Assessment Tools for Detecting Malnutrition among Elderly in Shelter Homes: A Systematic Review

Abdul Mutalib M[a]*, Abdul Kadir NAA[b], Shamsuddin AS[c], Khalid K[d]

[a]School of Graduate Studies, Management and Science University (MSU), Shah Alam, Selangor Malaysia;
[b]Faculty of Food Science and Nutrition, Universiti Malaysia Sabah, Sabah, Malaysia;
[c]Institute for Environment and Development (LESTARI), Universiti Kebangsaan Malaysia (UKM), Selangor;
[d]Biotechnology and Nanotechnology Research Center, Malaysian Agriculture Research and Development Institute (MARDI), Serdang, Selangor.

Corresponding Author
Dr. Maisarah Abdul Mutalib
School of Graduate Studies
Management & Science University,
University Drive, Off Persiaran Olahraga,
40100 Shah Alam, Selangor

Email : maisarah_abdulmutalib@msu.edu.my

ABSTRACT

Assessing nutritional status in older people is essential to screen for malnutrition and identify the individuals requiring nutritional intervention for a better quality of life and longer life expectancy. This review aimed to investigate malnutrition and the role of nutritional assessment tools among older people in Malaysia. We systematically reviewed the publications from 2000 to 2019 using PubMed/MEDLINE and Scopus databases, recovering 15 original articles published until January 2022. This systematic review was conducted from May to September 2022. Two reviewers were involved in the process of the selection of articles and data extraction. Only research papers on malnutrition among older people in institutionalized settings in Malaysia were included. Four articles related to malnutrition in older people in old folk homes in Malaysia were included in this review. The tools with the most significant evidence were Mini Nutritional Assessment (MNA) and Nutritional Health Checklist (NHC) in residential care for the elderly. It was found that the incidence of malnutrition among the elderly in old folk homes in Malaysia ranged from 12.3% to 17.4%. Meanwhile, 40.4% to 57.7% of the population are documented to be at risk of malnutrition. NA and DETERMINE NHC were found to be most suitable for use in residential care due to their high sensitivity and specificity. A subsequent study is proposed to build and implement a scoring system to rate screening tools based on the validity, suitability, and practicability of the tools to help with malnutrition screening research and clinical practice in Malaysia and internationally.

INTRODUCTION

Aging is an inevitable process of people growing older at the cellular, organ, or whole body level, commonly measured by chronological age. According to the World Health Organization (WHO), a person aged 65 years or more is referred to as an elderly person, and most developed countries have accepted the chronological age of 65 years as a definition of an elderly individuals.[1] The aging population increases rapidly in number from time to time. According to the Department of Statistics Malaysia (DOSM), the increase in numbers of the elderly population in Malaysia in 2019 was from 10.0% in 2018 to 10.3%[2], which is increasing yearly. Malaysia has become an aging society, where in 2022, the percentage of the population aged 65 years and above has increased from 7.0% to 7.3% of the population for some period.[3] This increase is common around the globe, most likely due to effective enhancement in the quality of life (QoL) and health services provided in developed and developing countries. Also, the life expectancy of the average population expands.[4-8]

The social and health condition of the elderly is vastly diverse, extending from healthy and active persons to extremely frail and completely dependent people with chronic diseases.[9] The increasing prevalence of malnutrition among the elderly has been linked with malnutrition-associated health problems, including nutrient deficiency–related symptoms, reduced bone mass leading to osteoporosis, immune dysfunction, and delayed wound healing.[10,11] The disease-associated

malnutrition in the elderly in the United States of America is estimated to cost $51.3 billion annually, which is greater than that spent on obesity.[11] This estimation involves the cost of treatment for both the underlying disease and malnutrition. With proper prevention and treatment of malnutrition, healthcare costs could be significantly reduced. Therefore, malnutrition must be identified through screening, which can improve clinical outcomes and reduce healthcare expenditure.[1]

Elderly people are physically and physiologically susceptible to malnutrition.[15] Malnutrition refers to deficiencies, excesses, or imbalances of energy and nutrient intake in an individual.[13] It can be categorized as i) under-nutrition, ii) over-nutrition, iii) imbalance, and iv) specific deficiency.[14] However, malnutrition is often used synonymously with 'undernutrition' and is used as such in this article. This condition is becoming a concern as malnutrition in the elderly results in a measurable adverse effect on i) body composition (weight changes), ii) function (muscle loss, poor wound healing), and clinical outcomes (prolonged hospitalization, reduced immunity, and impaired respiratory and cardiac function. Consequently, morbidity and mortality rates in this age group were significantly high.[16]

Nutritional assessment is a process of interpreting data from dietary, laboratory, anthropometric, and clinical studies to determine the nutritional status of individuals or population groups generally affected by nutrient intake and utilization.[17] Assessing nutritional status in older people is essential to screen for malnutrition and malnutrition risks, which enables identifying individuals requiring nutritional intervention for a better QoL and longer life expectancy. Therefore, this review paper analyses publications on malnutrition and the role of nutritional assessment tools among elderly people in Malaysia.

MATERIALS AND METHODS

The study design is a systematic review of the literature from May to September 2019. Two reviewers were involved in selecting the inclusion criteria and data extractions of the publications in Malaysia. The literature search was done using electronic databases to locate relevant articles. PubMed, Medline, NCBI, Academia, and Google Scholars were the main databases for accessing malnutrition among older people. In addition, the lists of references cited in the articles were also reviewed. Several keywords and combinations of keywords were used to identify the relevant literature, namely, "elderly malnutrition in Malaysia", "elderly undernutrition in Malaysia", "nutritional status of elderly in Malaysia", "nutritional assessment of elderly in Malaysia", "geriatric nutritional status in Malaysia", "geriatric nutritional assessment in Malaysia" and "geriatric malnutrition in Malaysia".

All articles written in English which were most relevant and published from 2000 to 2019 were selected. Research papers on malnutrition among older people in institutionalized settings in Malaysia were the primary papers reviewed. Review papers, case studies, duplicates, and studies outside Malaysia and non-institutionalized settings were excluded. Studies conducted on participants aged less than 60 years old were also excluded from the analysis.

The procedures of selecting papers followed several stages. Firstly, articles were searched using the keywords mentioned earlier through different medical databases and bibliographies, yielding 1184 articles. Secondly, 1137 titles and abstracts of papers were filtered for their inclusion criteria, and any duplication and unrelated papers such as review papers, case studies, and letters to the editor were excluded. Thirdly, 47 papers were selected for the title reviews. Fourthly, the 37 abstracts of the selected papers were studied and screened before reviewing the full-text papers. Next, the second author considered 15 relevant and eligible papers to be reviewed for the full paper. Finally, four articles being reviewed and published in peer-reviewed journals were selected for this study. The systematic process of selecting the relevant papers is illustrated in **Figure 1.**
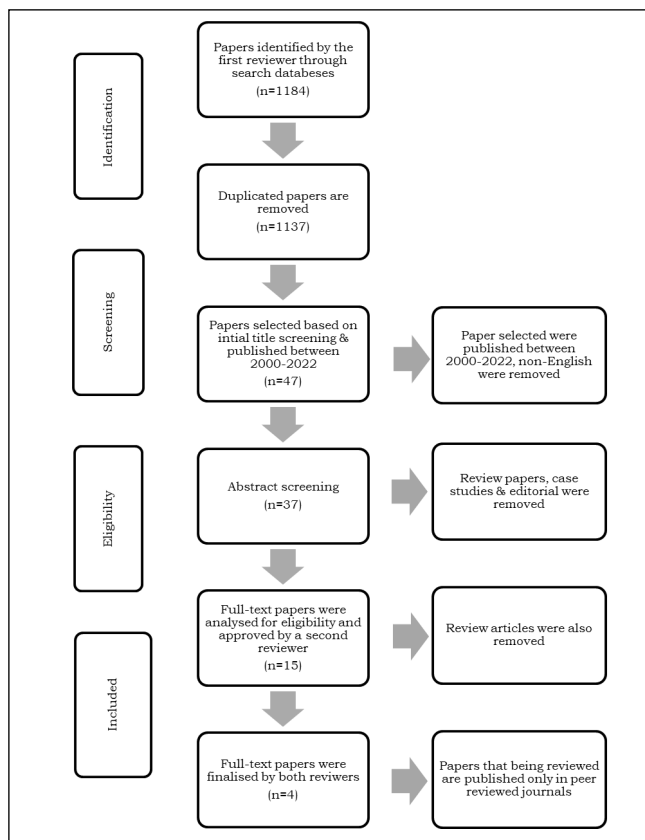
Figure 1. The steps in the selection of relevant paper

RESULTS

Table 1 shows the distribution of i) source, ii) study period, iii) study population and sample size, iv) type of study and objective, v) parameters, vi) survey tool, and vii) rate of prevalence of the reviewed articles.

After using different search engines and considering the inclusion and exclusion criteria, the four articles that were best relevant to malnutrition among older people at old folk homes were selected. The study was conducted from March 2002 to February 2019, involving elderly residing in old folk homes in different regions in Malaysia. The objectives of the four selected articles are summarised below:

i. Article 1 – Study the incidence of undernutrition and factors associated with undernutrition among the elderly in public-funded shelter homes in Peninsular Malaysia.[18]
ii. Article 2 – Study the prevalence of malnutrition among the elderly people in government-funded shelter homes in Northern Peninsular Malaysia.[3]
iii. Article 3 – Study the effect of diet on satisfaction with life among the elderly residing in the government-funded old folk home in Selangor.[19]
iv. Article 4 – Study the relation between the sufficiency of nutrition provision and plate wastage with risk of malnutrition among elderly in government-funded old folk homes in Selangor.[20]

Assessment of Methodology

All publications identified were cross-sectional studies conducted on older people at old folk homes in Malaysia

Table 1. Distribution of article source, study period, populations and sample sizes, study design, study instruments, response rate, prevalence, and significant findings of Malaysian elderly people malnutrition in old folk homes.

No.	Article Source	Study period	Population and sample size	Study design	Parameters	Tools	Response rate	Prevalence
1.	Visvanathan *et al.,* 2005[18]	March 2003 to Sept 2002	Elderly people residing in 9 publicly funded shelter homes in Peninsular Malaysia n = 1081	CS to determine the prevalence of undernutrition & factors associated with undernutrition	Nutritional status, cognition, physical function, depression, BMI	Questionnaires containing Determine Your NHC, ECAQ, modified Barthel Index, GDS-12R & anthropometrics	96%	41.4% were nourished, 32.1% were at moderate risk of undernutrition, and 26.6% were at high risk of undernutrition.
2.	Chen *et al.,* 2012[4]	April to May 2010	Elderly residents in 4 shelter homes in Northern Peninsular Malaysia n = 236	CS to determine the prevalence of malnutrition	Anthropometric measurements i.e., weight, height, and BMI	Anthropometric measurements	100%	17.4% were underweight, and 28.4% were overweight.
3.	Fatin-Izzaty *et al.,* 2018[19]	July to August 2018	Elderly residents in Rumah Seri Kenangan Cheras n = 57	CS to determine the associations between Satisfaction with Food Related Life (SWFL) and socio-demographics factors, dietary intake, food access and malnutrition	Sociodemographic characteristics, malnutrition, experiences of food access, SWFL, dietary intake, and anthropometric	Questionnaires containing sociodemographic, Mini Nutritional Assessment, Experiences of food access, SWFL, dietary intake and anthropometrics	96%	40.4 % were at risk of malnutrition, 12.3% were malnourished, 89.5% did not achieve RNI
4.	Siti Al-Baidakh *et al.,* 2019[20]	January to February 2019	Elderly residents in Rumah Seri Kenangan Cheras n = 46	CS to determine the association between adequacy of nutrition provision and plate wastage with the risk of malnutrition	Sociodemographic, anthropometric, risk of malnutrition, adequacy of nutrition provision, plate wastage	Mini Nutritional Assessment Form containing dietary, anthropometric, global, and self-viewed aspects of nutrition, digital food weighing scale	100%	50.3% were well-nourished, 13% were malnourished

Abbreviations: CS: cross sectional, BMI: body mass index, NHC: Nutritional Health Checklist, ECAQ: elderly cognitive assessment questionnaire, GDS-12R: short form geriatric depression scale, SWFL: satisfaction with food related life, MNA: mini nutritional assessment

that documented the prevalence of malnutrition, its contributing factors, and dietary intake. One of the studies also assessed the relationship between adequacy of nutrition provision, plate wastage, and the risk of malnutrition. There was no longitudinal study among the identified studies that evaluated the effects of an intervention on elderly residents. All four studies clearly described the sample selection procedure, and most reported the response rates and sociodemographic data. All studies used standard instruments.

Instruments Used

Various tools were used to assess malnutrition among the elderly. The different tools used were: 1) Nutritional Health Checklist (NHC), 2) Elderly Cognitive Assessment Questionnaire (ECAQ), 3) modified Barthel Index, 4) 12-item Geriatric Depression Scale (GDS-12R), 5) Mini Nutritional Assessment (MNA), 6) Experiences of Food Access, 7) Satisfaction with Food-Related Life (SFWL) and 8) Dietary Intake.

In two studies, malnutrition risks were identified by administering MNA (articles 1 and 2). The other two studies each used the NHC (article 1) and Body Mass Index (BMI) (article 2) to determine malnutrition and malnutrition risks. The anthropometric measurements were done in all four studies by measuring the body weight, height, and BMI. The Mid Upper Arm Circumference (MUAC) was analyzed in three studies (articles 2, 3, 4). Waist Circumference (WC) was also measured in one study (article 2), and Calf Circumference (CC) also was measured in one study (article 4). Among the four studies, only one study used ECAQ, modified Barthel Index, and GDS-12R to evaluate the cognitive status, ability to perform activities of daily living (ADL) independently, and depression status, respectively (article 1). Another study determined the elderly experiences of food access and dietary intake using the Experiences of Food Access and Dietary Intake, respectively (article 3). On the other hand, one of the studies identified the food served and plate wastage in the old folk home using a digital food weighing scale (article 4).

Nutritional Health Checklist (NHC)

NHC is a well-known tool used in North America that determines the factors of nutritional well-being and promotes the concern of nutritional problems in older persons by health professionals.[21] It was intended as a public awareness tool for self-administrating nutritional status among the elderly by family members or caregivers. It consists of 10 checklist items; scores of 0–2 indicate good nutritional health, 3–5 determine that the individual is at moderate nutritional risk, and scores of 6 and more signify a person is at high nutritional risk and is advised to bring the checklist to the doctors, dietitians or other qualified health professionals for consultation and further interventions. A European community study reported that the sensitivity and specificity of NHC are respectively 59% and 53%.[22]

Mini Nutritional Assessment (MNA)

MNA is a validated nutrition assessment tool designed to evaluate the nutritional status as a standard assessment of elderly patients in different settings such as clinics, nursing homes, hospitals, or frail elders. The full MNA consisted of 19 items categorized into four sections:

i.   Anthropometric measurements (BMI, weight, height, weight loss, arm, and calf circumference)
ii.   General measurements (lifestyle, medication, mobility, and signs of depression or dementia)
iii. Dietary intake (number of meals, food and fluid intake, and autonomy of feeding)
iv.   Subjective assessment (self-perception of health and nutrition).[23]

Each response contributes to the final score, which has a maximum of 30. A patient who scores ≥24 is considered well-nourished; 17 to 23.5 signifies a risk of malnutrition; meanwhile, scores ≤17 are considered malnourished. According to clinical status, MNA has 96%, 98%, and 97% sensitivity, specificity, and positive predictive values, respectively.[24]

Elderly Cognitive Assessment Questionnaire (ECAQ)

ECAQ is a 10-item questionnaire designed to assess the cognitive status *of* older people in developing countries.[25] The screening tool consists of questions (Qs) on age, birth, current knowledge, and memorization tests. A patient with scores of 0 to 3 indicates severe impairment, 4 to 6 indicates moderate impairment, and more than 6 indicates normal cognitive status. It can be administered in 12 minutes and is available in Chinese, Malay, and English.

Modified Barthel Index

Visvanathan *et al.* administered a 10-item Modified Barthel Index to assess the ability of the elderly to complete ADL independently.[18] The modified Barthel index assesses the patient on several parameters, including bowel function, bladder, dressing, toilet use, feeding, transfer, mobility, using the stairs, and bathing. It has a maximum score of 20.[26,27] The scores less than or equal to 14 indicate moderate to very severe disability, scores 15 to 19 indicate mild disability, and scores of 20 indicate independence entirely at performing ADL.

Geriatric Depression Scale

GDS-12R is 12 Qs of the Geriatric Depression Scale screening for major *depression* in the elderly living in housing facilities. It was first constructed by Yesavage *et al.* and tested on the elderly population.[28] The GDS-12R was established from the GDS-15 by eradicating items that are poor determinants of depression in nursing and residential home populations with 92% sensitivity and 89% specificity.[29] The three items that were deselected were the Qs relating to:

i. preference of going out rather than staying home,
ii. feelings of having more problems than other people, and
iii. feeling that most people are better off than them.

With maximum scores of 12, subjects who scored five and above were at high risk of depression.

Experiences of Food Access

Experiences of food access in shelter homes setting is a questionnaire containing five domains: i) feeling hungry (four items), ii) physical barriers (seven items), iii) organizational barriers (six items), iv) food choice (five items) and v) food quality (five items).[30] The Likert scale's scores are excellent, good, fair, poor, and unknown. The simple and short Qs are easy to be complete, yet it provides valid and reliable results in assessing patients' experiences of food access in a particular setting.

Dietary Intake

As defined by the WHO, maintaining an adequate nutrient intake is key to health and one prerequisite for well-being at a higher age. Nutrient deficiencies among the elderly, in particular, are frequently neglected. Clinical malnutrition results from an imbalance between macronutrient intake and requirement[31], causing a measurable reduction in tissue and, ultimately, weight. Unlike quantitative malnutrition, which is reflected by weight loss, micronutrient deficiencies are much harder to screen for and identify. However, most dietary intake surveys have specified an inadequate intake of a wide range of micronutrients in older adults.[32]

One study used a weighing method to determine food intake adequacy (article 4). The food provided for the lunch hour and plate excess were measured using a numerical food measuring scale.[20] In this method, the nutrient compositions of food provided and consumed by the subjects were evaluated using the Nutritionist Pro Software (Axxya system). The software program is a modular nutrition analysis and food labeling solution suitable for healthcare, fitness, food service, and manufacturing. It provides the tools for professionals to manage respondents' nutrition and nutritional information, recommend recipes, physical activity goals, plan menus, generates and print nutrition labels, and many more.

Anthropometric measurements

Anthropometric measurement is a vital component in assessing the nutritional status of the elderly.

Anthropometric indicators evaluate the prognosis of chronic and acute diseases, which is one of the important tools in the screening for malnutrition among the elderly before starting with medical and nutritional interventions. Anthropometric measurement assesses the body's composition by measuring height, weight, BMI, body circumferences (waist, hip, and limbs), and skinfold thickness. These measurements characterize diagnostic criteria primarily for obesity, significantly raising the risk for cardiovascular disease, hypertension, diabetes mellitus, and many more. Most importantly, it can be used as a baseline for an individual's physical fitness and measuring their fitness level progress.[33]

We identified that anthropometric measurements were measured in all four selected studies. Article 1 only included weight, height, and BMI. Article 2 included weight, height, BMI, MUAC, and WC in their study. For article 3, they included anthropometric measurements and MUAC; meanwhile, for article 4, they included anthropometric measurements, MUAC, and CC in their study.

Prevalence of Malnutrition

The four cross-sectional studies evaluated the malnutrition incidence among the elderly in the old folk home in Malaysia using the eight malnutrition screening tools. The prevalence rate of malnutrition reported varied from 12.3% [20] to 17.4% [4]. The rate of older people at risk of malnutrition were 40.4% [19] to 58.7% [18].

DISCUSSIONS

This review discusses the eight malnutrition screening tools used in the four studies on malnutrition in the elderly residing in sheltered homes in Malaysia. It is found that only three tools had been validated, and MNA and NHC were found to be the most popular tools for research in Malaysia. Anthropometric measurements were also commonly found to be used in all studies. The body BMI is an essential indicator of nutritional status commonly used internationally and locally due to its simplicity of application and reference categories that allow comparisons between populations, are not invasive, and have reasonable procedures.[34] However, the only constraint for its usage in the elderly were its poor identification of the exchange between compartments due to the aging process.[35]

Tools with the most significant validity evidence for the study design and outcomes appear to be the MNA and NHC in residential care for the elderly. It was found that the prevalence of malnutrition among the elderly in old folk homes in Malaysia ranged from 12.3% to 17.4%. Meanwhile, 40.4% to 57.7% of the population are at risk of malnutrition.

CONCLUSION

After a detailed critical review of the malnutrition screening tools for the elderly from sheltered homes, it is concluded that MNA and DETERMINE NHC are the most suitable tools to use in residential care in Malaysia owing to their high sensitivity and specificity. Although many of the tools used were lacking in the validation, previous research studies carried out to date are still beneficial for the positive effect of malnutrition screening, particularly in the older population.

The outcomes from this review paper will support evidence-based practice in managing malnutrition in older adults. A subsequent study is suggested to construct a scoring system that rates the screening tools based on their validity, suitability, and practicability to help harmonize malnutrition screening research and clinical practice across Malaysia.

CONFLICT OF INTEREST
None of the authors have any conflicts of interest.

REFERENCES

1. Department of Statistics Malaysia. Current population estimates, Malaysia, 2018-2019. Available from: https://www.dosm.gov.my/v1/index.php?r=column/cthemeByCat&cat=155&bul_id=aWJZRkJ4UEdKcUZpT2tVT090Snpydz09&menu_id=L0pheU43NWJwRWVSZklWdzQ4TlhUUT09.

2. World Health Organization (WHO). Nutrition for older persons. Available from: https://apps.who.int/nutrition/topics/ageing/en/index2.html.

3. Department of Statistics Malaysia. Current population estimates, Malaysia, 2022. Available from: https://www.dosm.gov.my/v1/index.php?r=column/cthemeByCat&cat=155&bul_id=dTZXanV6UUdyUEQ0SHNWOVhpSXNMUT09&menu_id=L0pheU43NWJwRWVSZklWdzQ4TlhUUT09

4. Chen ST, Ngoh HJ, Sakinah H. Prevalence of malnutrition among institutionalized elderly people in Northern Peninsular Malaysia: gender, ethnicity and age-specific. Sains Malaysiana. 2012;41(1):141–8.

5. Cho K-H, Chung Y, Roh Y-K, Cho B, Kim C-H, Lee H-S. Health care for older persons: a country profile–Korea. J Am Geriatr Soc. 2004;52(7):1199–204. https://doi.org/10.1111/j.1532-5415.2004.52322.x.

6. Gavazzi G, Herrmann F, Krause KH. Aging and infectious diseases in the developing world. Clin Infect Dis. 2004;39(1):83–91. https://doi.org/10.1086/421559.

7. Jitapunkul S, Kunanusont C, Phoolcharoen W, Suriyawongpaisal P, Ebrahim S. Determining public health priorities for an ageing population: the value of a disability survey. Southeast Asian J Trop Med Public Health. 2003;34(4):929–36.

8. Shahar S, Earland J and Rahman SA. Social and health profiles of rural elderly Malays. Singapore Med J. 2001;42(5):208–13.

9. Hickson M. Malnutrition and ageing. Postgrad Med J. 2006;82(963):2–8. http://dx.doi.org/10.1136/pgmj.2005.037564.

10. Hayflick L. Biological aging is no longer an unsolved problem. Ann N Y Acad Sci. 2007;1100:1-13. https://doi.org/10.1196/annals.1395.001.

11. Zia Agha. Senior malnutrition: a public health crisis impacting successful aging – why it should matter. 2018. Richmond: Health Quality Innovators – Maryland and Virginia Quality and Innovation Network.

12. Abd Aziz NAS, Teng NIMF, Abdul Hamid MR, Ismail NH. Assessing the nutritional status of hospitalized elderly. Clin Inter Aging. 2017;12:1615–25. https://doi.org/10.2147/CIA.S140859.

13. World Health Organization (WHO). Malnutrition. 2020. Available from: https://www.who.int/news-room/questions-and-answers/item/malnutrition.

14. Park K. Parks Textbook of Preventive and Social Medicine. 2000. 16th edition. M/S Banarsidas Bhanot, Jabalpur, 2000 India.

15. Federal Interagency Forum on Aging-Related Statistics. Older Americans 2016: Key indicators of well-being. Federal Interagency Forum on Aging-Related Statistics. 2016. Washington, DC. https://agingstats.gov/docs/LatestReport/Older-Americans-2016-Key-Indicators-of-WellBeing.pdf.

16. Sampson G. Weight loss and malnutrition in the elderly--the shared role of GPs and APDs. Aust Fam Physician. 2009;38(7): 507–10.

17. Gibson RS. Principles of nutritional assessment. 2005. 2nd edition. Oxford University Press Inc., New York.

18. Visvanathan R, Zaiton A, Sherina MS, and Muhamad YA. The nutritional status of 1081 elderly people residing in publicly funded shelter homes in Peninsular Malaysia. Eur J Clin Nutr. 2005;59(3): 318–24. https://doi.org/10.1038/sj.ejcn.1602075.

19. Fatin-Izzaty MS, Noraida O. Factors associated with total satisfaction with food-related life among elderly in Rumah Seri Kenangan Cheras, Selangor. International Journal of Public Health and Clinical Sciences. 2018;5(4):246–52.

20. Siti Al-Baidakh AA, Barakatun-Nisak MY, and Noraida O. Preliminary findings of malnutrition risk factors among older adults in a care home. International Journal of Public Health and Clinical Sciences. 2019;6(1): 209–18. https://doi.org/10.32827/ijphcs.6.1.209.

21. Guigoz Y. The mini nutritional assessment (MNA) review of the literature – What does it tell us? J Nutr

Health Aging. 2006;10(6):466–87.

22. Donini LM, Scardella P, Piombo L, Nerp B, Asprino R, Proietti AR, Carcaterra S, Cava E, Cataldi S, Cucinotta D, Di Bella G, Barbagallo M, Morrone A. Malnutrition in elderly: social and economic determinants. Journal of Nutrition Health and Aging. 2013;17(1):9–15. https://doi.org/10.1007/s12603-012-0374-8.

23. Guigoz Y, Vellas B. Test d'évaluation de l'etat nutritionnel de la personne âgee: le Mini Nutritional Assessment (MNA) [Test to assess the nutritional status of the elderly: The Mini Nutritional Assessment (MNA]. American Journal of Tropical Medicine and Hygiene. 1995;53:1965–9.

24. Dwyer J. Strategies to detect and prevent malnutrition in the elderly: The nutrition screening initiative. Nutrition Today. 1994;29(5):14–24.

25. Posner BM, Jette, AM, Smith KW, and Miller DR. Nutrition and health risks in the elderly: the nutrition screening initiative. Am J Public Health. 1993;83 (7):972–8. https://doi.org/10.2105/AJPH.83.7.972.

26. de Groot LC, Beck AM, Schroll M, van Staveren WA. Evaluating the DETERMINE Your Nutritional Health Checklist and the Mini Nutritional Assessment as tools to identify nutritional problems in elderly Europeans. Eur J Clin Nutr. 1998;52 (12):877–83. https://doi.org/10.1038/sj.ejcn.1600658.

27. Wade DT, Collin C. The Barthel ADL Index: a standard measure of physical disability? Int Disabil Stud. 1988;10(2):64–7. https://doi.org/10.3109/09638288809164105.

28. Yesavage JA, Brink TL, Rose TL, Lum O, Huang V, Adey M, and Leirer VO. Development and validation of a geriatric depression screening scale: a preliminary report. J Psychiatr Res. 1982;17(1):37–49. https://doi.org/10.1016/0022-3956(82)90033-4.

29. Sutcliffe C, Cordingley, L, Burns A, Mozley CG, Bagley H, Huxley P and Challis D. A new version of the geriatric depression scale for nursing and residential home populations: the geriatric depression scale (residential) (GDS-12R). Int Psychogeriatr. 2000;12(2):173–81. https://doi.org/10.1017/S104161020000630X.

30. Naithani S, Thomas JE, Whelan K, Morgan M, Gulliford MC. Experiences of food access in hospital. A new questionnaire measure. Clin Nutr. 2009;28 (6):625–30. https://doi.org/10.1016/j.clnu.2009.04.020.

31. Casadei K, Kiel J. Anthropometric Measurement. [Updated 2021 Oct 1]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2022 Jan-. Available from: https://www.ncbi.nlm.nih.gov/books/NBK537315/.

32. Kaiser MJ, Bauer JM, Ramsch C, Uter W, Guigoz Y, Cederholm T, et al. Validation of the Mini Nutritional Assessment short-form (MNA-SF): a practical tool for identification of nutritional status. J Nutr Health Aging. 2009;13(9):782–8. https://doi.org/10.1007/s12603-009-0214-7.

33. Oehlschlaeger MHK, Pastore CA, Cavalli AS, Gonzalez MC. Nutritional status, muscle mass and strength of elderly in Southern Brazil. Nutr Hosp. 2015;31(1):363-70. Doi: 103305/nh.2015.31.1.7264.

34. Bhattacharya A, Pal B, Mukherjee S. et al. Assessment of nutritional status using anthropometric variables by multivariate analysis. BMC Public Health. 2019;19:1045. https://doi.org/10.1186/s12889-019-7372-2.

35. Yeom J, Kim JK, Crimmins EM. Factors Associated with Body Mass Index (BMI) Among Older Adults: A Comparison Study of the U.S., Japan, and Korea. Hanguk Nonyonhak. 2009;29(4):1479-1500. PMID: 25285028; PMCID: PMC4184278.