Journal of Umm Al-Qura University for Medical Sciences

Journal homepage: https://uqu.edu.sa/en/mj

Research Article

Assessment of Nutritional Status and its Associated Factors in the Elderly Population from the Western Region, Saudi Arabia: A Cross-sectional Study

Firas S. Azzeh[1,*], Marea I. Alzhrani[1], Areej A. Al-Subhi[1], Ashwaq S. Bawazir[1], Nouf M. Al-Harbi[1], Safaa A. Sindi[1], Ayah F. Alattas[1], Baraah N. Qutub[1], Lutfiah H. Saifuddin[1], Toleen O. Mohandis[1]

[1]Clinical Nutrition Department, Faculty of Applied Medical Sciences, Umm Al-Qura University, Makkah, Saudi Arabia

ARTICLE INFO

Received: 27/08/2023
Revised: 18/10/2023
Accepted: 27/10/2023

Keywords:
Malnutrition, Makkah, Mini Nutritional Assessment, Risk factors, Socioeconomic factors.

***Corresponding author:**
Firas Azzeh
E: fsazzeh@uqu.edu.sa

ABSTRACT

Background: Old age is a physiological cycle that develops over time and results in senescence, or a reduction in biological capabilities and a body's capacity to respond to metabolic stress. Malnutrition is common in the elderly and refers to deficiency, excess, or calorie imbalance. This cross-sectional research is designed to find out the prevalence of malnutrition and assess the extent of the association between socioeconomic factors and malnutrition in elderly people dwelling in the Western region of Saudi Arabia.

Methods: The study was carried out on 623 elderly people. The inclusion criteria were elderly people aged 60-75 years from the Western Region of Saudi Arabia. An online questionnaire was submitted to eligible participants. The Mini Nutritional Assessment was used to determine the malnutrition status of elderly people.

Results: Study results showed that 37 (5.9%) of the participants were malnourished. Factors associated with malnutrition in the elderly were age, widowed, living alone, diabetes, hypertension, heart disease, disability, and dental problems.

Conclusion: The prevalence of malnutrition in elderly people dwelling in the Western region of Saudi Arabia was low. Factors associated with malnutrition were related to age, living alone, being widowed, and diseases such as diabetes, hypertension, heart problems, dental problems, and disability.

INTRODUCTION

Everyone in every country should have the chance to live a long and healthy life. Old age is a phase of life, and it is a physiological cycle that develops over time and results in senescence, or a reduction in biological capabilities and a body's capacity to respond to metabolic stress (AlHamdan et al., 2019). Old age is often viewed as a complex phenomenon that involves physical, psychological, and social changes. The benefit is that we gain desirable qualities like knowledge and experience (Al-Thaiban et al., 2023).

The number of older adults has been constantly growing around the globe. Old people can be defined as those who are 60 or older, contributing significantly to society as active members of families, volunteers, and employees (WHO, 2023). According to the latest estimates of the General Authority for Statistics in the Kingdom of Saudi Arabia (2019), the elderly constitute 4.2% of the total Saudi population, 24% of them in the Western region. Malnutrition is used to define nutrition-related disorders. It refers to deficiency, excess, or calorie imbalance. Malnutrition with micronutrients encompasses both insufficient amounts and excessive levels of essential vitamins and minerals (AlGhofaili et al., 2023). Malnutrition increases exacerbations, mortality, and expense while hurting exercise, muscle, and lung function in elderly people (Keogh & Mark, 2021). In addition, social and economic issues could be addressed to combat malnutrition among the elderly. Additionally, the medical impact of malnutrition has severe and long-lasting consequences for individuals, their families, communities, and nations. (Soeters et al., 2017; WHO, 2021).

This investigation aimed to determine the extent of the association between socioeconomic factors and malnutrition in elderly individuals dwelling in the Western region of Saudi Arabia.

MATERIALS AND METHODS

Study participants

A non-randomized, cross-sectional study using a convenience sampling technique was conducted from

Doi: https://doi.org/10.54940/ms71144099

October 2022 to January 2023 during the academic year of 2022/2023. The study was conducted on elderly people in the Western Region (Makkah, Jeddah, Medina, and Taif), Saudi Arabia.

The inclusion criteria were elderly people aged 60-75 years from Western Region. The exclusion criteria for the study were people not from the Western Region and aged less than 60 and more than 75 years. The Epi Info™ software was used (https://www.cdc.gov/epiinfo/index.html), and the minimal required sample size was 384 participants to achieve a study power of 95%. This study was approved by the Ethical Committee of Umm Al-Qura University (approval number AMSEC-6-954-2022) and performed by following the Declaration of Helsinki. Informed consent was obtained from all participants at the onset of the study. Participants were assured of confidentiality and their right to withdraw from the study.

Assessment of malnutrition

An online questionnaire was submitted to 623 eligible participants. Personal information was obtained through a closed questionnaire. The Mini Nutritional Assessment (MNA) was used to determine the malnutrition status of elderlies. The MNA questionnaire includes six sections: height and weight, calculated body mass index (BMI), food intake, weight loss, mobility, acute diseases, and neurophysiological problems. The income was determined as a total family income in Saudi Riyals (SAR). The income support group is defined as a benefit that helps people on a low income with their living costs.

The MNA questionnaire uses a scoring system in which each question is assigned a specific score based on the response provided by the elderly individual. An MNA score of 12-14 points for each question identifies patients with normal nutritional status. Scores between 8 and 11 identify those at risk for malnutrition, while values between 0 and 7 indicate malnutrition.

Statistical analysis

Statistical analysis was conducted using IBM-SPSS statistics (Statistic Package for Social Sciences; Armonk, NY) version 23, with P values <0.05 considered statistically significant. Continuous variables were expressed as mean ± standard deviation. The frequencies of categorical variables were compared using a Chi-squared test. The *Kruskal–Wallis test* was used to compare mean ranks between the three groups with non-normal distribution. The odds ratio (OR) and 95% confidence intervals (95% CI) were determined using univariate binary logistic regression to assess the risk factors related to malnutrition.

RESULTS

Table 1 represents the baseline characteristics of participants. The prevalence of normal nutritional status, at risk of malnutrition, and malnourished participants was 401 (64.4%), 185 (29.7%), and 37 (5.9%), respectively. The mean age was 65 years ± 5.5. Regarding gender, males were 277 (44.5%), and females were 346 (55.5%). 594 (95.3%) were Saudi, and 29 (4.7%) were non-Saudi.

Figure 1 illustrates that the highest percentage was for normal nutritional status (64.4%), followed by at risk of malnutrition (29.7%), and the lowest percentage was for

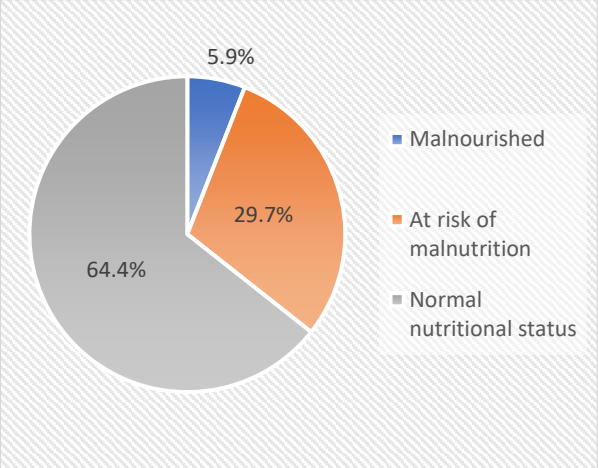

Figure 1: *Percent prevalence of malnutrition among the elderly. The highest percentage (64.4%) was for normal nutritional status, followed by at risk of malnutrition (29.7%), and the lowest percentage was for malnourished (5.9%).*

malnourished (5.9%). In Table 2, we have shown the relationship between the degree of malnutrition and participant characteristics. These variables show significant differences in the degree of malnutrition: age ($P < 0.001$), weight in kg ($P < 0.004$), BMI ($P < 0.001$), and MNA total score ($P < 0.001$). Widows have the highest percentage of malnourished (43.2%) and the most normal nutritional status in married (78.3%) in social status that have significant differences ($P<0.001$). Overall, the higher the educational level and income, the less malnutrition with significant differences ($P<0.001$) in nutrition status, such as in elementary and less have the highest percentage (27%), bachelor's degree in normal nutritional status (54.9%), income around 10001-20000 SAR have normal nutritional status by (39.9%) and the lowest income have the highest percentage of malnourished by (45.9%). The elderly people who were financially dependent were about 78.9% at risk of malnutrition. Dental problems (81.1%), diabetes (73%), and hypertension (67.6%) diseases had the highest risk of malnutrition, followed by heart disease (43.2%), and disability (43.2%).

Table 3 shows the results of the potentially significant predictors related to malnutrition. Age (OR= 1.150, 95% CI = 1.094 – 1.208), social state (widowed) (OR =7.578, 95% CI = 3.441 -16.687), (living alone OR= 7.493,95%, CI=3.089-18.175), diabetes (OR= 3.707, 95% CI= 1.747-7.863), hypertension (OR= 2.337,95%, CI= 1.142-4.78), heart disease (OR= 5.003, 95%, CI= 2.455-10.193), disability (OR=3.408, 95% CI= 14.396-97.313), and dental problems (OR=1.609, 95% CI=2.063-11.199) showed significant predictors for malnutrition in elderly people.

Table 1: *Baseline characteristics of participants (n=63)*

Variables	Frequency (%) Mean±SD
Age	65 ± 5.5
Gender	
Male	277 (44.5%)
Female	346 (55.5%)
Nationality	
Saudi	594 (95.3%)
Non-Saudi	29 (4.7%)
Residence	
Makkah	370 (59.4%)
Jeddah	190 (30.5%)
Al-Taif	28 (4.5%)
Al-Madinah	35 (5.6%)
Social state	
Married	448 (71.9%)
Single	22 (3.5%)
Devoured	48 (7.7%)
Widowed	105 (16.9%)
Educational level	
Elementary or less	80 (12.8%)
Middle school	33 (5.3%)
High school	95 (15.2%)
Bachelor's degree	317 (50.9%)
Postgraduate degree	98 (15.7%)
Family income	
5000 and less	140 (22.5%)
50001 - 10000	142 (22.8%)
10001- 20000	223 (35.8%)
20001 and more	118 (18.9%)
Income support group	
Children	214 (34.3%)
Other	409 (65.7%)
Describe your financial status	
Dependent	521 (83.6%)
Independent	102 (16.4%)
Living status	
Alone	82 (13.2%)
With wife or husband	366 (58.7%)
With children	175 (28.1%)
Diabetes	
Yes	298 (47.8%)
No	325 (52.2%)
Hypertension	
Yes	313 (50.2%)
No	310 (49.8%)
Heart disease	
Yes	120 (19.3%)
No	503 (80.7%)
Disability	
Yes	36 (5.8%)
No	587 (94.2%)
Dental problems	
Yes	328 (52.6%)
No	295 (47.4%)
Smoking	
Yes	113 (18.1%)
Ex-smoker	410 (65.8%)
No	100 (16.1%)

DISCUSSION

This cross-sectional study aimed to assess the extent of the correlation between socioeconomic factors and malnutrition in the elderly population (aged 60-75 years) residing in the Western region of the Kingdom of Saudi Arabia, including Makkah, Jeddah, Taif, and Medina. The results of this study indicated that the prevalence of malnutrition and the risk of malnutrition among participants were 5.9% and 29.7%, respectively. The study findings revealed that several factors, such as age, living alone, disability, diabetes, hypertension, social status (widowed), heart disease, and dental issues, were significantly associated with malnutrition and an increased risk of malnutrition.

A study in Riyadh, Saudi Arabia, found that 19.4% of elderly individuals were malnourished (AlGhofaili et al., 2023), a higher rate than in our study. This discrepancy may stem from different sample collection methods, as the Riyadh study was conducted in two medical centers, while our community-based study offers a broader representation of the elderly population, providing a more accurate assessment of malnutrition prevalence.

Higher age showed a significant increase in malnutrition. This might be explained by studies that found malnutrition is more prevalent in older adults compared with their younger counterparts because older people (>60y) had lower fat-free mass and higher fat mass remarkably (Besora-Moreno et al., 2020). The process of aging can contribute to malnutrition through its impact on coordination, stability, and balance, which in turn can hinder individuals' ability to carry out everyday tasks like grocery shopping and meal preparation (Besora-Moreno et al., 2020). Globally, the incidence of malnutrition in the elderly population was up to 24.6%. However, due to the aging population, the occurrence of malnutrition is anticipated to rise, with a projected prevalence of 29.1% by the year 2080 (Besora-Moreno et al., 2020). The finding is consistent with a study carried out in Jeddah by Alzahrani and Alamri (2017) that indicated a higher prevalence of malnutrition in older individuals. The authors noted that aging impacts nutritional status due to sensory changes (declines in smell, vision, and taste) that reduce appetite and food intake. Additionally, digestive system alterations disrupt nutrient absorption and digestion, contributing to malnutrition in the elderly.

Higher weight showed a significant increase in malnutrition. A loss of skeletal muscle mass and function that occurs over time due to ageing is known as sarcopenia (Cederholm et al., 2017). In Europe, between the ages of 60 and 70, there is a 5%–13% loss in muscle mass. Sarcopenia, which causes muscular deterioration and, eventually, muscle loss, is dramatically exacerbated by decreased physical activity. When present in high concentrations, the cytokines CRP, IL-6, TNF-α, and IL-10

Table 2*: Relationship between degree of malnutrition and participant characteristic*

Variable	Degree of Malnutrition Frequency (%)			P-value
	Malnourished (n=37)	Risk of malnutrition (n=185)	Normal nutritional status (n=401)	
Gender Male Female	20 (54.1%) 17 (45.9%)	74 (40%) 111 (60%)	183 (45.6%) 218 (54.4%)	0.213
Age	70.1 ± 7.4	65.4 ± 5	64.4 ± 5	<0.001
Height in cm	169 ± 12.7	164.9 ± 8.6	164.6 ± 9.6	0.103
Weight in kg	74.7 ± 25.1	75.9 ± 18.7	79.9 ± 16.9	0.004
BMI (kg/m^2)	26.1 ± 8	27.9 ± 6.7	29.5 ± 6.2	<0.001
MNA total score	5.5 ± 1.4	10.1 ± 1.0	13.3 ± 0.8	<0.001
Nationality Saudi Non-Saudi	 34 (91.9%) 3 (8.1%)	 170 (91.9%) 15 (8.1%)	 390 (97.3%) 11 (2.7%)	0.01
Social status Married Single Divorced Widowed	 13 (35.1%) 3 (8.1%) 5 (13.5%) 16 (43.2%)	 121 (65.4%) 6 (3.2%) 20 (10.8%) 38 (20.5%)	 314 (78.3%) 13 (3.2%) 23 (5.7%) 51 (12.7%)	<0.001
Educational level Elementary and less Middle school High school Bachelor's degree Post-graduate degree	 10 (27%) 6 (16.2%) 9 (24.3%) 7 (18.9%) 5 (13.5%)	 33 (17.8%) 14 (7.6%) 27 (14.6%) 90 (48.6%) 21 (11.4%)	 37 (9.2%) 13 (3.2%) 59 (14.7%) 220 (54.9%) 72 (18%)	<0.001
Family income (SAR) 5000 and less 5001- 10000 10001 – 20000 20001and more	 17 (45.9%) 6 (16.2%) 7 (18.9%) 7 (18.9%)	 52 (28.1%) 46 (24.9%) 56 (30.3%) 31 (16.8%)	 71 (17.7%) 90 (22.4%) 160 (39.9%) 80 (20%)	0.001
Income support group Children Other	 17 (45.9%) 20 (54.1%)	 61 (33%) 124 (67%)	 136 (33.9%) 265 (66.1%)	0.302
Describe your financial status Dependent Independent	 20 (54.1%) 17 (45.9%)	 146 (78.9%) 39 (21.1%)	 355 (88.5%) 46 (11.5%)	<0.001
living status Alone With wife or husband With children	 12 (32.4%) 11 (29.7%) 14 (37.8%)	 32 (17.3%) 94 (50.8%) 59 (31.9%)	 38 (9.5%) 261 (65.1%) 102 (25.4%)	<0.001
Diabetes Yes No	 27 (73%) 10 (27%)	 102 (55.1%) 83 (44.9%)	 169 (42.1%) 232 (57.9%)	<0.001
Hypertension Yes No	 25 (67.6%) 12 (32.4%)	 99 (53.5%) 86 (46.5%)	 189 (47.1%) 212 (52.9%)	0.034
Heart disease Yes No	 16 (43.2%) 21 (56.8%)	 51 (27.6%) 134 (72.4%)	 53 (13.2%) 348 (86.8%)	<0.001
Disability Yes No	 16 (43.2%) 21 (56.8%)	 12 (6.5%) 173 (93.5%)	 8 (2%) 393 (98%)	<0.001
Dental problem Yes No	 30 (81.1%) 7 (18.9%)	 109 (58.9%) 76 (41.1%)	 189 (47.1%) 212 (52.9%)	<0.001
Smoking Yes Ex-smoker No	 7 (18.9%) 21 (56.8%) 9 (24.3%)	 37 (20%) 118 (63.8%) 30 (16.2%)	 69 (17.2%) 271 (67.6%) 61 (15.2%)	0.544

Table 3: *Potentially significant predictors related to malnutrition**

Variable	OR	95% CI	P-value
Weight	0.982	0.961-1.004	0.102
Age	1.150	1.094-1.208	<0.001
Nationality Saudi Non-Saudi	 0.320 1	 0.085-1.201	 0.01
Social State Single Divorced Widowed Married	 5.574 5.251 7.578 1	 1.413-21.990 1.722-16.011 3.441-16.687	 0.014 0.004 <0.001
Educational level Elementary and less Middle school High school Bachelor's degree Post-graduate degree	 3.892 6.646 2.197 0.458 1	 1.239-12.223 1.756-25.021 698-6910 141-1.488	 0.020 0.005 0.178 0.194
Family income (SAR) 5000 and less 5001-10000 10001-20000 20001 and more	 2.736 0.762 0.50 1	 1.073-6.980 0.246-2.362 0.170-1.475	 0.35 0.638 0.209
Financial status Independent Dependent	 6.56 1	 3.206-13.420	 <0.001
Living status Alone with children with wife or husband	 7.493 3.257 1	 3.089-18.175 1.431-7.410	 <0.001 0.005
Diabetes Yes No	 3.707 1	 1.747-7.863	 0.001
Hypertension Yes No	 2.337 1	 1.142-4.780	 0.02
Heart disease Yes No	 5.003 1	 2.455-10.193	 <0.001
Disability Yes No	 37.429 1	 14.396-97.313	 <0.001
Dental problem Yes No	 4.807 1	 2.063-11.199	 <0.001

**The reference group is the normal nutritional status participants; Abbreviations: CI: Confidence interval, OR: Odds ratio.*

are most frequently linked to the onset of sarcopenia. Reduced sex hormones, glucocorticoid, and catecholamine levels, which develop with age, can enhance cytokine activity (Wang et al., 2017). According to a study conducted by AlHamadan et al. (2019), it was found that there is a high prevalence of obesity (43.2%) among older adults living in Riyadh. The study suggests that obesity can be a risk factor for malnutrition in the elderly. The researchers theorized that the increased fat percentage as-sociated with obesity can lead to sarcopenic obesity, ultimately contributing to higher rates of malnutrition in this population.

The reference group is the normal nutritional status a Widows showed a significant increase in malnutrition. A total of twenty-four studies examined the re-lationship between marital status and malnutrition or the risk of malnutrition, and eleven of those studies exposed significant findings. Research conducted by Besora-Moreno et al. (2020) revealed that living alone amplifies the risk of malnutrition by 1.8 times. The previous study found that both males and females who live alone are at a significantly greater risk of malnutrition. According to Alzahrani et al. (2016), elderly individuals who live alone are at a greater risk of experiencing depression and malnutrition. This finding was further corroborated by Al-Thaiban et al. (2023), who found that depressed elderly individuals living alone were more likely to be malnourished compared to those who were not de-pressed. Consequently, widows, who are often affected by psychological distress and reduced mental health, are particularly susceptible to malnutrition, by affecting their eating habits and overall nutrition-al status.

A particular strength of our study is the difference between other investigations that could be caused by differences in risk factors, socioeconomic status, social state, living status, and educational levels. Furthermore, no prior investigations have examined the nutritional status or prevalence of malnutrition among elderly individuals (aged 60-75 years) in the western region of Saudi Arabia. A limitation of the present study is using MNA-SF, malnutrition cannot be measured with an instrument that is perfectly accurate notwithstanding the MNA-SF being the most popular tool for screening and evaluating nutritional status. Finally, the participants themselves provided self-reporting of their height and weight.

CONCLUSION

Only 5.9% of the participants were malnourished. According to the MNA questionnaire, many socioeconomic factors are related to malnutrition, such as age, living alone, social status (widow), and diseases such as diabetes, hypertension, heart problems, dental problems, and disability. Further research should be conducted to better generalize findings in various areas and use a greater sample size. Further research is recommended to generalize these findings by covering various areas in Saudi Arabia. Furthermore, a greater sample size and more socioeconomic factors are recommended for further studies.

AUTHORS CONTRIBUTION

FA and MZ conceived and designed the study; AS and AB conducted research; NH, SS, AA, and BQ provided

research materials and collected the data; FA, LS, and TM analyzed and interpreted data; FA, MZ, and TM wrote the initial draft, and FA finalized the manuscript. All authors have critically reviewed and approved the final manuscript and are responsible for its content.

DECLARATIONS

Ethical Approval

This study was approved by the Ethical Committee of Umm Al-Qura University (approval number AMSEC-6-954-2022).

Participants Consent

All participants gave informed consent at the onset of the study. They were assured of confidentiality and their right to withdraw from the study.

Source of Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or non-profit sectors.

Conflict of Interest

All authors have declared that no financial support was received from any organization for the submitted work. All authors have declared that no other relationships or activities could appear to have influenced the submitted work.

OPEN ACCESS

REFERENCES

Agarwal, E., Miller, M., Yaxley, A., & Isenring, E. (2013). Malnutrition in the elderly: A narrative review. *Maturitas*, *76*(4), 296–302. https://doi.org/10.1016/j.maturitas.2013.07.013

Ahmed, T., & Haboubi, N. (2010). Assessment and management of nutrition in older people and its importance to health. *Clinical Interventions in Aging*, *5*(5), 207–216. https://doi.org/10.2147%2Fcia.s9664

Alghofaili, A. A., Aladel, A. I., Alsoghier, A. M., Othman, F., Shoqeair, M. M., Alqahtani, S. M., Alnughaimish, A. M., Alanazi, B. A., AI Mosallam, S. A., Alharbi, A. S., & Alquraishi, M. (2023). Association of Oral and General Health with Nutritional Status of Older Adults Attending Two Medical Centers in Riyadh, Saudi Arabia: A Cross-Sectional Study. *Nutrients*, *15*(18), 4032. https://doi.org/10.3390/nu15184032

Alhamdan, A. A., Bindawas, S. M., Alshammari, S. A., Al-Amoud, M. M., Al-Orf, S. M., Al-Muammar, M. N., & Calder, P. C. (2019). Prevalence of malnutrition and its association with activities of daily living in older adults attending primary health care centers: a multistage cross-sectional study: A multistage cross-sectional study. *Progress in Nutrition*, *21*(4), 1011–1018. https://doi.org/10.23751/pn.v21i4.8381

Alzahrani, S. H., & Alamri, S. H. (2017). Prevalence of malnutrition and associated factors among hospitalized elderly patients in King Abdulaziz University Hospital, Jeddah, Saudi Arabia. *BMC Geriatrics*, *17*(1). https://doi.org/10.1186/s12877-017-0527-z

Alzahrani, S. H., El Sayed, I. A., & Alshamrani, S. M. (2016). Prevalence and factors associated with geriatric malnutrition in an outpatient clinic of a teaching hospital in Jeddah, Saudi Arabia. *Annals of Saudi Medicine*, *36*(5), 346–351. https://doi.org/10.5144/0256-4947.2016.346

Althaiban, M. A., Aljefree, N. M., Almoraie, N. M., & Shatwan, I. M. (2023). Malnutrition is associated with increased disease risk in older people in the Makkah region of Saudi Arabia: A cross-sectional study. *Frontiers in Public Health*, *11*, 1149739. https://doi.org/10.3389/fpubh.2023.1149739

Besora-Moreno, M., Llauradó, E., Tarro, L., & Solà, R. (2020). Social and Economic Factors and Malnutrition or the Risk of Malnutrition in the Elderly: A Systematic Review and Meta-Analysis of Observational Studies. *Nutrients*, *12*(3), 737. https://doi.org/10.3390/nu12030737

Cederholm, T., Barazzoni, R., Austin, P., Ballmer, P., Biolo, G., Bischoff, S. C., Compher, C., Correia, I., Higashiguchi, T., Holst, M., Jensen, G. L., Malone, A., Muscaritoli, M., Nyulasi, I., Pirlich, M., Rothenberg, E., Schindler, K., Schneider, S. M., de van der Schueren, M. A. E., & Sieber, C. (2017). ESPEN guidelines on definitions and terminology of clinical nutrition. *Clinical Nutrition*, *36*(1), 49–64. https://doi.org/10.1016/j.clnu.2016.09.004

Dalle, S., Rossmeislova, L., & Koppo, K. (2017). The Role of Inflammation in Age-Related Sarcopenia. *Frontiers in Physiology*, *8*. https://doi.org/10.3389/fphys.2017.01045

General Authority for Statistics. (2019). *The Elderly in the Kingdom for the Year 2019*. https://www.stats.gov.sa/en/1006

Keogh, E., & Mark Williams, E. (2020). Managing malnutrition in COPD: A review. *Respiratory Medicine*, *176*, 106248. https://doi.org/10.1016/j.rmed.2020.106248

Kyle, U. G., Unger, P., Mensi, N., Genton, L., & Pichard, C. (2002). Nutrition status in patients younger and older than 60 y at hospital admission: a controlled population study in 995 subjects. *Nutrition*, *18*(6), 463–469. https://doi.org/10.1016/S0899-9007(01)00804-8

Siddique, N., O'Donoghue, M., Casey, M. C., & Walsh, J. B. (2017). Malnutrition in the elderly and its effects on bone health – A review. *Clinical Nutrition ESPEN*, *21*, 31–39. https://doi.org/10.1016/j.clnesp.2017.06.001

Soeters, P., Bozzetti, F., Cynober, L., Forbes, A., Shenkin, A., & Sobotka, L. (2017). Defining malnutrition: A plea to rethink. *Clinical Nutrition*, *36*(3), 896–901. https://doi.org/10.1016/j.clnu.2016.09.032

WHO (2021) *Malnutrition.* https://www.who.int/ar/news-room/fact-sheets/detail/malnutrition.

WHO (2023) *Ageing*. https://www.who.int/health-topics/ageing