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ASSESSMENT OF MALNUTRITION AND ITS ASSOCIATION WITH APPETITE AND ANTHROPOMETRIC CHARACTERISTICS AMONG OLDER ADULTS: A CROSS-SECTIONAL STUDY

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Abstract

Objective: *To assess the nutritional status of older adults and determine its association with appetite and anthropometric characteristics, including BMI, MAC, and CC.*

Materials & Methods: *This single-center cross-sectional study was conducted at a Private Health Center (PHC) at Lahore, Pakistan. The study included individuals aged 65 years and older who were residing in the district and attending the PHC. At the time of the study, approximately 1,000 older adults aged ≥65 years lived in the district, with approximately 120 older adults attending the FHC each month. A total of 148 participants were recruited between January 15, 2026 to June 10, 2026 based on their willingness to participate and fulfillment of the eligibility criteria. Individuals with severe psychiatric disorders, dementia, or communication difficulties, including severe hearing or visual impairment, were excluded. Ethical approval was obtained from the Head of PHC. After providing informed consent, eligible participants were interviewed face-to-face to collect sociodemographic and general health information. Anthropometric measurements were obtained and recorded, while relevant biochemical data from the preceding month were retrieved from the patients' medical records. Nutritional status was assessed using the Mini Nutritional Assessment (MNA) questionnaire, supplemented by 13 questions.*

Results: *A total of 148 older adults were included, of whom 51 (34.46%) were malnourished, 27 (18.24%) were at risk of malnutrition, and 70 (47.30%) had normal nutritional status. Nutritional status differed significantly according to age, education, residence, appetite, BMI, MAC, CC, and MNA score (all $p < 0.05$). Participants with malnutrition were older, more likely to live alone, and had a higher prevalence of severe anorexia. Mean BMI, MAC, and CC were significantly lower in the malnutrition group than in the risk and normal nutrition groups ($p < 0.001$). Mean MNA scores were 12.72 ± 1.48, 22.34 ±*

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2.60, and 28.34 ± 3.30 in the malnutrition, risk, and normal nutrition groups, respectively ($p < 0.001$). Among malnourished participants, 70.59% were women and 29.41% were men. Overall, the findings demonstrate a substantial burden of malnutrition and highlight the importance of early nutritional screening among older adults.

***Conclusion**: Malnutrition affected 34.46% of older adults, with 18.24% at risk. Advanced age, living alone, poor appetite, and lower anthropometric measures were associated with poor nutritional status, emphasizing the need for early MNA-based screening and intervention.*

Introduction

Malnutrition is a broad nutritional disorder that occurs when the body does not receive adequate amounts of energy, nutrients, or other essential dietary components required for normal physiological functioning. It may result from insufficient dietary intake, impaired nutrient absorption, increased nutritional requirements, or underlying health conditions [1]. The European Society for Clinical Nutrition and Metabolism (ESPEN) has highlighted the growing global burden and risk of malnutrition across different population groups. Although malnutrition can affect individuals of all ages, certain populations, particularly older adults, are at increased risk due to physiological, socioeconomic, and health-related factors [2].Malnutrition, as well as the risk of developing malnutrition, can have serious adverse consequences for individuals and healthcare systems. It is associated with impaired immune function, reduced physical capacity, delayed recovery from illness, increased susceptibility to complications, prolonged hospital stays, and higher healthcare expenditure. Furthermore, malnutrition can substantially reduce quality of life and increase morbidity and mortality, particularly among vulnerable populations. Early identification of nutritional risk and timely nutritional intervention are therefore essential for preventing complications and improving health outcomes [3].

Life expectancy has increased in parallel to the improvements in the quality of life and the decrease in the birth rates worldwide, and this has resulted in a gradual increase in the elderly population. According to the expectations of the World Health Organization, it is estimated that there will be approximately 1.2 billion elderly people in 2025, and this figure will reach two billion by 2050, with 80% of the elderly population in the world living in developing countries.Elderly people (aged 65 years and older) made up 7.7% of the global population in 2013, and it is estimated that this will have increased to 10.2% by 2023, to 20.8% by 2050 and 27.7% by 2075 [4].Changes in food consumption occur as people advance in age. In the elderly, inadequate food consumption due to a loss of appetite results in a decrease in muscle and fat mass and the development of malnutrition. Keeping a daily food log is extremely important in detecting conditions that develop secondary to nutritional status, although keeping such a food log can be difficult, which has led to the development of various screening tests for the measurement of nutritional status [5]. The Mini Nutritional Assessment (MNA) scale developed by Guigoz et al. in 1994 has been used as a screening test for the detection of malnutrition. European guidelines on nutritional screening recommend the use of MNA or the Mini Nutritional Assessment Short- Form (MNA-SF) in the geriatric population. In a report published in 2002, ESPEN stated that all individuals aged 65 years and older must be screened for their nutritional status at certain intervals, and similar recommendations are made in other ESPEN guidelines published since 2002 [6]. According to ESPEN, malnutrition is clinically defined as the inadequate consumption of food. However, malnutrition also reflects physical changes and the consequences of changes in function.

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Malnutrition causes impairments in physical and mental functioning, and the findings showed that providing nutritional support to patients with malnutrition leads to a restoration of physical and mental functioning.Nutritional screening is required to provide nutritional support [7].There are various studies of MNA and MNA-SF in different parts of the world. In a study by Kaiser et al. which aimed to detect cases of malnutrition in the community, MNA was used as a screening tool, and different rates were reported for the elderly people living in nursing homes, hospitals and in the community. The authors identified a correlation between malnutrition and dementia and sarcopenia and suggested that the MNA could be used to evaluate the nutritional status of elderly people [8]. Another study conducted on the geriatric population using the MNA scale found that individuals with malnutrition enter the aging process more rapidly, and have higher mortality rates than individuals with normal nutritional status [9]. Similarly, in another study, the MNA scale was administered to inpatients that had suffered heart failure and found that these patients had a higher mortality rate [10]. The present study aims to detect the prevalence of malnutrition in the elderly Turkish population using the MNA scale and to compare the results with the individuals in the literature.

Materials & Methods

This single-center cross-sectional study was conducted at a Private Health Center (PHC) at Lahore, Pakistan. The study included individuals aged 65 years and older who were residing in the district and attending the PHC. At the time of the study, approximately 1,000 older adults aged ≥65 years lived in the district, with approximately 120 older adults attending the FHC each month. A total of 148 participants were recruited between January 15, 2026 to June 10, 2026 based on their willingness to participate and fulfillment of the eligibility criteria. Individuals with severe psychiatric disorders, dementia, or communication difficulties, including severe hearing or visual impairment, were excluded. Ethical approval was obtained from the Head of PHC. After providing informed consent, eligible participants were interviewed face-to-face to collect sociodemographic and general health information. Anthropometric measurements were obtained and recorded, while relevant biochemical data from the preceding month were retrieved from the patients' medical records. Nutritional status was assessed using the Mini Nutritional Assessment (MNA) questionnaire, supplemented by 13 questions addressing sociodemographic, anthropometric, and health-related characteristics, including age, sex, educational level, household status, height, weight, waist and hip circumference, bed dependency, chronic diseases, blood pressure, total blood protein, and fasting blood glucose levels. The MNA evaluated anthropometric parameters, including body mass index (BMI), mid-upper arm circumference (MUAC), calf circumference, and body weight; dietary factors such as changes in food intake, number of meals, food and fluid consumption, and independent eating; general health parameters including lifestyle, medication use, mobility, psychological stress, dementia, and depression; and subjective self-assessment of health and nutritional status. The questionnaire required approximately 5–10 minutes to complete [11]. Height was measured using a fixed stadiometer, weight using a calibrated weighing scale, and waist, hip, mid-upper arm, and calf circumferences using a measuring tape. Blood pressure was also recorded. All anthropometric and clinical measurements were performed by the same investigator to ensure consistency. Fasting blood glucose and total blood protein levels were obtained from laboratory measurements documented in the participants' medical records within the previous month. Continuous variables with a normal distribution of independent measurements were analyzed using an Independent Samples T-test, and data without normal distribution were analyzed using a Mann-Whitney Rank Sum Test. A one-way ANOVA was used for continuous variables, and a Pearson Chi-square test was used for

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categorical variables. A probability of P<0.05 was considered statistically significant, and all data were analyzed using the SPSS 21 software package.

Results

Among the 148 participants, 51 (34.5%) were classified as malnourished, 27 (18.2%) were at A total of 148 participants were included in the analysis, comprising 51 (34.46%) malnourished, 27 (18.24%) at risk of malnutrition, and 70 (47.30%) with normal nutritional status. Among the malnourished participants, 36 (70.59%) were women and 15 (29.41%) were men; in the malnutrition-risk group, 14 (51.85%) were women and 13 (48.15%) were men; while in the normal nutrition group, 36 (51.43%) were women and 34 (48.57%) were men. A statistically significant difference in age was observed among the three nutritional-status groups ($p < 0.001$). Among women, the mean age was 63.17 ± 7.34 years in the malnutrition group, 59.12 ± 6.87 years in the malnutrition-risk group, and 54.12 ± 6.29 years in the normal nutrition group. Among men, the corresponding mean ages were 70.06 ± 8.14, 57.72 ± 6.71, and 49.93 ± 5.81 years, respectively.

Educational level also differed significantly among the groups ($p < 0.001$). No formal education was reported by 34 (66.67%) participants in the malnutrition group, compared with 11 (40.74%) in the malnutrition-risk group and 23 (32.85%) in the normal nutrition group. Participants who could only read and write accounted for 12 (23.52%), 10 (37.03%), and 42 (60.00%), respectively. Primary-school education was reported in 5 (9.80%), 5 (18.51%), and 5 (7.14%) participants, while high-school education was reported in 0 (0.00%), 1 (3.70%), and 0 (0.00%), respectively.Regarding comorbidities, diabetes was present in 15 (29.41%) malnourished participants, 6 (22.23%) participants at risk of malnutrition, and 30 (42.85%) participants with normal nutrition. Hypertension was observed in 29 (56.86%), 13 (48.14%), and 21 (30.00%), respectively. Hypoproteinemia was present in 5 (9.80%), 5 (18.51%), and 14 (20.00%), while other comorbidities were reported in 2 (3.92%), 3 (11.12%), and 5 (7.14%), respectively. Note: the value 0.893 shown in your table should not be used as the p-value for the entire comorbidity section; it is the sum of four p-values and is not a valid statistical test result. The exact overall comorbidity p-value should be calculated from the original participant-level data or from the complete contingency table.

A significant association was observed between residence and nutritional status ($p = 0.020$). Living with family was reported by 40 (78.43%) malnourished participants, 25 (92.59%) participants at risk, and 66 (94.28%) participants with normal nutrition. Living alone was reported by 11 (21.56%), 2 (7.40%), and 4 (5.71%), respectively.A significant difference was also observed in nutritional status/appetite ($p < 0.001$). Severe anorexia was present in 38 (74.50%) malnourished participants, compared with 5 (18.51%) participants at risk and 12 (17.14%) participants with normal nutrition. Mild anorexia was reported in 13 (25.49%), 20 (74.07%), and 19 (27.14%), respectively, whereas normal appetite was reported in 0 (0.00%), 2 (7.40%), and 39 (55.71%), respectively.Anthropometric measurements showed significant differences among the three groups. For BMI, women had mean values of 32.67 ± 3.80, 37.59 ± 4.37, and 41.10 ± 4.78 kg/m², while men had values of 31.89 ± 3.80, 35.70 ± 4.15, and 39.61 ± 4.61 kg/m² in the malnutrition, malnutrition-risk, and normal nutrition groups, respectively ($p < 0.001$).

Similarly, mid-upper arm circumference (MAC) differed significantly among the groups ($p < 0.001$). Among women, mean MAC was 31.82 ± 3.70, 36.90 ± 4.29, and 37.07 ± 4.31 cm, while among men it was 32.50 ± 3.78, 34.97 ± 4.07, and 38.56 ± 4.48 cm, respectively.A significant difference was also observed in calf circumference (CC) ($p < 0.001$). Women had mean CC values of 41.19 ± 4.79, 42.65 ± 4.96, and 45.71 ± 5.31 cm, whereas men had values of 39.91 ± 4.64, 42.40 ± 4.93, and 46.89 ± 5.45 cm across the three groups, respectively. Finally, the MNA score differed significantly among the three nutritional-status groups ($p < 0.001$). The mean MNA score

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was 12.72 ± 1.48 among malnourished participants, 22.34 ± 2.60 among those at risk of malnutrition, and 28.34 ± 3.30 among participants with normal nutritional status. These findings are consistent with the MNA classification criteria, indicating malnutrition, risk of malnutrition, and normal nutritional status, respectively.

Table 1: Characteristics of Participants

Characteristics	Malnutrition (n= 51) women=36 Men=15	Malnutrition Risk (n=27) Women=14 Men=13	Normal Nutrition (n=70) Women =36 Men=34	p-Value
Age				
Women	63.17 ± 7.34	59.12 ± 6.87	54.12 ± 6.29	<0.001
Men	70.06 ± 8.14	57.72 ± 6.71	49.93 ± 5.81	
Education Level				
No Education	34 (66.67%)	11 (40.74%)	23 (32.85%)	<0.001
Only Read & Wite	12 (23.52%)	10(37.03%)	42 (60.00%)	
Primary School	5 (9.80%)	5(18.51%)	5 (7.14%)	
High School	0 (0.00%)	1 (3.70%)	0 (0.00%)	
Comorbidities				
Diabetes	15 (29.41%)	6 (22.23%)	30 (42.85%)	0.893
Hypertension	29 (56.86%)	13 (48.14%)	21 (30.00%)	
Hypoproteinemia	5 (9.80%)	5 (18.51%)	14 (20.00%)	
Others	2 (3.92%)	3 (11.12%)	5(7.14%)	
Residence				
Family	40 (78.43%)	25 (92.59%)	66 (94.28%)	0.020
Single	11 (21.56%)	2 (7.40%)	4 (5.71%)	
Nutritional Status				
Severe anorexia	38 (74.50%)	5 (18.51%)	12 (17.14%)	<0.001
Mild anorexia	13 (25.49%)	20 (74.07%)	19 (27.14%)	
Normal	0 (0.00%)	2 (7.40%)	39 (55.71%)	
BMI (kg/m^2)				
Women	32.67 ± 3.80	37.59 ± 4.37	41.10 ± 4.78	<0.001
Men	31.89 ± 3.80	35.70 ± 4.15	39.61 ± 4.61	
MAC (cm)				
Women	31.82 ± 3.70	36.90 ± 4.29	37.07 ± 4.31	<0.001
Men	32.50 ± 3.78	34.97 ± 4.07	38.56 ± 4.48	
CC (cm)				
Women	41.19 ± 4.79	42.65 ± 4.96	45.71 ± 5.31	<0.001
Men	39.91 ± 4.64	42.40 ± 4.93	46.89 ± 5.45	
MNA Score	12.72 ± 1.48	22.34 ± 2.60	28.34 ± 3.30	<0.001

Discussion

Malnutrition among older adults is a multifactorial condition influenced by advancing age, inadequate dietary intake, chronic diseases, social circumstances, and functional limitations [12]. Early identification and appropriate management of malnutrition are important because poor nutritional status may adversely affect recovery, increase vulnerability to disease, and worsen overall health outcomes in the geriatric population. Therefore, nutritional assessment should incorporate clinical, dietary,

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anthropometric, and social factors. In the present study, nutritional status was assessed using the Mini Nutritional Assessment (MNA), and substantial differences were observed between participants with malnutrition, those at risk of malnutrition, and those with normal nutritional status [13].

In a cross-sectional study by Saka et al.[14] involving 413 elderly patients assessed using the MNA, 13% were classified as malnourished and 31% were at risk of malnutrition. The authors also reported that malnourished individuals and those at risk had poorer biochemical and clinical profiles and that comorbidity frequently accompanied malnutrition. The present study similarly demonstrated a considerable burden of poor nutritional status, with 51 of 148 participants (34.46%) classified as malnourished, 27 (18.24%) as being at risk of malnutrition, and 70 (47.30%) having normal nutritional status. Although the prevalence of malnutrition in the present study was higher than that reported by Saka et al., differences in study setting, population characteristics, sample size, and participant selection may explain the variation. The present findings nevertheless support the observation that malnutrition represents an important health concern among older adults.

Social circumstances also appeared to be associated with nutritional status in the present study. Guigoz et al.[15] reported that malnutrition is more common among hospitalized individuals, nursing-home residents, and older adults living alone.16 Consistent with this observation, the present study found that 21.56% (11/51) of malnourished participants lived alone, compared with 7.40% (2/27) of those at risk of malnutrition and only 5.71% (4/70) of participants with normal nutritional status. Conversely, living with family was reported by 78.43% of malnourished participants, 92.59% of those at risk, and 94.28% of those with normal nutritional status. The difference between the groups was statistically significant ($p = 0.020$), suggesting that living arrangements and the availability of family support may play an important role in maintaining adequate nutrition among older adults.

Age was another important factor associated with nutritional status. Feldblum et al.[16] reported that the risk of malnutrition increases with advancing age, although their study found a higher risk among males.Conversely, another study involving 152 elderly individuals reported a higher prevalence of malnutrition among females and older participants and also identified poor appetite as an important characteristic of malnutrition [17].The present findings support the relationship between increasing age and poorer nutritional status. Among women, the mean age was 63.17 ± 7.34 years in the malnutrition group, 59.12 ± 6.87 years in the malnutrition-risk group, and 54.12 ± 6.29 years in the normal nutrition group. Among men, the corresponding mean ages were 70.06 ± 8.14, 57.72 ± 6.71, and 49.93 ± 5.81 years, respectively. The differences were statistically significant ($p < 0.001$). These findings indicate that older age was strongly associated with poorer nutritional status in the present population.

Appetite was also strongly associated with nutritional status [18]. In the present study, 74.50% of participants with malnutrition had severe anorexia, compared with 18.51% of those at risk of malnutrition and 17.14% of participants with normal nutritional status. Mild anorexia was reported in 25.49%, 74.07%, and 27.14% of the respective groups, whereas normal appetite was observed in 0%, 7.40%, and 55.71%, respectively. The difference was statistically significant ($p < 0.001$). These findings are consistent with previous research demonstrating that reduced appetite is an important contributor to inadequate food intake and nutritional deterioration in older adults. The particularly high prevalence of severe anorexia among malnourished participants in the present study emphasizes the importance of routine appetite assessment during geriatric nutritional screening.

Anthropometric measurements, particularly BMI, mid-upper arm circumference (MAC), and calf circumference (CC), are important components of nutritional assessment. Hu et al.,[19] in a study

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conducted in China using the MNA, reported that BMI, CC, and MAC were lowest among malnourished participants, intermediate among those at risk of malnutrition, and highest among participants with normal nutritional status. The present study demonstrated the same overall pattern. Among women, mean BMI increased from 32.67 ± 3.80 kg/m² in the malnutrition group to 37.59 ± 4.37 kg/m² in the risk group and 41.10 ± 4.78 kg/m² in the normal nutrition group. Among men, the corresponding BMI values were 31.89 ± 3.80, 35.70 ± 4.15, and 39.61 ± 4.61 kg/m², respectively. The difference between the groups was statistically significant ($p < 0.001$). These findings indicate that lower BMI was associated with poorer nutritional status in the present study.

A similar gradient was observed for MAC. Among women, mean MAC was 31.82 ± 3.70 cm in the malnutrition group, 36.90 ± 4.29 cm in the risk group, and 37.07 ± 4.31 cm in the normal nutrition group. Among men, the corresponding values were 32.50 ± 3.78, 34.97 ± 4.07, and 38.56 ± 4.48 cm, respectively. MAC differed significantly between the nutritional-status groups ($p < 0.001$). These findings support the use of MAC as a simple anthropometric indicator for identifying older adults with compromised nutritional status. Calf circumference showed a comparable association. Mean CC among women was 41.19 ± 4.79 cm in the malnutrition group, 42.65 ± 4.96 cm in the risk group, and 45.71 ± 5.31 cm in the normal nutrition group. Among men, mean CC was 39.91 ± 4.64, 42.40 ± 4.93, and 46.89 ± 5.45 cm, respectively. The difference was statistically significant ($p < 0.001$). Thus, participants with poorer nutritional status generally demonstrated lower anthropometric measurements, consistent with previous evidence that reduced muscle and body mass are associated with malnutrition in older adults.

The present study also demonstrated a significant difference in MNA scores between the three groups. The mean MNA score was 12.72 ± 1.48 among participants classified as malnourished, 22.34 ± 2.60 among those at risk of malnutrition, and 28.34 ± 3.30 among participants with normal nutritional status ($p < 0.001$). The clear separation of MNA scores across the three groups supports the effectiveness of the MNA in distinguishing different levels of nutritional risk in the geriatric population. The findings also demonstrate a consistent relationship between MNA classification and anthropometric characteristics, appetite, age, and living arrangements.

Comorbid conditions were frequently observed across all nutritional-status groups. Diabetes was present in 29.41% of malnourished participants, 22.23% of those at risk, and 42.85% of those with normal nutrition, while hypertension was reported in 56.86%, 48.14%, and 30.00%, respectively. Hypoproteinemia was observed in 9.80%, 18.51%, and 20.00%, respectively. Although these conditions were common, the individual comorbidity distributions should be interpreted cautiously because the p-value 0.893 previously entered for the comorbidity section represents the arithmetic sum of several p-values and is not a valid overall statistical p-value. Therefore, the exact statistical significance of the overall comorbidity distribution should be determined from the original participant-level dataset or by applying an appropriate chi-square/Fisher's exact test to the complete contingency table.

Overall, the findings of the present study are broadly consistent with previous research showing that geriatric malnutrition is associated with increasing age, poor appetite, unfavorable social circumstances, and reduced anthropometric measurements. In particular, the significant differences in age ($p < 0.001$), residence ($p = 0.020$), appetite/nutritional status ($p < 0.001$), BMI ($p < 0.001$), MAC ($p < 0.001$), CC ($p < 0.001$), and MNA score ($p < 0.001$) demonstrate that nutritional status in older adults is influenced by a combination of demographic, social, clinical, and anthropometric factors. The higher proportion of malnutrition among older individuals and those living alone highlights the importance of early nutritional screening and social support [20]. Although the present study was conducted in a single center and included a relatively modest sample of 148

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participants, the findings provide useful evidence regarding the determinants of nutritional status in the studied geriatric population. Larger multicenter studies involving diverse geographic and socioeconomic populations are recommended to validate these findings and to identify effective nutritional intervention strategies for older adults.

Conclusion

Malnutrition is a major concern among older adults. In this study, 34.46% were malnourished, 18.24% were at risk, and 47.30% had normal nutritional status. Poor nutritional status was significantly associated with advanced age, living alone, poor appetite, and lower BMI, MAC, and CC. The findings highlight the importance of routine MNA-based nutritional screening and early intervention to identify at-risk older adults and improve their health outcomes.

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