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# NUTRITIONAL CHALLENGES FACING TERTIARY STUDENTS IN AFRICA AND THEIR RELATIONSHIP WITH LEARNING OUTCOMES: A STRUCTURED EVIDENCE REVIEW

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## ABSTRACT

**Background:** Food insecurity, hunger, and irregular meal patterns are common among tertiary students and may affect learning-related outcomes. However, evidence from Africa has not been synthesized separately from evidence that is mostly produced in high income countries.

**Objective:** To summarize and review the reported relationships between food insecurity, hunger, meal skipping or meal frequency, and diet proxies and learning outcomes of tertiary students in Africa and to evaluate the constraints and applicability of the evidence.

**Methods:** A structured systematic review was performed, using the PRISMA 2020 guidelines. No protocol could be found. The articles published from 2015 to 2026 were retrieved from PubMed, Scopus, Web of Science, CINAHL, PsycINFO, African Journals Online, Google Scholar, and open-web sources. The studies included were tertiary level students from Africa that reported food insecurity, hunger, meal skipping or meal frequency, or a proxy measure of food intake, and at least one learning related outcome. Comparative quantitative food insecurity or hunger or meal-pattern study (with food-secure students or students with better feeding) were eligible and included in the synthesis separately, as were qualitative and descriptive studies (without a comparator). Records were screened by two reviewers and data

were extracted and critically appraised by a third reviewer, using Joanna Briggs Institute checklists. Narrative synthesis of studies was conducted by the outcome and no meta-analysis, pooling or vote counting was done.

**Results:** Of 71 records screened, nine studies were eligible: six were from South Africa, one was from Nigeria, one was from Uganda and one was multi-country with nine African countries. In two South African studies based on institutional records, students with little or no hunger were found to have higher odds of academic progression compared with students experiencing hunger (adjusted odds ratio [OR] = 1.88, 95% confidence interval [CI] 1.45–2.42) and moderate food insecurity was associated with higher odds of dropping out (OR = 2.50, 95% CI 1.12–5.55), whereas mild and severe food insecurity were not. There was inconsistent and limited evidence for students' own perceptions of their academic performance. For Africa, the indirect finding for rarely or never eating breakfast and self-reported unsatisfactory academic performance (adjusted OR = 1.40, 95% CI 1.11–1.78) was found in a pooled multi-country analysis. A Ugandan study identified positive associations between frequency of breakfast consumption or of regular meals and self-reported CGPA, which were statistically significant as unadjusted correlations but not in adjusted regression. Record-based comparisons were available only for progression and dropout; for concentration and attendance, studies have reported only that hunger or food insecurity was perceived to have a negative impact on people's ability to concentrate and attend classes. The evidence was of low to very low quality.

**Conclusions:** Based on the evidence available, there is a possible link between food insecurity, hunger, missing meals and decreased learning outcomes for tertiary students in Africa. The evidence base is, however, limited, mostly cross-sectional, geographically limited and mostly based on self-reported or perceived outcomes. The results do not prove causation or provide reliable estimates of the size of effects. Future studies would benefit from longitudinal study designs, reliable and/or clearly operationalized food insecurity and meal patterns, and the inclusion of appropriate controls for confounding.

**Keywords:** Food Insecurity; Hunger; Meal Skipping; Tertiary Students; Academic Performance; Africa; Systematic Review

## 1 INTRODUCTION

Food insecurity is the situation in which people do not have adequate, sufficient food to enjoy an active, healthy life. Tertiary students are frequently assumed to be a privileged group (Loofbourrow & Scherr, 2023) but at the same time they are often managing for the first time their own budgets, schedules and living arrangements, and may have to rely on loans, allowances or irregular family support. A systematic review of 47 studies on higher education students, 37 of the studies in the U.S., found a weighted mean prevalence of 44.03% and a negative association between food insecurity and academic performance, in most studies (Galseku et al., 2026). A related literature has been found which also correlates school performance to missing meals and meals missed at breakfast, but most of the studies in this regard took place outside of Africa.

This fact cannot be just copied and pasted into Africa. There is no validated food insecurity instrument for students because their food resources (meal plans, food aid, family support) are different from those of households and prevalence rates are different across varying scales and time frames of food insecurity (Ellison et al., 2021). The global scoping review revealed that the majority of studies identified in this review were conducted in the USA (n = 69) (Afsharkohan et al., 2026) and there are important research gaps in screening, longitudinal design, and programme evaluation (Landry et al., 2024). The food, student financing and accommodation contexts of Africa vary from those in high income countries: for instance, South African authors have found that food assistance is inadequate for food needs (Sabi et al., 2018) and that food and housing deprivation can lead to exclusion from higher education (Dominguez-Whitehead, 2017). The prevalence of moderate or severe hunger (Household Hunger score) ranges from 7% in one South African university (Rudolph et al., 2018) to 84% - 91% across other universities (Jonker & Walsh, 2025, 2025; Sealetse & Kleynhans, 2026), likely reflecting variation in instruments and time frames of recall. Prevalence alone does not, therefore, tell much about learning.

Syntheses identified for this review focus on outcomes of learning from studies conducted in a global context, and are primarily from high-income countries with none done on learning related outcomes for tertiary students from Africa (Afsharkohan et al., 2026; Galseku et al., 2026). The diets or prevalence that are described in most of the primary studies in Africa are not measured by any learning outcome, and in those that are measured, there is variation in the learning outcome exposure, the learning outcome, and the design. It remains uncertain what African evidence suggests: Is there a relationship between feeding and learning and is it reliable?

This review was designed to combine the evidence and assess the methodological issues and applicability of evidence on associations between food insecurity or meal skipping, and dietary proxies of food intake as an indirect exposure category among tertiary students in Africa and learning-related outcomes.

## 2 METHODS

### 2.1 Review design, protocol and amendments

This is a systematic evidence review (structured, if applicable). It is reported in response to PRISMA 2020 statement (Page et al., 2021) and synthesis is undertaken according to the guidelines of Synthesis Without Meta-analysis (SWiM) (Campbell et al., 2020). The protocol is not registered. The review started with four objectives (meal frequency, meal quality and affordability, attendance and concentration, and academic performance) and the initial eligibility criteria were tightened following a first series of studies' reading.

Following the screening of all 71 records and subsequent reading of the full text of the 21 studies that were eligible, 12 studies were identified which reported feeding patterns and/or the prevalence of food insecurity, but not a learning-related outcome. Learning-related outcomes were thus selected as the review question (Table 1; Supplementary Table S1).

This amendment was made post full-text reading, which may have been influenced by the content of the supplementary studies included. The revised eligibility criteria were simply based on whether a study included or reported a learning related outcome – not on the direction, amplitude or statistical significance of the results. The 12 reclassified studies and reasons for the exclusion from synthesis are presented in Supplementary Tables S3 and S8. A total of 71 records were screened by two reviewers, who confirmed the eligibility of the final records. A third reviewer extracted the data from the source documents and completed the critical appraisal of the included studies using the JBI checklists. Extraction and appraisal were not independently duplicated (Section 4.5).

### 2.2 Eligibility criteria

**Table 1: Eligibility Criteria (PECO)**

| Element | Criteria |
|---|---|
| Population | Number of students in tertiary education (universities, colleges and middle level health training colleges) in Africa. Multi-country studies were eligible if they included African sites. |
| Exposure | Food insecurity (experience-based scale or self-developed items), meal skipping or meal frequency (including breakfast), or a dietary proxy such as a food consumption score. Diet quality and food affordability were only eligible if to be linked to a learning outcome. |
| Comparator | Food-secure students or students with better feeding; no comparator for qualitative or descriptive accounts. |
| Outcomes | Academic performance (grades, examination scores, cumulative grade point average, or self-reported performance); progression or dropout; class attendance; or concentration and at least one learning related outcome that was analyzed or reported by the study. Eligible effects on learning are summarized separately. Only studies that had a clear outcome and analysis and provided a statement of a learning effect were included. |
| Designs | Primary quantitative, qualitative, or mixed-methods studies (theses). Only reviews and perspective pieces were used for context. |
| Limits | Published 2015-2026; in English. Perspective pieces, preprints and non-peer reviewed articles, children and school-age articles, and articles for which the full text or date of publication could not be substantiated were excluded. |

Note. Two theses and dissertations were included as primary studies because they presented primary data that included a method and an institutional examiner's review. Preprints, which are not yet peer-reviewed, were not included as they at least provide a complete method description and an accountable institution with unpublished work. This boundary is defensible, but not neutral, and the single published undergraduate dissertation carries little weight as the adjusted estimates were not significant, its findings are reported as inconclusive (Section 3.6), and the exclusion of this dissertation would have no impact on the conclusions of the review.

### 2.3 Information sources and search strategy.

Open-web searching identified records and PubMed, Scopus, Web of Science, CINAHL, PsycINFO, African Journals Online and Google Scholar also were searched and 27 records were retained for screening.

The three concept blocks used for database searching were: food insecurity or feeding-pattern, tertiary-student, and African country or region, with 2015 to 2026 years and English language, depending on the database. The outcome terms were deliberately excluded from the strings in the database so that studies that reported a learning outcome as a

secondary finding would not be overlooked; the outcome terms were used in screening. The concept blocks, keywords, and Boolean strings are shown in Table 2.

**Table 2: Search Term Combinations Used to Identify Relevant Studies**

| Concept Area | Keywords | Boolean Operators / Search Strings |
|---|---|---|
| Exposure: food insecurity and feeding patterns | "Food insecurity" OR "Food security" OR "Hunger" OR "Meal skipping" OR "Breakfast skipping" OR "Dietary habits" OR "Eating habits" | ("food insecurity" OR "food security" OR "hunger" OR "meal skipping" OR "breakfast skipping" OR "dietary habits" OR "eating habits") |
| Population: tertiary students | "University students" OR "College students" OR "Tertiary students" OR "Kenya Medical Training College" | AND ("university students" OR "college students" OR "tertiary students" OR "Kenya Medical Training College") |
| Context: African countries and region | "Africa" OR "Kenya" OR "Ethiopia" OR "Ghana" OR "Nigeria" OR "South Africa" OR "Uganda" OR "Tanzania" OR "Zimbabwe" | AND ("Africa" OR "Kenya" OR "Ethiopia" OR "Ghana" OR "Nigeria" OR "South Africa" OR "Uganda" OR "Tanzania" OR "Zimbabwe") |
| Outcomes: learning-related | Not searched | No outcome terms were added to the database strings; outcomes were applied during screening |
| Limits | Publication year 2015 to 2026; English | Applied as database filters where the database allowed |

*Note.* The three concept blocks were combined with AND; terms within a block were combined with OR.

### 2.4 Study selection

The results were de-duplicated, non-research pages (news, blogs, funding pages and slide decks) were filtered out, and any remaining results were screened against the criteria by title, abstract and full text where available. Reports of the same study (for example a thesis and a journal article) were counted as one study, and each independent study was given an identifier (S1 to S8) linking all of its reports (Supplementary Table S3). (Wagner et al., 2024) and (Wagner et al., 2026) share the same sample of first-year students (5,684 invited, 726 responded, and 596 analyzed in September and October 2020) and are combined into one data source, while (Wagner et al., 2021) is an independent sample. Supplementary Table S8 provides a list of all records screened along with the decision and the reason for each record.

### 2.5 Data extraction

The third reviewer extracted setting, design, sample size, response rate, exposure instrument, outcome and whether it was recorded or self-reported, analysis and adjustment, and results with p values or confidence intervals, where reported. The same reviewer conducted the critical appraisal. The full texts of all 21 studies that satisfied the original criteria were read. Percentages calculated by the reviewer, by adding the response categories are indicated by †. Synthesis was not attempted for figures that did not reconcile with their sources, which are shown in Supplementary Table S4. No correspondence was made with authors. If an item is not found in the source, it is not reported. The covariates in (Wagner et al., 2021) were confirmed using full text (Section 3.4). The source and/or units of the cumulative grade point average in Ikuemonisan, (2024) and the adjustment set in Atwebembire, (2025) were not verified and are reported as unclear (Supplementary Table S4).

### 2.6 Risk of bias and critical appraisal

The quantitative studies were evaluated using the eight-item JBI checklist for analytical cross-sectional studies and the ten-item JBI checklist for qualitative research (Moola et al., 2020) was used to evaluate the qualitative studies. No official cut-offs were established for JBI tools, and the following informal convention was established: at least 75% = lower concern; 50% to 74% = some concerns; below 50% = serious concerns. These labels were used in interpreting, and not to exclude studies. (Rudolph et al., 2018) describes itself as action research, which involves a questionnaire survey and focus groups and the involvement of a subsample of 30 financial-aid recipients. The eight-item item checklist was used to appraise the survey component of the questionnaire as an action research design and the ten-item qualitative checklist for the focus-group and coping-strategy component of the questionnaire, and the two are reported separately (Supplementary Table S5).

### 2.7 Synthesis methods

No pooling of studies was done. There was not enough comparability of exposures (experience-based scales, self-developed items, a dietary proxy, single item breakfast skipping), outcomes (record-based progression and dropout, self-reported performance, perceptions), and effect measures (odds ratios, correlation coefficients, percentages, qualitative accounts) to perform meta-analyses. After SWiM, studies were categorized by outcome and within each outcome, exposure and the recording or self-report of the outcome. The synthesis outlines which studies measured the outcome for each group, direction and size of association, with uncertainty, if the analysis was adjusted, if the findings were comparable with similar measures, and how the risk of bias was interpreted.

Because the vote count method does not take into account precision and sample size, and can misrepresent, the number of statistically significant studies was not used as a synthesis method (McKenzie & Brennan, 2019). Perceived effects were qualitatively and descriptively summarized separately and reported as perceived, rather than measured, effects. Heterogeneity was examined in a qualitative way by exposure definition, outcome measurement, design and setting. With such limited similarity of studies, no sensitivity analysis or formal reporting bias assessment was possible.

### 2.8 Confidence in the evidence

The criteria from Table 3 were used to rate all outcomes as Very low, Low or Moderate in confidence in each outcome group. The level of confidence was rated as Low for observational designs and was further reduced to Very low for those designs in which two or more of the other four domains were in the lower column. None of the findings satisfied the criterion to elevate the confidence level from Low to above Low. Structurally, there are only two levels as a result of design setting the starting point at Low for all studies included and there being no domain that can lift it from Low. The Low rating for progression is based on the design of the evidence and the difference between the progression and dropout ratings is based on the precision and consistency domains, as the dropout estimate is based on 59 events.

The ratings are the review team's informal judgement, and not a formal GRADE assessment. The directness domain was revised in the narrow version of the question to eliminate the country or institution preferences.

**Table 3: Criteria Used to Rate Confidence in Each Outcome Group**

| Domain | Higher confidence | Intermediate | Lower confidence |
|---|---|---|---|
| Design | Longitudinal or intervention | Large observational with adjustment | Mainly cross-sectional or qualitative |
| Consistency | Similar results across studies | Some variation | Conflicting or single-study results |
| Directness | African tertiary students; exposure and learning outcome both measured directly | Dietary proxy for the exposure, or proxy outcome | Estimate pooled across continents, or outcome reported only as a perception |
| Measurement | Validated tools or record-based outcomes | Partly validated or self-reported | Self-developed items, proxies, single-item measures |
| Precision | Adequate sample and clear estimates | Some imprecision | Small samples or unclear estimates |

**Note.** The highest rating is Low and no outcome group can make it higher; so 'low to very low' is not interpreted as a graded distribution over the certainty range.

## 3 RESULTS

### 3.1 Study selection

Records, reports and studies flow as shown in Figure 1. Open-web searching gave 95 results and database searching gave 27 retained records giving 122 documented records. Of those, 51 were removed prior to screening, including 49 duplicates and non-research pages, one study proposal which was not a report, and one duplicate report of a study; 71 records were screened. Forty-six were excluded (published before 2015, 4; outside Africa, 14; not tertiary students, 9; review or perspective piece, 9; no eligible outcome, 6; date or full text unconfirmed, 4), and four companion reports were added in to their parent studies, leaving 21 studies that met original criteria.

Of these 21 studies, 12 were subsequently reclassified as background, 11 reporting on no learning-related outcome, and one (N. Ruth et al., 2023) stated that the food security effects on performance were not an analyzed academic outcome, as a conclusion (Supplementary Table S3). There were nine studies included.

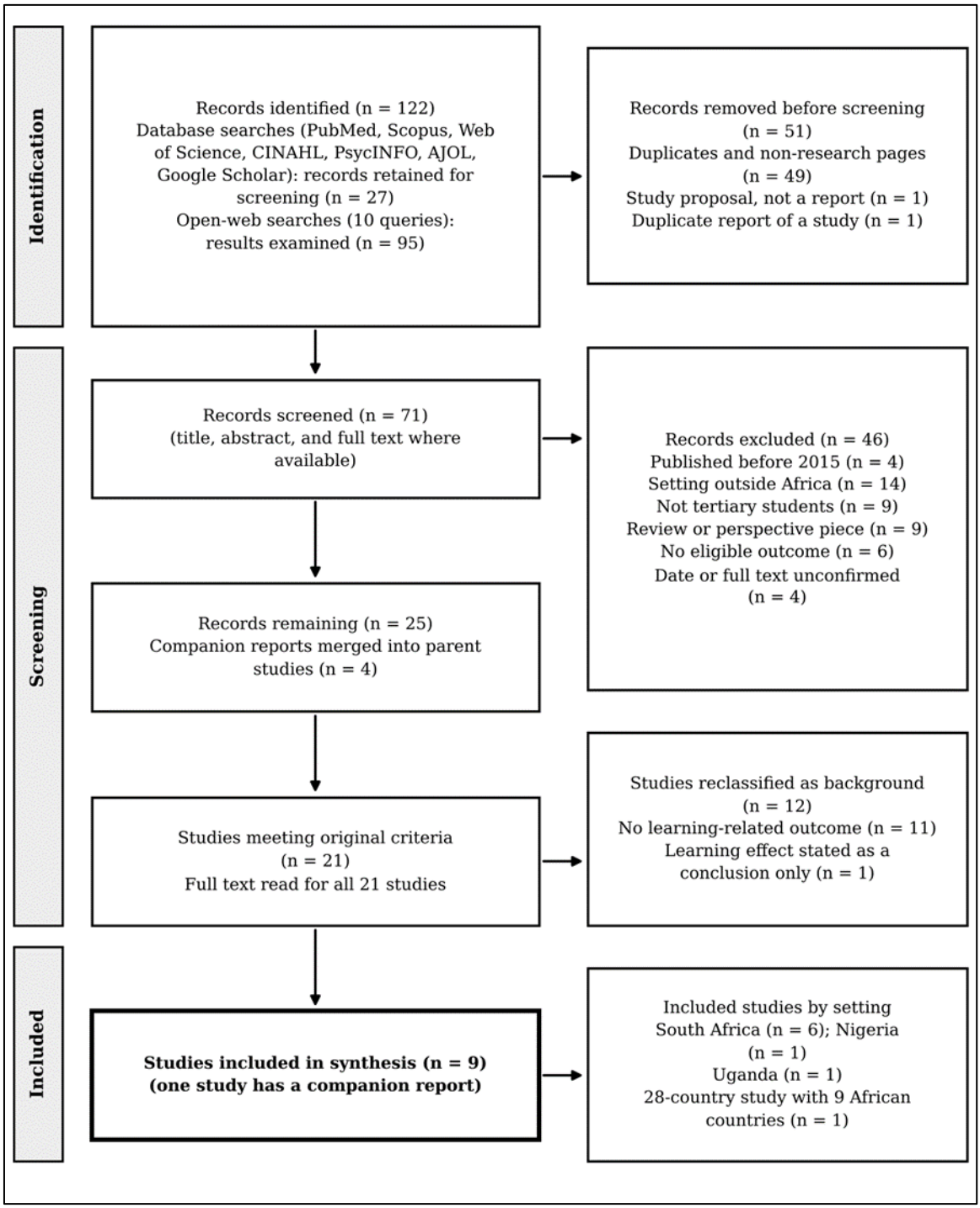



**Figure 1: PRISMA 2020 Flow Diagram of Record Identification, Screening, and Inclusion**

### 3.2 Characteristics of included studies

In South Africa six studies were conducted, followed by one each in Nigeria (18 universities), Uganda (Makerere University) and a study in 28 countries, which comprised nine African countries (Table 4). Seven were cross sectional survey, one was interview (qualitative), and one was action research. The size of the samples varied from 15 interviews to 21,972 survey respondents. In four studies, food insecurity was measured using the Household Food Insecurity Access Scale (HFIAS) or using items related to the HFIAS, in one study using self-developed Likert items, in one study using a food consumption score (a proxy measure of food intake) and in two studies by asking about breakfast skipping or meal regularity; one study used items from interview. All learning outcomes were self-reported or perceived, with the exception of two studies which were related to survey data and the university's institutional records (Wagner et al.,

2021) for progression and (Wagner et al., 2024) for dropout, which was defined as not re-enrolling in 2021 as per official university records). The response rate to the (Wagner et al., 2021) surveys was low (30%), as was that of the 2024 survey (12.8%), and (Wagner et al., 2024) took place during the COVID-19 pandemic. One of the studies is a master's thesis and one an unpublished undergraduate dissertation.

**Table 4: Characteristics of the Nine Included Studies**

| ID | Study | Setting | Design and sample | Exposure measure | Learning outcome (type) |
|---|---|---|---|---|---|
| S1 | Wagner et al. (2021) | South Africa, Johannesburg | Cross-sectional linked to records; *n* = 1,612 (30% response) | HFIAS | Academic progression (records) |
| S2 | Wagner et al. (2024) | South Africa, Wits first-years | Cross-sectional; 726 participated (12.8% of 5,684 invited); analytic *n* = 596 (10.5%) | HFIAS; PHQ-ADS | Dropout (official 2021 registration records) |
| S3 | Visagie (2019) | South Africa, Free State | Cross-sectional (thesis); 327 questionnaires, analytic *n* 296 to 314 | Self-developed Likert items | Self-reported performance, concentration, attendance |
| S4 | Sabi et al. (2019) | South Africa, KwaZulu-Natal | Cross-sectional; *n* = 456 (91.2% of 500) | HFIAS-related items | Self-reported concentration, missed classes |
| S5 | Majali & Tengeh (2026) | South Africa, Western Cape | Qualitative; 15 interviews | Interview accounts | Perceived concentration, attendance, performance |
| S6 | Pengpid & Peltzer (2020) | 28 countries incl. 9 African | Cross-sectional; *n* = 21,972 | Breakfast skipping (single item) | Self-reported unsatisfactory performance |
| S7 | Ikuemonisan (2024) | Nigeria, 18 universities | Cross-sectional; 399 sampled, 392 returned | Food consumption score (dietary proxy) | Cumulative GPA (source unclear) |
| S8 | Atwebembire (2025) | Uganda, Makerere | Cross-sectional (unpublished dissertation); *n* = 364 residents | Meal regularity, breakfast, habits | Self-reported performance |
| S9 | Rudolph et al. (2018) | South Africa, Wits | Action research; 387 undergraduates plus 30 aid recipients | HFIAS; dietary diversity score | Perceived effect on performance (self-reported) |

Note. HFIAS = Household Food Insecurity Access Scale; PHQ-ADS = Patient Health Questionnaire Anxiety and Depression Scale; GPA = grade point average; Wits = University of the Witwatersrand. (Wagner et al., 2026) reports the same sample as S2 and contributed no learning outcome.

### 3.3 Risk of bias within studies

Each of the studies included in the analysis was rated using design-appropriate JBI tools (Table 5; item-level ratings in Supplementary Table S5). The methodological concern for the qualitative study conducted by Majali & Tengeh, (2026) was lower, but the study was conducted in one institution and the sample was small and snowball, and the numbers in the tables were inconsistent, so transferability was limited. Of the quantitative studies, two were given a lower concern rating (S1, S2), four were given some concern rating (S3, S6, S7, S8), and two were given a serious concern rating (S4, S9). Frequently encountered study limitations included the use of self-developed or single-item measures of exposure, self-reported academic outcomes, inadequate adjustment for confounding factors, low response or participation rates, and limited generalizability from samples from a single institution.

The best quantitative study, (Wagner et al., 2021), adopted the standardized Household Food Insecurity Access Scale (HFIAS), garnered responses from the entire first-year undergraduate class, and tied the reports to end-of-year academic-progression outcomes. This rating is tempered by a limitation of the analysis. The reported estimate was from

a backward stepwise model whose final covariates were hunger status, gender, race, and home location; food-security status and first-generation status were considered but not retained. The confidence interval was also selected using the same data, so it is hard to make general statements about the interval without considering the selection of the covariates – this interval is likely to be too narrow – the estimate is an association adjusted for the covariates selected and cannot be interpreted as a pre-specified effect, nor would a pre-specified adjustment set have allowed for stronger inference.

The cross-sectional study design, however, does not allow for causal inferences, and the low response rate may lead to the risk of non-response bias of 30%. (Wagner et al., 2024) employed multivariable regression and HFIAS, but it has a participation rate of 12.8% and is based on the context of the COVID-19 pandemic, which result in lower confidence in their estimates, and has been estimated by multivariable regression on only 59 dropout events. (Sabi et al., 2020) had a high completion rate and their results were students' subjective perceptions of the impact of food insecurity on academic results instead of the objective measure; it adopted a modified 9 item HFIAS as well as single item indicators.

Atwebembire,(2025) employed a reasonable number of 364 students and validated instruments, however, the academic performance was self-reported CGPA, the study was an unpublished undergraduate dissertation, and the estimated regression results were not significant although there were significant bivariate correlation results. The methods are reported briefly and there is no description of inclusion criteria, confounding, analysis, or effect of food insecurity on academic performance, though this is stated in the full text by (Rudolph et al., 2018) who used HFIAS and dietary-diversity measures adapted to the individual, but were still rated as serious concerns, with only 30 financial-aid recipients included in the coping-strategies component. In general, the certainty of evidence is low due to non-response and selection bias, self-reported measures, and limited adjustment of any potential confounder, as well as the overwhelming number of cross-sectional designs.

**Table 5: Summary of Critical Appraisal**

| ID | Study | Tool | Score | Main concerns |
|---|---|---|---|---|
| S5 | Majali & Tengeh (2026) | JBI qualitative | 8/10 (lower concern) | Snowball sample of 15; one institution; table counts inconsistent |
| S7 | Ikuemonisan (2024) | JBI cross-sectional | 5/8 (some concerns) | Dietary proxy; CGPA source unclear; inconsistent mediation estimates |
| S6 | Pengpid & Peltzer (2020) | JBI cross-sectional | 5/8 (some concerns) | Single-item exposure; self-reported outcome; pooled across 28 countries; Asia-heavy sample |
| S3 | Visagie (2019) | JBI cross-sectional | 4/8 (some concerns) | Self-developed items; unadjusted; sample-size reporting |
| S1 | Wagner et al. (2021) | JBI cross-sectional | 7/8 (lower concern) | 30% response rate; single South African university; cross-sectional design; potential selection bias; HFIAS adapted for students without reported reliability. Strengths: standardised HFIAS and official progression records. |
| S2 | Wagner et al. (2024) | JBI cross-sectional | 7/8 (lower concern) | 12.8% participation rate; COVID-19 period; first-year students only; model estimated many parameters from 59 dropout events; dropout means non-re-enrolment, so transfers cannot be distinguished. Strengths: HFIAS ($\alpha$ = 0.95), PHQ-ADS, weighting, exposure measured before the outcome. |
| S4 | Sabi et al. (2018) | JBI cross-sectional | 2/8 | Academic impact was self-reported perception rather than objective performance; modified HFIAS and single-item measures; quota/purposive recruitment may introduce selection bias. High completion rate was a strength. |
| S8 | Atwebembire (2025) | JBI cross-sectional | 4/8 | Self-reported CGPA; unpublished undergraduate dissertation; adjusted associations were non-significant and |

| | | | | |
|---|---|---|---|---|
| | | | | imprecise; university-hall residents only; possible selection and recall bias. Strengths: n=364, adopted validated tools, correlation and regression analyses. |
| S9 | Rudolph et al. (2018) | JBI analytical cross-sectional (survey component) and JBI qualitative (focus-group and coping-strategy component), rated separately | 2/8 quantitative (serious concerns); 1/10 qualitative (serious concerns) | Brief reporting; inclusion criteria, confounding, and analysis not described; coping strategies based on only 30 financial-aid students; action-research design and student-representative-council involvement may influence responses; full text states that academic performance was not studied. HFIAS and dietary-diversity score were strengths. |

### 3.4 Food insecurity and academic progression or dropout

There were two studies in South Africa that linked food insecurity to progression and dropout; both relied on the outcome of institutional records (Table 6). Among 1,612 first-time, first-year undergraduate students (30% response rate) in (Wagner et al., 2021), students with little or no hunger had almost twice the odds of progressing to the next year of study compared with students experiencing food insecurity with hunger (OR = 1.88, 95% CI [1.45, 2.42], p < .001). This is an estimate from a backward stepwise multivariable model that included hunger status, gender, race, home location, and for which food-security status and first-generation status were considered but were not retained in the final model. In (Wagner et al., 2024) dropout was defined as not re-enrolling in 2021 and the sample was weighted by sex and population group. Moderate food insecurity was associated with higher odds of dropout (OR = 2.50, 95% CI [1.12, 5.55], p = .025), whereas mild (OR = 0.98, 95% CI [0.36, 2.68]) and severe food insecurity (OR = 1.09, 95% CI [0.46, 2.58]) were not. Severe mental distress (OR = 7.08) and male sex (OR = 2.70) were also associated with dropout. Overall dropout was 10.5% (weighted) and the data were collected during the COVID-19 pandemic.

While the two estimates agree on the direction of the results for the most affected groups, they are not directly comparable: they compare different levels of exposure (food insecurity versus hunger), different outcomes (progression versus dropout) and different covariates. In (Wagner et al., 2024) the association was not graded due to the absence of the association with severe food insecurity, and the large confidence interval around moderate food insecurity suggests lack of precision. Both of these results are based on institutional records, as opposed to self-report; and, (Wagner et al., 2024) food insecurity was assessed prior to the registration check, making the order of events more clear than studies that collected both assessments via survey. Both estimates have limited value, however, due to low participation rates and having been collected during a pandemic as well as the drop-out in the 2024 study, which is not an indicator of moving to another school. Severe mental distress was more strongly associated with dropout than food insecurity, although the confidence intervals overlap, suggesting that mental health could be confounding or could be on the pathway.

### 3.5 Food insecurity and the reported performance of students.

Two studies investigated food insecurity or dietary proxies in relation to self-reported academic performance. For Free State first-years, (Visagie, 2019) observed low negative correlations between the self-reported performance score and food insecurity severity, using both the unadjusted (Pearson r = −.282; Spearman ρ = −.321; N = 300; p < .001) and the self-developed items (Pearson r = −.376; Spearman ρ = −.405; N = 300; p < .001). In Nigeria, Ikuemonisan, (2024) reported an association between a poor food consumption score, a proxy measure and not a measure of access to food, and lower cumulative GPAs but could not determine the source of the performance measure; and the mediation estimates were internally inconsistent and excluded. It is not reported, not interpreted, and not cited in support of any claim, but it is nonetheless recorded in Supplementary Table S4, to ensure completeness of the audit trail. Visagie's study is thus the only one that can be interpreted for this outcome group; it is unadjusted and used self-developed items, so there is no agreement between two studies to report.

### 3.6 Meal skipping and academic performance

Meal patterns were studied in two studies. (Pengpid & Peltzer, 2020) combined the students from 28 countries in the Asia, Africa and Americas regions (n = 21,972; 21,858 for whom complete breakfast data was available). In adjusted analysis (age, sex, economic status, residence, country, social support, and religiosity), rarely or never eating breakfast, compared with eating it almost daily, was associated with self-reported unsatisfactory academic performance (AOR = 1.40, 95% CI [1.11, 1.78], p < .01), whereas eating breakfast sometimes was not (AOR = 0.98, 95% CI [0.83, 1.16]). This is indirect evidence: firstly, the estimate is not specific to African students, secondly, the large total sample does not represent an equivalent African evidence base, and thirdly, the exposures and outcomes were single, self-reported items.

Atwebembire, (2025) discovered in Uganda that while there was a weak positive correlation between regular meals and self-reported CGPA, the correlations were not statistically significant in regression. There was a positive correlation between breakfast frequency and CGPA (r = 0.214, p < .001) and between regular meal consumption and CGPA (r = 0.136, p = .009). The odds ratio for breakfast frequency, however, was 1.14 (95% CI 0.90, 1.44, p = .282) and the odds ratio for frequent eating of meals was 1.47 (95% CI 0.77, 2.82, p = .244), which were not statistically significant in adjusted logistic regression. However, it is limited and ambiguous because exposures and outcomes were measured differently and because it is based on only two pooled indirect estimates and on one unpublished dissertation.

### 3.7 Attendance and concentration

Three South African studies reported concentration or attendance, all by self-report. 64.3% of the students reported that hunger impacted on their concentration and vigour in the survey conducted by the University of KwaZulu-Natal, while 27.7% of the students indicated that they had missed classes due to hunger (Sabi et al., 2020). 84.8%† of the participants in (Visagie, 2019) survey said it was difficult to focus when hungry, 22.6%† said they missed class when they were hungry because they did not have food and 44.8%† said they missed class due to lack of energy. In interviews, 12 of 15 students reported reduced concentration, eight reported reduced studying, and five skipped classes to work to buy food (Majali & Tengeh, 2026). The results are consistent in direction across the two types of designs (survey and qualitative), but the results are students' own attributions rather than comparisons between food-secure and food-insecure groups, and no study reported attendance from registers.

### 3.8 Perceived effects on learning

Two pieces of research described perceptions of how hunger impacts learning. 97% of the students at the University of the Witwatersrand said hunger could adversely affect their performance and 52% of the students said they felt this (Rudolph et al., 2018). The full text makes no mention of a study relating the impact of food insecurity on academic performance, and there are no corresponding figures in the abstract (Supplementary Table S4); thus, these figures are poorly documented. Western Cape interviewees reported going hungry and being unable to pass tests (Majali & Tengeh, 2026). These accounts reveal student perceptions of the impact of hunger, but not measured impacts, nor do they count as impacts.

### 3.9 Effect estimates and confidence in the evidence

**Table 6: Effect Estimates Reported by Included Studies for Learning-Related Outcomes**

| Study | Exposure and outcome | Analysis | Estimate | Adjustment and main limitation |
|---|---|---|---|---|
| S1 Wagner et al. (2021) | Little or no hunger versus hunger; progression (records) | Multivariable logistic regression | OR = 1.876, 95% CI [1.454, 2.418], $p < .001$ | Backward stepwise model retained gender, race, and home location with hunger status; food-security status and first-generation status were not retained; 30% response |
| S2 Wagner et al. (2024) | Food insecurity category; dropout (official 2021 records) | Weighted multivariable logistic regression | Moderate: OR = 2.50, 95% CI [1.12, 5.55], $p = .025$; mild: 0.98 [0.36, 2.68]; severe: 1.09 [0.46, 2.58] | Also in model: sex (male OR = 2.70), financial aid, residence, COVID-19 infection, working from home, mental distress (severe OR = 7.08); 12.8% participation; COVID-19 period |
| S3 Visagie (2019) | Food insecurity severity; self-reported performance | Pearson and Spearman correlation | $r = -.282$; $\rho = -.321$; both $p < .001$ | Unadjusted; self-reported; weak association |
| S4 Sabi et al. (2020) | Hunger; concentration and missed classes | Descriptive | 64.3% reduced concentration; 27.7% missed classes | Self-report; no comparison group |

| | | | | |
|---|---|---|---|---|
| S6 Pengpid & Peltzer (2020) | Breakfast skipping; unsatisfactory performance | Adjusted logistic regression | Rarely or never versus almost daily: AOR = 1.40 [1.11, 1.78], $p < .01$; sometimes: AOR = 0.98 [0.83, 1.16] | Adjusted for age, sex, economic status, residence, country, social support, religiosity; single-item exposure; self-reported outcome; 28 countries pooled |
| S8 Atwebembire (2025) | Meal regularity and breakfast; self-reported performance | Correlation and adjusted logistic regression | Breakfast frequency: $r = 0.214$, $p < .001$; adjusted aOR = 1.14 [0.90, 1.44], $p = .282$. Regular meals: $r = 0.136$, $p = .009$; adjusted aOR = 1.47 [0.77, 2.82], $p = .244$ | unpublished; self-reported outcome; adjusted estimates not significant |
| S9 Rudolph et al. (2018) | Hunger and performance | Descriptive | 97% believed hunger could harm performance; 52% reported experiencing this | Self-reported; unadjusted; one university; figures appear in the abstract only |

Note. The odds ratios and confidence intervals are as reported by the studies cited. Percentages indicated with † following in Section 3.7 are from the reviewer. The percentages for concentration and attendance are based on S3 and S4, and are included in the text; S5 only provides interview count data.

For each outcome group, the confidence ratings in Table 7 were assigned according to the criteria in Table 3. Progress and leaving rate rated separately as they are measured differently and each are based on just one study. Although the findings are in agreement, because all outcomes are self-reported or perceived, the rating for attendance and concentration is Very low.

**Table 7: Confidence in the Findings by Outcome Group**

| Outcome group | Studies | Main finding | Confidence | Reasons |
|---|---|---|---|---|
| Progression | S1 | Students experiencing hunger had lower odds of progressing to the next year than students with little or no hunger. | Low | Cross-sectional design sets the starting level at Low. Measurement (HFIAS; record-based outcome), directness (African tertiary students; both variables measured directly), and precision (OR = 1.876, 95% CI [1.454, 2.418]) were in the higher column. Only consistency fell in the lower column, because the finding rests on a single study, so the rating stays Low. The 30% response rate limits representativeness but is not a domain in Table 3. |
| Dropout | S2 | Moderate, but not mild or severe, food insecurity was associated with higher odds of dropout. | Very low | Two domains fell in the lower column: consistency (single study) and precision (OR = 2.50, 95% CI [1.12, 5.55]; mild and severe categories showed no association). Measurement (HFIAS; official records) and directness were in the higher column. Participation was 12.8% and data were collected during COVID-19, which further limits applicability. |
| Self-reported performance with food insecurity | S3, S7 | Food insecurity showed weak adverse associations with self-reported academic performance, but effect sizes were uncertain. | Very low | Visagie (2019) used self-developed items and an unadjusted analysis; Ikuemonisan (2024) used a dietary proxy rather than a validated food-insecurity measure, had an unclear CGPA source, and reported inconsistent mediation estimates. Both were single-institution cross-sectional studies. |

| | | | | |
|---|---|---|---|---|
| Meal skipping and performance | S6, S8 | Rarely or never eating breakfast was associated with poorer performance in a pooled multinational analysis, but the association was not significant in a Ugandan regression. | Very low | Exposures and outcomes were measured differently across studies. Pengpid and Peltzer (2020) used a single-item breakfast measure, self-reported outcomes, and pooled data from 28 countries with substantial contextual heterogeneity. Atwebembire (2025) was an unpublished dissertation using self-reported CGPA; its adjusted estimates were imprecise and non-significant. |
| Attendance and concentration | S3, S4, S5 | Students attributed poorer concentration and missed classes to hunger or food insecurity. | Very low | The direction of the findings was similar across three studies (consistency, higher column). Outcomes were reported only as perceptions or self-reports (directness, lower), measured with self-developed items, single items, or interview accounts (measurement, lower), and given as percentages without comparison groups or adjustment (precision, lower). Three domains in the lower column give a rating of Very low; consistent direction does not offset these limits. |
| Perceived effects | S5, S9 | Most students believed that hunger or food insecurity could harm academic performance. | Not rated | These were perceptions rather than measured associations between food insecurity and academic outcomes; the confidence criteria apply to associative findings, not beliefs or perceived effects. |

Note. Ratings are the review team's informal judgement and are not a formal GRADE assessment

## 4 DISCUSSION

### 4.1 Principal findings

In Africa, studies measuring the learning outcome indicated that food insecurity/hunger was related to poorer outcomes, on average, among tertiary students. Lower progression was observed in students who were experiencing hunger and higher dropout was observed in moderately food insecure students in two South African studies using institutional records, but not in students with mild or severe food insecurity. Correlations with measures of self-reported performance were small and/or ambiguous, and in three studies students reported that hunger affected their ability to concentrate and miss classes. Direct evidence of meal skipping was limited and inconclusive, with some of it coming from a pooled estimate of multi-continent, which was indirect for Africa. The evidence was observational, largely cross-sectional, self-reported, and limited to South Africa and confidence in the evidence was low to very low. It helps to confirm the possibility of an association but not its size or cause.

### 4.2 Comparison with previous evidence

Some of the African findings are in line with the global synthesis, as the majority of 47 studies found a negative relationship between food insecurity and academic performance (Galseku et al., 2026), and studies in the United States found similar results (Camelo & Elliott, 2019, 2019; El Zein et al., 2019). Other evidence on breakfast habits from India, Bangladesh and Mexico confirms that consistent consumption of a breakfast is associated with improved performance (Atasi et al., 2024; Kaushik et al., 2023; Rana et al., 2026). The African evidence is less robust: it is minor, seldom adjusted, frequently self-reported, and measured using inconsistent tools and is reported as ranging from 7% moderate or severe hunger to 91% food insecurity (Rudolph et al., 2018; Sealetse & Kleynhans, 2026), as Ellison et al., (2021) and Landry et al., (2024) warn. Therefore, this supports the plausibility of the association but not the size of the association.

### 4.3 Interpretation and other explanations

Poor feeding was most consistently explained as being due to cost and insufficient allowances in the African literature, including background studies reviewed (Supplementary Table S3). Other factors can contribute to missed meals and sub-optimal functioning include financial burden, paid work, lack of accommodation, mental health issues, poor sleep, long commute and heavy workloads. Simple comparisons might be confounded by the (Wagner et al., 2021) finding of association with progression for first generation status. The relationship between severe mental distress and drop-out

had a larger point estimate (OR = 7.08, 95% CI 2.67–18.81) than the link between moderate food insecurity and drop-out (OR = 2.50, 95% CI 1.12–5.55), although the intervals overlap, suggesting that mental health may interact and/or mediate this relationship. It is also possible that poor performance could increase stress or result in eating less in more paid work, while the unfavourable timetables could lead to eating less due to time constraints or other factors, as a Ghana study of barriers to breakfast reported by (Adonu et al., 2023). These explanations cannot easily be distinguished from one another in cross sectional studies.

Differences in what was measured seem to explain the findings that appear to be contradictory. (Wagner et al., 2021, 2024) employed an experience-based scale (HFIAS), and institutional data of advancement or attrition of first-year students in a large South African university. The exposure, the outcome and the population are not comparable as Atwebembire, (2025)used self-reported meal regularity and breakfast frequency (these are self-reported performance measures) and a sample of the residents of halls of residence in one Ugandan university. Two differences in adjustment were noted: Wagner et al. report on their covariates, while the adjustment set in the dissertation could not be confirmed. Finally, the Ugandan adjusted estimates were imprecise (aOR = 1.14, 95% CI [0.90, 1.44]; aOR = 1.47, 95% CI [0.77, 2.82]). Although the point estimates in their study are in the same direction as the South African estimates, their intervals do contain values that are consistent with a modest benefit so a non-significant result should not be interpreted as no association at all. The two series of studies are thus not mutually exclusive, but neither are they mutually supporting.

### 4.4 Limitations of the included evidence

The most significant restriction is the size of the effective evidence base. Nine studies were included but the main finding is based on two cross sectional surveys of first year students at large universities in Johannesburg in South Africa. Of the remaining seven, one study by (Visagie, 2019) had an unadjusted correlation with a self-reported performance score, and the one study using a dietary proxy had an uninterpretable estimate, while the other two were an unpublished undergraduate dissertation with non-significant adjusted estimates, and three reported perceptions but not comparisons between food-secure and food-insecure students. When the criterion is a record-based learning outcome, the evidence base comprises of two studies. The review should thus be taken as an indication that an association is plausible and testable in African contexts, but not a measure of its size.

Most of the studies included were cross-sectional and single-institution studies, and all but 2 learning outcomes were self-reported or perceived. There were different types of exposure measures used, ranging from experience-based scales to self-developed items, a single item as part of the student's breakfast, and a dietary proxy, but no study included a measure of food insecurity validated for students. Two of the surveys by Wagner et al. had low response rates, two were grey literature (thesis and unpublished undergraduate dissertation), and one data collection was during the COVID-19 restrictions and may not represent usual conditions. (Pengpid & Peltzer, 2020) combined data from three continents but did not estimate the value for Africa. It was not possible to resolve inconsistencies in several of the source documents (Supplementary Table S4) and evidence was limited almost exclusively to the South African higher education system, making it difficult to transfer to other African higher education systems.

### 4.5 Limitations of the review process

The protocol was not registered and eligibility criteria was set and narrowed after an initial set of studies were read, limiting the study selection to a certain degree. Records were screened by two reviewers, but the eligibility decisions and the narrowing of the question were not verified by anyone else. A third reviewer alone extracted the data and carried out the critical appraisal, so these steps were not independently duplicated, and study authors were not contacted. Records were only available in English from 2015 onwards and un-indexed grey literature may not be included. The harvest was small (27) and the restriction to English-language and exclusion of unindexed and local-journal works may have underestimated works published in Nigeria, Ethiopia and Ghana. A claim for the continent should be based on the synthesis of the literature indexed in English and not on the African literature and the review should be read in that sense. The exclusion of preprints, while retaining an unpublished undergraduate dissertation is a boundary that seems inconsistent, justifiable only by the full method reporting a dissertation requires (Table 1 note), and disclosed here rather than left to the reader. There was no formal assessment of reporting bias and the confidence ratings are informal and are not a formal GRADE assessment. The restriction to Africa only implies that high income evidence was used for context rather than synthesized, as well as that the Introduction and Discussion rely on studies that were not appraised.

### 4.6 Implications for Practice and Research.

The literature in Africa was consistent in that cost was the most common barrier reported for practice, and this may warrant an evaluation of the financial accessibility of campus food by institutions if possible. This review is not able to measure the impact that such changes would have on learning. Research requires longitudinal designs, food security measures based on experience, with a specified recall period, outcomes based on records (such as exam results and

attendance, etc.), and controlling for sources of confounding, such as income, first-generation status, paid work, mental stress, etc. Evidence-based studies from other African countries (excluding South Africa) as well as consistent reporting on adjustment sets and confidence intervals would support the evidence base.

### 4.7 What a Kenyan study would need to measure

The result of this review leaves no trace of Kenyan evidence, and it is more a specification of the next study than a finding on institutions in Kenya. The aforementioned Kenyan studies present descriptive evidence of student feeding, such as expensive and repetitive eating habits, poor access to food and food insecurity (e.g., in two public universities, 57.6% of 872 students self-reported food insecurity at Moi University and the University of Eldoret (Mwaniki et al., 2025; N. Ruth et al., 2023; Ndung'u et al., 2025; Lokuruka & Sewe, 2022; Onsomu et al., 2025). None of it correlates food insecurity or feeding patterns with a learning outcome.

Secondly, none of the evidence of learning outcomes is Kenyan; all of it is from South Africa, Nigeria, Uganda and one multi-country study. Third, none of the Kenyan studies cited in this review examined the relationship between attendance, concentration or academic performance and feeding, thus there is a lack of direct evidence to establish the relationship between feeding and academic performance in Kenyan colleges. Most of the evidence cited from South African universities does not have a similar loan or bursary system as in Kenya and can only contribute to deciding on the variables and the measures to be used, but not predict effect sizes in Kenyan colleges. This is a gap that can be directly closed through studies conducted at Kenyan tertiary institutions linking an experience-based food-insecurity indicator to academic results from the school records.

## 5 CONCLUSION

The amount of the synthesized evidence is less than the number of studies included suggests. Only two cross-sectional surveys of first-year students in South Africa have been conducted, and they have suggested that hunger is associated with lower rates of progression and moderately food-insecure students with higher rates of drop-out. There is limited and inconclusive evidence of meal skipping and self-reported academic performance. The overall cross-sectional design, the heterogeneity of the measurements, and the weak evidence of causality and effect size prevents firm conclusions about causality or effect size. No evidence from tertiary institutions in Kenya was found and longitudinal studies with specifically defined feeding measures and clearly defined record-based academic outcomes are required.

## STATEMENTS ON COMPLIANCE WITH ETHICAL STANDARDS

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### *Disclosure of conflict of interest*

No conflict of interest to be disclosed.

### *Registration and protocol*

No registration and no protocol published. Eligibility criteria were formulated after the initial reading, and revised following full text screening (Section 2.1; Supplementary Table S1).

### *Availability of data*

All data were accessed from published or publicly available resources: Extraction, appraisal, search and screening records are in the Supplementary Material.

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[33] Wagner, F., Kolanisi, U., Wagner, R. G., Makuapane, L. P., Masango, M., & Gómez-Olivé, F. X. (2026). Effect of returning home on university student hunger during South African COVID-19 lockdown. *PLOS One*, *21*(1), e0340350. https://doi.org/10.1371/journal.pone.0340350

[34] Wagner, F., Wagner, R. G., Makuapane, L. P., Masango, M., Kolanisi, U., & Gómez-Olivé, F. X. (2024). Mental distress, food insecurity and university student dropout during the COVID-19 pandemic in 2020: Evidence from South Africa. *Frontiers in Psychiatry*, *Volume 15-2024*. https://doi.org/10.3389/fpsyt.2024.1336538

## APPENDIX

These tables preserve the audit trail for the review.

**Supplementary Table S1. Amendment of the Review Question and Eligibility Criteria**

| Element | Original criteria (first applied) | Revised criteria (this review) |
|---|---|---|
| Question | Four objectives: meals per day; meal quality and affordability; attendance and concentration; academic performance | Associations between food insecurity or meal skipping and learning-related outcomes (academic performance, progression, attendance, concentration) |
| Outcomes | At least one of: meal frequency or skipping; meal quality or affordability; attendance or concentration; academic performance or progression | At least one analyzed or reported learning-related outcome; a learning effect stated only as a conclusion does not count |
| Exposure | Food insecurity, meal skipping or frequency, diet quality, or food affordability | Food insecurity, meal skipping or frequency, or dietary proxy; diet quality and affordability only when related to a learning outcome |
| Population, designs, limits | As in Table 1 | Unchanged |
| Timing of amendment | Original criteria fixed after an initial set of studies had been read | Amended after all 71 records had been screened and the full texts of 21 studies read |
| Reason | | 12 of 21 eligible studies described feeding patterns or prevalence with no learning-related outcome, so they could not contribute to the stated question |
| Effect | 21 studies | 9 studies included; 12 reclassified as background (Tables S3 and S8) |

Note. The amendment was defined by the outcomes studies measured, not by the direction or size of their findings.

**Supplementary Table S2. Definitions**

| | Definition used in this review |
|---|---|
| Food insecurity | Limited or uncertain access to adequate food, measured with experience-based scales such as the Household Food Insecurity Access Scale (HFIAS) |
| Dietary proxy | A measure of food intake or variety (for example a food consumption score, dietary diversity score, or habit score) that does not directly measure access to food |
| Meal skipping | Not eating a usual meal during a stated period, or reducing meal size, because of cost or other constraints |
| Meal frequency | Reported number of meals eaten per day or per week |
| Diet quality | Variety, adequacy, and balance of foods eaten |
| Hunger | Self-reported physical sensation of hunger or going without food |
| Concentration | Self- or interviewer-reported ability to focus in class or while studying |
| Attendance | Reported or recorded presence at scheduled teaching sessions |
| Academic performance | Grades, examination scores, CGPA, progression, or self-reported performance; each study is labelled recorded or self-reported |

Note. Food insecurity, dietary proxies, and meal skipping are related but not interchangeable, and each study is classified by what it actually measured.

**Supplementary Table S3. Study Register and Background Studies**

**S3a. Included Studies and Linked Reports**

| ID | Study | Linked reports | Note |
|---|---|---|---|
| S1 | Wagner et al. (2021) | None | Separate dataset from S2 |
| S2 | Wagner et al. (2024) | Wagner et al. (2026): same survey confirmed (5,684 invited, 726 participants, analytic 596) | The 2026 report contributes no learning outcome |
| S3 | Visagie (2019) | None | Master's thesis |
| S4 | Sabi et al. (2020) | Sabi framework thesis (merged as companion report) | |
| S5 | Majali & Tengeh (2026) | None | |
| S6 | Pengpid & Peltzer (2020) | None | Multi-country; African sites only partly identifiable |
| S7 | Ikuemonisan (2024) | None | |
| S8 | Atwebembire (2025) | None | Unpublished undergraduate dissertation |
| S9 | Rudolph et al. (2018) | None | |

**S3b. Background studies**

These 12 studies met the original criteria but reported no learning-related outcome that was analysed, so they are not synthesised. Their descriptive findings are kept here for context.

| ID | Study | Setting and sample | Exposure measure | Descriptive findings | Reason |
|---|---|---|---|---|---|
| B1 | Mwaniki et al. (2025); Mwaniki (2024) thesis; two companion reports | Kenya, KMTC; mixed-methods cross-sectional, *n* = 293 | Dietary diversity, meal frequency (proxy) | 87% diverse diets and five meals; 21.5% never took a mid-morning snack, 28.1% never an afternoon snack; mean pocket money KES 2,533 (*SD* = 1,741); costly cafeteria food, small portions, starch-heavy diets, no cooking in hostels | No learning outcome |
| B2 | Onsomu et al. (2025) | Kenya, public tertiary; *n* = 422 | Nutrition communication, dietary practices | 78.8% no meal plan; 84.5% monthly income KES 0 to 5,000 | No learning outcome |
| B3 | Ndung'u et al. (2025) | Kenya, Kenyatta University; *n* = 249 | Eating habit score (proxy) | 35.7% ate three meals daily | No learning outcome |
| B4 | Otunga et al. (2023) | Kenya, Moi University and University of Eldoret; 872 questionnaires, 24 interviews | Self-reported food insecurity; meals per day | 57.6% food insecure; 56.4% two meals a day; 4.4% nutritionally balanced diet | Performance effect stated as conclusion only |

| | | | | | |
|---|---|---|---|---|---|
| B5 | Sewe & Lokuruka (2022) | Kenya, Karatina University; *n* = 94 residents | Meal skipping due to lack of money | 27.85% skipped a meal for lack of money 1 to 3 days a month; 48.9% relied on simple, cheap meals | No learning outcome |
| B6 | Adonu et al. (2023); Takoradi eating-patterns thesis | Ghana, Takoradi Technical University; *n* = 347 third-year residents | Breakfast intake and barriers | 35.7% ate breakfast regularly; barriers included insufficient funds, campus food cost, limited time, and unfavourable schedules | No learning outcome |
| B7 | Mkomagi et al. (2021) | Tanzania, two institutions; *n* = 140 | Availability, utilisation, access proxies | 44.3% ate fewer than three meals a day; 59.3% reduced meal size | No learning outcome |
| B8 | Jonker & Walsh (2025) | South Africa, health sciences; 149 questionnaires, 6 focus groups (*n* = 17) | Modified HFIAS (pandemic recall) | 84% food insecure; 70% worried about not having enough food | No learning outcome |
| B9 | Wagner et al. (2026) | South Africa, Wits first-years; *n* = 596 (same sample as S2) | Household Hunger Scale | Weighted hunger prevalence 16.4%; aOR 1.78 (first-generation), 2.69 (financial aid), 3.38 (financial worry) | No learning outcome; linked to S2 |
| B10 | Sealetse & Kleynhans (2026) | South Africa, Mpumalanga; 382 survey (of 3,887), 36 in focus groups | Food insecurity prevalence | 91% food insecure; 58% two meals a day; 57% skipped meals, most often breakfast | No learning outcome; conference proceedings |
| B11 | Vilakazi (2023) | South Africa, University of Johannesburg health sciences; *n* = 175 | Modified 10-item HFSSM | 75.4% lacked money for food in past 12 months; 58.1% of aid-dependent students did not have enough food | No learning outcome; mini-dissertation |
| B12 | Steenkamp et al. (2016) | South Africa, NMMU; convenience *n* = 63 students living with HIV | Household food insecurity; dietary intake | Inadequate micronutrient intake was common | No learning outcome; special population |

*Note.* KMTC = Kenya Medical Training College; HFSSM = Household Food Security Survey Module; NMMU = Nelson Mandela Metropolitan University. Prevalence figures from different instruments are not combined.

S4a. Source inconsistencies and how they were handled.

**Supplementary Table S4. Source Inconsistencies and Verification of Key Figures**

| Source and issue | Check against original | Handling |
|---|---|---|
| Mwaniki et al. (2025) [B1]: BMI category labels do not match cut-offs (for example normal 25 to 29.9) | The thesis key gives standard cut-offs, but its results table repeats the mislabelling | Unresolved; category labels not used; background study |
| Mwaniki et al. (2025) [B1]: statements that knowledge was and was not associated with BMI | The thesis reports a chi-square association ($p$ = .001) and a non-significant logistic regression | Unresolved; excluded from synthesis |
| Mwaniki et al. (2025) [B1]: hydration AOR 0.265 described as higher likelihood | The thesis shows crude OR 4.626 and adjusted OR 0.265, so direction is unclear | Unresolved; excluded from synthesis |
| Ikuemonisan (2024) [S7]: mediation estimates larger than products of path coefficients | Not resolvable from the article | Unresolved; mediation excluded; direct |

| | | |
|---|---|---|
| | | coefficient used with caution |
| Majali & Tengeh (2026) [S5]: table refers to seven food-insecure students although 15 were interviewed | Not resolvable from the article | Unresolved; abstract counts used |
| Majali & Tengeh (2026) [S5]: attribute 70% food insecurity at UKZN to Sabi et al. (2018) | Checked in the full text of the Sabi et al. (2018) review: no such figure (it reports that 53% of UKZN students come from economically disadvantaged backgrounds) | Figure not used |
| Wagner et al. (2026) [B9]: abstract gives $p$ = .015 for the first-generation aOR, whereas the Results text and Table 3 give $p$ = .037 | Checked in the full text | Table 3 value used; background study |
| Visagie (2019) [S3]: abstract reports 269 responses; tables show 296 to 314 | The thesis reports 327 questionnaires (269 online and 58 paper) with missing data by item | Resolved; analytic $n$ reported as 296 to 314 |
| Adonu et al. (2023) [B6]: Table 4 headed $N$ = 347, but percentages imply a denominator of about 246 (for example 194 = 78.9%) | Checked in the full text; not explained there | Unresolved; cited as reported; background study |
| Adonu et al. (2023) [B6]: abstract and text give AOR 5.13 [2.16, 12.19] (buying breakfast) and 0.40 [0.18, 0.85] (female sex), whereas Table 3 gives 5.03 [2.43, 10.40] and 0.40 [0.19, 0.84]; the text says females were less likely although their regular intake was higher (40.9% vs 29.8%) | Checked in the full text; not explained there | Unresolved; Table 3 estimates used; direction for sex not interpreted |
| Pengpid & Peltzer (2020) [S6]: $n$ = 21,972 in the abstract, but 21,858 had complete breakfast data; the abstract says infrequent and frequent skipping were associated with poor performance, but Table 3 shows eating breakfast sometimes was not significant | Checked in the full text | Table 3 estimates used; abstract wording not used |
| Pengpid & Peltzer (2020) [S6]: abstract and conclusion state skipping breakfast was associated with 10 of 15 health risk behaviours, but the results list and Discussion give 11 | Checked in the full text (Table 2) | Behaviour count not used; performance estimates taken from Table 3 |
| Wagner et al. (2024) [S2] and Wagner et al. (2026) [B9]: both report 596 first-year Wits students from one institutional survey | Methods of both papers (5,684 invited; 726 participants; analytic 596; September to October 2020) | Confirmed from both methods sections; treated as one sample with two reports |
| Wagner et al. (2021) [S1]: the earlier draft listed first-generation status among the adjusted covariates, but the final model in the paper (Table 5) retained gender, race, home location, and hunger status | Checked in the full text: first-generation status and food-security status entered the backward stepwise model but were not retained | Resolved; final-model covariates reported in Section 3.4 and Table 5 |
| Rudolph et al. (2018) [S9]: the abstract reports that 97% of students believed hunger could harm performance and 52% had experienced this, but the full text says the impact on academic performance was not included in the study and presents no corresponding results | Checked in the full text | Unresolved; figures kept as perceptions only, not rated, and flagged as weakly documented |
| Rudolph et al. (2018) [S9]: the 1% severe and 6% moderate figures are Household Hunger scores, not overall food insecurity | Checked in the full text (section 4.3) | Resolved; reported as hunger, not food insecurity |

| | | |
|---|---|---|
| Ikuemonisan (2024) [S7]: source and units of the cumulative grade point average could not be established | Not resolvable from the article | Unresolved; coefficient reported for the audit trail only and not interpreted (Section 3.5) |
| Atwebembire (2025) [S8]: adjustment set for the adjusted logistic regression could not be verified | Could not be verified against the source | Unresolved; reported as unclear; adjusted estimates interpreted with caution (Sections 2.5 and 3.6) |

Note. Bracketed codes link each source to Table S3. Inconsistencies in background studies do not affect the synthesis.

Figures were traced to the source documents. Figures marked † were calculated by the reviewer by adding response categories.

**Supplementary Table S4b. Verification of key numerical findings.**

| Statistic | Source and location | Type | Notes |
|---|---|---|---|
| 64.3% concentration; 27.7% missed classes | Sabi et al. (2019), abstract | Reported | *n* = 456 |
| OR 1.876 [1.454, 2.418]; 30% response; *n* = 1,612 | Wagner et al. (2021), abstract and Table 5 | Reported | Final-model covariates: gender, race, home location (with hunger status) |
| 63.8% reduced or skipped meals weekly or more | Visagie (2019), Table 5.1 | Calculated† (19.3 + 11.7 + 15.0 + 17.8) | Remaining 36.2% none |
| 69.3% cannot afford balanced meals | Visagie (2019), Table 5.1 | Calculated† (15.2 + 13.7 + 11.2 + 29.2) | |
| 84.8% concentration; 22.6% missed class; 44.8% skipped class | Visagie (2019), Tables 4.5 and 4.6 | Calculated† (31.5 + 53.3; 13.0 + 9.6; 28.3 + 16.5) | Agree plus strongly agree |
| OR 2.50 [1.12, 5.55]; OR 7.08 [2.67, 18.81]; male OR 2.70; dropout 10.5% weighted (9.9% crude) | Wagner et al. (2024), abstract, Table 4, Results 3.1 | Reported | Mild OR 0.98 and severe OR 1.09 also reported |
| *r* = −.282; ρ = −.321 (*N* = 300) | Visagie (2019), Tables 4.11 and 4.12 | Reported | Unadjusted |
| 7/15 skipped meals; 12/15 concentration; 14/15 insufficient funds | Majali & Tengeh (2026), abstract | Reported | 15 interviews |
| Coefficients −15.311 and −22.108; about 60% poor consumption | Ikuemonisan (2024), results and discussion | Reported | Units unclear |
| 13.8%, 34.2%, 51.9% breakfast categories | Pengpid & Peltzer (2020), Results | Reported | *n* = 21,972 |
| 87% diverse diets and five meals; 21.5% and 28.1% never snack | Mwaniki et al. (2025), abstract and Table 3 | Reported (checked 63/293; 82/293) | Background study |
| Mean pocket money KES 2,533 (*SD* 1,741) | Mwaniki et al. (2025), p. 252 | Reported | Background study |
| 78.8% no meal plan; 84.5% income KES 0 to 5,000 | Onsomu et al. (2025), abstract | Reported | Background study |
| 35.7% three meals daily | Ndung'u et al. (2025), results summary | Reported | Background study |
| 44.3% fewer than three meals; 59.3% reduced meal size | Mkomagi et al. (2021), abstract | Reported | Background study |

| | | | |
|---|---|---|---|
| 35.7% regular breakfast | Adonu et al. (2023), Table 3 | Reported | Differs from abstract (Table S4a); background study |

Note. Selected figures could not be independently verified because source reports contained internal inconsistencies (Table S4a).

JBI checklist for analytical cross-sectional studies

Items: (1) inclusion criteria defined; (2) subjects and setting described; (3) exposure measured validly and reliably; (4) objective, standard criteria used to measure the condition; (5) confounders identified; (6) strategies to address confounders stated; (7) outcomes measured validly and reliably; and (8) appropriate statistical analysis.

**Supplementary Table S5. Appraisal Tools and Item-Level Ratings**

| Study | Status | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | Score |
|---|---|---|---|---|---|---|---|---|---|---|
| Ikuemonisan (2024), S7 | Included | Y | Y | U | Y | Y | Y | U | U | 5/8 |
| Visagie (2019), S3 | Included | Y | Y | U | U | Y | N | U | Y | 4/8 |
| Pengpid & Peltzer (2020), S6 | Included | Y | Y | U | U | Y | Y | U | Y | 5/8 |
| Wagner et al. (2021), S1 | Included | Y | Y | U | Y | Y | Y | Y | Y | 7/8 |
| Wagner et al. (2024), S2 | Included | Y | Y | Y | Y | Y | Y | Y | U | 7/8 |
| Sabi et al. (2019), S4 | Included | U | Y | U | N | Y | N | U | U | 2/8 |
| Atwebembire (2025), S8 | Included | Y | Y | U | U | Y | Y | U | U | 4/8 |
| Rudolph et al. (2018), S9: survey component | Included | U | Y | U | Y | N | N | U | U | 2/8 |
| Mwaniki et al. (2025), B1 | Background | Y | Y | Y | U | Y | Y | Y | U | 6/8 |
| Onsomu et al. (2025), B2 | Background | Y | Y | Y | U | U | U | Y | Y | 5/8 |
| Adonu et al. (2023), B6 | Background | Y | Y | U | N | Y | Y | U | U | 4/8 |

Note. Y = yes; N = no; U = unclear. Scores represent the number of items rated Y out of eight; N and U are retained separately to distinguish identified limitations from insufficient reporting. Background studies were appraised before the question was narrowed and are retained for transparency; they were not included in the synthesis or its confidence ratings.

**Supplementary Table S6. Search Strategy and Search Result**

| No. | Query | Mode | Results |
|---|---|---|---|
| 1 | food insecurity academic performance university students Kenya | Standard | 10 |
| 2 | Kenya Medical Training College students dietary habits nutrition | Standard | 9 |
| 3 | meal skipping breakfast academic performance university students cross-sectional Africa | Standard | 10 |
| 4 | food insecurity class attendance concentration university students survey | Standard | 9 |
| 5 | Kenya university students food insecurity prevalence determinants | Extended | 10 |
| 6 | Ethiopia university students food insecurity academic performance cross-sectional | Standard | 10 |
| 7 | Ghana Nigeria university students food insecurity academic performance GPA | Standard | 9 |
| 8 | South Africa university students food insecurity academic performance hunger concentration study | Standard | 9 |
| 9 | Uganda OR Tanzania OR Zimbabwe university students meal frequency food insecurity academic performance | Standard | 9 |
| 10 | Kenya college students eating habits meal skipping academic performance Moi OR Kenyatta OR Egerton OR Maseno | Extended | 10 |

Note. Total results examined = 95.

**Supplementary Table S7: PRISMA 2020 Checklist**

| Item | Topic | Status | Location and comment |
|---|---|---|---|
| 1 | Title | Met | Title |
| 2 | Abstract | Met | Abstract |
| 3 | Rationale | Met | Section 1 |
| 4 | Objectives | Met | Section 1, final paragraph |
| 5 | Eligibility criteria | Met | Section 2.2; Table 1; Table S1 |
| 6 | Information sources | Partly Met | Section 2.3; Table 2 gives generic strings; database-specific strings and search dates were not added |
| 7 | Search strategy | Partly Met | Section 2.3; Table 2 gives generic strings; database-specific strings and search dates were not added |
| 8 | Selection process | Partly Met | Section 2.4; screened by two reviewers (Sections 2.1 and 4.5); whether screening was independent and we did not report how disagreements were resolved |
| 9 | Data collection process | Met | Sections 2.1 and 2.5; data were extracted by a third reviewer. |
| 10a | Outcomes sought | Met | Section 2.2; Table 1 |
| 10b | Other variables sought | Met | Section 2.5 |
| 11 | Risk of bias assessment | Partly Met | Sections 2.6 and 3.3; Table 5 and Supplementary Table S5. Item-level ratings are shown for the quantitative appraisal; the qualitative component is reported as an overall 1/10 score, without item-by-item ratings. |
| 12 | Effect measures | Met | Sections 2.7 and 3.4 to 3.7 (odds ratios, correlations, percentages as reported) |
| 13a | Eligibility for synthesis | Met | Section 2.7 |
| 13b | Data preparation for synthesis | Met | Sections 2.5 and 2.7; Table S4a |
| 13c | Tabulation and visual display | Met | Tables 4 and 6 |
| 13d | Synthesis methods | Met | Section 2.7 (SWiM) |
| 13e | Exploring heterogeneity | Met | Section 2.7; Sections 3.4 to 3.7 (qualitative) |
| 13f | Sensitivity analyses | Not applicable | No pooled analysis |
| 14 | Reporting bias assessment | Not assessed | Section 2.7; Section 4.5 |
| 15 | Certainty assessment | Met | Section 2.8; Tables 3 and 7 (informal criteria, not GRADE) |
| 16a | Study selection | Met | Section 3.1; Figure 1; Tables S6 |
| 16b | Excluded studies | Partly Met | Table S3b lists the 12 studies reclassified as background, with reasons; Table S8 (all screened records) is not yet included |
| 17 | Study characteristics | Met | Table 4 |
| 18 | Risk of bias in studies | Met | Section 3.3; Table 5 (overall appraisal for all nine studies); item-level ratings in Table S5 |

| | | | |
|---|---|---|---|
| 19 | Results of individual studies | Met | Table 6 |
| 20a | Results of syntheses | Met | Sections 3.4 to 3.8 |
| 20b | Results of statistical syntheses | Not applicable | No meta-analysis |
| 20c | Heterogeneity investigations | Met | Sections 3.4 to 3.7 |
| 20d | Sensitivity analyses | Not applicable | No pooled analysis |
| 21 | Reporting biases in synthesis | Not assessed | Section 4.5 |
| 22 | Certainty of evidence | Met | Table 7 |
| 23a | Interpretation | Met | Sections 4.1 to 4.3 |
| 23b | Limitations of the evidence | Met | Section 4.4 |
| 23c | Limitations of the review process | Met | Section 4.5 |
| 23d | Implications | Met | Section 4.6 |
| 24a | Registration and protocol | Met (reported as not registered) | Section 2.1; Declarations |
| 24b | Where the protocol can be accessed | Not applicable | No protocol |
| 24c | Amendments | Met | Section 2.1; Table S1 |
| 25 | Support | Met | Declarations (no funding received) |
| 26 | Competing interests | Met | Declarations (none declared) |
| 27 | Availability of data, code, and materials | Met | Declarations; Supplementary Material. Extraction (Tables 4 and 6), appraisal (Table S5) and search log (Table S6) are included; |

Registration status and review type are reported separately: this is a structured evidence review that was not registered. Locations refer to sections of this manuscript. Items 6 and 7 are partly met because the database-specific search strings, search dates for each database, and database-level retrieval counts are not reported. Table 2 presents the generic concept blocks. Item 11 is partly met because item-level ratings are provided for the quantitative appraisal, but the qualitative appraisal is reported only as an overall score. These limitations are reflected in the checklist statuses below.