

## SYSTEMATIC REVIEW

# Prevalence and Factors Associated with Geriatric Malnutrition in Healthcare Institutions: A Systematic Review

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## ABSTRACT

**Aim and Design:** The world's population is ageing. Not only it changes the body composition, but ageing also causes psychological, pathological and economic alterations. These may impact an individual's quality of life and nutritional status. Thus, this systematic review article aims to review the prevalence of geriatric malnutrition in healthcare institutions and its associated factors. **Data Sources:** The articles are screened and reviewed based on their titles, abstracts and keywords. English written articles, open-accessed and published between January 2009 and December 2019 are then selected. **Review Methods:** The PRISMA method is used for this study. Potential studies related to geriatric malnutrition in healthcare institutions were identified using two different combinations and two major electronic search engines, namely Pubmed and Science Direct. **Results:** From a search of 1011 articles, 22 articles were identified related to geriatric malnutrition in healthcare institutions. Globally, it is found that the prevalence of malnourished elderly patients ranged between 6% – 74.5%. The factors associated with malnutrition among the elderly in the healthcare institutions were recognised, namely socio-demography, medical background, anthropometry data, biochemical data, nutrition-focus physical findings, and dietary inadequacy. **Conclusion and Impact:** Despite the studies done, geriatric malnutrition is still a matter of concern. Hence, future strategies for interventions need to be taken to aid in overcoming this issue otherwise affecting the health status and life expectancy of the elderly.

**Keywords:** Geriatric malnutrition, Elderly, Undernutrition, Risk factors, Systematic review

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## INTRODUCTION

The term 'elderly' is defined as individuals of  $\geq 65$  years of age (1). However, some countries distinctively agreed that old age refers to the year when an individual receives his or her pension benefits. Thus, the United Nations have agreed on a cut off point for an elderly to be set at the age of  $\geq 60$  years (2). According to the National Health Morbidity Survey (NHMS) (2018), the elderly in Malaysia starts at the age of  $\geq 60$  years (3). Globally, the proportion of elderly was reported to be approximately 703 million, with Eastern and South-Eastern Asia having the highest proportion (260 million) (4). Surprisingly, the global elderly population was expected to elevate up to 1.5 billion in the next three decades. Meanwhile, the proportion of elderly in Malaysia was reported at 9.9% (3.3 million of 32.4 million total population) (3).

According to the World Health Organization, in community settings, only the global prevalence of

elderly malnutrition were reported to be at the range of 1.3 – 47.8% (5). Clinically, it was found that the worldwide prevalence of hospitalised elderly patients ranged between 12% - 75% (6). The prevalence was later classified into four categories of a different venue. Namely rehabilitation settings (50.5%), hospitals (38.7%), nursing homes (13.8%) and the community (5.8%) (7).

Geriatric malnutrition is often related to prolonged hospital stays, functional impairment, increase in infection rate, as well as morbidity and mortality rate (7,8). Furthermore, it was reported that one-fourth of geriatric patients who were at risk of malnutrition did not receive nutrition support or counselling needed, although they had contact with health care professionals (9).

Despite the various studies and approach done in aid of overcoming geriatric malnutrition, the prevalence remains excessively high. Therefore, this systematic review aims to identify the prevalence and factors associated with geriatric malnutrition in healthcare institutions to help other health care professionals to overcome malnutrition among geriatric patients.

## METHODS

### Search strategy

The Preferred Reporting Items for Systematic and Meta-Analyses (PRISMA) Statement Protocol was used to develop this systematic review as shown in Fig. 1 (10). The electronic search engines used were Pubmed and Science Direct to identify the potential studies related to geriatric malnutrition in healthcare institutions. The search string consisted of keywords describing older people, elderly, geriatric, nutritional status, risk factors and geriatric malnutrition.

### Selection of studies

All papers written in English and published between 2009 and 2019 were evaluated for inclusion if they presented data about geriatric malnutrition. After removing duplicates of all records received, the titles and abstracts were then screened for discrepancies. In a second selection step, the full-text articles were screened for their eligibility. To be included in the review, the study must follow the following criteria:

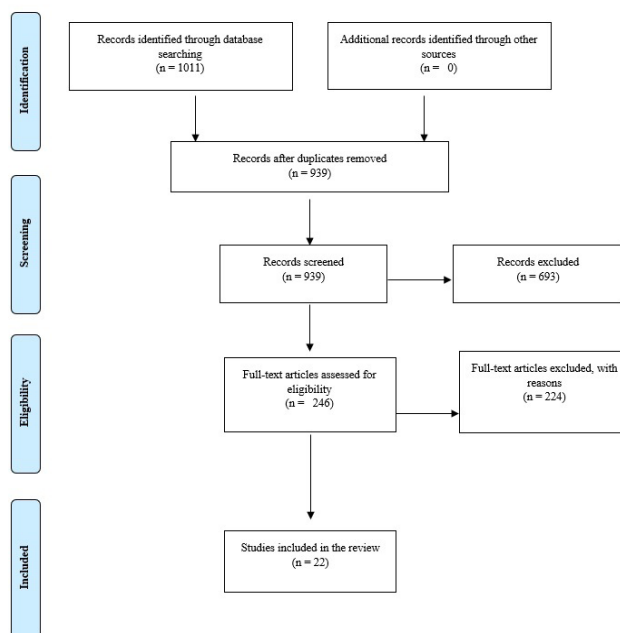
### Selection criteria

- 1) Article focus: Articles that focused on nutritional status (malnutrition) of geriatric patients living in healthcare institutions (hospitalised, patients in outpatient setting, rehabilitation facilities and nursing homes) were included.
- 2) Malnutrition screening tool: Articles that used established screening tools for elderly [Mini Nutritional Assessment (MNA) and its shorter version: the Mini Nutritional Assessment Screening Form (MNA-SF), Subjective Global Assessment (SGA), Patient-Generated Subjective Global Assessment (PG-SGA), Nutrition Risk Screening (NRS-2002), Geriatric Nutrition Risk Index (GNRI), Short Nutrition Assessment Questionnaire (SNAQ) and Nutrition Screening Initiative Checklist (NSI)] were included.
- 3) Type of studies: Studies eligible to be included if they were observational studies including cohort, case-control, cross-sectional, prospective and retrospective studies.
- 4) Publication year: Articles published between the year 2009 and 2019 were included in this study.
- 5) Article access type: Only open access articles were eligible to be put in this study.
- 6) Language: Articles written in English were included.

Articles that did not fit into any of the criteria stated were excluded from this review.

### Data extraction

Information such as authors, year of publication, country, the purpose of the study, study design, number of respondents, data collection setting, tools used to assess malnutrition, the prevalence of malnutrition and at risk of malnutrition as well as factors associated with malnutrition were extracted and summarised in Table I.



**Figure 1: PRISMA flow chart illustrating the selection process of articles for the review**

## RESULTS

The identification step retrieved 1,011 publications using the search engines mentioned and two different combination keywords. Unrelated studies and duplicates were removed, leaving 246 publications to be reviewed for eligibility for inclusion review. Finally, 22 articles that met the inclusion and exclusion criteria were summarised and tabulated in Fig. 1.

According to Table I, the prevalence of malnourished elderly patients in healthcare institutions is 9% - 74.5% among patients admitted in hospitals, 6% - 19% among outpatients, 7.3% - 28% in rehabilitation settings and 36% - 49.1% in nursing homes.

Nutritional status among geriatric patients in the selected studies was assessed using established screening tools as mentioned in selection criteria earlier. Based on the findings in Table I, it appears that MNA is commonly practised among healthcare practitioners. The tool comprises of geriatric-related assessment questions that focus on both nutritional and health conditions of geriatric patients (8). These include anthropometry measurement, dietary intake, subjective and global assessments for the past three months. MNA's quick screening has allowed health professionals to identify the elderly's nutritional status based on the individual's living condition, meal patterns and medical conditions (11). The limitation of this tool is that it could be lengthy for the patients to answer.

Meanwhile, the SGA nutritional status is graded based on the patient's weight loss, changes in dietary intake, presence of gastrointestinal tract symptoms, physical

**Table 1: Summary of prevalence and factors associated with geriatric malnutrition in healthcare institutions.**

Author, Year, Origin	Study characteristics	Tools to assess malnutrition	Prevalence of malnutrition &/or at risk of malnutrition (%)	Factors associated with malnutrition
Alzahrani & Alamri (2017)(7) Saudi Arabia	Design: Cross-sectional Setting: King Abdul Aziz University Hospital Subjects: 248 Age: ≥ 60 years	MNA-SF	Malnutrition: 29.0 At risk: 47.6	Living alone Low calf circumference (< 31 cm) Hypalbuminaemia Anaemia Low total lymphocyte count (TLC) Presence of comorbidities Inadequate calorie intake Immobile
Marshall, Young, Bauer & Iserning (2016)(13) Australia	Design: Cross-sectional Setting: Public rehabilitation centres in New South Wales, Australia Subjects: 57 Age: ≥ 65 years	MNA and PG-SGA	MNA Malnutrition: 28.1 At risk: 57.9  PG-SGA Malnutrition: 26.3 At risk: 26.3	Longer hospital stays
Saeidlou & Merdol (2011)(19) Iran	Design: Cross-sectional Setting: Nursing homes in Urmia, Iran Subjects: 106 Age: > 65 years	MNA-FF	Malnutrition: 49.06 At risk: 38.68	Female Smoking Lack of education Inadequate income Living alone Having psychological problems
Gündüz et al. (2015)(21) Turkey	Design: Cross-sectional Setting: Geriatric outpatient clinics Subjects: 1030 Age: ≥ 65 years	MNA-FF	Malnutrition: 19.0 At risk: 29.1	BMI ≤ 18.5 kg/m <sup>2</sup> Low-income status Low educational status Comorbidity (≥ 4) Poor functional status Depression score (GDS ≥ 14)
Tan et al. (2016)(22) Singapore	Design: Retrospective analysis study Setting: Outpatient oncology clinic Subjects: 249 Age: ≥ 70 years	Nutrition Screening Initiative checklist (NSI)	Malnutrition: 0 Moderate – high risk: 73.9	Advanced cancer stage Depression Anaemia Poor functional status
Toffanello et al. (2013)(23) Italy	Design: Observational study Setting: Acute Geriatric Section Department of Medical and Surgical Sciences Padova University Subjects: 96 Age: ≥ 65 years	MNA-FF	Malnutrition/at risk: 74.5	Taste loss Polypharmacy
Donini, Neri, De Chiara, Poggiogall & Muscaritoli (2013)(24) Italy	Design: Cross-sectional Setting: Hospitals and nursing care homes Subjects: 100 Age: ≥ 70 years	MNA-FF	Malnutrition: 36.0 At risk: 46.0	Older age (≥ 80 years) Cognitive and functional impairment Hypalbuminaemia Anaemia Low total protein Low TLC level Lack of foodservice satisfaction
Sahran, Harith & Mohamed (2016)(25) Malaysia	Design: Cross-sectional Setting: Hospital Universiti Sains Malaysia Subjects: 130 Age: 60-89 years	SGA	Malnutrition: 9.2 At risk: 26.2	Female Low appetite BMI < 18.5 kg/m <sup>2</sup> Hypoalbuminaemia (< 35g/L) MUAC (men < 23 cm, women < 22 cm) CC (men < 30.1 cm, women < 27.3 cm)
Demir et al. (2015)(26) Turkey	Design: Cross-sectional Setting: Sakarya Education and Research Hospital Subjects: 160 (< 65 years), 130 (≥ 65 years)	MNA-FF and SGA (for patients ≥ 65 years old)	Malnutrition: 37.0 At risk: 31.0	Weight BMI ≤ 18.5 kg/m <sup>2</sup> Hypalbuminaemia
Lee, Choi, Son & Lyu (2013)(27) Korea	Design: Cross-sectional Setting: Hospitals in Busan Subjects: 578 (29 – 59 years), 366 (60 – 70 years)	NRS 2002	Malnutrition: 0 High risk: 32.5 Low risk: 67.5	Age BMI < 20.0 kg/m <sup>2</sup> Hypoalbuminemia (< 3.6 g/dL) Low total cholesterol Higher LOS

**Table 1: Summary of prevalence and factors associated with geriatric malnutrition in healthcare institutions (continued.....)**

Author, Year, Origin	Study characteristics	Tools to assess malnutrition	Prevalence of malnutrition &/or at risk of malnutrition (%)	Factors associated with malnutrition
Jaroch, Głyszewska-Siedlecka, Jaroch & Kędziora-Kornatowska (2017)(28) Poland	Design: Cross-sectional Setting: Jurasz University Hospital Subjects: 1100 Age: ≥ 65 years	NRS 2002	High risk: 18.8 Low risk: 81.2	BMI <22.0 kg/m <sup>2</sup> Hypoalbuminemia (<3.4 g/dL) Arm circumference <24 cm Calf circumference <31 cm
Chatindiara et al. (2018)(29) New Zealand	Design: Cross-sectional Setting: Hospitals in Auckland, New Zealand Subjects: 234 Age: ≥ 65 or ≥ 55 years for Maori or Pacific ethnicity	MNA-SF	Malnutrition: 26.9 At risk: 46.6	BMI <23.0 kg/m <sup>2</sup> Low HGS Cognitive impairment
Sánchez-Rodríguez et al. (2017)(30) Spain	Design: Longitudinal, prospective study Setting: Post-acute geriatric care unit Subjects: 88 Age: ≥ 70 years	MNA-SF	Malnutrition: 19.3 At risk: 80.7	BMI ≤18.5 kg/m <sup>2</sup> Unintentional weight loss
Nor Farahain, Noraida, Muhammad Zaki, Ummi Nadira & Siti Nur Asyura (2019)(31) Malaysia	Design: Cross-sectional study Setting: Hospital Serdang Subjects: 108 Age: ≥ 65 years	MNA-SF	Malnutrition: 12.0 At risk: 53.0	BMI ≤18.5 kg/m <sup>2</sup> Fat free mass index (male ≤ 16 kg/m <sup>2</sup> , female ≤ 15 kg/m <sup>2</sup> ) Poor health-related quality of life
Pierik et al. (2017)(32) Amsterdam	Design: Observational, prospective, longitudinal study Setting: VU University Medical Centre, Amsterdam Subjects: 378 Age: ≥ 70 years	SNAQ	Malnutrition: 0 At risk: 34.8 Low risk: 65.2	Low muscle mass
Robb et al. (2017)(33) South Africa	Design: Cross-sectional Setting: Long term care facilities Subjects: 124 Age: ≥ 60 years	MNA-FF	Malnutrition: 7.3 At risk: 55.6	Low socioeconomic status MUAC < 21 cm CC < 31 cm Weight loss >3 kg in 3 months
Reijniers et al. (2015)(34) Netherlands	Design: Cross-sectional study Setting: Geriatric outpatient clinic, Bronovo Hospital Subjects: 185 Age: ≥ 65 years	SNAQ	Malnutrition: 0 At risk: 16.0 Low risk: 84.3	BMI ≤18.5 kg/m <sup>2</sup> Unintentional weight loss (≥ 3 kg) Poor functional status Loss of appetite
Jacobsen, Brovold, Bergland & Bye (2016)(35) Norway	Design: Cross-sectional Setting: Acute geriatric hospital wards Subjects: 120 Age: ≥ 65 years	MNA-FF	Malnutrition: 32.0 At risk: 58.0	Poor activities of daily living (ADL) Poor balance, mobility and muscle strength
Matsumura et al. (2015)(36) Japan	Design: Cross-sectional Setting: Public hospitals Subjects: 63 Age: ≥ 65 years	GNRI	High risk: 30.2 Low risk: 69.8	Lower ADL
Akbar & Setiati (2018)(37) Indonesia	Design: Cross-sectional Setting: Geriatric Outpatient Clinic of Cipto Mongunkusumo Hospital Subjects: 98 Age: ≥ 60 years	MNA-FF	Malnutrition: 6.1 At risk: 60.2	Low handgrip strength (HGS) (men <26 kg, women <18 kg)
El Osta et al. (2014)(38) Hawaii	Design: Cross-sectional study Setting: Beirut primary care clinics Subjects: 121 Age: ≥ 65 years	MNA-FF	Malnutrition: 14.0 At risk: 56.0	Poor dental status
De Oliveira & Leandro-Merhi (2011)(39) Brazil	Design: Cross-sectional Setting: Piracicaba Hospital Subjects: 240 Age: ≥ 60 years	MNA-FF	Malnutrition: 29.1 At risk: 37.1	Inadequate calorie intake

† MNA-FF : Mini Nutritional Assessment Full Form  
MNA SF : Mini Nutritional Assessment Screening Form  
‡ NSI : Nutrition Screening Initiative Checklist  
PG-SGA : Patient-Generated Subjective Global Assessment  
§ SGA : Subjective Global Assessment  
¶ SNAQ : Short Nutrition Assessment Questionnaire  
† NRS 2002 : Nutritional Risk Score – 2002  
§ GNRI : Geriatric Nutrition Risk Index

function and physical examination (12). This tool is also proved to be useful due to its simplicity. However, the accuracy could be doubtful due to the subjectivity of the tool. Although SGA is commonly used for geriatric patients, it is not initially developed for this population. Therefore, the sensitivity could be wavering.

On the other hand, the PG-SGA is an adapted version of SGA that is commonly used to measure nutritional status. The tool encompasses questions on the patient's weight, food intake, nutrition impact symptoms, functional status, medical condition, metabolic stress and physical examination (13). According to Marshall, Young, Bauer and Isenring (2015), the PG-SGA is favourable for use in oncology, acute medical, renal, stroke, neurology, respiratory patients and those in a residential aged care setting (13). However, this tool has yet to be evaluated in the older population and the rehabilitation setting. Having adapted from its original version, NRI, the GNRI was developed in 2005, specifically to identify nutritional status for the elderly (14). The NRI was initially developed especially for surgical patients, to identify the likelihood of having postoperative complications by determining their weight changes and albumin levels. Since measuring weight in elderly patients is a strenuous job, the GNRI has made an alteration where it uses their ideal weight instead. On a positive note, the GNRI has proven to be a quick and easy tool to be used in measuring the elderly's nutritional status (14). However, the GNRI is said to be valid if it is to be used concurrently with another tool.

The NRS-2002 is another nutritional screening tool used in hospital settings. It assesses a patient's nutritional status via measurements of anthropometry, food intake, disease severity and age (15). According to Barbosa, Vicentini and Langa (2019), this easy to use tool is suitable for both young and elderly patients, with special attention given to the scoring adjustment for those over 70 years of age (15). Limitations found for NRS-2002 is the difficulty in finding the reduction in food intake and measuring the height and weight of the patients.

Next, the SNAQ can make a good nutritional screening tool for it does not require trained personnel (16). Furthermore, this tool has been recommended by the Dutch Malnutrition Steering Group in the Netherlands due to its simplicity. Even so, the SNAQ is validated in the adult population that it may give poor results when used in the elderly.

Also known as DETERMINE, the NSI is a nutrition screening tool that questions on the elderly's dietary intake, general (health status, medications and weight changes) and social assessments (social interactions and socioeconomic status) (17). Like any other tools, the NSI is also considered simple and does not oblige trained personnel. However, there has been a remark by Sahyoun, Jacques, Dallal and Russell (1997) who

mentioned that the risk factor of the NSI checklist is, it does not point to a specific condition (18). Rather, these questions only cater to general problems faced by the elderly. Thus, this tool can only be validated as an educational tool for community-dwelling elderly instead of those admitted in the hospitals.

Table I indicates the summary of geriatric malnutrition and factors associated in healthcare institutions. Based on Table I, it is found that socio-demographic background is directly associated with hospitalised geriatric malnutrition such as living alone (7,19,20), having low financial status (19,21) and lack of education (19,21). Having comorbidities (7,21,22) and polypharmacy (23) also act as the risk factors for malnutrition among geriatric patients.

Another factor demonstrated to be the predictor of geriatric malnutrition is having poor biochemical readings with anaemia, hypoalbuminemia and low total lymphocyte count being the most common (7,24,22,25,26,27,28). Referring to Table I, malnutrition is also associated with poor anthropometry measurements. They are seen through low body mass index (BMI) (21,25,26,27,28,29,30,31,32), unintentional weight loss (30,33,34) as well as having low mid-upper arm (MUAC) and calf circumferences (CC) (7,25,33).

Ageing and frailty often intersects with each other, causing the geriatric patients to have poor functional status (7,21,22,23,24,29,32,34,35,36,37,38), which results in the episode of malnutrition. The same happens in one's nutritional needs. Inadequate dietary consumption often occurs and is directly the cause of malnutrition (7,39). According to Amarya, Singh and Sabharwal (2015), ageing has caused changes in the digestive system (20). The gastric acid secretion reduces, which limits the absorption of vitamin B12 and iron. Furthermore, saliva production lessens, limiting food intake. Gastrointestinal motility also dwindles and eventually causes constipation. In time, the elderly suffer from loss of appetite and lose interest in eating (20).

## DISCUSSION

This systematic review presents information on the prevalence and factors associated with geriatric malnutrition in healthcare institutions.

The first factor mentioned in the table that affects the geriatric patients' nutritional status is their sociodemographic background. It can be seen that their sociodemographic background predicts their nutritional status. According to Alzahrani and Alamri (2017), elderly who are unmarried or having loss of a partner, often live alone (7). Hence, social isolation among elderly increases which eventually raises the chance for them to be malnourished. This is because, these individuals are frail and often require extra hands especially in food

preparation. Somehow, social isolation could be the verdict to malnutrition among the elderly as they lack moral support and motivation. Interestingly, a study has found that the elderly could consume an average of extra 114 kcal in the presence of family members in a single meal, as compared to those who eat alone (40). The reason being is because the elderly spend more time during meals when the family is present.

On the other hand, being financially dependent is associated with reduction in their food intake, as these patients become more decisive in choosing their food (41). Due to not having job and insufficient amount of savings, these causes them to opt for unhealthy food as they experience limited access to the healthy food available in the markets (7). On top of that, some of the elderly individuals claimed to still provide financial support to their relatives, which only contributes to the insufficiency of their income (41). Unfortunately, the elderly with no family income tend to be vulnerable to malnutrition twice as high as compared to those earned at least three times a minimum wage (40).

Formal education serves as a good indicator to good health status (42). A person with less than nine years of schooling has a 44–49% chances of higher mortality rate as compared to those who received higher education. According to Moreira and Padra (2004), individuals with higher educational level consumed more fruits, vegetables, milk and fish as compared to otherwise (43). This could be because people with higher educational level have more access to information and higher understanding of the importance of nutrition, thus, become more concerned about their health (40). Hence, this further proves that educational level plays a vital role in the elderly's nutritional status.

Furthermore, the second factor that contributes to geriatric malnutrition is the presence of underlying illnesses (7,21,22) and polypharmacy (23). It is found that, these two are the common risk factors for geriatric malnutrition. As the body's physiological processes decline with age, the state of having multiple disorders or illnesses are common. Thus, having impaired nutritional status are presumed. Notably, geriatric patients with comorbidities had a 3.5-fold increased in risk of malnutrition (21). This is due to the appetite reduction experienced by the elderly with acute or chronic diseases (21). Not only that, such comorbidities usually cause the body to experience inflammation and catabolism, which finally increases the chance of being malnourished (40).

Polypharmacy refers to the term used when an individual consumes multiple drugs prescribed by their respective physicians. It is often prescribed due to having multiple comorbidities. Polypharmacy and geriatric malnutrition are found to be significantly associated with each other. This is because, the elderly are prone to be more

vulnerable to side effects due to their poor metabolism rate (33). The ingestion of drugs may cause adverse side effects such as nausea, malabsorption and taste alteration, leading to low dietary intake (31). This eventually hinders them from having sufficient absorption of nutrients. Therefore, physicians, pharmacists and caretakers need to be fully cautious on the elderly's drug regimens.

Moreover, another factor associated with geriatric malnutrition is biochemical data of the patients (7,24,22,25,26,27,28). High prevalence of anaemia is often found among geriatric patients (6). This is because, the shifting of nutritional metabolism during illness affects their haemoglobin status (25). However, nutritional alone does not confirm this matter, as several other factors may act as the culprit, such as ageing itself, disease severity, blood loss and medication. On the other hand, serum protein is often used to measure the nutritional status of geriatric patients. Alzahrani and Alamri (2017) reported that serum albumin could be used as an indicator for mortality in elderly patients (7). Moreover, hypoalbuminemia among geriatric patients could predict longer hospital stays and high risk of hospital readmittance.

Furthermore, anthropometry measurements also play an important factor in recognising geriatric malnutrition. From Table 1, it is found that geriatric malnutrition correlates with BMI  $\leq 18.5$  kg/m<sup>2</sup> (21,25,26,27,28,29,30,31,32), unintentional weight loss (30,33,34) as well as low MUAC and CC (7,25,33). It is found that, patients with poor BMI, MUAC and CC are associated with geriatric malnutrition.

According to ESPEN (2018), the criteria of geriatric malnutrition is having body mass index (BMI)  $\leq 18.5$  kg/m<sup>2</sup> and unintentional weight loss  $>5\%$  of their body weight with reduced BMI (44). Other than that, studies show that geriatric malnutrition is significantly associated with low levels of MUAC and CC (7,25,33). Low MUAC and CC indicate that patients have muscle-related disability and functional decline in older adults. Moreover, small MUAC and CC simply means having small muscle mass and could increase the chance of frailty. Eventually, the elderly will lose their strengths and have declined physical function (33). In some events, it is called sarcopenia or muscle wasting (45).

Another common factor of geriatric malnutrition is deprivation of functional status. Low muscle mass or presence of sarcopenia among geriatric patients often increase the tendency for them to have poor functional status, which leads to malnutrition (7,21,22,23,24,29, 32,34,35,36,37,38). There are two common functional status that are related to geriatric malnutrition; handgrip strength (HGS) and dental status. Several factors are found resulting to having poor HGS. They are unintentional weight loss, having low BMI, MUAC and CC. These factors are found to cause protein depletion. It can be

explained by several mechanisms such as a reduction in protein synthesis and an increase in proteolysis. Thus, resulted in poor HGS. This can be seen through poor functional status in the elderly which includes their low handgrip strength (37). The study also shows a positive correlation between handgrip strength (HGS) and the elderly's nutritional status. This is because, muscle mass contains the highest amount of protein in the body, while muscle function is related to an individual's body protein and anthropometry.

Next functional status that is often measured is the geriatric patients' dental status. Poor dental status is significantly associated with malnutrition, as it resulted in low dietary intake (38). Common issues related to dental status in geriatric patients are chewing difficulties due to loss of teeth and pain when swallowing, especially when consuming fibre-rich foods and meat. Other than that, elderly patients often suffer from xerostomia or hyposalivation. In such event, these elderly patients would experience loss of appetite and lack of satisfaction when eating. Hyposalivation are found to cause disruption in bolus formation in early masticatory stages (38).

In addition, dietary inadequacy is also one of the predictors of geriatric malnutrition. It is found that dietary inadequacy is significantly associated with geriatric malnutrition (7,39). Patients with good nutritional status may have experienced dietary inadequacy during their early days of hospitalisation, due to their existing illness. However, after some time, these well-nourished patients managed to catch up in fulfilling their dietary intake. Contrarily, those who are already malnourished prior to admission are found to become anorexic under the same circumstance (46).

According to Agarwal, Miller and Yaxley (2013), malnourished elderly only consumed  $\leq 25\%$  of the food portion for every meal served (47). This is a serious matter, considering that if it is left untreated, other health complications would occur such as protein-energy malnutrition (PEM), anaemia and reduced bone density (47). This gives the idea that most geriatric patients require extra care, especially during feeding (48).

Besides having inadequate dietary intake, another factor of geriatric malnutrition is the lack of food service satisfaction. With nutrition being a part of hospital care, the author believes that a patient's relationship with food is just as important. Therefore, lack of foodservice satisfaction could easily lead to insufficient dietary intake, resulting in malnutrition (24). It can be deduced that one's perceived satisfaction is highly influenced by the food quality (taste, presentation, preparation, variety) (49). A study by Johns, Hartwell and Morgan (2010) assessed that some patients believed that hospital meals were cooked from cheap ingredients, which explained why the food served was unpleasant (50).

Johns, Hartwell and Morgan (2010) have also surveyed that patients generally find hospital environment foreign to them, especially over medical discussion (50). Consequently, conversations between patients and healthcare practitioners are often kept limited and professional. This result is in line with a study by Donini, Neri, de Chiara, Poggiogale and Muscaritoli (2013) who reported that elderly patients claimed to notice little attention was paid by the medical and nursing staffs on their nutritional intake (24). With that being the case, patients often draw their attention to foodservice staff, whom they can interact well. The 'friendliness' of foodservice staff is what fills the gap between patients and staff, making them feel less foreign, which eventually motivates them to eat (51).

All in all, the information stated in this systematic review is valuable to identify the factors associated with geriatric malnutrition in clinical settings. Early detection of geriatric malnutrition aids in timely intervention and prevention, eventually, give rise to positive outcomes.

#### **Limitation**

This review article professes a few limitations. The first limitation is that this review article only included open access, English articles, thus, some relevant articles may not be included in this review. Next, this systematic review only focuses on the prevalence and factors associated and may seem too descriptive. The heterogeneity of the articles' analysed variables, concept definition and methodology may be the reason to inconsistent results. No meta-analyses are done that could assess the magnitude of the effect.

#### **CONCLUSION**

This systematic review on geriatric malnutrition in healthcare institutions gives insights on the prevalence and factors associated with the mentioned matter. The prevalence of malnourished elderly patients in healthcare institutions is 9% - 74.5% among patients admitted in hospitals, 6% - 19% among outpatients, 7.3% - 28% in rehabilitation settings and 36% - 49.1% in nursing homes. The identified factors include socio-demography, medical background, anthropometry data, biochemical data, nutrition-focus physical findings, dietary inadequacy and lack of food service satisfaction. These findings prove that it is crucial to carry out nutrition screening among geriatric patients so as to appropriately intervene their dietary intake. Lastly, improvements in the hospital's food service system should be taken into account to ensure adequate quality and quantity of food served to the geriatric patients.

#### **ACKNOWLEDGEMENTS**

The authors would like to thank the Ministry of Higher Education, Malaysia, for the grant funding (FRGS/1/2019/SK06/UPM/02/17).

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appet.2015.09.023