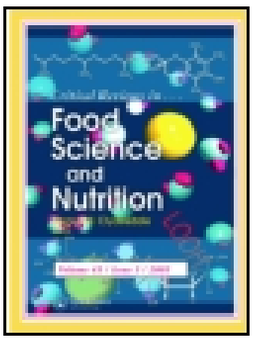

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REVIEW

Investigating food insecurity measurement globally to inform practice locally: a rapid evidence review

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ABSTRACT

The objective of this review was to examine the methods used to measure food insecurity (FI) globally, to inform considerations relating to adopting a novel, or reviewing an existing, FI measurement approach in developed countries. Considerations for measurement are examined with particular applicability to the United Kingdom (UK) which has recently announced adoption of the US Household Food Security Survey Module (HFSSM) as an indicator to facilitate annual FI monitoring. This study uses a Rapid Evidence Assessment (REA) methodological approach to systematically review the literature on FI measurement and considers: geographical jurisdiction, methodological approach, sampling strategy, FI indicator(s) used, and implications for measurement. Results found that the majority of papers reviewed emanate from North America with the *US Household Food Security Scale Module (HFSSM)* and its various adapted forms being the most commonly reported indicator. FI is becoming a key concern within developed countries with a range of indicators being used to report on the severity of the issue. This paper provides a contribution to knowledge by: (i) identifying various approaches to FI measurement and commonalities of existing measurement approaches; (ii) providing a summation of the methodologies and findings of studies relating to FI measurement, and associated implications for measurement, (iii) providing a justification evidenced by the literature for the adoption of the HFSSM in the UK; and (iv) assessing the methodological usefulness of a REA review. Understanding the components of robust FI indicators and their effectiveness can help inform existing and novel measurement approaches to ensure that data collected on FI are meaningful and thereby useful to inform future policy work in this area.

KEYWORDS

Food insecurity; food poverty; measurement; rapid review; inequality

Introduction

Food insecurity (FI), defined as

> *"a situation that exists when people lack secure access to sufficient amounts of safe and nutritious food for normal growth and development and an active and healthy life"* [FAO 2017, 107],
>
> is often considered a developing world problem (Kneafsey et al. 2013).

However, an increased research focus on identifying and understanding FI in developed countries such as Canada (e.g. Faught et al. 2017), Australia (e.g. Butcher et al. 2019), the United States (US) (e.g. Bowen et al. 2019) and the UK (e.g. Dowler and Lambie-Mumford 2015), has proved this phenomenon is not exclusive to developing nations. Despite acknowledging the gap between the scale and severity of those living in developing market economies who experience severe poverty, hunger and starvation, and those defined as food insecure who live in 'developed market economies', Riches (2011, 769) rationalizes the importance of discussing food insecurity in developed market economies on the same level as that in developing countries as the statistics are cause for concern, with 49 million people in the US defined as food insecure, and 43 million at risk of food insecurity in the EU (Riches 2011).

Originally, the term 'food security' referred to the national level, regarding whether countries had adequate food supply to feed their populations. However, perceptions have evolved in that food security (FS) is increasingly considered at the micro level of communities, households and individuals (Dowler 2001). The literature primarily defines food (in)security at the household/population level, citing availability, accessibility, affordability and stability as defining elements which must be optimally achieved to ensure a food secure household/population (Kruzslicika 2015; Leroy et al. 2015; Lebel et al. 2016). Food should be made available in countries through adequate production and imports, and in localities by having an adequate diversity of food choices available in a neighborhood. Food should be physically accessible to consumers in their locality, and should also be financially accessible (affordable) by being offered at a reasonable price. Food supply should be stable: consumers

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should have permanent and sustainable access to food, and food should also be healthy, safe for consumption and of adequate nutritious value (Kruzslicika 2015). Measurement approaches should aim to capture these dimensions.

Various indicators have been used to approximate FI in developing and developed countries. However, due to the multifaceted nature of FI, there currently exists no universal global indicator (Becquey et al. 2010). While FI has been measured annually in the US since 1995 (Rafiei et al. 2009) and in Canada since 2004 (Tarasuk 2016) using standardized indicators, FI has not been regularly measured in the UK (Loopstra, Reeves, and Tarasuk 2019). However, despite ministers' previous reluctance to adopt a methodology of regular, consistent FI measurement similar to Canada and the US (Butler 2019), a recent decision has been made by the Department of Work and Pensions that as of 2019, FI data will be collected across all four areas of the UK in the annual Family Resources Survey (Taylor 2019).

FI is a serious public health problem as it results in poorer nutrient intake, and is associated with reduced cognitive and emotional development in children, and depression and diet-related chronic diseases in adults (Chilton and Rose 2009; Urke, Cao, and Egeland 2014). Human rights literature has successively set a precedent for a rights-based approach to food justice, outlined in the Universal Declaration of Human Rights 1948 (United Nations 2020a), and in documentation from the World Food Summit 1996 (FAO, 2020a) and World Summit on Food Security 2009 (FAO 2020b). Further, in light of the Sustainable Development Goals, adopted by all United Nations member states in 2015 (United Nations 2020b), reducing FI is a target for many countries (Maricic et al. 2016). In addition to individual issues of health and social exclusion that FI may cause, FI can have wider ramifications for society and the economy. From an economic outlook, food insecure populations will be less productive, and furthermore related health problems can create increased cost burdens on the health service.

Longitudinally measuring FI enables trends to be monitored on an annual basis, and can allow for more focused strategies and targeted interventions to tackle diet-related health inequalities in society. Measuring FI consistently can enable Governments to assess the resultant effects of social and economic change over time and across locations (Kennedy et al. 2010; O'Connell et al. 2019). This paper aims to identify various approaches to FI measurement globally and review commonalities across methods used to help inform the review of existing, or adoption of new, measurement approaches for FI in developed countries such as the UK.

Methods

Search strategy

A Rapid Evidence Assessment (REA) was conducted to systematically search the literature to identify and evaluate the current body of evidence on the measurement of FI. A REA is a validated search strategy which has been recognized as a rigorous, systematic method to synthesize knowledge about policy or practice issues in a shorter timeframe than that of a traditional systematic review (Grant and Booth 2009; Ganann, Ciliska, and Thomas 2010). The setting of search parameters and screening criteria in the REA process is useful to identify the most relevant and methodologically robust studies. Published studies which use a similar method and which are also related to FI include Marques et al. 2015; Poulsen et al., 2015; Gebremariam et al. 2017. Sixteen relevant key terms were agreed (Appendix 1) and key word searches were executed across 10 relevant databases (ASSIA; EBSCO; Emerald Insight, Medline, PsycINFO, Proquest, Sage, Science Direct, Scopus, Web of Science). Key terms were truncated to provide optimal search results by widening the search to include variant, relevant word endings.

Inclusion criteria

Eligibility criteria for inclusion were determined to limit the conceptual boundaries of the research question and to ensure the rapid nature of this process. All searches were limited to English language, peer-reviewed journals with full text access. Only literature published between January 2007 and April 2019 was included. This timeframe was chosen to ensure recency of material within scope and within a manageable timeframe, while also serving to update the literature review presented in the last Northern Ireland-specific research and policy report on food poverty (Purdy et al. 2007). It is acknowledged that REAs, by nature, omit or limit certain aspects of the systematic review process (Grant and Booth 2009) and do not produce an exhaustive reflection of the published and gray literature (Ganann, Ciliska, and Thomas 2010). Due to both the aforementioned typical shorter timeframe of the REA process, and the authors' desire to investigate the usefulness of using a REA methodological approach in its most organic form, using only the specified databases and inclusion criteria, a search of the gray literature (e.g. Government reports, industry studies and media reports) was not undertaken. All search terms and their outcomes were recorded. Following this, titles and abstracts were briefly reviewed and those considered relevant and appropriate in relation to the research question were saved for further analysis.

Screening strategy

Each abstract was screened and in order to progress to full review each study needed to both (i) measure FI or discuss FI measurement, and (ii) contain either primary or secondary research (i.e. review studies were excluded). Ten per cent of the final sample was screened by an additional two researchers (SF and LH) to check for inter-coder reliability. Minimal discrepancies between scores were identified and corrections agreed.

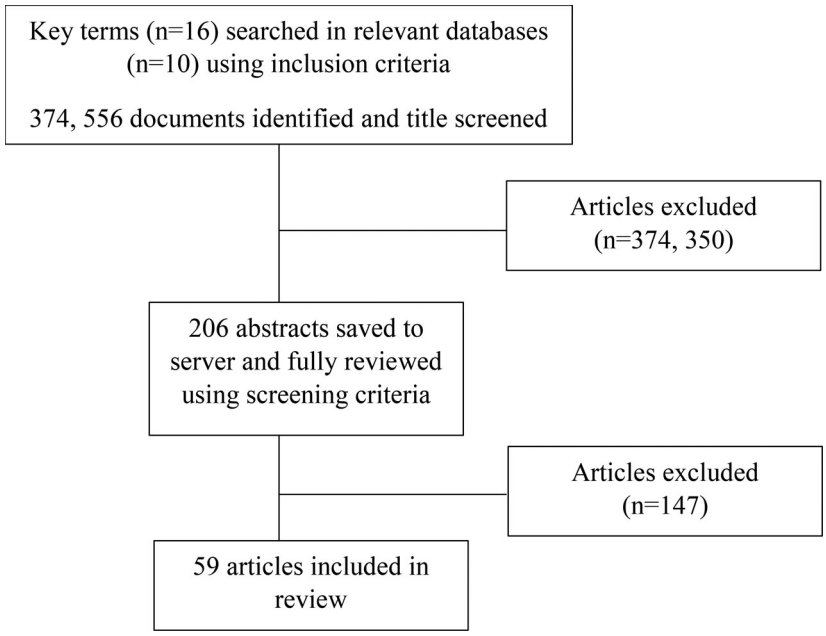

Figure 1. Schematic representation of article selection process.

Data analysis

Each paper was read several times to ensure a comprehensive understanding of the study. A deductive coding approach was applied and all papers were analyzed for the following information: study aim, geographical jurisdiction, methodological approach, nature of the data, target population, sample size, FI indicators used, results, and implications for measurement. Results were collated and summarized so that the study design, indicators and outcomes could be compared within the review.

Results

Keyword searches identified a total of 374, 556 articles (Figure 1). After excluding irrelevant material which did not pertain to the focus of the overarching research question on FI measurement, a final total of 206 academic papers were progressed to full abstract review using the aforementioned screening criteria, fifty-nine of which passed screening to proceed for inclusion in the review. All papers included in the final review are summarized in Table 1.

All studies within scope were reviewed against the identified parameters. Overall, twenty-five of the studies focused on the measurement of FI (i.e. using a particular indicator to assess the prevalence of FI in a particular population), while thirty-four focused on the wider food poverty measurement issue and/or used FI indicators to achieve their objective (e.g. examining the predictors of FI in a population and using a FI indicator to categorize the sample).

Geographic jurisdiction

Literature from North America was prominent: sixteen papers came from various states across the US. Ten studies were deployed in Canada (three of which were in Artic Canada among Inuit communities); six in Australia; four in Europe, one in South America (Peru) and one in India. The remainder ($n = 21$) were from countries across Africa and Asia.

Methodological approach

Thirty-nine papers were primary research studies; twenty-seven of which used quantitative methods, such as collecting primary data through questionnaires, and twelve used a mixed-methods design comprising an integrated approach using both quantitative and qualitative methods. Twenty papers used secondary data (e.g.) health surveys and analyzed these in a primary way.

Sampling strategy

The majority ($n = 41$) of the studies ($n = 59$) targeted general households in their location of study, and five of the studies specified a target population/sample below a particular income level. Anderson et al. (2016) specified that households for inclusion must have an income $\leq$200 per cent of the poverty line. Both Engelhard, Rabbitt, and Engelhard (2018) and Bartfeld and Ahn (2011) similarly specified that household income should be $\leq$185 per cent of the poverty line for inclusion, while Matheson and McIntyre (2014) specified inclusion of households with annual income of < $CAN 100,000. Two further studies (Eicher-Miller et al. 2009; Swindle, Whiteside-Mansell, and McKelvey 2013) specified that the sample must include only those engaging with named assistance programs for low-income consumers, and one study sampled only respondents living in the most socioeconomically disadvantaged census districts in their area of interest (McKechnie et al. 2018).

Of the primary research studies ($n = 39$), twelve were sampled from rural areas, thirteen from urban areas and

Table 1. Summary of papers included in the final review.

Author	Aim	Geographical jurisdiction	Methodological approach	Nature of the data	Target population	Sample size	FI Measures	Result	Measurement implications
1. Anderson et al. (2016)	To determine predictors of food insecurity among children	US	Secondary data analysis	Quantitative	Households with children and with income $\leq$ 200% of the poverty line	1800	HFSSM	Other household characteristic aside from income play a role	–
2. Archer, Gallegos, and McKechnie (2017)	To develop a measure of food and nutrition security for use among an Australian population that measures all pillars of food security and to establish its content validity	Australia	Focus groups Surveys	Mixed methods	Stakeholders in the area of food security	50	HFSSM Radimer/Cornell Food Security Scale New Zealand National Health Survey food security questions	Stakeholder consensus that a tool that measures all dimensions of food insecurity is needed	Need for an Australia specific measure of food insecurity.
3. Bartfeld and Ahn (2011)	To examine the relationship between the availability of the School Breakfast program and household food insecurity	US	Survey	Quantitative	Households with children and with income $\leq$ 185% of the poverty line	3010	HFSSM Probit model estimated to measure relationship between school breakfast availability and food insecurity.	Access to school breakfast reduced the risk of marginal food insecurity	–
4. Bauer et al. (2012)	To understand the prevalence of food insecurity among American Indian families with young children	US	Survey	Quantitative	Households with children	432	6-item HFSSM	Almost 40% of Indian families reported experiencing food insecurity	–
5. Bawadi et al. (2012)	To measure the prevalence of food insecurity among women in Northern Jordan	Northern Jordan	Survey	Quantitative	Women (aged 18 – 70)	500	6-item HFSSM and FFQ to estimate food intake, and self-reported BMI and income	32.4% of respondents reported experiencing food insecurity	–
6. Bjorney Urke, Cao, and Egeland (2014)	To assess if the Household Food Security Scale Module questionnaire is suitable to conduct a rapid evidence assessment of child and adult food insecurity	Artic Canada (Inuit)	Survey	Quantitative	Inuit households and children	1901 households and 249 children	HFSSM	Rapid assessment for food security using a 2-item questionnaire is feasible	Rapid approaches are feasible and can reduce costs.
7. Bowen et al. (2019)	To examine food insecurity in previously homeless people living in supportive housing	US	Survey interviews	Quantitative	Previously homeless individuals living in supportive housing	237	HFSSM	Two thirds of residents (67%) reported low or very low food security	–
8. Bruening et al. (2012)	To assess food insecurity among parents and to examine associations between food insecurity and parental weight status, eating patterns and the home food environment.	US (Minnesota)	Survey	Quantitative	Parents and caregivers	2095	HFSSM	Food insecurity was associated with parental overweight and obesity, binge eating and less healthy food available in the home. Food insecure parents were 2 to 4 times more likely to report barriers to accessing fruit and vegetables	–
9. Butaumocho and	To compare household food security measures	Zimbabwe	Secondary data analysis	Quantitative	Households	1260	HHS FCS CARI	HHS produced the least levels of food insecurity, followed by	The consolidated approach for reporting food security indicators is

	Chitiyo (2017)								the consolidated approach for reporting food security indicators (CARI), while the FCS produced the highest food insecurity prevalence	recommended for supporting long-term chronic food insecurity interventions and the household hunger score for food security assessments to inform emergency relief.
10.	Butcher et al (2018)	To investigate food security using the short form of the US Household Food Security Survey Module (HFSSM) within an Australian context	Australia	Surveys	Quantitative	Households	2334	6-item HFSSM	64% had high/marginal food security 20% low 16% very low	The use of a multi-item measure is worth considering as a national indicator of food security in Australia.
11.	Crawford et al. (2015)	To quantify the extent of food insecurity experienced by young people accessing support from homelessness services	Australia (Sydney)	Survey	Quantitative	Young people experiencing homelessness (aged 14-26)	50	A 27-item questionnaire (including a 13-item FFQ), adapted from other standardized tools (HFSSM) and measures recently used in population surveys.	70% of respondents reported recently experiencing food insecurity	–
12.	D'andreamatteo and Slater (2018)	To assess the use of the HFSSM among a homeless population	Canada	Survey Interview	Mixed methods	Homeless men	40	HFSSM	The HFSSM found that 90% of participants were food insecure, however qualitative data concluded that 100% of participants were food insecure	Valid tools for measuring FS among homeless populations should be developed.
13.	Davis and Geiger (2017)	To examine trends of food insecurity in rich countries	Europe	Secondary data analysis	Quantitative	Households	70,344	EU-SILC (1 of the food deprivation measures) 1 of HFSSM measures	Eastern European countries had the highest overall rates of food insecurity but that the Anglo-Saxon regime had the largest post-crisis rise	–
14.	Depa et al (2018)	To examine food insecurity status of food bank users	Germany	Survey	Quantitative	Adult food bank users	1033	FIES-SM (in German, English, Russian and Arabic)	Over 70% of the food bank users can be described as food insecure	–
15.	Eicher-Miller et al. (2009)	To determine the effect of Food Stamp Nutrition Education (FSNE) on participants' food insecurity	US (Indiana)	Survey	Quantitative	Female head of household (> 18 years old) in 24 eligible to receive FSNE services	219	6-item HFSSM and US Department of Agriculture Food Insufficiency Question	Food insecurity improved in the experimental group as opposed to the control group	–
16.	Eigbiremolen and Ogbuabor (2018)	To provide the first dynamic food poverty analysis for Nigeria, accounting for urban-rural income and price differentials	Nigeria	Secondary data analysis	Quantitative	Households	4671	Calculation of food poverty line	Estimates from the General Household Survey (GHS) longitudinal data reveal that about half of the population was food-poor in 2013	–
17.	Engelhard, Rabbitt, and Engelhard (2018)	To evaluate model household data fit of the HFSSM	US	Secondary data analysis	Quantitative	Households with children and with income $\leq$ 185% of the poverty line	7,324	HFSSM	The data suggest some household misfit with certain groups and the HFSSM	Valid measures of food insecurity are important to inform research, theory, and policy. The psychometric quality of measures of food insecurity have been widely evaluated however there is a gap in the literature

(*continued*)

Table 1. Continued.

Author	Aim	Geographical jurisdiction	Methodological approach	Nature of the data	Target population	Sample size	FI Measures	Result	Measurement implications
									regarding the household model-data fit evaluation of FI measures.
18. Faught et al. (2017)	To assess the relationship between food insecurity and academic achievement in Canadian school-aged children	Canada	Survey	Quantitative	Households	4105	6-item HFSSM FFQ	Low food security was reported by 9·8% of households; very low food security by 7·1% of households	–
19. Fram et al. (2011)	To examine children's awareness and experiences of food insecurity	US (South Carolina)	Interviews and Survey	Mixed Methods	Mothers and children (9-16 years old)	26	Separate semi-structured interviews with both children and adults. Adults only also completed the 6-item HFSSM	Children experienced awareness of food insecurity and took responsibility for managing food	Qualitative research provides useful insight when considering children's awareness and experiences of FI.
20. Gaines et al. (2014)	To assess food security and its risk factors	US (Alabama)	Survey	Quantitative	Undergraduate students (19-25 years of age)	557	The 2008 10-item Adult Food Security Survey Module (AFSSM) was used as an indicator for food insecurity	Food security is associated with resource adequacy	–
21. Geniez et al. (2014)	To jointly analyze 'food poverty' and 'nutrient poverty' by integrating their measurements into a single framework	Nepal	Secondary data analysis	Quantitative	Households in Nepal	Rural sample (n = 401) Urban sample (n = 857) *Total sample (n = 1258)*	Cost of Basic Need measure – food basket Minimum Cost of a Nutritious Diet measure Linear optimization used to calculate a "nutrient poverty" threshold	In the mountain region of Nepal, 34% of households were both food and nutrient poor and 24% were just nutrient poor. In Kathmandu 7% and 14% were food and nutrient poor, respectively	This integrated approach provides a more nuanced interpretation of economic access to a nutritious diet.
22. Gunderson (2008)	To measure the extent, depth and severity of food insecurity among American Indians in the USA	US	Secondary data analysis	Quantitative	American Indian population	1702	HFSSM	American Indians experience higher food insecurity levels than non-American Indians	–
23. Guo et al. (2015)	To estimate the prevalence of food insecurity during two different seasons in a city in Artic Canada, as well as identifying risk factors of food insecurity	Canadian Artic (Iqaluit, Nunavut)	Survey	Quantitative	Households in Artic Canada	2 samples n= 532 at 2 time points	Modified HFSSM	No significant difference between households in 2012 (28.7% food insecure) and 2013, (27.2% food insecure)	Modifying the HFSSM to a shorter recall period of 1 month allowed for repeated sampling and assessment of seasonality. This modification decision was decided following discussion with local residents and decision makers who expressed concerns that asking questions based on a 12-month recall period was too long.
24. Healy (2019)	To examine the experience of households who are not officially classified as food poor but who affirmatively answer the EU-SILC question	Ireland	Secondary data analysis	Quantitative	Households	5239	EU-SILC	Those who are not officially classified as food poor, but who cannot afford to entertain family or friends with food and/or drink once a month – are much more likely	Social exclusion is an important element of food insecurity experience.

		regarding food-related social exclusion							than non-food poor households to be experiencing multiple deprivations, to be unable to afford many household amenities, and, if employed, to be employed in jobs often associated with the working poor	
25.	Hjelm, Mathiassen, and Wadhwa (2016)	To examine whether measures of wealth based on asset ownership and housing characteristics are as effective in measuring food security as consumption and expenditure surveys	-Malawi -Nepal -Uganda -Tanzania Madagascar	Secondary data analysis	Quantitative	Households across each jurisdiction	41,605	Household consumption aggregate, wealth index, asset count, energy deficiency, the FCS, share of calories from staples, food expenditure share	Wealth indices correlate with consumption per capita	Although wealth indices and consumption per capita are related and both are drivers of food security, they cannot be used interchangeably for food security analysis. Each inequality measure is important for describing different aspects of food security.
26.	Huet et al. (2017)	To examine FI prevalence among the Inuit population with/ without children and between different seasons	Canada	Survey	Quantitative	Inuit households	899	Adapted HFSSM	Food insecurity is high among households with children in Iqaluit. No seasonal differences in food security and food consumption for households with children	Modifying HFSSM slightly according to culture, and using a shorter reference time is effective.
27.	Ip et al. (2015)	To identify food security patterns among US farmworker households over 24 months to examine the dynamic of change over time	US (North Carolina)	Survey	Quantitative	Farmworker households with preschool age children	248	HFSSM	51% of households were consistently food secure. Those in the least food secure state moved in and out of it	The state of low food security is particularly transient and unpredictable.
28.	Kennedy et al. (2010)	To provide an overview of two indicators used for food security assessment:the household dietary diversity score and the food consumption score	Burkina Faso, Lao PDR and Uganda	Secondary data analysis	Quantitative	Households across each jurisdiction	9509	HDDS FCS	Both indicators showed moderate correlations with other proxy measures of food security	Consistent use of one indicator would allow for tracking of trends over time and tracking in different locations.
29.	Kirkpatrick and Tarasuk (2008)	To examine the relationship between household food security status and adults' and children's dietary intakes	Canada	Interviews and secondary data analysis	Mixed methods	Canadian population aged 1-70	Survey — 35,107 Interviews (24hr recall) — 10,786	HFSSM 24-hr recall	Those in food insecure households had lower nutrient intake	Longitudinal research needed to address food insecurity and its nutritional consequences.
30.	Kisi et al. (2018)	To examine household food insecurity and coping strategies among pensioners	Ethiopia	Survey	Quantitative	Pensioners	399	HFIAS	Nearly 83.5% of households were food insecure.	–
31.	Kleve et al. (2017a)	To investigate the prevalence and frequency of food insecurity in low-to-middle-income households over time and identify factors	Australia	Secondary data analysis	Quantitative	Households	24 440	Australian National Health Survey single-item measure	Between 2006 and 2009, the prevalence of food insecurity ranged from 4.9 to 5.5% for total survey populations.	There is a need for a more sophisticated and regular Australian food security monitoring system to accurately capture the magnitude of household food

(*continued*)

Table 1. Continued.

Author	Aim	Geographical jurisdiction	Methodological approach	Nature of the data	Target population	Sample size	FI Measures	Result	Measurement implications
	associated with food insecurity in these households								insecurity across income groups and to inform salient public health responses that are available to all at-risk population groups.
32. Kleve et al. (2017b)	To compare a newly developed measure of food insecurity, the Household Food and Nutrition Security Survey (HFNSS) with the HFSSM	Australia	Survey	Quantitative	Households	134	HFNSS HFSSM	Compared with the HFSSM, the HFNSS identified a significantly higher proportion of food insecurity	The HFNSS may be a valid and reliable tool for the assessment of food insecurity among the Australian population and provides a means of assessing multiple barriers to food security beyond poor financial access (which has been identified as a limitation of other existing tools). Future research should explore the validity and reliability of the tool among a more representative sample, as well as specifically among vulnerable population subgroups.
33. Knowles et al. (2018)	To examine the usefulness of screening for food insecurity in a pediatric setting	US	Interviews Focus groups	Mixed methods	Children	7,284	HFSSM (2 questions)	Caregivers screened via paper screener reported food insecurity at over six times the rate of caregivers screened verbally by their child's physician (45.5% compared with 7.2% respectively).	People may be more likely to be truthful about their food security situation when a self-screening method is used (e.g. paper-based) rather than being asked screening questions face-to-face.
34. Li, Dachner, and Tarasuk (2016)	To describe the impact of changes in social policies on household food insecurity in British Columbia from 2005-2012	Canada	Secondary data analysis	Quantitative	Households	58, 656	HFSSM	Increasing social assistance benefits reduced incidences of food insecurity	–
35. Malkanthi, Silva, and Jayasinghe (2011)	To develop and validate a composite household food insecurity index by taking into account three dimensions of food security: accessibility, availability, utilization, to assess the level of household food insecurity in rural subsistence paddy-farming sector in Sri Lanka	Sri Lanka	Case study and survey	Mixed Methods	Adult rural paddy-farmer households	Case study n= 80 Survey N = 300	Seven indicators: economic, social, dietary, nutrition, water and sanitation, perception on food consumption and coping strategies were identified to develop the index	Households were categorized into four categories based on the scores obtained	This index could be used to capture the multidimensionality of food insecurity in this rural area.
36. Martin et al. (2016)	To examine the effect of a novel food pantry	US	Randomised Control Trial	Mixed methods	Adult food pantry users from Hartford, CA.	227	HFSSM	Both Freshplace and self-efficacy have	–

		intervention (Freshplace) on self-efficacy and food security		(RCT)					independent effects on food insecurity	
37.	Martin-Fernandez et al. (2018)	To characterize homeless families' living conditions, health needs, and the developmental problems in children	France	Survey	Quantitative	Homeless families	772	HFSSM (French translation)	14.0% were food secure, 43.3% had low food security and 9.8% had very low food security	Alternative translations of the HFSSM can be effectively used.
38.	Matheson and McIntyre (2014)	To investigate factors accounting for higher levels of reported household food insecurity by women in Canada	Canada	Secondary data analysis	Quantitative	Households with an annual income was <$CAN 100,000	Non-married (N = 25 176) Married (N = 40 014)	HFSSM	Higher reported levels of food insecurity were explained by lower socioeconomic status of unmarried women's households	Responses given can vary according to gender of the person answering module questions.
39.	Maxwell, Vaitla, and Coates (2014)	To compare how the most frequently used indicators of food security portray static and dynamic food security among the sample of rural households in Northern Ethiopia	Ethiopia	Secondary data analysis	Quantitative	Rural households	300 households	CSI Reduced CSI HFIAS HHS FCS HDDS Self-assessed measure of food security	The indicators differ in the element of food security they measure. Some of the indicators are only sensitive concerning a certain severity range of food insecurity	Categorizing food insecurity is dependent on which cutoff points are chosen.
40.	McKechnie et al. (2018)	To compare prevalence estimates of food insecurity using a single-item measure, with three adaptations of the United States Department of Agriculture Food Security Survey Module (USDA-FSSM)	Australia	Survey	Quantitative	Households	505	HFSSM Australian National Health Survey single-item measure	The prevalence of food insecurity was 19.5% using the single-item measure; significantly less than the 24.4%, 22.8% and 21.1% identified using the 18-item, 10-item and 6-item versions of the USDA-FSSM, respectively.	Future monitoring and surveillance efforts should seek to employ a more accurate measure of FI in Australia.
41.	(Megbowon and Mushunje 2018)	To analyze food security status and its determinants among households in the Eastern Cape Province of South Africa	South Africa	Secondary data analysis	Quantitative	Households	3,033	HDDS (24-hr recall)	61.7% of households had a high dietary diversity score, however nutrient-rich food groups were less commonly consumed than other food groups	–
42.	Mishra (2009)	To investigate the sensitivity of food poverty estimates to the choice of spatial price deflators	India	Secondary data analysis	Quantitative	Adults	1994	Poverty intensity index	Food poverty in cities is affected by the way prices are measured and spatial price deflectors	Setting a nationwide minimum food expenditure level to assess food poverty can be problematic as food prices can vary substantially between regions.
43.	Moffitt and Ribar (2016)	To identify thresholds of very low food security among households and children in the Three City Study that are comparable to thresholds in the Household Food Security Survey Module	US	Secondary data analysis	Quantitative	Households with children living in low income neighborhoods	2458	HFSSM	Financial assistance from others and a household's own financial assets reduce food insecurity, while outstanding loans increase food insecurity	–
			Kenya	Interviews	Mixed methods	Households				–

(*continued*)

Table 1. Continued.

Author	Aim	Geographical jurisdiction	Methodological approach	Nature of the data	Target population	Sample size	FI Measures	Result	Measurement implications
44. Momanyi et al. (2019)	To examine food insecurity status of families in certain regions of Kenya					216 pairs of caregivers/ children	FIES-SM HDDS (24hr recall) FFQ	The majority (98.2 per cent) of the households were food insecure	
45. Moroda, Tolossa, and Semie (2018)	To examine food insecurity in a rural district of Ethiopia using a suite of indicators	Ethiopia	Survey Interviews Focus groups Observation	Mixed methods	Rural households	397	HFIAS HDDS MAHFP	The results revealed that 26.5%, 21.7%, and 41.3% of respondents were highly food insecure through Months of Adequate Household Food Provisioning (MAHFP), Household Food Insecurity Access Scale, and Household Dietary Diversity Score, respectively	Choice of indicator can influence level of food (in)security identified in a population. Focus groups, interviews and observations can help supplement data from measurement modules about FI experience.
46. Ngema, Sibanda, and Musemwa (2018)	To estimate the household food security status of the "One Home One Garden" (OHOG) beneficiaries against that of non-beneficiaries	South Africa	Survey	Quantitative	Household	495	HDDS FCS	The results showed that food consumption patterns were characterized by medium (4.89) and average (4.22) HDDS for the OHOG beneficiaries and non-beneficiaries, respectively	–
47. O'Campo et al. (2017)	To examine food security levels among homeless individuals with mental illness and to evaluate the effect of a Housing First (HF) intervention on food security in this population	Canada	Randomized controlled trial	Quantitative	Homeless adults with mental illness	2148	HFSSM	Approximately 41% reported high or marginal food security at baseline;this figure varied with gender, age, mental health issues and substance use problems	–
48. Ogundari (2017)	To categorize households into different levels of food security states in Nigeria using two different indicators	Nigeria	Secondary data analysis	Quantitative	Households	18,870	Food expenditure HDDS	Approximately 66% and 60% of the households in the sample were food secure based on a single indicator such as FOODexp and HDDS, respectively. However, when the two indicators are combined, results reveal that approximately 42% of the households are actually food secure	Combining indicators can help reflect the multidimensional nature of food (in)security.
49. Olayemi (2012)	To investigate effects of family size on household food security in Osun State, Nigeria	Nigeria	Survey	Quantitative	Households	110	HFIAS	Only 24.5% of those studied were food secure	Common practice to select the head of the household as respondent.
		US		Quantitative			HFSSM		

50.	Rabbitt and Coleman-Jensen (2017)	To examine whether a Spanish language version of the HFSSM affects comparisons of food insecurity measures between Hispanic and non-Hispanic White households		Secondary data analysis		Hispanic and non-Hispanic White households	30, 264 (22,306 non-Hispanic White, Hispanic households 7,958)		Results suggest that the Spanish- and English-language HFSSMs produce comparable measures of food insecurity	Alternative translations of the HFSSM can be effectively used.
51.	Rhoe, Babu, and Reidhead (2008)	To analyze food security and poverty in Central Asia	Central Asia (Kazakhstan)	Case Study	Quantitative	Adults	1 country (Kazakhstan)	Per capita food consumption	The total poverty line captures more of the poor population	–
52.	Rosalina et al. (2007)	To develop and use a method of estimating food poverty status in any sociocultural setting	Indonesia (rural West Lombok)	24-hour recall Food Diary and Survey	Mixed methods	Women aged 20-45, married with at least one child, who were free from illness and from conditions that may affect their appetites.	240	24-Hour Food Diary HFSSM	Most mothers were considered food-poor	Relying on the household as the economic unit for determining food poverty, overlooks intra-household distribution issues, especially for women. Men and women can report food consumption differently (men can exaggerate their food consumption while women can underreport their food consumption). Questions may need to be modified, without changing their main objectives, to make them more culturally relevant.
53.	Sahyoun et al. (2014)	To validate the use of two similar food security modules in collecting data from two vulnerable populations, and to describe the development and validation of an Arab Family Food Security Scale	Lebanon	Survey	Quantitative	Adults	Southern Lebanon residents (n = 815) Palestinian refugees in Lebanon (n = 2501)	Arab Family Food Security Scale (modified HFSSM)	A strong significant association between food insecurity and lower food expenditure and lower intake of all food categories except for legumes	Important to ensure that questions are understood as intended, that language used is culturally appropriate, and that questions reflect the range of beliefs, opinions, and behaviors in the target population.
54.	Schwei et al. (2017)	To describe the relationship between household dietary diversity and consumption of vitamin A-rich foods; and the relationship between household dietary diversity and food security status	Ethiopia	Survey	Quantitative	Household	300	HFIAS (modified) HDDS	Participants who reported being food secure had 1·8 increased odds of greater dietary diversity (95% CI 1·0, 3·2) compared with participants who were food insecure	The HFIAS can be modified to assess FI status during a shorter time frame.
55.	Sholeye, Animasahun, and Salako (2019)	To assess food security and dietary diversity among adults in a rural community in Remo, Ogun State, Nigeria	Nigeria	Interviews	Quantitative	Adults	134	HDDS (24hr recall) HFIAS	43.6 per cent of the respondents were food secure; 43.4 per cent were severely food insecure; 30.3 per cent were moderately food insecure, while 26.3	–

(*continued*)

Table 1. Continued.

Author	Aim	Geographical jurisdiction	Methodological approach	Nature of the data	Target population	Sample size	FI Measures	Result	Measurement implications
								per cent were mildly food insecure	
56. Srinita (2018)	To investigate the relationship between maternal, household and socio-economic characteristics and household food security in Aceh Province, Indonesia	Indonesia	Secondary data analysis	Quantitative	Households	23 districts	Per calories capita intake	The analysis proves that mother's age has a significant effect on average calorie intake at the household level	–
57. Swindle, Whiteside-Mansell, and McKelvey (2013)	To document the use of a brief screen for food insecurity by childcare providers	US	Interviews and Survey .	AQ1	Parents with children enrolled in agencies serving families eligible for Head Start	1050	HFSSM Family Map - Basic Needs, Physical Health, Parenting Practices, Parenting Stress Index, Environmental Safety and Caregiver Mental Health	The use of a 2-item screen is valid	The use of a 2-item screen is valid – this can be useful in various healthcare settings.
58. Tarraf et al. (2018)	To evaluate the prevalence of food insecurity in Sub-Saharan African and Caribbean migrants in Ottawa, and to explore determinants of FI in that population	Canada	Survey	Quantitative	Mothers born in Sub-Saharan Africa or the Caribbean living in Ottawa and having a child between 6 and 12 years old	190	HFSSM	45.1% of participants were found to be food insecure	–
59. Vargas and Penny (2010)	To adapt a scale to measure perceptions on food insecurity and hunger in urban and rural communities in Peru	Peru (Lima, Ayacuchi and San Martin)	Interviews, Focus Groups and Survey	Mixed methods	Households	Interviews (n= 14) Focus group participants(n = 26) Survey (n =300)	USDA Food Insecurity and Hunger Scale	Concern about food availability and access was common across the three regions. Mothers perceptions about the importance of balanced meals varied across households from different regions	When adopting measures for a particular area carried out mixed methods research is useful to find how best to alter the measure. Availability of, and access to food were important aspects of a measure, and the anxiety associated with not being able to access food was discussed among participants.

ourteen studies had a mixed sample. Twenty-six primary studies targeted households, and of these, nine studies explicitly specified that the household must contain at least one child. Six of the primary studies considered entire households, two focused on women only and four focused on parents, mothers or caregivers. Four studies targeted children but also included parents in the sample to either speak on the children's behalf regarding household FI or to provide context to children's responses. One study centered on undergraduate students, one on pensioners, one on refugees, and one examined the migrant population in an area. Five studies focused on those who were certain or likely to be experiencing some level of FI, indicated either by their use of food banks, their homeless status, or their presence at a homeless shelter. One study did not assess a population for FS status but rather the sample included various experts working in the area of FI and aimed to use their input to develop an indicator of FS. Of the primary studies which explicitly stated their objective to be measuring FI, study sample size ranged from 50 individuals to 2334 households.

The studies using secondary data ($n = 20$) and mixed method studies ($n = 12$) analyzed existing datasets from country or community health surveys. Data from the Canadian Community Health Survey (CCHS) were analyzed in three studies, and data from the US Current Population Survey were also analyzed in four studies. Sample size varied, with the largest incorporating three cycles of the European Quality of Life Survey to produce a total sample size of 70,344 (Davis and Geiger 2017). Studies with the smallest sample sizes focused on select segments of the population, such as those below a particular level of income, a particular people group, or a particular area.

Food insecurity indicators

Three main classifications of FI indicators were identified throughout the literature: experience-based indicators, dietary diversity indicators, and coping strategies (Maxwell, Vaitla, and Coates 2014).

Experiential indicators, which seek to capture how FI is experienced in terms of behavior and psychological response (Maxwell, Vaitla, and Coates 2014) appeared most commonly throughout the literature, in over eighty per cent of the studies ($n = 48$). The Household Food Security Survey Module (HFSSM) was the most commonly used indicator. Eighteen primary studies and eight secondary studies used either the full 18-item version ($n = 20$), the 10-item adult version ($n = 1$), the 6-item short version ($n = 6$) or an adapted/modified version ($n = 8$) of the HFSSM. Another experiential indicator, the Household Food Insecurity Access Scale (HFIAS), was used in five primary research papers, and in one secondary research paper. The European Union-Statistics on Income and Living Conditions (EU-SILC) food deprivation indicators were used in two papers, and the FAO Food Insecurity Experience Scale Survey Module (FIES-SM) was used in two papers. Various other experiential indicators used included the Radimer/Cornell single-item indicator (used in both the Australian and New Zealand National Health Surveys), the newly-developed Household Food and Nutrition Security Survey (HFNSS), the Household Hunger Scale (HHS) and the USDA Food Insecurity and Hunger Scale.

Dietary diversity indicators (e.g.) 24-hour dietary recall method, Food Frequency Questionnaire (FFQ), and the Household Dietary Diversity Score (HDDS) and the Food Consumption Score (FCS) were used in sixteen studies. Almost three-quarters of the studies did not include any indicator of dietary diversity ($n = 43$). Eleven studies adopted a composite approach, integrating both experiential and dietary diversity indicators.

Coping strategy indicators, which measure behavior related to how food is consumed, and in particular how food is consumed or obtained when it is in limited supply (Maxwell, Vaitla, and Coates 2014), were used least frequently, with one such indicator (the Coping Strategies Index (CSI)) being used in one of the studies.

Studies which tested more than one indicator on the same population found that the choice of indicator used influenced the level of FI identified in the sample population (Butaumocho and Chitiyo 2017; Moroda, Tolossa, and Semie 2018). Further, certain indicators are only sensitive concerning a certain severity of FI, and categorizing FI is dependent on the cutoff points chosen for severity levels (Matheson and McIntyre 2014). Therefore it is important that indicators chosen are valid and reliable for use in the context or location in which they are implemented, and that indicators are consistently used in order to facilitate comparisons across time and locations.

Various translations of experiential indicators were used and found to be effective in measuring FI; the HFSSM was translated to Spanish and French, while the HFIAS was translated to German, Russian and Arabic. These indicators were also adapted slightly in certain studies to use culturally relevant terminology, and to include a shorter reference time of four weeks/one month instead of twelve months. These papers therefore provide models of how indicators have been adapted which can inform and rationale adaptations as needed in similar contexts.

Discussion

The finding that the majority of relevant papers emanated from countries across Africa and Asia, followed by North America is reasonable considering FI is often associated with developing countries, and that the USA and Canada have used a standardized approach to food insecurity measurement since 1995 and 2004, respectively (Rafiei et al. 2009; Tarasuk 2016). This has provided a consistently comparable evidence base regarding the prevalence of FI in each country, and has facilitated tracking of FI across regions (PROOF 2019). Further, consistent data emanating from these countries have facilitated much knowledge on this issue, such as research on associated household risk factors (Anderson et al. 2016), insight into the proportion of those receiving welfare who are food insecure (Tarasuk, Dachner, and Loopstra 2014), and evaluations of the effect of

interventions to improve households' ability to access food (St-Germain, Galloway, and Tarasuk 2019). Collecting data on food insecurity, and conducting related research is therefore useful to inform decisions at the policy-making level regarding response to food insecurity. It is anticipated that the resultant data from the adoption of a standardized indicator in the UK will create opportunity for more robust research on FI to be carried out, and will thereby address the noted gap in UK FI measurement literature. Similarly to how it has been used in the US and Canada, annual UK FI data will allow for monitoring and comparison across different points in time and different regions, and will allow for assessment of predictors and outcomes associated with FI, and of how policy/welfare changes impact national FI.

Although literature from Africa and Asia used a wide range of indicators (e.g. the FCS, the HDDS, per capita food consumption), all literature from North America which measured household FI followed a consistent methodological approach, using the government-endorsed HFSSM measurement tool. The HFSSM has been identified as the indicator of choice to be implemented in the UK, albeit in the 10-item form (as opposed to the 18-item module used in the US and Canada which includes questions relating to child FI) (Butler 2019). Similarities between the UK and North America with regards to both being 'very high human development' index countries (Lee et al. 2018; UND) would indicate that measurement approaches used successfully in North America are likely to also be feasible for use in the UK, therefore the recent decision to use the HFSSM as an indicator for FI in the UK (Butler 2019) is appropriate.

As FI data are most commonly collected using quantitative survey methods, it is understandable that few studies in this review used qualitative methods. However, it would be useful when reviewing existing, or adopting a new measurement approach, to have qualitative feedback from people experiencing FI as to their opinions on current measurement approaches. First hand opinions from those actually experiencing FI would be extremely valuable in ascertaining whether or not current FI measurement questions encapsulate their lived experience, or how measurement approaches could better be adapted to be relevant and apply to their situation to increase accuracy of measurement. Certain studies (Vargas and Penny 2010; Guo et al. 2015) employed this approach in using feedback from the target population to modify FI measurement approach. The construction of the HFSSM was initially informed by Radimer et al.'s (1990) qualitative work with food poor households to conceptualize the FI experience, therefore involving those experiencing FI in revalidation of this module could be useful. One study (Archer, Gallegos, and McKechnie 2017) examined stakeholder perspectives of the HFSSM and the Radimer/Cornell Food Security Scale, as well as the national indicator used in its respective country (Australia). Although stakeholders have indicated the need for a standardized indicator in the UK (King et al., 2015; Sharpe 2016), there is currently a gap in the literature relating to stakeholder perspectives of FI indicators. It would be interesting therefore to examine stakeholder perspectives of the new agreed indicator for the UK.

Regarding sampling strategy, some studies discussed how choice of reference person can influence the accuracy of survey responses. Generally it was common practice to select as a respondent the head of the household (Olayemi 2012) or another adult over the age of eighteen who has primary responsibility for food preparation (Kennedy et al. 2010; Sahyoun et al. 2014; Guo et al. 2015). Rosalina et al. (2007) and Matheson and McIntyre (2014) both discussed the issue of different responses according to respondents' gender, as women may be more sensitive to household needs than men, and men and women may have different knowledge about the household FS situation. Further, certain studies (Rosalina et al. 2007; Geniez et al. 2014) discussed how food allocation and intake may differ according to gender, as cultural or societal norms may influence women to sacrifice their food intake to ensure that others in the household have enough. For this reason, Rosalina et al. (2007) elected to use the mother as the household reference person, reasoning that if the mother has secure FS status it can be assumed this is consistent throughout the household. The above examples indicate that when deciding on sampling strategy, choosing an informed approach based on the demographics and needs of the population to be sampled is important. However, due to the diversity of households and the various roles that adults living in the household may assume, particularly in developed countries where traditional gender roles are not as commonly adopted, it may not always be feasible to specify a particular respondent person (e.g. person responsible for food preparation or head of the household) when carrying out large scale population surveys. The Family Resources Survey which will carry the HFSSM questions to measure FI in the UK specifies that the Household Reference Person (HRP) should be the householder with the highest income, or on occasion where both householders' income is equal, the HRP should be the elder of the two (Department for Work and Pensions 2017). This clear definition of HRP provides consistency and can improve accuracy of responses (e.g. regarding household income and head of household education status). However, it is acknowledged that the intended HRP may not be as easily accessed or as willing to complete surveys as other members of the household, due to working hours constraining availability, or having less knowledge of the household food situation. A further sampling issues relevant to the UK is the need to appropriately weight data to account for variance in the population across different UK regions (NI, England, Scotland, Wales) (Nelson et al. 2007; FSA 2017). The Family Resources Survey has been designed to be representative and methodologically robust and thereby employs a methodology which weights data appropriately to account for different rates of sampling across regions; an approach informed in part by best practice in other national surveys such as the Labor Force Survey (Lound and Broad 2013). Like other nationally representative population surveys, the Family Resources Survey, while robust, does not claim to be representative of the entire low income population and

therefore its selection as the parent survey for the HFSSM may under-estimate the prevalence of FI among the sample. This was the conclusion of the Low Income Diet and Nutrition Survey (LIDNS) in 1997 which, when compared against other nationally representative surveys, confirmed LIDNS as deprived in relation to the remainder of the population (Nelson et al. 2007).

A further methodological consideration is measurement frequency. Certain indicators (e.g. HFSSM and HFIAS) rely on a recall period of twelve months, while others rely on shorter time periods of four weeks (e.g. FIES-SM), or enquire about typical consumption 'every second day', 'once a week', 'once a fortnight', or 'once a month' (e.g. EU-SILC food deprivation questions). Ip et al. (2015) collected quarterly data on FS among Latino farmworker families in the US over a period of twenty-four months, using the HFSSM modified to enquire about conditions in the past three months, rather than the usual twelve-month recall. This allowed examination of which households were consistently food secure and which moved in and out of FS. Examining this state longitudinally can provide understanding on its duration and can help inform measures to prevent low FS (Ip et al. 2015), and understand the drivers of transitional FS. This may be a useful approach in specialized populations such as the one used in Ip et al. (2015) study. The UK has recently decided to adopt the approach of annual FI measurement, thereby according with the US and Canada approach.

The FI indicators most frequently used varied according to the demographic of the country or sample. Very high human development countries, such as the US and Canada, primarily relied on experiential indicators to categorize respondents' level of FI, supporting the use of an experiential indicator (the HFSSM) in the UK. Meanwhile, the absence of alternative indicators, such as dietary diversity or coping strategies indicators, in the developed country studies imply that these indicators may not be appropriate for population level assessment of FI in developed countries such as the UK. Dietary diversity indicators require participants to specifically indicate the types and frequency of food consumed over a certain period, while experiential indicators enquire more generally about the adequacy and availability of food consumed over a certain period. Dietary diversity indicators may be less popular as it takes longer for the respondent to complete and is more complex for the research team to code/analyze. Additionally, dietary diversity indicators provide a more limited view of the varied dimensions of food security, focusing particularly on the food quality dimension, while experiential measures capture the various underlying elements of food insecurity (Maxwell, Vaitla, and Coates 2014). Coping strategies measures were used least frequently as they are used exclusively with households with recognized reduced access to food, therefore are only useful in studies examining exclusively food insecure populations as opposed to studies examining a general population for food insecurity.

The finding that the HFSSM dominated the literature examined was congruent with Marques et al. (2015) review of various indicators used in FI studies, which also found that the HFSSM and its variants were most commonly used. The HFSSM indicator was adapted from the food security measurement method developed in the US and has been used to monitor household food security annually in the US since 1995 (Rafiei et al. 2009) and in Canada since 2004 (Canadian Community Health Survey) (Matheson and McIntyre 2014). The measure consists of eighteen questions (in households with children), or ten questions (in households without children) which assess the degree of food security experienced by households (Coleman-Jensen 2015; Anderson et al. 2016). Questions relate to the accessibility, availability and utilization of food within the household and rely on self-reports from respondents (Health Canada 2012).

There is general consensus throughout the literature that FI is multifaceted in nature (Bhuiya et al. 2007; Ayinde et al. 2012), and that indicators that only capture one element of the phenomenon (e.g. physical or financial access) fail to fully encapsulate the FI experience (Maxwell, Vaitla, and Coates 2014). For this reason, as well as issues of reliability and sensitivity, single-item indicators (such as the Radimer-Cornell single-item scale) are regarded as insufficient, and a multi-item indicator (such as the HFSSM) which measures all dimensions of FI is instead recommended (Archer, Gallegos, and McKechnie 2017). In certain settings however, a shorter indicator can be useful. A two-item questionnaire has been found to be a feasible, useful approach in health care/social service settings when time is limited, and to reduce respondent burden (Swindle, Whiteside-Mansell, and McKelvey 2013; Urke, Cao, and Egeland 2014; Knowles et al. 2018). Therefore although a multi-item indicator is recommended when assessing national/household FI, a rapid approach using a shorter questionnaire has merit when assessing individual FI in a practitioner setting.

A number of studies used more than one indicator to approximate FI, with varying results of FI prevalence among the same sample (e.g. Butaumocho and Chitiyo 2017; Ogundari 2017; Kleve et al. 2017b; McKechnie et al. 2018; Moroda, Tolossa, and Semie 2018). For example, McKechnie et al. (2018) found that the prevalence of household FI using the Australian single-item indicator versus the HFSSM was 19.5% and 24.4%, respectively. Furthermore this study found that the three versions of the HFSSM (18-item, 10-item, 6-item), all classified FI prevalence differently (24.4%, 22.8%, and 21.1% respectively). It is evident therefore that the choice of indicator can influence the level of food (in)security identified in a population, and further, the choice of cut off points will also determine the severity level at which FI is categorized (Maxwell, Vaitla, and Coates 2014).

Food insecurity exists at varying levels of the spectrum, and indicators account for this by classifying respondents according to their situational severity (Gaines et al. 2014; Urke, Cao, and Egeland 2014), (e.g.) 'high' food security (no problems accessing food), 'marginal' food security (some anxiety over household food availability), 'low' food security (reduced variety and quality of food) and, in some cases, 'very low' food security (disrupted eating patterns due to food access issues) (Gaines et al. 2014). As 'very low' food

security is relatively uncommon, it is often normal practice in the food insecurity literature to collapse 'low' and 'very low' food security into one category (Gaines et al. 2014). When using a quantitative FI indicator, designation of cutoff points can be controversial when considering their universal applicability (Maxwell, Vaitla, and Coates 2014). The HFSSM is used in both the US and Canada, however there is variation between countries in how they classify food (in)security. In the US, households are classified as food insecure if adults answer affirmatively to three or more questions, while in Canada, households are classified as food insecure if they answer affirmatively to two questions. There is better consistency of approach regarding the children's questions, whereby both the US and Canada classify children as food insecure if they answer affirmatively to two or more questions (Bartfeld and Ahn 2011; Urke, Cao, and Egeland 2014). Although there is rationale to recommend different classification systems across countries to avoid misestimation of prevalence in differing contexts (Maxwell, Vaitla, and Coates 2014), it is to be noted that different classification systems across countries for the same module will result in prevalence statistics which are not fully comparable.

Due to the effect of the choice of indicator and cutoff levels on how prevalence of FI is indicated in a population, it is important that indicators are properly validated so that they are reliable and fit for purpose and can accurately inform research, theory and policy (Engelhard, Rabbitt, and Engelhard 2018). It is recommended that before a measurement approach is adopted in a particular country or region, it should be validated for use in that particular context, despite its past success in other areas. As the UK's chosen indicator to monitor household food insecurity (the 10-item HFSSM) was compiled based upon research in the US, and was last reevaluated in 2012, it is therefore recommended that it is assessed to examine its applicability to the FI experience in the UK.

Some studies reviewed indicated the need for indicators' language/terminology to resonate with the intended audience(s). When measuring FI in an Indonesian population, Rosalina et al. (2007) used the HFSSM, but altered the question "*We worried whether our food would run out before we got more*", replacing 'food' with 'rice', a food culturally perceived as an essential among this population, and therefore equated with enabling survival (Rosalina et al. 2007). When adapting measurement questions linguistically, it is important that translation does not affect how the questions are interpreted by prospective respondents, for example, Sahyoun et al. (2014) encountered this problem when they translated the question *"food bought did not last"* into Arabic, and it was interpreted by participants as referring to food spoilage. Additionally, it is important to ensure that language of questions is clear to ensure that respondents answering affirmatively to food insecurity questions are doing so because of financial constraints to an adequate diet rather than purposively excluding food for religious reasons or because they are dieting for weight-loss purposes (Gunderson 2008). The US HFSSM was developed in the English language, therefore problems relating to translation and cultural differences are likely to be minimal in the UK. However, globalization and the resultant language barriers of a multi-cultural society (Azam and Watson 2018) render the above considerations important as it is essential that a measurement approach is applicable and understandable to all nationalities in our society. Therefore, any future revalidation of the HFSSM should ensure the terms used in this module are understandable for non-native English speakers.

Limitations

The diverse methodological nature of the study sample makes it difficult to compare and uniformly rate the rigor of each study. As some studies used unique scales, indicators specific to a particular region or modified versions of existing scales, it is difficult to compare these against standardized indicators. Further, this review does not claim to be an exhaustive list of every indicator used globally to measure FI, nor does the present review conclusively present a single indicator as superior over another as it is acknowledged the diversity of sample does not lend itself to like for like comparison. Rather this review showcases the outcomes of using a REA methodological approach, and provides a summation of considerations for measurement forthcoming from the reviewing literature, and applies these as relevant to the UK context. Not including the gray literature from the search strategy may have potentially excluded additional useful perspectives on FI measurement, therefore the next stage of this research would therefore be to examine the gray literature, as well as other key literature which was not forthcoming from the REA, to assess the validity and reliability of any further alternative and relevant measurement methods.

Conclusions

The FI literature discussed various measurement methods including experience-based indicators, dietary diversity indicators and coping strategies. The literature indicates that the concept of a universal indicator is not feasible as norms relating to food consumption, beliefs and practices vary from country to country (Bhuiya et al. 2007). This is indicated by the wide variety of measurement tools used in various countries, and how common tools such as the HFSSM have been adapted in various regions. A key finding was that the HFSSM is the most cited measurement approach; therefore for regions which have not yet implemented a routine approach to measuring FI, it may be useful to examine whether the HFSSM, or an adapted version would be a suitable metric. Additionally, this review provides a summation of important considerations as to how an existing module, such as the HFSSM, may need to be adapted for use in another country, to ensure cultural appropriateness and relevance, and considerations to inform construction of a novel measurement module or approach. Longitudinally measuring FI using a consistent indicator was recommended to facilitate tracking of trends over time and comparison across locations (Kirkpatrick and Tarasuk 2008; Kennedy et al.

2010) to unequivocally confirm the prevalence and severity of FI. Therefore, the recent decision to adopt longitudinal measurement of FI using a standardized approach in the UK is a welcome announcement as evidencing the scale of the problem is the first step to implementing impactful change (Taylor 2019). Lessons can be learned from examining FI measurement globally to inform practice locally, therefore examining FI measurement practice in North America and elsewhere can aid UK researchers in successful implementation of a routine measurement approach, with the aim of ultimately translating research findings into policy or practice (i.e. interventions) to support those experiencing FI at various levels of the spectrum.

Abbreviations

CARI	Consolidated approach for reporting food security indicators
CCHS	Canadian Community Health Survey
CSI	Coping Strategies Index
EU-SILC	European Union-Statistics on Income and Living Conditions
FCS	Food Consumption Score
FFQ	Food Frequency Questionnaire
FI	Food Insecurity
FIES-SM	Food Insecurity Experience Scale Survey Module
FS	Food Security
HDDS	Household Dietary Diversity Score
HFIAS	Household Food Insecurity Access Scale
HFNSS	Household Food and Nutrition Security Survey
HFSSM	Household Food Security Survey Module
HHS	Household Hunger Scale
HRP	Household Reference Person
MAHFP	Months of Adequate Household Food Provisioning
NI	Northern Ireland
REA	Rapid Evidence Assessment
UK	United Kingdom
US	United States
USDA	United States Department of Agriculture

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Appendix 1. Key search terms

Search Term (s)	
1	Dietary Injustice
2	Food Poverty
3	Food Security
4	Food Insecurity
5	Food Deprivation
6	Food Rights
7	Food Equity
8	Food Deserts
9	Food Banks
10	Food Poverty AND Northern Ireland
11	Food Poverty OR Poverty AND Indicators
12	Food Poverty OR Poverty AND Measur*
13	Fuel Poverty
14	Nutrition Recession
15	Nutrition Security
16	Food Justice