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ORIGINAL RESEARCH

Association Between Geriatric Nutrition Risk Index and 90-Day Mortality in Older Adults with Chronic Obstructive Pulmonary Disease: a Retrospective Cohort Study

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Background: Malnutrition adversely affects prognosis in various medical conditions, but its implications in older adults with Chronic Obstructive Pulmonary Disease (COPD) in the ICU are underexplored. The geriatric nutritional risk index (GNRI) is a novel tool for assessing malnutrition risk. This study investigates the association between GNRI and 90-day mortality in this population.

Methods: We selected older adults with COPD admitted to the ICU from Medical Information Mart for Intensive Care (MIMIC)-IV 2.2 database. A total of 666 patients were categorized into four groups based on their GNRI score: normal nutrition (>98), mild malnutrition (92–98), moderate malnutrition (82–91), and severe malnutrition (≤81) groups. We employed a restricted cubic spline (RCS) analysis to assess the presence of a curved relationship between them and to investigate any potential threshold saturation effect.

Results: In multivariate Cox regression analyses, compared with individuals had normal nutrition (GNRI in Q4 >98), the adjusted HR values for GNRI in Q3 (92–98), Q2 (82–91), and Q1 (≤81) were 1.81 (95% CI: 1.27–2.58, p=0.001), 1.23 (95% CI: 0.84–1.79, p=0.296), 2.27 (95% CI: 1.57–3.29, p<0.001), respectively. The relationship between GNRI and 90-day mortality demonstrates an L-shaped curve (p=0.016), with an approximate inflection point at 101.5.

Conclusion: These findings imply that GNRI is a useful prognostic tool in older adults with COPD in the ICU. An L-shaped relationship was observed between GNRI and 90-day mortality in these patients.

Keywords: geriatric nutritional risk index, 90-day mortality, older adults, chronic obstructive pulmonary disease, MIMIC-IV

Introduction

According to the Global Initiative for Chronic Obstructive Lung Disease (GOLD) 2023 guidelines, COPD is a multifaceted lung condition marked by persistent respiratory symptoms (such as breathlessness, cough, and exacerbations) stemming from airway abnormalities (bronchitis, bronchiolitis) and/or alveolar abnormalities (emphysema).This condition leads to persistent airflow obstruction, which often worsens over time.[1] Despite ongoing efforts, COPD remains a significant global cause of premature death, with a consistently high mortality rate.

Critically ill patients, particularly the older adults, are at increased risk of malnutrition.[2,3] Data from prior studies indicates that malnutrition is prevalent in 30–60% of individuals with COPD.[4–6] Additionally, previous researches have consistently shown a negative correlation between malnutrition and both mortality and length of hospital stay (LOS), resulting in higher healthcare costs for these patients.[3,7,8]

Patients in the ICU are at a heightened risk of malnutrition. Identifying patients at risk of malnutrition is crucial, as they may benefit from clinical nutrition interventions, leading to improved outcomes and extended lifespans. Hence, there is a need

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to explore a dependable and valuable nutritional screening tool for these patients.[9] Numerous screening and assessment tools, including the Mini Nutritional Assessment (MNA), Malnutrition Universal Screening Tool (MUST), Short Nutritional Assessment Questionnaire (SNAQ), Malnutrition Screening Tool (MST), and Subjective Global Assessment (SGA), are utilized to evaluate nutritional status.[10] However, The American Society for Parenteral and Enteral Nutrition (ASPEN) and the Society for Critical Care Medicine (SCCM) recommend only the NRS 2002 and The Nutrition Risk in the Critically Ill (NUTRIC) score.[11–13] Patients categorized as "at risk" of malnutrition exhibit an NRS 2002 score exceeding 3, while those deemed "high risk" of malnutrition demonstrate a score of 5 or higher, or a NUTRIC score equal to or surpassing 5 (if interleukin-6 is not integrated, otherwise exceeding 6).[14] However, these tools have limitations for older adults patients with COPD due to subjectivity and cognitive impairments. Additionally, time constraints hinder their implementation. To address these issues, the GNRI, a simple and objective tool, offers a promising solution. Numerous studies have illustrated the ability of this index to predict short- and long-term outcomes in older adults patients.[15–20] Furthermore, its calculation relies solely on height, weight, and serum albumin (ALB) levels, rendering it a simple, easily obtainable, and cost-effective measure.[21] Previous studies have demonstrated its effectiveness in various chronic diseases,[22–27] but its application in COPD among the older adults remains unexplored. Hence, this study sought to investigate the relationship between GNRI and 90-day mortality in older adults ICU patients with COPD.

Materials and Methods

Database introduction

This study utilized correlative data obtained from the open-access Medical Information Mart for Intensive Care (MIMIC)-IV database (version 2.2). The database encompasses extensive information regarding 431,231 hospitalized individuals at Beth Israel Deaconess Medical Center (Boston, MA, USA) from 2008 to 2019.[28] Tingting Wang, a certified professional of the Collaborative Institutional Training Initiative (certification number: 46,460,489), employed PostgreSQL tools (version 11.21) for data extraction from the MIMIC-IV database. The absence of informed consent was justified by the utilization of publicly accessible data. Our study followed the guidelines set forth by the STROBE (Strengthening the Reporting of Observational Studies in Epidemiology) statement and adhered to the principles delineated in the Declaration of Helsinki. This project received approval from the Research Ethics Committee of the Second People's Hospital of Liaocheng (Approval No. 2023–7).

Study Population

The study encompassed a cohort of older adult patients diagnosed with COPD who were admitted to the ICU. Patient identification was conducted utilizing the International Classification of Diseases (ICD) codes, specifically ICD-9 codes 49,120, 49,121, 49,122, and 496, as well as ICD-10 codes J44, J440, and J441, within the MIMIC-IV 2.2 database.[29] We provided a detailed list of the specific ICD codes used as shown in Table S1. The study population comprised individuals with a first diagnosis of COPD. Inclusion criteria consisted of: (1) individuals aged 65 years or older, (2) initial admission to the ICU, and (3) an ICU length of stay equal to or exceeding 24 hours. Exclusion criteria included: (1) missing essential data such as height, weight, or albumin, and (2) an ICU length of stay less than 24 hours.

Data Extraction

The following data were obtained at the time of admission: (1) demographic variables (eg, age, sex, Ethnicity, height, weight); (2) vital signs (eg, heart rate (HR), respiratory rate (RR), mean arterial pressure (MAP), pulse oximetry-derived oxygen saturation (SpO2), temperature); (3) initial laboratory data such as hemoglobin (HB), platelets, white blood cell count (WBC), C-reactive protein (CRP), albumin (ALB), aspartate transferase (AST), alanine aminotransferase (ALT), total bilirubin (TBil), international normalized ratio (INR), activated prothrombin time (APTT), prothrombin time (PT), pH, partial pressure of oxygen (pO2), partial pressure of carbon dioxide (pCO2), potassium, sodium, blood urea nitrogen (BUN), creatinine (Cr); (4) Clinical severity scores such as Charlson comorbidity index (CCI), acute physiology score III (APSIII), sequential organ failure assessment (SOFA); (5) comorbidities including myocardial infarction, congestive heart failure, diabetes with or without complication, malignant cancer, severe liver disease, sepsis. We extracted the most

extreme values (ie, maximum and minimum) observed in vital signs and laboratory tests during ICU hospitalization. To address missing covariate data, we utilized multiple imputation by generating and subsequently analyzing five datasets.

Group

In this study, participants were stratified based on their GNRI scores, which were calculated using height (m), weight (kg), and ALB level (g/L). The GNRI score was computed using the formula: GNRI = 1.489 × ALB + 41.7 × [weight/(22 × height^2)].[30] A GNRI > 98 indicated normal nutritional status, while a GNRI ≤ 98 signified malnutrition, further categorized as GNRI=92–98 (mild malnutrition), GNRI=82–91 (moderate malnutrition), and GNRI ≤ 81 (severe malnutrition).[31]

Endpoint Definition

The primary outcome was 90-day mortality, with secondary endpoints comprising hospital and ICU length of stay.

Statistical Analysis

Continuous variables with normally distributed were presented as mean ± standard deviation (SD) or as median with interquartile range (IQR) otherwise. Categorical variables were presented as numbers and percentages. We utilized analysis of variance (ANOVA) or Kruskal–Wallis test as appropriate for continuous variables and the chi-square test or Fisher's exact for categorical variables to compare baseline characteristics among the four groups.

We conducted both univariate and multivariate Cox proportional hazard regressions to calculate hazard ratios (HRs) and their corresponding 95% confidence intervals (CIs) in order to assess the association between GNRI and 90-day mortality. Three models were constructed to obtain statistical inferences. Model 1 was adjusted for age and gender. Model 2 was adjusted for Model 1 adding with the factors that p values were less than 0.05 in the univariate analysis, including race, HR, MAP, SpO2, HB, BUN, Cr, PLT and WBC. Model 3 was fully adjusted, including covariates adjusted in Model 1 and Model 2, adding with myocardial infarction, congestive heart failure, severe liver disease, CCI and SOFA.

RCS regression was performed to assess the association between GNRI and 90-day mortality. Additionally, we analyzed the threshold saturation effect and employed Kaplan-Meier curves to compare survival probabilities among various GNRI groups. Subgroups analyses were conducted following age, sex, MAP, RR, Myocardial infarction, Congestive heart failure, Diabetes with complication, Malignant cancer, Sepsis and SOFA using stratified Cox regression models.

Considering the large differences between patients with COPD exacerbations requiring noninvasive or mechanical ventilation and patients with stable COPD admitted for a completely different acute problem, we conducted a sensitivity analysis incorporating four additional covariates- "AECOPD status", "presence of respiratory failure", "mechanical ventilation status", and "vasopressin use". The interactions among subgroups were tested using a likelihood ratio test.

Since the sample size was determined solely based on the available data, no prior statistical power estimates were conducted. All statistical analyses were conducted using R statistical software and Free Statistics software version 1.7,[32] with statistical significance defined as $p<0.05$.

Results

Baseline Characteristics

After screening, a total of 666 potentially eligible patients with COPD admitted to the ICU were enrolled into the study (Figure S1). As shown in Table 1, patients were divided into four groups: normal nutrition (GNRI > 98, 360 cases), mild malnutrition (GNRI = 92–98, 104 cases), moderate malnutrition (GNRI = 82–91, 114 cases) and severe malnutrition (GNRI ≤ 81, 88 cases). The mean age of participants was 75 (range 70 to 81) years old and approximately 56.2% were male. There were no significant differences in sex, race, RR, SpO2, Platelet, WBC, BUN, pH, pO2, pCO2, Myocardial infarction, Severe liver disease, CCI, Hospital LOS and ICU LOS among the four groups. Patients in the moderate to severe malnutrition group had a higher mean age and HR than normal nutrition group. Besides, the severe malnutrition group had a significantly lower HB, ALB, congestive heart failure and were more likely to have malignant cancer, sepsis, higher APSIII and SOFA score. However, there were no significant difference in hospital LOS and ICU LOS among these groups.

Table 1 Characteristics of Patients in Subgroups with Different GNRIs

Variables	GNRI				*p value*
	≤81 (n = 88)	82–91 (n = 114)	92–98 (n = 104)	>98 (n = 360)	
Demographic variables					
Age (years)	76.0 (70.0, 83.0)	77.0 (71.0, 83.0)	76.0 (70.0, 82.0)	74.0 (69.0, 80.0)	0.01
Male, n (%)	51 (58)	58 (50.9)	63 (60.6)	202 (56.1)	0.526
Ethnicity, n (%)					0.34
ASIAN	3 (3.4)	4 (3.5)	1 (1)	4 (1.1)	
BLACK	2 (2.3)	4 (3.5)	4 (3.8)	16 (4.4)	
HISPANIC/LATINO	3 (3.4)	0 (0)	0 (0)	6 (1.7)	
OTHER	23 (26.1)	23 (20.2)	30 (28.8)	96 (26.7)	
WHITE	57 (64.8)	83 (72.8)	69 (66.3)	238 (66.1)	
Vital signs					
HR (/min)	86.2 ± 16.7	88.89± 16.2	84.9 ± 16.8	83.8 ± 16.2	0.032
MAP (mmHg)	73.2 ± 8.4	73.8 ± 9.9	76.3 ± 9.7	76.1 ± 9.6	0.013
RR (/min)	20.3 ± 4.5	20.7 ± 4.0	19.8 ± 3.2	20.3 ± 3.6	0.439
Temperature (°C)	36.7 ± 0.5	36.7 ± 0.5	36.7 ± 0.8	36.9 ± 0.5	0.01
Spo2 (%)	96.9 ± 3.3	96.5 ± 2.6	96.2 ± 2.9	96.2 ± 2.1	0.156
Laboratory events					
Hb (g/dL)	9.3 ± 2.0	9.3 ± 2.1	9.8 ± 2.1	10.2 ± 2.1	< 0.001
Platelet (10^9/L)	176.5 (117.5, 244.2)	186.0 (137.2, 271.2)	184.0 (118.0, 260.0)	171.0 (125.8, 221.5)	0.302
WBC (10^9/L)	15.2 (11.3, 21.5)	14.4 (9.8, 19.7)	12.7 (9.6, 17.7)	13.3 (9.7, 18.4)	0.062
ALB (g/dL)	2.3 ± 0.5	2.9 ± 0.4	3.1 ± 0.5	3.4 ± 0.5	< 0.001
BUN (mg/dL)	31.0 (17.8, 48.2)	27.0 (17.0, 45.0)	27.0 (20.8, 44.8)	33.0 (21.0, 52.0)	0.094
pH	7.3 ± 0.1	7.3 ± 0.1	7.3 ± 0.1	7.3 ± 0.1	0.226
CR (mg/dL)	1.1 (0.8, 2.0)	1.2 (0.9, 1.9)	1.3 (0.9, 2.1)	1.4 (1.0, 2.2)	0.001
pO2 (mmHg)	77.0 (61.8, 96.8)	74.0 (56.0, 100.8)	74.0 (53.8, 91.2)	72.0 (55.0, 92.0)	0.282
pCO2 (mmHg)	49.0 (42.0, 58.0)	50.0 (41.2, 59.0)	48.5 (42.0, 54.0)	50.5 (43.0, 61.0)	0.142
Comorbidities, n (%)					
Myocardial infarction	20 (22.7)	39 (34.2)	37 (35.6)	110 (30.6)	0.219
Congestive heart failure	22 (25)	57 (50)	61 (58.7)	212 (58.9)	< 0.001
Diabetes with complication	6 (6.8)	8 (7)	10 (9.6)	54 (15)	0.034
Malignant cancer	21 (23.9)	23 (20.2)	21 (20.2)	32 (8.9)	< 0.001
Severe liver disease	4 (4.5)	0 (0)	3 (2.9)	13 (3.6)	0.12
Sepsis	76 (86.4)	91 (79.8)	81 (77.9)	255 (70.8)	0.01
Severity of disease					
CCI	7.0 (6.0, 10.0)	7.0 (6.0, 9.0)	8.0 (6.0, 10.0)	8.0 (6.0, 9.0)	0.499
APSIII	71.0 (53.8, 89.2)	58.5 (42.5, 76.8)	56.5 (42.5, 76.0)	54.0 (41.0, 73.0)	< 0.001
SOFA	4.0 (3.0, 5.0)	3.0 (2.0, 4.8)	3.0 (2.0, 4.0)	3.0 (2.0, 4.0)	0.034
Clinical outcome					
Hospital LOS (d)	11.2 (5.3, 19.8)	10.1 (5.9, 15.8)	9.1 (5.8, 14.9)	9.1 (5.5, 15.1)	0.462
ICU LOS (d)	4.2 (2.5, 10.3)	4.7 (2.1, 6.9)	4.5 (2.2, 8.5)	3.8 (2.2, 7.6)	0.425

Abbreviations: GNRI, geriatric nutritional risk index; HR, heart rate; MAP, mean arterial pressure; RR, respiratory rate; SpO2, pulse oximetry-derived oxygen saturation; HB, hemoglobin; WBC, white blood cell; ALB, albumin; BUN, blood urea nitrogen; CR, creatine; pO2, partial pressure of oxygen; pCO2, partial pressure of carbon dioxide; CCI, Charlson comorbidity Index; APSIII, acute physiology score III; SOFA, sequential organ failure assessment; LOS, length of stay; ICU, intensive critical care.

Relationship Between GNRI and 90-Day Mortality

Univariate Cox regression analysis identified several significant risk factors for 90-day mortality in older adults with COPD in the ICU (Table S2), including GNRI, age, MAP, HR, RR, temperature, HB, WBC, ALB, BUN, Cr, Sepsis, CCI, APSIII and SOFA score. Table 2 presents both unadjusted and adjusted analyses for GNRI and 90-day mortality. When GNRI was divided into quartiles in Model 1, compared with Q4 (GNRI>98), the adjusted HRs for Q1 (GNRI<81), Q2 (82–91), and Q3 (92–98) were 2.42 (95% CI:1.73–3.39, p<0.001), 1.2 (95% CI:0.83–1.73, p=0.333) and 1.73 (95% CI:1.23–2.44, p=0.002),

Table 2 Multivariable Cox Regression Analysis to Assess the Association Between GNRI and 90-Day Mortality

Variable	Unadjusted		Model 1		Model 2		Model 3	
	HR 95% CI	P-value	HR 95% CI	P-value	HR 95% CI	P-value	HR 95% CI	P-value
GNRI[a]	0.99 (0.98, 0.99)	< 0.001	0.99 (0.98~0.99)	<0.001	0.99 (0.98~1)	0.001	0.99 (0.98~1)	0.002
GNRI (vs Q4)								
Q4 (>98)								
Q3 (92–98)	1.77 (1.26~2.49)	0.001	1.73 (1.23~2.44)	0.002	1.87 (1.32~2.65)	<0.001	1.81 (1.27~2.58)	0.001
Q2 (82–91)	1.26 (0.88~1.82)	0.24	1.2 (0.83~1.73)	0.333	1.19 (0.82~1.74)	0.362	1.23 (0.84~1.79)	0.296
Q1 (≤81)	2.5 (1.79~3.5)	<0.001	2.42 (1.73~3.39)	<0.001	2.21 (1.56~3.12)	<0.001	2.27 (1.57~3.29)	<0.001
P for trend		<0.001		<0.001		<0.001		<0.001

Notes: Model 1 = Adjusted for (age + gender). Model 2 = Model1 + (race + HR + MAP + SpO2 + HB + BUN+ Cr + PLT + WBC). Model 3 = Model 2 + (myocardial infarction + congestive heart failure+severe liver disease+CCI+SOFA). GNRI[a] was entered as a continuous variable per 1 unit.
Abbreviation: GNRI, Geriatric Nutritional Risk Index.

respectively. In model 2, after accounting for the variables in model 1 and incorporating race, HR, MAP, SpO2, HB, BUN, Cr, PLT, and WBC, the HR and 95% CI for Q1 remained notably significant at 2.21 (1.56–3.12) ($p < 0.001$) when compared to Q4. Finally, in model 3, which further adjusted for myocardial infarction, congestive heart failure, severe liver disease, CCI and SOFA score, the lowest GNRI group (Q1) still showed a significant association with an increased risk of 90-day mortality (HR: 2.27, 95% CI: 1.57–3.29, $p < 0.001$) compared to the highest quartile (Q4).

After adjusting for potential confounding factors, our analysis revealed an L-shaped correlation between GNRI and 90-day mortality, as depicted in Figure 1. Utilizing a two-piecewise linear regression model, we pinpointed a crucial GNRI threshold at 101.5, as outlined in Table S3. Below this inflection point, we observed a significant decrease in 90-day mortality as GNRI levels increased (HR, 0.972; 95% CI, 0.956–0.988; P< 0.001) (Table S3 and Figure 1). In contrast, above the threshold, we found no discernible association between GNRI and 90-day mortality. This implies that beyond this threshold, there is no further reduction in the risk of 90-day mortality as GNRI levels increase.

In Figure 2, Kaplan-Meier survival curves reveal that patients in the lowest GNRI quartile (Q1) exhibited the poorest survival ($p < 0.0001$), showing a declining trend as GNRI decreased.

Subgroup Analyses Stratified by Potential Confounders

In the subgroup analyses (Figure 3), we conducted stratified assessments to explore potential modifications of the GNRI and its impact on 90-day mortality. Notably, we observed a significant interaction between GNRI and gender ($p < 0.05$). In the gender-stratified results, older men showed a lower mortality risk compared to older women.

Sensitivity Analysis

We conducted sensitivity analyses by adjusting for four additional covariates- "AECOPD status", "presence of respiratory failure", "mechanical ventilation status" and "vasopressin use", except for "vasopressin use", these covariates did not exhibit statistically significant differences across GNRI subgroups. These findings are summarized in Table S4. In addition, we added baseline characteristics between the survivors and non-survivors at 90 days after adjusting for the four additional covariates and found that in the non-survival group, there were more individuals with AECOPD and respiratory failure compared to the survival group, but the difference was not statistically significant. Additionally, a higher proportion of non-survivors were on invasive ventilation (Table S5). Furthermore, after adjusting for these covariates, we conducted a reassessment of the multivariable COX regression analysis, and the results remained stable (Table S6). The results of the restricted cubic spline (RCS) analysis and Kaplan-Meier survival curve analysis demonstrated that the relationship between GNRI and 90-day mortality remains robust after adjusting for these covariates (Figures S2 and S3).

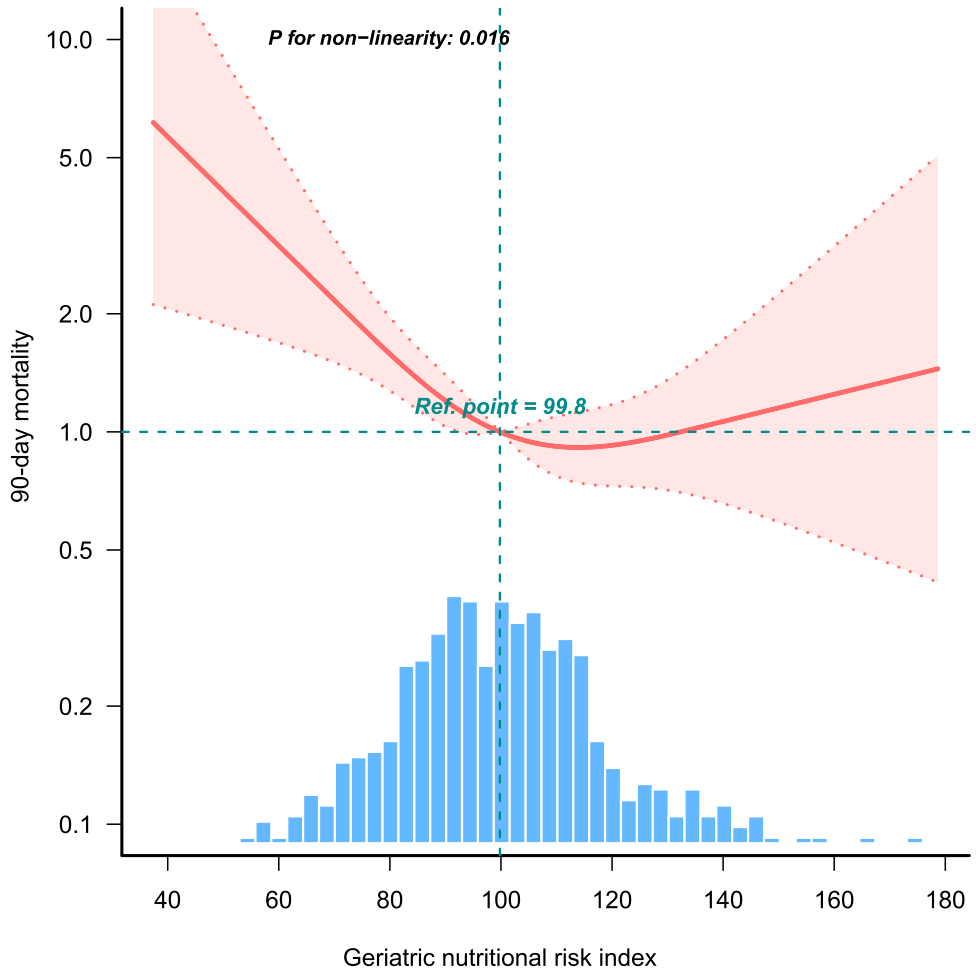

Figure 1 Relationship between GNRI (X) and 90-day Mortality (Y). The curve fitting equations of 90-day Mortality (Y) and GNRI (X) are used. A non-linear relationship is observed between Y and X, and the slope changes evidently, which may have a saturation effect.

Discussion

In the retrospective cohort study of older adults with COPD in the ICU, GNRI emerged as an independent predictor of 90-day mortality. Our findings indicate that higher GNRI levels are linked to lower 90-day mortality. Notably, the GNRI inflection point was identified at 101.5. We observed that the hazard ratio (HR) trend on either side of this inflection point was inconsistent, suggesting a likely nonlinear relationship between GNRI and 90-day mortality. Importantly, the impact of GNRI on 90-day mortality in COPD patients was significantly different when it was below or above the threshold of 101.5. At baseline assessment, a positive association was only evident for GNRI values below this threshold, while no statistically significant relationship was observed above it, indicating a saturation effect.

According to the ASPEN guidelines, critically ill patients with inadequate oral intake should be screened for nutritional risk within the first 48 hours of ICU admission.[14] Two commonly used tools for this purpose are the NRS 2002 and the NUTRIC score. The NRS 2002 is applicable to hospitalized patients aged 18–90 years and covers a wide range of populations. It is characterized by its relative simplicity and user-friendliness. However, NRS 2002 is not specifically designed for older adults and may overestimate the nutritional risk of critically older adults.[33] NUTRIC scoring system, developed by Heyland et al in Canada, is tailored specifically for critically ill ICU patients. Its assessment considers several factors, including patient age, disease severity, organ function, comorbidities, length of hospitalization prior to ICU admission, and indicators of inflammation, with a notable mention of interleukin (IL)-6. However, it's important to acknowledge that the limited availability of IL-6 data can hinder its widespread applicability.[34]

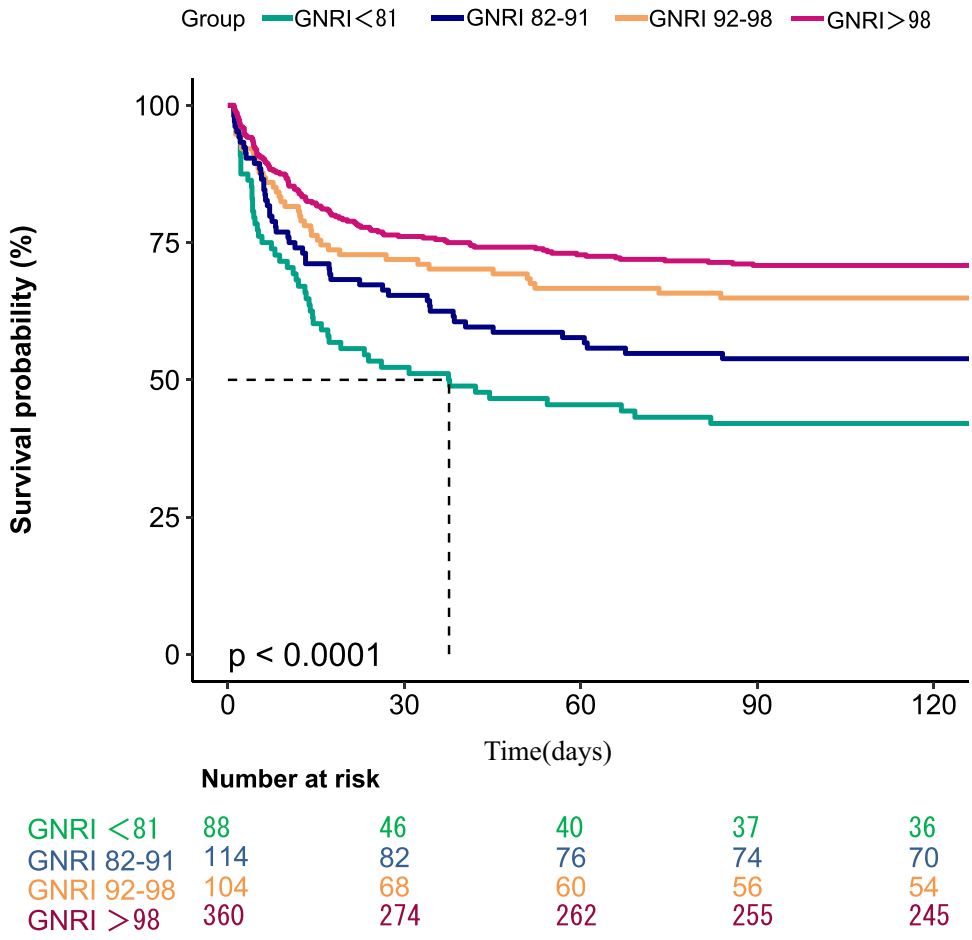

Figure 2 Kaplan-Meier curves of 90-day mortality according to the geriatric nutritional risk index (GNRI).

Older adults with COPD admitted to the ICU typically present with respiratory failure and dyspnea, conditions that may be exacerbated by the presence of malnutrition.[35] It is firmly established that nutritional status plays a pivotal role in the progression of COPD.[36] One effective method to assess nutritional risk is through longitudinal measurements of weight and body composition.[37] GNRI has emerged as a valuable tool for identifying morbidity and mortality risk in older hospitalized patients, and recent evidence supports its prognostic value across diverse medical populations.[38,39] Our findings underscore a compelling relationship between GNRI and 90-day mortality in COPD patients. Patients with lower GNRI scores, particularly those who were severely malnourished (GNRI ≤ 81), exhibited a 1.27-fold increased risk of death at 90 days (95% CI: 1.57 to 3.29) compared to the non-malnourished group (GNRI > 98).

Our study possesses several strengths. First, we utilized extensive real-world data from the MIMIC-IV database. The data was captured during routine clinical care, which might more closely recapitulate real-world experiences. Second, in this retrospective observational study, we implemented three robust adjustment models to rigorously minimize potential residual confounding. Third, we assessed GNRI using both continuous and categorical variables in the study. Prior studies often categorized GNRI scores based on their distribution, which reduced statistical reliability.[40–42] To address this limitation, we employed the RCS method to test for the presence of linear or nonlinear relationships between GNRI and 90-day mortality. An intriguing discovery in our study is the nonlinear relationship between GNRI and 90-day mortality, characterized by an L-shaped curve. Our analysis identifies this inflection point to be around 101.5. The existence of this nonlinear relationship emphasizes that patients with GNRI values below this critical threshold require special attention and intervention to improve their prognosis. This concept emphasizes the critical role of nutritional status in patient prognosis. Finally, our subgroup analyses revealed consistent and robust associations in various subgroups, except for gender.

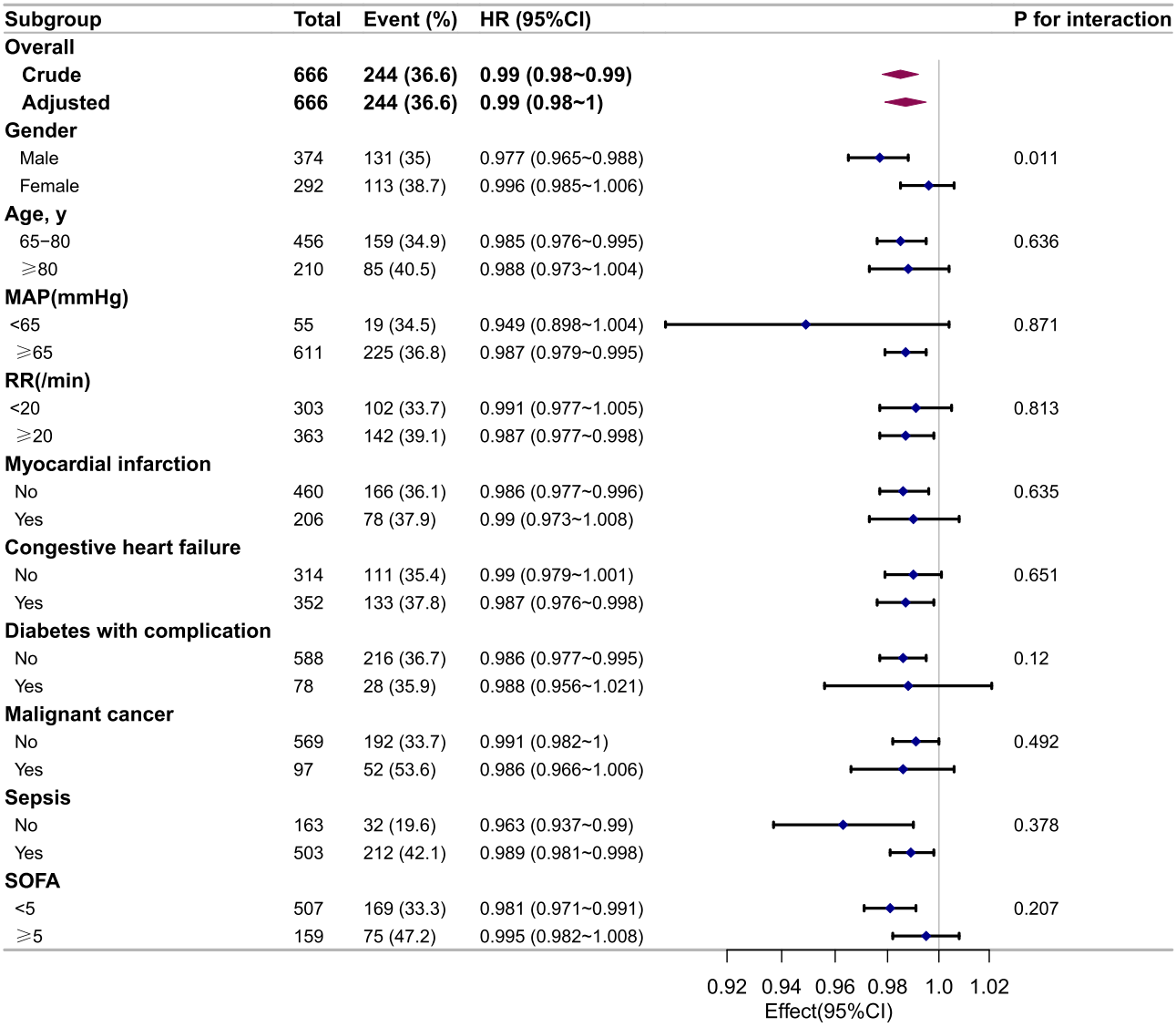

Figure 3 Subgroup analysis of the relationship between GNRI and 90-day mortality. Except sex, all other variables have no interaction (P for interaction > 0.05). In the results of sex stratification, the risk of 90-day mortality for older men maybe lower than that for older women. Each stratification was adjusted for all factors of Model 3 in Table 2 except for the stratification factor itself.

Abbreviations: GNRI, geriatric nutritional risk index; MAP, mean arterial pressure; RR, respiratory rate; SOFA, sequential organ failure assessment.

While our research offers valuable clinical insights, there are several limitations to consider. First, the primary limitation of this study is its retrospective and observational nature, as it utilized an administrative database, necessitating reliance on accurate coding. The limitation is that the identification of COPD patients relied solely on ICD codes extracted from the MIMIC-IV database. While ICD codes serve as a valuable tool for identifying patient cohorts, they may not capture all cases accurately. This approach might overlook individuals with undiagnosed or miscoded COPD, potentially leading to an underestimation or misrepresentation of the true COPD population within the database. Moreover, despite robust methods and covariate adjustments, unidentified confounders could have influenced our analyses. Second, in the MIMIC-IV database, we could not obtain data on dietary patterns and gut microbiota which may impact nutritional status. Future research should employ a more comprehensive approach to address these potential confounding variables. Third, our study focused on older adults with COPD in the ICU, which may limit the generalizability and applicability of our findings. Finally, our study is a post hoc analysis of the MIMIC-IV database, and due to the limited level of evidence, further high-quality prospective research is warranted to validate the relationship between GNRI and COPD prognosis.

Conclusion

This study demonstrates that the risk of malnutrition assessed by the GNRI score is linked to 90-day mortality in older adults with COPD in the ICU. These findings imply that GNRI serves as a valuable tool for prognostic assessment among older adults with COPD in the ICU.

Acknowledgments

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Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

Disclosure

The authors report no conflicts of interest in this work.

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