

Prevalence and correlates of food insecurity among children in high-income European countries. A systematic review

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Abstract

Background. In Europe, there is not routinely collected data on children's food insecurity. Indirect data show that food insecurity is on the rise in Europe, which may have a great impact on children's health.

Methods. Considering that, we systematically reviewed any evidence coming from European countries in the last 10 years that reported the prevalence and correlates of food insecurity among children, intending to serve as a starting point for policymakers and guidelines.

Results. We report worrying prevalence rates of food insecurity among children from 9 studies. There is a lack of evidence regarding this issue in many EU countries, especially Eastern Europe. Hence, the need for increased attention towards food insecurity among children in European countries.

Conclusions. Achieving food security means designing targeted policies and interventions, both at a national and EU level. Policymakers and governments should make the appropriate efforts to deliver food security as a public good.

Key words

- food insecurity/security
- households
- children
- prevalence
- Europe

INTRODUCTION

Food insecurity (FI) is an increasing public health issue in the world, affecting even developed countries [1, 2]. According to Food and Agriculture Organization (FAO), food insecurity is on the rise starting from mid-2014, with nearly 1 in 10 people in the world living in this condition [3].

That is even more worrying when talking about children, who, if affected, may be in danger, not only for present, but, also, future adverse health outcomes, since their developing brains and bodies can suffer long-term negative consequences [4].

Food security is achieved when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life. As it is seen, food security is a broad concept. It includes not only the quality of food and food shortage but also phys-

ical, social and economic access to food as well as food preferences [5]. The likelihood of experiencing food insecurity is higher among households with children, those who rely on social assistance, renters, households headed by a single parent, without a university degree, a divorced person, younger persons and most importantly, those with lower income [2]. Other factors may be the region of residence and family composition [6].

Food insecurity is worrying because of the negative consequences on children's health through physiological pathways such as a compromised dietary intake and being a strong stressor [7]. Furthermore, food insecurity is strictly connected to nutritional insecurity (sufficient calories but insufficient or unbalanced essential oligo-nutrients) and poor food safety (unsafe environments, poor hygiene, lack of clean water), creating a complex relationship and converging on a series of negative health outcomes.

FI is associated with worse diet quality, micronutrient deficiency, poor health status and stress situations [7]. Iron or zinc deficiencies, associated with food insecurity, may impair learning, delay cognitive development and decrease productivity and academic achievements [8]. These children have a higher probability of presenting cardio-metabolic risk factors [9] and chronic conditions, particularly asthma, depression and suicidal ideation in adolescence [3], as well as dental caries [10] anemia, hypercholesterolemia and hypertension [11]. As for the relationship between food insecurity and children's BMI, literature is ambivalent. While some studies have found a positive association between food insecurity and obesity [12], in other cases it is concluded that this correlation doesn't exist [13].

Unlike Europe, household food security is routinely monitored in the USA and Canada using the Household Food Security Survey Module (HFSM) through nationally representative surveys, providing accurate prevalence data on child food insecurity and its determinants [1, 2]. In Europe data regarding this issue come from reports published by FAO, UNICEF and Eurostat surveys, or from a limited number of studies conducted in only a few European countries [3, 14]. In most cases the tool used to measure food security is not HFSM. This implies that the duration of exposure is not specified, nor multiple dimensions of food insecurity captured, such as hunger or insecure access to sufficient quantities of food, as are measured by the HFSM [2]. Furthermore, in Europe, there is a lack of studies assessing the impact of food insecurity on children's health.

The importance of having these data rises from warnings that food insecurity has been increasing in Europe since the 2008 recession [15]. An indirect indication of this, is the proliferation of food banks since 2010, as observed in the UK [16], Greece, Spain, and France [17].

The evidence gap regarding food insecurity among children in a national and European level and the impact that it has on their health might be a missed opportunity to act. This evidence could guide future policies concerning food insecurity among children, both at a national or EU level. Considering that, we aimed at summarizing any evidence coming from European countries in the last 10 years that reported the prevalence and correlates of children living in food insecure households.

METHODS

Search strategy

We searched three major databases (Web of Science, PubMed, Scopus), looking for relevant articles published between January 1st, 2009 and June 1st, 2019. We considered this time frame in order to have information on children's food insecurity following the economic crisis that started 10 years ago in Europe. In PubMed, we searched the title/abstract of the articles using the keywords "food", "nutrition", "nourishment", "supply", "adequacy", "access", "security", "insecurity", "utilization", "availability", "poverty", "hunger", "children", "pediatric", "adolescent", "teenager", "kid", "Europe" using the Boolean operators AND, OR. The search was restricted to only humans and full-text availability. We adapted the search strategy for the other two databases.

Study selection and inclusion/exclusion criteria

Articles were imported to Excel and the duplicates were removed. The screening process was carried out separately by two reviewers (DZ, FC) and was divided in two rounds. During the first round, pertinent articles were selected based on titles/abstracts. Then, the full texts of these articles were obtained and entirely read and those satisfying all the inclusion criteria were included. We included studies that assessed the prevalence of children (until 18 years old), living in food insecure households in high-income countries in Europe (European Union). We included only these countries because of their economic and social similarities. Studies assessing food insecurity in children with disabilities or health problems were excluded. Cross-sectional studies were considered, as well as longitudinal ones, as long as the prevalence of food insecurity was measured at a specific time frame (i.e. baseline). We excluded articles that were not original studies and were not published in a peer-reviewed journal. Disagreements were resolved by consensus. The reference lists of the included studies were hand-searched to look for additional articles. If data from the same sample was reported in different studies, we decided to include the most recent one.

Data extraction and synthesis

Data extraction was performed independently by two reviewers (DZ, FC). A data extraction form (see *Table 1*) was used retrieving the following information for each eligible article:

- Study identification: first author, title, publication year
- Study characteristics: study period, country, design, sample
- Households' characteristics: demographic, socioeconomic status (SES), children's age
- Food insecurity measurement method, reported by who
- Food insecurity prevalence
- Socio-economic and health correlates of food insecurity.

Due to high heterogeneity between studies, especially in the population that was studied, a narrative synthesis was conducted. This included summarizing the characteristics of the studies and households, reporting the prevalence of children living in food insecure households and investigating its relationship with characteristics of the households, children's age and the tool used to assess food insecurity.

Quality assessment

Two examiners (DZ, FC) separately used the Newcastle Ottawa Scale, modified and adapted for cross-sectional studies, [18] and the Newcastle Ottawa Scale for cohort studies, [19] evaluating the selection process, comparability, outcome and appropriateness of statistical analysis. The final scores were compared, and discrepancies were resolved by consensus.

We used the PRISMA (Preferred Reporting Items for Systematic reviews and Meta-Analyses) statement, [20] as a guide for this review.

The protocol of this systematic review was registered in PROSPERO, registration number: CRD42018109745.

RESULTS

Characteristics of the included studies

Our search strategy produced a total number of 2105 articles. The results of the screening process are given in *Figure 1*. After the screening process, only 9 studies were included in the review (*Table 1*). The quality score in the final sample ranged from 6 to 8 (*Supplementary material 1, available online*).

Eight (89%) were cross sectional studies [21-28], while one (11%) was longitudinal [29]. One study (11%) was conducted in Spain [21], one (11%) in Germany [22], one (11%) in Greenland [23], one (11%) in Greece [26], two (22%) in France [24, 25] and three (35%) in the United Kingdom (UK) [27-29]. Six studies (67%) [23-27, 29] explored also the variables associated to household food insecurity, while two studies (22%) [23, 29] reported health correlates of this condition.

Characteristics of the households

Three studies (33%) [21, 23, 26] had directly recruited children and, then, retrieved information from their caregivers or from the children themselves, when age

pertinent, for a total of 28 029 children. The rest had included households with at least one child in them, for a total of 3342 households.

Participants were living in mainly urban locations (67%), with 3 studies (33%) [23, 27, 29] having a mixed location. Four studies (45%) [21, 23, 25, 29] included households with different socio-economic status (SES), others were focused only on low or very low SES households.

Children's age varied from 1 to 18 years old. One study (11%) included the age category 1-5 years old [29], one (11%) the category 6-11 [28], two (22%) the category 12-18 years old [21, 23], and four (45%) more than one of these categories [24-27]. One study (11%) did not report children's age [22].

Measurement of food insecurity

Food insecurity was measured using the HFISM in all the studies, except one [23]. Based on 18 questions, this questionnaire classifies the households as high, marginal, low and very low food security [30]. Five studies (55%) used the full version of HFISM [29, 24-26, 28], one (11%) used the 6-items adapted version [27] and one (11%) the 8-items adapted version [22]. When food insecurity was reported by children them-

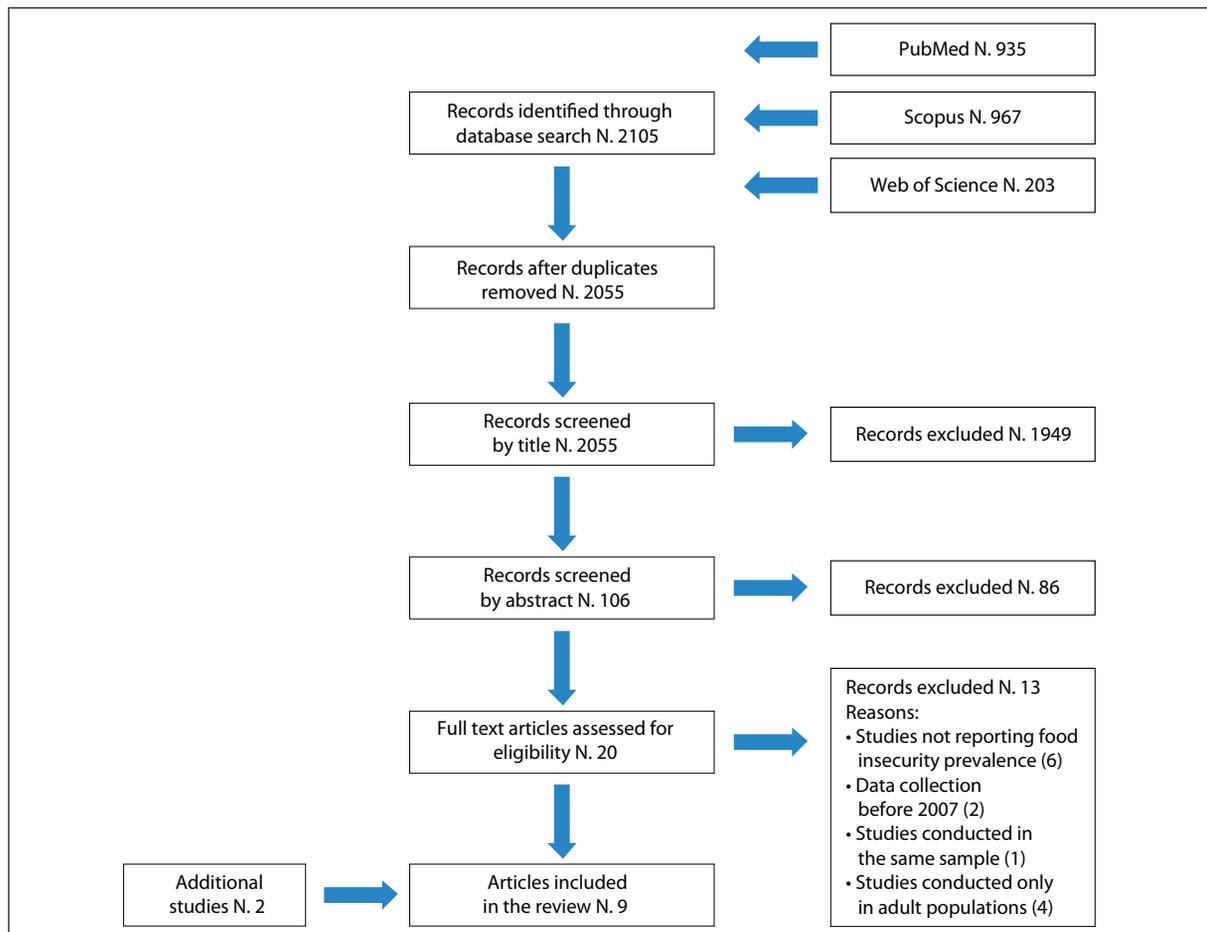


Figure 1
Flowchart of the screening process of the articles included in the review.

Table 1

Extraction form reporting relevant information from all the included articles in the systematic review

Author	Title	Period	Publication	Country	Design	Sample	Setting	Location
Shankar-Krishnan, et al.	Spanish adaptation and validation of the Child Food Security Survey Module (CFSSM-S)	2017	2018	Spain	Cross sectional	426 adolescents	Secondary public school in Terrassa, Catalonia	Urban
Depa et al.	Prevalence of food insecurity among food bank users in Germany and its association with population characteristics	2015	2018	Germany	Cross sectional	217 households with children	Foodbank users in Stuttgart, Berlin, Karlsruhe	Urban
Niclasen et al.	Adverse health effects of experiencing food insecurity among Greenlandic school children	2010	2013	Greenland	Cross sectional	2254 students in the 5th-10th grade from Health Behaviour in School-aged Children (HBSC) survey	School grades 5-10	Mixed
Yang et al.	Association of food security status with overweight and dietary intake: exploration of White British and Pakistani-origin families in the Born in Bradford cohort	2010	2018	England	Longitudinal	1104 mothers from Born in Bradford Study	Bradford Royal Infirmary for universal oral glucose tolerance testing at 26-28 weeks gestation.	Mixed
Martin-Fernandez et al.	Food Insecurity in Homeless Families in the Paris Region (France): Results from the ENFAMS Survey	2013	2018	France	Cross sectional	772 homeless families living in facilities in Paris from the ENFAMS Survey	Accommodation facilities in the Paris region	Urban
Martin-Fernandez et al.	Prevalence and socioeconomic and geographical inequalities of household food insecurity in the Paris region, France, 2010	2010	2013	France	Cross-sectional analysis	1139 households with children among 3006 households from SIRS (a French acronym for "health, inequalities and social ruptures")	Face to face interviews at home	Urban
Petralias et al.	The impact of a school food aid program on household food insecurity	2012-2013	2016	Greece	Cross sectional (before after)	25 349 students	162 elementary and secondary schools	Urban
Long et al.	The impact of holiday clubs on household food insecurity. A pilot study	2015	2017	UK	Cross sectional pilot study	38 families	Holiday clubs held in schools or church halls	Mixed
Harvey	When I go to bed hungry and sleep, I'm not hungry": Children and parents' experiences of food insecurity	2013	2016	London, UK	Cross sectional	72 parents	UK Charity that provides support for deprived children	Urban

Continues

*The age of children included in the studies was ordered according to the stages of children's development: toddlers and pre-schoolers (aged 1-5 years), children (aged 6-11 years), and adolescents (aged 12-18 years)

SES: Socio-economic status

HFSM: Household Food Security Module

USDA: United States Department of Agriculture

FI: Food Insecurity

LFS: Low Food Security

VLFS: Very Low Food Security

Table 1
Continued

Author	Ses	Children's age*	Tools (test/scores/questionnaire)	Reported by	Prevalence	Variables associated with FI	Health outcomes
Shankar-Krishnan et al.	Mixed	12 to 17 years (mean 13.8)	Child Food Security Survey Module-Spanish version	Children	FI 18.3%: 1.9% VLFS 16.4% LFS	/	/
Depa et al.	Low	No info	8 questions U.S. Household food Security Survey Module (US HFSSM)	Parents	FI 35%: 5.5% VLFS 29.5% LFS	/	/
Niclasen et al.	Mixed	Children aged 11-17	Answers to the following question: "Some young people go to school or to bed hungry because there is not enough food at home. How often does this happen to you?"	Children	37.7% of boys and 26.5% of girls	Boys, younger children, coming from low SES households experienced food insecurity more often.	Children experiencing food insecurity had poorer self-rated health (OR=1.60), more physical symptoms, like headache, stomach ache or backache (OR=1.34) and more medicine use (OR=1.79)
Yang et al.	Mixed	1-4 years old	United States Department of Agriculture (USDA) 18-items Household Food Security Module (HFSSM)	Mothers	FI: 9%	Ethnicity	Food insecurity was associated with dietary intakes, consuming more sugar-sweetened beverages and savoury snacks and less vegetables. Obesity was more frequent among food insecure children
Martin-Fernandez et al.	Very Low	Less than 13 years old	United States Department of Agriculture (USDA) 18-items HFSSM	Parents	FI 43.1%: 9.8% VLFS 33.3% LFS	Residential instability, single parenthood, having more than three children, parents' depressive symptoms, housing in social hostels, and difficult access to cheap or free food were associated with food insecurity in children	/
Martin-Fernandez et al.	Mixed	Less than 18 years old	United States Department of Agriculture (USDA) 18-items HFSSM	Parents	FI 9.1%: 3.8% VLFS 5.5% LFS	Household type, number of children in the household, household head's age, socio-occupational category and education level, income and neighbourhood socioeconomic status were associated with food insecurity	/
Petralias et al.	Low	Mean age 10.4	United States Department of Agriculture (USDA) 18-items HFSSM	Parents	64.2% of households: 26.9% VLFS 37.3% LFS	Middle and high school children, with higher number of siblings, with unmarried parents or living only with their mother and whose parents had lower education level or were unemployed experienced food insecurity more often.	/
Long et al.	Low	Ages 2-18	Six-item short adapted form of the HFSSM	Parents	FI 42%: 24% VLFS 18% LFS	Ethnicity, unemployment, lower income and larger households were associated with food insecurity	/
Harvey	Low	Aged 5-11 years	18 questions Food Security Survey Module	Parents	FI 100%: 86% VLFS 14% LFS	/	/

*The age of children included in the studies was ordered according to the stages of children's development: toddlers and pre-schoolers (aged 1-5 years), children (aged 6-11 years), and adolescents (aged 12-18 years)

SES: Socio-economic status

HFSSM: Household Food Security Module

USDA: United States Department of Agriculture

FI: Food Security

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selves, the 9-items form adapted for children was used [21].

The only study that did not use this questionnaire, asked the following question: "Some young people go to school or to bed hungry because there is not enough food at home. How often does this happen to you?" [23].

Prevalence of food insecurity among children

Prevalence of low food security ranged from 5.5% in a study conducted in the general population in France [25], to 43.3% in a study conducted in homeless families in the same country [24]. Very low food security ranged widely from 1.9% in a study in Spain [21], to 86% in a study conducted in deprived families receiving charity in England, UK [28]. The ranges of food insecurity in total (low and very low) went from 9% in a study conducted in the general population in England, UK [29], to 100% in a study conducted in deprived families receiving charity in the same country [28].

The two studies conducted in France reported a very different prevalence of food insecurity among children; 9.1% [25] vs 43.1% [24]. Also, studies conducted in the UK, reported high differences in prevalence values of food insecurity, going from 9% [29] to 42% [27] and 100% [28].

In the studies conducted in households with mixed SES, food insecurity prevalence ranged from 9% [29], to 37.7% [23], compared to the studies conducted in those with low or very low SES, where the prevalence of food insecurity ranged from 35% [22] to 100% [28].

Only two studies used a short version of the HFSM reporting food insecurity prevalence rates of 42% [27] and 35% [22]. The five studies that used the full version of the HFSM reported prevalence rates ranging widely from 9% [29]-100% [28]. In the two studies where food insecurity was reported by children themselves, prevalence rates were 18.3% [21] and 37.7% [23].

The study conducted in the age category 1-5 years old reported a prevalence of 9% [29]. Food insecurity prevalence in the study conducted in the age category 6-11 was 100% [28], while in the age category 12-18, 18.3% [21] and 37.7% [23]. The studies that included more than one of these categories reported a prevalence rate of 43.1% [24], 9.1% [25], 64.2% [26], and 42% [27].

Correlates of food insecurity

Among socio-economic correlates of food insecurity in children there were: low income [23, 25, 27], households with single parents [24, 26], with a higher number of children [24-26], household's structure [25, 27], parents' occupation [25-27] and education level [25, 26], household head's age [25], depressive symptoms in parents [24] and ethnicity [27, 29]. Among children's characteristics, younger ones [23, 26] and boys [23] were more often experiencing food insecurity. Children living in food insecure households had more physical symptoms, such as headache, stomachache or backache, used medicines more often and had in general poorer health [23]. They also consumed more sugar-sweetened beverages and savory snacks and fewer vegetables and experienced more often obesity [29].

DISCUSSION

In this review, we aimed at summarizing evidence from European countries on the prevalence and correlates of food insecurity among children in the last 10 years. Compared to other developed countries like the USA [1] or Canada [2], where food insecurity is monitored using the HFSM, providing accurate data on child food insecurity prevalence and determinants, in Europe, there is not routinely collected data on food insecurity. Following the economic downturns in Europe, there has been a rise in food insecurity in the population, including children [14]. But, since systematic national monitoring of food insecurity in Europe does not yet exist, there is only indirect data coming from food banks, reports published by FAO or UNICEF [3, 14] and a small number of studies conducted in a limited number of European countries. In fact, we included in our systematic review only nine studies reporting the prevalence and correlates of food insecurity among children, conducted in the UK, France, Germany, Greece, Spain and Greenland. This lack of studies could be because of less recognition of the concepts or lack of established measurements. Furthermore, the included studies were all from western Europe (except Greece), confirming a lack of evidence regarding this issue in east Europe countries. A study analyzing the trends of food insecurity in Europe after the 2008 crises concluded that there has been an increase in food insecurity in the general population, with the highest overall rates coming from eastern Europe, so studies addressing food insecurity among children in these countries are warranted [30].

The included studies report worrying prevalence rates, but, since there is no routinely collected data, we couldn't conclude about the trend of child food insecurity in Europe during the past 10 years. Prevalence varied widely between studies. This may be attributed to the differences in data collection and sample, geographical setting, family's SES, the method used to assess food insecurity, children's age.

As for the geographical location, as suggested by Bernell *et al.* [31], there's a higher likelihood of experiencing food insecurity in an urban location compared to a rural one. In this review, most studies (67%) were conducted in urban locations and the rest in mixed locations, without the possibility to stratify if it was rural or urban. So, it was not possible to say anything conclusive by comparing rural to urban locations. Further studies in Europe should evaluate the association between food insecurity and geographical location.

Half of the studies were focused on low-income households since family's income is most frequently associated with household food insecurity, although the population of poor and food insecure people overlap but are not identical [32]. In the USA, people with an income below the poverty line are 3.5 times more likely to experience food insecurity [33]. In our review, studies that included only low-income households with children reported the highest prevalence of food insecurity, with a range from 35% [22]-100% [28], compared to households with mixed SES, where prevalence ranged from 9% [29]-37.7% [23]. This im-

plies that the family's income remains a strong predictor of food insecurity and interventions to mitigate this condition should focus on low-income households with children.

In almost all studies, the tool used to assess food insecurity was the HFSM. Short versions of this questionnaire have been validated and used, minimizing the respondent fatigue and cost of administration [34]. One hesitation over using a shorter questionnaire, categorizing households as food insecure based on only one affirmative response, may be the increased number of false positives [35]. In two studies food insecurity was reported by children, since research has shown that children experience food insecurity more frequently than their parents think. Nord *et al.* conclude that caregivers' reports of adolescents' food insecurity do not agree with adolescents' own reports [35]. Using different versions of the HFSM is a reason for heterogeneity and we may have a situation of over-reporting when the short adapted versions were used, so the comparison was impossible.

Food insecurity is not experienced the same during a child's life. Some studies report that households with more severe food insecurity are also more likely to have older children compared to households reporting moderate or low food insecurity [1]. Almost half of the studies included in this review involved children of all ages, without the possibility to stratify for age category, so it was not possible to conclude about this possible association. Future studies should focus on stratifying by age when measuring food insecurity in children.

There are four included studies with a very high prevalence of food insecurity among households with children [24, 26-28], conducted in very low SES households and populations that are specifically susceptible to food insecurity, like homeless persons or foodbank users. One of these studies was conducted in Greece, in a low socio-economic status population during the economic crisis. It is known that Greece was one of the most affected countries by the crisis, so this high prevalence is expected [26].

As for correlates of food insecurity, only a few studies addressed this issue, along with reporting the prevalence of food insecurity. Among household characteristics associated to food insecurity there were low income [23, 25, 27], households with single parents [24, 26], with a higher number of children [24-26], household's structure [25, 27], parents' occupation [25-27], lower education [25, 26], head household's age [25], depressive symptoms in parents [24]. Ethnicity, as a factor correlated to food insecurity, was seen in only two studies [27, 29]. In a growing ethnic diversity Europe, future studies should address this evidence gap.

Among children's characteristics, younger ones [23, 26] and boys [23] were more often experiencing food insecurity. Anyways, age and sex need to be further investigated as correlates of food insecurity in children, since only two and one among the included studies, respectively, had explored the possible association.

As seen, there are only a few studies reporting these correlates and the evidence is not strong enough to

give definite conclusions as happens, for example, in the USA or Canada where there is ample evidence on the correlates of food insecurity in children [1, 2, 6, 36]. Knowing the populations at risk for food insecurity is important, to appropriately assist the more vulnerable children and prevent the negative health outcomes.

Only two of the studies included in the review explored the impact of food insecurity on children's health, reporting in general poorer health among food insecure children. [23] There is a need for more studies to explore the impact of food insecurity on children's health. Since food insecurity has long-term effects that may be seen even after many years, longitudinal studies would be appropriate to better explore the possible association.

This review has some limits. The included studies had, generally, a medium quality. Some of them did not give a good estimation of food insecurity in children since the majority were conducted in a specific population group, lacking representativeness and generalizability. Hence, the need for studies that could be representative of the general population. As in all systematic reviews, publication bias may be an issue, leading to the loss of small unpublished studies.

On the other hand, we used a comprehensive and rigorous methodological approach to identify every possible study reporting the prevalence of food insecurity among children living in Europe. To our knowledge, this is the first review reporting prevalence data of children living in food insecure households in Europe. It includes data from high-income countries and comes at a moment when food insecurity is considered a public health issue. The fact that countries with the same SES were considered is another strong point accounting for lack of heterogeneity regarding this aspect.

Implications for public health and policymakers

There is a need for evidence and increased attention towards this public health issue in Europe. Because of this lack of evidence, the establishment of a monitoring system of food insecurity becomes a priority for food and nutrition policies. We recommend monitoring the situation by annual surveys and conducting research regarding who and why certain groups are affected. Longitudinal studies are needed to explore the impacts of food insecurity on children's health. More studies should focus on the stress pathway of food insecurity, and not only the nutrition one, as well as assess the relationship between food insecurity, nutrition insecurity and food safety. Achieving food security means designing targeted policies and interventions, both at a national and EU level. Policymakers and governments should make the appropriate efforts to deliver food security as a public good. Considering the high prevalence of food insecurity among children in Europe and the impact it has on their health, this systematic review could serve as a starting point for framing guidelines on screening for food insecurity among children.

Declaration of interests

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