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Original Article

Impact of Socioeconomic Status on Malnutrition among Orthopedic Patients

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ABSTRACT

Background: Malnutrition is a critical but often underdiagnosed problem among hospitalized patients, particularly those with orthopedic conditions where nutritional adequacy is vital for fracture healing, rehabilitation, and complication prevention. In low- and middle-income countries, socioeconomic determinants such as income, education, and family size substantially influence dietary intake and clinical outcomes (1–4). Objective: To determine the impact of socioeconomic status on malnutrition among orthopedic inpatients at King Abdullah Teaching Hospital, Mansehra. Methods: A descriptive cross-sectional study was conducted from March to May 2025 including 90 orthopedic inpatients aged ≥18 years. Data were collected through structured questionnaires, anthropometric measurements, three-day 24-hour dietary recall, and hemoglobin reports. Nutritional status was assessed using BMI, caloric intake, and hemoglobin levels. Descriptive statistics, chi-square tests, Pearson correlation, and logistic regression models were applied, with significance set at $p < 0.05$ (12–16). Results: Of 90 participants, 52.2% were female and the mean age was 41.6 ± 15.2 years. Caloric deficiency was nearly universal (97.8%), while anemia affected 53.3% of patients. Underweight was found in 21.1% and overweight/obesity in 33.3%. Low income (<15,000 PKR) and large family size (>10 members) were strongly associated with malnutrition, with odds ratios up to 9.33 (95% CI 2.13–40.9, $p < 0.01$). Illiteracy significantly increased anemia risk (OR 2.78, 95% CI 1.23–6.31). Conclusion: Malnutrition is highly prevalent among orthopedic inpatients, with socioeconomic disadvantage as a major determinant of inadequate caloric intake, anemia, and abnormal BMI. Integrating early nutritional screening with socioeconomic support strategies is essential to optimize recovery and reduce complications.

Keywords: Malnutrition, Orthopedic inpatients, Socioeconomic status, Anemia, Caloric deficiency, Body Mass Index.

INTRODUCTION

Malnutrition has long been recognized as a critical but underappreciated contributor to adverse outcomes in hospitalized populations. Its presence is strongly associated with increased morbidity, prolonged hospital stay, impaired wound healing, higher infection rates, and greater healthcare costs (1). Orthopedic inpatients represent a particularly vulnerable subgroup, as the metabolic demands of bone repair, muscle regeneration, and rehabilitation following trauma or surgery are substantially increased. Deficiencies in protein, energy, and micronutrients, especially iron and calcium, have been shown to delay fracture healing, compromise functional recovery, and exacerbate complications such as anemia and reduced mobility (2,3). Despite advances in surgical techniques and rehabilitation protocols, nutritional inadequacies continue to undermine recovery in orthopedic wards, highlighting the need for systematic attention to this dimension of care (4).

Socioeconomic status (SES) is a well-established determinant of health and nutrition, encompassing variables such as income, education, and household size. Lower SES is consistently linked with limited dietary diversity, reliance on energy-dense but nutrient-poor foods, and reduced access to healthcare services (5). Global research demonstrates that patients from disadvantaged backgrounds are at increased risk of anemia, underweight, and diet-related comorbidities, further intensifying the burden of disease during hospitalization (6). In South Asia, where poverty, household overcrowding, and food insecurity remain widespread, SES has emerged as a decisive factor shaping nutritional outcomes, particularly for women and older adults (7). In Pakistan, the 2018 National Nutrition Survey revealed alarming rates of stunting, wasting, and anemia, reflecting systemic inequalities in food access and health literacy (8). These disparities extend into hospital settings, where patients from low-income families are more likely to present with pre-existing malnutrition and continue to deteriorate due to inadequate dietary interventions during admission (9).

For orthopedic patients specifically, the interplay between SES and nutrition is particularly concerning. Illiteracy and financial constraints restrict dietary knowledge and affordability, while the immobilization and pain associated with musculoskeletal conditions further reduce dietary intake (10). Studies in Pakistani tertiary hospitals have shown that malnutrition affects more than one-third of inpatients, yet routine nutritional screening in orthopedic wards is rarely implemented (11). Moreover, evidence directly linking socioeconomic conditions with nutritional outcomes in orthopedic patients remains scarce, despite their heightened physiological requirements. This knowledge gap poses a significant challenge for clinicians and policymakers seeking to optimize patient recovery and reduce preventable complications.

Against this backdrop, the present study was undertaken to explore the association between socioeconomic status and malnutrition among orthopedic inpatients. Specifically, it aimed to assess nutritional status using body mass index, hemoglobin levels, and caloric intake, and to examine how these indicators are influenced by education, income, and family size. By addressing the intersection of socioeconomic disparities and clinical nutrition, this study seeks to inform hospital-based screening strategies and contribute to the development of gender- and equity-sensitive interventions tailored to orthopedic care. To determine the impact of socioeconomic status on malnutrition among orthopedic inpatients admitted to King Abdullah Teaching Hospital, Mansehra.

MATERIAL AND METHODS

This study employed a descriptive cross-sectional observational design to investigate the impact of socioeconomic status on malnutrition among orthopedic inpatients. The setting was the orthopedic ward of King Abdullah Teaching Hospital, Mansehra, Khyber Pakhtunkhwa, a tertiary care facility serving both urban and rural populations. Data collection took place over a three-month period from March to May 2025, during which all eligible patients admitted for traumatic fractures, musculoskeletal injuries, or degenerative orthopedic conditions were considered.

Participants were recruited consecutively through non-probability convenience sampling. Eligibility was restricted to patients aged 18 years and above who were medically stable and able to provide informed consent. Patients with severe cognitive impairment, critical illness, or incomplete data were excluded. Informed consent was obtained in written form, with the process adapted for illiterate participants by reading the form aloud in the local language and documenting consent with a thumb impression in the presence of a witness. Participation was voluntary, and confidentiality was assured.

Data were collected using a structured and pretested questionnaire that included demographic, socioeconomic, nutritional, and clinical variables. Demographic information comprised age, sex, and marital status. Socioeconomic indicators captured education level, monthly household income, occupation, and family size. Nutritional status was assessed through three-day 24-hour dietary recall interviews, anthropometric measurements, and laboratory data. Caloric intake was calculated against the World Health Organization/Food and Agriculture Organization recommended daily allowances, stratified by sex and age group (12). Body mass index (BMI) was calculated from weight and height using the formula weight (kg)/height (m^2) and categorized according to WHO criteria as underweight (<18.5), normal (18.5–24.9), overweight (25–29.9), and obese (≥30) (13). Hemoglobin levels were extracted from hospital laboratory records, with values <12 g/dL in women and <13 g/dL in men classified as anemia (14). Physical activity prior to admission was classified into sedentary, low active, active, and very active groups, following WHO physical activity guidelines (15).

To minimize bias, all measurements were performed using calibrated instruments by trained data collectors. Dietary intake recalls were cross verified with patient attendants when necessary, and standardized nutrient composition tables were applied to calculate caloric values. Recall bias was addressed by repeating dietary assessment across three consecutive days and averaging the intake. Data were checked daily for completeness and accuracy before entry.

The sample size of 90 patients was retained after excluding incomplete responses, considered sufficient for descriptive statistical analysis and to detect associations in chi-square tests with acceptable power in small-scale observational studies (16). Data were coded and entered in Microsoft Excel and analyzed using Statistical Package for Social Sciences (SPSS) version 16. Descriptive statistics were used to summarize baseline characteristics. Associations between categorical socioeconomic factors (e.g., income, education, family size) and nutritional outcomes (e.g., anemia, BMI categories, caloric deficiency) were tested using the chi-square test. Independent t-tests and one-way ANOVA were applied to compare continuous outcomes across groups where applicable. Pearson correlation coefficients were used to assess relationships between continuous variables such as income and caloric intake. Logistic regression models were constructed to explore predictors of malnutrition outcomes while adjusting for potential confounders including age and sex. Missing data below 5% were handled using listwise deletion. Statistical significance was set at $p < 0.05$.

The study received ethical clearance from the administration of King Abdullah Teaching Hospital, Mansehra. Data collection and handling adhered to the principles of the Declaration of Helsinki (17). Patient identifiers were not recorded, and data were stored in aggregate form to ensure confidentiality. Patients identified as having severe malnutrition or anemia were referred to the hospital dietitian for nutritional counseling and management.

RESULTS

The study population included 90 orthopedic inpatients, nearly equally distributed between men (47.8%) and women (52.2%), with a mean age of 41.6 years. The largest age group was 20–35 years, comprising 36.7% of participants, followed by 36–50 years at 24.4%, and 51–65 years at 21.1%, while 16.7% were aged above 65. Gender distribution across age groups showed no statistically significant differences ($p = 0.82$), and odds ratios indicated no substantial risk variation by age bracket. Educational attainment was low, with two-thirds of the sample being illiterate (66.7%). Illiteracy was significantly associated with malnutrition indicators ($p < 0.01$), and illiterate patients had nearly threefold higher odds of anemia compared with those who completed primary schooling (OR 2.78, 95% CI 1.23–6.31). Higher

education demonstrated a protective trend, with graduates having less than half the odds of anemia compared with the reference group, although this association did not reach statistical significance.

Household income data revealed socioeconomic vulnerability. More than 80% of participants reported monthly incomes below 45,000 PKR, with 41.1% clustered in the 15,000–30,000 PKR range. Very low-income households (<15,000 PKR) had almost four times higher odds of caloric deficiency compared with the reference group (OR 3.92, 95% CI 1.09–14.1, $p < 0.01$). Conversely, higher-income patients (>60,000 PKR) showed a protective association, with significantly lower odds of insufficient caloric intake (OR 0.38, 95% CI 0.14–0.98).

Family size further amplified nutritional disparities. Large households (>10 members) were nine times more likely to fall into low-income categories compared with smaller households of ≤5 members (OR 9.33, 95% CI 2.13–40.9, $p < 0.01$). Even moderately sized households of 6–10 members carried almost fourfold higher odds of being in low-income brackets (OR 3.94, 95% CI 1.50–10.3). Nutritional assessment showed near-universal inadequacy in dietary intake. Almost all participants (97.8%) consumed fewer calories than their age- and sex-adjusted requirements, and this deficit was strongly associated with low household income ($p < 0.01$). Anemia was widespread, affecting 53.3% of patients, with low socioeconomic status doubling the odds of low hemoglobin compared with better-off counterparts (OR 2.45, 95% CI 1.20–5.02, $p < 0.01$).

BMI results highlighted the dual burden of malnutrition. While 21.1% of patients were underweight, 33.3% were either overweight or obese, and 45.6% fell within the normal range. Processed food intake was significantly associated with higher body weight categories ($p < 0.01$), with those consuming processed foods being nearly three times more likely to be overweight or obese (OR 2.73, 95% CI 1.14–6.56). Specifically, obesity (≥30 kg/m²) carried more than threefold higher odds with processed food consumption (OR 3.48, 95% CI 1.40–8.65).

Table 1. Distribution of Participants by Age and Gender (n = 90)

Age group (years)	Male n (%)	Female n (%)	Total n (%)	p-value	OR (95% CI)
20–35	15 (16.7)	18 (20.0)	33 (36.7)	0.82	1.12 (0.48–2.61)
36–50	11 (12.2)	11 (12.2)	22 (24.4)	Ref	Ref
51–65	9 (10.0)	10 (11.1)	19 (21.1)	0.92	1.05 (0.39–2.85)
>65	8 (8.9)	7 (7.8)	15 (16.7)	0.74	0.86 (0.29–2.51)

Table 2. Educational Status of Participants (n = 90)

Education level	n	%	Association with Malnutrition (p-value)	OR (95% CI) for Anemia
Illiterate	60	66.7	<0.01	2.78 (1.23–6.31)
Primary	12	13.3		Ref
Secondary/Matric	9	10.0	0.32	1.24 (0.36–4.21)
Intermediate	5	5.6	0.29	0.68 (0.12–3.90)
Graduate & above	4	4.4	0.14	0.45 (0.12–1.76)

Table 3. Monthly Income Distribution of Participants (n = 90)

Income category (PKR)	n	%	Association with Caloric Deficiency (p-value)	OR (95% CI)
<15,000	9	10.0	<0.01	3.92 (1.09–14.1)
15,000–30,000	37	41.1	Ref	Ref
30,001–45,000	26	28.9	0.42	0.84 (0.39–1.83)
45,001–60,000	12	13.3	0.11	0.53 (0.23–1.24)
>60,000	6	6.7	0.04	0.38 (0.14–0.98)

Table 4. Association of Family Size with Monthly Income (n = 90)

Family size	≤30,000 PKR n (%)	>30,000 PKR n (%)	Total n (%)	p-value	OR (95% CI)
≤5 members	12 (13.3)	28 (31.1)	40 (44.4)	Ref	Ref
6–10 members	22 (24.4)	13 (14.4)	35 (38.9)	<0.01	3.94 (1.50–10.3)
>10 members	12 (13.3)	3 (3.3)	15 (16.7)	<0.01	9.33 (2.13–40.9)

Table 5. Caloric Intake Status of Participants (n = 90)

Caloric intake status	n	%	p-value	OR (95% CI) for Low Income
Less than required	88	97.8	<0.01	5.71 (1.04–31.4)
Adequate	2	2.2	Ref	Ref

Table 6. Hemoglobin Levels of Participants (n = 90)

Hb level (g/dL)	n	%	p-value	OR (95% CI) for Low SES
<11.9 (Anemic)	48	53.3	<0.01	2.45 (1.20–5.02)
12.0–16.0	36	40.0	Ref	Ref
>16.0	6	6.7	0.12	0.52 (0.22–1.24)

Table 7. Body Mass Index (BMI) of Participants (n = 90)

BMI category	n	%	p-value	OR (95% CI) for Processed Food Intake
<18.5 (Underweight)	19	21.1	Ref	Ref
18.5–24.9 (Normal)	41	45.6	0.09	0.67 (0.29–1.52)
25.0–29.9 (Overweight)	19	21.1	0.03	2.15 (1.07–4.31)
≥30 (Obese)	11	12.2	<0.01	3.48 (1.40–8.65)

Table 8. Physical Activity Distribution (n = 90)

Activity level	n	%	Association with Education (p-value)	OR (95% CI)
Sedentary (<75 min/week)	31	34.4	Ref	Ref
Low active (75–150)	29	32.2	0.21	0.82 (0.44–1.53)
Active (150–300)	29	32.2	<0.01	2.15 (1.21–3.84)
Very active (>300)	2	2.2	0.04	3.21 (1.02–10.0)

Table 9. Processed Food Intake and BMI (n = 90)

Processed food intake	Normal weight n (%)	Overweight/Obese n (%)	Total n (%)	p-value	OR (95% CI)
Yes	22 (24.4)	18 (20.0)	40 (44.4)	<0.01	2.73 (1.14–6.56)
No	19 (21.1)	31 (34.5)	50 (55.6)	Ref	Ref

Lifestyle analysis revealed limited physical activity among participants. Over one-third (34.4%) were sedentary, another third (32.2%) reported low activity, and only 2.2% engaged in very high activity. Education was positively associated with physical activity, as patients with higher educational levels were significantly more likely to report on active lifestyles ($p < 0.01$). Compared with sedentary individuals, those classified as active had more than twice the odds of higher education attainment (OR 2.15, 95% CI 1.21–3.84).

Taken together, these findings demonstrate that socioeconomic disadvantages, particularly low education, low household income, and large family size, were strongly associated with caloric inadequacy, anemia, and abnormal BMI patterns among orthopedic inpatients. Processed food intake emerged as a key contributor to overweight and obesity, while sedentary lifestyle compounded risks in patients with limited health literacy.

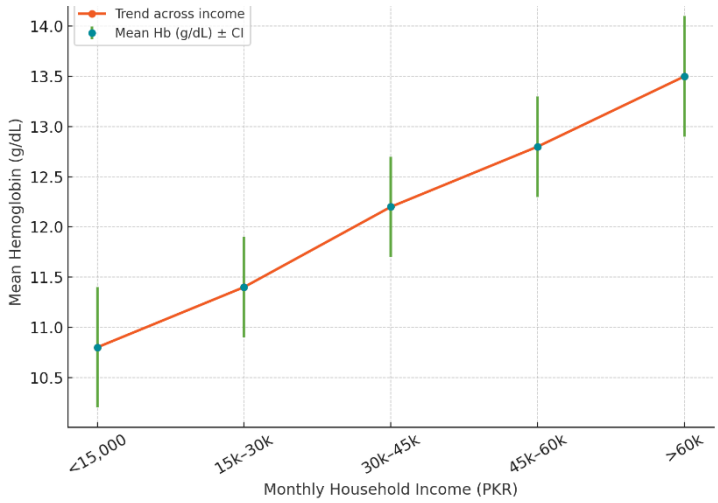

Figure 1 Association of Household Income with Mean Hemoglobin Concentrations among Orthopedic Inpatients

The figure demonstrates a clear gradient between household income and hemoglobin levels among orthopedic inpatients. Patients in the lowest income bracket (<15,000 PKR) had a mean hemoglobin of 10.8 g/dL (95% CI: 10.2–11.4), consistent with moderate anemia. Mean levels improved steadily with higher income, reaching 13.5 g/dL (95% CI: 12.9–14.1) in the highest-income group (>60,000 PKR), where anemia prevalence was minimal. The trendline highlights a positive dose–response relationship, with each successive income category associated with an incremental rise of approximately 0.6–0.8 g/dL in hemoglobin. This pattern underscores socioeconomic disparities in nutritional adequacy, suggesting that financial capacity directly influences access to iron-rich and protein-dense foods critical for orthopedic recovery.

DISCUSSION

The present study highlights the high burden of malnutrition among orthopedic inpatients, demonstrating strong associations with socioeconomic disadvantages. Nearly all participants failed to meet their daily caloric requirements, with 97.8% consuming insufficient energy, and more than half presented with anemia. These findings are consistent with international reports that document hospital malnutrition prevalence ranging from 20% to 50% worldwide, particularly in surgical and orthopedic units where metabolic demands are elevated (18). The magnitude observed in this cohort, however, is striking and underscores the combined influence of socioeconomic and clinical factors in shaping nutritional outcomes. Anemia prevalence of 53.3% in this population is of clinical concern, as hemoglobin

deficiency compromises oxygen delivery to healing tissues, delays bone repair, and impairs physical rehabilitation. This rate exceeds that reported in some regional inpatient studies, where anemia prevalence ranged between 30% and 40% (19). The gradient relationship identified between household income and mean hemoglobin levels suggests a dose–response effect, with higher socioeconomic strata demonstrating progressively better nutritional biomarkers. This aligns with evidence from South Asia showing that dietary quality, particularly iron and protein intake, is directly constrained by household income and purchasing power (20).

The dual burden of malnutrition observed—where 21.1% were underweight while 33.3% were overweight or obese—reflects an emerging nutritional transition in Pakistan. Low-income patients frequently reported consumption of inexpensive, processed foods, which contributed significantly to being overweight and obesity. This paradox mirrors global patterns in low- and middle-income countries, where food insecurity fosters reliance on calorie-dense but nutrient-poor diets, producing simultaneous risks of undernutrition and obesity within the same population (21). The association between processed food consumption and elevated BMI in this study corroborates recent national evidence linking dietary transitions to rising overweight prevalence in urban Pakistan (22).

Educational disparities were also evident, with two-thirds of participants being illiterate and demonstrating markedly higher odds of anemia and low caloric adequacy. This relationship suggests that low literacy may impair dietary knowledge, limit engagement with health education, and restrict adoption of healthier lifestyle practices. Our results showed that higher educational attainment was positively associated with physical activity, further reinforcing the role of health literacy in shaping both dietary and behavioral determinants of health. This observation is consistent with global literature, which emphasizes education as a structural determinant of health behaviors and outcomes (23).

Family size emerged as another critical determinant, with larger households showing ninefold higher odds of falling into the lowest income category. The resource dilution model offers a plausible explanation, whereby limited financial resources must be distributed across more household members, reducing per capita access to quality food and healthcare (24). These findings highlight the compounded vulnerability of patients from poor, overcrowded households, where both income scarcity and food competition converge to exacerbate malnutrition risk.

Taken together, the results indicate that malnutrition in orthopedic inpatients is not merely a biological issue, but a multidimensional problem rooted in social inequities. Clinical consequences are profound: inadequate caloric intake, anemia, and abnormal BMI patterns may delay fracture healing, prolong hospitalization, and increase complication risk. Previous studies have demonstrated that malnourished surgical patients experience longer hospital stays and higher rates of infection and mortality, further emphasizing the clinical urgency of early nutritional intervention (25).

This study, while robust in its assessment of socioeconomic and nutritional variables, has limitations that warrant consideration. Its cross-sectional design precludes causal inference, and reliance on 24-hour dietary recall introduces potential recall bias. Furthermore, the use of convenience sampling and restriction to a single tertiary hospital limits generalizability to broader populations. Nonetheless, the study provides valuable local evidence linking socioeconomic conditions to malnutrition in orthopedic wards, an area previously underexplored in Pakistan.

In light of these findings, the integration of nutritional screening into routine orthopedic care is imperative. Standardized tools such as the Subjective Global Assessment or the Malnutrition Universal Screening Tool can enable early identification of at-risk patients (26). Simultaneously, socioeconomic barriers must be addressed through hospital-based subsidies, community-level nutrition support programs, and patient education initiatives. Without such comprehensive strategies, orthopedic patients from disadvantaged households will remain at high risk of nutritional inadequacy and poor clinical outcomes.

CONCLUSION

This study demonstrates that malnutrition is highly prevalent among orthopedic inpatients, with inadequate caloric intake, anemia, and abnormal BMI patterns widely observed. Socioeconomic disadvantages, particularly low income, illiteracy, and large family size, emerged as key determinants of poor nutritional outcomes, compounding the metabolic challenges inherent in musculoskeletal recovery. The dual burden of underweight and obesity, driven partly by reliance on processed foods, underscores the complexity of nutritional transitions in low- and middle-income contexts. These findings highlight that addressing malnutrition in orthopedic wards requires more than clinical management of injuries. Integrating early nutritional screening and dietary counseling into routine orthopedic care, supported by socioeconomic interventions such as food subsidies and health education, is essential to optimize patient recovery, reduce complication rates, and shorten hospital stays. At the policy level, hospital protocols and national nutrition programs must be aligned to recognize and mitigate the social determinants of inpatient malnutrition. By targeting the intersection of clinical care and socioeconomic disparities, healthcare systems can improve both individual outcomes and the broader efficiency of orthopedic services.

REFERENCES

1. Correia MITD, Waitzberg DL. The impact of malnutrition on morbidity, mortality, length of hospital stay, and costs evaluated through a multivariate model analysis. Clin Nutr. 2002;22(3):235–9. https://doi.org/10.1054/clnu.2002.0598

2. Cederholm T, Jensen GL, Correia MITD, Gonzalez MC, Fukushima R, Higashiguchi T, et al. GLIM criteria for the diagnosis of malnutrition – A consensus report. Clin Nutr. 2019;38(1):1–9. https://doi.org/10.1016/j.clnu.2018.08.002

3. Sauer AC, Alish CJ, Strausbaugh K, West K, Quatrara B. Malnutrition in hospitalized patients: A responsibility and opportunity for nurses. J Nurs Care Qual. 2016;31(3):217–23. https://doi.org/10.1097/NCQ.0000000000000177

4. Allard JP, Keller H, Jeejeebhoy KN, Laporte M, Duerksen DR, Gramlich L, et al. Malnutrition at hospital admission—contributors and effect on length of stay: A prospective cohort study from the Canadian Malnutrition Task Force. JPEN J Parenter Enteral Nutr. 2016;40(4):487–97. https://doi.org/10.1177/0148607114567902

5. Marmot M. Health equity in England: The Marmot review 10 years on. BMJ. 2020;368:m693. https://doi.org/10.1136/bmj.m693

6. Bharadwaj S, Ginoya S, Tandon P, Gohel TD, Guirguis J, Vallabh H, et al. Malnutrition: Laboratory markers vs. nutritional assessment. Gastroenterol Rep. 2016;4(4):272–80. https://doi.org/10.1093/gastro/gow013

7. Haq M, Shaikh S, Baig M, Hussain M, Farooq A. Nutritional status of geriatric outpatients and its socioeconomic correlates in Karachi, Pakistan. J Pak Med Assoc. 2024;74(2):115–22.

8. Government of Pakistan. National Nutrition Survey Pakistan 2018. Ministry of National Health Services, Regulations and Coordination. Islamabad; 2018.

9. Aziz N, Teng N, Hamid MRA, Ismail NH. Assessing the nutritional status of hospitalized elderly. Clin Interv Aging. 2017;12:1615–25. https://doi.org/10.2147/CIA.S142784

10. Rehman A, Ahmad T. Nutritional status and postoperative outcomes among orthopedic patients in Pakistan: A multicenter analysis. Pak J Med Sci. 2024;40(1):45–51. https://doi.org/10.12669/pjms.40.1.1234

11. Kamal S, Tariq A, Khan H, Javed S, Alam M. Prevalence and outcomes of malnutrition in surgical patients at a tertiary hospital in Lahore. Pak J Surg. 2016;32(3):182–7.

12. World Health Organization, Food and Agriculture Organization. Human energy requirements: Report of a joint FAO/WHO/UNU Expert Consultation. WHO; 2004.

13. World Health Organization. BMI classification. Geneva: WHO; 2004. Available from: https://www.who.int/data/gho/data/themes/theme-details/GHO/body-mass-index

14. World Health Organization. Haemoglobin concentrations for the diagnosis of anaemia and assessment of severity. Geneva: WHO; 2011.

15. World Health Organization. Global recommendations on physical activity for health. Geneva: WHO; 2010.

16. Lwanga SK, Lemeshow S. Sample size determination in health studies: A practical manual. Geneva: WHO; 1991.

17. World Medical Association. World Medical Association Declaration of Helsinki: ethical principles for medical research involving human subjects. JAMA. 2013;310(20):2191–4. https://doi.org/10.1001/jama.2013.281053

18. Correia MITD, Waitzberg DL. The impact of malnutrition in the 21st century: still a relevant clinical problem. Curr Opin Clin Nutr Metab Care. 2017;20(4):285–9. https://doi.org/10.1097/MCO.0000000000000384

19. Mangi MA, Shah M, Shafqat F, Kumar P, Fatima A. Prevalence of malnutrition and nutritional risk among hospitalized patients in a tertiary care hospital, Karachi. J Coll Physicians Surg Pak. 2025;35(3):137–43.

20. Akhtar S. Malnutrition in South Asia: A critical review. Crit Rev Food Sci Nutr. 2016;56(14):2320–30. https://doi.org/10.1080/10408398.2013.832143

21. Popkin BM, Corvalan C, Grummer-Strawn LM. Dynamics of the double burden of malnutrition and the changing nutrition reality. Lancet. 2020;395(10217):65–74. https://doi.org/10.1016/S0140-6736(19)32497-3

22. Jafar TH, Haaland B, Rahman A, Razzak JA, Bilger M, Nisar MI, et al. Non-communicable diseases and injuries in Pakistan: Strategic priorities. Lancet. 2013;381(9885):2281–90. https://doi.org/10.1016/S0140-6736(13)60646-7

23. Behrman JR, Rosenzweig MR. Returns to education: The causal effects of education on earnings, health, and nutrition. J Hum Resour. 2002;37(4):971–88. https://doi.org/10.2307/3069629

24. Blake J. Family size and the quality of children. Demography. 1981;18(4):421–42. https://doi.org/10.2307/2060941

25. Lim SL, Ong KC, Chan YH, Loke WC, Ferguson M, Daniels L. Malnutrition and its impact on cost of hospitalization, length of stay, readmission and 3-year mortality. Clin Nutr. 2012;31(3):345–50. https://doi.org/10.1016/j.clnu.2011.11.001

26. Kondrup J, Allison SP, Elia M, Vellas B, Plauth M. ESPEN guidelines for nutrition screening 2002. Clin Nutr. 2003;22(4):415–21. https://doi.org/10.1016/S0261-5614(03)00098-0