Food Insecurity among Adolescent Students from 95 Countries Is Associated with Diet, Behavior, and Health, and Associations Differ by Student Age and Sex

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ABSTRACT

Background: Adolescents' developmental tasks and challenges vary based on age, sex, and social context. Food insecurity affects adolescents, but existing research has been limited to a few country contexts and has treated adolescence as a singular developmental moment with limited consideration of potential differences in how food insecurity relates to developmental experiences based on adolescent age and sex.

Objectives: We aimed to describe relations between student-reported food insecurity and students' profiles of nutritional, physical activity, school absenteeism, health/mental health, and victimization experiences, and how these differ by student age and sex.

Methods: Using cross-sectional data from the Global School-based Student Health Survey, we examined adolescent reports of their food security among 337,738 students 11–18 y old from 95 countries. We identified their profiles of focal experiences, and used mixed-effects linear and logistic regression models to examine differences in these profiles by student food insecurity and how these differ by student age and sex.

Results: Of students, 25.5% aged 11–14 y compared with 30% aged 15–18 y reported food insecurity in the past 30 d. Food insecurity was associated with less frequent fruit and vegetable intake; more frequent soft drink intake; worse mental health; less physical activity; more missed school; higher odds of smoking, drinking, and using drugs; and more bullying victimization and sexual partners. Food insecurity was associated with reduced age- and sex-specific protection: greater substance use among younger adolescents, more sexual partners among older females, and greater worry among younger males. Food insecurity was also associated with increased age-specific risk: greater soft drink consumption among younger adolescents.

Conclusions: Across countries, adolescent food insecurity was associated with poorer nutritional, mental health, behavioral, and relationship profiles; these associations differed with student age and sex. Food insecurity interventions should attend to adolescent developmental stage and the gendered contexts through which adolescents navigate daily life. *Curr Dev Nutr* 2022;6:nzac024.

Introduction

Adolescence—the ages of 10–19 y—is a sensitive period of human development with complex and rapid changes in physical, neurodevelopmental, psychological, and social formation (1, 2). Food insecurity is associated with poor adolescent development. Adolescents experiencing food shortage are likely to have low diet quality; poor health; and problems with development, behaviors, educational attainment, school absenteeism, and bullying (3–9). They often experience worry and shame (10–12) and mental health problems because of the stress associated with food shortage in their families (13–15). They are more vulnerable to unwanted sexual contact and sexual exploitation (16), early entry to the labor market, criminal justice system involvement, and constrained choices such as failing classes or going to jail as a survival strategy to cope with hunger (11).

Developmental tasks and challenges shift substantially across this developmental stage, as adolescents become increasingly independent in navigating daily life, rely more on peer rather than parental support and guidance, develop physically and sexually, and begin to clarify their pathways toward adult roles and identities (17). Older adolescents and younger adolescents therefore may have distinct lived experiences, including those relating to food insecurity. Adolescence is also a time when sex and gender differences become increasingly salient, both to physical development and at the intersection of identity, culture, and

social norms that differentially shape opportunities and expectations; food insecurity experiences may differ with sex and gender as well (18–20). Most existing research on adolescence and food insecurity, however, treats adolescence as a singular experience, lumping together children across the age and developmental span and across sex differences. Improving our understanding of the food insecurity experiences of adolescents requires nuanced attention to how food insecurity shapes outcomes for adolescents of different ages and sexes.

Improving our understanding is particularly important now because COVID-19 has exacerbated food insecurity globally (21–23), interrupting many programs that promote well-being among adolescents (e.g., schools and school meals programs) (24–26). The COVID-19 pandemic and other shocks such as civil strife and environmental disasters compound existing vulnerabilities, such that the greatest challenges accrue to adolescents who have access to the fewest resources to promote their healthy development within their households, communities, and countries (27). Understanding the food insecurity experiences of adolescents globally and the possible consequences of those experiences is important, but studies on adolescent food insecurity outside the United States are few, raising uncertainty about the extent to which current thinking about food insecurity and adolescent development is specific to the social construction of adolescence in the United States.

Global data on adolescent food insecurity, particularly those reported by adolescents themselves, are scant (28), but the Global School-based Student Health Survey (GSHS) provides an important source of global information about adolescent food insecurity across the developmental range of adolescence. The GSHS focuses on health behaviors and protective and risk factors among adolescent students aged 11–18 y in >90 countries (29), making these data particularly useful for examining adolescent food insecurity at a global level. One item in the GSHS asks students directly about their food insecurity experience. We have therefore used the GSHS data to, first, describe the prevalence of food insecurity among and the dietary, behavioral, and health profiles of adolescent students; and, second, investigate how these profiles differed between food-secure and food-insecure students, overall and by age group and sex.

Methods

We used the GSHS public data collected from 2003 to 2016 from 95 countries and territories (hereafter referred to as countries), retrieved from the WHO's website as of January 2020 (29). The GSHS was conducted among adolescent students aged 11–18 y in participating countries using a standardized 2-stage sample selection process at school and classroom levels (30). The GSHS had core questionnaire modules, core-expanded questions, and country-specific questions. The core modules focused on 11 topics: alcohol use; drug use; mental health; protective factors; sexual behaviors, HIV, sexually transmitted diseases, and unintended pregnancy; dietary behaviors; hygiene; physical activity; tobacco use; violence; and unintentional injury. At least 6 out of the 10 core modules were required in each country survey. The questionnaire was self-administered during a regular class period. The GSHS data were collected from 2003 to 2016, 1 time or multiple times in a country.

The WHO provides technical support to countries during the planning and implementation of the GSHS. The data are owned by the official country agency that conducted or sponsored the survey. Students participate in the survey in their classroom, their participation is voluntary, and their identity is not reported on the questionnaire. The privacy of participating schools and students is protected, and no school or student identifiers are included in the public-use data set.

In our study, the most recent data from each country were used for the analysis. The country data were from the national survey or from subnational surveys that were combined with equal weighting. The grand sample ($n = 337,738$) included all observations without missing data for food insecurity, age group, and sex of the adolescent students. Those adolescent students were from 95 countries of 6 WHO regions (28.3% Americas, 23.7% Western Pacific, 19.6% Eastern Mediterranean, 14.1% Africa, 13.7% South-East Asia, and 0.61% Europe). Most adolescents who participated were from low- or middle-income countries (38.4% lower-middle, 31.1% upper-middle, 14.0% high-, 11.9% low-, and 4.59% unclassified-income countries).

Exposure variable

In the GSHS, food insecurity information was collected by asking the students: "During the past 30 days, how often did you go hungry because there was not enough food in your home?" The response options consisted of a 5-point Likert scale: never, rarely, sometimes, most of the time, and always (29). In our analysis, food insecurity was indicated if the response was "sometimes," "most of the time," or "always."

Stratification variables

Students' age and sex were used to stratify the analysis. In the GSHS, the students were aged from 11 to 18 y. Given the current limited understanding of the food insecurity experience of global adolescents, particularly those <15 y old, we dichotomized the response into younger (11–14 y) and older (15–18 y) adolescent age groups to enable investigation of food insecurity among younger adolescents in addition to the older ones. The student's self-reported sex was coded as 1 if the respondent identified being female, and 0 for male (these were the only response options provided in the survey).

Dependent variables

For food and drink intakes, the students provided information about the frequencies of eating fruits, eating vegetables, and drinking soft drinks over the past 30 d: 1 = I did not [eat vegetables/eat fruits/drink soft drinks] during the past 30 d, 2 = <1 time/d, 3 = 1 time/d, 4 = 2 times/d, 5 = 3 times/d, 6 = 4 times/d, and 7 = ≥5 times/d. We recoded the responses to reflect the daily frequencies of the intakes: 0, 0.5, 1, 2, 3, 4, and 5 times/d.

Physical activity was measured by student reports of the number of days in a week when the student was physically active for a total of ≥60 min/d.

School absenteeism was measured by student reports of the number of days of missed classes or school without permission during the past 30 d: 1 = 0 d, 2 = 1 or 2 d, 3 = 3–5 d, 4 = 6–9 d, and 5 = ≥10 d. We recoded these responses as 0, 1.5, 4, 7.5, and 10 d to reflect the number of absent days during the past 30 d.

For mental health, the students were asked, during the past 12 mo, the frequencies of having felt lonely, and of having been so worried that they could not sleep at night (never, rarely, sometimes, most of the time, and always). We recoded the 5-point Likert-scale responses

to contrast students experiencing more chronic loneliness and worrying (those who reported having the experience most of the time or always) with those reporting more occasional experiences (never, rarely, sometimes). We also included 1 item on suicidal ideation, in which students were asked whether they seriously considered attempting suicide (yes/no).

Health behaviors were assessed by asking if, during the past 30 d, the student had on any day smoked cigarettes or used any other form of tobacco (yes/no), or had ≥1 drink of alcohol (yes/no). Students were also asked if they ever used drugs (yes/no) and reported their total number of sexual partners (count of number of people with whom the adolescent student had sexual intercourse).

Bullying victimization was identified if the student reported having been bullied on any day during the past 30 d (yes/no).

Statistical analysis

We focused on first identifying dietary, physical activity, school absenteeism, mental health, health behavior, and bullying victimization profiles among sampled adolescents. We then investigated differences in these profiles by student food security status across student age groups and sexes.

Data analysis was conducted using Stata version 14.2 (StataCorp). We stratified all analyses into 4 age-sex groups: age 11–14 female, age 11–14 male, age 15–18 female, and age 15–18 male. Whereas the total sample included all observations without missing values for food insecurity, age group, and sex, the analytic sample sizes in addition excluded observations having missing values in the dependent variables (Table 1). To examine the dietary, behavioral, and health profiles of adolescent students, we obtained summary statistics and frequency tables for food and drink intakes, physical activity, school absenteeism, mental health, health behaviors, bullying victimization, and food insecurity by age-sex group. We used t test or χ^2 tests to compare difference by age group among all students and by sex among students in the same age group. To understand differences in those profiles by food insecurity across the age-sex groups, we used mixed-effects linear and logistic regression to model continuous and binary dependent variables, respectively, with food insecurity as a fixed effect and with countries, schools, and classrooms as random effects (i.e., random intercepts) to account for variability at these 3 levels.

Results

Food insecurity and adolescent profiles

About one-quarter of students aged 11–14 y compared with 30% of students aged 15–18 y reported that during the past 30 d they sometimes, most of the time, or always went hungry because there was not enough food in their home. A slightly higher percentage of males experienced food insecurity than females among the students aged 11–14 y (26.4% and 25.5%, respectively; $P < 0.0001$), whereas no difference was found among male and female students aged 15–18 y (30.2%).

Adolescent students' dietary, behavioral, and health profiles varied by age group and/or sex (Table 1). Students aged 11–14 y had higher frequencies of intakes of fruits, vegetables, and soft drinks than students aged 15–18 y ($P < 0.0001$), although the difference was small. Male students had more days when they were physically active for ≥60 min

than female students in both age groups ($P < 0.0001$). Students aged 15–18 y had more days missing school during the past 30 d than students aged 11–14 y ($P < 0.0001$), and the mean number of days missing school was slightly higher for males than for females within the same age group ($P < 0.0001$). More students in the 15–18 age group had chronic loneliness, chronic worrying, and suicidal ideation than students in the 11–14 age group ($P < 0.0001$), and the percentages of students having those mental health issues were higher for females than for males in both age groups ($P < 0.0001$). The percentages of students reporting smoking, drinking, and using drugs and the number of sexual partners were higher for students aged 15–18 y than for students aged 11–14 y ($P < 0.0001$) and higher among males than among females in both age groups ($P < 0.0001$). More students aged 11–14 y were bullied than students aged 15–18 y ($P < 0.0001$) and more males were bullied than females in both age groups ($P < 0.0001$).

Differences in adolescent profiles by food insecurity

Food insecurity was associated with less frequent intakes of fruits and vegetables and more frequent intakes of soft drink among students in all age-sex groups, except for the frequencies of vegetable intakes among female students aged 11–14 y (Table 2). The association of food insecurity with less frequent intake of fruits was stronger for female students (differences: −0.0795; 95% CI: −0.0997, −0.0594 times/d for 11–14 y and −0.0760; 95% CI: −0.0957, −0.0562 times/d for 15–18 y) than for male students (differences: −0.0480; 95% CI: −0.0699, −0.0260 times/d for 11–14 y and −0.0455; 95% CI: −0.0661, −0.0248 times/d for 15–18 y) in both age groups. Stronger association of food insecurity with less frequent intake of vegetables was found among male students than among female students. The association of food insecurity with more frequent intake of soft drinks was stronger for students aged 11–14 y (differences: 0.0615; 95% CI: 0.0393, 0.0837 times/d for females and 0.0765; 95% CI: 0.0526, 0.100 times/d for males) than for students aged 15–18 y (differences: 0.0213; 95% CI: 0.0000944, 0.0425 times/d for females and 0.0305; 95% CI: 0.0087, 0.0524 times/d for males).

Food insecurity was associated with fewer days having ≥60 min being physically active in a week and more days missing school in a month among all student groups. The association of food insecurity with fewer physically active days was stronger for male than for female students and strongest among male students in the older age group (difference: −0.208; 95% CI: −0.249, −0.167 d/wk). Stronger association of food insecurity with more days missing school was found among students who were male or older (differences: 0.250–0.286 d/mo) than among younger female students aged 11–14 y (difference: 0.236; 95% CI: 0.209, 0.264 d/mo).

Food insecurity was associated with higher odds of having chronic loneliness, chronic worrying, and suicidal ideation among all student groups. The OR of having chronic worry among food-insecure compared with food-secure students was higher among male students than among female students in both age groups (OR: 1.98; 95% CI: 1.86, 2.10 for males compared with 1.88; 95% CI: 1.79, 1.98 for females aged 11–14 y; OR: 1.88; 95% CI: 1.79, 1.99 for males compared with 1.76; 95% CI: 1.68, 1.85 for females aged 15–18 y). For suicidal ideation, the OR was slightly larger among older female students (OR: 1.60; 95% CI: 1.53, 1.67) than among younger female students (OR: 1.53; 95% CI: 1.46, 1.61) but slightly smaller among older male students (OR: 1.55; 95%

TABLE 1 Adolescents' characteristics by age group and gender[1]

Variable	Countries, n	Age 11–14 y				Age 15–18 y			
		Female		Male		Female		Male	
		Sample	Value	Sample	Value	Sample	Value	Sample	Value
Food insecurity	95	94,708	25.5	82,533	26.4	80,446	30.2	80,051	30.2
Food and drink intakes									
Fruits, times/d (range: 1–5)	95	94,065	1.57 ± 1.34	81,863	1.58 ± 1.38	79,976	1.39 ± 1.37	79,425	1.39 ± 1.32
Vegetables, times/d (range: 1–5)	95	93,940	1.73 ± 1.34	81,714	1.74 ± 1.37	79,880	1.65 ± 1.31	79,399	1.64 ± 1.33
Soft drinks, times/d (range: 1–5)	71	70,520	1.23 ± 1.34	61,263	1.25 ± 1.36	66,913	1.14 ± 1.31	64,960	1.18 ± 1.32
Physical activity									
Active ≥60 min/d, d/wk (range: 0–7)	90	90,340	2.22 ± 2.35	78,636	2.76 ± 2.59	75,385	2.20 ± 2.30	75,097	2.90 ± 2.56
School absenteeism									
Missing school, d/mo (range: 0–10)	85	81,615	0.690 ± 1.73	71,344	0.870 ± 1.94	71,544	0.920 ± 1.96	70,737	1.12 ± 2.18
Mental health									
Chronic loneliness, yes/no	87	84,880	12.5	74,377	8.50	73,786	15.3	73,283	11.1
Chronic worrying, yes/no	85	84,689	10.5	73,433	7.50	72,654	14.0	72,222	9.80
Suicidal ideation, yes/no	81	77,015	16.0	66,818	12.0	70,217	18.5	68,662	13.2
Health behaviors									
Smoking, yes/no	85	85,099	8.90	74,039	16.1	73,562	12.6	72,635	24.4
Drinking, yes/no	71	65,701	19.5	56,180	21.4	59,789	27.5	56,560	33.3
Drugs, yes/no	58	58,113	5.30	48,959	9.30	57,826	7.90	54,396	14.5
Sexual relationships, n people (range: 0–6)	63	55,824	0.170 ± 0.710	47,832	0.460 ± 1.21	55,212	0.440 ± 1.12	51,738	0.980 ± 1.76
Bullying victimization									
Bullied, yes/no	91	84,188	31.4	71,651	36.1	72,760	28.9	71,577	31.5

[1]Data were from the Global School-based Student Health Survey (2003–2016). Values are mean ± SDs or percentages.

TABLE 2 Coefficients or ORs for the association of food insecurity with adolescent profiles stratified by age group and gender[1]

| | Age 11–14 y | | Age 15–18 y | |
| | Female | Male | Female | Male |
Adolescent outcome	Coeff. or OR (95% CI)	Coeff. or OR (95% CI)	Coeff. or OR (95% CI)	Coeff. or OR (95% CI)
Food and drink intakes				
Fruits, times/d	−0.0795 (−0.0997, −0.0594)	−0.0480 (−0.0699, −0.0260)	−0.0760 (−0.0957, −0.0562)	−0.0455 (−0.0661, −0.0248)
Vegetables, times/d	−0.0134 (−0.0336, 0.00674)	−0.0325 (−0.0543, −0.0107)	−0.0230 (−0.0433, −0.00258)	−0.0392 (−0.0599, −0.0185)
Soft drinks, times/d	0.0615 (0.0393, 0.0837)	0.0765 (0.0526, 0.100)	0.0213 (0.0000944, 0.0425)	0.0305 (0.0087, 0.0524)
Physical activity				
Active ≥60 min/d, d/wk	−0.126 (−0.162, −0.0894)	−0.180 (−0.222, −0.139)	−0.0630 (−0.0999, −0.0262)	−0.208 (−0.249, −0.167)
School absenteeism				
Missing school, d	0.236 (0.209, 0.264)	0.260 (0.227, 0.293)	0.250 (0.218, 0.282)	0.286 (0.250, 0.322)
Mental health				
Chronic loneliness, yes/no	1.86 (1.77, 1.95)	1.89 (1.79, 2.00)	1.82 (1.74, 1.90)	1.83 (1.74, 1.93)
Chronic worrying, yes/no	1.88 (1.79, 1.98)	1.98 (1.86, 2.10)	1.76 (1.68, 1.85)	1.88 (1.79, 1.99)
Suicidal ideation, yes/no	1.53 (1.46, 1.61)	1.60 (1.51, 1.69)	1.60 (1.53, 1.67)	1.55 (1.48, 1.63)
Behavioral health				
Smoking, yes/no	1.47 (1.38, 1.56)	1.41 (1.35, 1.48)	1.41 (1.33, 1.49)	1.31 (1.26, 1.37)
Drinking, yes/no	1.36 (1.28, 1.43)	1.32 (1.25, 1.40)	1.15 (1.09, 1.21)	1.13 (1.08, 1.19)
Drugs, yes/no	1.61 (1.47, 1.76)	1.52 (1.41, 1.64)	1.42 (1.32, 1.54)	1.36 (1.28, 1.44)
Sexual relationships, people	0.0577 (0.0435, 0.0719)	0.0523 (0.0272, 0.0774)	0.0847 (0.0646, 0.105)	0.0262 (−0.00589, 0.0583)
Bullying victimization				
Bullied, yes/no	1.93 (1.86, 2.00)	1.81 (1.74, 1.88)	1.91 (1.83, 1.98)	1.82 (1.75, 1.89)

[1]Mixed-effects linear or logistic regression for adolescent outcomes with food insecurity as a fixed effect and country, school, and classroom as random effects (random intercept). Data were from the Global School-based Student Health Survey (2003–2016). Coeff., regression coefficient.

CI: 1.48, 1.63) than among younger male students (OR: 1.60; 95% CI: 1.51, 1.69).

Food insecurity was associated with higher odds of smoking, drinking, and using drugs among all student groups. The ORs of drinking and using drugs among food-insecure compared with food-secure students were greater for younger students aged 11–14 y (OR: 1.32–1.36 for drinking and 1.52–1.61 for using drugs) than for older students aged 15–18 y (OR: 1.13–1.15 for drinking and 1.36–1.42 for using drugs). The ORs of using drugs were also greater for female students than for male students within the same age groups (ages 11–14 y: OR: 1.61; 95% CI: 1.47, 1.76 for females compared with 1.52; 95% CI: 1.41, 1.64 for males; ages 15–18 y: OR: 1.42; 95% CI: 1.32, 1.54 for females compared with 1.36; 95% CI: 1.28, 1.44 for males). Food insecurity was associated with more sexual partners in younger groups and older female students and the association was strongest among older female students (difference: 0.0847; 95% CI: 0.0646, 0.105). Food insecurity was associated with higher odds of being bullied, and the association was stronger for female students than for male students in the same age groups (ages 11–14 y: OR: 1.93; 95% CI: 1.86, 2.00 for females compared with 1.81; 95% CI: 1.74, 1.88 for males; ages 15–18 y: OR: 1.91; 95% CI: 1.83, 1.98 for females compared with 1.82; 95% CI: 1.75, 1.89 for males).

Discussion

Food insecurity was prevalent among adolescent students in this global sample, with 25%–30% of students, depending on age group and sex, reporting going hungry because there was not enough food at some point in the last 30 d. Hunger is an experience associated with very low food security and is relatively infrequent compared with food-related worries or cutbacks in food quality (31), so the actual prevalence of less severe food insecurity is likely higher than was assessed with the 1 question available in the GSHS. This finding highlights the importance of monitoring and intervention to promote food security, including among students who are generally at lower risk of food insecurity in part owing to the food they receive while in school (32).

Food insecurity was associated with differences in adolescent profiles in ways that are consistent with previous literature, including associations with worse dietary quality (33, 34), poorer mental health (6, 12, 14, 15), less physical activity (35–37), more substance use (38), more sexual risk taking and partners (11, 39, 40, 16), and more exposure to bullying victimization (9, 41) on average among youth experiencing food insecurity than among food-secure peers. These findings hold across countries spanning from low to high income, suggesting a broad pattern of food insecurity as a marker for pervasive risks to adolescent development.

Profiles for diet, behavior, and health differed by adolescent students' sex and age. Female students had, on average, worse mental health and engaged in less frequent physical activities than their male peers, but they also had less exposure to substance use, fewer sexual partners, and were less likely to report having been bullied. These patterns reflect common aspects of the social construction of gender that is often overlaid with an individual's biological sex (42–46), for instance shaping what it means to be female in ways that lead to both protection (less drug use, fewer sexual partners, less exposure to externalized behaviors such as bullying) and risks (less physical activity, more in-

ternalizing behaviors such as worry and loneliness) in relation to their development. For older compared with younger adolescent students, risk profiles were generally worse for both sexes, including less fruit consumption, higher substance use, more sexual partners, and worse mental health. Age group differences reflect core processes of youth development, with increasing autonomy and responsibility, less adult supervision, and greater sexual maturation shaping behavior as adolescents get closer to adulthood (17).

The likelihood of food insecurity was similar by sex but was greater among older adolescents. The greater prevalence of food insecurity among older adolescents may reflect patterns found in existing literature, with younger children being more protected from household food shortages by parents' food management strategies (47), and older children compromising their own food security to prioritize the food needs of their younger siblings (48, 49). Food insecurity was associated with greater developmental risk overall. Some risk and protective profiles were associated with food insecurity similarly across age and sex groups, but food insecurity tended to be associated with neutralized age- and sex-specific protection. For instance, boys, and especially older boys, tended to be more physically active than their female counterparts; greater physical activity is protective against a range of health problems (50, 51) and has been associated with better academic performance (52). The largest average physical activity reduction associated with food insecurity was found among older boys, the group with the highest overall rate of physical activity. Similarly, younger adolescents had lower prevalence of substance use, but food insecurity was associated with larger increases in likelihood of substance use (especially drinking alcohol and drug use) among those younger adolescents. Younger boys were least likely to report chronic worry, but food insecurity was associated with the largest difference in chronic worry for this group. Girls in general had fewer sexual partners than boys, protecting them from a range of risks associated with sexual activity, but the magnitude of relation between food insecurity and number of sexual partners was >3 times larger among girls than among boys in the older age group. Food insecurity was also associated with exacerbation of already poor profiles. Younger adolescents on average consumed more soda than their older peers, and food insecurity was associated with greater average soda consumption among the younger group. In these ways food insecurity was associated with exacerbated risk profiles, worse underlying vulnerabilities, and reduced protective factors associated with sex and age group norms. These data cannot explain how or why that occurs, but several possibilities are worth considering.

First, adolescent food insecurity may be a marker for a wide set of individual, social, and household challenges that contribute to adolescent profiles. For instance, families that struggle to meet adolescent food needs may also struggle more broadly with lack of material, time, and community resources necessary for the supervision of youth activities, resulting in greater experimentation with drugs, alcohol, and sex than would be expected based on age and gender norms (53). Second, protection may erode at times of food insecurity because resources that enable protection are lost or diverted. Fruit and vegetable consumption was lower among food-insecure adolescents, likely because households opt for cheaper foods at times of scarcity (54, 55). Physical activity becomes less frequent, perhaps as adolescents divert time to activities aimed at helping meet household needs (48). That diversion of activity could be greater for those with more time to divert (e.g., older boys,

who generally spend more time on physical activity). Third, adolescents may engage in risky or unhealthy behaviors to cope with stress (56–58), in this case the stress of food insecurity. The higher chronic worry, loneliness, and suicidal ideation associated with food insecurity across all age and sex groups suggest that food insecurity strains adolescents' coping skills. Greater stress may equalize unhealthy coping skills, overwhelming protective age and gender norms for substance use and sexual activity. Fourth, feelings of stigma and shame about food insecurity may lead some adolescents to engage in behaviors they think will help them to fit in with or impress peers (59, 60). Adolescents tend to overestimate the prevalence of popular peers engaging in substance use and sexual activity, and thus may misunderstand which behavioral choices will make them more like those peers (61).

More knowledge is needed on how experiences of food insecurity of different groups of adolescents shape their choices and behaviors. This knowledge would allow for development of tailored interventions to address not just food-related challenges but also the profiles that go along with food insecurity and the material and social conditions in which adolescents are affected by household food conditions. Given the results of this study, interventions may need to be tailored to the outcomes, vulnerabilities, and protections that differ by adolescent age and sex.

To our knowledge, this study provides the most comprehensive examination to date of food insecurity and related nutritional, behavioral, and health experience profiles among different age and gender groups of adolescents, but findings should be interpreted considering several limitations. First, a single item was used to assess adolescent food insecurity, focusing on not having enough food (i.e., going hungry). Child food insecurity has multiple domains (62), only 1 of which was assessed. Second, we are not aware of information about the sources of the specific items in the GSHS survey or how those items perform, leading to potential for measurement issues. Finally, although the coverage of the GSHS is global, the surveys are limited to adolescents who are attending school. Girls are less likely than boys to attend schools in many countries. Food insecurity may be higher among adolescents not in school, those whose households have limited access to education, and where poverty and local norms lead to early entry to the labor market or marriage (63–65). This study likely underestimates the prevalence of adolescent food insecurity for these reasons and because experiences of food insecurity that are more frequent than going hungry were not assessed. Furthermore, the profiles associated with food insecurity may be different for adolescents attending school than for their peers who are not in school, and sex differences in school participation and in food security may interact in ways that are not captured in this school-based sample. The sample of students in school does, however, provide information on food-related hardships that may be particularly important in the context of the COVID-19 pandemic and other shocks such as civil strife and environmental disasters which disrupt the lives of school-going adolescents who are no longer in school and without access to school meals programs. Without these meals, students are left without a food source that, on average, represents 30%–50% of their daily nutrition requirements (26); they also have increased exposure to household environments that for some adolescents include material, social, and other challenges for daily life and healthy development.

Adolescent food insecurity is a prevalent and consequential problem, one that could be addressed through effective and targeted intervention. This study provides new information on how frequently adolescent students experience the food insufficiency domain of food insecurity, on the developmental profiles associated with food insecurity, and how those differ by sex and age. In addition, this study adds to the literature indicating that food insecurity is about more than food. Food hardships are associated with pervasive threats to healthy development, and intervention should attend to food insecurity as a complex phenomenon that shapes how adolescents feel and what they do, at different moments in their development, and in the gendered contexts through which they navigate the transition to adulthood.

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Data Availability

Data described in the article, code book, and analytic code will be made available upon request to the corresponding author.

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