

Association of food insecurity with children's emotional, behavioural, and academic outcomes in Masaka District, Uganda: a cross-sectional study

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Abstract

Aims

Food insecurity is an important social determinant of children's mental health and educational outcomes. However, evidence on the independent and combined roles of household and school-based food insecurity remains limited, particularly in sub-Saharan Africa. This study aimed to examine the associations of household and school-based food insecurity with children's emotional, behavioural, and academic outcomes, and investigate whether school-based food insecurity modified the associations between household food insecurity and children's mental health difficulties among primary school children in Uganda.

Methods

A cross-sectional study was conducted among 661 children aged 7–13 years attending three randomly selected government-aided primary schools in Masaka District, Uganda. Household and school-based food insecurity were assessed using the Children's Food Insecurity Experience Scale (CFIES) and the School-based Food Insecurity Experience Scale (SFIES), respectively. Emotional and behavioural difficulties were measured using the Child and Adolescent Symptom Inventory-5 Teacher Rating Scale (CASI-5-T), and academic performance was obtained from school report cards. Multiple linear regression models with HC3 heteroskedasticity-consistent standard errors were used to examine the associations between household food insecurity (primary exposure) and children's emotional and behavioural difficulties and academic performance (outcomes), while assessing school-based food insecurity as both an independent exposure and a moderator of the associations between household food insecurity and these outcomes, adjusting for sociodemographic, household, and school-level factors.

Results

Approximately 47.2% of children reported moderate-to-severe household food insecurity, and 46.4% experienced moderate-to-critical school-based food insecurity. Clinically significant emotional and behavioural difficulties were identified in 5.3% of children, including 6.2% with elevated internalising difficulties and 4.5% with elevated externalising difficulties. Higher household and school-based food insecurity were associated with worry/anxiety ($\beta = -1.27$ and 0.87 , respectively), fear/panic/OCD/PTSD/somatic ($\beta = -0.98$ and 0.25), ADHD/inattention ($\beta = 0.92$ and 0.08), oppositional/defiant ($\beta = 0.95$ and -0.07), chronic irritability/disruptive mood dysregulation ($\beta = 0.90$ and -0.03), and externalising symptoms ($\beta = 0.98$ and 0.03) (all $p < 0.05$). School-based food insecurity was associated with poorer overall academic performance ($\beta = -0.06$, $p = 0.048$), mathematics ($\beta = -0.08$, $p = 0.015$), and literacy II/social studies achievement ($\beta = -0.07$, $p = 0.022$), whereas household food insecurity was associated only with literacy II/social studies achievement ($\beta = -0.07$, $p = 0.014$). School-based food insecurity modified associations between household food insecurity and worry/anxiety ($\beta = -1.35$, $p = 0.006$), fear/panic/OCD/PTSD/somatic ($\beta = -0.94$, $p = 0.047$), externalising ($\beta = 0.86$, $p = 0.014$), ADHD/inattention ($\beta = 0.92$, $p = 0.025$), oppositional/defiant ($\beta = 0.97$, $p = 0.024$), and chronic irritability/disruptive mood dysregulation symptoms ($\beta = 1.09$, $p = 0.020$), but not academic performance outcomes. Neither household

nor school-based food insecurity were associated with overall composite scores of mental health difficulties or internalising conditions.

Conclusions

Household- and school-based food insecurity were associated with worse specific emotional, behavioural, and academic outcomes. School-based food insecurity modified associations between household food insecurity and emotional and behavioural difficulties, underscoring the importance of considering food insecurity across multiple developmental contexts. Interventions addressing food insecurity in both household and school settings may improve children's mental health and educational outcomes.

1 Background

Food insecurity, defined as limited or uncertain access to sufficient, safe, and nutritious food necessary for an active and healthy life, remains a major public health challenge affecting millions of children worldwide, particularly in low- and middle-income countries (LMICs) [1].

Contemporary developmental frameworks increasingly conceptualise food insecurity as a chronic psychosocial stressor rather than solely a nutritional problem [2]. Beyond inadequate dietary intake, food insecurity exposes children to repeated uncertainty regarding food availability, disrupted meal routines, and food-related stigma, contributing to chronic activation of stress-response systems, impaired emotional regulation, reduced self-regulation, and difficulties engaging with educational environments [3, 4]. Consequently, food insecurity is an important social determinant of child mental health [5–7].

A growing body of evidence connects food insecurity with a broad range of children's emotional and behavioural difficulties, including anxiety, depressive symptoms, social withdrawal, attention difficulties, behavioural dysregulation, aggression, and conduct problems [6, 8]. In the present study, these outcomes are conceptualised within a dimensional framework comprising internalising and externalising symptom domains, consistent with developmental psychopathology models that recognise common environmental adversities as contributing to multiple manifestations of psychopathology [9, 10, 11].

Food insecurity has also been consistently associated with poorer academic outcomes. Compared with their food-secure peers, food-insecure children are more likely to experience difficulties with concentration, attendance, classroom participation, and educational attainment [12, 13, 14]. Educational functioning is also closely linked to children's psychological well-being, with poorer academic performance associated with anxiety, depressive symptoms, behavioural dysregulation, and lower self-esteem [15, 16, 17]. Together, these findings suggest that food insecurity may have important implications for both educational and psychosocial development.

Understanding these relationships requires consideration of the contexts in which food insecurity occurs. Most previous research has focused on household food insecurity, which reflects constraints on food availability and access within families, whereas children also experience food insecurity in school settings through missed meals, inadequate school feeding, and uncertainty about food availability during the school

day [18]. Although household and school-based food insecurity are correlated, they are conceptually and empirically distinct experiences that may influence children's development through different mechanisms [19, 20].

Although household and school-based food insecurity are conceptually distinct, it remains unclear whether school-based food insecurity modifies the associations between household food insecurity and children's emotional, behavioural, and academic outcomes. Most existing studies rely on household-level measures of food insecurity and provide limited insight into children's own experiences of hunger within school settings [21, 22]. Addressing this gap may improve understanding of how food insecurity across multiple developmental contexts influences children's mental health and educational outcomes.

These questions are particularly relevant in Uganda, where food insecurity remains common among school-aged children and evidence on its implications for children's mental health and educational outcomes is limited [23]. Few studies in sub-Saharan Africa have simultaneously examined household food insecurity, school-based food insecurity, children's emotional and behavioural difficulties, and academic performance within a single analytical framework [24]. The present study set out to address this gap by examining the associations between household food insecurity, school-based food insecurity, children's emotional and behavioural difficulties, and academic performance among primary school children in Masaka District, Uganda.

The objectives of this study were to:

1. Describe the prevalence and distribution of household food insecurity, school-based food insecurity, children's emotional and behavioural difficulties, and academic performance.
2. Examine the associations between household food insecurity, school-based food insecurity (exposures), and children's emotional and behavioural difficulties, and academic performance (outcomes).
3. Determine whether school-based food insecurity modifies the strength of the associations between household food insecurity and children's emotional and behavioural difficulties.
4. Determine whether school-based food insecurity modifies the strength of the associations between household food insecurity and academic performance.

The following hypotheses (H) were tested:

H1

Higher levels of household food insecurity are associated with greater emotional and behavioural difficulties among children.

H2

Higher levels of household food insecurity are associated with poorer academic performance.

H3

Higher levels of school-based food insecurity are associated with greater emotional and behavioural difficulties among children.

H4

Higher levels of school-based food insecurity are associated with poorer academic performance.

H5

School-based food insecurity moderates the association between household food insecurity and children's emotional and behavioural difficulties.

H6

School-based food insecurity moderates the association between household food insecurity and academic performance.

2 Methods

2.1 Study design

This study employed a cross-sectional observational design and was conducted among school-aged children enrolled in government-aided primary schools in Masaka District, Uganda. All variables included in the present analyses were measured at a single time point, without administering any intervention that reduced food insecurity and its effects on children's mental health outcomes. A cross-sectional design was selected to enable simultaneous examination of associations among food insecurity experienced in both household and school contexts, children's mental health difficulties, and academic performance in a resource-limited educational setting [25].

2.2 Sampling and participant selection

At the first stage, four sub-counties within Masaka District served as sampling strata. Within each sub-county, eligible primary schools were identified in collaboration with local education authorities. Schools were then randomly selected at the sub-county level using the Microsoft Excel random number generator (RAND function). Specifically, each eligible school within a sub-county was assigned a random number, and schools were sorted in descending order of the values generated. The school whose random number appeared at the top of the list was selected to participate. One school per sub-county was selected to ensure geographic representation across the district.

Although four schools were initially selected, cross-sectional data were ultimately collected from three schools. The fourth school experienced significant governance instability which limited the feasibility of maintaining consistent coordination, supervision, and scheduling required for school-based research involving children. Following consultation with district education authorities and the research supervision team (CL and TTS), and to maintain procedural integrity and ethical oversight, data collection at that school was discontinued.

At the second stage, children within each selected school were randomly sampled. Eligible children were identified from class registers, and random selection was conducted using ballot papers marked with the letter "Y" or "N" to determine participation. This procedure ensured that each eligible child in a selected

school had an equal probability of selection while remaining culturally appropriate and feasible in the school setting.

Eligibility criteria for participation included:

1. enrolment in a participating primary school;
2. being of age between seven and 13 years old; and
3. having the ability to self-report their food insecurity experiences.

Caregivers provided written informed consent for their children's participation and received a bar of soap as a token of appreciation. Children provided assent prior to data collection and were given a small snack (a biscuit and a bottle of packed fruit juice) at the conclusion of the interview. This refreshment was provided to all participating children, regardless of their responses, and was not contingent on completing specific questionnaire items. Teachers also provided written informed consent, completed the Child and Adolescent Symptom Inventory–5 Teacher rating scale (CASI-5-T; [26]), and received monetary compensation for each completed mental health report for each participating child.

Prior to administering child-reported measures, children's ability to complete self-report instruments, with the support of four data collectors, was informally assessed to ensure comprehension and literacy adequacy. Specifically, children were asked to write their full name, write their age in words (rather than digits), and spell age-appropriate common words provided by the data collector based in each selected school. These brief tasks were used as a pragmatic screening tool to confirm basic reading and writing proficiency sufficient to understand and respond to cognitively pretested questionnaire items independently.

Children who demonstrated difficulty completing these tasks were provided with additional clarification and, where necessary, items were read aloud individually in a neutral, non-leading manner to ensure comprehension without influencing responses. This procedure was implemented to minimise response error due to literacy limitations and to avoid impulsive responses (e.g., "I don't know"), while preserving the child-centred nature of the food insecurity measure. The approach is consistent with best practice recommendations for administering self-report instruments to school-aged children in resource-limited school settings, where literacy levels may vary within grade cohorts [27].

2.3 Data collection procedures

Data were collected by trained research assistants with prior experience in school-based child mental health research. Training, conducted in September 2025, was based on established guidance for ethical research with children and the administration of experience-based measures, drawing on UNICEF procedures for ethical engagement with children [28], the Food Insecurity Experience Scale (FIES) implementation guidance [29], the CASI-5-T administration manual, best-practice recommendations for interviewer neutrality and cognitive interviewing [27], and international ethical guidelines for research involving children [30]. The programme emphasised child safeguarding, age-appropriate communication, neutral interviewing techniques, voluntary participation, and appropriate responses to participant distress through role-play and supervised practice.

Cross-sectional data collection occurred between September and December 2025 across participating schools. Interviews and questionnaire administration were conducted in quiet, private spaces within school premises, such as empty classrooms or designated areas approved by school authorities. Data collection was scheduled during non-instructional periods, such as school breaks or after lessons, to minimise disruption and reduce potential coercion associated with classroom authority dynamics. Data collectors were trained to monitor children’s verbal and nonverbal cues throughout the assessment and to pause or terminate the interview if a child appeared distressed or uncomfortable.

Data were collected offline using the Qualtrics XM platform installed on password-protected tablets, enabling uninterrupted fieldwork in settings with limited internet connectivity. Completed questionnaires were uploaded to the secure platform once a stable internet connection became available. Data were collected in pseudonymised form using unique study identifiers, with direct identifiers stored separately and accessible only to authorised research team members. All datasets were fully anonymised before data cleaning and statistical analysis in accordance with institutional data protection requirements.

2.4 Measures

2.4.1 Household food insecurity

Household food insecurity was assessed using the 10-item Children’s Food Insecurity Experience Scale (CFIES; [31]), a child-reported, experience-based measure capturing children’s direct experiences of household food insecurity. The CFIES assesses key dimensions of food insecurity, including food-related worry, reduced dietary quantity or quality, and disrupted eating patterns due to insufficient household food resources, reflecting experience-based frameworks that conceptualise food insecurity as both material deprivation and a psychosocial stressor [29, 32].

Child report was used, recognising that children are active informants of their own lived experiences and may perceive and experience food insecurity differently from caregivers [33]. Empirical research indicates that caregiver reports may underestimate children’s exposure due to stigma, social desirability bias, or efforts to shield children from knowledge of household hardship [34] and that child-reported food insecurity demonstrates construct validity and independent associations with mental health, behavioural, and educational outcomes [8, 12, 21, 35].

Items were administered in an age-appropriate format and coded according to standard scoring procedures. Responses were summed to generate a continuous total score (range 0–10), with higher scores indicating greater severity of household food insecurity. The CFIES was treated as a dimensional measure, preserving variability across the full severity spectrum rather than imposing categorical thresholds, consistent with contemporary practice in food insecurity research [18].

Conceptually, the CFIES aligns with established experience-based measures such as the Household Food Insecurity Access Scale and the Food Insecurity Experience Scale, which emphasise subjective experiences of uncertainty and constrained access to food rather than caloric insufficiency alone [34]. This framing is particularly appropriate for examining associations with children’s mental health difficulties and academic performance, outcomes theorised to be shaped by chronic stress and environmental unpredictability [3, 6].

2.4.2 School-based food insecurity

School-based food insecurity was assessed using the 4-item School-based Food Insecurity Experience Scale (SFIES; [23]), a child-reported, experience-based measure developed for Ugandan school settings. The SFIES captures children's experiences of hunger and inadequate food access during the school day, including skipping meals at school, feeling hungry during lessons, and difficulty concentrating due to lack of food. The scale has demonstrated acceptable reliability and validity and reflects the context-dependent nature of food insecurity across children's daily environments [35].

Items were administered in an age-appropriate format and scored according to standard procedures. Responses were summed to generate a continuous total score (range 0–4), with higher scores indicating greater severity of school-based food insecurity. As with the CFIES, the SFIES was treated as a continuous, dimensional measure, preserving variability in exposure severity and aligning with best practice in experience-based food insecurity research [18].

Conceptually, the SFIES complements household-level food insecurity measures by capturing context-specific exposure within the school environment, which may exert distinct effects on learning and mental health through acute physiological and cognitive pathways.

2.4.3 Children's mental health difficulties

Children's emotional and behavioural difficulties were assessed using the 83-item, cognitively pretested Child and Adolescent Symptom Inventory-5 Teacher Rating Scale (CASI-5-T) [26]. Teachers completed the instrument based on sustained classroom observations of children's emotional and behavioural functioning. The teacher-report version was selected to minimise the potential emotional burden of directly assessing sensitive psychological symptoms in children, consistent with ethical guidance recommending the use of valid alternative informants where appropriate [28, 30].

CASI-5-T domains were organised into two higher-order dimensions consistent with dimensional models of child psychopathology: internalising difficulties and externalising difficulties [11, 36].

Internalising difficulties comprised anxiety-related and depressive symptom domains, including worry/anxiety, fear/panic, obsessive–compulsive disorder (OCD), post-traumatic stress disorder (PTSD), somatic anxiety, social anxiety/shyness, and depressive symptoms. These domains were aggregated to generate an internalising composite score ranging from 0 to 105, representing 35 internalising symptoms captured by the CASI-5-T.

Externalising difficulties comprised behavioural dysregulation domains, including attention-deficit/hyperactivity disorder (ADHD; inattention and hyperactivity/impulsivity), oppositional defiant disorder (ODD)/defiance, conduct problems, aggression/school violence, and chronic irritability/disruptive mood dysregulation disorder (DMDD)-like symptoms. These domains were aggregated to generate an externalising composite score ranging from 0 to 144, representing 48 externalising symptoms captured by the CASI-5-T.

2.4.4 Academic performance

Academic performance was assessed using official school report-card records from the same academic term. Subject-specific scores were derived from routine school assessments conducted under standard educational conditions, comprising beginning-of-term (20%), mid-term (20%), and end-of-term (60%) examinations. This weighting structure reflected both cumulative classroom engagement and summative academic attainment across the term.

To facilitate pooling of academic performance data across schools, raw subject scores were converted to within-school percentile ranks, accounting for differences in grading standards, examination difficulty, and marking practices between schools. Percentile ranks reflect each child's performance relative to peers within the same school context. Clustering by school was addressed separately in the regression analyses.

Percentile ranks were calculated separately for core subjects (e.g., English, Mathematics, Literacy I or Basic Science, Literacy II or Social Studies) and averaged across subjects to generate a composite academic performance score. This composite total score, derived from subject-specific total scores, reflects general academic functioning and reduces measurement error associated with subject-specific variability.

2.4.5 Covariates

Household socioeconomic status

Household socioeconomic status (SES) was assessed using child-reported information on the primary caregiver's employment and household economic conditions. SES was included as a covariate because socioeconomic disadvantage is an established determinant of household food insecurity and children's mental health and educational outcomes [37, 38], and adjustment reduces potential confounding arising from broader socioeconomic deprivation.

Simplified asset index

The 12-item Simplified Asset Index (SAI) [39] was administered to children as a supplementary measure of long-term household wealth. The index comprises household asset and living-standard indicators and was analysed as a continuous composite score (range: 5–26), with higher scores indicating greater affluence. Asset-based measures capture relatively stable socioeconomic conditions and complement employment- and income-related indicators, particularly in low- and middle-income settings where income may be informal or unstable [40, 41].

Child status index

The 12-item Child Status Index (CSI) [42] was administered directly to children to assess broader dimensions of vulnerability, including health, shelter, protection, education, caregiving, and psychosocial support [43, 44]. Child self-report administration has previously been used and evaluated in Ugandan children [42]. Scores ranged from 12 to 20, with higher scores indicating greater vulnerability. The CSI was included as a covariate to adjust for co-occurring adversities that may independently influence children's mental health and academic performance [45].

2.5 Cognitive Pretesting and Instrument Preparation

Prior to field administration, all study instruments underwent structured cognitive pretesting with school-aged children from non-study schools within the district to assess linguistic clarity, cultural appropriateness, comprehension, and response processes using established cognitive interviewing procedures [46]. Think-aloud and verbal probing techniques [47] were used to identify ambiguities, refine wording and administration instructions, and ensure developmental and cultural appropriateness while preserving conceptual equivalence. Particular attention was given to context-specific concepts, including worry, skipping meals, and hunger during school time.

The CASI-5-T was further contextually adapted through structured feedback from 37 teachers, who assessed the clarity, interpretability, cultural relevance, and classroom applicability of the items. Revisions were limited to clarifying language and adding examples while preserving the underlying DSM-5 constructs. The SAI and CSI were similarly reviewed for cultural relevance, confirming the appropriateness of household asset and caregiving indicators for assessing socioeconomic position and child well-being in the local context.

2.6 Data analysis

The analytic strategy followed a two-stage, theory-informed approach designed to ensure transparency, parsimony, and methodological rigour in evaluating associations between household food insecurity, school-based food insecurity, child mental health difficulties, and academic performance. All analyses were specified a priori and preregistered on the Open Science Framework (OSF DOI:10.17605/OSF.IO/T4PA9).

2.6.1 Scaling and Standardisation Procedures

Household (CFIES) and school-based food insecurity (SFIES) scores were standardised (z-scores) before interaction and moderated mediation analyses to facilitate interpretation and comparability of effects. Standardised scores were used to construct the interaction term (CFIES $\times$ SFIES), reducing non-essential multicollinearity and facilitating interpretation of conditional effects [48, 49]. All other variables, including internalising difficulties, externalising difficulties, academic performance, SES, SAI, and CSI, were analysed as continuous variables in their original metrics to preserve scale interpretation and avoid the loss of statistical power and information associated with categorisation [50].

2.6.2 Analytical approach

Stage 1: Descriptive and Prevalence Analyses

Descriptive analyses were conducted to characterise the distributions of food insecurity, emotional and behavioural difficulties, and academic performance within the study population. Continuous variables were summarised using means, standard deviations, ranges, skewness, and kurtosis statistics to assess central tendency, variability, and distributional properties.

School-based food insecurity (SFIES), household food insecurity (CFIES), CASI-5-T symptom domains, and academic performance indicators were analysed primarily as continuous variables. Standardised T-scores were used for the CASI-5-T and academic performance measures, with higher CASI-5-T scores indicating greater emotional and behavioural difficulties and higher academic T-scores indicating better academic performance.

Teacher-reported emotional and behavioural difficulties among children were assessed using the CASI-5-T and were additionally categorised for prevalence estimation using conventional clinical interpretation thresholds. T-scores < 60 were classified as within the normative range, scores of 60–64 as at-risk symptom levels, scores of 65–69 as clinically elevated difficulties, and scores ≥ 70 as clinically significant symptom severity. Binary prevalence indicators were additionally derived using the conventional T-score threshold of ≥ 65 to indicate elevated mental health difficulties.

Academic performance T-scores were categorised descriptively using standardised educational performance conventions, whereby scores ≥ 60 indicated above-average academic performance, scores between 40 and 59 indicated average academic performance, and scores < 40 indicated below-average academic performance.

Frequencies and percentages were calculated to estimate the prevalence of food insecurity severity categories, elevated internalising difficulties, elevated externalising difficulties, overall emotional and behavioural difficulties, and academic performance categories within the sample. Continuous scores were retained for regression analyses, consistent with dimensional approaches to child psychopathology and educational functioning.

Despite evidence of variance heterogeneity and non-normality across several emotional and behavioural domains, variables were retained in their original metric form to preserve clinical interpretability and consistency with dimensional psychopathology approaches. Parametric analyses were retained given the large sample size and the robustness of regression-based approaches to moderate departures from normality.

Stage 2: Regression and Interaction Analyses

Multiple linear regression models were used to examine the associations between household food insecurity (independent exposure) and school-based food insecurity (independent exposure) and children's emotional and behavioural difficulties and academic performance (outcomes). Separate models were estimated for each outcome, adjusting for child sex, age, sibship size, family structure, caregiver occupation, CSI, SAI, and school clustering. To account for the clustered sampling design, school was included as a stratifying variable in all analyses.

To examine whether the associations between household food insecurity and study outcomes varied according to levels of school-based food insecurity, interaction effects were evaluated by including a household food insecurity $\times$ school-based food insecurity (CFIES $\times$ SFIES) product term in the regression models. Significant interaction effects were probed using simple slopes analyses and visual inspection of interaction plots. Predicted associations between household food insecurity and outcomes were estimated at low (-1 SD), mean, and high ($+1$ SD) levels of school-based food insecurity to facilitate interpretation of interaction effects.

Regression parameters were estimated using HC3 heteroskedasticity-consistent standard errors, which provide robust estimates in the presence of heteroskedasticity and are recommended for moderate sample

sizes. Results are presented as unstandardised regression coefficients (β), omnibus F-statistics, 95% confidence intervals (CIs), and corresponding p-values. Statistical significance was defined as $p < 0.05$.

2.6.3 Inference and Decision Criteria

All tests were two-tailed ($\alpha = 0.05$), with statistical inference based on regression coefficients, effect sizes, and 95% and bootstrap confidence intervals, emphasising effect magnitude and precision rather than p-values alone.

Evidence of an association was inferred when the estimated regression coefficient differed significantly from zero, indicated by a two-tailed p-value < 0.05 and a corresponding 95% confidence interval that excluded zero. Interaction effects between household food insecurity (CFIES) and school-based food insecurity (SFIES) were considered supported when the interaction coefficient was statistically significant and the associated confidence interval excluded zero. Significant interactions were subsequently examined using simple-slopes analyses and graphical inspection of predicted values at lower (-1 SD), average (mean), and higher ($+1$ SD) levels of school-based food insecurity to characterise the magnitude of indirect effects.

2.6.4 Handling of missing data

Imputation was performed using the Fully Conditional Specification (FCS) procedure in SPSS, with regression models selected based on variable type. To maximise the plausibility of the missing-at-random assumption and ensure compatibility between the imputation and analytic models, all variables included in the substantive analyses, including household food insecurity, school-based food insecurity, academic performance, internalising and externalising symptom scores, socioeconomic status (SES), Simplified Asset Index (SAI), Child Status Index (CSI), and school indicators, were included in the imputation model. Fifty imputed datasets were generated, consistent with contemporary recommendations to reduce Monte Carlo error and improve the stability of pooled estimates [51, 52]. Parameter estimates were pooled using Rubin's rules to obtain final regression coefficients, standard errors, confidence intervals, and significance tests [53].

General linear regression analyses, accounting for school clustering, were conducted using pooled estimates from an imputed dataset. Regression coefficients were estimated using HC3 heteroskedasticity-consistent standard errors, and indirect effects were evaluated using 5,000 bias-corrected bootstrap resamples to improve the robustness of statistical inference.

3 Results

3.1 Sample Characteristics

The final analytic sample comprised 661 children from three randomly selected schools across three sub-counties. Children in the sample had a mean (SD) age of 10.29 (1.88) years, and 332 (50.2%) were female. Most children lived in nuclear families (60.7%), with farming as the caregiver's main occupation (69.0%). School-based food insecurity was common, with 307 (46.4%) children classified as moderately, severely, or critically food insecure at school. Household food insecurity was even more prevalent, with 312 (47.2%) children classified as moderately or severely food insecure at home. Overall, 562 (85.0%) children were within the normative range for emotional and behavioural difficulties, whereas 35 (5.3%) exhibited clinically

significant difficulties. Clinically significant internalising difficulties were reported for 41 (6.2%) children, while 30 (4.5%) exhibited clinically significant externalising difficulties. Most children demonstrated average academic performance (62.5%) (see Table 1).

Table 1
Sociodemographic characteristics, food insecurity, mental health difficulties,
and academic performance.

Variable	Prevalence n (%)
Sex	
Male	329 (49.8)
Female	332 (50.2)
Age group	
7–9 years	250 (37.8)
10–13 years	411 (62.2)
Sibship size	
Below-average sibship size (below 5 children per household)	294 (44.5)
Average sibship size (5 children per household)	122 (18.5)
Above-average sibship size (above 5 children per household)	245 (37.0)
Family structure	
Nuclear (living with both biological parents)	401 (60.7)
Extended (not living with biological parents)	260 (39.3)
Caregiver occupation	
Farmer	456 (69.0)
Trader/hawker	94 (14.2)
Civil servant	29 (4.4)
Artisan	27 (4.1)
Other	55 (8.3)
School-based food insecurity (SFIES)	
Food secure	180 (27.2)
Mild food insecurity	174 (26.3)
Moderate food insecurity	164 (24.8)
Severe food insecurity	100 (15.1)
Critical food insecurity	43 (6.5)
Household food insecurity (CFIES)	

Variable	Prevalence n (%)
Sex	
Food secure	61 (9.2)
Mild food insecurity	288 (43.6)
Moderate food insecurity	215 (32.5)
Severe food insecurity	97 (14.7)
Overall mental health difficulties (CASI-5-T)	
Within normative range (< 60 T scores)	562 (85.0)
At-risk (between 60.00 and 64.99 T scores)	43 (6.5)
Clinically elevated (between 65.00 and 69.99 T scores)	21 (3.2)
Clinically significant (≥ 70.00 T scores)	35 (5.3)
Internalising difficulties	
Within normative range	582 (88.0)
At-risk	28 (4.2)
Clinically elevated	10 (1.5)
Clinically significant	41 (6.2)
Externalising difficulties	
Within normative range	569 (86.1)
At-risk	38 (5.7)
Clinically elevated	24 (3.6)
Clinically significant	30 (4.5)
Academic performance	
Above-average academic performance	127 (19.2)
Average academic performance	413 (62.5)
Below-average academic performance	121 (18.3)
SFIES = School-based Food Insecurity Experience Scale	
CFIES = Children's Food Insecurity Experience Scale	
CASI-5-T = Children and Adolescent Symptom Inventory-5 Teacher Version	

Insert Table 1 about here

3.2 Distributional Characteristics

School-based food insecurity (median = -0.39, Q1 = -1.21, Q3 = 0.43) and household food insecurity (median = -0.62, Q1 = -0.62, Q3 = 0.55) demonstrated relatively symmetric distributions with modest positive skewness (0.40 and 0.18, respectively) and slight negative kurtosis (-0.83 and -0.65, respectively).

Mental health outcomes demonstrated greater departures from normality. Overall CASI-5-T scores showed moderate positive skewness (1.56) and kurtosis (3.44). Internalising symptoms exhibited substantial positive skewness (1.93) and kurtosis (5.22), with the greatest departures observed for fear/panic/obsessive-compulsive/trauma-related/somatic symptoms (skewness = 2.92, kurtosis = 15.07), chronic irritability/disruptive mood dysregulation symptoms (skewness = 3.35, kurtosis = 13.20), and aggression/school violence symptoms (skewness = 3.59, kurtosis = 13.99), indicating elevated symptoms were concentrated within relatively small subgroups of children.

In contrast, academic performance measures approximated normal distributions. The academic performance composite demonstrated near-zero skewness (0.01) and mild negative kurtosis (-0.88), with similar patterns observed across English, Mathematics, Literacy I/Science, and Literacy II/Social Studies (see Table 2).

Table 2
Distributional characteristics of food insecurity, mental health difficulties, and academic performance

Variable	Median (Q1, Q3)	Skewness	Kurtosis
Food insecurity (z-scores)			
SFIES	-0.39 (-1.21, 0.43)	0.40	-0.83
CFIES	-0.62 (-0.62, 0.55)	0.18	-0.65
Mental health difficulties (T-scores)			
CASI-5-T Total	47.39 (42.11, 54.78)	1.56	3.44
Internalising	47.30 (41.46, 53.13)	1.93	5.22
Worry/Anxiety (Category D)	44.47 (44.47, 55.45)	2.40	7.92
Fear/Panic/OCD/PTSD/Somatic (Category E)	44.00 (44.00, 53.91)	2.92	15.07
Depressive Symptoms (Category F)	45.37 (45.37, 45.37)	2.52	6.59
Social Anxiety/Shyness (Category K)	47.57 (42.40, 52.75)	1.59	2.22
Externalising	46.75 (42.92, 53.14)	1.83	4.62
ADHD/Inattention (Category A)	48.28 (42.09, 54.47)	1.33	1.81
Hyperactivity/Impulsivity (Category B)	43.56 (43.56, 57.23)	1.95	4.28
Oppositional/Defiant (Category C)	43.42 (43.42, 50.65)	2.24	5.96
Chronic Irritability/DMDD (Category Q)	45.80 (45.80, 51.48)	3.35	13.20
Aggression/School Violence (Category Rz)	46.92 (46.92, 46.92)	3.59	13.99
Academic performance (T-scores)			
Academic Performance Composite	50.24 (42.40, 57.49)	0.01	-0.88
English	49.64 (42.45, 57.93)	0.08	-0.92
Mathematics	49.71 (42.06, 57.60)	0.08	-0.93
Literacy I/Science	49.49 (41.89, 58.16)	0.07	-1.08
Literacy II/Social Studies	51.66 (42.54, 57.81)	-0.34	-0.83

Insert Table 2 about here

3.3 Regression Diagnostics

For mental health difficulties, Levene's tests showed significant differences in variance across scores: overall $F(1, 659) = 12.25, p < 0.001$; internalising difficulties $F(1, 659) = 5.98, p = 0.015$; externalising difficulties $F(1, 659) = 32.36, p < 0.001$. For academic performance, Levene's tests confirmed that the assumption of homogeneity of variances was met across all academic performance domains, including overall academic

achievement, English, Mathematics, Literacy I/Basic Science, and Literacy II/Social Studies, with non-significant differences in variance across all domains ($F_s(1, 659) = 1.40-2.57$, all p -values > 0.05).

White and modified Breusch–Pagan tests were conducted to assess heteroskedasticity of model residuals across all regression models. For the overall CASI-5-T, internalising composite, social anxiety/shyness symptoms, hyperactivity/impulsivity symptoms, and aggression/school violence symptoms models, both White and modified Breusch–Pagan tests were non-significant (all $p > 0.05$), indicating no evidence of heteroskedasticity (see Table 3).

Table 3
Regression diagnostic statistics

Outcome	White $\chi^2(df)$	Breusch–Pagan $\chi^2(df)$	HC3 conclusion
CASI-5-T Total	8.77 (5)	0.97 (1)	Unchanged
Internalising	6.68 (5)	1.49 (1)	Unchanged
Worry/Anxiety (Category D)	77.2 (5) **	13.6 (1) **	Unchanged
Fear/Panic/OCD/PTSD/Somatic (Category E)	110.0 (5) **	39.1 (1) **	Unchanged
Depressive Symptoms (Category F)	11.86 (5) *	0.52 (1)	Unchanged
Social Anxiety/Shyness (Category K)	2.33 (5)	0.24 (1)	Unchanged
Externalising	66.3 (5) **	16.7 (1) **	Unchanged
ADHD/Inattention (Category A)	25.3 (5) *	29.9 (1) *	Unchanged
Hyperactivity/Impulsivity (Category B)	5.27 (5)	0.62 (1)	Unchanged
Oppositional/Defiant (Category C)	44.5 (5) *	18.5 (1) **	Unchanged
Chronic Irritability/DMDD (Category Q)	66.5 (5) **	32.3 (1) **	Unchanged
Aggression/School Violence (Category Rz)	7.84 (5)	0.08 (1)	Unchanged

Insert Table 3 about here

Evidence of heteroskedasticity was observed for several symptom domains. Significant White and modified Breusch–Pagan tests were identified for worry/anxiety symptoms (White $\chi^2(5) = 77.2$, $p = 0.009$; Breusch–Pagan $\chi^2(1) = 13.6$, $p = 0.001$), fear/panic/obsessive-compulsive/trauma-related/somatic symptoms (White $\chi^2(5) = 110.0$, $p = 0.002$; Breusch–Pagan $\chi^2(1) = 39.1$, $p = 0.002$), externalising difficulties (White $\chi^2(5) = 66.3$, $p = 0.004$; Breusch–Pagan $\chi^2(1) = 16.7$, $p = 0.002$), ADHD/inattention symptoms (White $\chi^2(5) = 25.3$, $p = 0.020$; Breusch–Pagan $\chi^2(1) = 29.9$, $p = 0.015$), oppositional/defiant symptoms (White $\chi^2(5) = 44.5$, $p = 0.012$; Breusch–Pagan $\chi^2(1) = 18.5$, $p = 0.004$), and chronic irritability/disruptive mood dysregulation symptoms (White $\chi^2(5) = 66.5$, $p = 0.005$; Breusch–Pagan $\chi^2(1) = 32.3$, $p = 0.001$). Depressive symptoms demonstrated evidence of heteroskedasticity according to the White test only ($\chi^2(5) = 11.86$, $p = 0.037$), whereas the modified Breusch–Pagan test was non-significant ($\chi^2(1) = 0.52$, $p = 0.473$).

3.4 Associations of Food Insecurity with Children's Emotional and Behavioural Difficulties

School-based food insecurity was significantly associated with several symptom domains (see Table 4). Higher school-based food insecurity was associated with worry/anxiety symptoms ($\beta = 0.87$, 95% CI [-0.01, 1.76], $p = 0.003$), fear/panic/obsessive-compulsive/trauma-related/somatic symptoms ($\beta = 0.25$, 95% CI [-0.64, 1.14], $p = 0.017$), externalising difficulties ($\beta = 0.03$, 95% CI [-0.86, 0.91], $p = 0.029$), ADHD/inattention symptoms ($\beta = 0.08$, 95% CI [-0.81, 0.97], $p = 0.035$), oppositional/defiant symptoms ($\beta = -0.07$, 95% CI [-0.96, 0.81], $p = 0.031$), and chronic irritability/disruptive mood dysregulation symptoms ($\beta = -0.03$, 95% CI [-0.92, 0.85], $p = 0.044$).

Table 4

Associations between school-based food insecurity, household food insecurity, and mental health difficulties

Outcome	Model F(df1, df2)	R ²	SFIES β (95% CI)	CFIES β (95% CI)
CASI-5-T T-Score	1.27 (2, 658)	0.004	0.15 (-0.74, 1.04)	0.53 (-0.36, 1.42)
Internalising Composite	1.43 (2, 658)	0.004	0.35 (-0.54, 1.24)	-0.76 (-1.65, 0.13)
Worry/Anxiety (Category D)	4.14 (2, 658)*	0.12	0.87 (-0.01, 1.76)**	-1.27 (-2.16, -0.39)**
Fear/Panic/OCD/PTSD/Somatic (Category E)	2.58 (2, 658)	0.08	0.25 (-0.64, 1.14)*	-0.98 (-1.87, -0.10)*
Depressive Symptoms (Category F)	0.94 (2, 658)	0.03	0.26 (-0.63, 1.15)	-0.62 (-1.51, 0.27)
Social Anxiety/Shyness (Category K)	0.00 (2, 658)	< 0.001	-0.02 (-0.91, 0.87)	-0.00 (-0.89, 0.89)
Externalising Composite	3.26 (2, 658)*	0.10	0.03 (-0.86, 0.91)*	0.98 (0.09, 1.86)*
ADHD/Inattention (Category A)	3.10 (2, 658)*	0.09	0.08 (-0.81, 0.97)*	0.92 (0.04, 1.81)*
Hyperactivity/Impulsivity (Category B)	0.18 (2, 658)	0.001	-0.05 (-0.94, 0.85)	0.25 (-0.64, 1.14)
Oppositional/Defiant (Category C)	2.77 (2, 658)	0.08	-0.07 (-0.96, 0.81)*	0.95 (0.06, 1.84)*
Chronic Irritability/DMDD (Category Q)	2.59 (2, 658)	0.08	-0.03 (-0.92, 0.85)*	0.90 (0.01, 1.79)*
Aggression/School Violence (Category Rz)	0.16 (2, 658)	< 0.001	0.13 (-0.76, 1.02)	-0.26 (-1.15, 0.63)

Insert Table 4 about here

Household food insecurity similarly demonstrated significant associations with several symptom domains. Higher household food insecurity was associated with greater worry/anxiety symptoms ($\beta = -1.27$, 95% CI [-2.16, -0.39], $p = 0.005$), fear/panic/obsessive-compulsive/trauma-related/somatic symptoms ($\beta = -0.98$, 95% CI [-1.87, -0.10], $p = 0.030$), externalising difficulties ($\beta = 0.98$, 95% CI [0.09, 1.86], $p = 0.031$), ADHD/inattention symptoms ($\beta = 0.92$, 95% CI [0.04, 1.81], $p = 0.041$), oppositional/defiant symptoms ($\beta = 0.95$, 95% CI [0.06, 1.84], $p = 0.036$), and chronic irritability/disruptive mood dysregulation symptoms ($\beta = 0.90$, 95% CI [0.01, 1.79], $p = 0.047$).

At the model level, significant overall associations were observed for worry/anxiety symptoms, $F(2, 658) = 4.14$, $p = 0.016$, $R^2 = 0.012$; externalising difficulties, $F(2, 658) = 3.26$, $p = 0.039$, $R^2 = 0.010$; and ADHD/inattention symptoms, $F(2, 658) = 3.10$, $p = .046$, $R^2 = 0.009$. Models examining fear/panic/obsessive-compulsive/trauma-related/somatic symptoms, oppositional/defiant symptoms, and chronic irritability/disruptive mood dysregulation symptoms approached statistical significance, with F -statistics ranging from 2.58 to 2.77 ($p = 0.063$ – 0.077 ; $R^2 = 0.008$). The explained variance was also modest, ranging from < 0.001 to 0.012 (see Table 5).

Table 5

Interaction analyses examining the effects of household and school-based food insecurity on children's mental health difficulties

Outcome	Interaction β (unstandardised)	Robust SE (95% CI)	R^2	ΔR^2	Interpretation
Worry/Anxiety	-1.35	0.49 (-2.25, -0.45)**	0.013	0.001	Significant negative interaction
Fear/Panic/OCD/PTSD/Somatic	-0.94	0.47 (-1.86, -0.019)*	0.008	0.000	Significant negative interaction
Externalising Composite	0.86	0.35 (0.175, 1.547)*	0.012	0.002	Significant positive interaction
ADHD/Inattention	0.92	0.41 (0.114, 1.722)*	0.011	0.002	Significant positive interaction
Oppositional/Defiant	0.97	0.43 (0.129, 1.815)*	0.010	0.002	Significant positive interaction
Chronic Irritability/DMDD	1.09	0.47 (0.174, 2.016)*	0.011	0.003	Significant positive interaction

Insert Table 5 about here

Significant interaction effects (see Fig. 1) were observed for worry/anxiety symptoms ($\beta = -1.35$, $SE = 0.49$, $p = 0.006$), fear/panic/OCD/PTSD/somatic symptoms ($\beta = -0.94$, $SE = 0.47$, $p = 0.047$), externalising difficulties ($\beta = 0.86$, $SE = 0.35$, $p = 0.014$), ADHD/inattention symptoms ($\beta = 0.92$, $SE = 0.41$, $p = 0.025$), oppositional/defiant

symptoms ($\beta = 0.97, SE = 0.43, p = 0.024$), and chronic irritability/disruptive mood dysregulation symptoms ($\beta = 1.09, SE = 0.47, p = 0.020$).

Insert Fig. 1 about here

3.5 Association of Food Insecurity with Academic Performance

Household food insecurity was significantly associated with Literacy II/Social Studies achievement, $F(4, 649) = 3.59, p = 0.014$, but was not associated with the Academic Composite score, $F(4, 649) = 2.07, p = 0.104$, English achievement, $F(4, 649) = 1.09, p = 0.351$, Mathematics achievement, $F(4, 649) = 1.35, p = 0.259$, or Literacy I/Basic Science achievement, $F(4, 649) = 1.80, p = 0.147$.

School-based food insecurity was significantly associated with the Academic Composite score, $F(4, 649) = 2.41, p = 0.048$, Mathematics achievement, $F(4, 649) = 3.12, p = 0.015$, and Literacy II/Social Studies achievement, $F(4, 649) = 2.89, p = 0.022$. However, school-based food insecurity was not associated with English achievement, $F(4, 649) = 1.33, p = 0.257$, or Literacy I/Basic Science achievement, $F(4, 649) = 1.78, p = 0.131$.

Insert Table 6 about here

Table 6

Associations between household food insecurity, school-based food insecurity, and academic performance outcomes, adjusting for covariates

Predictor	Academic Composite SE (β)	English SE (β)	Mathematics SE (β)	Literacy I/Basic Science SE (β)	Literacy II/Social Studies SE (β)
Household Food Insecurity (CFIES)	2.07 (0.104)	1.09 (0.351)	1.35 (0.259)	1.80 (0.147)	3.59 (0.014*)
School Food Insecurity (SFIES)	2.41 (0.048*)	1.33 (0.257)	3.12 (0.015*)	1.78 (0.131)	2.89 (0.022*)
CFIES $\times$ SFIES (Interaction term)	1.40 (0.168)	0.88 (0.562)	1.79 (0.052)	1.28 (0.234)	1.15 (0.318)
Sex	-2.26 (< 0.001***)	-3.09 (< 0.001***)	-1.44 (0.031*)	-1.83 (0.003**)	-2.05 (0.001**)
Age	-2.23 (< 0.001***)	-1.68 (< 0.001***)	-2.13 (< 0.001***)	-2.17 (< 0.001***)	-2.34 (< 0.001***)
Sibship Size	-0.18 (0.162)	-0.19 (0.154)	-0.05 (0.736)	-0.27 (0.036*)	-0.16 (0.247)
Family Structure	1.52 (0.014*)	1.53 (0.014*)	1.74 (0.011*)	1.37 (0.028*)	1.05 (0.109)
Caregiver Occupation	-0.15 (0.645)	-0.04 (0.899)	-0.24 (0.493)	-0.08 (0.801)	-0.20 (0.557)
Child Status Index (CSI)	0.57 (0.003**)	0.61 (0.002**)	0.53 (0.012*)	0.58 (0.003**)	0.40 (0.049*)
Simplified Asset Index (SAI)	0.07 (0.501)	0.04 (0.705)	0.03 (0.815)	0.08 (0.439)	0.11 (0.301)
R ²	0.458	0.446	0.346	0.455	0.395
Adjusted R ²	0.436	0.423	0.320	0.433	0.370
Statistical significance: $p < 0.05$ (*), $p < 0.01$ (**), $p < 0.001$ (***).					

The interaction between household and school-based food insecurity was not statistically significant for the Academic Composite score, $F(16, 649) = 1.40$, $p = 0.168$, English achievement, $F(16, 649) = 0.88$, $p = 0.562$, Literacy I/Basic Science achievement, $F(16, 649) = 1.28$, $p = .234$, or Literacy II/Social Studies achievement, $F(16, 649) = 1.15$, $p = 0.318$. Although the interaction approached statistical significance for Mathematics achievement, $F(16, 649) = 1.79$, $p = 0.052$, it did not reach the conventional threshold for statistical significance.

Several covariates were independently associated with academic performance. Female sex was associated with lower Academic Composite scores ($\beta = -2.26$, $p < 0.001$), English achievement ($\beta = -3.09$, $p < 0.001$), Mathematics achievement ($\beta = -1.44$, $p = 0.031$), Literacy I/Basic Science achievement ($\beta = -1.83$, $p = 0.003$),

and Literacy II/Social Studies achievement ($\beta = -2.05, p = 0.001$). Older age was consistently associated with lower academic performance across all domains, including the Academic Composite score ($\beta = -2.23, p < 0.001$), English ($\beta = -1.68, p < 0.001$), Mathematics ($\beta = -2.13, p < 0.001$), Literacy I/Basic Science ($\beta = -2.17, p < 0.001$), and Literacy II/Social Studies ($\beta = -2.34, p < 0.001$).

Higher Child Status Index scores were associated with better academic performance across the Academic Composite score ($\beta = 0.57, p = 0.003$), English ($\beta = 0.61, p = 0.002$), Mathematics ($\beta = 0.53, p = 0.012$), Literacy I/Basic Science ($\beta = 0.58, p = 0.003$), and Literacy II/Social Studies ($\beta = 0.40, p = 0.049$). Compared with children living in extended families, those living with both biological parents in nuclear families, had higher Academic Composite scores ($\beta = 1.52, p = 0.014$), English achievement ($\beta = 1.53, p = 0.014$), Mathematics achievement ($\beta = 1.74, p = 0.011$), and Literacy I/Basic Science achievement ($\beta = 1.37, p = 0.028$), but not Literacy II/Social Studies achievement ($\beta = 1.05, p = 0.109$). Sibship size was negatively associated only with Literacy I/Basic Science achievement ($\beta = -0.27, p = 0.036$). Neither caregiver occupation nor household asset status was significantly associated with any academic performance outcome.

Full models explained between 34.6% and 45.8% of the variance in academic performance outcomes ($R^2 = 0.346$ – 0.458 ; adjusted $R^2 = 0.320$ – 0.436). The highest proportion of explained variance was observed for the Academic Composite score ($R^2 = 0.458$) and Literacy I/Basic Science achievement ($R^2 = 0.455$), whereas the Mathematics model explained the lowest proportion of variance ($R^2 = 0.346$).

4 Discussion

4.1 Overview of Key Findings

Four important findings emerged from this study. First, food insecurity was highly prevalent and broadly distributed across the study population, whereas elevated emotional and behavioural difficulties were concentrated among a smaller subgroup of children. Second, both household and school-based food insecurity were associated with specific emotional and behavioural symptom domains rather than overall psychopathology. Third, school-based food insecurity demonstrated more consistent associations with academic performance than household food insecurity. Finally, school-based food insecurity modified the association between household food insecurity and several emotional and behavioural outcomes, but did not modify the association with academic performance.

4.2 Prevalence and Distribution of Food Insecurity, Mental Health Difficulties, and Academic Performance

Food insecurity was highly prevalent and broadly distributed across the study population, consistent with evidence from low-resource settings indicating that it functions as a chronic, socially patterned developmental exposure affecting children across varying levels of severity [54, 55]. The greater variability observed in household food insecurity than in school-based food insecurity may reflect greater heterogeneity in household socioeconomic circumstances, whereas school environments expose children to more uniform structural conditions.

In contrast to the broad distribution of food insecurity, clinically significant emotional and behavioural difficulties were concentrated among a relatively small subgroup of children. Several symptom domains, including fear/panic/OCD/PTSD/somatic symptoms, depressive symptoms, chronic irritability/disruptive mood dysregulation symptoms, and aggression/school violence symptoms, demonstrated marked positive skewness and kurtosis, suggesting that exposure to food insecurity and related adversities does not result in uniform psychological outcomes. Rather, these findings support developmental psychopathology frameworks, which propose that children exposed to similar adversities exhibit varying patterns of vulnerability and resilience [11, 56]. This interpretation is consistent with previous studies reporting substantial heterogeneity in children's psychological responses to poverty, psychosocial stress, and household instability [3, 8, 57].

By contrast, academic performance was more evenly distributed across the study population, consistent with its approximately normal distribution. This pattern is consistent with ecological models of educational attainment, which propose that learning outcomes reflect the combined influence of nutrition, school quality, attendance, psychosocial functioning, household resources, and educational opportunities [37, 38]. Unlike emotional and behavioural difficulties, which were concentrated among a relatively small subgroup of children, the broader distribution of academic performance suggests that educational achievement is shaped by multiple interacting influences rather than food insecurity alone.

4.3 Associations Between Food Insecurity and Children's Emotional and Behavioural Difficulties

Consistent with hypotheses H1 and H3, both household and school-based food insecurity were associated with specific emotional and behavioural symptom domains but not with overall mental health difficulties or the internalising composite. Significant associations were observed for worry/anxiety, fear/panic/OCD/PTSD/somatic symptoms, ADHD/inattention, oppositional/defiant symptoms, chronic irritability/disruptive mood dysregulation symptoms, and externalising difficulties. This pattern is consistent with growing evidence that food insecurity influences specific dimensions of child mental health rather than broad psychopathology [8, 58, 59]. The stronger and more consistent associations observed for behavioural symptom domains also accord with previous studies linking food insecurity to attentional difficulties, irritability, aggression, emotional dysregulation, and disruptive behaviours among children and adolescents [6, 60, 61, 62].

Developmental psychopathology perspectives suggest that food insecurity may contribute to specific emotional and behavioural symptoms through chronic activation of physiological stress systems and disruptions in self-regulation, executive functioning, and emotional reactivity [11, 3, 8]. This interpretation is supported by developmental neuroscience evidence indicating that chronic adversity alters attentional control, behavioural regulation, and executive functioning through neurobiological stress-response mechanisms [63, 64, 65]. Such mechanisms may help explain the stronger associations observed for behavioural manifestations of distress, including ADHD/inattention, oppositional/defiant behaviour, chronic irritability/disruptive mood dysregulation, and broader externalising difficulties.

The findings for anxiety-related symptoms were more complex. Contrary to studies reporting positive associations between food insecurity and anxiety or emotional distress [12, 8, 66, 67], higher household food

insecurity was associated with lower levels of teacher-reported worry/anxiety and fear/panic/OCD/PTSD/somatic symptoms. One possible explanation is that emotional distress may manifest differently in contexts of chronic adversity, through withdrawal, resignation, reduced classroom participation, or behavioural adaptation rather than overt anxiety-related behaviours [67, 68, 69]. In addition, teachers may be better able to observe externalising behaviours than children's internal emotional experiences [70], while prolonged exposure to adversity may contribute to emotional disengagement or blunted affect, reducing the visibility of anxiety-related symptoms despite persistent psychosocial stress [3, 53].

Together, these findings suggest that food insecurity may be associated with specific emotional and behavioural symptom domains rather than broad elevations in psychopathology, highlighting the importance of examining individual symptom domains rather than relying solely on composite measures of children's mental health.

4.4 Associations between Food Insecurity and Academic Performance

Consistent with hypotheses H2 and H4, food insecurity was associated with academic performance, although the pattern differed across food insecurity contexts. School-based food insecurity demonstrated more consistent associations with academic outcomes than household food insecurity, being associated with overall academic performance, mathematics achievement, and literacy II/social studies achievement, whereas household food insecurity was associated only with literacy II/social studies achievement. These findings are broadly consistent with evidence that food insecurity impairs educational attainment through reduced concentration, attentional capacity, fatigue, executive functioning, and school engagement [12, 13, 18], and with studies reporting poorer academic achievement, school attendance, and cognitive performance among food-insecure children in both high-income and low- and middle-income countries [14, 6, 71]. The stronger associations observed for school-based food insecurity may reflect the more immediate effects of hunger during the school day on attention, memory, and classroom engagement, consistent with experimental and observational evidence linking short-term hunger to impaired cognitive performance and learning [72, 73, 74]. The more limited associations observed for household food insecurity may reflect contextual differences in educational systems, adaptation to chronic adversity, or the inclusion of multiple socioeconomic and developmental covariates in the present analyses [13, 14, 6].

Poorer academic performance may itself contribute to psychosocial stress through reduced self-esteem, negative academic feedback, strained relationships with teachers and peers, and greater exposure to disciplinary practices [15, 75]. Although academic performance was not examined as a mediating pathway in the present study, these findings highlight the potential interplay between educational functioning and children's mental health in food-insecure contexts, warranting further longitudinal investigation.

4.5 Moderating effect of School-Based Food Insecurity

Consistent with hypothesis H5, school-based food insecurity modified the associations between household food insecurity and several emotional and behavioural outcomes, including worry/anxiety, fear/panic/OCD/PTSD/somatic symptoms, externalising difficulties, ADHD/inattention, oppositional/defiant, and chronic irritability/disruptive mood dysregulation symptoms. Although the interaction effects explained

only a modest proportion of the variance, they suggest that the mental health consequences of household food insecurity may depend partly on children's experiences of food insecurity within school environments.

For worry/anxiety and fear/panic/OCD/PTSD/somatic symptoms, increasing school-based food insecurity attenuated the associations with household food insecurity. As discussed earlier, this counterintuitive pattern may reflect differences in the expression and recognition of internalising symptoms under conditions of chronic adversity. Repeated exposure to adversity may contribute to emotional suppression, withdrawal, adaptation, or stress habituation [3, 76], while deprivation may alter emotional and neurodevelopmental processes in ways that influence behavioural manifestations of distress [77]. The possibility that teachers are less able to detect internalising than externalising symptoms [78] should also be considered when interpreting these findings and represents an important limitation of teacher-reported assessments.

In contrast, school-based food insecurity strengthened the associations between household food insecurity and behavioural symptom domains, including externalising difficulties, ADHD/inattention, oppositional/defiant, and chronic irritability/disruptive mood dysregulation symptoms. These findings are consistent with cumulative-risk frameworks, which propose that multiple adversities interact to undermine children's developmental functioning [79, 80, 81]. Concurrent exposure to food insecurity across household and school environments may increase cumulative stress and self-regulatory demands, thereby compromising attentional control, emotional regulation, and behavioural functioning [82].

School-based food insecurity did not modify the associations between household food insecurity and academic performance. One possible explanation is that academic performance represents a cumulative developmental outcome shaped by multiple influences, including prior learning, instructional quality, school attendance, household resources, and cognitive ability, whereas emotional and behavioural symptoms may be more responsive to children's immediate experiences across home and school contexts. Consequently, although school-based food insecurity may alter the emotional and behavioural consequences of household food insecurity, its additional contribution to academic performance may be less readily detectable. This interpretation is consistent with evidence suggesting that schools may partially buffer household disadvantage through school feeding programmes, supportive teacher relationships, and peer networks [71, 83]. Academic performance may have been influenced by many educational, developmental, and socioeconomic factors, and the small moderating effect of school-based food insecurity on the association between household food insecurity and performance may be overshadowed by these broader factors [84].

Collectively, these findings support ecological models of child development, which emphasise that developmental outcomes arise through interactions across multiple environmental systems, including home and school [85, 86]. They further suggest that assessing children's experiences of food insecurity across both contexts may provide a more comprehensive understanding of their emotional and behavioural functioning than relying on household measures alone.

4.6 Strengths and Limitations

This study has several strengths. To our knowledge, it is among the first studies on the African continent to simultaneously examine household food insecurity, school-based food insecurity, children's emotional and behavioural difficulties, and academic performance within a single analytical framework [2]. Additional

strengths include the large sample of school-aged children, the use of a child-centred measure of school-based food insecurity, the examination of specific emotional and behavioural symptom domains rather than global mental health indicators, the inclusion of objective school-record measures of academic performance, and adjustment for school clustering and a broad range of sociodemographic and household covariates.

Several limitations should be acknowledged. First, the cross-sectional design precludes causal inference and prevents conclusions regarding the temporal ordering of household food insecurity, school-based food insecurity, children's emotional and behavioural difficulties, and academic performance. Consequently, it remains unclear whether food insecurity precedes these outcomes or whether bidirectional relationships exist. Longitudinal studies are needed to clarify developmental pathways and establish temporal ordering. Second, emotional and behavioural outcomes were assessed using teacher reports, which may be less sensitive than child self-report measures for detecting internalising symptoms such as anxiety [78]. This may partly explain the inverse associations observed for some anxiety-related symptom domains, which should therefore be interpreted cautiously. Future studies should incorporate multiple informants, including teachers, caregivers, and children, to provide a more comprehensive assessment of children's emotional and behavioural functioning. Third, the study was conducted within a single district in Uganda, which may limit the generalisability of the findings to other geographical, cultural, and educational contexts. Replication in other regions of Uganda and across sub-Saharan Africa would help establish the external validity of these findings.

Finally, although analyses adjusted for school clustering and a broad range of sociodemographic and household characteristics, residual confounding from unmeasured factors cannot be excluded. Future research should consider additional determinants, including school quality, caregiver mental health, parenting practices, and neighbourhood characteristics, to further elucidate the associations between household and school-based food insecurity with children's mental health and educational outcomes.

5 Conclusions

Household and school-based food insecurity were associated with specific emotional, behavioural, and academic outcomes among primary school children in Uganda. School-based food insecurity additionally modified the associations between household food insecurity and several emotional and behavioural symptom domains, demonstrating that children's experiences of food insecurity within school settings provide important information beyond household measures alone. These findings highlight school-based food insecurity as a distinct developmental exposure rather than simply a proxy for household food insecurity and support integrated interventions that address food insecurity across both household and school settings to promote children's mental health, well-being, and educational outcomes.

Declarations

Ethics approval and consent to participate

Ethical approval for this study was obtained from the King's College London Research Ethics Committee (Reference: HR/DP-23/24-42553), the Uganda Virus Research Institute Research Ethics Committee (Reference: GC/127/1046), and the Uganda National Council for Science and Technology (Reference:

HS4997ES). Written informed consent was obtained from parents or legal guardians, written assent was obtained from participating children, and written informed consent was obtained from participating teachers before data collection. All procedures were conducted in accordance with the Declaration of Helsinki and relevant national ethical guidelines.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

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Author Contribution

IK conceived the study, developed the methodology, conducted the investigation, curated the data, performed the formal analyses, and wrote the original draft of the manuscript. CL contributed to the study conceptualisation and methodology, supervised the research, and critically reviewed and edited the manuscript. TTS contributed to the study conceptualisation and methodology, supervised the research, and critically reviewed and edited the manuscript. JKA contributed to the study conceptualisation and methodology and critically reviewed and edited the manuscript. HMQ contributed to the study conceptualisation and methodology and critically reviewed and edited the manuscript. All authors read and approved the final manuscript.

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Data Availability

The datasets generated and analysed during the current study are not publicly available because they contain sensitive information from child participants and are subject to ethical and confidentiality restrictions. De-identified data may be made available by the corresponding author upon reasonable request, subject to approval by the relevant institutional ethics committees and applicable data-sharing agreements.

References

1. World Health Organization. International Fund for Agricultural Development, United Nations Children's Fund, World Food Programme. The State of Food Security and Nutrition in the World 2023: Urbanization, agrifood systems transformation and healthy diets across the rural–urban continuum. Rome: FAO; 2023. 10.4060/cc3017en.
2. Kasujja I, Lund C, Taylor Salisbury T. Food insecurity and mental health among children and adolescents in sub-Saharan Africa: a systematic review. *Child Youth Serv Rev*. 2025;177:108493. 10.1016/j.chilyouth.2025.108493.
3. Evans GW, Kim P. Childhood poverty, chronic stress, self-regulation, and coping. *Child Dev Perspect*. 2013;7(1):43–8. 10.1111/cdep.12013.
4. Blair C, Raver CC. Poverty, stress, and brain development: new directions for prevention and intervention. *Acad Pediatr*. 2016;16(3 Suppl):S30–6. 10.1016/j.acap.2016.01.010.
5. Belot M, James J. Healthy school meals and educational outcomes. *J Health Econ*. 2011;30(3):489–504. 10.1016/j.jhealeco.2011.02.003.
6. Shankar P, Chung R, Frank DA. Association of food insecurity with children's behavioral, emotional, and academic outcomes: a systematic review. *J Dev Behav Pediatr*. 2017;38(2):135–50. 10.1097/DBP.0000000000000383.
7. Whitaker RC, Phillips SM, Orzol SM. Food insecurity and the risks of depression and anxiety in mothers and behavior problems in their preschool-aged children. *Pediatrics*. 2006;118(3):e859–68. 10.1542/peds.2006-0239.
8. McLaughlin KA, Green JG, Alegría M, Costello EJ, Gruber MJ, Sampson NA, Kessler RC. Food insecurity and mental disorders in a national sample of U.S. adolescents. *J Am Acad Child Adolesc Psychiatry*. 2012;51(12):1293–303. 10.1016/j.jaac.2012.09.009.

9. Caspi A, Houts RM, Belsky DW, Goldman-Mellor SJ, Harrington H, Israel S, et al. The p factor: one general psychopathology factor in the structure of psychiatric disorders? *Clin Psychol Sci*. 2014;2(2):119–37. 10.1177/2167702613497473.
10. Kotov R, Krueger RF, Watson D, Achenbach TM, Althoff RR, Bagby RM, et al. The Hierarchical Taxonomy of Psychopathology (HiTOP): a dimensional alternative to traditional nosologies. *J Abnorm Psychol*. 2017;126(4):454–77. 10.1037/abn0000258.
11. Cicchetti D, Toth SL. The past achievements and future promises of developmental psychopathology: the coming of age of a discipline. *J Child Psychol Psychiatry*. 2009;50(1–2):16–25. 10.1111/j.1469-7610.2008.01979.x.
12. Alaimo K, Olson CM, Frongillo EA Jr. Food insufficiency and American school-aged children's cognitive, academic, and psychosocial development. *Pediatrics*. 2001;108(1):44–53. 10.1542/peds.108.1.44.
13. Jyoti DF, Frongillo EA, Jones SJ. Food insecurity affects school children's academic performance, weight gain, and social skills. *J Nutr*. 2005;135(12):2831–9. 10.1093/jn/135.12.2831.
14. Belachew T, Hadley C, Lindstrom D, Gebremariam A, Michael K, Getachew Y. Food insecurity, school absenteeism and educational attainment of adolescents in Jimma Zone, Southwest Ethiopia. *Paediatr Int Child Health*. 2011;31(1):29–35. 10.1186/1475-2891-10-29.
15. Masten AS, Roisman GI, Long JD, Burt KB, Obradović J, Riley JR, et al. Developmental cascades: linking academic achievement and externalizing and internalizing symptoms over 20 years. *Dev Psychol*. 2005;41(5):733–46. 10.1037/0012-1649.41.5.733.
16. Gustafsson JE, Allodi MW, Alin-Åkerman B, Eriksson C, Eriksson L, Fischbein S, et al. School, learning and mental health: a systematic review. Stockholm: Health Committee, Royal Swedish Academy of Sciences;; 2010.
17. McLeod JD, Uemura R, Rohrman S. Adolescent mental health, behavior problems, and academic achievement. *J Health Soc Behav*. 2012;53(4):482–97. 10.1177/0022146512455426.
18. Gundersen C, Ziliak JP. Food insecurity and health outcomes. *Health Aff (Millwood)*. 2015;34(11):1830–9. 10.1377/hlthaff.2015.0645.
19. Kasujja I, Asiimwe JK, Melgar-Quinonez H, Lund C, Taylor Salisbury T. Food insecurity and child mental health in Masaka District, Uganda: Qualitative study using a realist thematic analysis. *Camb Prisms: Global Mental Health*. 2026a;13:e123. 10.1017/gmh.2026.10232.
20. Noor RA, Paulo HA, Shinde S, Tadesse AW, et al. School health and nutrition environments: a multicountry survey in five countries of sub-Saharan Africa—Burkina Faso, Ethiopia, South Africa, Sudan, and Tanzania. *Matern Child Nutr*. 2025;21(Suppl 1):e13614. 10.1111/mcn.13614.
21. Connell CL, Lofton KL, Yadrick K, Rehner TA. Children's experiences of food insecurity can assist in understanding its effect on their well-being. *J Nutr*. 2005;135(7):1683–90. 10.1093/jn/135.7.1683.
22. Connell CL, Nord M, Lofton KL, Yadrick K. Food security of older children can be assessed using a standardized survey instrument. *J Nutr*. 2004;134(10):2566–72. 10.1093/jn/134.10.2566.
23. Kasujja I, Asiimwe JK, Melgar-Quinonez H, Lund C, Salisbury TT. Development and psychometric evaluation of the School- based Food Insecurity Experience Scale in Masaka District, Uganda. *Popul Health Metrics Preprint*. 2026b. 10.2139/ssrn.6680898.

24. Kasujja I, Asiimwe JK, Melgar-Quinonez H, Lund C, Salisbury TT. Children's experiences of food insecurity, emotional and behavioural states in Masaka District, Uganda: A qualitative study using a multi-modal, interpretivist paradigm. *SSM – Mental Health Adv* online publication. 2026c;910.1016/j.ssmmh.2026.100650.
25. Levin KA. Study design III: Cross-sectional studies. *Evid Based Dent*. 2006;7(1):24–5. 10.1038/sj.ebd.6400375.
26. Gadow KD, Sprafkin J. Child and Adolescent Symptom Inventory-5 (CASI-5): Technical Manual. Stony Brook (NY): Checkmate Plus; 2013. <https://eprovide.mapi-trust.org/instruments/child-and-adolescent-symptom-inventory-5-teacher-version>
27. Willis G, Cognitive Interviewing. A Tool for Improving Questionnaire Design. Thousand Oaks, CA: Sage; 2005. 10.1037/e538062007-001.
28. Graham A, Powell MA, Taylor N, Anderson D, Fitzgerald R. Ethical Research Involving Children. Florence: UNICEF Office of Research; 2013. <https://www.unicef.org/innocenti/media/9181/file/Ethical-Research-Involving-Children-compendium-2013-EN.pdf>.
29. Nord M, Cafiero C, Viviani S. Methods for estimating comparable prevalence rates of food insecurity experienced by adults throughout the world. Rome: Food and Agriculture Organization; 2016. 10.1088/1742-6596/772/1/012060.
30. Council for International Organizations of Medical Sciences (CIOMS). International ethical guidelines for health-related research involving humans. Geneva: CIOMS; 2016. <https://cioms.ch/wp-content/uploads/2017/01/WEB-CIOMS-EthicalGuidelines.pdf>.
31. Frongillo EA, Fram MS, Ghattas H, Bernal J, Jamaluddine Z, Kirkpatrick SI, et al. Development, validity, and cross-context equivalence of the Child Food Insecurity Experiences Scale for assessing food insecurity of school-age children and adolescents. *J Nutr*. 2022;152(9):2135–44. 10.1093/jn/nxac127.
32. Radimer KL, Olson CM, Greene JC, Campbell CC, Habicht JP. Understanding hunger and developing indicators to assess it in women and children. *J Nutr Educ*. 1992;24(1):S36–44. 10.1016/S0022-3182(12)80137-3.
33. Fram MS, Frongillo EA, Draper CL, Fishbein EM. Development and validation of a child report assessment of child food insecurity and comparison to parent report assessment. *J Hunger Environ Nutr*. 2013;8(2):128–45. 10.1080/19320248.2013.790775.
34. Coates J, Swindale A, Bilinsky P. Household Food Insecurity Access Scale (HFIAS) for Measurement of Household Food Access: Indicator Guide (Version 3). Washington (DC): Food and Nutrition Technical Assistance Project (FANTA); 2007. https://www.fantaproject.org/sites/default/files/resources/HFIAS_ENG_v3_Aug07.pdf
35. Bernal J, Frongillo EA, Herrera HA, Rivera JA. Food insecurity in children but not in their mothers is associated with altered activities, school absenteeism, and stunting. *J Nutr*. 2014;144(10):1619–26. 10.3945/jn.113.189985.
36. Achenbach TM, Rescorla LA. Manual for the ASEBA School-Age Forms & Profiles. Burlington (VT). University of Vermont, Research Center for Children, Youth, & Families; 2001. <https://aseba.org/wp-content/uploads/School-age-bpm-manual.pdf>.

37. Bradley RH, Corwyn RF. Socioeconomic status and child development. *Annu Rev Psychol.* 2002;53:371–99. 10.1146/annurev.psych.53.100901.135233.
38. Duncan GJ, Magnuson K, Votruba-Drzal E. Moving beyond correlations in assessing the consequences of poverty. *Annu Rev Psychol.* 2017;68:413–34. 10.1146/annurev-psych-010416-044224.
39. Chakraborty NM, Fry K, Behl R, Longfield K. Simplified asset indices to measure wealth and equity in health programs: a reliability and validity analysis using survey data from 16 countries. *Glob Health Sci Pract.* 2016;4(1):141–54. 10.9745/GHSP-D-15-00384.
40. Filmer D, Pritchett LH. Estimating wealth effects without expenditure data—or tears: an application to educational enrollments in states of India. *Demography.* 2001;38(1):115–32. 10.1353/dem.2001.0003.
41. Howe LD, Hargreaves JR, Huttly SRA. Issues in the construction of wealth indices for the measurement of socioeconomic position in low-income countries. *Emerg Themes Epidemiol.* 2008;5:3. 10.1186/1742-7622-5-3.
42. Mutenyo F, Machingaidze S, Okello W, et al. Multistage Processes of Identifying Children at Risk or Out of Family Care: a Case of DOVCU Project Methods in Uganda. *Glob Soc Welf.* 2020;7:201–13. 10.1007/s40609-019-00140-9.
43. United States Agency for International Development (USAID). The Child Status Index: A Tool for Assessing the Well-Being of Orphans and Vulnerable Children. Washington (DC): USAID; 2009. <https://www.hciproject.org/node/1237/>.
44. O'Donnell K, Nyangara F, Murphy R. Child Status Index: A tool for assessing the well-being of orphans and vulnerable children. *Eval Program Plan.* 2014;43:111–8. <https://www.measureevaluation.org/resources/publications/ms-08-31a.html>.
45. Victora CG, Huttly SRA, Fuchs SC, Olinto MTA. The role of conceptual frameworks in epidemiological analysis: a hierarchical approach. *Int J Epidemiol.* 1997;26(1):224–7. 10.1093/ije/26.1.224.
46. Beaton DE, Bombardier C, Guillemin F, Ferraz MB. Guidelines for the process of cross-cultural adaptation of self-report measures. *Spine (Phila Pa 1976).* 2000;25(24):3186–91. 10.1097/00007632-200012150-00014.
47. Beatty PC, Willis GB. Research synthesis: the practice of cognitive interviewing. *Public Opin Q.* 2007;71(2):287–311. 10.1093/poq/nfm006.
48. Aiken LS, West SG. Multiple Regression: Testing and Interpreting Interactions. Newbury Park (CA). Sage; 1991. <https://www.scribd.com/document/792759395/Aiken-L-Multiple-Regression.-Testing-and-Interpreting-1991>.
49. Cohen J, Cohen P, West SG, Aiken LS. Applied Multiple Regression/Correlation Analysis for the Behavioral Sciences. 3rd ed. Mahwah (NJ): Lawrence Erlbaum Associates; 2003. 10.4324/9780203774441.
50. Royston P, Altman DG, Sauerbrei W. Dichotomizing continuous predictors in multiple regression: a bad idea. *Stat Med.* 2006;25(1):127–41. 10.1002/sim.2331.
51. Little RJA, Rubin DB. Statistical analysis with missing data. 2nd ed. New York: Wiley-Interscience; 2002. 10.1002/9781119013563.
52. Graham JW, Olchowski AE, Gilreath TD. How many imputations are really needed? Some practical clarifications of multiple imputation theory. *Prev Sci.* 2007;8(3):206–13. 10.1007/s11121-007-0070-9.

53. Rubin DB. Multiple imputation for nonresponse in surveys. Wiley; 1987.
54. FAO et al. (2023). The State of Food Security and Nutrition in the World 2023. Urbanization, agrifood systems transformation and healthy diets across the rural–urban continuum. Rome, FAO. 10.4060/cc3017en
55. Gundersen C, Ziliak JP. Food insecurity and health outcomes. *Health Aff.* 2005;34(11):1830–9. 10.1377/hlthaff.2015.0645.
56. Masten AS. Ordinary magic: Resilience in development. Guilford Press; 2014.
57. Yoshikawa H, Aber JL, Beardslee WR. The effects of poverty on the mental, emotional, and behavioral health of children and youth. *Am Psychol.* 2012;67(4):272–84. 10.1037/a0028015.
58. Fram MS, Ritchie LD, Rosen N, Frongillo EA. Child experience of food insecurity is associated with child diet and physical activity. *J Nutr.* 2015;145(3):499–504. 10.3945/jn.114.194365.
59. Melchior M, Chastang JF, Falissard B, Galéra C, Tremblay RE, Côté SM, Boivin M. Food insecurity and children's mental health: a prospective birth cohort study. *PLoS ONE.* 2012;7(12):e52615. 10.1371/journal.pone.0052615.
60. Slopen N, Fitzmaurice G, Williams DR, Gilman SE. Poverty, food insecurity, and the behavior for childhood internalizing and externalizing disorders. *J Am Acad Child Adolesc Psychiatry.* 2010;49(5):444–52. 10.1016/j.jaac.2010.01.018.
61. Howard LL. Does food insecurity at home affect non-cognitive performance at school? A longitudinal analysis of elementary student classroom behavior. *Econ Educ Rev.* 2011;30(1):157–76. 10.1016/j.econedurev.2010.08.003.
62. Johnson AD, Markowitz AJ. Food insecurity and family well-being outcomes among households with young children. *J Pediatr.* 2018;196:275–e2821. 10.1016/j.jpeds.2018.01.045.
63. McEwen BS. Protective and damaging effects of stress mediators. *N Engl J Med.* 1998;338(3):171–9. 10.1056/NEJM199801153380307.
64. Blair C, Raver CC. Poverty, stress, and brain development: New directions for prevention and intervention. *Acad Pediatr.* 2016;16(3 Suppl):S30–6. 10.1016/j.acap.2016.01.010.
65. Blair C. School readiness: Integrating cognition and emotion in a neurobiological conceptualization of children's functioning at school entry. *Am Psychol.* 2002;57(2):111–27. 10.1037/0003-066X.57.2.111.
66. Murray AL, Eisner M, Ribeaud D. Developmental relations between internalising symptoms, externalising symptoms and aggressive behaviour in adolescence. *J Adolesc.* 2021;91:1–13. 10.1016/j.adolescence.2021.07.003.
67. Poole-Di Salvo E, Silver EJ, Stein REK. Household food insecurity and mental health problems among adolescents: What do parents report? *Acad Pediatr.* 2016;16(1):90–6. 10.1016/j.acap.2015.08.005.
68. Murray AL, Eisner M, Ribeaud D. Developmental relations between internalising symptoms, externalising symptoms and aggressive behaviour in adolescence. *J Adolesc.* 2021;91:1–13. 10.1016/j.adolescence.2021.07.003.
69. Patel V, Flisher AJ, Hetrick S, McGorry P. Mental health of young people: A global public-health challenge. *Lancet.* 2007;369(9569):1302–13. 10.1016/S0140-6736(07)60368-7.

70. Achenbach TM, McConaughy SH, Howell CT. Child/adolescent behavioral and emotional problems: Implications of cross-informant correlations for situational specificity. *Psychol Bull.* 1987;101(2):213–32. 10.1037/0033-2909.101.2.213.
71. Aurino E, Tranchant JP, Diallo AS, Gelli A. School feeding or general food distribution? Quasi-experimental evidence on the educational impacts of emergency food assistance during conflict in Mali. *J Dev Stud.* 2020;56(5):945–64. 10.1080/00220388.2019.1687874.
72. Pollitt E, Cueto S, Jacoby ER. Fasting and cognition in well- and undernourished schoolchildren: a review of three experimental studies. *Am J Clin Nutr.* 1998;67(4 Suppl):S779–84. 10.1093/ajcn/67.4.779S.
73. Hoyland A, Dye L, Lawton CL. A systematic review of the effect of breakfast on the cognitive performance of children and adolescents. *Nutr Res Rev.* 2009;22(2):220–43. 10.1017/S0954422409990175.
74. Adolphus K, Lawton CL, Dye L. The effects of breakfast on behavior and academic performance in children and adolescents. *Front Hum Neurosci.* 2013;7:425. 10.3389/fnhum.2013.00425.
75. Zhu M, Urhahne D, Rubie-Davies CM. The longitudinal effects of teacher judgement and different teacher treatment on students' academic outcomes. *Educ Psychol.* 2018;38(5):648–68. 10.1080/01443410.2017.1412399.
76. McEwen BS, Gianaros PJ. Central role of the brain in stress and adaptation: Links to socioeconomic status, health, and disease. *Ann N Y Acad Sci.* 2010;1186:190–222. 10.1111/j.1749-6632.2009.05331.x.
77. McLaughlin KA, Sheridan MA, Lambert HK. Childhood adversity and neural development: Deprivation and threat as distinct dimensions of early experience. *Neurosci Biobehav Rev.* 2014;47:578–91. 10.1016/j.neubiorev.2014.10.012.
78. Reinke WM, Stormont M, Herman KC, Puri R, Goel N. Supporting children's mental health in schools: Teacher perceptions of needs, roles, and barriers. *Sch Psychol Q.* 2011;26(1):1–13. 10.1037/a0022714.
79. Sameroff AJ, Seifer R, Baldwin A, Baldwin C. Stability of intelligence from preschool to adolescence: The influence of social and family risk factors. *Child Dev.* 1993;64(1):80–97. 10.2307/1131438.
80. Sameroff AJ. Developmental systems and psychopathology. *Dev Psychopathol.* 2000;12(3):297–312. 10.1017/S0954579400003035.
81. Appleyard K, Egeland B, van Dulmen MHM, Sroufe LA. When more is not better: The role of cumulative risk in child behavior outcomes. *J Child Psychol Psychiatry.* 2005;46(3):235–45. 10.1111/j.1469-7610.2004.00351.x.
82. Evans GW, Li D, Whipple SS. Cumulative risk and child development. *Psychol Bull.* 2013;139(6):1342–96. 10.1037/a0031808.
83. Kristjansson EA, Robinson V, Petticrew M, MacDonald B, Krasevec J, Janzen L, et al. School feeding for improving the physical and psychosocial health of disadvantaged elementary school children. *Cochrane Database Syst Rev.* 2007;1CD004676. 10.1002/14651858.CD004676.pub2.
84. Kristjansson EA, Gelli A, Welch V, Greenhalgh T, Liberato S, Francis D et al. Costs, and cost-outcome of school feeding programmes and feeding programmes for young children. 2016;48(C), 79–83. 10.1016/j.ijedudev.2015.11.011
85. Bronfenbrenner U. The ecology of human development: Experiments by nature and design. Cambridge (MA): Harvard University Press; 1979.

86. Bronfenbrenner U, Morris PA. The bioecological model of human development. In: Damon W, Lerner RM, editors. Handbook of child psychology. Theoretical models of human development. Volume 1, 6th ed. Hoboken (NJ): Wiley; 2006. pp. 793–828.

Figures

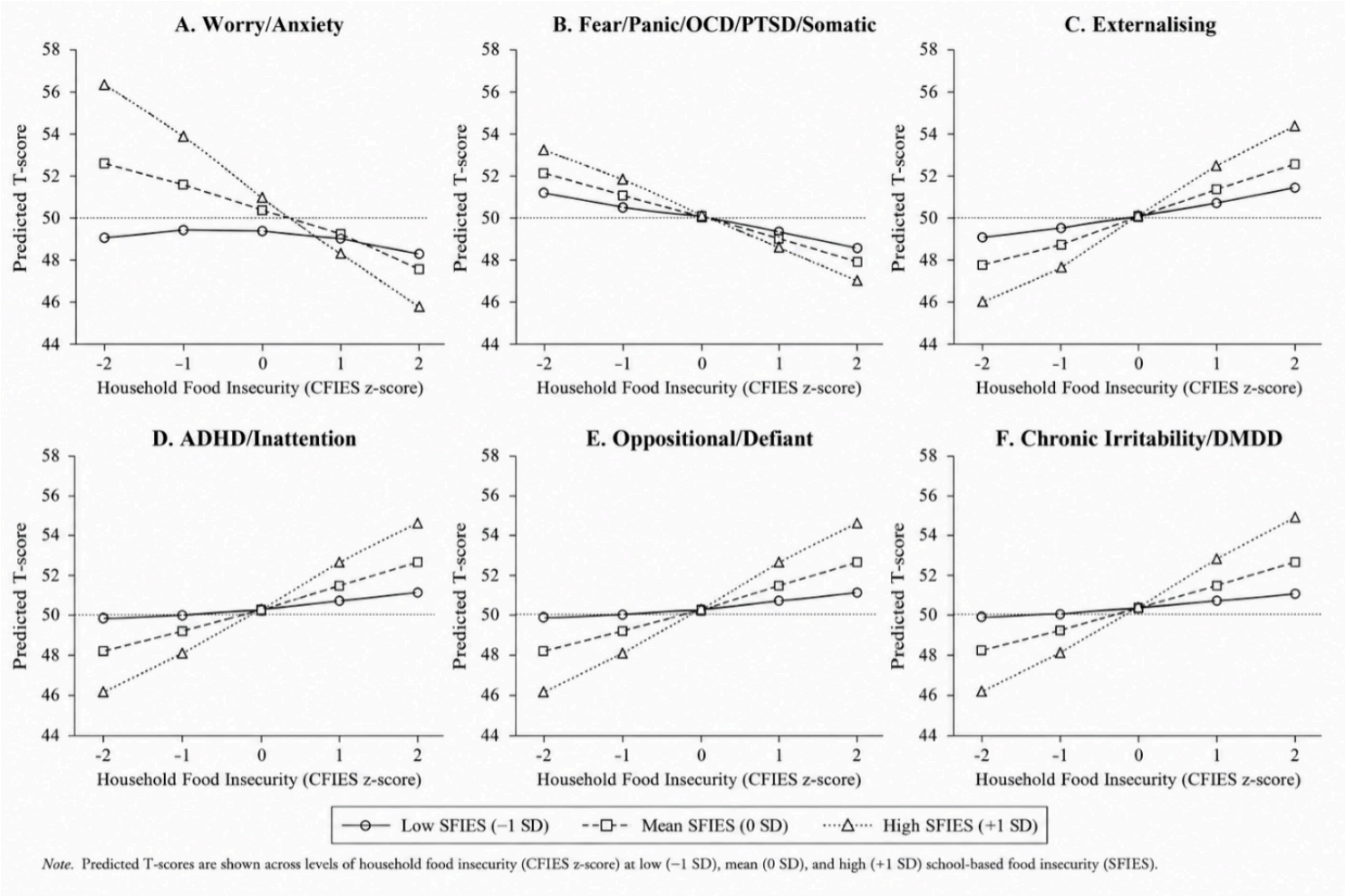


Figure 1

Significant interaction effects differed by symptom domain.