Malnutrition, low diet quality and its risk factors among older adults with low socio-economic status: a scoping review

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Abstract

Low socio-economic status (SES) is often associated with various health-related problems. Therefore, the present paper aims to review the available literature to identify the prevalence of malnutrition, prevalence of poor diet quality and its associated risk factors among older adults with low SES. A literature search was performed using four databases, namely PubMed, Google Scholar, Springer and Science Direct. The search terms used were 'diet quality', 'nutritional status', 'dietary intake', 'overweight', 'obesity', 'underweight', 'older people' and 'low socioeconomic status (SES)'. The overall prevalence of undernutrition among older adults with low SES worldwide was in the range of 28·9 to 48 %, while overnutrition was reported to be between 8·1 to 28·2 %. In Asia, the prevalence of undernourished older adults ranged from 3 to 64·9 %, while 2·5 to 32·8 % were overnourished. Most of the studies (60 %) included in the present review used BMI as the tool to identify malnutrition, but none of the nutritional screening tools were considered to be the 'gold standard'. For dietary assessment, FFQ and multiple 24 h dietary recall improved the estimation of individual dietary intake. Risk factors for poor diet quality included financial hardship, functional limitation, sex, place of residence, smoking and oral health. Poor nutritional status, especially lack of good-quality diet, and thinness are prevalent among older adults with low SES. Hence, it is important to establish nutrition-related programmes and intervention studies among this group of individuals for improving their health status and quality of life.

Key words: Malnutrition: Diet quality: Older adults: Low socio-economic status: Poverty

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Introduction

Population ageing is now becoming a phenomenon worldwide. The WHO Global Forum on Innovations for Ageing Populations has discussed the rapid growing of older populations especially in middle- and low-income countries. Over the next 40 years, it is expected that developing countries will be home to about 80 % of the population of older adults in the world[1]. With advances in healthcare treatment and accessibility, older adults nowadays can live longer, healthier and with enhanced functional fitness. The increasing life expectancy of older adults, with an average of 20·4 years for men and 17·8 years for women, further contributed to the booming of the baby boomer population[2]. In many federal programmes, older adults are considered as those who are aged 65 years and older. The UN defines elderly as those aged 60 years and older[3]. On the other hand, the United States Census Bureau defines older adults in a stratified system where those aged 65–74 years are considered as 'young old', 75–84 years as 'old' and 85 years or older as 'oldest old'[2].

Quality of life, health status and functional independence of older adults depend highly on their nutritional well-being. However, ageing-associated changes including physiological changes, chronic illness, chewing and swallowing difficulties, reduced energy expenditure and psychosocial problems can make it more difficult to meet nutritional needs[4]. However, the impact of these changes is definitely stronger for older adults who live in the most disadvantaged communities. The majority of the older adults with low socio-economic status (SES) are unemployed, have low education, lack of financial assistance, mostly reside in a rural area, have greater disabilities, have a higher risk of cognitive impairment and higher risk of malnutrition due to poor diet quality[5,6].

Diet quality is a concept which emphasises the totality of what an individual eats and drinks, examines patterns of healthy eating as a whole, with the aim to ensure permanent improvements in individual and population health[7]. Poor diet quality is characterised by limited consumption of fruits, vegetables, beans and whole grains as well as overconsumption of high-energy, low-nutrient-dense foods with added sugars[8]. Ageing itself may increase the risk of malnutrition due to the co-existence of several factors such as poor oral health, frailty, chronic disease, psychosocial problems and physical limitations which will gradually worsen body function[9]. However, older

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adults who are socio-economically disadvantaged would have higher risk of malnutrition due to a lack of availability of good-quality food. Therefore, this article reviews the prevalence of malnutrition and diet quality of older adults with low SES.

Methods

Search strategy

The search for published research papers related to nutritional status and diet quality of older adults with low SES was conducted using four databases including PubMed, Google Scholar, Springer and Science Direct for articles published from 2009 to 2019 by using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) method[10]. The review includes only cross-sectional studies. The terms used to search the related articles were 'diet quality', 'nutritional status', 'malnutrition', 'dietary intake', 'overweight', 'obesity', 'underweight', 'older people' and 'low socioeconomic status (SES)'. Since the study is a review article, ethics approval and informed consent were not required.

Inclusion criteria

Studies chosen for this review investigated the prevalence of malnutrition referring to either under- or over-nutrition, or prevalence of poor diet quality and its associated risk factors among older adults with low SES. The publication year of the studies chosen for the present review ranged between the years 2010 and 2019.

Exclusion criteria

Articles were excluded if not published in English and not focusing on older adults.

Study selection

The prime literature search was conducted by the authors. The duplicate articles were removed. A hand search was conducted to confirm that the duplicate articles were removed. Papers included for the present review were chosen based on the title and abstract followed by retrieval of the full article from the database. Relevant articles were downloaded and assessed for eligibility. Non-English language articles were excluded at this time point.

Data organisation and reporting

The final articles selected for the present review were read thoroughly and each article was summarised according to the country where the study was conducted, study design, population characteristic, sample size, tool used for malnutrition classification, and findings of the study. The studies were reported according to PRISMA guidelines[10]. Fig. 1 explains the processes involved in the searching of the articles to be included in the present review.

Results

Study selection

A total of 8208 records were identified through searching four electronic databases. About 3323 duplicates were removed and the screening was done to the remaining articles based on title. A total of fifty articles qualified for the full-text review. However, thirty-three articles had to be excluded from the review because five were not cross-sectional studies, fourteen did not focus on low-SES older adults, and fourteen studies were not related to diet quality or nutritional assessment. Thus, a total of seventeen studies were included in the final review, where seven articles measured the prevalence of malnutrition in older adults[11-17], seven measured diet quality and dietary assessment of older adults[18-24] and three articles assessed both components[5,25,26]. Seven of the studies were conducted in Asian countries: one in Indonesia[25], one in Lebanon[14], one in Nepal[15], two in India[16,24], one in Malaysia[5] and one in China[17]. Another ten studies were conducted in non-Asian countries: one in Texas, USA[11], one in Zambia[26], one in Brazil[12], one in New Zealand[13], two in the UK[18,21], one in Spain[19], one in the Netherlands[20], one in Greece[22] and one in the USA[23]. Nine studies had a sample size of less than 1000 individuals, six studies had a sample size between 1000 and 3000 individuals and another two had a sample size of >3000 individuals. As stated in the Methods section, the studies included in the present review had a cross-sectional study design. The duration of the included studies ranged from a minimum of 5 months to a maximum of 1 year.

Prevalence of malnutrition among older adults

A total of ten studies[5,11-17,25,26] measured the prevalence of malnourished older adults with low SES as shown in Table 1 and Table 2. Six studies used BMI as the criterion for malnutrition[5,11,12,16,17,26], two used the Mini Nutritional Assessment (MNA)[14,15], one used the Seniors in the Community: Risk Evaluation for Eating and Nutrition (SCREEN II)[13] and another one used several criteria including the MNA, Malnutrition Universal Screening Tool (MUST), Malnutrition Screening Tool (MST), Short Nutritional Assessment Questionnaire (SNAQ) and Geriatric Nutrition Risk Index[25].

Diet quality among older adults

A total of ten studies measured the diet quality and dietary assessment of older adults with low SES as shown in Table 3 and Table 4[5,18-26]. Among the studies, four studies used FFQ[18,20,22,26], three used 24 h dietary recall (24HR)[19,21,24], one used a diet history questionnaire[5] and another one used both FFQ and 24HR[25] to measure dietary assessment. All studies used different approaches to measure diet quality including variety and quantity of fruits and vegetables, Healthy Eating Index (HEI), Diet Diversity Score, Diet Quality Index, adherence to Dutch dietary guidelines and adherence to the Mediterranean diet. The heterogeneity in assessment methods used did not allow the data to be synthesised by meta-analysis. Besides that, the present review included studies which explored the risk factors of poor diet quality among low-SES older adults. A total of
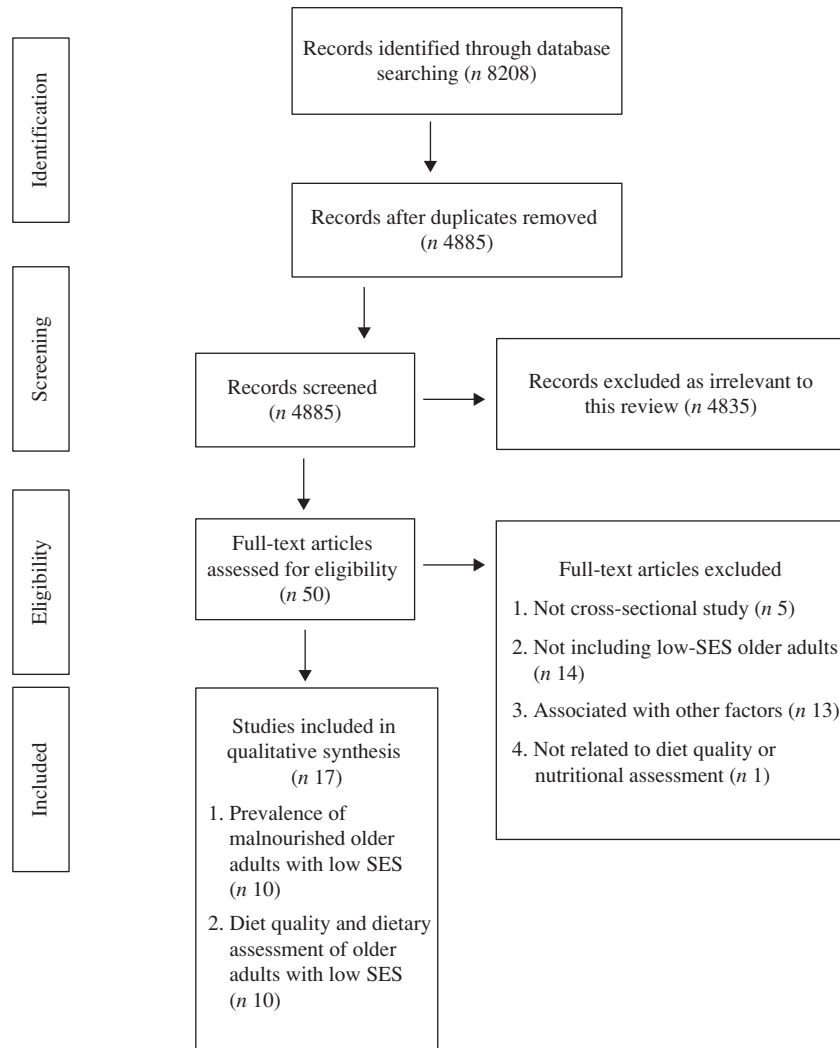
Fig. 1. Flowchart of search strategy and selection process. SES, socio-economic status.

eight studies reported the risk factors including financial hardship, functional limitation, sex, place of residence, smoking and oral health[5,18-23,25].

Discussion

Prevalence of malnourished older adults with low socio-economic status

Malnutrition is defined as the state of being over- or undernourished accompanied with physical and physiological changes[27]. Therefore, within the context of the present review, malnutrition can be referred to as both over- and undernutrition. As years have passed, the prevalence of malnutrition has shown an increment globally, specifically among older adults[28]. In this review, it was found that the prevalence of undernutrition or at risk of undernutrition among older adults with low SES in non-Asian countries was within the range of 28·9 to 48 % between the years 2010 and 2019[12,13,26]. Meanwhile, in Asia, the prevalence of undernourished low-SES older adults ranged from 3 to 64·9 % between the years 2010 and 2019[5,14-17,25]. Moreover, the

prevalence of overweight/obesity among older adults with low SES ranged from 8·1 to 28·2 % for non-Asian countries[11,12,26] and from 2·5 to 32·8 % in Asian countries[5,16]. The variation in the prevalence of malnutrition across the world may be due to the different criteria used to identify the presence of malnutrition and its risk.

A wide variety of nutritional screening and assessment tools has been developed. Accurate and earlier identification of malnutrition in older adults using structured assessment tools will allow planning of intervention strategies to overcome the problem at an early stage. A nutritional screening and assessment tool with high sensitivity will allow for accurate detection of those with nutritional problems and very few will go undetected, while a tool with high specificity will reduce the risk of overtreatment of malnutrition, especially in those who do not need it[29]. Most of the studies (60 %) included in the present review used BMI as the criterion to identify malnutrition[5,11,12,16,17,26]. BMI is one of the most common criteria used to identify malnutrition as it is considered a cheap, simple, quick and practical measure where the level of malnutrition risk is assigned according to descending BMI cut-off points[30]. However, variation of the BMI cut-off

Table 1. Prevalence of malnourished older adults with low socio-economic status in non-Asian countries

Study	Country	Method	Population/sample size	Tool for assessing malnutrition	Findings
Ahn et al. (2011)[11]	Texas, USA	Cross-sectional study	Elderly who were receiving or applying for Medicaid personal care services (disadvantaged in terms of being poor and having functional disability) with BMI ≥18·5 kg/m² (n 705)	BMI	28 % overweight, 50 % obese
Maila et al. (2019)[26]	Zambia	Cross-sectional study	Elderly aged ≥ 50 years from Luapula (second poorest province in Zambia) (n 135)	BMI	30·4 % underweight, 8·1 % overweight
Fares et al. (2012)[12]	Brazil	Cross-sectional study	Elderly from urban António Carlos (good health indicators and QoL, with a high HDI) and rural Lafaiete Coutinho (poor with one of the worst HDI) (n 793)	BMI	Rural: 28·2 % overweight; 28·9 % underweight Urban: 52·8 % overweight; 8·2 % underweight
Wham et al. (2015)[13]	New Zealand	Cross-sectional study	Maori aged between 80 and 90 years and non-Maori aged 85 years (n 655)	SCREEN II	48 % of Maori participants and 37 % non-Maori participants with low income (pension only income) have high nutrition risk (undernourished)

QoL, quality of life; HDI, Human Development Index; SCREEN, Seniors in the Community: Risk Evaluation for Eating and Nutrition.

points used in the studies from 18·5 kg/m² to 23 kg/m² may affect the sensitivity and specificity of the tool in identifying malnutrition risk depending on the target group's characteristics[30]. The study by Arjuna et al.[25] used a variety of screening tools to identify malnutrition among older adults including the MNA, Malnutrition Universal Screening Tool (MUST), Malnutrition Screening Tool (MST), SNAQ and Geriatric Nutritional Risk Index. Most assessment tools found that older adults in rural areas had poorer nutritional status compared with those in urban areas, except for SNAQ which identified that nutritional status was better for rural compared with urban older adults. A closer look at each item of the SNAQ questionnaire revealed that more of the study participants from the urban areas reported losing more than 6 kg, which gave them 2 points and classified them as moderately malnourished[25]. It must be noted that none of the nutritional screening tools is considered to be the 'gold standard' and there might be inconsistency in the accuracy of these screening tools depending on the setting in which they were validated and are used now[30].

Diet quality and dietary assessment of older adults with low socio-economic status

A total of 44·4 % of the studies included in the present review used FFQ[18,20,22,26], 33·3 % of the studies[19,21,24] used 24HR to obtain dietary assessment, 11·1 % used diet history questionnaires[5] and another 11·1 % used both FFQ and 24HR[25]. Subjective dietary assessment methods that can be used to assess an individual's intake may include 24HR, dietary records, dietary history and FFQ[31]. The 24HR are open-ended questionnaires used to collect a variety of detailed information regarding food consumption over the previous 24 h. Compared with other methods, 24HR give more detailed intake data and give minimal burden to the subjects, as literacy not required. However, 24HR mainly focus on short-term intake. Thus, multiple 24HR are needed to measure average intake. On the other hand, a FFQ is a checklist form used to assess how often and how much food subjects eat over a specific duration. A FFQ allows the assessment of long-term dietary intakes in a simple, time-efficient and cost-effective way[31]. Both methods have a possibility of recall bias as all information depends on the subjects' memory. However, the burden of memory loss for 24HR method may be less as compared with FFQ, especially among older adults, because FFQ require subjects to recall their food intake over a long period of time (1 year ago). Nevertheless, it must be noted that dietary intake is difficult to assess and no single method is able to assess dietary intake perfectly. Therefore, it has been suggested that combining methods such as FFQ with 24HR should be considered to obtain more accurate estimation of dietary intakes as compared with an individual method[32]. A recent study by Freedman et al.[33] also agreed that the combination of FFQ with multiple 24HR modestly improves the accuracy of estimation of individual intakes.

All the studies included in the present review used different types of approaches to assess the diet quality of older adults. Most of the studies (71·4 %) used diet quality indices such as the HEI, Diet Diversity Score, Diet Quality Index, Mediterranean Diet Score and guidelines such as the Dutch

Table 2. Prevalence of malnourished older adults with low socio-economic status (SES) in Asia

Study	Country	Method	Population/sample size	Criteria for malnutrition	Findings
Arjuna *et al.* (2017)[25]	Indonesia	Cross-sectional study	Older adults living in rural or urban areas of Yogyakarta aged 65–102 years (*n* 527)	MNA ≤17 (malnourished)	Rural: 3 % malnourished Urban: 6 % malnourished
				MUST (2, high risk of malnutrition)	Rural: 32 % high risk Urban: 18 % high risk
				MST ≥2 (risk of malnutrition)	Rural: 33 % at risk Urban: 18 % at risk
				SNAQ (≥2, moderately malnourished; ≥3, severely malnourished)	Rural: 5 % (moderate); 3 % (severe) Urban: 12 % (moderate); 8 % (severe)
				GNRI (<82, major risk of malnutrition; 82–91, moderate risk; 92–98, low risk)	Rural: 3 % (major); 22 % (moderate); 35 % (low) Urban: 2 % (major); 12 % (moderate); 21 % (low)
Boulos *et al.* (2016)[14]	Lebanon	Cross-sectional study	Community-dwelling rural Lebanese elderly aged ≥65 years (*n* 1200)	MNA	8 % malnourished and 29·1 % at risk of malnutrition (undernourished)
Ghimire *et al.* (2017)[15]	Nepal	Cross-sectional study	Elderly aged ≤60 years and permanent residents of Okharpauwa, a remote hilly village in Nuwakot District (poverty rates are higher in rural areas of Nepal) (*n* 242)	MNA	64·9 % at risk of malnutrition, 24 % malnourished (undernourished)
Selvamani & Singh (2018)[16]	India	Cross-sectional study	Elderly aged ≥50 years in India (*n* 6372)	BMI	For elderly with lowest wealth quartile, 56·1 % underweight, 2·5 % overweight and 1·1 % obese
Shahar *et al.* (2019)[5]	Malaysia	Cross-sectional study	Elderly aged ≥60 years and Malaysian citizens (*n* 2237)	BMI	For elderly with low SES, 45·7 % underweight and 32·8 % overweight
Liu *et al.* (2018)[17]	China	Cross-sectional study	Elderly aged ≥75 years and participants of CNHS (*n* 2552)	BMI	For elderly with low income level, 12·7 % undernourished

MNA, Mini Nutritional Assessment; MUST, Malnutrition Universal Screening Tool; MST, Malnutrition Screening Tool; SNAQ, Short Nutritional Assessment Questionnaire; GNRI, Geriatric Nutritional Risk Index; CNHS, Chinese Nutrition and Health Surveillance.

Malnutrition and diet quality in older adults

Table 3. Diet quality and dietary assessment of older adults with low socio-economic status (SES) in non-Asian countries

Study	Country	Method	Population/sample size	Diet quality and dietary assessment	Component	Findings
Conklin et al. (2014)[18]	UK	Cross-sectional study	Elderly aged 50–79 years in the nationally representative EPIC study cohort (n 9580)	FFQ	Quantity = total amount of fruits, vegetables and both. Variety = sum of the total number of unique items consumed, irrespective of quantity	Quantity of fruits and vegetables shows no consistent differences by any economic factor, except education in men. Lower education, lower social class and renting were associated with lower fruit variety and vegetable variety
Francis-Granderson & Pemberton (2010)[19]	Spain	Cross-sectional study	Low-income elderly aged 65–103 years enrolled with the Ministry of Social Development (n 300)	24 h diet recall HEI		83·3 % had HEI score 51–80 (need for diet improvement), 9·0 % scored ≥80 (good diet), while 6·3 % scored ≤50 (poor diet)
Dijkstra et al. (2014)[20]	The Netherlands	Cross-sectional study	Community-dwelling older adults, aged 55–85 years (n 1057)	FFQ Adherence to the Dutch dietary guidelines	Fruit, vegetable and fish intake	82·5 % reported adhering to the fruit guideline, 65·1 % to the vegetables guideline and 31·7 % to the fish guideline. The lowest education group adhered less often to the vegetables guideline. The lowest income group adhered less often to the fruit and fish guidelines
Maila et al. (2019)[26]	Zambia	Cross-sectional study	Elderly aged ≥ 50 years from Luapula (second poorest province in Zambia) (n 135)	FFQ DDS		64·4 % of the subjects had DDS below the mean value (low dietary diversity) while 35·6 % had scores above the mean value
Holmes & Roberts (2011)[21]	UK	Cross-sectional study	Elderly aged ≥65 years from the UK Low Income Diet and Nutrition Survey (a national survey of materially deprived individuals in the UK) (n 662)	24 h diet recall DQI		Based on DQI score, 26·1 % women had the poorest diet quality and 27·9 % of men had the poorest diet quality
Katsarou et al. (2010)[22]	Greece	Cross-sectional study	Elderly aged ≥65 years from Mitilini, Samothraki, Cephalonia, Crete, Corfu, Lemnos and Zakynthos islands (n 1129)	59-item SQFFQ Mediterranean Diet Score	Adherence to the Mediterranean diet	The lowest SES was associated with a lower Mediterranean Diet Score. A significant positive association was found between Mediterranean Diet Score and years of school and financial status
Chang & Hickman (2017)[23]	USA	Cross-sectional study	Elderly aged ≥65 years with household incomes ≤130 % of the federal poverty level (n 1323)	Food insecurity. Perceived poor-quality diet (1 = poor/fair, 0 = good/very good/ excellent)		17·2 % have food insecurity, 6·7 % have very low food security and 19·9 % have poor diet quality

EPIC, European Prospective Investigation in Cancer and Nutrition; HEI, Healthy Eating Index; DDS, Diet Diversity Score; DQI, Diet Quality Index; SQFFQ, semi-quantitative FFQ.

Table 4. Diet quality and dietary assessment of older adults with low socio-economic status (SES) in Asia

Study	Country	Method	Population/sample size	Diet quality and dietary assessment	Component	Findings
Arjuna et al. (2017)[25]	Indonesia	Cross-sectional study	Older adults living in rural or urban areas of Yogyakarta aged 65–102 years (n 527)	SQFFQ 24 h diet recall	Energy, macro- (protein, fat, carbohydrate) and micronutrients	Rural residents had lower intakes of protein, sugar, fibre, MUFA, vitamin C, pantothenic acid, niacin, K, Ca, P, Zn and higher intakes of Na compared with urban residents
Rajhans and Sharma (2011)[24]	India	Cross-sectional study	Elderly aged 60–80 years in Nangpur City (n 200)	24 h diet recall Dietary intake compared with RDA for adult Indians		Mean energy intake was higher in 60–70 years than in 70–80 years of age. Energy intake among elderly with low income had no significant difference as compared with those with high income
Shahar et al. (2019)[5]	Malaysia	Cross-sectional study	Elderly aged ≥60 years and Malaysian citizens (n 2237)	Diet history questionnaire	Macronutrient (protein, fat, carbohydrate), fibre and micronutrient intake and energy restriction	In urban areas, elderly with low SES had low dietary fibre and protein intake and less frequent practice of energy restriction. In rural areas, elderly with low SES had lack of dietary fibre and fruit intake

SQFFQ, semi-quantitative FFQ.

dietary guidelines to measure diet quality. The study by Conklin et al.[18] used quantity and variation of fruits and vegetables as a measure of diet quality whereas Chang & Hickman[23] focused on food insecurity and perceived poor diet quality. Perceived poor diet quality in the Chang & Hickman study[23] was assessed based on the diet behaviour and nutrition component of the National Health and Nutrition Examination Survey (NHANES) questionnaire where the question is 'In general, how healthy is your overall diet?'. Perceived poor-quality diet was determined and coded as 1 if the subjects answered poor or fair and 0 if replied good, very good or excellent. Even the consistency of this perception-based approach might be debatable as a measure of diet quality; the wide heterogeneity in dietary requirements associated with ageing and functional decline make it hard to assess the subjects' diet quality on an index-based metric[23]. Diet quality indices are mathematical algorithms which aim to quantify the extent to which real food and nutrient intake adhere to the reference intake values recommended in national dietary guidelines, or at analysing dietary patterns in the population and weighing those components whose consumption has been linked, in scientific studies, either to the appearance of the disease or to the preservation of an optimal state of health[34]. The Diet Quality Index, Healthy Diet Indicator and Mediterranean Diet Score are three internationally recognised diet indices[35]. Diet quality indices were developed based on the target group for which they were intended to be used. Different age and sex groups have different requirements due to differences in food preferences and physiological needs. However, there are diet quality indices that have been developed for a wide population group, such as HEI-2010[36]. Furthermore, there are also country-specific indices which have been developed based on native food-based dietary guidelines that are tailored to a country's specific disease profile and food habits. These diet quality indices have been important indicators for within-country comparison[37].

The present review supports the existence of an association between poor diet quality and low SES among older adults. The majority of the studies (90 %) included in the present review reported that older adults with low SES had poor diet quality, with the exception of one study by Rajhans & Sharma[24], which reported no association. The study by Rajhans & Sharma[24] found an insignificant association between income and energy intake. Instead, the study only found an association between energy intake and age where mean energy intake was higher in those aged 60–70 years than in those of 70–80 years of age[24]. Several studies have reported a positive association between low income and poor diet quality score[19,21,26], lower fruit and vegetable variety[18], lower adherence to the fruit and fish guidelines[20], food insecurity and perceived poor diet quality[23] and lower adherence to the Mediterranean diet[22]. The study by Francis-Granderson & Pemberton[19], which used the HEI as the tool for diet quality assessment, found that 6·3 % of low-income older adults have poor diet quality and the majority of subjects (83·3 %) needed dietary improvement. Another study using the Diet Diversity Score that was conducted among older adults in a poor province in Zambia found that most of the subjects (64·4 %) had low dietary diversity, which indicated lack of accessibility to a wide variety of food[26].

Risk factors of poor diet quality among older adults with low socio-economic status

With an increasing interest in understanding the association between poor diet quality among older adults with low SES, eight of the studies included in the present review investigated the risk factors contributing to the relationship[5,18-23,25]. The most important risk factor of poor diet quality especially among older adults with low SES is financial hardship and four studies found this to be a risk factor[5,18,20,25]. Conklin et al.[18] reported significant differences in mean fruit and vegetable variety intake among subjects with different levels of financial hardship (FH), whereby the group with the highest financial hardship reported the least variation of fruit and vegetable intake. In addition, Arjuna et al.[25] also reported that intakes of protein, fibre, vitamins and minerals were positively correlated with level of income and education. This is consistent with the findings from the study by Dijkstra et al. (2014)[20] where lower income levels were independently associated with lower adherence to fruit and fish guidelines. These differences might be explained by the fact that fruit and fish as well as a healthy diet, such as nuts, legumes and seeds, may be perceived as being expensive as compared with a less healthy diet[38,39].

Apart from income, the risk factors identified in the present review affecting poor diet quality among older adults with low SES are sex, geographical area, transportation availability and living status. Francis-Granderson & Pemberton[19] found that one of the strongest predictors of HEI score was sex. Older men had better HEI scores compared with females. This may be associated with the cultural socialisation of males in society where males are better provided for or taken care of by their female partners[19]. Another identified risk factor was geographical location or place of residence. Katsarou et al.[22] found a significant association between place of residence and the Mediterranean Diet Score. The study found that individuals residing in rural areas adhered more closely to the traditional Mediterranean dietary pattern as compared with those living in urban areas. On the other hand, Shahar et al.[5] found that there was lower fruit intake by older individuals staying in rural areas in Malaysia. Location of residence is indeed an important factor affecting the eating pattern of an individual, especially those residing in rural areas that lack accessibility to various foods due to fewer supermarkets and large grocery stores. Rural areas were found to be only equipped with small stalls with limited food choices and this narrowed the purchasing choices of fruits by older adults[5]. Besides that, lack of transport to purchase food and a far distance of the shops from home may contribute to poor diet quality among older adults with low SES, especially for those living alone or with their spouse[40]. An 'empty nest' is very prevalent among older adults, especially those with low SES as their children migrate to cities for to seek job opportunities[41].

Poor diet quality among older adults with low SES is also related to functional limitations. Chang & Hickman[23] reported that functional limitation was positively associated with the likelihood of food insecurity, increasing the odds by 75 %. Functional limitations in low-income older adults were associated with 65 % higher odds of perceived poor-quality diet due to the physical barrier in accessing and preparing healthy foods[23]. This condition was further worsened by economic hardship due to meagre earnings and chronic healthcare burden associated with disability. Besides that, living arrangements may contribute to the perceived poor diet quality among older adults[23]. It was found that living with a non-partner adult was associated with 67 % higher odds of perceived poor diet quality as compared with those living with a partner. Furthermore, for older adults who lived with their partner, the association of physical functionality with food insecurity and perceived diet quality was much weaker. Spouses had a crucial role in ensuring healthy food preparation for older adults with functional impairment. Lack of spousal support may contribute to increased complexity of adaptation to the food environment for older adults with functional limitation.

Another risk factor of poor diet quality among older adults with low SES is smoking. Holmes & Roberts (2011)[21] reported that being a current smoker was an independent predictor of poor diet quality. Holmes & Roberts[21] demonstrated that older adults who smoked consumed less fruit and vegetables and more white bread and processed meats as compared with non-smokers[21]. Smokers had lower intakes of vitamin C, folate, K, Mg, Fe and iodine. In agreement with this, Katsarou et al.[22] found smoking to be associated with Mediterranean Diet Score. Older adults with a current smoking habit were found to have poor adherence to the traditional Mediterranean diet.

Besides that, Holmes & Roberts[21] also found that having difficulty in chewing was another independent predictor of poor diet quality. Older adults who had chewing difficulties consumed significantly lower amounts of vegetables, meat or meat dishes and wholemeal bread, and thus had lower intakes of protein, folate and K. Poor dentition is indeed a main problem affecting the dietary intake of older adults. Modification in food preparation such as preparing a soft diet, cutting the vegetables and meat in smaller pieces, cooking the meat till soft, and dipping bread in beverages are strategies which can be implemented by older adults or their caregivers to improve dietary intake. Other studies not included in the review also reported that oral-related problems including gum diseases, tooth decay, dentures, infection and chewing problems might interfere with fruit intake[42,43].

Strengths and limitations

The present review is a current analysis of the prevalence of malnutrition, poor diet quality and its associated risk factors among older adults with low SES which included studies from 2009 to 2019, comprising the current publications regarding 'malnutrition' and 'diet quality'. However, limitations were that the studies included in the review are observational studies where all studies are cross-sectional and cannot be used to imply causality. Moreover, this review only included articles that were published in English and thus could have missed other research related to the review that was published in other languages.

Conclusion

In summary, the review found that the prevalence of malnutrition among older adults with low SES varied between Asian

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and non-Asian countries due to the differences in the assessment tool used for screening malnutrition. The prevalence range among low-SES older adults in Asian countries ranged from as low as 3 % to as high as 64·9 %, while in the non-Asian countries, prevalence was between 28·9 and 48·0 %. In addition to this, a total of 90 % of the studies included in this review demonstrated that older adults with low SES had poor diet quality. Several risk factors have been found to be associated with poor diet quality among older adults with low SES including sex, place of residence, functional limitations, living arrangements, smoking and oral health. Thus, it is important to establish nutrition-related programmes targeting low-SES individuals for educating them on dietary choices, appropriate portion size and food modification. Government policies should implement several strategies to improve the quality of life of poor older adults such as monthly subsidies for food, providing free healthy food, free meals for disabled or older adults living alone and providing weekly transport for those residing in rural areas to purchase food from wholesale markets.

Acknowledgements

References

1. World Health Organization Centre for Health Development (2014) *Report: WHO Global Forum on Innovations for Ageing Populations*. 10–12 December 2013 Kobe, Japan. https://extranet.who.int/kobe_centre/sites/default/files/GFIAP_report_0.pdf (accessed July 2020).

2. Wellman NS & Kamp BJ (2016) Nutrition in aging. In *Krause's Food & the Nutrition Care Process*, 14th ed., pp. 367–381 [LK Mahan and JL Raymond, editors]. St Louis, MO: Saunders.

3. United Nations Department of Economic and Social Affairs (2015) *World Population Ageing 2015*. New York: United Nations.

4. Leslie W & Hankey C (2015) Aging, nutritional status and health. *Healthcare (Basel)* **3**, 648–658.

5. Shahar S, Vanoh D, Mat Ludin AF, *et al.* (2019) Factors associated with poor socio-economic status among Malaysian older adults: an analysis according to urban and rural settings. *BMC Public Health* **19**, Suppl., 549.

6. Donini LM, Poggiogalle E, Piredda M, *et al.* (2013) Anorexia and eating patterns in the elderly. *PLOS ONE* **8**, e63539.

7. Hiza HAB, Koegel KL & Pannucci TRE (2018) Diet quality: the key to healthy eating. *J Acad Nutr Diet* **118**, 1583–1585.

8. Pascual RW, Phelan S, La Frano MR, *et al.* (2019) Diet quality and micronutrient intake among long-term weight loss maintainers. *Nutrients* **11**, 3046.

9. Fávaro-Moreira NC, Krausch-Hofmann S, Matthys C, *et al.* (2016) Risk factors for malnutrition in older adults: a systematic review of the literature based on longitudinal data. *Adv Nutr* **7**, 507–522.

10. Moher D, Liberati A, Tetzlaff J, *et al.* (2009) Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. *Ann Intern Med* **151**, 264–269.

11. Ahn S, Huber C, Smith ML, *et al.* (2011) Predictors of body mass index among low-income community-dwelling older adults. *J Health Care Poor Underserved* **22**, 1190–1204.

12. Fares D, Barbosa AR, Borgatto AF, *et al.* (2012) Factors associated with nutritional status of the elderly in two regions of Brazil. *Rev Assoc Med Bras* **58**, 434–441.

13. Wham CA, Teh R, Moyes S, *et al.* (2015) Health and social factors associated with nutrition risk: results from life and living in advanced age: a cohort study in New Zealand. *J Nutr Health Aging* **19**, 637–645.

14. Boulos C, Salameh P & Barberger-Gateau P (2016) Malnutrition and frailty in community dwelling older adults living in a rural setting. *Clin Nutr* **35**, 138–143.

15. Ghimire S, Baral BK & Callahan K (2017) Nutritional assessment of community-dwelling older adults in rural Nepal. *PLOS ONE* **12**, e0172052.

16. Selvamani Y & Singh P (2018) Socioeconomic patterns of underweight and its association with self-rated health, cognition and quality of life among older adults in India. *PLOS ONE* **13**, e0193979.

17. Liu Z, Pang SJ, Man QQ, *et al.* (2018) Prevalence of undernutrition and related dietary factors among people aged 75 years or older in China during 2010–2012. *Biomed Environ Sci* **31**, 425–437.

18. Conklin AI, Forouhi NG, Suhrcke M, *et al.* (2014) Variety more than quantity of fruit and vegetable intake varies by socioeconomic status and financial hardship. Findings from older adults in the EPIC cohort. *Appetite* **6**, 73–77.

19. Francis-Granderson I & Pemberton C (2010) Factors influencing nutritional status of rural low income elderly in Trinidad. In *28th West Indies Agricultural Economics Conference/2009 Barbados National Agricultural Conference*, July 2019, no. 529–2016–38277. Barbados: Caribbean Agro-Economic Society.

20. Dijkstra SC, Neter JE, Brouwer IE, *et al.* (2014) Adherence to the dietary guidelines for fruit, vegetables and fish among older Dutch adults; the role of education, income and job prestige. *J Nutr Health Aging* **18**, 115–121.

21. Holmes BA & Roberts CL (2011) Diet quality and the influence of social and physical factors on food consumption and nutrient intake in materially deprived older people. *Eur J Clin Nutr* **65**, 538–545.

22. Katsarou A, Tyrovolas S, Psaltopoulou T, *et al.* (2010) Socioeconomic status, place of residence and dietary habits among the elderly: the Mediterranean Islands Study. *Public Health Nutr* **13**, 1614–1621.

23. Chang Y & Hickman H (2017) Food insecurity and perceived diet quality among low-income older Americans with functional limitations. *J Nutr Educ Behav* **50**, 476–484.

24. Rajhans K & Sharma R (2011) Relationship between socioeconomic status and energy intake of elderly from Central India. *J Indian Acad Geriatr* **7**, 167–174.

25. Arjuna T, Soenen S, Hasnawati RA, *et al.* (2017) A cross-sectional study of nutrient intake and health status among older adults in Yogyakarta, Indonesia. *Nutrients* **9**, 1240.

26. Maila G, Audain K, Marinda PA, *et al.* (2019) Association between dietary diversity, health and nutritional status of older persons in rural Zambia. *South Afr J Clin Nutr* **2019**, 1641271.

27. Shakersain B, Santoni G, Faxen-Irving G, *et al.* (2016) Nutritional status and survival among old adults: an 11-year population-based longitudinal study. *Eur J Clin Nutr* **70**, 320–325.

28. Chern CJH & Lee SD (2015) Malnutrition in hospitalized Asian seniors: an issue that calls for action. *J Clin Gerontol Geriatr* **6**, 73–77.

29. Sakinah H & Tan SL (2012) Validity of a local nutritional screening tool in hospitalized Malaysian elderly patients. *J Environ Health* **3**, 59–65.

30. Ng WL, Collins PF, Hickling DF, *et al.* (2018) Evaluating the concurrent validity of body mass index (BMI) in the identification of malnutrition in older hospital inpatients. *Clin Nutr* **38**, 2417–2422.

31. Shim JS, Oh K & Kim HC (2014) Dietary assessment methods in epidemiologic studies. *Epidemiol Health* **36**, e2014009.

32. Carroll RJ, Midthune D, Subar AF, *et al.* (2012) Taking advantage of the strengths of 2 different dietary assessment instruments to improve intake estimates for nutritional epidemiology. *Am J Epidemiol* **175**, 340–347.

33. Freedman LS, Midthune D, Arab L, *et al.* (2018) Practice of epidemiology combining a food frequency questionnaire with 24-hour recalls to increase the precision of estimation of usual dietary intakes – evidence from the Validation Studies Pooling Project. *Am J Epidemiol* **187**, 2227–2232.

34. Gil Á, Martinez De Victoria E, Olza J, *et al.* (2015) Indicators for the evaluation of diet quality. *Nutr Hosp* **31**, 128–144.

35. Guerrero MLP & Pérez-Rodríguez F (2017) Diet quality indices for nutrition assessment: types and applications. In *Functional Food: Improve Health Through Adequate Food*, pp. 283–308 [MC Hueda, editor]. Croatia: IntechOpen.

36. Guenther PM, Casavale KO, Reedy J, *et al.* (2013) Update of the Healthy Eating Index: HEI-2010. *J Acad Nutr Diet* **113**, 569–580.

37. Trijsburg L, Talsma EF, De Vries JHM, *et al.* (2019) Diet quality indices for research in low- and middle-income countries: a systematic review. *Nutr Rev* **77**, 515–540.

38. Blakely T, Mhurchu CN, Jiang Y, *et al.* (2011) Do effects of price discounts and nutrition education on food purchases vary by ethnicity, income and education? Results from a randomised, controlled trial. *J Epidemiol Community Health* **65**, 902–908.

39. Waterlander WE, De Haas WE, Van Amstel I, *et al.* (2010) Energy density, energy costs and income – how are they related? *Public Health Nutr* **13**, 1599–1608.

40. Wunderlich S, Brusca J, Johnson-Austin M, *et al.* (2012) Eating behaviors of older adults participating in government-sponsored programs with different demographic backgrounds. *Global J Health Sci* **4**, 204–215.

41. Chen D, Yang X & Aagard SD (2012) The empty nest syndrome: ways to enhance quality of life. *Educ Gerontol* **38**, 520–529.

42. Hafizah II, Zahara AM, Noramilin S, *et al.* (2016) Association of fruit and vegetable consumption with mild cognitive impairment among older persons living in low-cost residential areas in Kuala Lumpur. *Malays J Nutr* **21**, 335–344.

43. Nicklett EJ & Kadell AR (2013) Fruit and vegetable intake among older adults: a scoping review. *Maturitas* **75**, 305–312.