

Food Insecurity and Dietary Intake Among Elderly Population: A Systematic Review

Abstract

Background: This review seeks to determine the relationship between food insecurity among elderly people over the past decades and nutrient deficiency, which is rather unclear. We aim to systematically review the relationship between food insecurity and dietary intake among elderly population. **Methods:** In this systematic review, we systematically searched the international databases including PubMed, Web of Sciences, and Scopus for scientifically related papers which have been published up until January 2018. For a more refined search, we used the Medical Subject Headings (MeSH) terms and Emtree. In terms of search protocol, no restrictions were placed on time and language. Two independent reviewers conducted the data refining processes. Validated form (PRISMA) was used to conduct quality assessment and data extraction. **Results:** Eight cross sectional studies have been included in this review. Two of the studies were conducted in Asia and the remaining six studies were largely based in the United States and Canada. Food insecurity was associated with low levels of vitamin and mineral intakes such as vitamins E, A, B, and D and also zinc, calcium, magnesium, and iron. Most studies also reported insufficient energy, and micro and macronutrients intake among elderly people. **Conclusions:** The findings of this review evidence a considerable amount of food insecurity and nutrient deficiency, including vitamins E, C, D, B 2, and B 12 and zinc, phosphorus, and calcium among elderly population. These findings could be used as reliable evidence by policy makers and future complementary analyses.

Keywords: Elderly, food insecurity, nutrient deficiency, nutrient insufficient, nutrient intake

Introduction

Food insecurity with its wide and varied target population is a social and public health priority around the world.^[1] In most developed and developing countries, food insecurity is considered as a common factor of poor households which possibly contributes to poor nutritional and health outcomes.^[1] Food-insecure people mostly report a lower quality in their dietary intake which makes them more prone to health risks such as hypertension, diabetes, and other health problems.^[2,3] Around 14% (17.4 million) of U.S. households, 13% of Australian older adults, and 13% of Canadian individual households experience food insecurity and its adverse health outcomes.^[4-6] However, considering the trends of life expectancy, the elderly population, being the age group, which is experiencing the highest level of food insecurity, demands a higher attention.^[7] The steady growth in the elderly population

leads to a greater demand in the public health system. There is a need for more public services such as medical care and social amenities for the direct and indirect adverse outcomes of food insecurities and its deleterious consequences on nutritional, physical, and mental health and quality of life of the elderly people.^[8] The determinants of food insecurity among elderly people include age, low income, low level of education, and living circumstances. Consequences of food insecurity on the physical and mental health, well-being, and quality of life of the elderly population were also reported.^[8] Adverse health effects of food insecurity such as hunger, malnutrition, and lack of balanced diet were confirmed through several studies among different age groups.^[8,9] Previous investigations found that food insecurity, especially among elderly people, was significantly associated with a lack of social support, health problems, and functional impairments.^[10,11]

In an aim for a better management of the problems, interventional programs

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should be designed and followed based on reliable evidences.^[7,12,13] For the aforesaid purposes, reliable data are considered as an essential requirement for ongoing evidence-based health policies.^[14-16] Notwithstanding the gravity of the problems, to the best of our knowledge, to date, no study with a comprehensive review has assessed the relationship between food insecurity and nutrient intake among the elderly population. Considering the limitations of related scientific evidences and benefitting from a well-developed protocol for comprehensive systematic review, this study aims to assess the relationship between food insecurity and nutrient deficiency among the elderly population.

Methods

The systematic review is conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA)^[17] and covers all relevant PRISMA checklist items.

Data source and search strategy

The investigators of this study systematically searched the international databases, which include PubMed, Web of Sciences, and Scopus using Medical Subject Headings (MeSH) terms and Emtree terms for the purposes of identifying scientific papers that have been published and for peer-review articles, up to the year 2017.

The keywords for initial research included the following “elderly,” “old age,” “aged,” “aging,” dietary intake,” “food insecurity,” “micronutrient deficiency,” “food supply,” and “nutrient insufficient” [Table 1]. The results were limited to human subject and without any restriction in language. For non-English articles, translations were considered. Studies listed in the reference list below are the complete list of studies that were conducted manually to identify relevant studies.

Other sources

Related grey literature and reference lists of relevant primary studies and related key journals ($n = 10$) were searched for additional publications.

Study selection

Endnote software was used to manage the bibliographic information of the studies that were selected for the purposes of this review. Three main steps of data refinement which comprises of assessments of article titles, its abstracts, and full texts were used. Two investigators (i.e., the student and her cosupervisor) independently reviewed all identified articles.

Inclusion and exclusion criteria

The investigators included all observational studies (cross-sectional, case-control, and cohort studies) that were conducted on related subjects (food insecurity, nutrient deficiency, and elderly people). Studies on specific subgroup such as patients were excluded. The specific inclusion criteria are as follows:

- 1) Targeted people between 60 and 100 years of age. However, if the age range of respondents in a study was not above 60 years but the respondents were still within the range of our study, such respondents have still been considered
- 2) Evaluation of food insecurity and nutrient intake in developed and developing countries
- 3) Assessment of nutrient intake among elderly people (24-h dietary recall, food frequency questionnaire, and 3 days' food records).

If there was more than one extracted paper with respect to a specific research, a more completed report was considered. The investigators also deleted papers with duplicate citations and excluded studies on children and adolescents, studies that did not assess vitamins and minerals, and

Table 1: Search strategy

PubMed

((“dietary supplements” [Mesh] OR “food supply” [Mesh] OR “food” [Mesh] OR “Micronutrients” [Mesh] OR “dietary intake” [Title/Abstract] OR “food insecurity” [Title/Abstract]) OR “nutrient insufficient” [Title/Abstract] OR “Food supply” [Mesh]) AND (“Aged” [Mesh] “OR “elderly” [Title/Abstract]))

Scopus

((TITLE-ABS-KEY “dietary supplements”) OR TITLE-ABS-KEY (“foodsupply”)) AND ((TITLE-ABS-KEY (food) OR TITLE-ABS-KEY (Micronutrients) OR TITLE-ABS-KEY (“dietary intake” OR TITLE-ABS-KEY (“food insecurity”) OR TITLE-ABS-KEY (“nutrient insufficient”) OR TITLE-ABS-KEY (Food supply)) AND (TITLE-ABS-KEY (“aged”) OR TITLE-ABS-KEY (“aging”) OR TITLE-ABS-KEY (elderly))

ISI/WOS

TOPIC: (“dietary supplements”) OR TOPIC: (“food supply”) OR TOPIC: (food) OR TOPIC: (Micronutrients) OR TOPIC: (“dietary intake”) OR TOPIC: (“food insecurity”) OR TOPIC: (“nutrient insufficient”)

OR TOPIC: (“Food supply”)

TOPIC: (“aged”) OR TOPIC: (“elderly”) OR TOPIC: (“aging”) OR TOPIC: (“old age”)

Timespan=All years AND

Indexes=SCI-EXPANDED, SSCI, CPCI-S, CPCI-SSH Timespan=All years

studies on elderly people with disabilities or acute diseases such as cancer, dementia, Parkinson's, Alzheimer's, and HIV/AIDS.

Data extraction and quality assessment

The data extraction was performed based on a checklist developed by the researchers which comprised 11 dimensions, namely, citation, publication year, study year, place of study, type of study, population, total sample size, age range, type of measures for food insecurity, results of the measures, and such other information. The dietary intake measures included the method of collection of dietary intakes (such as 24-h recall, 3-day records, and food frequency questionnaire). Size (gram or servings), frequency, or intake recommendations (percentage of the recommended daily allowance or dietary reference intake (DRI)) were considered as interested outcomes. The assessments, definitions, and level of food insecurities based on household surveys were extracted from each study.

The quality of studies was assessed using the Newcastle Ottawa Scale (NOS) designed for observational studies.^[18] Under this scale, the maximum score which can be attained by a study is 9 which comprises 4 scores for the selection of study groups, 2 scores for the comparability of the groups, and 3 scores for the assessment of the outcomes. For purposes of this study, publications with an NOS score of ≥ 6 were considered as high quality. All processes of systematic search, assessment of quality, and the extraction of data were adhered to independently by both researchers (the Kappa statistic for agreement for quality assessment was 0.92). Probable discrepancies were resolved by referring to third-party expert opinion(s), that is, if the first researcher stated that the design was cross-sectional and the second researcher found cohort study, the third-party confirmed which one was correct.

Statistical analysis

The significant level of association between food insecurity and dietary intake from each included study was extracted for a qualitative analysis. Such findings were used for a qualitative analysis given the high level of heterogeneity between the studies.

Results

This article investigates the relationship between food insecurity and dietary intake among the older population. Through primary database searches, 1083 articles were identified [Figure 1]. Out of the 1083 articles identified, 1052 articles were excluded after an assessment of relevancy based on titles and abstracts. Full texts of the remaining 31 articles were assessed based on the selection criteria of the study, and accordingly, 23 articles were excluded as it did not meet the required inclusion criteria.

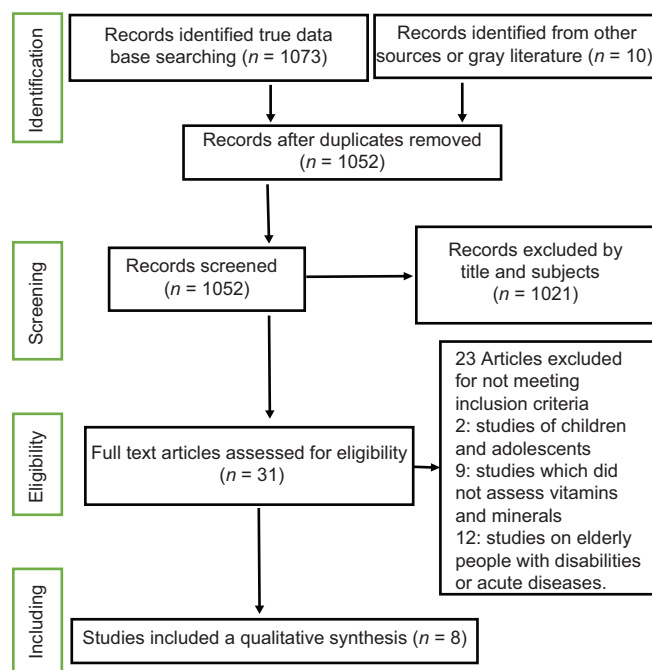


Figure 1: PRISMA flow chart of selection studies for systematic reviews

The 23 excluded articles comprise 2 studies on children and adolescents, 9 studies that did not assess vitamins and minerals, and 12 studies on elderly people with disabilities or acute diseases such as cancer, dementia, Parkinson's, Alzheimer's, and HIV/AIDS.

The remaining eight articles that met all the inclusion criteria were selected for text appraisal. All eight articles selected were population-based studies which were conducted at national levels [Figure 1]. Articles retrieved were up to the year 2017. The results extracted from the eight articles are reported in Table 2. All papers were initial studies with cross-sectional design which statistically assessed the relationship between food insecurity and dietary intake.

The lower age ranges considered for elderly people were 60, 65, and 70 years.^[9,12,19] In five articles, the upper limit age ranges reported were 75, 74, 90, and 93 years.^[10,11,13,20-22]

Four studies had used data from national representative samples of more than 1000 older adults.^[9,11,12,22] Five studies were from national samples that attained their target.^[9,11-13,22] All eight studies were stratified by age groups or age and sex.

Among all studies, food insecurity was mostly measured in households and were indicated in four categories as follows: (1) moderate/severe food insecurity, mild food insecurity, and food security (reference category); (2) food secure and food insecure; (3) food insecure and food insufficient (a condition where the respondent reported that "sometimes or often the family did not get sufficient food to eat"); and (4) food-sufficient families and food-insufficient families.

Table 2: Summary of results from the cross-sectional of the relationship between food insecurity and nutrient intake

Authors, citations	Study year	Study name	Age range and sex ratio	Instrument	Design	Findings	Quality score
Kirkpatrick <i>et al.</i> ^[9]	2004	The 2004 Canadian Community Health Survey and the 2003-2006 NHANES (USA)	51-70 years in Canada: M: 2716 F: 3403 70≥years: M: 1598 F: 2763 51-70 years in USA: M: 1183 F: 1213 70≥years: M: 792 F: 796	18-item HFSSM; Dietary intake data were collected using 24HR methodology in both surveys under protocols calling for one recall to be administered to all individuals by in-person interview and a second recall to be administered to a subsample of individuals in Canada and to all respondents in the United States via telephone, 3-10 days after the first recall.	Cross-sectional	Food insecurity in Canada and USA were 13% and 21%, respectively. Larger gaps in the prevalence of inadequate intakes between those in food-secure and food-insecure households were observed in Canada than in USA for calcium and magnesium. For calcium, the prevalence of inadequate intakes among those in food-secure and food-insecure households in Canada were 50% and 66%, respectively, as opposed to 50% and 51%, respectively, in USA. For magnesium, the prevalence of inadequate intakes among those in food-secure and food-insecure households in Canada was 39% and 60%, respectively, as opposed to 60% and 61%, respectively, in USA. These findings remained largely unchanged after they accounted for participation in the food and nutrition assistance programs in the USA.	8
Kirkpatrick and Tarasuk ^[18]	The 2004 Canadian Community Health Survey (cycle 2.2)	Analyzed 24HR and household food security data for persons age 1-70 years old from the 2004 Canadian Community Health Survey (cycle 2.2)	51-70≥years	18-item HFSSM; Dietary intake data were collected using 24HR	Cross-sectional	Food insecurity in Canada was 13%. Poorer dietary intakes were observed among adults and older adults in food-insecure households and quite a number of differences on food security status persisted after accounting for potential confounders in multivariate analyses. Higher estimated prevalence of nutrient inadequacy was apparent among adolescents and adults in food-insecure households with principal differences mostly being marked for protein, vitamins A, B-1, B-2, B-6, and B-12 and folate magnesium, phosphorus, and zinc.	

Contd...

Table 2: Contd...

Authors, citations	Study year	Study name	Age range and sex ratio	Instrument	Design	Findings	Quality score
Do Nascimento Jacinto de Souza, <i>et al.</i> ^[10]	2013	This study included 427 elderly from <i>Campinas, São Paulo</i> ; half were users of a government-run soup kitchen and the others, their neighbors of the same sex	60≥years M: 270 F: 157	Food insecurity was measured by the Brazilian Food Insecurity Scale. Food intake was determined by a food frequency questionnaire with 8 foods or food groups and their respective intake frequencies (does not eat; 1-2/month, 1-2/week, 3-6/week and daily).	Cross-sectional	Prevalence of food insecurity was 21.8% in Berezil. Elderly people living in incomplete houses who did not consume fruits or meats daily were more likely to be food insecure.	7
Montoya <i>et al.</i> ^[11]	2000	Cross-sectional survey of large national samples, from the National Health & Nutrition Examination Surveys (1988-1994 & 2001-2002), in the United States	60≥years Mean±SD: 66.18±0.45 M: 5039 F: 2040	The HEI (2000 and 2005) as a measure of diet quality; food security status was categorized as food secure and did not receive food stamps, food insecurity received food stamps	Cross-sectional	Prevalence of food insecurity was 21.7%. Individuals with food security had a better quality of food intake compared to the individuals with food insecurity. There was no significant association between older individuals and food-insecure individuals who are receiving food stamps and quality food intake.	8
Champagne <i>et al.</i> ^[12]	2000	Foods of Delta Study (Lower Mississippi Delta region)	55-75 75≥years 1607 male and female N=1600	Food security status and diet quality, as defined by adherence to the HEI and DRIs by determinations from self-reported food intake (1 day intake). Food security status was evaluated by the 18-item Household Food Security Module to construct the 12-month food security scale that classifies households as food secure or food insecure with or without hunger.	Cross-sectional	Prevalence of food insecurity among older participants was 3.6% in the years 1988-1994 (3.3% for those living alone) and 10.4% in the years 2001-2002 (9.8% for those living alone). Food-secure adults scored higher on HEI than food insecure adults. Individuals with food security consecutively had higher percentages of the DRI especially the adequate intakes and estimated average requirements compared to individuals with food insecurity. Larger differences were noted for zinc, copper, and vitamin A and very small differences were noted for vitamins C, B12, B1, B6, B2, and E. Both groups had extremely low level of dietary fiber consumption.	8
Bartali <i>et al.</i> ^[20]	2006	CHIANTI (Invecchiare in Chianti, aging in the Chianti area) study (Italy)	65-93 years Mean±SD: 74.1±6 6.5 M: 352 F: 450		Cross-sectional	A poor consumption of protein, vitamins D, E, and C and folate. Low level of consumption of >3 nutrients.	7

Contd...

Table 2: Contd...

Authors, citations	Study year	Study name	Age range and sex ratio	Instrument	Design	Findings	Quality score
Shahar <i>et al.</i> ^[21]	2003	(Southern Israel) Jewish study	65-74 years M: mean±SD: 68.8±2.8 F: mean±SD: 68.9±2.7 M: 96 F: 128		Cross-sectional	Calcium and zinc intake was lower than the National Nutrition. The intake of both folic acid and vitamin E which play important roles in aging mechanism was lower than 60% from the DRI. Energy intake was directly associated with subjective health status among men. On the other hand, energy intake was inversely associated with appetite among women. Low-energy intake was associated with more gastrointestinal problems for women. For both sexes, lower energy intake was associated with lower snack consumption	6
Dixon <i>et al.</i> ^[22]	1988-1994	Third National Health and Nutrition Examination Survey	>60 years 3334 F and M		Cross-sectional	Elderly people who were above 60 years old had lower consumption of total energy, zinc magnesium, iron, and vitamin B-6. They tend to have zinc and iron intakes lower than 50% of the recommended intake per day. They also had lower concentrations of serum HDL, albumin, and vitamins A and E	8
Lee <i>et al.</i> ^[13]	2001	Third National Health & Nutrition Examination Survey (1988-94) and the Nutrition Survey of the Elderly in New York State (1994)	Elderly persons 60-90 years, (N=56,596) were sampled in the NHANES III (1988-1994)	In NHANES III, food insufficiency was defined as “an inadequate amount of food intake due to lack of resources” (Briefel and Woteki 1992). The food-insufficiency question was a part of the family questionnaires in the NHANES III, and was designed to measure individual food insufficiency on the basis of the reported adequacy of the family’s food resources. In NHANES III, detailed nutrient intake information was available based on a single 24HR dietary recall taken in the MEC	Cross-sectional	Prevalence of food insecurity was 1.7%. Food-insecure elderly people had significantly lower intakes of energy, protein, carbohydrate, saturated fat, niacin, vitamins B-2, B-6, and B-12, magnesium, iron and zinc, and lower skinfold thickness. In addition, food-insecure elderly people were more likely to report fair/poor health status and had higher nutritional risk. These results indicate that food-insecure elderly people have poorer dietary intake, nutritional and health status than those food-secure elderly people. It is necessary to ensure the nutritional well-being of all elderly people who are at nutritional and health risks (including those who are food insecure) and have poorer nutritional and health status than those who are food secure	7

24HR=24-h recall; HEI=Healthy Eating Index; SD=Standard deviation; DRI=Dietary reference intake; NHANES III=Third Health and Nutrition Examination Survey; HDL=High-density lipoprotein; MEC=Mobile Examination Center; HFSSM=The Household Food Security Survey Module

This study measured the food insecurity levels based on the type of person affected. The data sets used for food insecurity measures were questions on food insufficiency in the Third Health and Nutrition Examination Survey (NHANES III, 1988–1994) and the three food insecurity items in the Nutrition Survey of the Elderly in New York State (NSEN, 1994). One study used health status labeled as “very poor” and “excellent.”^[10]

There were convincing study outcomes that adults with food insecurity consume significantly lower amount of fruits, vegetables, and dairy products and had poor dietary consumption of vitamins A and B-6, zinc, magnesium, and calcium. In one of the investigation, the deficiency of daily intake of vitamin B-6, zinc, magnesium, and iron was high.^[5] Another study emphasized that older participants have 50% lower zinc and iron dietary intakes than the recommended daily intake.^[22]

The quality assessment of studies selected was performed using NOS. Based on this scale, all studies selected were of high quality [Table 1].

Discussion

This article provides an evidence on the considerable prevalence of food insecurity and nutrient deficiency among elderly population. This review indicates that food insecurity has a direct association with nutrient intakes and can contribute to nutrient deficiencies such as vitamins E, C, B-2, B-12, and D and zinc, phosphorus, and calcium deficiencies.^[13,19,20,23] In some cases, elderly people who did not have sufficient financial support did not receive enough meat, vegetables, fruits, and dairy food products. As a result thereof, they were exposed to iron, zinc, magnesium, calcium, vitamins A, E, C, B-2, and B-12, and folate deficiencies.^[8,24]

A study reported that the adjustment of energy intake in about 802 elderly people age between 60 and 90 years by a low intake of more than three nutrients, such as protein, vitamins D, E, and C, and folate, independently and significantly resulted in frailty among the elderly people.^[20]

The association between food insecurity and quality of nutrient intake is evidentially confirmed.^[13,20,22] Based on the evidences, energy intake is directly associated with the subjective health status among men, whereas energy intake is inversely associated with appetite among women. A low-energy intake is associated with more gastrointestinal problems for women. For both sexes, lower energy intake is associated with lower snack consumption.^[20,22] In Iran, Nouri indicated that, except for carbohydrate and iron intakes, all other nutrient consumptions were lower than the DRI. Based on the data collected using food frequency questionnaire among elderly subjects in in-house nursing, a high proportion of the elderly subjects had inadequate dietary consumption of vegetables, fruit, meat, fish, and

dairy products.^[25] Dixon *et al.* confirmed that elderly people who were above 60 years old had lower consumption of total energy, zinc magnesium, iron, and vitamin B-6. They tend to have zinc and iron intakes which were lower than 50% of the recommended intake per day. They also had lower concentrations of serum high-density lipoprotein, albumin, vitamins A, and E.^[22]

Lower intakes of energy, carbohydrate, protein, saturated fat, niacin, vitamins A, B-6, B-12, B-1, and B-2, and iron, zinc, magnesium, folate, and phosphorus were identified in food-insecure elderly people.^[13,24,26,27] Champagne *et al.*'s investigation conducted among 1675 people between 18 and 75 years of age found that adults and older adults with food security had higher Healthy Eating Index score compared with adults with food insecurity.^[12] Individuals with food security had consistently higher percentages of DRI than individuals with food insecurity. The differences were larger for zinc, copper, and vitamin A as opposed to vitamins C, B-12, B-1, B-6, B-2, and E where the differences were rather small. Both groups had extremely low-level dietary fiber consumption.^[12]

This systematic review gathered all available scientific evidences to depict the relationship between food insecurity and dietary intake among the elderly population. The limitation of this systematic review is its limited validity and applicability which is mainly due to the reporting quality of studies which have not been included. With regard to data visibility, limitations faced were with the quality and quantity of results presented in the articles. This systematic review also had limited generalization of findings due to the heterogeneity of the search results.

Conclusions

To the best of our knowledge, this is the first systematic review assessing food insecurity and nutrient intake among the elderly population. There were convincing evidences from previous studies that adults with food insecurity consumed lower amounts of fruits, vegetables, and dairy products and also had lower dietary consumption of vitamins A and B-6, zinc, magnesium, and calcium. The present findings could be useful for the promulgation of better health policies, more planned studies, and future complementary analyses.

Ethical considerations

This study had obtained ethical approval from the ethical committee of University Putra Malaysia and the Alborz University of Medical Sciences. Every study selected for the systematic review is cited in all the study reports and study publications.

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Conflicts of interest

There are no conflicts of interest.

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