ORIGINAL ARTICLE

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GLIM Defined Malnutrition in Community Dwelling Older Adults: Prevalence, Predictors, Functional Impact, and Comparison with MNA and GNRI Introduction

Toplumda Yaşayan Yaşlı Bireylerde Nütrisyon Tarama Araçları Arasındaki Uyum: Erken Tanı ve Önleme Açısından Çıkarımlar

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ABSTRACT

Aim: Malnutrition remains a major global health challenge, particularly among older adults, where it contributes to frailty, sarcopenia, and chronic diseases. The Global Leadership Initiative on Malnutrition (GLIM) provides standardized diagnostic criteria to improve early detection. This study aimed to determine the prevalence of malnutrition among community-dwelling older adults using the GLIM criteria and to compare its diagnostic agreement with Mini Nutritional Assessment (MNA) and Geriatric Nutritional Risk index (GNRI).

Materials and Methods: This cross-sectional study included 251 older adults aged 65 years or older from a university hospital's geriatric outpatient clinic. Nutritional status was assessed using GLIM, MNA, and GNRI. Anthropometric measures, body composition (as determined by bioelectrical impedance analysis), handgrip strength, and laboratory markers were evaluated. Cognitive and functional assessments were also conducted. Concordance among tools was analyzed using kappa statistics.

Results: According to GLIM, 51.2% of participants were malnourished, compared to 42.4% with MNA and 7.1% with GNRI. GLIM identified malnutrition in 12.8% of patients with normal body mass index. Agreement between GLIM and MNA was moderate ($p<0.001$), while agreement between GLIM and GNRI was weak ($p=0.001$). Malnutrition was significantly associated with advanced age, female sex, cognitive impairment, and lower physical performance. GLIM showed greater sensitivity in identifying malnutrition and its clinical correlates.

Conclusion: GLIM criteria are more sensitive in detecting malnutrition compared to MNA and GNRI, particularly in identifying individuals with subtle nutritional deficits. A multidimensional approach integrating GLIM with cognitive, functional, and body composition assessments is essential for early diagnosis and prevention in geriatric populations.

Keywords: GLIM, malnutrition, elderly, nutritional assessment, community-dwelling, geriatric screening

ÖZ

Amaç: Yetersiz beslenme, özellikle yaşlı yetişkinlerde kırılganlık, sarkopeni ve kronik hastalık yükünü artırması nedeniyle küresel çapta önemli bir halk sağlığı sorunu olmaya devam etmektedir. Küresel Malnütrisyon Liderlik Girişimi (GLIM), erken tanıyı iyileştirmek amacıyla standardize edilmiş tanı kriterleri sunmaktadır. Bu çalışma, toplumda yaşayan yaşlı yetişkinlerde GLIM kriterlerine göre yetersiz beslenme yaygınlığını belirlemeyi ve GLIM'in tanısal uyumunu Mini Nutrisyon Değerlendirmesi (MNA) ve Geriatrik Beslenme Risk indeksi (GNRI) ile karşılaştırmayı amaçlamaktadır.

Gereç ve Yöntem: Bu kesitsel çalışmaya, bir üniversite hastanesinin geriatrik polikliniğine başvuran 65 yaş ve üzeri 251 birey dâhil edilmiştir. Beslenme durumu GLIM, MNA ve GNRI kullanılarak değerlendirilmiştir. Antropometrik ölçümler, vücut kompozisyonu (biyoelektrik impedans analizi),

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el kavrama gücü ve laboratuvar parametreleri kaydedilmiştir. Ek olarak bilişsel ve işlevsel durum değerlendirmeleri yapılmıştır. Değerlendirme araçları arasındaki tanısal uyum kappa istatistikleri ile analiz edilmiştir

Bulgular: GLIM kriterlerine göre katılımcıların %51,2'si malnütrisyonlu bulunmuştur; bu oran MNA'da %42,4, GNRI'de ise %7,1 olarak saptanmıştır. GLIM, normal vücut kitle indeksine sahip bireylerin %12,8'inde malnütrisyonu tespit edebilmiştir. GLIM ile MNA arasındaki uyum orta düzeyde (p<<0,001), GLIM ile GNRI arasındaki uyum ise zayıf bulunmuştur (p=0,001). Malnütrisyon; ileri yaş, kadın cinsiyeti, bilişsel bozukluk ve düşük fiziksel performansla anlamlı şekilde ilişkiliydi. GLIM kriterleri malnütrisyonu ve klinik ilişkilerini tanımlamada daha yüksek duyarlılık göstermiştir.

Sonuç: GLIM kriterleri, özellikle hafif düzeyde beslenme yetersizliği olan bireyleri belirlemede, MNA ve GNRI'ye kıyasla daha duyarlıdır. GLIM'in bilişsel, işlevsel ve vücut kompozisyonu değerlendirmeleriyle bütünleştirilmesi, toplumda yaşayan yaşlı bireylerde erken tanı ve önleme stratejilerinin güçlendirilmesi açısından önem taşımaktadır.

Anahtar Kelimeler: GLIM, yetersiz beslenme, yaşlı yetişkin, beslenme değerlendirmesi, toplumda yaşayan yaşlılar, geriatrik tarama

INTRODUCTION

Malnutrition, driven by factors such as disease, poverty, hunger, conflict, and natural disasters, continues to affect a significant proportion of the global population. Despite advances in agriculture, healthcare, industry, and living standards, nutrition-related disorders remain a persistent global challenge[1] . Among vulnerable populations, older adults are particularly at risk. Nutrition plays a vital role in promoting health, functionality, and quality of life in older adults. Consequently, nutritional status should be a primary focus in the care and management of aging individuals. Malnutrition—including both undernutrition and obesity—contributes to the progression of various chronic conditions such as cancer, cardiovascular disease, and dementia, and is also a major contributor to sarcopenia and frailty[2-4]. It is strongly linked to higher rates of morbidity and mortality, as well as greater healthcare expenditures. Identifying nutritional risk at an early stage and implementing suitable interventions can substantially enhance patient outcomes and lessen the strain on healthcare services[5].

Until recently, a universally endorsed definition or diagnostic standard for malnutrition had not been available. In response to this need, the Global Leadership Initiative on Malnutrition (GLIM) was formed in 2016 to provide a unified diagnostic framework for adults. The GLIM approach integrates phenotypic markers—such as unintentional weight loss, low body mass index (BMI), and diminished muscle mass—with etiologic components, including insufficient food intake, impaired nutrient assimilation, or the presence of inflammation. A diagnosis is made when at least one etiologic and one phenotypic criterion are present, after which the severity is categorized as stage 1 (moderate) or stage 2 (severe) (1).

With increasing life expectancy and the rising proportion of older adults worldwide, aging-related nutritional challenges are emerging as pressing public health issues[6,7]. Age-related declines in muscle strength, mobility, and balance further contribute to dependency on daily living activities[6,8]. In this context, early identification of malnutrition using reliable tools such as GLIM is critical.

This study aims to assess malnutrition prevalence among older adults using the GLIM criteria and to ascertain the correlation between nutritional status and age groups within a population of community-dwelling older adults.

MATERIALS AND METHODS

Study Design and Participants

In this cross-sectional analytical study, 251 community-dwelling older adults aged 65 years and above were retrospectively enrolled from the geriatric outpatient clinic of a university hospital as part of a healthy aging initiative. Initially, the medical records of 757 older adults were screened. However, participants with missing data necessary to apply the full GLIM criteria—such as anthropometric or etiologic indicators—were excluded. Consequently, 251 participants with complete GLIM-relevant data comprised the final sample. Since this was a retrospective analysis, the sample size was not determined by a priori power analysis but was based on data availability from routine clinical records. The study population included both functionally independent older individuals and those with geriatric syndromes, all of whom underwent comprehensive nutritional and functional assessments during routine health evaluations.

Exclusion criteria were: (i) age below 65 years, (ii) inability to obtain essential data required for the GLIM assessment (e.g., anthropometric, etiologic, or functional measures), and (iii) inability to perform handgrip strength testing or undergo body composition analysis via bioelectrical impedance analysis (BIA). In addition, individuals with acute illness (e.g., active infection, delirium, or recent unstable cerebrovascular events), active malignancy (e.g., ongoing oncologic treatment or cancer cachexia), or terminal conditions (e.g., end-stage organ failure with limited life expectancy requiring palliative care) were excluded from the study.

Prior to participation, written informed consent was obtained from all individuals. The study received approval from the Ege University Medical Faculty Hospital Institutional Research Ethics Committee (approval no: 20-5.1T/53, date: 28.05.2020) and was conducted in conformity with the principles of the Declaration of Helsinki.

Data Collection and Clinical and Nutritional Assessment

Demographic characteristics, comorbidities, clinical and functional data, medication records, and laboratory parameters (hemoglobin, albumin, lymphocytes, platelets) were extracted (Figure 1). Medication use was summarized descriptively according to drug classes. Additional information on cognitive and functional status was recorded using standardized tools, including the Mini-Mental State Examination (MMSE), Katz Activities of Daily Living (ADL), and Lawton Instrumental Activities of Daily Living (IADL) scales. Nutritional parameters were obtained from assessments conducted by trained geriatricians and nurses.

In this study, clinical and nutritional evaluations were retrospectively conducted based on data collected from patients aged 65 years and older who visited the geriatric outpatient clinic. Anthropometric measurements, including BMI, calf circumference (CC), triceps skinfold thickness, and mid-arm circumference, were assessed using standardized protocols. Body composition was measured via BIA (Tanita Body Composition Analyzer), which provided a fat-free mass index, phase angle, body water percentage, visceral fat level, and skeletal muscle mass. Muscle strength was assessed using a handgrip dynamometer (EH101, CAMRY, China), recording the highest value of three attempts from the dominant hand.

Nutritional status was examined using three validated assessment methods: the GLIM framework, the Mini Nutritional Assessment (MNA) and the Geriatric Nutritional Risk index (GNRI). According to the GLIM approach, a diagnosis of malnutrition required at least one phenotypic indicator (such as unintentional weight loss, low BMI, or diminished muscle mass) together with one etiologic factor (including reduced food intake or absorption, or evidence of inflammation).

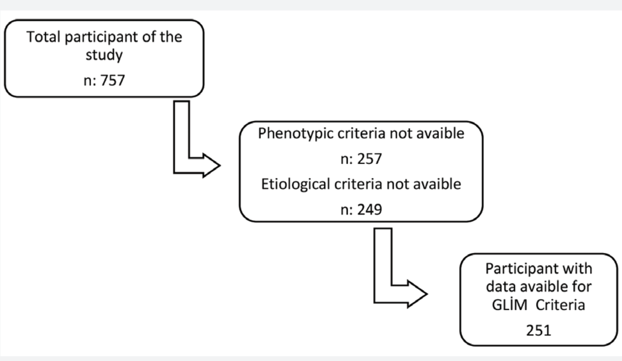

Figure 1. Study Flowchart

GLIM: Global Leadership Initiative on Malnutrition

Muscle mass reduction was identified using CC thresholds (<30 cm for men and <29 cm for women), consistent with criteria commonly applied in sarcopenia evaluation. Data regarding recent weight change and dietary intake were gathered from patient-reported information and medical documentation. Malnutrition severity was categorized as stage 1 (moderate) or stage 2 (severe) based on phenotypic measures. For the etiologic component of the GLIM criteria, reduced food intake or assimilation and inflammation were assessed retrospectively, in accordance with the GLIM consensus report. Reduced food intake or assimilation was defined based on patient self-reports and medical documentation indicating reduced oral intake, prolonged inadequate intake lasting more than two weeks, or the presence of gastrointestinal conditions adversely affecting food intake or absorption.

Inflammation was defined as disease burden–related inflammation and was assumed in patients with at least one documented chronic inflammatory condition (e.g., chronic heart failure, chronic kidney disease, chronic obstructive pulmonary disease, diabetes mellitus, or malignancy). Supportive laboratory markers, including C-reactive protein (CRP) and serum albumin levels, were reviewed as supportive proxy indicators of inflammation, in line with GLIM recommendations[9]. Elevated CRP (≥5 mg/L) and/or hypoalbuminemia (serum albumin <3.5 g/dL) measured at the time of nutritional assessment were considered indicative of systemic inflammation. Although parameters derived from BIA (e.g., lean mass index, skeletal muscle mass, and phase angle) were evaluated, CC was used as the primary indicator of reduced muscle mass for GLIM classification. This approach is consistent with the GLIM consensus, which recognizes anthropometric measurements such as CC as valid and clinically applicable alternatives, particularly in older adults and routine clinical practice. BIA-derived indices were therefore considered complementary measures to support body composition assessment.

The determination of malnutrition and its severity classification followed GLIM recommendations and is detailed in Tables 1 and 2. Laboratory findings included hemoglobin, serum albumin, platelet count and lymphocyte count, which were used to compute the HALP score (hemoglobin × albumin × lymphocytes / platelets). Additional clinical assessments incorporated the Charlson Comorbidity index (CCI), Katz ADL, Lawton IADL, the MMSE, and depressive symptom scores. All data were reviewed by trained geriatric nurses and physicians to ensure consistency and accuracy of GLIM assessments.

Statistical Analysis

Statistical analyses were conducted using IBM SPSS Statistics software (version 24; IBM Corp., Armonk, NY, USA). In the context of the study, continuous variables were summarised using the

Table 1. Diagnostic criteria according to GLIM framework				
Phenotypic criteria			Etiologic criteria	
Weight loss (%)	Low body mass index (kg/m^2)	Reduced muscle mass	Reduced food intake or assimilation	Inflammation
>5% body weight loss within the past 6 months, or >10% if beyond 6 months	<20 kg/m^2 if <70 years, <22 kg/m^2 if ≥70 years	Reduced by validated body composition measuring techniques	50% of ER>1 week, or any reduction for>2 weeks, or any chronic GI condition that adversely impacts food assimilation or absorption	Acute disease/ injury, for chronic disease-related

Cederholm et al.[1], GI: Gastro-intestinal, ER: Energy requirements, GLIM: Global Leadership Initiative on Malnutrition

Table 2. Phenotypic severity grading of malnutrition based on GLIM			
	Phenotypic criteria		
	Weight loss (%)	Low body mass index (kg/m^2)	Reduced muscle mass
Stage 1/moderate malnutrition	5-10% within the past 6 mo, or 10-20% beyond 6 mo	<20 if <70 yr, <22 if >70 yr	Mild to moderate deficit (per validated assessment method see below)
Stage 2/severe malnutrition	>10% within the past 6 mo, or>20% beyond 6 mo	<18.5 if <70 yr, <20 if >70 yr	Severe deficit (per validated assessment method see below)

Cederholm et al.[1], GLIM: Global Leadership Initiative on Malnutrition

mean and standard deviation, while categorical variables were presented as numerical data accompanied by the relevant percentages. The Kolmogorov-Smirnov and Shapiro-Wilk tests were employed to analyse the variable distributions. Non-parametric Kruskal-Wallis H tests were conducted to compare functional (Katz ADL, Lawton IADL) and cognitive (MMSE, Clock Drawing test) performance across nutritional risk groups as defined by GLIM, MNA, and GNRI. Post-hoc pairwise comparisons were performed when appropriate. Subgroup analyses stratified by age (<74 years vs. ≥75 years) were also conducted to evaluate age-related variations in these associations. The agreement between the malnutrition classifications provided by GLIM and MNA was assessed using the McNemar test and cross-tabulation with chi-square analysis. Decision tree modeling via the chi-squared automatic interaction detection (CHAID) algorithm was applied to explore potential predictors of malnutrition based on each nutritional tool and to identify distinct risk profiles. HALP scores were analyzed across nutritional risk groups and relevant clinical variables using non-parametric statistical methods. Variables such as age, sex, educational status, and anthropometric measures were considered as independent predictors. For all statistical tests, a two-tailed p-value below 0.05 was regarded as indicative of statistical significance. Descriptive statistics were reported for MNA (n=243) and GNRI (n=227) scores. The difference in sample size is due to missing biochemical data required for GNRI calculation in 23 participants. As several secondary analyses were exploratory in nature, no formal multiple-comparison correction was applied. All reported p-values are unadjusted and should be interpreted cautiously.

RESULTS

Participants

The participants had a mean age of 76.75±7.3 years, and the sample was predominantly female (63.4%). More than half of the individuals were married (54.5%), and the most common living arrangements were cohabitation with a spouse (51.4%) or with another family member (21.5%), while 21.9% reported living alone (Table 3). The median MNA score was 24.5 interquartile range (IQR: 21.5-27.0) among 243 participants. The median GNRI score was 118.2 (IQR: 110.4-125.6) among 227 individuals. Antihypertensive agents were the most commonly used medications (67.9%), followed by other medications (73.3%) and antidiabetic agents (35.4%). Cardiac medications were used by 28.8% of participants, whereas dementia-related drugs (12.3%) and biological or antineoplastic agents (4.5%) were less frequently prescribed. A small proportion of participants (6.2%) reported no regular medication use.

Ordinal Logistic Regression Analysis: GLIM Stages and Predictors

Ordinal logistic regression was performed to evaluate the effects of sex and age group on malnutrition severity according to GLIM staging (normal, moderate, severe). The overall model demonstrated statistical significance ($\chi^2(2)=13.57$, p=0.001), and model fit indices were acceptable (Pearson p=0.165; deviance p=0.207). Sex and age group were both significant predictors. Specifically, males had higher odds of being in a more severe malnutrition category compared to females [odds ratio (OR)=1.77, 95% confidence interval (CI): 1.07-2.93,

Table 3. Sociodemographic characteristics and body composition parameters of the participants (n=251)

Variable	Category	n (%)/mean ± SD
Age (years)		76.75±7.3
Sex	Female Male	159 (63.4) 92 (36.6)
Body mass index (kg/m^2)	Female Male	29.7±6.2 26.8±4.8
Age group	<75 years ≥75 years	112 (44.4) 139 (55.6)
Marital status	Marriage Single Widowed Divorced	137 (54.5) 7 (2.7) 98 (39.0) 9 (3.5)
Living arrangement	Lives with spouse Lives alone Nursing home Lives with other family members Lives with a caregiver	129 (51.4) 55 (21.9) 10 (3.9) 54 (21.5) 3 (1.2)
Educational level	Illiterate Literate Elementary school Middle school High school College/university	28 (11.1) 24 (9.5) 89 (35.6) 21 (8.4) 37 (14.7) 52 (20.7)
Fat-free mass index (kg/m^2)	Female Male	18.5±2.3 19.5±3.4
Calf circumference (cm)	Female Male	37.6±5.0 36.54±4.07
Triceps skinfold thickness (cm)	Female Male	30.02±3.9 28.68±3.8
Handgrip strength (kg)	Female Male	17.4±6.3 27.41±8.7

SD: Standard deviation

p=0.025]. Participants aged <75 years had significantly lower odds of severe malnutrition compared to those aged ≥75 (OR=0.50, 95% CI: 0.31-0.82, p=0.006). Interaction effects were not included due to non-significant age × sex interaction in preliminary GLM analyses (Figures 2, 3).

Correlation between Nutritional Status and Functional/Cognitive Outcomes

Both the correlation analyses and the comparisons between groups revealed significant relationships between nutritional status and outcomes related to functional and cognitive performance. Spearman correlation analyses showed that GLIM-defined malnutrition (binary coded) was moderately and

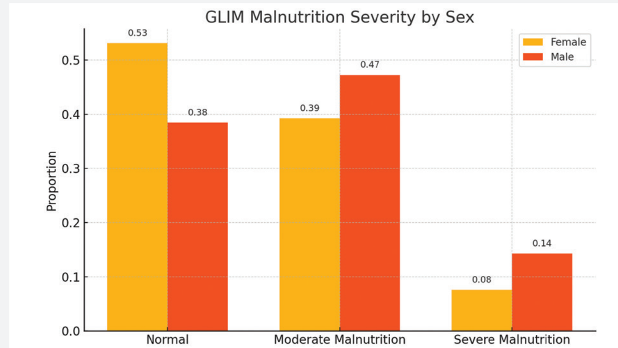

Figure 2. Distribution of GLIM-defined malnutrition severity by sex

GLIM: Global Leadership Initiative on Malnutrition

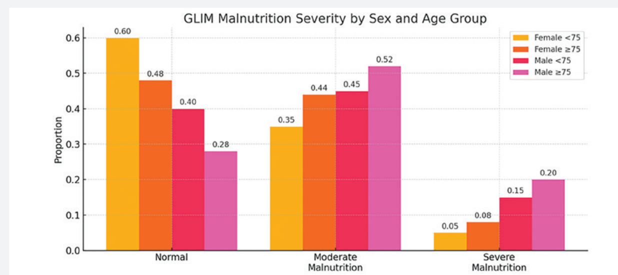

Figure 3. Distribution of GLIM-defined malnutrition severity by sex and age group Malnutrition was more prevalent in males and participants aged ≥75 years, particularly in the moderate and severe categories,

GLIM: Global Leadership Initiative on Malnutrition

negatively associated with MMSE scores (rho=–0.264, p<0.01), Katz ADL (rho=–0.225, p<0.01), and Lawton IADL scores (rho=–0.327, p<0.01). Kruskal-Wallis tests further revealed that functional and cognitive performance decreased progressively across GLIM and MNA nutritional categories (p<0.001 for all). Subgroup analyses indicated that these associations were particularly evident in participants aged ≥75 years, where MMSE and Lawton IADL scores were most affected by malnutrition severity.

Binary Logistic Regression: Predictors of GLIM-defined Malnutrition

Binary logistic regression model was constructed using GLIM-based malnutrition status as the outcome variable (0 =normal nutrition, 1=malnutrition). The model was statistically significant [$\chi^2(20)=55.41$, p<0.001] and achieved an overall classification accuracy of 68.0%. Significant predictors of malnutrition were older age (p<0.001), male sex (p=0.025), lower MMSE scores (p<0.001), lower educational attainment (p=0.012), being single (p=0.043), and lower BMI (p=0.046). The model demonstrated a sensitivity of 66.4% and a specificity of 69.8% (Figure 4).

Group Comparisons Across GLIM and MNA Categories

CCI, CC, triceps skinfold thickness, and HALP scores (all p<0.05). Phase angle, edema percentage, and visceral fat levels did not significantly differ. Similarly, significant differences between MNA groups were found for CC (p<0.001), triceps skinfold (p<0.001), and HALP score (p=0.016), but not for phase angle, edema, visceral fat or CCI.

Participants with elevated CRP levels had significantly lower HALP scores than those with normal CRP levels (p=0.029).

Across GLIM stages, there were differences in objective physical and metabolic parameters, including disease burden and muscle/fat reserves, while MNA groups showed differences in nutritional risk factors related to appetite and the psychosocial domain (Figures 5, 6).

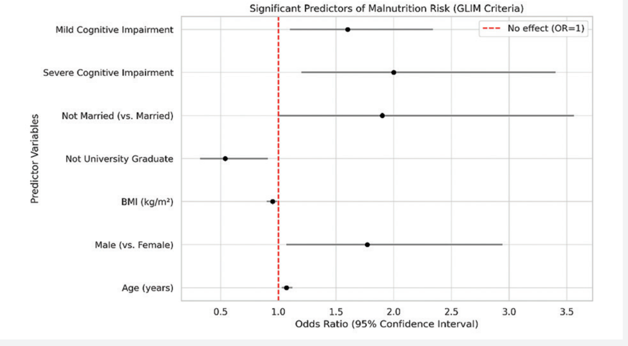

Figure 4. Predictors of GLIM-defined malnutrition
GLIM: Global Leadership Initiative on Malnutrition, BMI: Body mass index

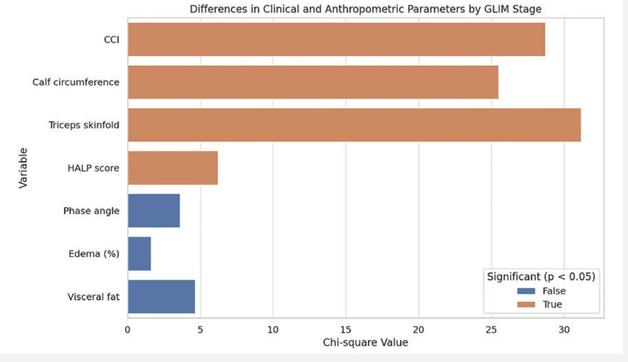

Figure 5. Differences in clinical and anthropometric parameters by GLIM stage
CCI: Charlson Comorbidity index, GLIM: Global Leadership Initiative on Malnutrition

Decision Tree Analyses (CHAID): GLIM, MNA, and GNRI Models

a. GLIM-based Model (Supplementary 1)

The GNRI decision tree identified BMI as the only significant predictor (χ^2=23.620, p<0.001), with a split value of 28.01 kg/m^2. Participants with BMI values above this threshold were predominantly classified as normal or low nutritional risk. However, due to the marked class imbalance in GNRI-defined malnutrition (7.1% at risk), the model failed to adequately identify individuals with mild, moderate, or severe nutritional risk. Consequently, the high overall classification accuracy [93.0%; risk estimate=0.070, standard error (SE)=0.017] primarily reflects prediction of the majority class rather than true discriminatory performance.

b. GNRI-based Model (Supplementary 2)

The GNRI decision tree included only BMI as a predictor (χ^2=23.620, p<0.001). Participants with a BMI>28.01 were classified as "normal or low risk" (100%). However, due to the marked class imbalance in GNRI-defined malnutrition, the model failed to adequately identify individuals at mild, moderate, or severe nutritional risk categories. Consequently, the high overall classification accuracy (93.0%) with a low risk estimate (0.070, SE=0.017) mainly reflects prediction of the majority class rather than true discriminatory performance.

c. MNA-based Model (Supplementary 3)

The CHAID model for MNA classification identified BMI and age group as the main predictors. A BMI>28.20 was associated with a higher probability of normal nutritional status, whereas individuals aged ≥75 years showed an increased likelihood of malnutrition. Although the model correctly classified all individuals with normal nutritional status (100%), its ability to distinguish malnourished or at-risk participants was limited (risk estimate =0.428, SE=0.032), suggesting reduced discriminatory performance across nutritional risk categories.

Comparative Model Performance

Figure 7 presents accuracy and risk estimates across the three decision tree models. The GNRI model showed the highest classification accuracy (93.0%) with the lowest error rate. The MNA and GLIM models demonstrated classification accuracies of 57.2% and 54.6%, respectively.

Concordance Between GLIM and MNA

A McNemar test revealed significant discordance between GLIM and MNA classifications (χ^2=8.862, p=0.003). GLIM identified more individuals as malnourished compared to MNA. Agreement between GLIM and MNA was moderate (Cohen's kappa κ =0.467, p<0.001). GLIM classified 128 individuals

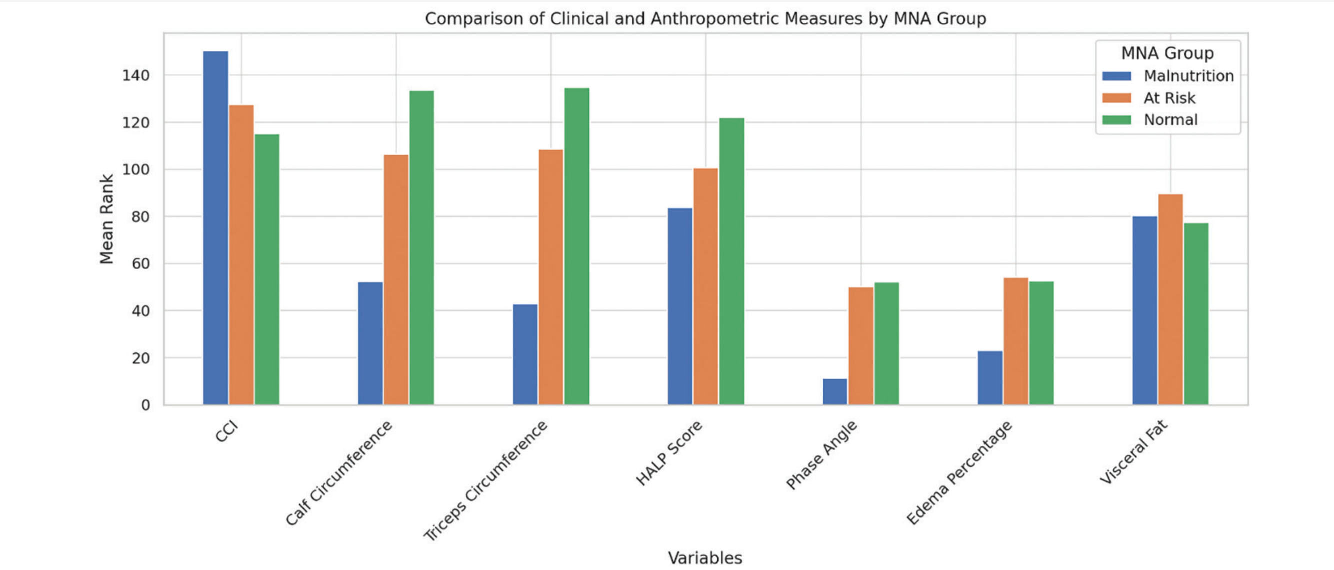

Figure 6. Differences in clinical and anthropometric parameters by MNA stage
MNA: Mini Nutritional Assessment, CCI: Charlson Comorbidity index

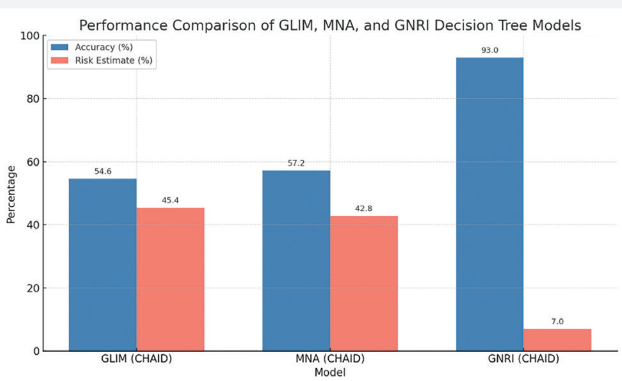

Figure 7. Comparison of accuracy and risk estimates across GLIM, MNA, and GNRI decision tree models
GLIM: Global Leadership Initiative on Malnutrition, MNA: Mini Nutritional Assessment, GNRI: Geriatric Nutritional Risk index, CHAID: Chi-Square Automatic Interaction Detection

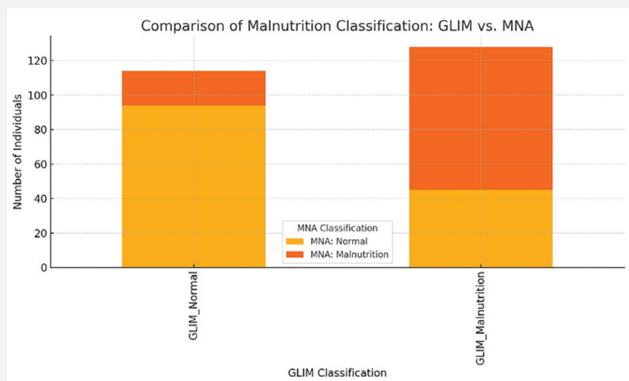

Figure 8. Comparison of malnutrition classification: GLIM and MNA
GLIM: Global Leadership Initiative on Malnutrition, MNA: Mini Nutritional ssessment

as malnourished, whereas MNA classified 103, with 45 cases detected by GLIM but not by MNA. Agreement between GLIM and GNRI varied by cut-off. With a GNRI threshold of 92, agreement was poor and not significant (Cohen's kappa $\kappa=0.022$, $p=0.234$). Using a cut-off of 98 improved statistical significance (Cohen's kappa $\kappa=0.105$, $p=0.001$), but agreement remained weak. GNRI classified 16 individuals as malnourished compared to 122 by GLIM (Figure 8).

Associations with Functional and Cognitive Status

GLIM and MNA classifications were significantly associated with functional and cognitive measures. Katz ADL, Lawton IADL, Clock Drawing test, and MMSE scores decreased progressively with increasing malnutrition severity ($p<0.001$ for all). In the <75 age group, all MNA-based comparisons were significant except MMSE in the GLIM model. In participants aged ≥75, significant associations were observed in Lawton IADL and

MMSE, particularly with MNA classification. Depressive symptoms were present in 15.9% of participants; however, no statistically significant association was observed between depressive symptom status and nutritional status as classified by either MNA or GLIM ($p>0.05$ for both).

Nutritional and Body Composition Differences by Age Group

Nutritional and body composition parameters were compared across age groups using Mann-Whitney U tests. GNRI scores significantly differed by age group ($p=0.019$), with individuals aged ≥75 years having lower values. Participants aged ≥75 years had significantly lower MNA scores than younger individuals ($p=0.044$). HALP scores did not reach statistical significance across age groups ($p=0.078$). BMI ($p=0.238$) and skeletal muscle index (SMI) ($p=0.593$) likewise showed no significant differences by age group.

Effects of Sex and Age Group on GLIM-based Malnutrition Severity

A two-way ANOVA examined the effects of sex and age group on GLIM-based malnutrition severity. The analysis revealed significant main effects of both sex ($p=0.015$) and age group ($p=0.025$), indicating that malnutrition severity was higher in specific sex and age categories. However, the interaction between sex and age group was not statistically significant ($p=0.437$), indicating that the effect of sex on malnutrition severity did not vary across age groups.

DISCUSSION

Our findings align with previous studies indicating the superior sensitivity of the GLIM criteria in detecting malnutrition among older adults. In our study, 51.2% of community-dwelling older individuals were classified as malnourished by GLIM, a figure consistent with hospital-based estimates reported in Asian populations (16%-78%) but significant given the non-hospitalized nature of our cohort[3]. Notably, 12.8% of individuals categorized as "normal" by BMI were identified as malnourished using GLIM, emphasizing its ability to detect subclinical malnutrition overlooked by traditional anthropometric measures.

Previous studies have demonstrated that GLIM criteria effectively identify malnutrition in geriatric populations[10]. Large nationwide cohort studies have reported a higher proportion of men among individuals with GLIM-defined malnutrition, although sex differences were not consistently significant across populations[11]. In our regression analysis, male sex emerged as an independent predictor of greater malnutrition severity. Furthermore, our findings echo the results of Galindo Martín et al.[12], who reported that GLIM-defined malnutrition was associated with higher mortality and poorer clinical outcomes. In their study, malnourished patients had significantly higher in-hospital mortality and unplanned transfers to critical care, and the odds of adverse outcomes increased progressively with malnutrition severity. Although our study did not assess prognosis, the strong association of malnutrition with cognitive decline and impaired ADL/IADL supports GLIM's multidimensional utility.

According to GLIM, 51.2% of participants were classified as malnourished, compared with 42.4% by MNA and 7.1% by GNRI. Notably, GLIM identified malnutrition in 12.8% of individuals with normal BMI, highlighting its ability to detect cases that may be overlooked by BMI-based assessments. Agreement between GLIM and MNA was moderate, whereas agreement with GNRI was weak. Malnutrition was significantly associated with advanced age, cognitive impairment, and lower physical performance. These findings are consistent with previous research demonstrating the greater sensitivity of GLIM in identifying malnutrition and its clinical correlates in older adults[13].

A study from New Zealand also reported that nutritional risk Mini Nutritional Assessment-Short Form (MNA-SF ≤11) was associated with increasing age, reduced gait speed, and dysphagia risk. Although the prevalence was lower (12%), likely due to the use of MNA-SF, these findings support the importance of incorporating functional parameters into nutritional assessment, consistent with the broader evaluation provided by GLIM[14].

In our study, HALP scores showed significant differences between GLIM and MNA categories but did not differ across age groups; this finding suggests that HALP may be considered a composite marker reflecting nutritional status and disease burden rather than chronological age. Although HALP has been reported to be associated with prognostic outcomes in the literature, the cross-sectional design of our study does not allow for prognostic inferences. Accordingly, and in line with previously reported associations between HALP, muscle mass, and mortality in NHANES data, HALP was interpreted in the present study solely as a composite marker of nutritional status and disease burden[15]. Consistent with population-based analyses demonstrating an inverse association between HALP and CRP levels, our findings showed significantly lower HALP scores in participants with elevated CRP, further supporting the interpretation of HALP as an integrated nutrition–inflammation marker, particularly relevant in older adults[16].

Unlike studies conducted in hospitalized or institutionalized populations, our study highlights the burden of malnutrition among community-dwelling older adults. The prevalence observed in our cohort is comparable to rates reported in inpatient studies, such as those by Hiraike et al.[17] and Ohta et al.[18] (≈46%). These findings indicate that malnutrition is also common in outpatient settings. Moreover, previous studies have shown that GNRI predicts mortality in hospitalized older adults, emphasizing the clinical importance of early nutritional assessment. Our inclusion of cognitive, functional, and body composition variables allowed a broader evaluation of nutritional risk. Previous studies indicate that the diagnostic performance of GNRI varies by clinical setting; while it may show stronger prognostic value in hospitalized populations, its discriminatory capacity appears limited in community-based settings, supporting its role primarily as a screening rather than a diagnostic tool[19,20].

Although prognostic outcomes such as mortality or hospitalization were not evaluated, the observed associations between malnutrition, age, sex, cognitive status, and physical performance highlight the importance of routine multidimensional nutritional screening. GLIM-based assessment, integrated with functional and cognitive evaluation, may support earlier identification of at-risk older adults in community settings. Future studies should explore the prognostic impact of GLIM-defined malnutrition and the potential benefits of community-based, nurse-led screening and intervention programs[21].

Study Limitations

Our study has several strengths, including its focus on community-dwelling older adults and the use of a comprehensive geriatric assessment incorporating functional, cognitive, anthropometric, and laboratory parameters. The application of the GLIM criteria in a real-world outpatient setting and the demonstration of associations between malnutrition and multidimensional outcomes enhance the clinical relevance of our findings. Nevertheless, certain limitations should be acknowledged. The cross-sectional design precludes causal inference, and the single-center setting may limit generalizability. Missing data in the MNA and GNRI assessments restricted some analyses to complete cases, introducing potential selection bias. In addition, the CHAID model for GNRI showed high overall accuracy driven by class imbalance, limiting its ability to identify individuals at nutritional risk. Finally, due to the exploratory nature of several analyses, no multiple-comparison correction was applied; therefore, findings should be interpreted cautiously and confirmed in future studies.

CONCLUSION

This study highlights the multidimensional nature of malnutrition in older adults and emphasizes the necessity of comprehensive nutritional assessment. The GLIM criteria demonstrated higher sensitivity in detecting malnutrition, while age and sex emerged as significant independent predictors of malnutrition severity. Conventional metrics such as BMI and SMI may overlook subtle nutritional impairments in older populations. Furthermore, the association between malnutrition and both cognitive and functional decline reinforces the need for integrated geriatric evaluations. A multidimensional approach encompassing anthropometric, functional, cognitive, and demographic parameters is essential for accurate and timely diagnosis of malnutrition in the older adults.

Ethics

Ethics Committee Approval: The study received approval from the Ege University Medical Faculty Hospital Institutional Research Ethics Committee (approval no: 20-5.1T/53, date: 28.05.2020) and was conducted in conformity with the principles of the Declaration of Helsinki.

Informed Consent: Prior to participation, written informed consent was obtained from all individuals.

Footnotes

Concept: Z.D., S.Ş., E.T., H.E.A., S.F.A., Design: Z.D., S.Ş., E.T., H.E.A., S.F.A., Data Collection or Processing: Z.D., E.T., Analysis or Interpretation: Z.D., S.Ş., S.F.A., Literature Search: Z.D., E.T., H.E.A., Writing: Z.D., S.Ş., S.F.A.

Conflict of Interest: No conflict of interest was declared by the authors.

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REFERENCES

1. Cederholm T, Jensen GL, Correia MITD, Gonzalez MC, Fukushima R, Higashiguchi T, et al. GLIM criteria for the diagnosis of malnutrition - a consensus report from the global clinical nutrition community. Clin Nutr. 2019;38:1-9.
2. Volkert D, Beck AM, Cederholm T, Cruz-Jentoft A, Goisser S, Hooper L, et al. ESPEN guideline on clinical nutrition and hydration in geriatrics. Clin Nutr. 2019;38:10-47.
3. Abd Aziz NAS, Teng NIMF, Abdul Hamid MR, Ismail NH. Assessing the nutritional status of hospitalized elderly. Clin Interv Aging. 2017;12:1615-25.
4. Shlisky J, Bloom DE, Beaudreault AR, Tucker KL, Keller HH, Freund-Levi Y, et al. Nutritional considerations for healthy aging and reduction in age-related chronic disease. Adv Nutr. 2017;8:17-26.
5. Zhang X, Tang M, Zhang Q, Zhang KP, Guo ZQ, Xu HX, et al. The GLIM criteria as an effective tool for nutrition assessment and survival prediction in older adult cancer patients. Clin Nutr. 2021;40:1224-32.

6. Jung W, Park H. Circuit exercise promotes health related factors in sarcopenic obesity elderly: a mini-review. MOJ Gerontol Geriatr. 2018;3:233-6.

7. Park HY, Jung WS, Kim SW, Lim K. Relationship between sarcopenia, obesity, osteoporosis, and cardiometabolic health conditions and physical activity levels in korean older adults. Front Physiol. 2021;12:706259.

8. Greco EA, Pietschmann P, Migliaccio S. Osteoporosis and sarcopenia increase frailty syndrome in the elderly. Front Endocrinol (Lausanne). 2019;10:255.

9. Cederholm T, Jensen GL, Correia MITD, Gonzalez MC, Fukushima R, Higashiguchi T, et al. GLIM criteria for the diagnosis of malnutrition - a consensus report from the global clinical nutrition community. Clin Nutr. 2019;38:1-9.

10. Clark AB, Reijnierse EM, Lim WK, Maier AB. Prevalence of malnutrition comparing the GLIM criteria, ESPEN definition and MST malnutrition risk in geriatric rehabilitation patients: RESORT. Clin Nutr. 2020;39:3504-11.

11. Liu Z, Feng J, Fang Y, Cheng Y, Li S. Barriers to prophylactic treatment among patients with haemophilia a in shandong province, China: a qualitative study. Orphanet J Rare Dis. 2023;18:226.

12. Galindo Martín CA, Aportela Vázquez VA, Becerril Hernández F, Aguilar Medina CR, Ayala Carrillo SL, Chávez Flores A, et al. The GLIM criteria for adult malnutrition and its relation with adverse outcomes, a prospective observational study. Clin Nutr ESPEN. 2020;38:67-73.

13. Zhang X, Wang Y, Xu M, Zhang Y, Lyu Q. The malnutrition in AECOPD and its association with unfavorable outcomes by comparing PNI, GNRI with the GLIM criteria: a retrospective cohort study. Front Nutr. 2024;11:1365462.

14. Chatindiara I, Williams V, Sycamore E, Richter M, Allen J, Wham C. Associations between nutrition risk status, body composition and physical performance among community-dwelling older adults. Aust N Z J Public Health. 2019;43:56-62.

15. Liu S, Huang J, Hu X, Chen S, Lin M. The association of HALP score with low muscle mass in older adults. Front Nutr. 2025:1618736.

16. Antar R, Farag C, Xu V, Drouaud A, Gordon O, Whalen MJ. Evaluating the baseline hemoglobin, albumin, lymphocyte, and platelet (HALP) score in the United States adult population and comorbidities: an analysis of the NHANES. Front Nutr. 2023;10:1206958.

17. Hiraike T, Momoki C, Habu D. Comparison of the adequacy of Geriatric Nutritional Risk index with that of the mini nutritional assessment-short form and global leadership initiative on malnutrition criteria in assessing nutritional status to predict the 1-year prognosis of hospitalized Japanese older adults: a single-institutional cohort study. BMC Geriatr. 2023;23:35.

18. Ohta M, Imamura Y, Chebib N, Schulte-Eickhoff RM, Allain S, Genton L, et al. Oral function and nutritional status in non-acute hospitalised elders. Gerodontology. 2022;39:74-82.

19. Abd Aziz NAS, Mohd Fahmi Teng NI, Kamarul Zaman M. Geriatric nutrition risk index is comparable to the mini nutritional assessment for assessing nutritional status in elderly hospitalized patients. Clin Nutr ESPEN. 2019;29:77-85.

20. Baek MH, Heo YR. Evaluation of the efficacy of nutritional screening tools to predict malnutrition in the elderly at a geriatric care hospital. Nutr Res Pract. 2015;9:637-43.

21. Kasa AS, Traynor V, Lee SC, Drury P. On the relationship between frailty, nutritional status, depression and quality of life among older people. Int J Older People Nurs. 2024;19:e12644.