diet quality score of 20.6 (±4.0) out of a maximum score of 40. The diet quality score was highest in Sudan (23.8 ± 3.2), lowest in Burkina Faso (19.3 ± 3.6) and Tanzania (19.3 ± 4.2). Overall, 7.3% of adolescents had a high risk of poor diet quality (diet quality score>15), while 26.8% had a low risk of poor diet quality (diet quality score <23). Tanzania had the highest risk of poor diet quality (15.0%) and Sudan had the lowest (0.5%). Detailed analyses on dietary intake and quality from this multicountry survey have been published elsewhere (Madzorera et al., 2023).

Figure 2 shows the proportion of meals prepared by source. Parents prepared the meals for their children, with 87% preparing dinner, 75% preparing lunch, and 57% preparing breakfast. About 21% of the food prepared in the school canteen is snacks.

4 | DISCUSSION

Health-related policies or guidelines were lacking in most schools. Only a few school administrators interviewed were aware of a school-based health and nutrition policy, guidelines, or curriculum. The provision of health, nutrition, and WASH services was

TABLE 6 Food items sold on the day of the survey as reported by food vendors located in and around schools (%).

Food type	Food items	Burkina Faso (N = 18)	Ethiopia (N = 343)	South Africa (N = 23)	Sudan (N = 72)	Tanzania (N = 309)	Total (N = 765)
Snacks	Peanuts, sweet sesame, dried bananas or fruits, milk bonbons, chips, croquette, monkey bread, cakes, popcorn, biscuits, and local groundnut cluster	14 (78.0)	231 (67.4)	7 (30.0)	71 (98.6)	207 (67.0)	530 (69.3)
Processed foods	Meat, fish, soy and avocado sandwiches, sausages, and candy chocolate	13 (72.0)	169 (49.3)	3 (13.0)	0 (0.0)	200 (64.7)	385 (50.3)
Beverages	Water, sweet beverages, fruit juices, local juices, and mixed fruit juices	10 (56.0)	245 (71.4)	4 (17.4)	0 (0.0)	122 (39.5)	381 (49.8)
Deep fried foods	Fried fish and bananas, donuts, wheat, dough deep fried	4 (22.0)	78 (22.7)	2 (8.7)	0 (0.0)	76 (24.6)	160 (20.9)
Fresh fruits	Mangos, bananas, oranges, and cucumbers	3 (17.0)	36 (10.5)	3 (13.0)	0 (0.0)	25 (8.1)	67 (8.8)
Animal products	Milk, yogurt, eggs	1 (6.0)	111 (32.4)	4 (17.4)	0 (0.0)	19 (6.2)	135 (17.6)

inadequate. SHN curricula were implemented in some schools, but school health nutrition services, such as school feeding, water and sanitation services, medical checks and disease prevention screenings, and micronutrient supplements, were insufficient. School food environments, which include food sold by vendors, were not regulated. School canteens were few, so most students got their meals prepared at home by parents or housemaids. While a small percentage of students consumed breakfast regularly, the majority bought lunch from a food vendor located within or near the school premises. The majority of food vendors sold snacks and processed foods, with only a few offering fresh fruit.

A recent systematic review of SHN policies and interventions from 44 global and regional data sets supports our findings (UNESCO, 2022). The review found that one in three schools in the world does not have safe drinking water, one in three does not have adequate sanitation, and almost half have no handwashing facilities with water and soap. Although many countries have made efforts to integrate SHN services, relatively few have adopted comprehensive approaches to deliver school feeding with other interventions. To our best knowledge, this is one of the first multicountry studies in the region to evaluate the SHN environment, inspired by the NFSI framework. In the following sections, we discuss the implications of our findings and provide specific recommendations to improve the SHN environment in SSA.

4.1 | Translation of SHN policies and guidelines

According to the WHO's Global Accelerated Action for the Health of Adolescents (AA-HA!) guideline, 'each school should be a health-promoting school'. (WHO, 2017, 2021b). Consequently, the WHO school policy framework, global standards and indicators for health-promoting schools and systems, evidence mobilization on the NFSI, and the WHO guidelines on school health services have been implemented to promote SHN (Sawyer et al., 2021; WHO, 2008, 2021b). However, the translation of global policies, standards, and frameworks has been slow, and country-level implementation has been limited (Sawyer et al., 2021). Our study confirms this with only a very small percentage of administrators aware of national or subnational policies on health and nutrition in schools. Furthermore, only a few schools across countries implemented health and nutrition services, with wide variations and inadequacies. The WHO also encourages governments to promote nutrition standards among food vendors within and around schools. Yet, school administrators were not aware of food vendor guidelines (WHO, 2008). Various studies have shown that a comprehensive school nutrition policy can change the school food environment and improve dietary habits and nutritional status (WHO, 2020). Standards for foods and beverages sold outside of school meal programmes (referred to as competitive foods and beverages) can reduce the total consumption of sugary beverages (0.18 servings/day) and unhealthy snacks (0.17 servings/day). In response to school meal standards (primarily lunch), fruit consumption increased (0.76 servings/day) and

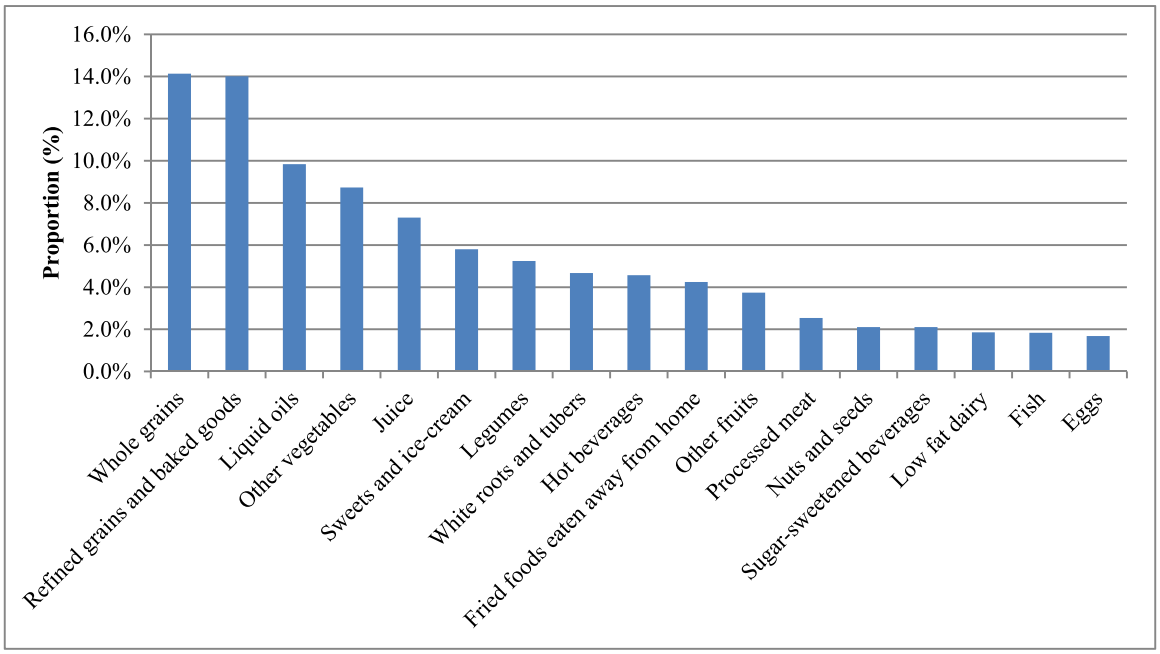

FIGURE 1 Foods reported to be consumed by students over the previous 24 h ($N = 4999$).

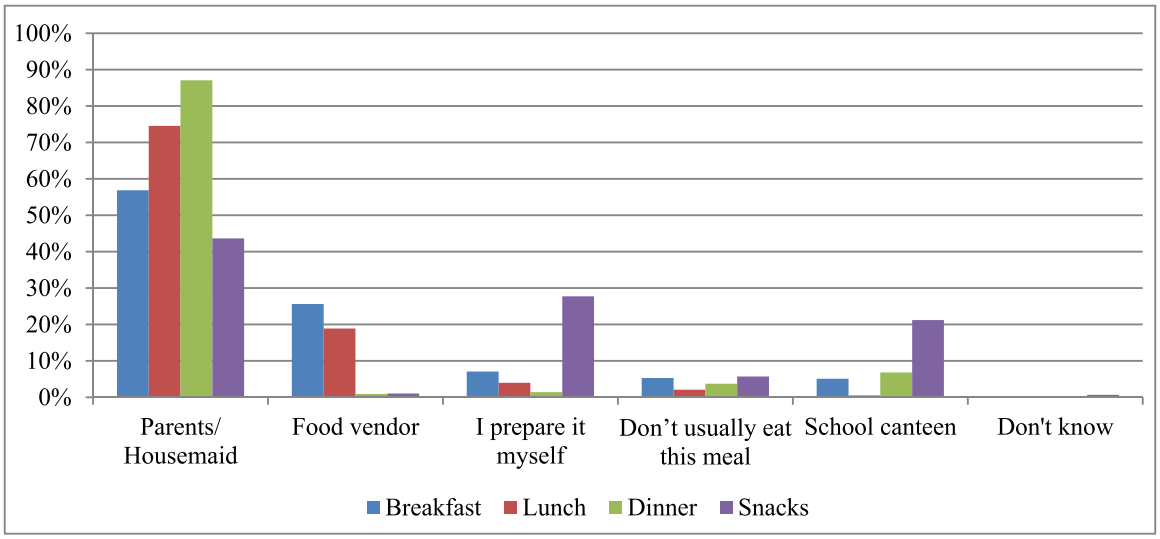

FIGURE 2 Student reports on the proportion of meals prepared by different sources ($N = 4999$).

sodium and fat intake decreased (Micha et al., 2018). Without translating and promoting global policies and frameworks to the local contexts of SSA, implementation of school health nutrition environment interventions remains challenging.

4.2 | School health, nutrition, and WASH services

Our study found that school-based health services were inadequate and inconsistent. Particularly, no micronutrient supplements or screenings for vision, hearing, or oral health were provided. Weekly iron-folic acid supplementation can reduce anaemia in adolescent girls by 27%, improve their learning capacity, school attendance and performance, and improve their economic prospects (WHO, 2018a).

Similarly, we found that school-based WASH services are insufficient and inadequate across countries. Handwashing with soap and water can reduce diarrhoea cases among school children by one-third (Ejemot-Nwadiaro et al., 2015). According to WHO guidelines on school water and sanitation, toilet facilities should be private, secure, easy to access, clean, and culturally appropriate (WHO, 2021a). This guideline suggests separate toilets for males and females (WHO, 2009).

This study shows that children in public schools are engaged in physical education and activities. However, only two-thirds of

schools had a playground or track field. Children and adolescents should engage in at least 60 min of physical activity daily for optimum health benefits (WHO, 2018b) as low physical activity in early adolescence carries major health implications into adulthood (Cowley et al., 2021). Sports facilities and lessons can promote physical activity among students (de Rezende et al., 2015).

Health and education investments in adolescents can generate returns on investments ranging from 6 to 12 times (Sheehan et al., 2017). In the studied countries, however, health and health promotion have been poorly integrated and institutionalized into the public education systems. Health and nutrition curricula were not available in most schools in our study, and only a few schools had health and nutrition teachers. These findings are supported by existing literature and data. An analysis of 11 countries reveals that their primary school feeding policies are not standardized (Smith et al., 2022). Furthermore, nutrition education curriculum focuses primarily on cooking and health instead of social-cultural issues, equity, and sustainability. SSA countries also face a shortage of qualified teachers, with 70% of countries facing shortages in the primary and 90% at the secondary levels (UNESCO, 2016).

With the goal of strengthening the capacity of the education sector to integrate health and well-being considerations and promote health through a whole-school approach, WHO, UNESCO, and other United Nations partners launched the 'Making Every School a Health Promoting School' initiative (WHO, 2021b). While many countries have adopted these standards and are providing SHN services, they are often not evidence-based, poorly implemented, underfunded, or have a limited reach and scope. With the growing school enrolment in SSA (UNESCO, 2021), schools are in an ideal position to provide nutrition and health programmes that are intensive, long-term, and large-scale. Using inextricable linkages between health, education and other ministries is essential to adapt evidence-based guidelines and practices at the national and subnational levels.

4.3 | State of the school food environment

School feeding programmes were not offered in schools across countries, making it difficult for students to access nutritious foods. Furthermore, most schools lacked a kitchen or canteen. This explains why so many students reported receiving meals from home. With many not eating breakfast, home meals are likely to be inadequate and lacking in nutrients. Our study also found that food vendors mostly sold unhealthy snacks and processed foods rather than fruits. Several studies have shown that school feeding programmes can reduce hunger, micronutrient deficiency, anaemia, and obesity, and improve school attendance and academic performance (Wang et al., 2021). A systematic review of the contribution of the home and school environment on children's weight and food choices in Africa shows that the availability of healthy foods at home and in schools positively impacts the children's food choices (Pacific et al., 2020) while school food vendors may also reduce the odds of obesity and unhealthy eating habits among schoolchildren.

The WHO School Policy Framework requires school feeding services to adhere to nutrition standards determined by national or regional dietary guidelines (WHO, 2008). A reference value of 30% of the recommended nutrient intake for age should be used in countries where school meals are provided. Schools should be required to create healthy food environments by setting standards for foods provided or sold in schools to prevent all forms of malnutrition (UNICEF, 2020).

Students can learn about healthy eating and vegetable production by participating in school gardens. Increasing fruit and vegetable consumption is associated with improved academic performance, lower micronutrient deficiencies, and lower risk of noncommunicable diseases (Afshin et al., 2019; Berezowitz et al., 2015). Despite this, most participating schools did not have school gardens. Many factors can be attributed to the lack of school gardens, including land and water availability, seasonality, time commitment, and a low yield. School gardens in developed countries have been shown to contribute to healthier food choices when integrated with strong links to the community or home gardens (Hunter et al., 2020; Turner et al., 2020). Providing school feeding and nutrition education programmes, regulating food vendors, and integrating gardens into school and community environments will strengthen the school food environments.

4.4 | Study strengths and limitations

Many global reports and reviews available that provide quantitative insights that, when translated into local programming and context, require a deeper understanding of the underlying factors. To our knowledge, this is the first study to evaluate SHN environments among young adolescents in SSA, which attempts to fill in the gap in existing evidence through quantitative data from multiple sources. Among the main key stakeholders surveyed are school administrators, food vendors, and in-school adolescents. Food environments across diverse settings are not assessed and benchmarked with standardized instruments, indicators, and metrics. With the development of appropriate and high-quality measurement methods that can be applied broadly across a variety of country contexts (Turner et al., 2020), this study contributes to addressing the current need. Our work, however, has several limitations. Our study included predominantly urban and public schools, which limited the generalizability of the findings. A relatively small sample size is another limitation of this study, resulting in a high level of heterogeneity that prevents cross-national comparisons. Moreover, only one school administrator per school was interviewed, and not all food vendors in and around the school premises were interviewed, which could potentially bias the results. We cannot, therefore, exclude potential information bias due to the high level of categorization; for example, school-based health and nutrition services in the reviews may include a wide range of strategies. This high-level categorization may, therefore, not provide enough details to assess what measures and interventions are needed to improve SHN. Lastly, this cross-sectional study did not allow for long-term assessments and observations of changes in diets, nutritional status, and health over time.

5 | CONCLUSIONS

This study may inform governments, policymakers, and researchers of the critical need to improve SHN environments in SSA. Schools have a key role to play in improving the health and nutrition of adolescents, especially in addressing the persistent burden of undernutrition, the increasing burden of overweight and obesity, and improving academic achievement. Several key gaps are identified in this study when translating and implementing existing global frameworks for nutrition-friendly schools, such as insufficient policy and programming environments in SSA focusing on SHN, heterogeneity in SHN activities, weak sectoral linkages despite evidence that health and education can collaborate to improve SHN, and missed opportunities to engage school food vendors, from policy to SHN programming. In addition, investments promoting physical activities and especially sports may provide a powerful platform to improve nutrition health, learning and protection for school age children and adolescents in SSA. It is therefore important for countries to make use of this evidence base and to translate existing SHN frameworks, such as the SHN environment, to national policies and programmes. By doing so, schools can maximize their potential as a platform for enhancing adolescent nutrition and health, and thereby contribute to a longer life of health, well-being, and productivity for them.

AUTHOR CONTRIBUTIONS

Ramadhani A. Noor, Till Bärnighausen, Deepika Sharma, and Wafaie W. Fawzi designed research. Amare W. Tadesse, Amani Tinkasimile, Huda Sherfi, Roisin Drysdale, Mary Mwanyika-Sando, Till Bärnighausen, Deepika Sharma, and Wafaie W. Fawzi conducted research. Ramadhani A. Noor and Heavenlight A. Paulo analysed data. Ramadhani A. Noor wrote the first draft of the paper. Ramadhani A. Noor, Sachin Shinde and Wafaie W. Fawzi had primary responsibility for the final content. All authors have read and approved the final manuscript.

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CONFLICT OF INTEREST STATEMENT

The authors declare no conflict of interest.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

ETHICS STATEMENT

This study was approved by the Institutional Review Boards at Harvard T. H. Chan School of Public Health, the Ethics Committee of the Medical Faculty of Heidelberg University, and ethical review boards in each site, including the Centre de Recherche en Santé de Nouna in Burkina Faso, the Institutional Ethical Review Board of Addis Continental Institute of Public Health in Ethiopia, the University of KwaZulu-Natal Biomedical Research Ethics Committee in South Africa, the Institutional Review Board of Ahfad University for Women in Sudan, and the National Institute for Medical Research in Tanzania.

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