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






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RESEARCH ARTICLE



## Research trends and gaps concerning food insecurity in college students in the United States: a scoping review

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### ABSTRACT

**Objective:** This scoping review explores the broad body of peer-reviewed research measuring food insecurity in post-secondary students in the U.S. to identify trends and gaps to inform future research.

**Methods:** Three search engines (PubMed, Web of Science, and CINHAL Full Text) were systematically searched for articles reporting on food security status in U.S. college students.

**Results:** One-hundred and sixty studies met inclusion criteria. Emerging high-risk student characteristics include gender non-conforming (GNC) and non-binary, financial independence in college, and pregnant and parenting students. Emerging correlates include lack of transportation, anxiety, and eating disorders.

**Conclusions:** Prevalence data can be used by colleges to advocate for services and programs. Additional multi-institutional cohort, longitudinal and qualitative studies are needed to identify timely interventions and effective solutions. A new “rights-based” approach to food security solutions that includes nutrition and food literacy for all students is needed.

### ARTICLE HISTORY

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### KEYWORDS

College students; food insecurity; food security; scoping review; university students

## Introduction

Food insecurity (FI) is defined as a household measure of “limited or uncertain availability of nutritionally adequate and safe foods or the ability to acquire acceptable foods in socially acceptable ways is limited or uncertain”.<sup>1</sup> It is becoming widely accepted that college students are at-risk for FI, and studies documenting the prevalence and correlates of FI among post-secondary students has been used to advocate for interventions and nutrition policy changes. In their 2020 scoping review, Nikolaus et al.<sup>2</sup> reported tremendous variability of FI prevalence in college students, from as low as 10% to as high as 75%, with an overall weighted estimate across all studies of 41%. In comparison, the prevalence of FI in the general population in 2019 was 10.5%.<sup>3</sup> Unemployment during the COVID-19 pandemic worsened the problem.<sup>4,5</sup> However, in their 2022 commentary, Landry et al.<sup>6</sup> acknowledged gaps in understanding the prevalence, severity, and persistence of the problem. For example, the reliability of existing data is hampered by the lack of a standardized measurement tool,<sup>2,7,8</sup> and the need for nationally representative random sampling of all student types.<sup>6</sup> In addition, the effectiveness of campus-based interventions and societal hunger-relief efforts for college students is in doubt. The overarching aim of this scoping review is to explore the breadth of peer-reviewed research on FI in

post-secondary students in the U.S. to identify research trends and gaps to inform future research. Secondary aims are to identify the scope of correlating variables, research methods and theories applied.

## Methods

This scoping review followed the enhanced methodological framework as described in the JBI Manual for Evidence Synthesis.<sup>9</sup> The first author, B.J.G. conducted a preliminary search on 5/23/22 to identify existing scoping reviews. This initial search was limited to systematic and scoping reviews on FI and college students in the U.S., using PubMed and CINHAL Full Text databases with no time restriction. A total of 9 records were found. Seven records were removed (3 duplicates and 4 not measuring FI in college students in the U.S.). This left one systematic and one scoping review. Nikolaus et al.<sup>2</sup> conducted a scoping review of the literature from June 2017 to June 2018 with three research aims: (1) develop a weighted estimate of FI among college students, (2) evaluate the quality of literature, and (3) describe study characteristics related to prevalence estimates. In contrast, the goal of the current scoping review is to summarize the breadth of the literature as it relates to specific study characteristics that can be synthesized and used to identify

trends and gaps that inform future research. We also add to the literature (through 6/1/2022) by extending the scope of the systematic narrative review from 2000 to 2016 by Bruening et al.<sup>7</sup> In addition, to our knowledge, we are the first to report on the theoretical frameworks applied to this body of research. The review protocol was made publicly available via Open Science Framework (<https://osf.io/gxyb9>). The checklist of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) Extension for Scoping Reviews (PRISMA-ScR) (Table 1).<sup>10</sup>

### Identifying the research question

The primary research question of interest was, what are the research trends and gaps concerning FI among college students in the U.S.? Secondary questions were (i) what student sub-populations and correlating variables characterize the data? (ii) which methodologies and theoretical frameworks have been applied? (iii) what do qualitative studies contribute? and (iv) what interventions are documented in this literature?

**Table 1.** The checklist of preferred reporting items for systematic reviews and meta-analyses extension for scoping reviews (PRISMA-ScR)<sup>10</sup>.

Section	Item	Prisma-ScR checklist item	Reported on page #
Title			
Title	1	Identify the report as a scoping review.	Page 1
Abstract			
Structured summary	2	Provide a structured summary that includes (as applicable): background, objectives, eligibility criteria, sources of evidence, charting methods, results, and conclusions that relate to the review questions and objectives.	Page 1
Introduction			
Rationale	3	Describe the rationale for the review in the context of what is already known. Explain why the review questions/objectives lend themselves to a scoping review approach.	Page 1
Objectives	4	Provide an explicit statement of the questions and objectives being addressed with reference to their key elements (e.g., population or participants, concepts, and context) or other relevant key elements used to conceptualize the review questions and/or objectives.	Page 1
Methods			
Protocol and registration	5	Indicate whether a review protocol exists; state if and where it can be accessed (e.g., a Web address); and if available, provide registration information, including the registration number.	Page 2
Eligibility criteria	6	Specify characteristics of the sources of evidence used as eligibility criteria (e.g., years considered, language, and publication status), and provide a rationale.	Page 3
Information sources*	7	Describe all information sources in the search (e.g., databases with dates of coverage and contact with authors to identify additional sources), as well as the date the most recent search was executed.	Page 3
Search	8	Present the full electronic search strategy for at least 1 database, including any limits used, such that it could be repeated.	Table 2
Selection of sources of evidence <sup>†</sup>	9	State the process for selecting sources of evidence (i.e., screening and eligibility) included in the scoping review.	Page 3
Data charting process <sup>‡</sup>	10	Describe the methods of charting data from the included sources of evidence (e.g., calibrated forms or forms that have been tested by the team before their use, and whether data charting was done independently or in duplicate) and any processes for obtaining and confirming data from investigators.	Page 3
Data items	11	List and define all variables for which data were sought and any assumptions and simplifications made.	Page 3
Critical appraisal of individual sources of evidence <sup>§</sup>	12	If done, provide a rationale for conducting a critical appraisal of included sources of evidence; describe the methods used and how this information was used in any data synthesis (if appropriate).	NA
Synthesis of results	13	Describe the methods of handling and summarizing the data that were charted.	3
Results			
Selection of sources of evidence	14	Give numbers of sources of evidence screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally using a flow diagram.	Figure 1
Characteristics of sources of evidence	15	For each source of evidence, present characteristics for which data were charted and provide the citations.	Tables 5 and 6
Critical appraisal within sources of evidence	16	If done, present data on critical appraisal of included sources of evidence (see item 12).	NA
Results of individual sources of evidence	17	For each included source of evidence, present the relevant data that were charted that relate to the review questions and objectives.	Table 4
Synthesis of results	18	Summarize and/or present the charting results as they relate to the review questions and objectives.	Figure 2, Tables 3, 7 and 9
Discussion			
Summary of evidence	19	Summarize the main results (including an overview of concepts, themes, and types of evidence available), link to the review questions and objectives, and consider the relevance to key groups.	Page 34
Limitations	20	Discuss the limitations of the scoping review process.	Page 35
Conclusions	21	Provide a general interpretation of the results with respect to the review questions and objectives, as well as potential implications and/or next steps.	Page 35
Funding			
Funding	22	Describe sources of funding for the included sources of evidence, as well as sources of funding for the scoping review. Describe the role of the funders of the scoping review.	Page 36

\*Where sources of evidence (see second footnote) are compiled from, such as bibliographic databases, social media platforms, and Web sites.

<sup>†</sup>A more inclusive/heterogeneous term used to account for the different types of evidence or data sources (e.g., quantitative and/or qualitative research, expert opinion, and policy documents) that may be eligible in a scoping review as opposed to only studies. This is not to be confused with information sources (see first footnote).

<sup>‡</sup>The frameworks by Arksey and O'Malley (6) and Levac and colleagues (7) and the JBI guidance (4, 5) refer to the process of data extraction in a scoping review as data charting.

<sup>§</sup>The process of systematically examining research evidence to assess its validity, results, and relevance before using it to inform a decision. This term is used for items 12 and 19 instead of "risk of bias" (which is more applicable to systematic reviews of interventions) to include and acknowledge the various sources of evidence that may be used in a scoping review (e.g., quantitative and/or qualitative research, expert opinion, and policy documents).

## Identifying the relevant studies

To ensure broad coverage, three search engines were employed, with no date restrictions. The open time frame was chosen to provide historical context to the research questions. A university research librarian with expertise in health science was consulted to create a research strategy and define the utilized databases. The literature search was conducted by the first author (BJG) on June 1, 2022, using the following databases: PubMed, Web of Science, and CINHAL Full Text, and terms and subjects related to food insecurity and college students (Table 2).

## Study selection

All citations were imported into Mendeley reference manager and transferred to Rayyan software and checked for duplicates. Two reviewers (BJG and CF) independently reviewed the title and abstract of all records considering the previously established inclusion criteria: (1) reported FI prevalence; (2) focused on college or university students in the U.S.; (3) published in peer-reviewed journals (reviews, case studies, symposium reports, conference proceedings and commentaries excluded); (4) full-text available in English. There was 96% agreement between the two reviewers (BJG and CF), who discussed the conflicting records until reaching 100% agreement.

## Charting the data

A pre-structured form in Microsoft Excel was used to extract information from all articles. In accordance with the participants, concept, and context (PCC) of scoping reviews,<sup>10</sup> the form included information about participants (select characteristics and total numbers), concept (related to this scoping review aims) and context (geographical regions, cultural, social, ethnic or gender factors). The categories extracted were: (i) citation, (ii) research design and theoretical framework applied, (iii) main objective, (iv) population, (v) key findings, (vi) practical significance (vii) research gaps and implications for future research.

## Collating, summarizing, and reporting the results

The main findings were synthesized into tables and figures with all the relevant information collected. Emerging themes from the main findings were summarized to show research trends and gaps in the literature.

## Results

The search yielded a total of nine hundred records (322 from Web of Science, 452 from PubMed and 126 from CINHAL plus Full Text). Rayyan auto deduplication removed 224 exact duplicates and manual deduplication removed an additional 13 duplicates. Based on previously established criteria, the remaining titles and abstracts were screened for relevance and an additional 499 records were excluded. The final number of articles included in this review was 160. A summary of the screening process is illustrated in Figure 1.

## Research trends and gaps; student sub-populations and correlating variables

### Select sub-populations

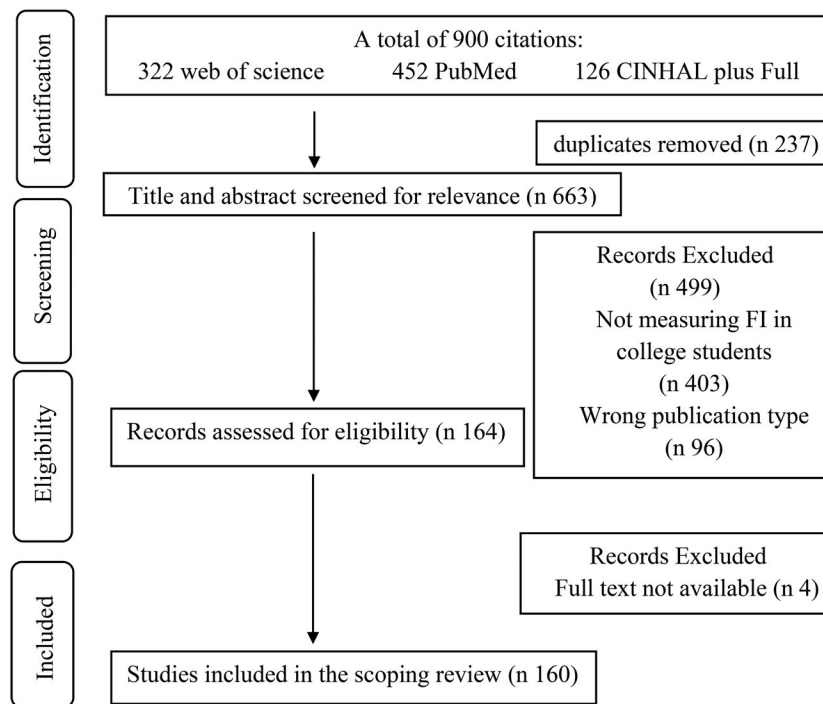
Chaparro et al published the first study on FI in college students in the U.S. in 2009.<sup>11</sup> Figure 2 shows number of published records per publication year. Early studies focused on FI prevalence, associations, and predictors among the general population of university students. Later investigations included select student populations ( $n=21$ ), including male collegiate athletes,<sup>12</sup> Deferred Action for Childhood Arrivals (DACA)-eligible students,<sup>13</sup> graduate students,<sup>14</sup> and international students<sup>15</sup> (Table 3).

### High risk demographics

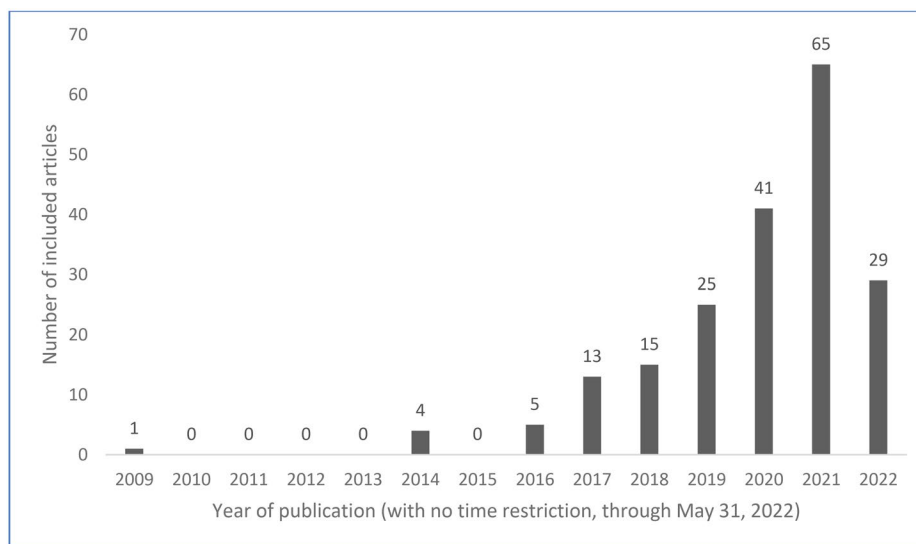
FI correlating variables identified in main findings were extracted from quantitative studies (Table 4). As shown in Table 4, emerging high-risk demographics include gender non-conforming; emerging student characteristics include childhood FI; developing health correlates include anxiety, eating disorders, neurological brain changes, and sleep deprivation. Given the overwhelming evidence that minority, non-white, multi-ethnic, African-American, and Hispanic students are at higher risk, future research is needed to address the racial and ethnic disparities of FI prevalence.<sup>59</sup> There is a need to oversample minority populations,<sup>52</sup> retain detailed information on ethnicity from students who identify with more than one racial/ethnic group,<sup>55</sup> desegregate by both race/ethnicity and gender, and instead of reporting FI as a dichotomous variable describe levels of FI as levels of an outcome variable within ethnicities.<sup>54</sup> LGBTQ, gender non-conforming (GNC) and non-binary students, and those who are pregnant and parenting are also at higher risk. Women of color may be at higher risk than men and white women; however, food insecure men appear to have worse

**Table 2.** Search databases criteria.

Database	Date	Search terms in the database
PubMed	6/1/22	((food insecurity[MeSH Terms] AND (english[Filter])) OR ("food securit*[Title/Abstract] OR "food securit*[Title/Abstract] OR "food insufficienc*[Title/Abstract] OR "food disparit*[Title/Abstract] OR hunger[Title/Abstract] AND (english[Filter])) AND (english[Filter])) AND ((students[MeSH Terms] AND (english[Filter])) OR ("college student*[Title/Abstract] OR "university student*[Title/Abstract] OR undergraduate[Title/Abstract] OR "undergraduate student*[Title/Abstract] AND (english[Filter]))
CINHAL full text	6/1/22	AB "food securit*" OR "food securit*" OR "food insufficienc*" OR "food disparit" OR hunger OR SU food insecurity AND AB "college student*" OR "university student*" OR "undergraduate student*" OR undergraduate OR SU students, college OR students, undergraduate OR students, graduate
Web of science	6/1/22	(TS=("college student*" OR "university student*" OR "undergraduate student*" OR undergraduate*) AND TS=("food insecurity" OR "food security" OR "food insufficiency" OR hunger OR "food disparity")



**Figure 1.** Flow diagram of the literature search and filtering results for a scoping review of food insecurity in college students in the U.S.



**Figure 2.** Number of peer-reviewed articles measuring FI in college students in the U.S. by publication year.

dietary intake compared to women.<sup>76,77</sup> Spaid et al.<sup>21</sup> reported that community college women over 20 years of age were 2.8 times more likely to be food insecure compared to 18-year-old women. Coakley et al.<sup>89</sup> ( $n=800$ ), found that age was not associated with FI or basic needs insecurity but was significantly and positively associated with housing insecurity.

#### **Student characteristics**

Year in school, first or second-generation, and status as an undergraduate, graduate, or international student all appear to impact FI risk. Coffino et al.<sup>14</sup> found that nearly half of graduate students studied ( $n=263$ ) were food insecure, and very low FS was associated with elevated levels of depression,

anxiety, and stress. Yet, others found higher rates of FI in undergraduate compared to graduate students. Wooten et al.<sup>64</sup> ( $n=4,842$ ) found that only undergraduate seniors were more likely to experience FI compared to graduate students. Hagedorn et al.<sup>118</sup> ( $n=13,642$ ) reported that FI peaked during the undergraduate sophomore year. The food security experiences of the on-line student population, and students with medical conditions have been largely ignored.

#### **Financial factors: basic needs, housing insecurities and household characteristics**

Emerging financial factors include employment, financial assistance, familial financial support, financial independence,



**Table 3.** Select populations of students included in the study of FI in college students in the U.S.

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Nursing students <sup>16,17</sup>
Deaf students <sup>18</sup>
Foster youth undergraduates <sup>19</sup>
Community college students, <sup>20–23</sup> with at least 1 dependent child <sup>24</sup>
Hispanic serving institution (HSI) <sup>25–27</sup>
Historically black colleges and universities (HBCU) <sup>28</sup>
Freshman only <sup>29–34</sup> Freshman females only <sup>35</sup>
Graduate students only, <sup>14</sup> graduate vs. undergraduate students <sup>36</sup>
International students <sup>15</sup>
Public administration graduate students <sup>37</sup>
Health sciences graduate students <sup>38</sup>
Private liberal arts school students <sup>39</sup>
Social work students <sup>40,41</sup>
Collegiate athletes <sup>12,42–44</sup>
Health professions students <sup>45</sup>
Medical students <sup>46</sup>
Dental students <sup>47</sup>
DACA eligible college students <sup>13</sup>
Marginally food secure students only <sup>48</sup>
Transgender and gender nonconforming students (GNC) <sup>5,49</sup>

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financial priority and budgeting factors, basic needs insecurity, housing insecurity, homelessness, household characteristics, and lack of reliable transportation (Table 4). It was recently reported that students who experienced FI in childhood,<sup>69</sup> and those who are financially independent in college,<sup>108</sup> have the highest prevalence of FI. Not surprisingly, students who were financially independent immediately before COVID-19 were more likely to experience higher levels of FI during the pandemic, compared to students who were financially dependent.<sup>125</sup> Students who experienced homelessness and severe FI were at profoundly greater academic risk compared to peers who were not facing these challenges.<sup>91</sup> Household characteristics associated with increased risk include students living off-campus, students living off campus with roommates, and students living off campus without parents or guardians.

### Coping strategies

Taken as whole, coping strategies cluster into 3 categories; financial strategies, strategies that influence academics, and food seeking behaviors (including food assistance) (Table 4). Students find ways to allocate money to food and stretch their food dollar. Examples include keeping monthly food budgets, selling and/or trading off textbook purchases to buy food, purchasing cheap foods, and processed foods, rationing food, compensatory fasting, grocery shopping less frequently, eating less healthy foods to eat more, and skipping meals. Students also experience time constraints, they rarely eat home cooked meals, and will choose between academics and shopping for, or preparing food. They will bridge the food gap by going home on the weekends for meals and seeking food from family and friends. Students utilize food-related public assistance, and free food options, including those on campus. Yet, little is known about the effectiveness<sup>34</sup> and physical and emotional consequences of these coping strategies.<sup>42</sup> Continued development of reliable and valid assessments of coping behaviors employed by college students would help identify threats to health, diet, and food security.<sup>82</sup> Further study of food-related decisions and tradeoffs under resource constraints are needed.<sup>80</sup>

### Diet quality and nutrition status

Most studies show a relationship between FI, dietary intake, and body weight. In an online survey during the COVID 19 pandemic ( $n=503$ ), Silva et al.<sup>70</sup> found that those with very low FS had Healthy Eating Index (HEI) scores significantly lower than students with high or marginal FS. Similarly, Leung et al.<sup>72</sup> sampled students at a large public Midwestern university, skewed to represent minority, low income, and first-generation students ( $n=754$ ), and used the NCI dietary screener to show that students with very low FS had higher intakes of sugar and SSB. Not all studies show this association, possibly due to the overall poor diets of this population or insensitivity of diet screening measures.<sup>31</sup> Future research is needed to examine how hunger and FI are specifically impacting a broad measure of college students' diets.<sup>42</sup> The mechanisms for the association between FI and obesity are still not well elucidated.<sup>71,95</sup> Using statistical path analysis, Martinez, et al.<sup>95</sup> found that FI was directly and indirectly related to an increase in BMI and poor health through three mechanisms: fewer days of adequate sleep, fewer days of moderate to vigorous physical activity, fewer daily F/V. Results support the “food insecurity-obesity paradox” hypothesis, that food insecurity may cause weight gain due to increased consumption of calorie-dense, poor-quality foods, and metabolic changes due to episodic undereating.

### Nutrition literacy, food, and cooking agency

FI may be related to nutrition literacy, and variables measuring food preparation frequency, ability, access, and self-efficacy.<sup>82</sup> Food insecure students want information on meal preparation and budgeting,<sup>53</sup> and assistance with job opportunities, affordable meal plans, money management, and eating healthy.<sup>33</sup> Improving nutrition literacy, food preparation skills and self-efficacy should be a target of efforts aimed at decreasing FI among college students. Toward this end, future studies examining characteristics associated with these variables and their relationship with dietary intake are needed.<sup>81</sup>

### Physical health and wellbeing

Emerging health correlates include anxiety, eating disorders, neurological brain changes, and sleep deprivation (Table 4). The only case-controlled study was in the natural sciences, using brain magnetic resonance imaging to compare FI with FS students.<sup>114</sup> There appears to be a correlation between FI and poor sleep, sleep apnea, physical health, physical activity, energy levels, hunger pangs and feelings of “lightheadedness”. Small study size tends to limit consensus. Ryan et al.<sup>74</sup> ( $n=257$ ) found no relationship between FI and sleep quality. It has been reported that FI affects perceived health status,<sup>15</sup> and subjective social status mediates the relationship between FI and self-reported mental and physical health status.<sup>78</sup>

### Mental health and psychosocial development

Compared to food secure students, those who experience FI are more likely to experience anxiety, stress, depression, loneliness, suicidal, and self-injurious behavior (Table 4).

**Table 4.** FI correlates or factors identified in main findings of quantitative studies.

Categories	FI correlating variables <sup>a</sup>
Demographics	<ul style="list-style-type: none"> <li>• Race: minority,<sup>10,50–52</sup> non-white race,<sup>53</sup> multi-ethnic,<sup>54</sup> African American,<sup>12,52,54–56,57–60,61</sup> Hispanic,<sup>12,52,55,60,62</sup></li> <li>• Gender and sexuality: men,<sup>15,54</sup> women,<sup>60</sup> community college women of color,<sup>21</sup> transgender/non-binary/gender non-conforming (GNC)<sup>49,51,56,63</sup></li> </ul>
Student characteristics	<ul style="list-style-type: none"> <li>• Age: Community college women &gt;20y were 2.8 times more likely to be food insecure than women who were 18.<sup>21</sup></li> <li>• Pregnancy and parenting status,<sup>26</sup> single parents.<sup>21</sup></li> <li>• Enrollment: Year in school,<sup>15,64</sup> higher prevalence in fall vs. spring enrollment,<sup>65</sup> freshman vs. upper classman,<sup>66</sup> 3rd year students,<sup>50</sup> international students,<sup>17</sup> graduate students,<sup>14</sup> graduate students vs. undergraduates,<sup>36</sup> first,<sup>12,55,56,65</sup> and second-generation students.<sup>67</sup></li> <li>• Meal plan: Type and use predicted FI,<sup>68</sup> no or limited meal plan.<sup>60</sup></li> <li>• Parents and family: Parental BMI (overweight or obese),<sup>35</sup> parental educational achievement (high school or less),<sup>35</sup> father employed full time/mother with a college degree correlated with FS, FI before college,<sup>12,64,69</sup> childhood FI 7 times more likely to be FI in college,<sup>62</sup> lower rate of family FI compared to on-campus FI reported by freshman.<sup>33</sup></li> <li>• Low-income,<sup>26</sup> women of low socioeconomic status<sup>61</sup></li> <li>• Not having reliable transportation to campus.<sup>15,26</sup></li> <li>• Homeless.<sup>62,69</sup></li> </ul>
Dietary intake, nutritional status	<ul style="list-style-type: none"> <li>• Diet quality: Not related to FI,<sup>31</sup> related to FI.<sup>38,70</sup></li> <li>• Sugar and SSB related to FS,<sup>71–74</sup></li> <li>• F/V intake: Related to FI,<sup>71,73,75,76</sup> not related to FI,<sup>74</sup> lower intake in FI males than females.<sup>76,77</sup></li> <li>• BMI related to FI,<sup>32,71,72,78</sup> not related to FI.<sup>31,59,63</sup></li> <li>• % Body fat not related to FI.<sup>59</sup></li> </ul>
Food and nutrition literacy	<ul style="list-style-type: none"> <li>• Cooking: Self-efficacy,<sup>79,80</sup> frequency,<sup>15,81</sup> food preparation scores,<sup>80</sup> cooking and food agency,<sup>72</sup> food preparation ability and access to cooking facilities,<sup>82</sup> wanting information on meal prep and budgeting,<sup>53</sup> pre and post culinary nutrition course decreased very low FI and increased FS.<sup>83</sup></li> <li>• Nutrition literacy.<sup>84,85</sup></li> <li>• Perceptions of healthful eating.<sup>30,31</sup></li> </ul>
Food seeking behaviors, and barriers	<ul style="list-style-type: none"> <li>• Frequency of shopping.<sup>45</sup></li> <li>• Meal plan: Participation did not prevent FI,<sup>28</sup> no association with meal plan participation.<sup>64</sup></li> <li>• Transportation.<sup>46,54,86</sup></li> <li>• Utilizing free food options.<sup>45</sup></li> <li>• Stigma,<sup>27</sup> bootstrapping<sup>27</sup> and the myths of student hunger and politics of worthiness/ deservingness.<sup>87</sup></li> <li>• Food cost.<sup>53</sup></li> </ul>
Healthcare access	<ul style="list-style-type: none"> <li>• Related to FI<sup>88</sup></li> </ul>
Basic needs insecurity	<ul style="list-style-type: none"> <li>• Related to FI<sup>40,89,90</sup></li> </ul>
Homelessness, housing, and housing access	<ul style="list-style-type: none"> <li>• Homelessness related to FI.<sup>58</sup></li> <li>• Housing insecurity related to FI.<sup>54,88,91</sup></li> <li>• Household characteristics related to FI: Size, living with parents,<sup>92</sup> living with roommates,<sup>10</sup> residing off campus,<sup>53,93</sup> residing off-campus without parents or guardians,<sup>57</sup> part-time students living alone had the highest rates of FI.<sup>6</sup></li> <li>• Changes in living situation during the COVID-19 pandemic.<sup>4</sup></li> </ul>
Psychosocial health and wellbeing	<ul style="list-style-type: none"> <li>• Psychosocial health<sup>18</sup>/distress,<sup>94</sup> peer support inversely related,<sup>18</sup> mental health,<sup>31,94–96</sup> pain (mediated by depression),<sup>97</sup> anxiety,<sup>14,89,98–101</sup> depression,<sup>15,30,51,58,59,99–101</sup> loneliness,<sup>50,99</sup> languishing,<sup>99</sup> worry,<sup>45</sup> stress,<sup>14,32,47,51,61</sup> suicidal behavior,<sup>50</sup> social support/engagement,<sup>29,50</sup> perceived need for help,<sup>99</sup> self-injurious behavior.<sup>99</sup></li> <li>• Cultural food security (feelings of identity degradation).<sup>102</sup></li> <li>• Views of campus climate.<sup>103</sup></li> <li>• Legal concerns.<sup>54</sup></li> </ul>
Physical health and wellbeing	<ul style="list-style-type: none"> <li>• Physical health,<sup>54,61,88,96</sup> physical activity,<sup>31,75</sup> energy levels,<sup>20</sup> lightheadedness and hunger pains.<sup>45</sup></li> <li>• Poor sleep/sleep apnea,<sup>47,75,96</sup> no association with sleep.<sup>32,74,101,104,105</sup></li> <li>• Eating disorders,<sup>32,101,104,105</sup> emotional eating association with FI higher in males than females,<sup>77</sup> binge eating, compensatory fasting, disordered eating behaviors.<sup>43,106</sup></li> <li>• Subjective social status plays a mediating role in the relationship between FI and self-reported mental and physical health status.<sup>53,78</sup> perceived health status.<sup>15</sup></li> <li>• “FI-Obesity paradox” FI related to poor sleep, fewer days of moderate to vigorous physical activity, poor health, and fewer daily servings of FV.<sup>75</sup></li> </ul>
Financial factors	<ul style="list-style-type: none"> <li>• Financial factors.<sup>46,64,84,107</sup></li> <li>• Financial independence correlates with FI,<sup>108,109</sup> not receiving college loans,<sup>38</sup> identify family’s financial situation better than others correlated with FS.<sup>35</sup></li> <li>• Financial assistance: Familial financial support,<sup>108</sup> financial,<sup>53,57,58,60,62,67,108,110</sup> or food assistance,<sup>108</sup> Pell grant recipients,<sup>12,21,55,71,111</sup> DACA students’ ineligibility for financial aid.<sup>13</sup></li> <li>• Budgeting behaviors,<sup>108,112</sup> concerns about paying for college,<sup>51</sup> credit card ownership and exogenous shock (the presence of any adverse financial or health related circumstances),<sup>108</sup> financial priority,<sup>84</sup> money expenditure scale (MES) predicted FI, spending \$ on other items before purchasing food.<sup>113</sup></li> <li>• Employment and number of hours worked,<sup>53,54,71</sup> unemployed and seeking work.<sup>52</sup></li> </ul>
Academic tasks/success/challenges	<ul style="list-style-type: none"> <li>• Academic tasks,<sup>47,88</sup> attentiveness in class,<sup>17</sup> energy and concentration levels,<sup>20,45,62</sup> procrastination,<sup>50</sup> executive functioning difficulties evident by brain magnetic resonance imaging.<sup>114</sup></li> <li>• Challenges with faculty.<sup>50</sup></li> <li>• Commitment to retention and completion,<sup>111,115</sup> retention,<sup>52,91</sup> completion,<sup>91,116</sup> achievement of academic goals,<sup>117</sup> academic progress scale predicted FI,<sup>118</sup> academic success inversely related to FI.<sup>113</sup></li> <li>• Lower GPA,<sup>17,20,29,34,57,60–62,64,68,95,111,119</sup> psychological well-being and sleep mediated the link between FI and GPA,<sup>120,121</sup> FI partially mediated the association between student characteristics and GPA for students who are Black and Hispanic.<sup>55</sup></li> <li>• Perceptions of campus climate: FS is not a significant predictor of “Respectful and Fair Treatment,” but it is a significant predictor of “Sense of Belonging,” “Commitment to Diversity,” and “Inequitable Treatment.”<sup>122</sup></li> </ul>
Covid-19 pandemic effects on FI students	<ul style="list-style-type: none"> <li>• Worry, stress increased in females.<sup>123</sup></li> <li>• Decreased physical activity and fruit consumption, increased sedentary behavior, alcohol intake and FI (prevalence doubled).<sup>124</sup></li> <li>• Mental health problems increased but FI, substance abuse, physical inactivity and sexual behavior all decreased.<sup>63</sup></li> <li>• Employment status, housing,<sup>4</sup> and financial independence changed.<sup>125</sup></li> <li>• COVID-19 infection.<sup>125,126</sup></li> <li>• FI prevalence increased during the pandemic, newly emerged vulnerable groups included international students, students that lived on campus before the pandemic, students with at least one child, and students aged 25 and older.<sup>5</sup></li> </ul>

Table 4. Continued.

Categories	FI correlating variables <sup>a</sup>
Tradeoffs and coping strategies	<ul style="list-style-type: none"> <li>Academics: Choosing between studying/ and shopping for and preparing food,<sup>45</sup> selling and/or trading off textbook purchases to buy food.<sup>60</sup></li> <li>Food seeking behaviors: going to bed without food,<sup>112</sup> skipping breakfast,<sup>30</sup> skipping lunch,<sup>45</sup> skipping meals,<sup>127,128</sup> grocery shopping less frequently,<sup>127</sup> rationing/stretching food,<sup>13,129</sup> compensatory fasting,<sup>34</sup> stretching the food dollar,<sup>33</sup> going home on weekends for meals, receiving food from relatives,<sup>13,30</sup> asking friends or family for food,<sup>33</sup> rarely eating home cooked meals,<sup>30</sup> less likely to eat lunch at home,<sup>45</sup> purchasing "cheap,"<sup>42,53</sup> and processed food,<sup>33,129</sup> eating less healthy foods to eat more.<sup>129</sup></li> <li>Food assistance: SNAP,<sup>86,87,89,130,131</sup> utilizing free food options,<sup>45</sup> seeking free meals on campus.<sup>30</sup></li> <li>Finances: Keeping monthly food budgets.<sup>30</sup></li> <li>29-Item CSS coping strategies scale measured how often students used coping strategies (that addressed food intake/access, saving, support, and selling) predicted FI.<sup>19,118</sup></li> <li>More coping strategies.<sup>113</sup></li> <li>In community college students.<sup>20</sup></li> <li>Lived experiences.<sup>16,119</sup></li> </ul>
Hunger-relief programs SNAP	<ul style="list-style-type: none"> <li>SNAP is a coping strategy as shown above, however, studies show low SNAP participation among FI students.<sup>67</sup></li> <li>In a large sample of undergraduate post-secondary students (<math>n=33,000</math>), 31% with very low levels of FS received food related public assistance (SNAP, WIC and/or school lunch) compared with 5% of the food secure.<sup>133</sup></li> <li>In another large sample (<math>n=22,153</math>), FI prevalence was 44.1%, but only 3% of these were enrolled in SNAP.<sup>133</sup> In a third study (<math>n=1973</math>), 14.8% were FI, and only 2.1% enrolled in SNAP.<sup>134</sup> Surprisingly, SNAP participation was a predictor of housing insecurity but not associated with FI score (<math>n=833</math>).<sup>89</sup> Small studies also show low SNAP participation rates.<sup>85,135</sup></li> <li>A mixed methods study that included in-depth interviews indicated that college students do not consider federal programs as part of their food security safety net, and experience barriers accessing these programs.<sup>25</sup></li> </ul>
Campus food pantry visits	<ul style="list-style-type: none"> <li>Improved sleep, improved depressive symptoms and improved perceived health.<sup>136</sup></li> <li>Students who used the CFP because of financial insecurity had higher odds of FI.<sup>136</sup></li> <li>Barriers to use (stigma, self-identity).<sup>137,138</sup></li> <li>All visitors were FI: 88.2% with hunger, and 11.8% without hunger. Low vegetable consumption was significantly associated with FI with hunger. ANOVA revealed statistically significant differences between cumulative GPA and number of visits.<sup>139</sup></li> <li>Only 38% of FI students reported food pantry use, international students, and those receiving a student loan or Pell grant were most likely to use the pantry.<sup>138</sup></li> <li>Access to the direct food assistance provided by the food pantry enabled them to allocate financial resources to other basic needs, such as rent.<sup>25</sup> Social support and the use of an on-campus food pantry were primary factors in maintaining a food security safety net.</li> </ul>
Food scholarship program	Did not change FI, but increased intake of some nutrients and vegetable servings were achieved (Healthy Eating Index) HEI-2015. <sup>140</sup>
Food delivery program	Did not improve FI or dietary intake. <sup>23</sup>
Food literacy-based curriculum	<ul style="list-style-type: none"> <li>Did not improve FI.<sup>141</sup></li> <li>Increased FS and decreased FI.<sup>62</sup></li> </ul>

<sup>a</sup>Significance ranges from  $p \leq 0.05$  to  $p < 0.001$ .

The relationship between anxiety and FI is bidirectional, anxiety has been shown to precede FI.<sup>142</sup> However, the pathways linking mental health to FI are under still under investigation.<sup>99</sup> Future mental health correlates should include anxiety as a variable,<sup>51</sup> and further research is needed to address the risk of depression in FI college students.<sup>59</sup> The experience of FI diminishes student psychosocial health and wellbeing.<sup>18,50</sup> FI appears to influence student views of the campus climate,<sup>103</sup> and feelings of identity degradation as related to cultural food security.<sup>102</sup>

### Eating disorders (ED)

Disordered eating behaviors (DEBs) correlate with FI and may be associated with worse health outcomes among vulnerable college students. Males who experience FI may be at greater risk for emotional eating.<sup>77</sup> FI and ED are both independently associated with anxiety and depression; however, these mental health constructs may not explain the underlying mechanism between FI and ED. In an analysis of the 2020–2021 Healthy Minds Study data ( $n=121,627$ ), Zickgraf et al.<sup>101</sup> confirmed a robust association between FI and ED in a large nationally representative sample of university students but found it to be independent of anxiety and depression. It could be that FI driven changes in food choices and eating habits lead to ED, suggesting that preventing and treating ED within the food insecure student population

warrants interventions specific to FI. FI prevalence was higher in cisgender women and transgender/gender diverse students compared to cisgender males, however the association between FI and ED was robust for all genders. To understand the presumed causal relationship between FI and ED, future studies are needed to assess risk factors, gender differences, and the mediating influences of anxiety and depression.

### Academic success, student retention and completion

FI is a known barrier to academic success and student commitment to retention and completion (Table 4). Schools that measure FI prevalence are in a better position to advocate for policy changes at state and federal levels regarding college affordability and student financial assistance. This body of research compels schools to screen incoming students for food and basic needs insecurities and include FI strategies in efforts to address student success and persistence. FI was found to influence social adjustment and performance, pointing to the need to restructure Bowman's Model of student retention to include FI.<sup>29</sup> Future research is needed to identify how FI mediating factors, such as cognitive functioning, food seeking behaviors, academic self-confidence and financial factors combine to influence student success.<sup>50,60,143</sup> Prospective studies are needed to examine the



effect of chronic and acute FI on academic success over time.<sup>34,120,144</sup>

### **COVID-19 impacts on food security**

This scoping review uncovered 14 records related to COVID-19 published prior to June 2022 (Table 4). Thirty-five percent of the records published in 2021 were on this topic. Taken as a whole, research shows that student risk for FI during the pandemic varied depending on living situation and employment. Silva, et al.<sup>70</sup> surveyed students in June 2020 ( $n=502$ ); those who lost their jobs and were without a safety net, were at the highest risk for FI. Owens et al.<sup>4</sup> surveyed students in May 2020 ( $n=651$ ) and found that those whose living arrangement had been impacted by the pandemic had 2.70 greater odds of FI. Similarly, Davitt et al.<sup>145</sup> reported higher rates of FI in students ( $n=1434$ ) who lived on their own during April/May 2020. Risk of FI and COVID-19 was bidirectional. Students with FI were more likely to report COVID-19 infection. Using Fall 2020 data from the annual #realcollegesurvey of students at 202 colleges and universities in 42 states ( $n=100,000$ ), Goldrick-Rab et al.<sup>126</sup> reported that FI was a risk factor for self-reported COVID-19 infection. Other risk factors were anxiety, depression, minority status, parenting or employed. Students with very low FS during the pandemic had lower diet quality scores compared to food secure students.<sup>70</sup> Glantsman et al.<sup>5</sup> found that self-reported FI prevalence increased during COVID-19, compared to before COVID-19; newly emerged vulnerable groups included international students, students that lived on campus before the pandemic, students with at least one child, and students aged 25 and older.

### **Research trends and gaps; methodological approaches**

#### **USDA food security survey module (FSSM)**

Most studies utilized some form of the USDA Food Security Survey Module (FSSM); 30% measured FI using the 6-item short form, and 25% used the 10-item adult version (Tables 5 and 6). However, in both qualitative and quantitative explorations, the 10-item version failed psychometric testing with college students.<sup>8,92</sup> Questioning the validity of applying the FSSM to college students, Gundersen<sup>147</sup> analyzed Current Population Survey Data from 2014 to 2018 for respondents in single-person households, age 18–25y, and found 9.9% FI rates among full-time students, compared to 16.8% among non-students. College student households vary (living alone, with family or roommates) leading to differing interpretations of AFSSM items. Alternate scales with household definitions, applied to students living alone or with family, such as the Household Food Insecurity Access Scale (HFAS), address this concern.<sup>112,127</sup> The original AFSSM screener asks respondents to consider “the last 12 months” which may include when students still permanently lived at home. To ensure that questions are focused on student issues, Olfert et al.<sup>69</sup> altered the time frame to “since being in college.” A key limitation of the AFSSM is that it focuses on financial deprivation and may ignore the lived experiences of college students. It has been adapted to include food access

measures, such as transportation resources, and the affordability, proximity, and adequacy of food options,<sup>143</sup> although this adaptation has not been widely used. Importantly, survey modality may affect the reliability of self-reported data: Nikolaus et al.<sup>156</sup> reported that FI prevalence differed by 15% between online and paper-and-pencil assessments (40.9 and 25.8%, respectively). Finally, the Adult FSSM denotes four levels of food security (FS): high, marginal, low, and very low FS. As a dichotomous measure, FI is denoted by the bottom two levels and FS by the top two. However, evidence indicates that marginally food-secure students are also at risk for diminished health and academic success,<sup>48</sup> and the very low food secure classification may be the most sensitive FI measure.<sup>92</sup> Future studies should look separately at the four levels, separate the marginal and high food-secure groups, and investigate the nuances inherent in the food insecure classification.

#### **Study design/sampling strategy**

Taken as a whole, this literature lacks sufficient multi-institutional, longitudinal, random controlled trials, and quasi-experimental research. Convenience samples, small sample sizes, and low survey response rates limit reliability. Best practices replaced self-reported data with auto-populated a-priori college database data on demographics, GPA, college-standing and financial aid status.<sup>29,60,136</sup> To improve validity; self-reported variables such as diet quality, physical health, coping strategies, and financial expenditures should be based on scales that have prior use with the student population.<sup>118</sup> All but 3 studies identified in this scoping review were cross-sectional surveys. Ninety-three percent of the surveys used only one data point, only 10% drew data from multi-institutions; and only 4 used a nationally representative sample. Surveys, focus groups and interviews give a snapshot of experiences at one point in time. However, longitudinal studies show preceding factors, changes over time, and carryover effects after graduation. About 7% of the studies in this review used a longitudinal design ( $n=11$ ). Studying diverse freshman at one university ( $n=1158$ ), Bruening et al.<sup>31</sup> found that FI prevalence was higher at the end of the fall and spring semesters, coinciding with final exams. In the only published longitudinal nationally representative sample, researchers found that food insecure students, especially first-generation students, were less likely to graduate, and less likely to obtain bachelors, graduate, and professional degrees.<sup>116</sup> Preceding factors also appear to have a significant impact on FI prevalence in college. Results from a large ( $n=4,824$ ) cross-sectional online survey indicated that previous FI was the strongest predictor of FI in college.<sup>64</sup> However, when researchers asked freshman ( $n=456$ ) to complete the 10-item USDA Adult Food Security Survey Module (AFSSM) twice; once for their family experience and once for their campus experience, they found higher rates of FI on campus.<sup>33</sup> These results support previous evidence that financial independence confers greater FI risk. Longitudinal studies beginning in childhood could shed light on both home and school factors that impact academic success in college.<sup>55</sup> Studies that examine potential impacts

**Table 5.** Select characteristics of quantitative studies examining US college student food insecurity (*n* = 117).

Author, title, year (ref)	University setting/Description	Study population	Study design/Sampling strategy	Sample size/(response rate %)	FI prevalence (%) / measurement instrument	Research gaps mentioned by authors
Abu B, Oldewage-Theron W. <sup>112</sup> Food insecurity among college students in West Texas. 2019	Texas Tech University	Students	Cross-sectional (purposeful and snowball sample)	773 (0.5)	59.5 Household Food Insecurity Access Scale (HF/IAS)	Future studies should employ random sampling and verifiable data on GPA.
Ahmed T, Iliwa RT, Shane J, et al. <sup>88</sup> A developing crisis in hunger: food insecurity within 3 public colleges before and during the COVID-19 pandemic. 2022	3 Diverse urban public colleges in NYC	Health science students	Cross-sectional (convenience)	1989	NR USDA Adult FSSM, 10 items	NR
Alexis TD, Unruh D, Wang W, et al. <sup>140</sup> Implementation of a food scholarship program improves nutrient intake and dietary quality of college students. 2020	Texas Women's University, Houston Texas	Students	Quasi-experimental pre and post A food scholarship intervention delivered ~ 38 lbs. of food bimonthly, 46% was fresh produce, the rest was from all food groups.	49 Volunteers	53 Baseline 47 10 weeks USDA Short Form FSSM, 6-items	NR
Ames AJ, Barnett TM. <sup>8</sup> Psychometric validation of the 10-item USDA food security scale for use with college students 2019	Public university in the southern US	Students	Cross-sectional	478	21-34 USDA Adult FSSM, and optional screener 11 items	The AFSSM should include a household definition or change to an individual point of reference and be reevaluated.
Barry MR, Sonnevile KR, Leung CW. <sup>104</sup> Students with food insecurity are more likely to screen positive for an eating disorder at a large, public university in the Midwest. 2021	Large, public, Midwestern US University	Students	Cross-sectional	762	USDA Adult FSSM, 10 items	More research is needed to understand the complicated relationship between FI and EDs among college students.
Becerra MB, Becerra BJ. <sup>94</sup> Psychological distress among college students: role of food insecurity and other social determinants of mental health. 2020	California State University/a mid-size 4-year public minority-serving institution	General education students $\geq 18$ y old	Cross-sectional (convenience)	302	37.5 USDA Short Form FSSM, 6 items	NR
Becerra MB, Bol BS, Granados R, et al. <sup>146</sup> Sleepless in school: The role of social determinants of sleep health among college students. 2020	California State University	general psychology students	Cross-sectional (convenience)	282	31.9 Unable to afford balanced meals. 19.9 skipping or reducing meal size. 17.7 food not lasting long enough. 9.9 going hungry indication of very low FS. modified USDA AFSSM, 4 items	NR
Broton, K. M., & Goldrick-Rab, S. <sup>133</sup> (2018). Going without: an exploration of food and housing insecurity among undergraduates. 2018	Study 1 73 community colleges in 24 states Study 2 10 community colleges in 7 states Study 3 10 public and private 2- and 4- y Wisconsin colleges and Universities Study 4 42 public 2- and 4-y Wisconsin colleges and universities	Community college undergraduates Community college undergraduates Freshman/Sophomore undergraduates	Cross-sectional (convenience) Cross-sectional (convenience) Cross-sectional (convenience) Longitudinal (convenience)	26,131 (4) 4,185 (9) 1,007 (64) 1,442 (77)	56 USDA Short Form FSSM, 6 items 30d 39 USDA Short Form FSSM, 6 items 30d 51 USDA Short Form FSSM, 6 Items 12 mo 57 Adapted screener, 1 item	Additional research examining the efficacy of programmatic and policy responses to students' material hardship challenges is crucial to promoting student well-being and college attainment.

(Continued)

Table 5. Continued.

Author, title, year (ref)	University setting/Description	Study population	Study design/Sampling strategy	Sample size/(response rate %)	FI prevalence (%) / measurement instrument	Research gaps mentioned by authors
Brown ML, Karpinski C, Bragdon M, et al. <sup>12</sup> Prevalence of food insecurity in NCAA Division III collegiate athletes. 2021	20 Of the 44 DIII conferences	NCAA DIII collegiate athletes, ~2/3rds female, ~90% 18–21y representing 19 of the 24 sports.	Cross-sectional (census)	787	14.7 modified USDA Short Form FSSM, 22 items	NR
Bruening M, Brennhofner S, van Woerden I, et al. <sup>30</sup> Factors related to the high rates of food insecurity among diverse, urban college freshmen. 2016	University of Arizona	Freshman students in residence halls	Secondary analysis of data for a pilot study for SPARC (social implications of physical activity and nutrition in college).	221 (41.5)	32% 30d 37% 90 d Modified HFSSM 2 item screener.	Examine the longitudinal effects of FI on weight and weight-related behaviors and academic achievement. Test the effectiveness of affordable meal plans to cover all meals and/ or subsidized breakfast or lunches for students (as in the National School Lunch Program). More research is needed to ascertain how FI impacts the diet of college students.
Bruening M, van Woerden I, Todd M, et al. <sup>31</sup> Hungry to learn: the prevalence and effects of food insecurity on health behaviors and outcomes over time among a diverse sample of university freshmen. 2018	Arizona State University	Freshman students in residence halls 69% female 49% non-white	Longitudinal (convenience)	1138	28 Start of school year 35, 36 end of each semester USDA Short Form FSSM, 6 items, 1 month	
Camelo K, Elliott M. <sup>55</sup> Food insecurity and academic achievement among college students at a public university in the United States. 2019	Public, mid-sized western US university	Students	Cross-sectional (census)	3,245 (19.8)	23 Modified point of reference to include only the individual respondent USDA Short Form FSSM, 6 items,	Longitudinal studies to track the cyclical nature of FI from early childhood through college. Students from underrepresented racial/ethnic minority groups should be oversampled, detailed information on ethnicity should be retained from students who identify with more than one racial/ethnic group. Standard USDA measures of FI should be included.
Castellanos DC, Holcomb J. <sup>84</sup> Food insecurity, financial priority, and nutrition literacy of university students at a mid-size private university. 2020	Mid-size private Catholic university	Undergraduates and graduates	Cross sectional (census)	560 (5)	35.8 USDA FSS 6-question food insecurity screener	Examine FI before, during and post-graduation to understand possible carry-over effects.
Chaparro MP, Zaghoul SS, Holck P, et al. <sup>10</sup> Food insecurity prevalence among college students at the University of Hawai'i at Manoa. 2009	University of Hawaii, Manoa	Graduate and undergraduates, excluding freshman, ill and pregnant students	Cross-sectional (stratified, random course selection)	410	21 USDA Adult FSSM, 10 items	NR
Christensen KA, Forbush KT, Richson BN, et al. <sup>95</sup> Food insecurity associated with elevated eating disorder symptoms, impairment, and eating disorder diagnoses in an American University student sample before and during the beginning of the COVID-19 pandemic. 2021	University of Kansas	University students	Longitudinal (stratified, random)	579	52.8 Modified Radimer/Cornell hunger and FI scale, 8 items	NR
Coakley KE, Cargas S, Walsh-Dillely M, et al. <sup>89</sup> Basic needs insecurities are associated with anxiety, depression, and poor health among university students in the state of New Mexico. 2022	Large, urban university in SW	8,000 Undergraduate and postgraduate students surveyed in 4/2021 during the pandemic	Cross-sectional (stratified, random)	833 (10.4%)	25.6 USDA Adult FSSM, 10 items over the past 30 days	Multi-institutional cohort studies and RCTs are needed to understand how to best implement solutions and determine impacts of basic needs insecurities on dietary quality, mental and physical health indicators, and academic achievement. Interventions addressing housing insecurity and homelessness among students have yet to be widely studied.

(Continued)

Table 5. Continued.

Author, title, year (ref)	University setting/Description	Study population	Study design/Sampling strategy	Sample size/(response rate %)	FI prevalence (%) / measurement instrument	Research gaps mentioned by authors
Cockerham M, Camel S, James L, et al. <sup>17</sup> Food insecurity in baccalaureate nursing students: A cross-sectional survey. 2021.	Woodlands campus of Sam Houston State University.	Full-time nursing students, ≥18y old	Cross-sectional (purposive)	55 (18.8%)	60 USDA Adult FSSM, 10 items	NR
Coffino JA, Spoor SP, Drach RD, et al. <sup>14</sup> Food insecurity among graduate students: prevalence and association with depression, anxiety and stress. 2021	College of arts and sciences at an upstate NY university	Graduate students, ≥18y old, fluent in English	Cross-sectional (Census)	263	40.3 USDA Short Form FSSM, 6 items	NR
Collier DA, Fitzpatrick D, Brehm C, et al. <sup>29</sup> Structuring first-year retention at a regional public institution: validating and refining the structure of Bowman's SEM analysis. 2020.	Western Michigan University	First time in any college freshman students	Cross sectional (census)	487 (21%)	Not reported. USDA Short Form FSSM, 6 items	If the influence of FS on social adjustment within the Bowman's model is not addressed, interventions that address only the attributes or behaviors we hope students will change may not be very effective.
Darling K, Fahrenkamp A, Wilson S, et al. <sup>32</sup> Physical and mental health outcomes associated with prior food insecurity among young adults. 2017	Northeastern Ohio University	Freshman psychology students	Cross-sectional (convenience)	98	28 Hunger vital sign 2 itemsb	NR
Davidson AR, Morrell JS. <sup>67</sup> Food insecurity prevalence among university students in New Hampshire. 2020	University of New Hampshire	Undergraduate and graduate students	Cross-sectional (census)	943	25 USDA Short Form FSSM, 6 items	NR
Davitt ED, Heer MM, Winham DM. <sup>45</sup> Effects of COVID-19 on university student food security. 2021	Iowa State University	Students who had been on campus prior to COVID-19 restrictions were emailed a survey during spring 2020.	Cross-sectional (census)	1434 (7.5%)	17 USDA ERS Core Food Security Survey Module, 6 items 30d	NR
DeBate R, Himmelgreen D, Gupton J, et al. <sup>50</sup> Food insecurity, well-being, and academic success among college students: implications for post COVID-19 pandemic programming. 2021	Large urban university	Undergraduates and graduate students. Surveyed in March 2020	Cross-sectional (random) Secondary analysis of the American College Health Association-National College Health Assessment III (ACHA-NCHA III)	1743	46.8 USDA Short Form FSSM, 6 items	The data do not present a clear answer as to why FI students experienced increased academic challenges. Further study is needed to examine the effects of the pandemic on student stress and resilience.
DeMunter J, Rdesinski R, Vintro A et al. <sup>45</sup> Food insecurity among students in six health professions' training programs. 2021	Oregon Health and Science University	Students in 6 health science programs	Cross-sectional (census)	1,050 (36%)	46.8 USDA Short Form FSSM, 6 items	NR
Diamond KK, Stebleton MJ, delMas RC et al. <sup>51</sup> Exploring the relationship between food insecurity and mental health in an undergraduate student population. 2020	Large, public, predominantly White institution (PWI) in the US	Undergraduates, excluding freshman	Cross-sectional (random)	1,229 (24.7%)	36 (Over 30 d) 32 (over 12 mo) Modified USDA AFSSM, 9 items	Future qualitative inquiries that explore the short- and long-term implications of FI. Research multiple institutions, including diverse two- and four-year schools, graduate programs and include anxiety as a variable.
Duke NN, Campbell SD, Sauls DL, et al. <sup>28</sup> Prevalence of food insecurity among students attending four Historically Black Colleges and Universities. 2021	4 Historically black colleges and universities in urban North Carolina	Undergraduates and graduates 91.2% non-Hispanic Black 80.6% female 90.9% college meal plan participants	Cross-sectional (census)	351	72.9 Modified hunger vital sign 2 items	Further research on meal plans (relationships with differences in the number and quantity of meals). Qualitative inquiries into links between FI, food access, choice, and intake among young adult populations of color is critical to help circumvent chronic disease outcomes.

(Continued)

Table 5. Continued.

Author, title, year (ref)	University setting/Description	Study population	Study design/Sampling strategy	Sample size/(response rate %)	FI prevalence (%) / measurement instrument	Research gaps mentioned by authors
El Zein A, Colby SE, Zhou W, et al. <sup>71</sup> Food insecurity is associated with increased risk of obesity in US college students. 2020	University of Florida, Auburn University, South Dakota State University, University of Maine, West Virginia University, Kansas State University, Syracuse University, University of Tennessee	Second year students, eligibility criteria were selected based on the purpose of the parent study.	Cross-sectional (census) Secondary analysis of data collected under a USDA-funded research project called Get Fruved.	683	19.0–34.1 With a mean of 25.4 for the entire sample. USDA adult FSSM, 10 items	Future research should address: (1) validation of the USDA AFSSM in college students, (2) mechanisms for the association between obesity and FI, (3) meal plan subsidies as a mechanism to conjointly address food access and promote healthy food choices.
El Zein A, Sheinutt KP, Colby S, et al. <sup>144</sup> Prevalence and correlates of food insecurity among US college students: a multi-institutional study. 2019	University of Florida, Auburn University, South Dakota State University, University of Maine, West Virginia University, Kansas State University, Syracuse University, University of Tennessee	First year students, eligibility criteria were selected based on the purpose of the parent study.	Cross-sectional (census) Secondary analysis of data collected under a USDA-funded research project called Get Fruved.	855	19 USDA Adult FSSM, 10 items	Future studies should examine: (1) FI effect on retention, graduation, and health outcomes over time. (2) Strategies aimed at addressing student FI. (3) Upstream solutions to student food poverty should go beyond the boundaries of need-based food pantries, to a broader food system, with a "rights-based approach to FS".
Esaryk EE, Arriaga EEJ, Kalaydjian S, et al. <sup>136</sup> Campus food pantry use addresses a gap among California public university students. 2021	University of California system (10 campus)	Campus food pantry or CalFresh users	Cross-sectional (census)	1513	49 USDA Short Form FSSM, 6 items	More studies of CFP use in other student populations, such as community colleges, are warranted.
Flynn MM, Monteiro K, George P, et al. <sup>46</sup> Assessing food insecurity in medical students. 2020	Warren Alpert Medical School of Brown University	Medical students	Cross-sectional (census)	132 (22.4)	11.8 USDA Short Form FSSM, 6 items	NR
Frank ML, Sprada GB, Hultstrand KV, et al. <sup>77</sup> Toward a deeper understanding of food insecurity among college students: examining associations with emotional eating and biological sex. 2021	4-year public university in the Midwestern US	Undergraduates ≥18y, fluent in English	Cross-sectional (convenience)	232 (NR)	37.5 USDA Short Form FSSM, 6 items	Future research should investigate risk factors and coping mechanisms linked to both FI and emotional eating among college students, considering differences based on sex and utilize a longitudinal design to determine whether periods of food adequacy correspond with episodes of emotional eating.
Gaines A, Robb CA, Knol LL, Et al. <sup>108</sup> Examining the role of financial factors, resources and skills in predicting food security status among college students. 2014	University of Alabama	Undergraduates 19–25 y old, excluding freshman, pregnant and part-time students	Cross-sectional (random by classes)	557	14 USDA Adult FSSM	NR

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Table 5. Continued.

Author, title, year (ref)	University setting/Description	Study population	Study design/Sampling strategy	Sample size/(response rate %)	FI prevalence (%)/measurement instrument	Research gaps mentioned by authors
Giantsman O, McGarity-Palmer RM, Swanson HL, et al. <sup>5</sup> Risk of food and housing insecurity among college students during the COVID – 19 pandemic. 2022	Large, private, urban university in the midwestern US	Undergraduates and graduates	Cross-sectional (census)	1,956 (8.2%)	25 12 Months before COVID 29 Since COVID USDA Adult FSSM, 10 items	Future longitudinal studies to examine changes in FI for various demographic groups, controlling for income and employment. Psychometric testing of the USDA AFSSM is needed. Multiple modes of data collection (e.g., online, paper format, and phone call) to improve accessibility to a more representative sample. Adopt a person–environment interaction lens to evaluate potential environmental or societal changes, using ecological systems theory.
Goldrick-Rab S, Coca V, Gill J, et al. <sup>126</sup> Self-reported COVID-19 infection and implications for mental health and food insecurity among American college students. 2022	202 Colleges and universities in 42 states	Undergraduates	Cross-sectional survey mailed in the fall 2020	100,488 (11)	Not reported USDA Adult FSSM	NR
Guerithault N, McClure SM, Ojinnaka CO, et al. <sup>14</sup> resting-state functional connectivity differences in college students with and without food insecurity. 2022	Arizona State University	Undergraduates	Case-controlled observational	20 FS 20 FI	Not reported USDA Adult FSSM, 10 items	More research is needed to understand the mechanistic link between FI, executive function, eating choices, and academic performance.
Gundersen C. <sup>147</sup> Are college students more likely to be food insecure than nonstudents of similar ages? 2021	Household census data	Full and part-time college students, and non-college students 18–25 y old, living with the respondent and not living with the respondent (i.e. one-person household)	Longitudinal	~ 50,000 Households per year	9.9 Full-time college students, not a child of the respondent. 16.2 part-time students, not a child of the respondent. 18.8 non-students, not a child of the respondent. Current Population Survey 2014–2018	Based on the results of this study researchers may wish to concentrate on the FI status of those who are not in college.
Hagedorn RL, McArthur LH, Hood LB, et al. <sup>118</sup> Expenditure, coping, and academic behaviors among food-insecure college students at 10 higher education institutes in the Appalachian and southeastern regions. 2019	10 public universities; Mississippi, North Carolina, Tennessee, and West Virginia	Undergraduates and graduates	Cross-sectional (convenience)	13,642	22.4–51.8 Range 30.5 average USDA Adult FSSM, 10 items	Future research to validate FI measurement with college students. Verifiable income data is needed to study FI student socioeconomic status. Capture the FI risk factors identified by the Government Accountability Office in their 2018 report to Congress.
Hagedorn, RL Olfert, MD. <sup>113</sup> Food insecurity and behavioral characteristics for academic success in young adults attending an Appalachian university. 2018	Large land grant university in central Appalachia	Undergraduates and graduates	Cross-sectional (nonprobability)	692 (2.4%)	36.6 USDA Adult FSSM, 10 items	NR
Hagedorn RL, Barr ML, Famodu OA, et al. <sup>48</sup> Food insecurity among college students at West Virginia University and self-reported health status. 2017	West Virginia University in central Appalachia	Undergraduates and graduates	Cross-sectional (nonprobability)	639	35 USDA HFSSM	Further investigation is warranted to determine the relationships between FI, health status and weight gain.

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Table 5. Continued.

Author, title, year (ref)	University setting/Description	Study population	Study design/Sampling strategy	Sample size/(response rate %)	FI prevalence (%)/measurement instrument	Research gaps mentioned by authors
Hagedorn RL, Olfert MD, MacNeill L, et al. <sup>96</sup> College student sleep quality and mental and physical health are associated with food insecurity in a multi-campus study. 2021	22 Colleges and universities in 12 states	Graduates and undergraduates	Cross-sectional	17,686	43.4 USDA Adult FSSM, 10 items (since starting college)	NR
Hagedorn RL, Walker AE, Wattick RA, et al. <sup>142</sup> Newly food-insecure college students in Appalachia during the COVID-19 pandemic.2022	West Virginia University	Students ≥18 y old Surveyed in March/April 2020 during pandemic restrictions.	Cross-sectional (census)	2,018 (5.1)	31.6 Modified USDA Adult FSSM 2-item Hunger Vital Sign Screener	Development of more reliable and valid assessments and comprehensive analysis of the behavioral factors related to coping with FI is warranted.
Halfacre K, Chang Y, Holben DH, et al. <sup>82</sup> Cooking facilities and food procurement skills reduce food insecurity among college students: a pilot study. 2021.	Mississippi State University	Undergraduates	Cross-sectional (representative)	338 (5.63)	41.4 USDA Adult FSSM, 10 items	NR
Haskett ME, Kottler-Gruhn D, Majumder S. <sup>134</sup> Prevalence and correlates of food insecurity and homelessness among university students. 2020	Large public university in the southeastern US	Graduates and undergraduates	Cross-sectional (random)	1923 (27.5)	14.8 USDA Adult FSSM, 10 items 30d	Longitudinal and wholistic studies are needed to explore the relationships between wellness homelessness, and FI, consider retention graduation rates, perhaps more critical indicators of academic success than GPA.
Haskett ME, Majumder S, Kottler-Gruhn D, et al. <sup>20</sup> The role of university students' wellness in links between homelessness, food insecurity, and academic success. 2021	Large, southeastern US University	Graduates and undergraduates	Cross-sectional (random)	1330 (28)	15.49 Modified USDA Adult FSSM, 10 item, 30d	This finding should be replicated and longitudinal data should be collected before sweeping recommendations can be made regarding the best interventions related to academic success in FI students.
Hiller MB, Winham DM, Knoblauch ST, et al. <sup>53</sup> Food security characteristics vary for undergraduate and graduate students at a Midwest university. 2021	Iowa State University	Undergraduates and graduates 18–34 y old	Cross-sectional (convenience)	675 (4.5)	32 USDA Adult FSSM, 10 items	Future studies: (1) disaggregate data by more than non-Hispanic White and Other dichotomy. (2) Look at methods to improve food assistance program messaging to boost engagement and general awareness. (3) Research self-efficacy and perceived health of FI students, who typically rate their health lower than their food-secure peers.
Huelskamp A, Waity J, Russell J et al. <sup>149</sup> Effects of campus food insecurity on obesogenic behaviors in college students. 2021	Medium-sized university in southeastern US.	Undergraduates and graduates excluding students without at least one class on campus.	Cross-sectional (random)	547 (14.9)	62.56 Modified USDA Adult FSSM, 10 items to change the point of reference to include only the individual respondent	Future studies: (1) research the link between FI and obesity. (2) Implement and evaluate on-campus educational programs teaching meal planning, budgeting, and cooking using nutritionally dense, inexpensive ingredients
Johnson KE. <sup>98</sup> Symptoms of anxiety in college students and the influence of social determinants of health. 2020	Two urban universities in the southeastern US	Undergraduates in human services	Cross-sectional (convenience)	219	NR Life Screen College (TLS-C) 1 item	Future research (1) Modify an SDOH measure to include a Likert scale, adding items to obtain a more comprehensive View of the needs of college students. (2) Representative and longitudinal studies are needed to assess prior anxiety among college students and the impact of FI on anxiety.

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Table 5. Continued.

Author, title, year (ref)	University setting/Description	Study population	Study design/Sampling strategy	Sample size/(response rate %)	FI prevalence (%)/measurement instrument	Research gaps mentioned by authors
Keefe S, Garagiola-Bernier A, Kiley E, et al. <sup>39</sup> Campus food insecurity: bringing private institutions into conversations on basic needs. 2021	Small, private university	Undergraduates	Cross-sectional (census)	359 (17)	31.5 USDA Short Form FSSM, 6 items	NR
Keller M, Von Kahle B, Gordon B, et al. <sup>50</sup> Prevalence and demographic profiles of food insecure college students at main and satellite campuses in northwestern USA Nutr Health. 2022	Idaho State University	Undergraduates and graduates	Cross-sectional (convenience)	983 (10.8)	45 Main campus 34 satellite campuses USDA Adult FSSM, 10 items	NR
Keogh B, Kushalnagar P, Engelman A. <sup>18</sup> Peer support and food security in deaf college students. 2020	Gallandet University	Undergraduate, graduate and special students who are deaf	Cross-sectional	166 (NR)	39.3 Modified USDA Short Form FSSM, 6 items to include individual and other others in the household.	NR
Kinarsky AR. <sup>19</sup> Fostering success: Understanding the experience of foster youth undergraduates. 2017	Public University in California	Undergraduate former foster youth ≥18 y	Cross-sectional (census)	60 (75.9)	47.5 Modified USDA FSSM 1-item	Understand how FI can be mitigated or prevented in former foster youth in college and why some seek food support and others do not.
Knol LL, Robb CA, McKinley EM, et al. <sup>151</sup> Food insecurity, self-rated health, and obesity among college students 2017	University of Alabama	College students ≥19 y old, living off-campus, excluded if they ate meals at a panhellenic house, lived with parents, or followed a restricted diet due to food allergy or intolerance.	Cross-sectional (convenience)	351 (~3)	38.3 USDA Adult FSSM, 10 items	Understand food-related decisions and tradeoffs (home cooking vs. fast foods) that students make when resources are low.
Knol LL, Robb CA, McKinley EM, et al. <sup>152</sup> Very low food security status is related to lower cooking self-efficacy and less frequent food preparation behaviors among college students. 2019	University of Alabama	College students ≥19 y old, living off-campus, excluded if they ate meals at a panhellenic house, lived with parents, or followed a restricted diet due to food	Cross-sectional (convenience)	368 (3.5)	38.3 USDA Adult FSSM, 10 items	Further study of food-related decisions and tradeoffs under resource constraints are needed.
Lanza ST, Whetzel CA, Linden-Carmichael AN, et al. <sup>65</sup> Change in college student health and well-being profiles as a function of the COVID-19 pandemic. 2022	Large, multi-campus public university in the Northeastern region of the U.S.	Undergraduates 18–24 y old	Longitudinal November 2019 and May 2020 during pandemic restrictions	1,004 (NR)	33.0 Before pandemic restrictions 20.5 during pandemic restrictions Modified USDA Adult FSSM 2-item hunger vital sign Screener	Efforts to consider the broad long-term health effects of the recent pandemic, and stress, offer opportunities to tailor university services to improve student outcomes and reduce health disparities.

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Table 5. Continued.

Author, title, year (ref)	University setting/Description	Study population	Study design/Sampling strategy	Sample size/(response rate %)	FI prevalence (%)/measurement instrument	Research gaps mentioned by authors
Laska MN, Lenk K, Lust K, et al. <sup>56</sup> Sociodemographic and health disparities among students screening positive for food insecurity: Findings from a large college health surveillance system. 2021	2- and 4-Year Minnesota colleges and universities (27 institutions (13 two-year public, 9 four-year public, 5 four-year private)). University of Michigan	Data were drawn from the 2015–2018 CSHS, an annual statewide surveillance system.	Cross-sectional (random) Sampling range varied from 12.5–100% by institution	13,720 (36.1)	24 Modified USDA Adult FSSM 2-item hunger vital sign screener	To inform interventions, additional research is urgently needed, including cohort studies, controlled trials, and quasi experimental research based on rigorous evaluation of policy initiatives now being considered at institutional, state and federal levels.
Leung CW, Faroouqi S, Wolfson JA, et al. <sup>153</sup> Understanding the cumulative burden of basic needs insecurities: associations with health and academic achievement among college students. 2021	University of Michigan	Students of all academic levels	Cross-sectional (random)	793 (43)	33.6 USDA Adult FSSM, 10 items	NR
Leung CW, Insolera N, Cohen AJ, et al. <sup>109</sup> The long-term effect of food insecurity during college on future food insecurity. 2021	Data were drawn from the Panel Study of Income Dynamics (PSID)	1999–2003 Data on students aged 16–29 y old enrolled in >1 y of college who remained in the sample for follow up in 2015–2017 as economically independent adults	Longitudinal (nationally representative)	1508 (NR)	14.9 USDA Household FSSM, 18 items Economically independent participants during college completed their own FSSM (n=301). For economically dependent participants during college, HFSSM was completed by the householder of their family unit (i.e., parent/caregiver; n = 1,207).	NR
Leung CW, Wolfson JA, Lahne J, et al. <sup>72</sup> Associations between food security status and diet-related outcomes among students at a large, public midwestern university. J Acad Nutr Diet. 2019	University of Michigan	Undergraduate, graduate, and professional degreed students.	Cross-sectional (random) oversampling of minority racial/ethnic from lower income households and first-generation students.	754 (43)	31.1 USDA Adult FSSM, 10 items	NR
Macke C, Averitt Taylor J, et al. <sup>122</sup> Food insecure students' perceptions of campus climate: implications for social work educators and practitioners. 2020	Northern Kentucky University	Undergraduates and graduates	Cross-sectional	1295 (NR)	10 1-Item hunger measurement	Further research should examine the impacts of campus climate perceptions and experiences of FI among students, especially as related to student recruitment and retention. Use device-based measures of behavior to further explore the value of physical activity for promoting health and well-being during a time of trauma and uncertainty.
Maher JP, Hevel DJ, Reifsteck EJ, et al. <sup>154</sup> Physical activity is positively associated with college students' positive affect regardless of stressful life events during the COVID-19 pandemic. 2021	Minority serving institution in southeastern US	Upper-level undergraduate kinesiology students	Cross-sectional (convenience) before (T1) and during (T2) pandemic restrictions	107 (NR)	16 T1 35 T2 USDA Household FSSM, 18 item	NR
Mialiki K, House LA, Mathews AE, et al. <sup>155</sup> COVID-19 and college students: food security status before and after the onset of a pandemic. 2021	Large land grant university in the southeastern US	Undergraduates and graduates	Cross-sectional (non-probability)	3,206 (NR)	24.8 Prior to COVID USDA Adult FSSM, 10 items	NR

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Table 5. Continued.

Author, title, year (ref)	University setting/Description	Study population	Study design/Sampling strategy	Sample size/(response rate %)	FI prevalence (%)/measurement instrument	Research gaps mentioned by authors
Mallinson DJ. <sup>37</sup> Food insecurity among public administration graduate students. 2021	Penn State University	Graduate in Public Administration (MPA) students.	Cross-sectional (census)	336 (36)	14 USDA Adult FSSM, 10 items	Solutions such as on-campus food pantries and meal vouchers do not work for online students. More research is needed on the online student population, as it has been largely ignored.
Marshall TA, Zheng R, Anderson CL, et al. <sup>47</sup> Is food insecurity a barrier to dental student success? 2021	University of Iowa College of Dentistry	Dental students	Cross-sectional (census)	328 (24.7)	21 USDA Adult FSSM, 10 items	NR
Martinez SM, Frongillo EA, Leung C, et al. <sup>25</sup> No food for thought: food insecurity is related to poor mental health and lower academic performance among students in California's public university system. 2020	10 colleges in the University of California system	Undergraduates and graduates	Cross-sectional (random)	8,705 (18)	40 USDA Short Form FSSM, 6 items	Longitudinal studies are needed to explain the impacts of FI on educational achievement and interventions.
Martinez SM, Grandner MA, Nazmi A, et al. <sup>75</sup> Pathways from food insecurity to health outcomes among California university students. 2019	10 colleges in the University of California system	Undergraduates and graduates	Cross-sectional (random)	8,705 (18)	40 USDA Short Form FSSM, 6 items	The longitudinal impact of FI on health has yet to be determined. The college years may be a vulnerable period given student risk for weight gain, commonly referred to as the freshman 15 (pounds), which may be either exacerbated or confounded by FI.
Martinez SM, Webb K, Frongillo EA, et al. <sup>62</sup> Food insecurity in California's public university system: What are the risk factors? 2018	10 colleges in the University of California system	Undergraduates and graduates	Cross-sectional (random)	8,705 (18)	40 USDA Short Form FSSM, 6 items 22 Total sample 43 FI students Family FI History 2 items	NR
Matias SL, Rodriguez-Jordan J, McCoin M. <sup>83</sup> Integrated nutrition and culinary education in response to food insecurity in a public university. 2021	Large public University in California	Undergraduate nutrition students in a semester long integrated nutrition and teaching kitchen lab	Interventional pre and post	171	23 Very low FS pre intervention 6 Very low FS post intervention USDA Short Form FSSM, 6 items	NR
McArthur LH, Faszczewski KS, Wartinger E, et al. <sup>33</sup> Freshmen at a university in Appalachia experience a higher rate of campus than family food insecurity. 2018	University Western North Carolina	Freshman	Cross-sectional (random)	456 (22.8)	7.1 Family FI 21.5 Campus FI USDA Adult FSSM, 10 items 46.2	NR
McArthur LH, Ball L, Danek AC, et al. <sup>29</sup> High prevalence of food insecurity among university students in Appalachia reflects a need for educational interventions and policy advocacy. 2018	University Western North Carolina	Sophomore through graduate students	Cross-sectional (non-probability)	1,093 (18.2)	USDA Adult FSSM, 10 items	Future research to: (1) examine potential impacts of familial variables to identify possible underlying causes of student FI that could serve as the basis for campus interventions. (2) Evaluate the effectiveness of campus and community food assistance programs.

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Table 5. Continued.

Author, title, year (ref)	University setting/Description	Study population	Study design/Sampling strategy	Sample size/(response rate %)	FI prevalence (%)/measurement instrument	Research gaps mentioned by authors
Mechler H, Coakley K, Walsh-Dilley M, et al. <sup>52</sup> Examining the relationship between food insecurity and academic performance: implications for diversity and equity in higher education. 2021	Large, public, minority serving, urban university in the Southwestern US	Undergraduates, graduates, and professional students	Cross-sectional, longitudinal (random, stratified)	2,654 (22.1)	30.7 USDA Adult FSSM, 10 items	NR
Mei J, Fuly AP, Wolfson JA, et al. <sup>73</sup> Food insecurity and dietary intake among college students with unlimited meal plans at a large, midwestern university. 2021	University of Michigan	Students who ate at the dining hall at least once per day (unlimited meal plans assumed).	Cross-sectional (census)	1084 (36)	14 USDA Short Form FSSM, 6 items	Study whether FI students may respond differently than FS students to interventions to promote healthier beverages. Qualitative approaches to the experiences of diverse FI students, longitudinal studies to see how FI affects long-term health and academic outcomes.
Miller LMS, Falbe JL, Rico TE, et al. <sup>103</sup> Associations between campus climate perceptions and food insecurity among undergraduates at a public university. 2021	Public university in northern California	Undergraduates	Secondary data 2019 American College Health Association (ACHA)-National College Health Assessment II (ACHA-NCHA-II).	1378	39.4 Modified USDA HFSSM 2-item, 30d	In light of the findings that race and financial status predict FI but not campus climate perceptions, future research is needed to better understand how students' campus climate perceptions can inform programs that effectively address food insecurity on college campuses.
Mirabitur E, Peterson KE, Rathz C, et al. <sup>76</sup> Predictors of college-student food security and fruit and vegetable intake differ by housing type. 2016	Large, midwestern public university	Undergraduates, graduates, and non-degree seeking students $\geq 18$ y old	Cross-sectional (random)	727 (7)	41.5 USDA Short Form FSSM, 6-item	Reassess: (1) the convention of grouping those with high and marginal food security together. (2) the effect of tighter food-assistance policies on college students in particular
Moore CE, Davis KE, Wang W. <sup>85</sup> Low food security present on college campuses despite high nutrition literacy. 2021	Texas Woman's University 3 campuses: Houston, Dallas and Denton	College students $\geq 18$ y	Cross-sectional (random, purposeful)	672 (NR)	44 USDA Short Form FSSM, 6-item	NR
Morgan M, Arrowood J, Farris A, et al. <sup>141</sup> Assessing food security through cooking and food literacy among students enrolled in a basic food science lab at Appalachian State University. 2023	Appalachian State University	Basic food science lab students	Cross-sectional (convenience)	51 (91)	26 Pre-intervention 32 Post intervention Modified USDA Short Form FSSM, 3-items	Long-term follow-up may determine "lasting" delayed effects of a food literacy-based curriculum on FS status.
Morris LM, Smith S, Davis J, et al. <sup>57</sup> The prevalence of food security and insecurity among Illinois university students. 2016	Four public Illinois universities, including Eastern Illinois University, Northern Illinois University, Southern Illinois University, and Western Illinois University.	Undergraduates $\geq 18$ y old, fluent in English, access to college email system	Cross-sectional	1882 (3.87)	35 USDA Short Form FSSM, 6-item	Study the relationship between FS status and race, GPA, loan use, and living location to develop services for those in need.
Moya EM, Wagler A, Ayala J, et al. <sup>26</sup> Analysis of food and housing insecurity among university students at a public Hispanic-serving institution. 2022	Public Hispanic Serving Institution near the US Mexico border.	University students $\geq 18$ y old.	Cross-sectional (census)	2,767 (11.12)	Modified USDA Short Form FSSM, 2 items	NR

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Table 5. Continued.

Author, title, year (ref)	University setting/Description	Study population	Study design/Sampling strategy	Sample size/(response rate %)	FI prevalence (%)/measurement instrument	Research gaps mentioned by authors
Nikolaus CJ, Ellison B, Nickols-Richardson SM. <sup>156</sup> Food insecurity among college students differs by questionnaire modality: an exploratory study. 2020	A land grant university in the midwestern US	Undergraduates 18–24 y old, fluent in English	Cross section (random)	343 Completed an online survey. 66 (29) Completed the same items in paper-and-pencil format. 462	40.9 Online 25.8 Paper and pencil	Further testing of FI surveys are needed, as accurate FI estimates are essential to serving college students.
Nikolaus CJ, Ellison B, Nickols-Richardson SM. <sup>157</sup> Are estimates of food insecurity among college students accurate? Comparison of assessment protocols. 2019	Midwestern university	Undergraduates	Cross-sectional (random)	462	19.1 USDA Adult FSSM, 10-item plus food insufficiency screener 2-item 19.9 SDA Short Form FSSM, 6-item plus food insufficiency screener 2-item 32 USDA Adult FSSM, 10-item 34.9 USDA Short Form FSSM, 6-item 30.8 Modified USDA Adult FSSM 2-item hunger vital sign screener	The 10-item FSSM and 2-item screener yields the most accuracy in this sample, but it is unknown why students respond to FSSM items differently than the general population. Further qualitative and quantitative evaluations are needed to determine which assessment protocol is the most valid and reliable for use.
Oh H, Smith L, Jacob L, et al. <sup>99</sup> Food insecurity and mental health among young adult college students in the United States. 2022	Healthy minds study data 9/20–6/21	Graduates and undergraduates aged 18–34 y old	Cross-sectional (nationally representative random or census)	96,379 (14)	NR	
Olfert MD, Hagedorn-Hatfield RL, Houghtaling B, et al. <sup>99</sup> Struggling with the basics: food and housing insecurity among college students across twenty-two colleges and universities. 2021	17 Public 4-yr institutions (7 land-grant), three private institutions, one academic medical center, and one state college, in Alabama, Arizona, Hawaii, Illinois, Kansas, Louisiana, Mississippi, North Carolina, Northern Mariana Islands, Tennessee, Utah, Virginia, and West Virginia.	Graduates and undergraduates ≤18 y old participating in the #realcollege survey in the fall of 2019	Cross-sectional, longitudinal	22,153 (NR)	44.1 USDA Adult FSSM, 10 items, since being in college 20.3 Since childhood hunger vital sign 2 item	NR
Owens MR, Brito-Silva F, Kirkland T, et al. <sup>4</sup> Prevalence and social determinants of food insecurity among college students during the covid-19 pandemic. 2020	3 Public universities in Texas	Undergraduates and graduates, ≥18 y old, fluent in English, access to the internet	Cross-sectional (census) Surveyed during pandemic restrictions in May, 2020	502 (4.4)	34.5 Stepwise approach: Food sufficiency screener 2 items. USDA Short Form FSSM, 6 items 30d	Poor SNAP utilization by college students suggests that both expanded access to and increased awareness of SNAP may be needed.

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Table 5. Continued.

Author, title, year (ref)	University setting/ Description	Study population	Study design/Sampling strategy	Sample size/ (response rate %)	FI prevalence (%)/measurement instrument	Research gaps mentioned by authors
Patton-López MM, López-Cevallos DF, Cancel-Tirado DJ, et al. <sup>135</sup> Prevalence and correlates of food insecurity among students attending a midsize rural university in Oregon. 2014	Midsize rural university in Oregon	Undergraduates and graduates	Cross-sectional (non-probability)	354 (7)	59 USDA Short Form FSSM, 6 items	Future research to: (1) Expand the focus on college students' risk behaviors to different campus settings. (2) Include social and economic factors including income, debt, employment, housing costs. (3) Explore FI among college student families with children and assess not only eating behaviors but also the campus nutrition environment to further strengthen nutrition support systems. (4) Longitudinal and qualitative studies should be considered to monitor the persistence of FI throughout the college years.
Payne-Sturges DC, Tjaden A, Caldeira KM, et al. <sup>36</sup> Student hunger on campus: food insecurity among college students and implications for academic institutions. 2018	Large mid-Atlantic public university	Undergraduates ≥18 y enrolled in family science, community health or agricultural courses	Cross-sectional (convenience)	250 (62%)	15 USDA Household FSSM, 18 items	NR
Phillips E, McDaniel A, Croft A. <sup>115</sup> Food insecurity and academic disruption among college students. 2018	Large, urban, public university is the midwestern US	Undergraduates	Cross-sectional (random)	508 (10.2)	36.7 USDA Short Form FSSM, 6 items	Future research should continue to: (1) Vary studies of FI prevalence by institution type, location, and student diversity. (2) Include longitudinal and nationally representative studies to help researchers make more causal claims about the relationship between FI, academic disruptions, and student success. (3) Draw connections between students' FI experiences and their academic experiences. (4) Be directly applicable to students practitioners, and solutions.
Poll KL, Holben DH, Valliant M. <sup>43</sup> Food insecurity is associated with disordered eating behaviors in NCAA division 1 male collegiate athletes. 2020	University of Mississippi	Ncaa div 1, ≥18 y, males	Cross-sectional (census)	111 (94.1)	9.9 Modified USDA Adult FSSM Last 9–12 m 13.5 Senior y of high school 2-items NR	Further research should include females, across institutions, larger sample sizes and inventory of foods in lockers to replace self-reported hoarding data.
Randles A. <sup>44</sup> Dietary behaviors & perceived nutrition availability of small college student-athletes: a pilot project. 2018	Small midwestern urban college	Varsity athletes >18 y	Cross-sectional (census)	272 (NR)	NR Modified FLASHE survey adolescent dietary survey instrument with i-item on FS	Future research to: (1) continue nutritional tracking of small-college athletes, and whether they have the available food needed for athletic and academic success, (2) implement and evaluate interventions to improve dietary intake: not only for performance, but also for health.
Raskind JG, Haardorfer R, Berg CJ. <sup>21</sup> Food insecurity, psychosocial health and academic performance among college and university students in Georgia, USA. 2019	Seven colleges and universities in Georgia	Students, 18–25 y old, fluent in English, enrolled at least part-time.	Cross-sectional (random, census)	15,607 (22.9)	29 USDA Short Form FSSM, 6 items	Future longitudinal studies should include additional waves of data to support the temporal relationships between FI exposure, mediator and outcome, and understand the temporal intersects of FI (frequency, seasonality, duration) and health effects.

(Continued)

Table 5. Continued.

Author, title, year (ref)	University setting/Description	Study population	Study design/Sampling strategy	Sample size/(response rate %)	FI prevalence (%)/measurement instrument	Research gaps mentioned by authors
Reeder N, Tapanee P, Persell A, et al. <sup>59</sup> Food insecurity, depression, and race: correlations observed among college students at a university in the southeastern United States. 2020	Mississippi State University	College students 18–24 y old	Cross-sectional	131 (NR)	38.2 USDA Short Form FSSM, 6 items	Study strategies to address the risk of depression among FI college students and the racial disparity in FI rates
Riddle ES, Niles MT, Nickerson A. <sup>65</sup> Prevalence, and factors associated with food insecurity across an entire campus population. 2020	Urban/suburban university in a predominately rural northeastern state.	Undergraduate, graduate, and medical students	Cross-sectional, repeated	1,037 (24.5) Spring 1,123 (25.8) USDA Adult FSSM, 10-item 2,514 (10.7)	19.6 Spring 15 fall	Future research should explore in greater detail the vulnerability of specific types of staff (ranging from administrative support to janitorial services) to FI.
Robbins MK, Spence M, Steeves EA. <sup>30</sup> A cross sectional assessment of basic needs insecurity prevalence and associated factors among college students enrolled at a large, public university in the Southeastern U.S. 2022	Large, public university in the southeastern US	Undergraduate, excluding freshman, graduates and professional students.	Cross-sectional (census)	533 (NR)	48.5 Modified USDA Adult FSSM 2-item hunger vital sign screener	More specific questions related to student finances could discern varying levels of financial independence. Longitudinal or cohort studies could discern the directionality of demographics, social and financial factors associated with BNI, FI, and HI.
Royer MF, Ojinnaka C, Bruening M. <sup>106</sup> Greater food insecurity is related to increased disordered eating behaviors among college students. 2021	NR	College students 18–25y old	Cross-sectional (convenience)	257 (NR)	40 USDA Adult FSSM, 10 items	Future research to: (1) longitudinal inquiry into the potential causal relationship between FI and EDs. (2) Test the link observed between FI and restraint in college students with other populations, (3) focus on FI and DEBs disparities among vulnerable populations.
Ryan RA, Murphy B, Deierlein AL, et al. <sup>74</sup> Food insecurity, associated health behaviors, and academic performance among urban university undergraduate students. 2022	New York University	Undergraduates ≥18 y	Cross-sectional (convenience)	344 (NR)	41 USDA Short Form FSSM, 6 items	Follow-up research into the association between FI and SSB intake in larger samples of diverse college students is warranted.
Sackey JD, Pike K, Rothpletz-Puglia P, et al. <sup>38</sup> Food insecurity among health sciences graduate students at a large northeastern university. 2021	Large Northeastern US University	Graduate students in health sciences	Cross-sectional (NR)	952 (32.8)	30 USDA Short Form FSSM, 6 items	NR
Savoie-Roskos MR, Harrison C, Coombs C, et al. <sup>37</sup> Food insecurity exists among college students at a mid-sized university in Utah. J Hunger Environ Nutr. 2021	Utah State University	Undergraduates and graduates	Cross-sectional (random)	291 (NR)	Modified USDA Adult FSSM, 10 item, 30d	Research is needed to identify programs, policies, education, and/or support that college students are most likely to utilize and determine the most effective ways to market on and off campus pantries and relief programs.
Sidebottom C, Ullevig S, Cheever K, et al. <sup>124</sup> Effects of COVID-19 pandemic and quarantine period on physical activity and dietary habits of college-aged students. 2021	Public university in the southwestern US	Undergraduates and graduates 18–24y old, with perceived changes in physical and/or dietary habits during campus-wide closure.	Cross-sectional (convenience)	Pre-covid Item 1 8.9 Item 2 6.0 During pandemic restrictions Item 1 19.6 Item 2 9.0 2-itemc	Future studies investigating changes in lifestyle and public health strategies improving college students' health and wellness should be implemented to address adverse changes during the pandemic.	

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Table 5. Continued.

Author, title, year (ref)	University setting/Description	Study population	Study design/Sampling strategy	Sample size/(response rate %)	FI prevalence (%)/measurement instrument	Research gaps mentioned by authors
Simon A, Goto K, Breed J, et al. <sup>66</sup> Factors associated with food insecurity and food assistance program participation among university students. 2018	University students in Northern California	General nutrition students who bought and prepared their own food	Cross-sectional (convenience, non-random)	116 (NR)	43.1 USDA Short Form FSSM, 6 items	Future research: (1) on factors that hinder food assistance program participation, such as stigma, lack of knowledge of or access to existing programs, (2) intervention studies focusing on program participation may help better understand its effectiveness. Future studies should separate graduates from undergraduates because effective intervention will differ for each.
Soldavini J, Berner M., Da Silva, J. <sup>36</sup> Rates of and characteristics associated with food insecurity differ among undergraduate and graduate students at a large public university in the Southeast United States. 2019	University of North Carolina, Chapel Hill	Undergraduates and graduates	Cross-sectional (census)	4819 (NR)	25.2 Undergraduates 17.8 graduates USDA Adult FSSM, 10 items	Future studies should (1) include larger, more diverse samples, (2) compare health and academic outcomes by FS levels, and (3) address conflicts in the literature (FS status of freshman v. graduate students; impact of meal plan participation, cooking frequency, and marriage and parenting on FS status). Future studies should look separately at all four levels, or at least consider separating the marginal and high food-secure groups.
Soldavini J, Berner M. <sup>81</sup> Characteristics associated with cooking frequency among college students. 2021	Large, public university in North Carolina	Undergraduates and graduates	Cross-sectional (census)	4,829 (16.2)	22.2 USDA Adult FSSM, 10 items	Future studies should (1) be conducted with students from other universities, (2) explore strategies for addressing FI among college students during the COVID-19 pandemic, (3) explore ways for students to meet their food needs regardless of where they are located, as well as evaluations of the efficacy of these strategies.
Soldavini J, Andrew H, Berner M. <sup>25</sup> Characteristics associated with changes in food security status among college students during the COVID-19 pandemic. 2021	Large public University in southeastern US.	Undergraduates, graduates and professional students ≥18 y, enrolled spring 2020	Cross-sectional (census)	2,039 (7)	10.8 Pre-covid 14.5 During pandemic restrictions USDA Adult FSSM, 10 items	Future studies should (1) be conducted with students from other universities, (2) explore strategies for addressing FI among college students during the COVID-19 pandemic, (3) explore ways for students to meet their food needs regardless of where they are located, as well as evaluations of the efficacy of these strategies.
Soldavini J, Andrew H, Berner M. <sup>15</sup> Campus-based food insecurity: the case of international students at a southeastern university.	Large public University in southeastern US.	International students	Cross-sectional (census)	263	24 FI 25 marginal FS USDA Adult FSSM, 10 items	Conduct surveys and/or interviews with international students on their FI status, academic performance, and the resources they use, using verifiable academic data.
Spaid RL, Gillett-Karam R, Liburd LC, et al. <sup>20</sup> Sustenance for success: connections between community college students and food insecurity. 2021	Ten community colleges on the US east coast.	Community college students from 8 schools.	Cross-sectional (intercept)	858 (NR)	52 Spaid and Gillett-Karam (2018) 30 Liburd (2020) 99 Monroe (2020) USDA Adult FSSM, 10 items 81 Prior FI Modified 6-item FS scale.	Future qualitative studies that use HFSSM questions to guide interviews or focus groups among community college students at rural, suburban, and urban colleges and among various ethnic groups and genders are needed. Large-scale studies at regional or national levels could confirm these results. Future qualitative research on FI and (1) coping behaviors, (2) academic performance, (3) the factors contributing to the widespread presence of FI among female students, (4) the effectiveness of food assistance programs/services offered on campus.
Taylor LC, Delavega E, Jin SW, et al. <sup>111</sup> The prevalence and correlates of food insecurity among students at a multi-campus university. 2019.		Undergraduates at university of Memphis	Cross-sectional (random)	524 (NR)		

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Table 5. Continued.

Author, title, year (ref)	University setting/Description	Study population	Study design/Sampling strategy	Sample size/(response rate %)	FI prevalence (%)/measurement instrument	Research gaps mentioned by authors
Umeda M, Ullevig SL, Chung E. <sup>96</sup> Depression mediates the relationship between food insecurity and pain interference in college students. 2021	Hispanic serving southwestern US state university	Undergraduates enrolled in an introductory kinesiology course	Cross-sectional (convenience)	176	24.4 USDA Adult FSSM, 10 items 30d	NR
van Woerden I, Hruschka D, Bruening M. <sup>34</sup> Food insecurity negatively impacts academic performance. 2019	Arizona State University	Undergraduates living in residence halls	Cross-sectional (convenience) longitudinal	537 Spring 375 fall 321 spring and fall	37 Spring 38 Fall USDA Short Form FSSM, 6 items	Larger, longitudinal studies to test the impact of FI on academic performance and retention with frequent measures of FI, GPA and potential mediators of this association (e.g., hunger, depression, poor health) using verified not self-reported data.
van Woerden I, Hruschka D, Schaefer DR. <sup>159</sup> Evaluating potential behavioral mediators for increasing similarity in friends' body size among college students. 2019	Large, public southwestern university	Undergraduates living in first year residence halls and their assistants	Cross-sectional (convenience) longitudinal	509 Study 1 Friendship similarity 428 Study 2 evaluating anthropometrics	37 Spring 38 Fall USDA Short Form FSSM, 6 items	Future research should use social network analyses to explore the relationship of friendship selection and influence on dining hall use, hours of sleep on weekdays, and stress and how these impact the anthropometrics of emerging adults.
van Woerden I, Hruschka D, Vega-López S, et al. <sup>68</sup> Food insecure college students and objective measurements of their unused meal plans. 2019	Arizona State University	Undergraduates living in first year residence halls.	Cross-sectional (convenience)	534	37 Spring 38 Fall USDA Short Form FSSM, 6 items	Validation studies should examine students at universities which (a) require students to purchase a meal plan, (b) provide students with the option of purchasing a meal plan, and (c) do not provide meal plans.
Wattick RA, Hagedorn RL, Olfert MD. <sup>100</sup> Relationship between diet and mental health in a young adult Appalachian college population. 2018	Large Appalachian university	Undergraduates and graduates ≥18 y.	Cross-sectional (convenience)	1,956 (NR)	36.7 USDA AFSSM 30d	Future research is needed (1) on the relationships between mental health, diet and FI, (2) use validated diagnostic tools, such as the Patient Health Questionnaire, and Beck Anxiety Inventory, and (3) diet quality tools that encompasses a variety of foods with quantities consumed measured.
Weaver RR, Vaughn NA, Hendricks SP, et al. <sup>60</sup> University student food insecurity and academic performance. 2020	Public University in New Jersey	Undergraduates ≥18 y	Cross-sectional (census)	2,055 (15)	48 Modified USDA Adult FSSM, 10 items 30d	A qualitative examination of FI high achievers that offset the negative influence of FI on academic performance.
Wilcox M, Baker C, Burish E, et al. <sup>61</sup> Inequitable hunger: scope, effects, and perceptions of college student food insecurity. 2022	Public institution in Louisiana	Undergraduates and graduates	Cross-sectional (convenience)	605 (4.8)	34.3 College and University Food Bank Alliance (CUFBA) 2 items	Future research should document FI impact on minoritized students, develop and evaluate interventions which will likely be institution- and context-specific.
Willis DE. <sup>78</sup> Feeding inequality: food insecurity, social status and college student health. 2021.	University of Missouri Kansas City	Undergraduates excluding graduating seniors	Cross-sectional (random)	379 (9.7)	32 USDA Short Form FSSM, 6-item 30d	The stress process model must continue to look to experiences of inequality outside of the traditional income, poverty, or employment indicators to understand how inequality shapes health disparities.

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Table 5. Continued.

Author, title, year (ref)	University setting/ Description	Study population	Study design/Sampling strategy	Sample size/ (response rate %)	FI prevalence (%) / measurement instrument	Research gaps mentioned by authors
Willis DE. <sup>60</sup> Feeding the student body: unequal food insecurity among college students. 2019	University of Missouri Kansas City	Undergraduates excluding graduating seniors	Cross-sectional (random)	379 (9.7)	32 USDA Short Form FSSM, 6-item 30d	Future research should (1) gather longitudinal data from multiple universities throughout the school year or all 4 years, so that FI triggers and impact can be examined across both time and place, as well as help answer questions of causality related to academic, social, and health outcomes. (2) Examine the social costs of unequal opportunity (3) including multiple universities could allow for some multilevel analyses, which might reveal the important institutional predictors of FI or patterns of less insecurity among universities with certain policies in place to address the issue. (4) Develop ways of gathering random samples in this population that yield higher response rates.
Wolfson JA, Insojera N, Cohen A. <sup>16</sup> The effect of food insecurity during college on graduation and type of degree attained: evidence from a nationally representative longitudinal survey. 2022.	Secondary analysis of longitudinal panel of income dynamics	College students	Cross-sectional (nationally representative) longitudinal	1,574	14.5 1999–2003 USDA household FSSM, 18 items	NR
Wood JL, Harris F. <sup>34</sup> Experiences with “acute” food insecurity among college students. 2018	5 southern California colleges Data from Community College Success Measure (CCSM)	Community college students	Cross-sectional (random by class section, census within sections)	6,003	16.5 Multiethnic 16 Black 10.4 Latino 9.2 Asians and Whites 35.6	Future research can construct models that disaggregate by both race/ethnicity and gender and describe levels of FI as levels of an outcome variable: within ethnicities.
Wooten R, Spence M, Colby S, et al. <sup>64</sup> Assessing food insecurity prevalence and associated factors among college students enrolled in a university in the Southeast USA. 2019	Large public university in the Southeastern US.	Undergraduates, graduate students, excluding freshman and students <18 y.	Cross-sectional (census)	4,842 (12.5)	USDA Adult FSSM, 10 items 19.9 “before I came to college” Modified 2-item screener	ADDITIONAL research is needed to confirm these findings and explore the factors in college settings that may exacerbate preexisting FI. Explore the socioeconomic effects on FI status, particularly among the college students who may have varying sources of support that can be difficult to measure. Future studies should explore interventions, programming and policies that influence known predictors to help reduce food insecurity rates. The relationship between spending habits and FI status should continue to be studied.
Zickgraf HF, Hazzard VM, O'Connor SM, et al. <sup>101</sup> Food insecurity is associated with eating disorders independent of depression and anxiety: findings from the 2020–2021 Healthy Minds Study. 2022.	140 US colleges and universities	Undergraduate and graduate students	Cross-sectional, nationally representative (random, census depending on school size).	121,627 (14 Fall) 15 Spring)	31.9 Hunger vital sign 2-item	Study the underlying mechanisms and presumed causal relationship between FI and ED. Confirm our findings that the relationship may be weaker for transgender women compared to other gender identities, explore the relationship in a sample of gender diverse individuals further stratified by gender (e.g. transgender men, transgender women, nonbinary people).

<sup>a</sup>Note that the USDA 6-item AFSSM denotes a dichotomous variable (FS (high and marginal FS) vs. FI (low and very low FS) in contrast to the continuous FS variables (high, marginal, low, and very low) of the 10-item AFSSM. The time frame is 12 months, unless otherwise noted. FI prevalence is reported as the sum of low and very low FS, unless otherwise noted.

<sup>b</sup>Identifies households as being at risk for FI if they answer that either or both of the following two statements is “often true” or “sometimes true” (vs. “never true”): “Within the past 12 months we worried whether our food would run out before we got money to buy more.” “Within the past 12 months the food we bought just didn’t last and we didn’t have money to get more.”

<sup>c</sup>Item 1 unable to afford healthy food or balanced meals/item 2 skipped meals or ate less because of not enough money or food.

**Table 6.** Select characteristics of qualitative studies examining US college student food insecurity (*n* = 43).

Author, title, year (ref)	University setting/Description	Study population	Study design/Sampling strategy	Sample size/response rate (%)	FI prevalence (%) / measurement instrument	Research gaps mentioned by authors
Abu B, Tavaraz S, Oldewage-Theron W. <sup>127</sup> University students suggest solutions to campus food insecurity: a mixed methods study.	4-Year university in west Texas	Undergraduate, graduate, domestic and international students	Mixed method Cross-sectional on-line survey (convenience) Focus group discussions (FGDs)	173 (0.5% of Total student body) sample) 16 (10% of survey sample) 8 students in each of 2 FGDs	NR 62.5 (% of FGDs sample) HFIAS Household Food Insecurity Access Scale, 9-items	Future pilot programs targeting proposed solutions to address causes of FI. Separate in-depth discussions among each of the four levels of FS. Solicit student perspectives on the solutions to FI on their unique college campuses as a commitment to sustainable solutions.
Adamovic E, Newton P, House V. <sup>110</sup> Food insecurity on a college campus: prevalence, determinants, and solutions. 2022	Large state university in western US	Undergraduate and graduate students	Mixed method Cross-sectional on-line survey (convenience) Closed and open-ended survey questions	339 (1% of Total student body)	54 USDA Short Form FSSM, 6-item <sup>a</sup>	NR
Ahmed T, Ilieva RT, Clarke A. et al. <sup>119</sup> Impact of a student-led food insecurity intervention on diverse community college students. 2021	Kingsborough community college	Community college students	Mixed method Cross-sectional on-line survey (convenience) Pre- and post-intervention. Closed and open-ended survey questions (post-intervention)	307 Pre-intervention NR 48 post-intervention NR 34 Provided narrative responses post-intervention. 8	45 Pre-intervention NR	Students, researchers, and faculty can draw upon our strategies to advocate for more student awareness of FI and food justice within campuses. In the future, our team will create new online and offline games that target feelings of stigma that may reduce students' use of campus food programs.
Beam M. <sup>132</sup> Nontraditional students' experiences with food insecurity: a qualitative study of undergraduate students. 2020	Mid-sized public 4-year university	Self-selected from a previous study of students who identified as FI and meet the definition of nontraditional. <sup>b</sup>	Semi structured interviews with predetermined questions	8	100 NR	Further research on effective strategies that improve retention and success among FI students who face financial challenges. Institutions should find ways to challenge policies preventing students from getting the support they need. Identify strategies to assist college students achieve optimal nutrient intake, especially in rural areas. Qualitative research into students' perceptions on the health determinates of alcohol use and its impact on dietary intake should be further explored.
Birmachu A, Heidelberger L. <sup>79</sup> Exploration of dietary beliefs and social cognitive factors that influence eating habits among college students attending a rural Midwestern university.	Rural midwestern university	Undergraduates and graduates	Focus groups <i>n</i> = 7, 6–9 students per group.	49	22.3 USDA AFSSM	Identify strategies to assist college students achieve optimal nutrient intake, especially in rural areas. Qualitative research into students' perceptions on the health determinates of alcohol use and its impact on dietary intake should be further explored.
Bydalek K, Williams SG, Fruh SM, et al. <sup>16</sup> Food insecurity among nursing students: A mixed methods study. 2020	Southern university in the US gulf coast	Undergraduate junior and senior BSN students	Mixed method descriptive/cross-sectional on-line survey (census) Closed and open-ended survey questions	100 (23.4)	52 Modified USDA FSSM, 8-items, during past 9 months	Examining FI in nursing students from other geographic locations in the US for comparison. Study the effectiveness of interventions such as campus food pantries.
Crutchfield RM, Carpena A, McCloyn TN, et al. <sup>161</sup> The starving student narrative: how normalizing deprivation reinforces basic need insecurity in higher education. 2020	California State University, 23 campuses	FI and/or homeless undergraduates and graduates who participated in an online survey <i>n</i> = 24,324 (5.76)	Focus groups and interviews/ convenience	213 Not applicable	NR	More research is needed to change perceptions of poverty, challenge the starving student narrative, and understand how students and campus normalize deprivation.

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Table 6. Continued.

Author, title, year (ref)	University setting/Description	Study population	Study design/Sampling strategy	Sample size/response rate (%)	FI prevalence (%) / measurement instrument	Research gaps mentioned by authors
Crutchfield RM, Maguire J, Campbell, et al. <sup>40</sup> "I'm supposed to be helping others": exploring food insecurity and homelessness for social work students. 2020	California State University	FI and/or homeless BSW and MSW social work students from northern, southern and central campuses who participated in an online survey <i>n</i> = 24,324 (5.76)	Interviews/convenience	16 Not applicable	NR	Research how BNI impact insecure social work students with insecure clients and their motivation to pursue degrees in the helping professions.
Daugherty JB, Birnbaum M, Clark A. et al. <sup>107</sup> "Having enough": students' understanding of food insecurity and campus food pantry use. 2019	Rocky mountain institute	Students who use the campus food pantry	Narrative interviews/purposeful	3	NR	Additional research methods (surveys, focus groups, visual methods, and observations) at the campus food pantry, with more participants and study sites could add to this body of knowledge.
Dickinson M. <sup>87</sup> SNAP, campus food insecurity, and the politics of deservingness. <i>Agric Human Values</i> . 2022	City University of New York, 3 community colleges and 2 4-year colleges	Students who participated in an online survey	Narrative interviews/convenience	20	90 Hunger vital sign 2 itemsc	NR
El Zein A, Vilario MJ, Shelnutt KP et al. <sup>162</sup> Obstacles to university food pantry use and student-suggested solutions: A qualitative study. 2022	University of Florida	Undergraduates and graduates $\geq 18y$ , identified as FI using a modified US AFSSM 2-items	Exploratory descriptive interviews/purposeful	41	82.5 USDA Adult FSSM, 10 itemsd	Interview more diverse students (racial minorities and graduate students with families). Examine different food pantry models and the effectiveness of interventions to reduce stigma and negative perceptions associated with food assistance.
El Zein A, Mathews AE, House L, et al. <sup>38</sup> Why are hungry college students not seeking help? predictors of and barriers to using an on-campus food pantry. 2018	University of Florida	Undergraduates and graduates	Mixed method descriptive/cross-sectional on-line survey (non-probability) Closed and open-ended survey questions	899	32 USDA Adult FSSM, 10 items	Further investigate culturally sensitive strategies to address FI in international students. Longitudinal studies that measure changes in FS status, self-sufficiency, and diet quality of food pantry users are needed. Qualitative research to explore students' perceived barriers to access and attitudes of food pantry users toward how they are treated at the pantry and their perception of the quality and quantity of food provided.
Fortin K, Harvey S, Swearingen White S. <sup>130</sup> Hidden hunger: understanding the complexity of food insecurity among college students. 2021	Large midwestern University	Undergraduates and graduates, $\geq 18y$ , English fluency. Qualitative participants, characterized as v. low FS., indicated willingness to participate in focus groups in the earlier survey	Mixed method/Cross-sectional (random) on-line survey Cross-sectional (purposeful) Focus groups and interviews	755 (32%) 30	32 Very low FS USDA Short Form FSSM, 6-item	Future research needed to (1) evaluate effective interventions, (2) understand each complex domain identified here (student characteristics of FI, campus resource access barriers, student adaptation and coping, additional support needs, and health and well-being).
Gamba RJ, Schmeltz MT, Ortiz N, et al. <sup>48</sup> "Spending all this time stressing and worrying and calculating": marginal food security and student life at a diverse urban university. 2021	Large public institution in the US West Coast	Undergraduates in the college of science, $\geq 18y$ , with a mobile phone with internet access.	Semi-structured interviews/purposeful	30	100 FS USDA AFSSM	The results emphasize that students experiencing marginal FS should not be grouped with students experiencing high FS. Misclassification is likely, subsequent research is needed to identify a validated FS questionnaire for college students.

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Table 6. Continued.

Author, title, year (ref)	University setting/Description	Study population	Study design/Sampling strategy	Sample size/response rate (%)	FI prevalence (%)/ measurement instrument	Research gaps mentioned by authors
Gamba RJ, Wood LM, Ampil A, et al. <sup>163</sup> Investigating the feasibility of a restaurant delivery service to improve food security among college students experiencing marginal food security, a head-to-head trial with grocery store gift cards. 2021	Large public institution in the US West Coast	Undergraduates in the college of science ≥18y, with a mobile phone with internet access.	Mixed method head-to-head cross-over trial Pre- and post-intervention survey, semi-structured interviews	30	100 FS USDA AFSSM	More research is needed to explore whether allowing SNAP recipients to redeem their benefits with restaurant delivery services is a viable mechanism to address food challenges among college students experiencing marginal FS.
Henry L. <sup>164</sup> Understanding food insecurity among college students: experience, motivation, and local solutions. 2017	University of North Texas	students	27 semi-structured interviews of FI students and 5 focus groups of FS students/ convenience	NR	100% Self-identified as "Students who have experienced the crisis of hunger, who have worried about where their next meal will come from, who have worried about getting enough to eat, or who don't have enough money to eat." FS students were those for whom food was consistently available.	Further research on (1) prevalence and factors leading to higher FI prevalence in Black and female students (2) the relationships between medical condition and FI in college, (3) the self-perception that FI college students are not deserving of social services outside of the university, (4) local and state policies that potentially exclude college students with financial need from receiving support and (5) assessment and evaluation of local solutions to FI among college students.
Hernandez DC, Daundasekara SS, Walton QL, Eigege CY, et al. <sup>23</sup> Feasibility of delivering an on-campus food distribution program in a community college setting: a mixed methods sequential explanatory investigation. 2021	Community college in Texas	Full- and part-time students, ≥18y, financially independent from family and reported ≤\$25,000 annual income.	Mixed method sequential explanatory design on-line survey and semi-structured focus groups	385 (35) Completed pre- and post-intervention surveys	61 Baseline 58.7 Post-intervention USDA adult FSSM, 18 items	Recommendations for community college food distribution programs: (1) implement a substitute shopper approach (2) provide the FDP more frequently on the same campus or provide the opportunity to attend an FDP that is located within a particular geographic area, off-campus (3) implement transportation assistance or a food delivery system Further investigate: (1) Athletes, support, education they receive around FS and nutrition. (2) Required meal plans effect on hunger and the social experience of first-year students. (3) Multiple universities with more diverse demographics. (4) Physical and emotional consequences in college students when they cope with hunger.
Hickey A, Shields D, Henning M. <sup>42</sup> Perceived hunger in college students related to academic and athletic performance. 2019	Liberal arts college in New Hampshire	Undergraduates	Mixed method (convenience) On-line survey with closed- and open-ended questions.	371 (10)	36.4 Hunger affected academics. 34.6, among student athletes, hunger affected athletic performance Novel perceived hunger scale	Examine the inadvertent signals that institutions send to FI students through their food policies such as price and geographical access to healthy foods, find effective approaches to overcome existing barriers, examine the gap between growing anti-hunger efforts and persistent FI. Expand research examining FI and academic performance and campus FI relief programs
Ilieva RT, Ahmed T, Yan A. <sup>145</sup> Hungry minds: investigating the food insecurity of minority community college students. 2019	HSI public community college in NYC	Psychology undergraduates	Mixed method (convenience) on-line survey with closed-end questions and narrative prompts.	50	100 Modified USDA adult FSSM, 10-item, 3 months	

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Table 6. Continued.

Author, title, year (ref)	University setting/Description	Study population	Study design/Sampling strategy	Sample size/response rate (%)	FI prevalence (%) / measurement instrument	Research gaps mentioned by authors
Khosla N, Gamba R, Taylor S, et al. <sup>17</sup> Academic goal-setting among college students experiencing food insecurity, housing instability, and other challenges in a diverse public university. 2020	A California state university campus	Students likely to be experiencing personal, academic or financial challenges.	Mixed method (purposive) On-line survey closed-ended questions and semi-structured interviews	53	64 Modified hunger vital sign 2 itemse	More research on the relationship between housing insecurity and goal attainment is needed.
Kirby SR, Linde JA. <sup>49</sup> Understanding the Nutritional needs of transgender and gender-nonconforming students at a large public Midwestern university. 2020	Flagship campus of large, Midwestern Public University	Students identified as transgender or GNC, ≥18y, fluent in English	Mixed method (purposive) On-line survey closed- and open-ended questions and semi-structured interviews	26	50 Derived from the Rainbow Health Initiative's Voices of Health Survey (VHS)if	FI and eating disorder interventions should be inclusive and culturally appropriate for GNC students given their higher rates of FI, compared to LGQTB and cis-gender students.
Klobodu SS, Paiva M, Rodriguez J, et al. <sup>3</sup> Perceived drivers of food insecurity and coping strategies of daca-eligible college students-an exploratory study. 2021	Mid-sized public university in northern California	DREAMer identified, completed one college semester and currently enrolled.	Mixed method (cross-sectional, targeted snowball) On-line survey closed-ended questions and focus groups	18 (~6) Survey 8 Focus groups	72 of Survey participants USDA Adult FSSM, 10-item	Future research should: (1) determine the national prevalence of FI DREAMers; (2) integrate culturally relevant cooking workshops/classes onto college campuses, (3) determine thoughtful and inclusive solutions that address the unique barriers to access (4) advocate for policy to address the complex cultural and financial barriers and (5) broaden the safety nets already in place for non-DREAMer college students.
Kozak B Tipsword-Kizer A Lanier J. <sup>65</sup> Combating student food insecurity: an examination of the usage and outreach of a college campus food pantry. 2019	Large public Midwestern University	students who consent to on-line research, campus faculty and administrators	Mixed method (convenience) on-line student survey closed-ended questions and faculty and administrator interviews	464 NR	36-57 Of students surveyed experienced some level of FI in the last 12 months. Modified US FSSM	NR
Manboard M, Johnson CM, Thornton H, et al. <sup>25</sup> The HOME Study: understanding how college students at a Hispanic serving institution coped with food insecurity in a pandemic. 2021	Texas state university	Full- and part time undergraduates and graduates, currently enrolled, campus food pantry clients, identified as FI.	Mixed method (convenience) On-line survey with open-and closed-ended questions and in-depth zoom interviews	18	NR USDA Short Form FSSM, 6-item	Future research to identify levers for increasing FS would benefit from examining the household food environments of college students as they are different than those of other FI individuals
Martinez SM, Esaryk EE, Moffat L, et al. <sup>66</sup> Redefining basic needs for higher education: it's more than minimal food and housing according to California university students. 2021	University of California, 5 campuses	Undergraduates and graduates recruited from basic needs centers.	Mixed method (purposively) on-line survey closed-ended questions and semi-structured focus groups	58	98 USDA Short Form FSSM, 6-item	A more holistic and comprehensive student-informed definition of basic needs (food, housing, mental health, sleep, hygiene, and transport) should inform future research, programs, and policy. Research will require the development of standardized assessment tools to measure housing security among students across diverse higher education samples. Future research should address structural competency and inequalities in higher education to move toward inclusive learning environments and belongingness.

(Continued)

Table 6. Continued.

Author, title, year (ref)	University setting/Description	Study population	Study design/Sampling strategy	Sample size/response rate (%)	FI prevalence (%) / measurement instrument	Research gaps mentioned by authors
Meier C, Ryan G, Askelson N, et al. <sup>24</sup> Meeting household food needs: a qualitative examination of food access among parenting community college students. 2022	Community college in the Midwest	Students with at least 1 dependent child who indicated in an earlier survey that they were interested in participating (n=107)	Mixed method/purposive survey and in-depth telephone interviews	18 (17)	41.5 Survey respondents answered often or sometimes true that the "food purchased didn't last the month and they did not have money to purchase more" (Askelson, Ryan, et al., 2018).	Future quantitative studies to (1) understand specific food expenditures and total budget allocation to inform the development of interventions focusing on food purchasing budgeting (2) explore food purchasing from multiple food retailers to understand purchasing and decisions across food purchasing types (3) identify how effective of a money saving strategy shopping at multiple food retailers is (4) conduct a comprehensive needs assessment, to improve student access to services and (5) consider food shopping literacy programs to combat misconceptions of healthy foods being out of reach of low-income students.
Meza A, Altman E, Martinez S, et al. <sup>167</sup> "It's a feeling that one is not worth food": a qualitative study exploring the psychosocial experience and academic consequences of food insecurity among college students. 2019	Large California public university	Undergraduates and graduates, ≥18y, campus food pantry recipients	Mixed method/ purposive and snowball sampling survey and in-depth telephone interviews	25 (NR)	88 USDA Adult FSSM, 10-item	Future research is needed to: (1) determine the driving factors and causality of FI and evaluate interventions to alleviate FI and support mental health (2) enhance understanding of the physical and psychological mechanisms that affect multiple dimensions of academic performance, including concentration on schoolwork, grade point average, retention, and graduation. To corroborate these findings additional research across other SW educational settings, institutions (e.g., community colleges, non-research intensive universities) and geographic locations, is necessary. SW educational programs should seek to identify the correlates of FI and other material needs among their students.
Miles R, McBeath B, Brockett S, et al. <sup>41</sup> Prevalence and predictors of social work student food insecurity. 2017	Public university in the pacific northwest	Students in 5 degree granting programs in the school of social work (SW).	Cross-sectional/nonprobability survey with closed- and open-ended questions	476 (NR)	43 Modified USDA HFSSM, 15-items	Assuming these results are confirmed with diverse student populations (2-year schools, nontraditional aged students, graduate students), modifications to the current FSSMs or development of new tools is essential. Subtle modifications to the existing FSSMs might address psychometric issues (e.g., placing the financial clause at the beginning of each item, listing meal plans or other common financial resources alongside money, and providing more than 3 response options). Alternatively, the very low FS classification could better distinguish FI students. Tests of concurrent validity are needed. Until appropriate measures are established, intervention evaluation will be compromised.
Nikolaus CJ, Ellison B, Nickols-Richardson SM. <sup>92</sup> College students' interpretations of food security questions: results from cognitive interviews. 2019	4-Year university	Undergraduates 18–24y, fluent in English, who agreed in an earlier survey to be contacted for future studies. N=343	Mixed method/ cross-sectional (random)	8 FS 11 FI	NR USDA Adult FSSM, 10-item	

(Continued)

Table 6. Continued.

Author, title, year (ref)	University setting/Description	Study population	Study design/Sampling strategy	Sample size/response rate (%)	FI prevalence (%) / measurement instrument	Research gaps mentioned by authors
Paola J. DeBate R. <sup>139</sup> Employing evaluation research to inform campus food pantry policy. 2018	University of South Florida	Campus food pantry visitors who completed an intake form during 2016–2017 academic year.	Mixed method/Cross-sectional (census) survey with closed- and open-ended questions	221	88.2 With hunger 11.8 without hunger USDA Short Form FSSM, 6-item, 30d Modified USDA Adult FSSM, 10-item	Add FI and other social determinants of health (SDH) to the Am. College Health Assessment (ACHA). Institutions without a campus residency requirement (or have only a first-year requirement) should assess SDH to inform program planning. Addressing campus FI may require an ideological shift to food sovereignty that allows campuses to consider food an entitlement, instead of charity, and allow students more control over food options and pricing on campus. We encourage future researchers to (1) continue examining how students manage basic needs over time (2) report examples of universities who have broken or reversed vicious paradoxical cycles by creating virtuous cycles via long-term commitments to student needs (3) analyze institutional responses to students seeking financial aid or help alleviating basic needs.
Peterson ND, Freidus A. <sup>86</sup> More than money: barriers to food security on a college campus. 2020	4-Year public university in southeastern US.	General student body	Mixed method/Cross-sectional (random) survey with closed- and open-ended questions interviews	320 (8%) 24	NR 5-items	NR
Schraedley MK, Jenkins JJ, Ireland M. et al. <sup>27</sup> The neoliberalization of higher education: paradoxical students' basic needs at a Hispanic-serving institution. 2021	4-Year, public, HSI in southern California	Undergraduates, self-identified as racial/ethnic minority, low-income and or first generation in college, from diverse disciplines.	Cross-sectional (purposive) semi-structured interview	30 (NR)	NR	Future researchers should (1) use de-identified data to link individual students' academic performance-using grades, GPA, or attendance, (2) focus groups and qualitative data could build greater understanding of issues, as well as systemic factors that contribute to school success.
Silva FB, Osborn DE, Owens MR, et al. <sup>70</sup> Influence of COVID-19 Pandemic restrictions on college students' dietary quality and experience of the food environment. 2021	large, diverse, public university in Texas, USA	Freshman $\geq 18$ y, fluent in English, with internet access	Mixed method descriptive/cross-sectional on-line survey (census) closed and open-ended survey questions	502 (4.4)	34.5 Validated 2-item food sufficiency screener, USDA Short Form FSSM, 6-item	Future researchers should (1) probe the mixed data found here and in the literature on meal plan use among FI freshman, and the influence of race/ethnicity on FI prevalence in highly diverse student bodies. (2) Evaluate multifaceted interventions, including access to healthy food, nutrition literacy and cooking self-efficacy. (3) Qualitative studies in this field should also be considered to better understand students' FI status and needs.
Silva MR, Kleinert WL, Sheppard AV, et al. <sup>91</sup> The relationship between food security, housing stability, and school performance among college students in an urban university. 2017	Urban university	Undergraduates and graduates	Mixed method cross-sectional on-line survey (convenience) closed and open-ended survey questions	390 (NR)	~25 Novel 4-item scale	Future researchers should (1) probe the mixed data found here and in the literature on meal plan use among FI freshman, and the influence of race/ethnicity on FI prevalence in highly diverse student bodies. (2) Evaluate multifaceted interventions, including access to healthy food, nutrition literacy and cooking self-efficacy. (3) Qualitative studies in this field should also be considered to better understand students' FI status and needs.
Silva FB, Wang W, Moore CE. et al. <sup>35</sup> Factors associated with food security of Texas woman's university freshmen. 2022	Texas Woman's University	Freshman $\geq 18$ y	Mixed method descriptive/cross-sectional on-line survey (census) closed and open-ended survey questions	73 (2.7)	54.2 Modified USDA Short Form FSSM, 6-items, during last school years (fall and spring term March 2020)	Future researchers should (1) probe the mixed data found here and in the literature on meal plan use among FI freshman, and the influence of race/ethnicity on FI prevalence in highly diverse student bodies. (2) Evaluate multifaceted interventions, including access to healthy food, nutrition literacy and cooking self-efficacy. (3) Qualitative studies in this field should also be considered to better understand students' FI status and needs.

(Continued)

Table 6. Continued.

Author, title, year, (ref)	University setting/Description	Study population	Study design/Sampling strategy	Sample size/response rate (%)	FI prevalence (%) / measurement instrument	Research gaps mentioned by authors
Spaid R, Gillett-Karam R. <sup>21</sup> Food for thought: food insecurity in women attending community colleges. 2018	Community colleges Maryland	Administrators and students	Mixed method (purposive) In-depth interviews of administrators and campus leaders Survey of students (NR)	22 Interviews 200+ students	52 Modified HFSSM 8-item	Further research on ways to keep the pantries full, to devise a systematic way of collecting data without compromising anonymity, and finally, to research FI over a greater area and with more community colleges.
Stableton MJ, Lee CK, Diamond KK, et al. <sup>168</sup> Understanding the food insecurity experiences of college students: a qualitative inquiry. 2020	Large public research-intensive institution in the Midwestern US	FI undergraduates, diverse in terms of race, ethnicity, and gender.	Semi-structured interviews/ deductive theoretical sampling	23 (NR)	100 USDA Short Form FSSM, 6-item	Future research needed on (1) longitudinal student interviews to understand how college and life events affect food access and hunger. (2) Multi-institutional studies that explore students' experiences across a range of institutional types. (3) Quantitative studies that focus on student success and persistence should incorporate variables related to FI. (4) The intersection of FI and mental health, socio-economic class, and related factors. (5) and interventions evaluation.
Trawver KR, Hedwig T. <sup>169</sup> Food and housing insecurity and homelessness among students in an open-enrollment university. 2020	University of Alaska	Total enrolled population	Mixed method Cross-sectional (random) Open- and closed-ended survey questions	193 (6.4%)	44 Novel 11-items	Further research should document poverty-related FI prevalence in fully representative student samples and more fully understand the student experience and needs.
Watson T, Malan H, Glik D, et al. <sup>128</sup> College students identify university support for basic needs and life skills as key ingredient in addressing food insecurity on campus. 2017	University of California Los Angeles	Undergraduates and graduates, residential and nonresidential, students using free food resources.	Mixed method cross-sectional (purposive) Short FI survey and focus groups	82 (NR)	54% USDA Short Form FSSM, 6-item	Further research to understand the student experience of FI and assess the feasibility and effectiveness of interventions.
White SS. <sup>170</sup> Student food insecurity and the social equity pillar of campus sustainability. 2020	Kansas State University	Undergraduates and graduates who indicated in an earlier survey their willingness to participate in a focus group	Mixed method Cross-sectional (random) survey focus groups and interviews	755 (12.6) 30 (NR)	31.5 Very low FS ~90 USDA Short Form FSSM, 6-item	Future research should take a systems approach to campus sustainability and identify trends over time: (1) regular FI measures, comparing results with changes in the full cost of attendance. (2) Campus food pantries to collect and share anonymous user data. (3) Explore creative solutions for providing on-campus healthy, affordable food. (4) Identify bridges among the individual topics within a campus sustainability plan so that FI does not place limitations on students.

(Continued)

Table 6. Continued.

Author, title, year (ref)	University setting/Description	Study population	Study design/Sampling strategy	Sample size/response rate %	FI prevalence (%)/measurement instrument	Research gaps mentioned by authors
Wright KE, Lucero JE, Ferguson JK, et al. <sup>171</sup> The impact that cultural food security has on identity and well-being in the second-generation U.S. American minority college students. 2021	University of Nevada Reno	2nd Generation American (SGA) students $\geq 18$ , undergraduates and graduates, self-identified member of a cultural or ethnic minority, believed that food was a component of their cultural/ethnic identity.	Semi-structured interviews/ purposeful sampling	16 (NR)	56.3 USDA Short Form FSSM, 6-item	Further research should: (1) use qualitative interviews with SGA students to explore best practices addressing the cultural, social, and cognitive challenges of academic transition, ensuring academic success and identity maintenance. (2) Study the inter-connections and operationalization within cultural food security, foodways, identity, and well-being in cultural and ethnic groups. Future research will include additional quantitative and qualitative measures to assess the differences in culture shock and acculturative stress between SGA and INT students. The increase in SGAs and INTs at universities warrants the investigations of methods to ameliorate SGA and INT health and well-being.
Wright KE, Lucero JE, Ferguson JK, et al. <sup>102</sup> The influence of cultural food security on cultural identity and well-being: a qualitative comparison between second-generation American and international students in the United States. 2021	University of Nevada Reno	2nd Generation American (SGA) students and international (INT) students $\geq 18$ , graduates, undergraduates, self-identified member of a cultural or ethnic minority, believed that food was a component of their cultural/ethnic identity.	Semi-structured interviews/ purposeful sampling	31	56.3 SGA 33.3 INT USDA Short Form FSSM, 6-item	Future research will include additional quantitative and qualitative measures to assess the differences in culture shock and acculturative stress between SGA and INT students. The increase in SGAs and INTs at universities warrants the investigations of methods to ameliorate SGA and INT health and well-being.
Zigmont VA, Linsmeier AM, Gallup P. <sup>131</sup> Understanding the why of college student food insecurity. 2021	Public university in New England	Undergraduates, $\geq 18$ , who volunteered to be interviewed and who self-identified as FI by answering yes to 1 item screen: "In the last 12 months, were you ever hungry but didn't eat because there wasn't enough money for food?"	Cross-sectional (convenience and snowball sample) Semi-structured interviews	21	90 USDA Short Form FSSM, 6-item	More qualitative research is needed to gain a broader understanding of FI among college students at other campuses and focus on specific populations which may have greater risk for FI, including commuter students. College students should be involved in the development and evaluation of food insecurity resources and programming on campuses.

<sup>a,d</sup>Note that the USDA 6-item AFSSM denotes a dichotomous variable (FS (high and marginal FS) v. FI (low and very low FS) in contrast to the continuous FS variables (high, marginal, low, and very low) of the 10-item AFSSM. The time frame is 12 months, unless otherwise noted. FI prevalence is reported as the sum of low and very low FS, unless otherwise noted.

<sup>b</sup>According to the National Center for Educational Statistics (NCES) a non-traditional student meets at least one of the following characteristics: (a) financially independent, (b) dependents other than a spouse, (c) delayed enrollment, (d) enter college with a GED rather than a high school diploma, (e) attend school part-time, (f) work full-time, (g) are a single parent.

<sup>c</sup>Identifies households as being at risk for FI if they answer that either or both of the following two statements is 'often true' or 'sometimes true' (vs. 'never true'): "Within the past 12 months we worried whether our food would run out before we got money to buy more." "Within the past 12 months the food we bought just didn't last and we didn't have money to get more."

<sup>e</sup>Identifies households as being at risk for FI if they answer that either or both of the following two statements is 'often true' or 'sometimes true' or 'always' (vs. 'never true'): "Within the past 12 months we worried whether our food would run out before we got money to buy more." "Within the past 12 months the food we bought just didn't last and we didn't have money to get more."

<sup>f</sup>Answered often or sometimes true to: "the food I bought didn't last and I didn't have money to buy more."

of familial variables (e.g., family composition, economics, dietary habits, and health beliefs) could identify possible underlying causes of student FI and serve as the basis for campus-based interventions.<sup>129</sup> If parental coping strategies shield the family from FI effects, understanding and translating these coping strategies to the college experience could help ameliorate FI in college. Qualitative studies that interview students' multiple times could identify how specific college and life events affect food access and hunger.<sup>168</sup> Finally, little is known about carryover effects after college. Leung et al.<sup>109</sup>( $n=1,508$ ), found that financial independence in college resulted in a greater than 2-fold increase in the likelihood of FI in adulthood, potentially impacting future employment and earnings. Future research should examine how FI may persist after graduation and upon job attainment,<sup>141</sup> as well as how college FI impacts health and well-being over time.<sup>72</sup>

### Qualitative study designs

Increasingly, qualitative research designs ( $n=43$ ) including mixed methods ( $n=27$ ), appear in the literature (Table 6). Intended to describe the lived experiences of food insecure students, qualitative study designs shed light on students' emotional, mental, and physical states. Table 7 lists methodologies, and Table 8 summarizes student experiences identified in the main findings of qualitative studies. Students relate tipping points, such as medical emergencies, transferring schools and legal problems.<sup>165</sup> They connect their food insecure experience to low academic motivation and poor concentration on academic tasks.<sup>143</sup> Believing the "starving student narrative" that student FI is normal and preventable through "bootstrapping" led students to negate and cover-up severe health consequences.<sup>162</sup> Students identify overwhelming feelings of shame, based on the inability to provide for themselves, as obstacles to seeking help, such as SNAP benefits.<sup>165</sup> Students report feeling stigma,<sup>107</sup> anxiety, embarrassment, and guilt over asking for free food.<sup>35</sup> Some report stress and anxiety related to lack of healthy food,<sup>128</sup> and future health issues.<sup>48</sup> How these perceptions inform programs that effectively address FI on college campuses is largely unknown.

### Theories applied

Twenty-one distinct theories were applied in 17% of total records ( $n=28$ ) (Table 9). Alaimo was among the first to present a conceptual model of FI, framing FI resolution as a function of self-reliance, informal bartering, and structured

**Table 7.** Qualitative research designs used in the study of FI in college students in the U.S.

Interviews <sup>27,40,48,49,132,163,165,92,168</sup>
Focus groups <sup>79,167,128</sup>
Interviews and focus groups <sup>162</sup>
Narrative inquiry (semi-structured interviews, journaling, and photo elicitation) <sup>107</sup>
Survey and interviews <sup>13,16,21,42,87,130,164,117,166,70,86,139,102,131,170,171</sup>
Survey and focus groups <sup>23,127</sup>
Photo and text-elicitation, <sup>25</sup> photo-elicitation <sup>23</sup>
Open- and closed-ended survey questions <sup>35,41,45,110,143,70,169</sup>

**Table 8.** FI experiences identified by students in the main findings of qualitative studies.

"Lived" experiences. <sup>162,167</sup>
Coping strategies. <sup>16,25,48,127,162,128,131</sup>
Eating nonperishable items only, <sup>162</sup> little time for food preparation. <sup>13,48</sup>
High food costs, and the feeling of isolation or lack of socializing. <sup>128</sup>
Stress and anxiety around lack of healthy food <sup>170</sup> and future health issues. <sup>48</sup>
Physical and mental strain. <sup>132,48</sup>
Financial challenges. <sup>13</sup>
Stigma. <sup>144</sup>
Believing that food and housing insecurity are normal during college also led students to negate and cover up the severe health repercussions they were experiencing. <sup>162</sup>
Campus support. <sup>122,130,128,167</sup>
Commuters. <sup>167</sup>
Commitment toward degree completion, adverse academic implications. <sup>132</sup>
Low academic motivation by not fully participating in their courses due to few healthy food options or missing meals. <sup>48</sup>
Low self-perception of health when eating poorly. <sup>48</sup>
Cultural food insecurity. <sup>166</sup>
Basic needs insecurity. <sup>162,128</sup>
Thematic analyses identified:
<ul style="list-style-type: none"> <li>• Sub-themes that match the definition of FI, such as "financial challenges to buying food," "insufficient quantity and quality of food," and "uncertainty about meals."<sup>35</sup></li> <li>• Participants often reported subjective responses related to fear, anxiety, embarrassment, and guilt. These responses were grouped into a sub-theme called "emotional response toward FI."<sup>35</sup></li> <li>• Overwhelming feelings of shame from the inability to provide for themselves was a factor that stopped participants from seeking help from parents and other social services, such as SNAP benefits and housing subsidies.<sup>150</sup></li> <li>• Experiences with food insecurity were the result of tipping points, which were usually a combination of events that prevented students from being able to manage for themselves. Such events were described as breakdowns in family relationships, divorce, development of medical conditions, medical emergencies, loss of seasonal employment, legal trouble, and transferring schools.<sup>150</sup></li> <li>• Students' written narratives demonstrate their desire for more appealing and affordable food on campus and reveal their distrust of the college institution. Furthermore, students connect their food insecurity to their ability to concentrate on academic tasks.<sup>172</sup></li> <li>• Thematic analysis of individual student interviews produced three findings: (a) learning to work around hunger, (b) managing anxieties around food and wellness, and (c) acknowledging that food insecurity is a shared and critical issue.<sup>91</sup></li> </ul>

**Table 9.** Theoretical framework, hypothesis or model applied to the study of FI in college students in the U.S.

Biopsychosocial model <sup>32</sup>
Chickering's identity theory based on Erikson's stages of psychosocial development <sup>162</sup>
Cognitive interviewing approach <sup>45</sup>
Experiential learning theory <sup>141</sup>
FI-obesity paradox <sup>25</sup>
Food stamp cycle hypothesis <sup>71</sup>
Goal attainment scaling approach (allows for integration of survey and interview data) <sup>117</sup>
Grounded theory approach <sup>87,86</sup>
Hettler's six dimensions of wellness model <sup>51</sup>
Maslow's theory of human motivation <sup>91</sup>
Organizational paradox of neoliberalism in higher education <sup>27</sup>
Place-based phenomenon <sup>143</sup>
Radimer's hunger model <sup>20</sup>
Social cognitive theory <sup>141,79</sup>
Social determinants of health (SDOH) <sup>98</sup>
Social-ecological model <sup>25,29,53</sup>
Starving student narrative/bootstrap theory <sup>162</sup>
Stress-process model <sup>78</sup>
Symbolic interactionism (SI) theoretical framework <sup>107</sup>
Systems theory approach to the social pillar of campus sustainability <sup>170</sup>
The conceptual model of food insecurity proposed by Alaimo (2005) <sup>108,66,143</sup>
Tinto's (1993) model of student departure <sup>29</sup>
Validation theory <sup>162</sup>
Wholistic student development <sup>168</sup>



food assistance.<sup>108</sup> In contrast to a focus on self-reliance, Crutchfield, et al.<sup>40</sup> utilizes Chickering's identity development theory to explain the stigma associated with hunger in terms of 'starving student narrative' and 'bootstrapping' myths. Social and behavioral theories applied most often were Social Cognitive Theory<sup>79,141</sup> and Social Ecological Model.<sup>25,29,53</sup>

### **Research trends; program exploration and evaluation**

#### **Campus food pantries (CFPs), and other campus-based programs**

The value of CFPs as a food-security safety net has been demonstrated on some college campuses,<sup>136</sup> however, overall awareness and use of CFPs is low,<sup>138</sup> and evidence regarding the effectiveness of campus-based programs is lacking.<sup>172</sup> Esaryk et al.<sup>136</sup> surveyed student CFP users ( $n=1205$ ), concluding that CFP served an important emergency food assistance role. Similarly, in interviews ( $n=18$ ), Manboard et al.<sup>25</sup> found that students viewed the CFP as a food security safety net during the COVID-19 pandemic. In a seminal study on CFPs, El Zein et al.<sup>138</sup> reported that only 38% of FI students surveyed ( $n=899$ ) used the CFP. International students and those receiving student loans or Pell grants were the most likely to use the pantry. Only one study looked for differences in diet quality based on frequency of CFP visits and found none.<sup>139</sup> Longitudinal studies are needed to assess the influence of CFP visits on FI and diet quality over time.<sup>129</sup> Students report feelings of stigma and embarrassment related to CFP visits.<sup>107</sup> To reach more vulnerable students, future research is needed to enhance understanding of how campus climate perceptions influence student interaction with the pantry and its policies.<sup>96</sup> Four studies evaluated other campus-based programs intended to address FI and diet with varying success.<sup>23,83,140,141</sup> Matias et al.<sup>83</sup> reported that a 14-week food and nutrition literacy curriculum covering basic nutrition and cooking concepts, including meal planning, and budgeting increased FS and decreased FI. More research is needed to determine if these results are replicable and scalable. To assess the impact of food and nutrition literacy curricula on future FI, longitudinal studies are needed.

#### **SNAP and pell grants**

Students cope with FI by utilizing public assistance programs including the Supplemental Nutrition Assistance Program (SNAP). However, studies report low SNAP participation rates. For example, in 2019 Olfert et al.<sup>69</sup> reported an FI prevalence of 44.1% ( $n=2,2153$ ), but only 3% of food insecure students were enrolled in SNAP. These results are supported by a 2019 #realcollege survey of over 86,000 students at 123 colleges and universities which showed that only 20% of food-insecure college students received SNAP.<sup>126</sup> SNAP reduces poverty for millions, improves food security, and is linked with improved health.<sup>173</sup> However, an antiquated 1980 federal law was designed to restrict SNAP access to many full-time students who may appear to have low-income while attending college but receive financial support from their parents.<sup>116</sup> This so called "student rule" imposed strict work requirements on able bodied adults without

dependents (ABAWD). In addition to meeting SNAP eligibility requirements, students must be enrolled at least half-time and work at least 20h per week.<sup>174</sup> Exemptions have been applied to the student rule to increase SNAP eligibility for high-risk students. Examples include caring for a child under 6years of age or having a physical or mental disability. According to Esaryk et al.<sup>175</sup> "Future research is warranted to identify policy leverage points at the county, state, and federal levels, such as eliminating the student rule, to ensure equitable access to SNAP among college students". A better understanding of SNAP awareness and use,<sup>137</sup> and accessibility,<sup>66</sup> could be translated into strategies to improve SNAP program effectiveness. Uncovering the lived experiences of college students who apply and use SNAP benefits and those who do not, would add to this body of knowledge. Pell grant recipients are more likely to experience FI. Spaid et al.<sup>21</sup> studied community college women ( $n=217$ ) and found that those who received Pell grants were 2.3 times more likely to be food insecure compared to women who did not. Pell grants have not kept pace with the rising costs of college.<sup>176</sup> Additionally, Pell grant money spent on food is considered as taxable income further diminishing its value for the food insecure student population.

### **Discussion**

The vast body of research revealed in this scoping review contributes considerable knowledge, and research gaps elucidate important next steps. Tables 5 and 6 summarize research gaps mentioned by authors. In brief, further research is needed to: (1) formulate a validated FI survey tool, useful for diverse college students, including all levels and disciplines of undergraduates, graduates, parenting, 1st- and 2nd-generation, homeless, international, on- and off-campus, on-line, and athletes, (2) research methods that minimize non-response bias, maximize response rates, use multiple modes of data collection, oversample underrepresented racial/ethnic and gender groups, utilize validated scales, and maximize use of verified data, (3) implement longitudinal and nationally representative studies on prevalence, risk factors, and consequences of FI before, during and after college, (4) advance research on the bi-directional interplay between FI and academic success (retention and completion in addition to GPA), levels of student financial independence, meal plan structure and utilization, food access and food choices, emotional eating and eating disorders, and anxiety, (5) identify and evaluate "upstream" solutions to student poverty as well as effective community- and campus-based interventions (including cooking, nutrition, and food literacy courses), using improved messaging and design to boost engagement and reach all student types, including underrepresented racial/ethnic and gender groups, (6) integrate the lived experience of FI into student services addressing the increased rates of depression, eating disorders and other mental health constructs.

The problem of FI in college student remains an intractable issue with deleterious effects on a wide scope of variables that potentially affect academic success, both short and long-term

student health, and long-term financial success. This growing body of research can be used to inform solutions. For example, targeted mental health support could ease the suffering of food insecure students. A better understanding of the role of anxiety on factors that correlate with FI in college students, such as poor academic performance, coping strategies, and eating disorders, can be used to tailor interventions. Future studies are needed to better understand the demographic factors that influence relationships between FI and academic success; next steps include over-sampling high-risk groups and stratifying by race and ethnicity, gender, and FS level.

Data on the influence of FI on the nutritional status of students is limited, partly due to overall poor diets of this population in general. FS is defined by the USDA as a household condition of financial constraint affecting food procurement. Yet, in addition to finances, lack of access to adequate, nutritious food, that meets dietary preferences impinges on college student attainment of a healthful diet. To fully address the problem of attaining a healthful diet, there is a need to conceptualize FI within the broader construct of nutrition security (NS). Mozaffarian et al.<sup>177</sup> defined NS as “having consistent access, availability, and affordability of foods and beverages that promote well-being and prevent (and if needed, treat) disease”. Calloway et al.<sup>178</sup> were the first to develop a valid, reliable NS survey tool for use with FI adults in the US. In doing so, they acknowledged that personal choice adds an element of dignity to the concept of NS. There is a vital need to develop or adapt the NS scale for college students that considers their lived experiences.

Federal and state governments provide financial and structural support for higher education, whose mission is to create a self-actualized, informed citizenship and economically viable workforce. Yet, FI continues to hamper academic success, negatively impacting student retention and completion. Financially independent students experience longitudinal cycles of FI, disrupting the economic advantages of college. This is a persistent problem partly because the highly effective societal solutions to hunger (e.g., SNAP) largely excludes college students. All evidence shows low SNAP participation rates among the eligible student population. Outdated food assistance policies from the 1980s, directed toward full-time college students, are based on the politics of “worthiness/deservingness” and restrict access to food assistance. The result is a large group of society’s young adults struggling to balance their personal and professional goals with the harsh reality of basic resource limitations such as healthy food access, reliable housing, and transportation.

Given student feelings of shame and stigma inherent in “class-based identity”,<sup>162</sup> and the normalization of FI put forth by the myths of the “starving student narrative” and “bootstrapping”, there is a pressing need to reframe campus-based food pantries, Pell grants and SNAP for college students, adopting a “rights-based approach to food security”.<sup>144</sup> This shift would counteract feelings of shame or stigma that hold students back. Campus-based solutions target students who live on campus, including international students who don’t otherwise qualify for federal food assistance programs, but would be least effective for commuter colleges and the growing on-line student population.

Integrating strategies that combat FI into the general college curriculum is a way of sidestepping the stigma associated with food assistance. Matias et al.<sup>83</sup> reported preliminary evidence that a semester long nutrition and food literacy course improves food security in the college population. Future research is needed to study the effectiveness of this approach in a variety of college settings. It is time for a new skills-based approach to food security on college campuses that addresses gaps in nutrition and food literacy for all students, including those at risk for FI.

## Summary and recommendations

In their systematic review of the literature between 2001 and 2016, Bruening et al.<sup>7</sup> reported factors related to FI in college students, and suggested interventions. In their scoping review, Nikolaus et al. evaluated the quality of FI prevalence data in college students, published between 1995 and 2018.<sup>2</sup> Our focus extends the reach of these reviews through 2022, reviews the expanding body of quantitative and qualitative studies, student sub-populations and correlating variables, and indexes theories applied. We summarize trends, and synthesize gaps, identified by the authors themselves, to inform future research. However, our study design does have limitations. The decision to restrict records to those that measure FI limited the number of articles focused specifically on program evaluation. The 160 articles extracted were diverse in terms of research discipline, representing both the natural and social sciences; however, the decision to restrict the search to peer-reviewed studies excludes theses/dissertations, conference extracts and reports and other grey literature that would have extended the scope of this review.

Despite widespread documentation of FI prevalence and correlating factors in diverse college students in a variety of settings, the problem persists. There is a pressing need to address methodological issues with measurement, minimize the use of self-reported data and utilize validated scales, and execute longitudinal nationally representative studies that over-represent high risk groups. These strategies are needed to shift the focus beyond documenting prevalence, toward regional and national solutions that address the needs of the most vulnerable.

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