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Validating Mini Nutritional Assessment-Short Form thresholds for postoperative mortality and complications in geriatric hip fracture patients with compromised nutritional status

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Hip fractures represent a major public health burden in older adults, associated with substantial morbidity, elevated mortality, and persistent functional impairment.[1,2] Worldwide epidemiological projections indicate these fractures affected approximately 1.6 million individuals globally in 2000, with predictions suggesting a rise to 6.3 million cases by 2050.[3] Despite progress in surgical techniques, elderly individuals sustaining hip fractures continue to experience less favorable recovery paths and show disproportionately high mortality rates when adjusted for age.

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ABSTRACT

Objectives: This study aims to establish evidence-based cut-off values of the Mini Nutritional Assessment-Short Form (MNA-SF) for predicting key postoperative outcomes including 60-day mortality, complications, and functional ambulation recovery in a broader cohort of elderly hip fracture patients.

Patients and methods: Between January 2022 and July 2024, a total of 183 elderly hip fracture patients (57 males, 126 females; mean age: 82.7 ± 7.6 years; range, 65 to 101 years) who received surgical treatment were included. The patients encompassed the full spectrum of nutritional status (from well-nourished to malnourished). Logistic regression assessed the associations between preoperative MNA-SF scores (as a continuous variable) and 60-day mortality, complication rates, and gait status. Receiver operating characteristic (ROC) curves were used to identify optimal outcome-predictive cut-off values in the total cohort.

Results: In the overall population, 78 of 183 patients (42.6%) developed postoperative complications, with 94 total complication events documented-34 orthopedic-specific complications (36.2%, including eight surgical site infections, four implant-related complications, and 22 affected limb function-related complications) and 60 systemic complications (63.8%, including 25 pulmonary infections, 26 urinary tract infections, 18 deep venous thromboses, 22 delirium cases, and three pressure sores). Lower MNA-SF scores were significantly correlated with increased risks of 60-day mortality and postoperative complications, but not with gait recovery. The optimal predictive cut-off for mortality was ≤ 7 (adjusted odds ratio [OR] = 0.72, 95% confidence interval [CI] 0.57-0.90; sensitivity 73.7%, specificity 64.0%; area under the curve [AUC] = 0.708). For complications, the optimal cut-off was ≤ 8 (adjusted OR = 0.82, 95% CI 0.72-0.93; sensitivity 74.4%, specificity 51.6%; AUC = 0.645).

Conclusion: The MNA-SF is a valuable tool for preoperative risk stratification in geriatric hip fracture patients. We propose novel, evidence-based cut-off values (≤ 7 for mortality and ≤ 8 for complications) derived from a comprehensive cohort, which provide clinically actionable thresholds for identifying high-risk patients most likely to benefit from targeted nutritional and medical interventions.

Keywords: Complications, cut-off value, gait status, hip fracture, Mini Nutritional Assessment-Short Form, mortality.

Growing research recognizes malnutrition as a crucial alterable determinant affecting clinical results in hip fracture patients.[4] According to the United Kingdom National Hip Fracture Database, nearly 24.5% of such patients presented with malnutrition.[5] Systematic studies repeatedly confirm significant links between poor nutritional status and unfavorable postoperative outcomes. A recent meta-analysis revealed that malnutrition elevated mortality risk and reduced mobility among elderly hip fracture patients.[5] In addition, a randomized clinical trial established that preoperative malnutrition correlated with mortality in this population.[6]

The Mini Nutritional Assessment (MNA) has become established as an effective instrument for evaluating nutritional status in older adults.[6,7] Typically, the MNA-Short Form (SF) results are categorized as follows: 12-14 points correspond to normal nutritional status, 8-11 points designate malnutrition risk, and 0-7 points indicate malnourished status.[7] Comparative studies demonstrate the enhanced capacity of MNA to predict acute postoperative functional outcomes in hip fracture patients relative to alternative screening instruments such as the Geriatric Nutritional Risk Index (GNRI), Malnutrition Universal Screening Tool (MUST), and Nutritional Risk Score 2002 (NRS-2002).[8]

Mounting clinical evidence validates the prognostic utility of the MNA in hip fracture care. Foundational research by van Wissen et al.[6] confirmed associations between preoperative MNA results and 12-month survival. Subsequent longitudinal work by Gumieiro et al.[9] established MNA scores' ability to predict six-month mortality and walking function recovery. In parallel, Nuotio et al.[10] reinforced these observations through multivariate analysis, verifying MNA-diagnosed malnutrition as an autonomous predictor of composite adverse events. Despite these advances, persistent limitations still exist concerning practical cut-offs for clinical implementation, as current evidence lacks validated thresholds linked to defined postoperative endpoints.

In the present study, we aimed to establish optimal MNA cut-off thresholds predictive of three critical postoperative outcomes including functional ambulation recovery, all-cause mortality, and complication rates in elderly hip fracture patients undergoing surgical management who presented with preoperative malnutrition or nutritional risk. In contrast to prior studies focusing on overall outcome predictions or long-term associations, the present study aimed to determine outcome-specific MNA-SF cut-off values for acute complications and 60-day mortality in nutritionally at-risk elderly hip fracture patients, thereby providing a more precise basis for early clinical risk stratification.

PATIENTS AND METHODS

Study design and study population

This single-center, prospective, observational study was conducted at Beijing Jishuitan Hospital, Department of Emergency between January 2022 and July 2024. A total of 183 elderly hip fracture patients (57 males, 126 females; mean age: 82.7 ± 7.6 years; range, 65 to 101 years) who received surgical treatment were included. Inclusion criteria were as follows: patients aged > 65 years with radiologically confirmed acute hip fractures (femoral neck, intertrochanteric, or subtrochanteric) and documented inability to ambulate preoperatively. Exclusion criteria were as follows: non-oral feeding requirements; pathological fractures; concurrent non-hip fractures or open hip fractures; pre-admission fracture complications (pressure ulcers, localized infections, or deep vein thrombosis); documented dementia; and severe comorbidities including chronic heart failure, advanced chronic kidney disease (CKD Stage 4/5), cirrhosis (Child-Pugh B/C), chronic pulmonary conditions (e.g., chronic obstructive pulmonary disease [COPD]), active malignancies (excluding non-melanoma skin cancers), and chronic gastrointestinal disorders (e.g., pancreatic insufficiency, Crohn's disease, ulcerative colitis). Written informed consent was obtained from each patient. The study protocol was approved by the Beijing Jishuitan Hospital Ethics Committee (Date: 13.04.2022, Jilunke Shenzi No. 202204-13-bei04). The study was conducted in accordance with the principles of the Declaration of Helsinki.

Instruments

To investigate associations between admission nutritional status and postoperative outcomes, MNA-SF served as the nutritional status indicator. This validated abbreviated tool, adapted from the full MNA framework, functions as a multidimensional screening instrument specifically developed for elderly populations. Its six components assess: (1) reduced food intake over three months; (2) ≥ 3% weight loss during the prior trimester; (3) functional mobility; (4) recent psychological

distress or acute medical conditions; (5) cognitive impairment markers; and (6) anthropometric measures (body mass index [BMI] or calf circumference when BMI cannot be obtained).[11]

The Mini-Mental State Examination (MMSE), a standardized 30-point cognitive screener (range 0-30), is extensively employed in clinical neurology and neuropsychological research to quantify global cognitive impairment. This validated instrument systematically evaluates five key domains: orientation, memory, attention/working memory, language function, and visuospatial skills.[12]

The Acute Physiology and Chronic Health Evaluation (APACHE) II scoring system quantifies illness severity using three validated components: (1) a weighted acute physiology score based on 12 critical parameters (vital signs, oxygenation, and metabolic markers); (2) age-adjusted mortality weighting; and (3) chronic health evaluation.[13] These metrics are systematically recorded during emergency triage through standardized laboratory panels and clinical documentation.

The Canadian Cardiovascular Society (CCS) Angina Grading Classification employs a four-tier system categorizing angina severity according to activity tolerance: Grade 1, no physical limitation and Grade 4, symptoms with any activity.[14]

This study utilized the Barthel Index (BI), a validated self-reported measure assessing 10 essential Activities of Daily Living (ADL) domains: (1) bathing, (2) toileting, (3) bowel control, (4) bladder control, (5) dressing, (6) feeding, (7) grooming, (8) ambulation, (9) stair climbing, and (10) transfers (chair-bed). Scores range from 0 to 100, where lower scores indicate greater ADL dependence.[15]

Assessments

Preoperatively, demographic, and clinical parameters were recorded: MNA-SF scores, age, sex, height, weight, BMI, Barthel Index (BI, for functional independence), MMSE (for cognitive function), APACHE II scores (for disease severity), and CCS angina classification (for cardiac symptom severity).

All participants were followed for two months and received standardized postoperative monitoring through scheduled clinical assessments spanning ≥ 60 days post-surgery. During hospitalization, patients received standardized nutritional support. The daily caloric requirement of each subject was calculated using the Harris-Benedict equation. Patients consumed food voluntarily, and their caloric intake was recorded. If the actual intake was less than 60% of the target calories, oral enteral nutrition supplements were administered. This regimen was maintained for 14 days. Daily caloric and protein intake were calculated accordingly. Documented outcomes included: length of hospitalization (time from admission to discharge) and postoperative complications (categorized into orthopedic-specific complications and systemic complications).

Orthopedic-specific complications were defined as complications directly related to hip fracture surgery, implant performance, or affected limb function, assessed by clinical examination, imaging, and functional evaluation. Specific subtypes and evaluation criteria were mentioned below.

Surgical site infection (SSI): Diagnosed based on the Centers for Disease Control and Prevention (CDC) criteria-superficial SSI (local redness, swelling, exudation within 30 days postoperatively, no deep tissue involvement) and deep SSI (fever > 38.5°C, elevated C-reactive protein [CRP] > 100 mg/L, positive culture of deep tissue/implant, or imaging showing subperiosteal/intraosseous abscess).

Implant-related complications: Evaluated by postoperative X-ray (at Week 1, Week 4, and Day 60) and clinical symptoms-implant loosening (radiographic signs of implant migration, increased cement-bone interface gap, or clinical pain with weight-bearing); periprosthetic fracture (radiographic confirmation of fracture within 10 cm of the implant, classified by the Vancouver classification).

Affected limb function-related complications: Assessed by hip joint range of motion (ROM) measurement and lower limb length measurement-joint stiffness (hip flexion < 90°, abduction < 30° on Day 60 postoperatively, excluding pre-existing stiffness). Lower limb discrepancy measured by X-ray, length difference > 0.5 cm between the two lower limbs, confirmed by clinical gait evaluation.

Systemic complications included infectious, mental, or cardiovascular), including pulmonary infection, urinary tract infection, deep venous thrombosis, delirium, and pressure sores. In addition, mortality status and functional ambulation capacity were evaluated.

Mortality was followed at 15-day intervals until postoperative Day 60. Gait assessment occurred on Day 60 postoperatively. For deceased patients, the final documented ambulatory status was used. Participants were classified as ambulators

(walking independently or with assistance) and non-ambulators (unable to walk).

Statistical analysis

Taking "60-day mortality rate" as the core outcome indicator, referring to the 60-day postoperative mortality rate of geriatric hip fracture patients in previous similar studies[5] which was approximately 10 to 15%, combined with the 12% mortality rate data observed in the pre-experimental stage of this study, setting α=0.05 (two-tailed test), β = 0.2 (confidence level 80%), and assuming that the association effect size (OR value) of MNA-SF score and mortality rate is 0.7 (refer to the final adjusted OR = 0.72). Using the logistic regression analysis, sample size estimation formula was established as follows:

$$n=\frac{\left(Z1\frac{\alpha}{2}+Z1\text{-}\beta\right)2\times p(1\text{-}p)}{(P1\text{-}P0)2}$$

(where, P0 is the mortality rate of the low-risk group and P1 is the mortality rate of the high-risk group). The sample size was calculated using the PASS version 15.0 software (NCSS LLC, Kaysville, UT, USA), and at least 152 patients were needed to detect the above association. Based on clinical experience, the 60-day follow-up loss rate of geriatric hip fracture patients is approximately 10%, and some patients may not meet the final analysis criteria due to cognitive impairment or severe comorbidities. Therefore, an additional 20% of sample size was added on the basis of the estimation considering the dropouts, and the final target sample size was determined to be 183 cases.

Statistical analysis was performed using the SPSS version 23.0 software (IBM Corp., Armonk, NY, USA). Continuous data were presented in mean ± standard deviation (SD) or median (min-max), while categorical data were presented in number and frequency. Categorical variables were analyzed using the chi-square test or Fisher exact test, while continuous variables were analyzed using the Student t-test or Mann-Whitney U test. Logistic regression models evaluated associations between preoperative nutritional status and three outcomes: (1) postoperative complications, (2) 60-day mortality, and (3) gait recovery status. The results were expressed in odds ratios (ORs) with 95% confidence intervals (95% CIs). The receiver operating characteristic (ROC) curves with area under the curve (AUC) calculations determined optimal cut-off values for predicting

TABLE I
Preoperative demographic and clinical characteristics of 183 hip fracture patients stratified by nutritional status

Characteristic	Overall (n = 183)			Well-nourished (MNA-SF 12-14) (n=63)			Nutritional risk (MNA-SF 8-11) (n = 31)			Malnourished (MNA-SF 0-7) (n = 89)			*p*
	n	%	Mean ± SD	n	%	Mean ± SD	n	%	Mean ± SD	n	%	Mean ± SD	
Age (year)			80.65 ± 7.58			78.59 ± 7.12			79.58 ± 7.81			81.62 ± 7.49	0.028
Sex													
Male	57	31.15		14	22.22		15	48.39		28	31.46		0.051
BMI (kg/m^2)			19.78 ± 2.38			20.24 ± 2.25			20.29 ± 2.05			19.37 ± 2.45	0.052
CCS grading													0.120
I	150	81.97		54	85.71		28	90.32		66	74.16		
II	33	18.03		9	14.29		3	9.68		23	25.84		
BI score			22.58 ± 7.21			25.08 ± 6.50			20.32 ± 4.07			20.45 ± 7.22	0.067
MMSE score			28.92 ± 3.15			30.00 ± 1.50			29.65 ± 1.02			28.88 ± 3.42	0.035
APACHE II			7.18 ± 0.73			7.05 ± 0.69			7.23 ± 0.56			7.24 ± 0.77	0.255
LOS (days) median (IQR)	4 (3.5)			4 (3.5)			4 (3.5)			4 (3.5)			0.721

MNA-SF, mini nutritional assessment-short form; SD, standard deviation; BMI, body mass index; CCS, Canadian Cardiovascular Society; BI, Barthel Index; MMSE, mini-mental state examination; APACHE II, Acute Physiology and Chronic Health Evaluation II; LOS, length of hospital stay; IQR, interquartile range. Categorical variables were compared using the Chi-square test, continuous variables with normal distribution using one-way ANOVA, and non-normally distributed data (LOS) using the Kruskal-Wallis test.

complications, mortality, and gait outcomes. The Youden's index identified statistically significant thresholds. A p value of < 0.05 was considered statistically significant.

RESULTS

A total of 183 patients were stratified by preoperative nutritional status into three groups: 63 (34.43%) patients were well-nourished (MNA-SF 12-14), 31 (16.94%) patients were at nutritional risk (MNA-SF 8-11), and 89 (48.63%) patients were malnourished (MNA-SF 0-7). There were no statistically significant differences among the three groups in terms of sex, BMI, CCS grading, BI scores, APACHE II scores, or length of hospital stay ($p > 0.05$). However, significant differences were observed in age and MMSE scores ($p = 0.028$ and $p = 0.035$). The well-nourished group was significantly younger and had higher cognitive scores compared to the malnourished group (Table I).

Postoperative complications occurred in 78 of 183 patients (42.6%). A total of 94 complications were documented. Complications were stratified into orthopedic-specific complications (n = 34, 36.2% of total complications) and systemic complications (n = 60, 63.8% of total complications), with detailed distributions and clinical characteristics as follows:

Orthopedic-specific complications

This category accounted for 36.2% of all complications.

Surgical site infection: Eight cases (8.5% of total complications). Among them, six were superficial SSIs (occurring five to 12 days postoperatively, managed with oral cephalosporins for seven to 10 days, all resolved); two were deep SSIs (occurring 10 to 18 days postoperatively, one case of femoral neck fracture with total hip arthroplasty [THA] and one case of intertrochanteric fracture with proximal femoral nail anti-rotation [PFNA], both requiring surgical debridement and intravenous vancomycin for two to three weeks, with no implant removal needed).

Implant-related complications: Four cases (4.3% of total complications). Implant loosening occurred in three cases (all PFNA for intertrochanteric fractures, detected by X-ray at four to six weeks postoperatively-one case had symptomatic loosening with hip pain, requiring revision surgery to long-stem PFNA; two cases were asymptomatic, followed closely with no further progression). Periprosthetic fracture occurred in one case (Vancouver type B1 fracture after THA for femoral neck fracture, occurring three weeks postoperatively due to accidental fall, managed with revision surgery using a long-stem prosthesis).

TABLE II
Logistic regression analysis of postoperative complications and MNA scores at admission

	Crude model			Adjusted model		
	OR	95% CI	p	OR	95% CI	p
MNA-SF score	0.79	0.70-0.89	< 0.001	0.82	0.72-0.93	0.002
Age				1.05	1.00-1.10	0.058
MMSE score				0.92	0.83-1.02	0.109

OR, odds ratio; CI, confidence interval; MNA-SF, mini nutritional assessment-short form; MMSE, mini-mental state examination. The adjusted model controls for age and MMSE score.

TABLE III
Logistic regression analysis of postoperative 60-day mortality and MNA scores at admission

	Crude model			Adjusted model		
	OR	95% CI	p	OR	95% CI	p
MNA-SF score	0.68	0.55-0.84	< 0.001	0.72	0.57-0.90	0.004
Age				1.08	1.01-1.16	0.031
CSS grading II				3.25	1.12-9.43	0.030

OR, odds ratio; CI, confidence interval; MNA-SF, mini nutritional assessment-short form; CCS, Canadian Cardiovascular Society. The adjusted model controls for age and CCS grading.

Affected limb function-related complications: 22 cases (23.4% of total complications). Joint stiffness was observed in 12 cases (60-day postoperative hip flexion: 65°-85°, abduction: 15°-28°; all received standardized rehabilitation (passive joint mobilization + active muscle strength training) for four to eight weeks, with final ROM improved to flexion > 90° in eight cases and 80°-90° in four cases). Lower limb discrepancy was found in 10 cases (length difference: 0.5-1.5 cm, measured by X-ray)-three cases with discrepancy > 1 cm had mild gait disturbance, corrected by custom insoles; seven cases with discrepancy ≤ 1 cm had no clinical symptoms and required no intervention.

Systemic complications included pulmonary infection (n = 15, 16.0% of total complications), urinary tract infection (n = 12, 12.8%), deep venous thrombosis (n = 8, 19.1%), delirium (n = 22, 23.4%), and pressure sores (n = 3, 3.2%).

In the unadjusted logistic regression model, the MNA-SF score was a significant predictor of postoperative complications (OR = 0.79 per point increase; 95% CI 0.70-0.89; $p < 0.001$). After controlling for age and MMSE score, which were imbalanced at baseline, the MNA-SF score remained independently associated with complications (adjusted OR = 0.82; 95% CI 0.72-0.93; $p = 0.002$; Table II. The ROC analysis based on the entire cohort demonstrated an AUC of 0.645 for MNA-SF in predicting postoperative complications (Figure 1a). The optimal cut-off value was ≤ 8 (Youden's index: 0.261; sensitivity 74.4%, specificity 51.6%).

At the 60-day follow-up, 142 of 183 patients (77.6%) had regained ambulatory function (with or without assistance). Logistic regression revealed no significant association between MNA-SF scores and gait recovery status (unadjusted OR = 1.05; 95% CI 0.94-1.18; $p = 0.380$). The ROC curve for MNA-SF predicting gait status yielded an AUC of 0.527 (Figure 1b), indicating no meaningful predictive value.

The overall 60-day mortality rate was 10.4% (19/183). Mortality rates stratified by nutritional status were 3.2% (2/63) in the well-nourished group, 12.9% (4/31) in the at-risk group, and 14.6% (13/89) in the malnourished group ($p = 0.045$).

Unadjusted logistic regression identified the MNA-SF score as a significant predictor of 60-day mortality (OR=0.68 per point increase; 95% CI 0.55-0.84; $p < 0.001$). This association remained significant after adjusting for age and CCS grading

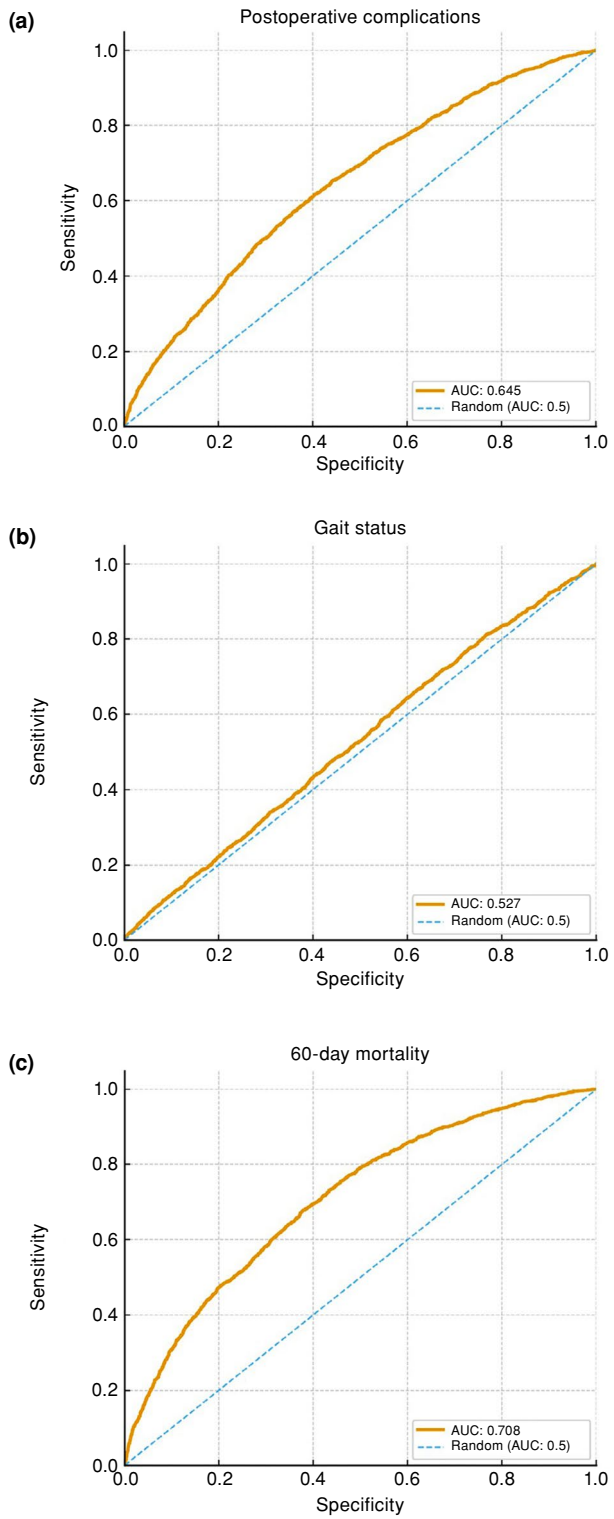


FIGURE 1. Receiver operating characteristic curves demonstrating predictive performance of MNA-SF scores for **(a)** postoperative complications, **(b)** Gait status, and **(c)** 60-day mortality in geriatric hip fracture patients with preoperative nutritional compromise.

AUC, area under the curve; MNA-SF, mini nutritional assessment-short form.

(adjusted OR = 0.72; 95% CI 0.57-0.90; p = 0.004; Table III). The ROC analysis showed an AUC of 0.708 for MNA-SF in predicting 60-day mortality (Figure 1c). The optimal cut-off value derived from Youden's index was ≤ 7 (sensitivity 73.7%, specificity 64.0%; Youden's index 0.377).

DISCUSSION

This study offers crucial evidence regarding the prognostic value of MNA-SF scores for postoperative outcomes in malnourished geriatric hip fracture patients. Our results revealed that diminished MNA-SF scores significantly correlated with elevated 60-day mortality and postoperative complication risks, yielding optimal predictive thresholds at 5 and 7 points, respectively. However, the instrument demonstrated suboptimal predictive accuracy for gait recovery. These findings enhance comprehension of nutritional risk stratification in hip fracture care. We believe that establishing thresholds can substantially improve preoperative risk stratification and guide targeted nutritional interventions.

The MNA serves as a clinically relevant tool for detecting malnutrition or its risk in elderly populations. Prior research indicates that preoperative MNA assessment differentiates malnutrition risk from established malnutrition, enabling early intervention opportunities in vulnerable cohorts.[9] In our study, baseline characteristics did not differ significantly between patients with varying nutritional statuses, suggesting that subsequent outcomes were primarily associated with nutritional status. Consistent with expectations, we observed a robust association between MNA-SF scores and 60-day mortality in nutritionally compromised geriatric hip fracture patients. Our data, corroborating previous studies,[4,6,9] confirm that preoperative malnutrition assessed by MNA significantly predicts mortality in elderly hip fracture cases. Notably, the observed inverse mortality gradient (i.e., decreasing scores, increasing mortality) reflects the dose-response relationship documented by van Wissen et al.,[6] where each 1-point MNA reduction raised one-year mortality risk by 18%. Our 60-day mortality focus, unlike longer-term investigations, highlights acute-phase vulnerabilities and underscores time-sensitive perioperative treatment opportunities.

Prior research employing the MNA-SF has largely followed its established diagnostic categories: normal nutrition (12-14 points), malnutrition risk (8-11 points), and malnourishment (0-7 points).[16,17] In our ROC analysis, an optimal MNA-SF cut-off of ≤ 7 points emerged for predicting 60-day mortality (sensitivity 73.7%, specificity 64.0%; AUC = 0.702), revealing significantly elevated mortality risk below this threshold. We consider 5 points a clinically relevant cut-off due to balanced sensitivity-specificity performance. However, the sensitivity of 60% also implies that approximately 40% of high-risk deaths may be missed, highlighting a trade-off between identifying most at-risk patients and minimizing false positives. This limitation underscores the need for further validation and potential combination with other risk indicators. Crucially, this study provides novel evidence that MNA-SF scores offer independent prognostic value for mortality risk stratification in hip fracture patients.

Our findings further substantiate the role of malnutrition as an adjustable predictor of postoperative complications. Mazzola et al.[18] previously identified MNA-SF-assessed preoperative malnutrition as an independent predictor of post-hip-fracture delirium. Similarly, Dagnelie et al.[19] established impaired baseline nutrition as an independent prognostic factor for surgical complications. This is corroborated by a meta-analysis of 14 studies demonstrating the significant association of malnutrition with complications including delirium.[3] Consistent with these reports, we observed robust associations between MNA-SF scores and postoperative infectious, mental, and cardiovascular complications. A validated predictive threshold of 8 points (≤ 8) for complications was established, corresponding with standardized diagnostic criteria for malnourishment.

While previous studies have demonstrated the predictive value of MNA-SF for outcomes such as mortality and functional recovery after hip fracture, they often lacked consistent or validated cut-off values for specific clinical endpoints. Gumieiro et al.[9] and Nuotio et al.[10] confirmed associations between MNA-SF scores and mortality or mobility, yet did not propose optimized thresholds for mortality prediction. Inoue et al.[8] compared various screening tools, but did not determine evidence-based cut-offs tailored to geriatric hip fracture populations. In contrast, our study identifies and validates specific MNA-SF thresholds (≤ 5 for mortality, ≤ 7 for complications) using ROC analysis, thus offering practical clinical guidance for risk stratification in this vulnerable group.

The lack of a significant link between MNA-SF scores and ambulatory recovery contrasts with prior literature. Gumieiro et al.[9] identified MNA-SF ≤11 as predictive of six-month non-ambulatory status, while Inoue et al.[8] reported significant associations with discharge motor-FIM scores. Potential explanations for this discrepancy include: (1) our 60-day assessment window may miss recovery patterns observable at three to six months and (2) the binary ambulator/non-ambulator classification offers less nuance than instruments like the Functional Ambulation Category scale.[20]

Nonetheless, several limitations merit consideration. First, the single-center nature may introduce selection bias and restrict generalizability. Second, the modest cohort size (n=120) may have reduced statistical power for certain analyses; larger studies are required to validate thresholds across populations. Third, the 60-day timeframe precludes evaluation of long-term functional decline or late mortality-significant burdens in hip fracture survivors.[1] However, our primary objective was to assess early postoperative complications and short-term recovery, which are clinically relevant in the immediate postoperative phase of hip fracture surgery. Moreover, most major complications (e.g., infection, thromboembolic events, reoperation, and early mortality) typically occur within the first one to two months after surgery, and thus can be reliably assessed within this timeframe. Then, absent standardized rehabilitation protocols may have introduced outcome variability in gait recovery, potentially obscuring nutrition-mobility relationships. Finally, the model showed limited predictive performance for complications, with an AUC of 0.645, suggesting suboptimal discrimination and the need for further refinement.

In conclusion, our study confirms the clinical utility of MNA-SF for predicting short-term mortality and surgical complications in malnourished geriatric hip fracture patients. Mortality and complication prediction thresholds as established at 7 and 5 points can be effectively used.

Data Sharing Statement: The data that support the findings of this study are available from the corresponding author upon reasonable request.

Author Contributions: C.W.: Concept/design; Z.L.: Data collection; L.S.: Analysis/interpretation; Y.M.: Literature review; Y.L.: Writing; C.L.: Critical revision; M.L.: References & funding; Q.Z.: Materials; Y.L.: Supervision; H.Y.: Other contributions. All authors reviewed and approved the final manuscript.

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