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Association between food insecurity and depressive symptoms among adolescents aged 12-15 years from 22 low- and middle-income countries

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ABSTRACT

Food insecurity may be a risk factor for depression in adolescents. However, data on this topic from low- and middle-income countries (LMICs) are scarce, despite food insecurity being most common in LMICs. Therefore, we aimed to examine the association between food-insecurity and depressive symptoms among school-going adolescents from 22 LMICs.

Cross-sectional data from the Global school-based Student Health Survey were analyzed. Self-report measures assessed past 12-month depressive symptoms and past 30-day food insecurity (hunger). Multivariable logistic regression and meta-analysis were conducted to assess associations.

Data on 48,401 adolescents aged 12–15 years were analyzed [mean (SD) age 13.8 (0.9) years; 51.4 % females]. The prevalence of depressive symptoms was 29.3 %, and those of moderate and severe food insecurity were 45.0 and 6.3 %, respectively. After adjustment for potential confounders, compared to no food insecurity, the pooled OR (95 %CI) of moderate and severe food insecurity were 1.36 (1.30–1.42) and 1.81 (1.67–1.97), respectively. The level of between-country heterogeneity was low.

Food insecurity was associated with significantly higher odds for depressive symptoms among adolescents in LMICs. Policies to address food insecurity may also help prevent depression in this population, pending future longitudinal research.

1. Introduction

The main symptoms of depression consist of persistent sadness and a lack of interest or pleasure in activities which were previously rewarding or enjoyable (World Health Organization, 2023). Depression is a common mental disorder, which affects more than 264 million people worldwide, and 80 % of the global depression burden is concentrated in low- and middle-income countries (LMICs) (World Health Organization,

2021). Importantly, depression is highly prevalent among adolescents globally. For example, in a recent systematic review and meta-analysis among adolescents, the global point prevalence of elevated self-reported depressive symptoms was reported to be 34 %, with particularly high prevalence being observed in the Middle East, Africa, and Asia (Shorey et al., 2022).

The high prevalence of depression among adolescents is of public health concern as depression in adolescents is associated with a plethora

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Table 1
Survey characteristics and prevalence of depressive symptoms and food insecurity.

Country	Year	Response rate (%)	N	Depressive symptoms (%)	Moderate food insecurity (%)	Severe food insecurity (%)
Low-income countries						
Kenya	2003	84	2971	47.8	47.3	14.4
Myanmar	2007	95	2227	14.7	32.4	2.9
Uganda	2003	69	1904	39.3	42.4	8.4
Zambia	2004	70	1365	51.5	52.8	29.5
Lower middle-income countries						
Djibouti	2007	83	962	37.5	27.2	18.6
Egypt	2006	87	4981	35.1	36.8	5.1
Guyana	2004	80	1070	32.5	34.3	8.4
Indonesia	2007	93	3022	21.0	58.7	5.7
Jordan	2007	99.8	1648	37.1	37.1	13.2
Morocco	2006	84	1986	36.5	35.7	9.0
Philippines	2007	81	3484	36.6	61.8	6.5
Sri Lanka	2008	89	2504	31.8	26.2	6.7
Thailand	2008	93	2675	16.6	49.1	3.5
Tunisia	2008	83	2549	35.9	33.3	7.7
Upper middle-income countries						
Argentina	2007	77	1537	29.5	29.0	2.6
Botswana	2005	95	1397	39.0	48.8	14.3
Grenada	2008	78	1299	23.4	35.2	7.0
Lebanon	2005	88	4524	36.1	36.0	3.0
Seychelles	2007	82	1154	32.0	41.9	16.6
St. Lucia	2007	82	1072	23.3	37.8	5.5
St. Vincent & the Grenadines	2007	84	1188	27.5	33.9	6.8
Uruguay	2006	71	2882	16.6	17.2	1.5

of detrimental outcomes (e.g., substance use (Rudolph et al., 2008), risky sexual behavior (Tesfaye et al., 2019), overweight and obesity (Méndez-Giménez, 2020; Zhao et al., 2019), poorer educational outcomes (Wickersham et al., 2021), functional impairment, and suicidality (Balázs et al., 2013)). Moreover, depression in adolescence can also have long-term negative effects that can last into adulthood; this includes depression in adulthood (Johnson et al., 2018), but also a range of other problems including anxiety, illicit drug disorders, criminality, and impaired social functioning (Copeland et al., 2021). Thus, it is of utmost importance to identify risk factors for depression among adolescents to inform targeted intervention or policy. In particular, identifying risk factors for depression in the context of LMICs is important as the prevalence of depression is high in this setting, while over 75% of people in need of treatment for mental health complications receive no treatment (World Health Organization, 2021).

Although a large body of literature exists on the risk factors of adolescent depression, one potentially important but understudied risk factor, especially in the context of LMICs, is that of food insecurity. Food insecurity is often defined as disruption of food intake or eating patterns owing to lack of financial and other resources (Nord et al., 2006), and is most common in LMICs (Fares et al., 2020; World Health Organization, 2019). For example, in Kenya, one study reported that the prevalence of adolescent household food insecurity was 36 % (McReil et al., 2022). Food insecurity is plausibly associated with depression, owing to, for example, poor nutrition or increased feelings of shame, which are factors that can increase the risk for depression (Gilbert, 2000; Li et al., 2017).

In a recent systematic review, 10 out of 14 studies on food insecurity and depressive symptoms in young people found significant positive associations (Cain et al., 2022). Moreover, longitudinal studies have demonstrated that food insecurity at age 5 years was associated with depressive symptoms throughout childhood and at age 15 years (Hatem et al., 2020; Whitaker et al., 2006). However, all studies identified in the review utilized samples of young people exclusively from single high-income countries, and studies on this topic from LMICs are scarce. For example, one study found a positive association between food insecurity and depressive symptoms among school-going adolescents in Ecuador but this study did not utilize nationally representative data (Romo et al., 2016). Clearly, more data on food insecurity and depressive symptoms from LMICs are necessary to establish policies that aim to address food insecurity and its mental health sequelae.

Given this background, the aim of the present study was to examine the cross-sectional association between food-insecurity and depressive symptoms in a sample of 48,401 in-school adolescents aged 12–15 years from 22 LMICs using nationally representative data.

2. Methods

2.1. The survey

Data from the Global School-based Student Health Survey (GSHS) were analyzed. Details on this survey can be found at the following websites: <https://www.who.int/teams/noncommunicable-disease/surveillance/data> and <http://www.cdc.gov/gshs>. In brief, the GSHS is an open-access dataset, and was developed by the World Health Organization (WHO) together with the US Centers for Disease Control and Prevention (CDC) and other UN allies [i.e., United Nations Children's Fund (UNICEF), United Nations Educational, Scientific and Cultural Organization (UNESCO), Joint United Nations Programme on HIV/AIDS (UNAIDS)]. The aim of the survey was to provide comparable health-related data on students aged 13–17 years to inform global school and youth health policies. The survey collected information on leading causes of youth and adult morbidity and mortality (e.g., substance use, dietary behavior, physical activity etc.). The GSHS employed a two-stage sampling method. The first stage consisted of the selection of schools with a probability proportional to their enrolment size. In the second stage, among the selected schools, school classes (which included students aged 13–15 years) were selected at random, and all students in these classes were eligible to participate in the survey regardless of age. Thus, the survey also included students who were not within this age range. Data collection was performed during one regular class period. An anonymous, self-administered, computer-scannable questionnaire with multiple-choice response options was used to collect data. The questionnaire was initially developed in English and Spanish, and this was subsequently translated and validated by the participating countries into the local language. The computer scannable sheets were processed by the CDC data collection center. All GSHS surveys were approved, in each country, by both a national government administration (most often the Ministry of Health or Education) and an institutional review board or ethics committee. Student privacy was protected through anonymous and voluntary participation, and informed consent was obtained as

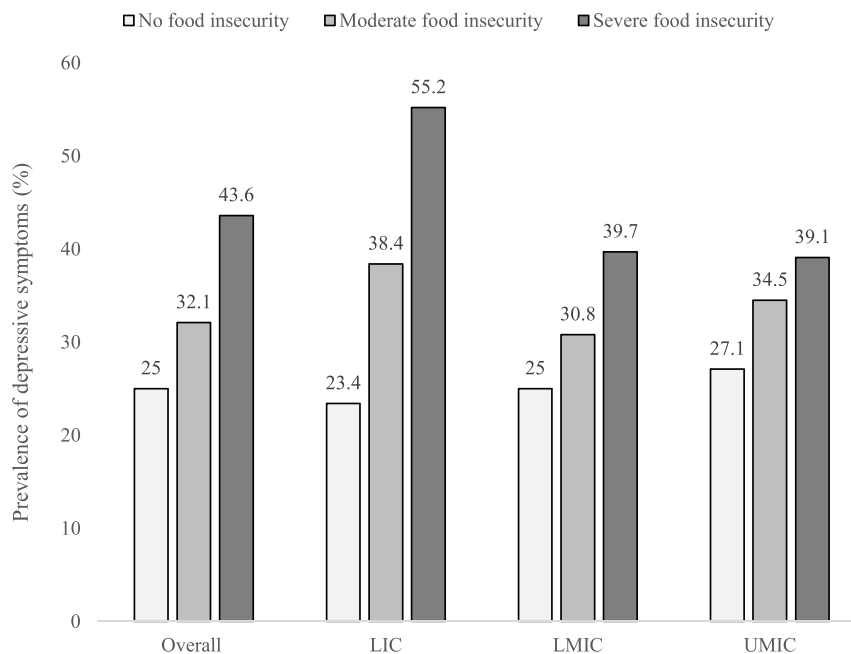


Fig. 1. Prevalence of depressive symptoms by levels of food insecurity (overall and by country income level). Abbreviation: LIC Low-income country; LMIC Lower middle-income country; UMIC Upper middle-income country.

appropriate from the students, parents and/or school officials. Data were weighted for non-response and probability selection.

We selected all nationally representative datasets from LMICs that included the variables pertaining to our analysis. If there were more than two datasets from the same country, we chose the most recent dataset. Based on these criteria, a total of 22 countries were included in the current study. The characteristics of each country including country income level, survey year, response rate, sample size, and prevalence of depressive symptoms and food insecurity are provided in Table 1. For the included countries, the survey was conducted between 2003 and 2008, and consisted of four low-income, ten lower middle-income, and eight upper middle-income countries based on the World Bank classification at the time of the survey.

2.2. Depressive symptoms

Depressive symptoms were assessed by the question: “During the past 12 months, did you ever feel so sad or hopeless almost every day for two weeks or more in a row that you stopped doing your usual activities?” with yes/no answer options.

2.3. Food insecurity (hunger)

Food insecurity (hunger) was assessed by the question “During the past 30 days, how often did you go hungry because there was not enough food in your home?” Answer options were categorized as: no food insecurity (never), moderate food insecurity (rarely/sometimes), and severe food insecurity (most of the time/always) (McKinnon et al., 2016). These categories were named as such because moderate food insecurity is often considered to be an indication that quality/quantity of food consumed has been compromised, while severe food insecurity refers to disrupted eating patterns and reduced food intake (McIntyre et al., 2013).

2.4. Control variables

The selection of the control variables was based on previous literature and included sex, age, bullying victimization and parental involvement (Romo et al., 2016). Bullying victimization was selected as

a control variable as it has been found to be associated with both food insecurity and mental health outcomes (Kim et al., 2009), while parental involvement can also influence the child’s diet and also mental health of the child (Flouri and Buchanan, 2002; Huang et al., 2010). Bullying victimization referred to being bullied on one day or more during the last 30 days (Koyanagi et al., 2019). Low parental involvement referred to answering ‘rarely’ or ‘never’ to all of the following three questions: (a) ‘during the past 30 days, how often did your parents or guardians check to see if your homework was done?’; (b) ‘during the past 30 days, how often did your parents or guardians understand your problems and worries?’; and (c) ‘during the past 30 days, how often did you parents or guardians really know what you were doing with your free time?’ (Romo et al., 2016).

2.4.1. Statistical analysis

Statistical analyses were performed with Stata 14.2 (Stata Corp LP, College station, Texas). The analysis was restricted to those aged 12–15 years as most students were within this age range, while the exact age outside of this age range was not available in the majority of countries. We used logistic regression analysis to estimate the country-wise association between food insecurity (exposure) and depressive symptoms (outcome), while adjusting for age, sex, bullying victimization, and parental involvement. Overall pooled estimates and those by country-income levels were obtained by combining the estimates for moderate food insecurity (vs. no food insecurity) and severe food insecurity (vs. no food insecurity) separately for each country into a fixed effect meta-analysis. In order to assess between-country heterogeneity in the association between food insecurity and depressive symptoms, we calculated the Higgins I^2 which represents the degree of heterogeneity that is not explained by sampling error with a value of <40% often considered as negligible and 40–60% as moderate heterogeneity (Higgins and Thompson, 2002). Heterogeneity between groups by country-income level was tested by Cochran’s Q tests.

All variables were included in the regression analysis as categorical variables except for age (continuous variable). Under 2.8 % of the data were missing for all the variables used in the analysis except for bullying victimization (15.3 %). For the variable on bullying victimization, we included a missing category in the model to avoid the exclusion of a large number of participants from the analysis. Sampling weights and

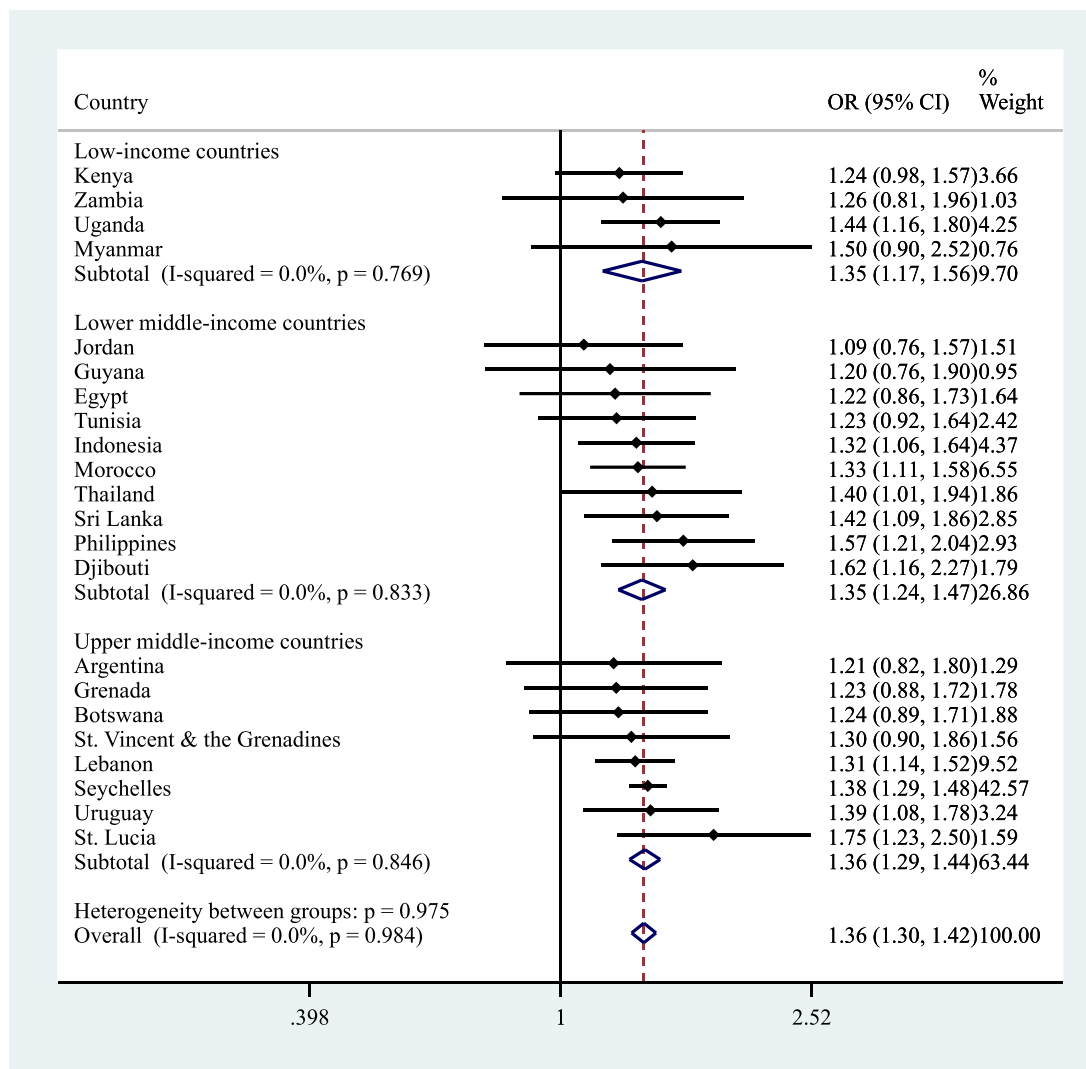


Fig. 2. Country-wise association between moderate food insecurity (vs. no food insecurity) and depressive symptoms estimated by multivariable logistic regression. Abbreviation: OR Odds ratio; CI Confidence interval. Models are adjusted for sex, age, bullying victimization, and parental involvement. Overall estimate was obtained by meta-analysis with fixed effects.

the clustered sampling design of the surveys were considered to obtain nationally representative estimates. The level of statistical significance was set at two-sided $p < 0.05$.

3. Results

A total of 48,401 adolescents attending school were included in the analysis [mean (SD) age 13.8 (0.9) years; 51.4 % females]. Overall, the prevalence of past 12-month depressive symptoms was 29.3 %. Past 30-day moderate and severe food insecurity was experienced by 45.0 and 6.3 % of the students, respectively. The prevalence of depressive symptoms ranged from 14.7 % in Myanmar to 51.5 % in Zambia. The range of the prevalence of moderate food security was 17.2 % (Uruguay) to 61.8 % (Philippines); and that of severe food security was 1.5 % (Uruguay) to 29.5 % (Zambia). The prevalence of depressive symptoms increased with increasing severity of food insecurity in the overall sample and samples stratified by country income level (Fig. 1). For example, in the overall sample, the prevalence of depressive symptoms was 25.0 % among those with no food insecurity but this increased to 43.6 % among those with severe food insecurity. The country-wise associations between moderate vs. no food insecurity and severe vs. no food insecurity are shown in Figs. 2 and 3, respectively. The pooled OR

(95 %CI) for all countries was 1.36 (1.30–1.42) and 1.81 (1.67–1.97) for moderate and severe food insecurity, respectively. The estimates were similar for estimates obtained by country income level, and the level of between-country heterogeneity based on the overall sample was low (i. e., $I^2=0.0\%$ for moderate food insecurity and $I^2 = 17.2\%$ for severe food insecurity).

4. Discussion

4.1. Main findings

In our study including nearly 50,000 school-going adolescents from 22 LMICs, we found that the overall prevalence of depressive symptoms and food insecurity was high. Indeed, nearly one-third of the adolescents had depressive symptoms, while more than half experienced moderate or severe food insecurity. Food insecurity was dose-dependently associated with higher odds for depressive symptoms. Specifically, there was a 36 and 81 % increased odds for depressive symptoms for moderate and severe food insecurity, respectively, with a low level of between-country heterogeneity being observed. The estimates were also similar by country-income level. To the best of our knowledge, this is one of the very few studies on food insecurity and depressive symptoms among

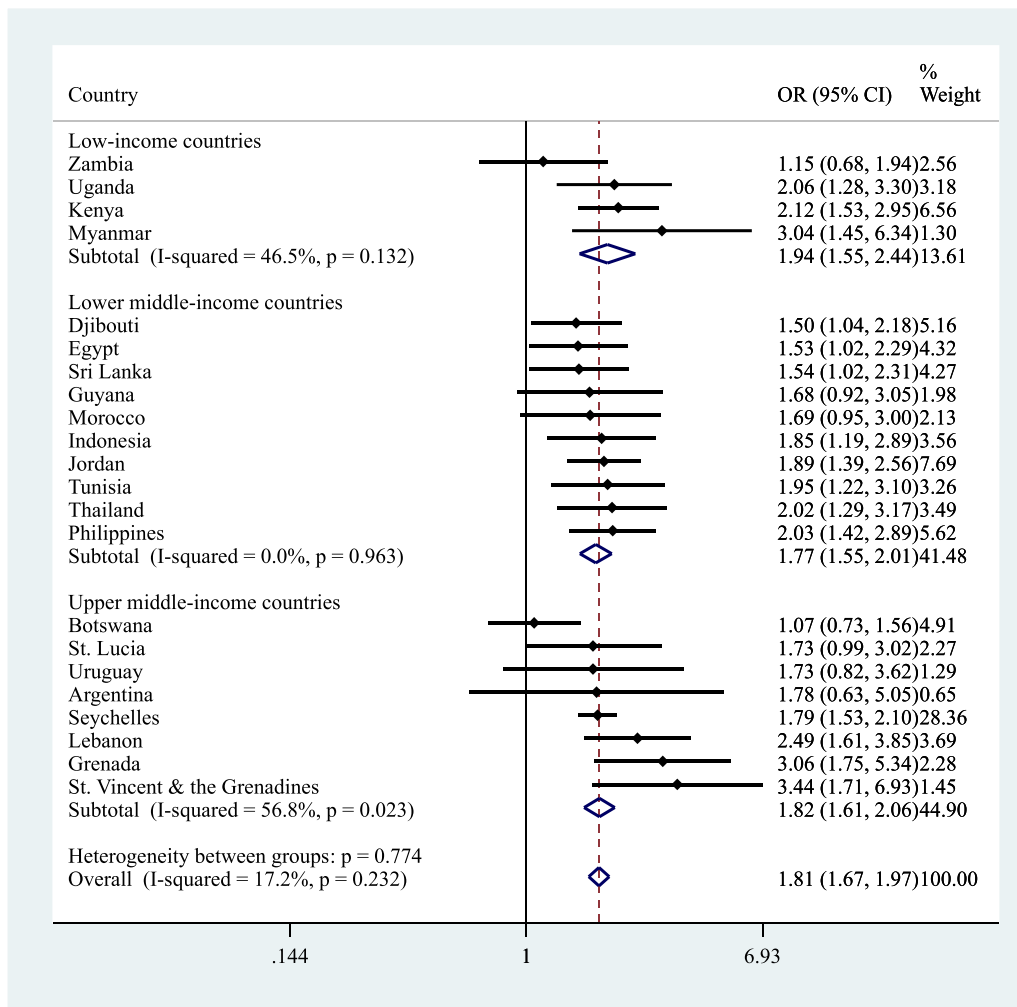


Fig. 3. Country-wise association between severe food insecurity (vs. no food insecurity) and depressive symptoms estimated by multivariable logistic regression. Abbreviation: OR Odds ratio; CI Confidence interval. Models are adjusted for sex, age, victimization, and parental involvement. Overall estimate was obtained by meta-analysis with fixed effects.

adolescents from LMICs, and is the first study on this topic which includes data from countries across multiple continents.

4.2. Interpretation of the study findings

The results of our study are in line with the majority of studies on this topic which were conducted in single high-income countries (Cain et al., 2022), and the few mainly single-country LMIC studies which were conducted in Africa and Latin America (Romo et al., 2016). There are several plausible mechanisms that likely explain the association between food insecurity and depression in adolescents. First, when food becomes scarce, people tend to change their dietary habits to cheaper but less nutritious options (e.g., low vitamins and micronutrients, high fat, and carbohydrates), and poor nutrition, in turn, has been associated with a higher risk for depression in adolescents (Khanna et al., 2019). For example, Western dietary patterns (e.g., consumption of sweetened beverages, fried foods, processed meats, and baked products) have been shown to be associated with an increased risk of depression in longitudinal studies, whereas healthy foods such as olive oil, fish, nuts, legumes, dairy products, fruits, and vegetables have been inversely associated with the risk of depression longitudinally (Khanna et al., 2019). This can also be explained by deficiency in antioxidants (e.g., vitamin C, vitamin E, and other carotenoids compounds), which is often observed in food insecurity, contributing to depression (Li et al., 2017). Second, food insecurity could induce feelings of shame and stigma due

to material deprivation including food, and these can increase one’s risk for depression (Gilbert, 2000). Third, the Family Stress Model posits that greater food insecurity can cause higher levels of adolescent behavior problems through the negative impact of food insecurity on caregiver psychological distress. These factors can lead to poorer caregiver–adolescent relationship quality, which could account for poorer adolescent psychosocial adjustment, including an increased risk for depression (Kotchick et al., 2021). Fourth, food insecurity in adolescents is associated with poor educational outcomes and this may be owing to food insecurity acting as a psychological or emotional stressor, affecting parent and child behavior (Jyoti et al., 2005; Wickersham et al., 2021). Indeed, poor educational outcomes are associated with a higher risk of depression (Rahman et al., 2018) likely owing to feelings of hopelessness or failure. Finally, food insecurity may result in higher levels of stress, and stress is associated with higher levels of depression, which is likely owing to impaired hypothalamic–pituitary–adrenal axis function (Smith et al., 2021).

4.3. Policy implications

Findings from the present study suggest that interventions to address food insecurity may also aid in the prevention of depressive symptoms among adolescents. While there are general strategies to reduce food insecurity that apply to the entire population (e.g., increasing agricultural productivity, investment in rural infrastructure, alleviation of

poverty (United Nations, 2022)), there are some strategies which are aimed at reducing food insecurity specifically among school-going adolescents. For example, successful initiatives may include free school meals, breakfast clubs, and school operated food banks. The literature proposes the following to address food insecurity in schools in LMICs: robust collaboration with the agriculture sector; integrate culturally appropriate nutrition and health education into the existing school curriculum; and support efforts by employing a skilled workforce, including nutrition and public health professionals as school staff. Importantly, parental and community engagement is the cornerstone for program sustainability and success in such settings (Xu et al., 2021). Moreover, findings from the present study suggest that mental health practitioners should be aware that food insecurity may be an underlying factor of depressive symptoms among adolescents (Spirito et al., 2011).

4.4. Strengths and limitations

The analysis of large representative samples of school-going adolescents from 22 LMICs across multiple continents is a clear strength of the present study. However, findings must be interpreted in light of the study's limitations. First, the study was cross-sectional in nature, and thus, the direction of the association cannot be determined. Further, the link between food insecurity and depressive symptoms may be explained by shared risk factors that were not accounted for in this study. Second, all variables were self-reported, potentially introducing some level of bias into the findings (e.g., social desirability, recall). Third, in our study, food insecurity (hunger) was based on a single question on hunger due to lack of food at home, which can be a rare and extreme manifestation of food insecurity. We were therefore unable to assess all aspects of food inadequacy and shortage. Relatedly, adolescent hunger was evaluated using a single question, with uncertain validity about a subjective experience. However, a study compared a single question about hunger (which was similar to the one asked in this study) to a validated tool assessing food insecurity and found reasonable sensitivity (83 %) and specificity (80 %) in a US population (Kleinman et al., 2007). Finally, it is possible that the association observed in our study is explained by factors which were not adjusted for in our study (residual confounding). For example, food insecurity could be a general marker of other types of material deprivation that can cause depressive symptoms (e.g., poor housing conditions). However, previous studies on food insecurity and depression have found significant associations even after adjustment for indicators of wealth (Smith et al., 2021), suggesting that the association is not explained purely by poverty.

4.5. Conclusion

In the present study including large representative samples of school-going adolescents from 22 LMICs, food insecurity was associated with higher odds for depressive symptoms. National efforts to develop and implement policies to address food insecurity among adolescents may also have the additional benefit of reducing depressive symptoms in this population.

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Contributors

All authors have made a substantial, direct and intellectual contribution to the work. All authors have read and approved the final version of the manuscript, and agree with the order of presentation of the authors.

Ethics

All GSHS surveys were approved, in each country, by both a national government administration (most often the Ministry of Health or Education) and an institutional review board or ethics committee. Student privacy was protected through anonymous and voluntary participation, and informed consent was obtained as appropriate from the students, parents and/or school officials.

Declaration of Competing Interest

None.

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