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Evaluation of the relationship of nutritional status with comorbidities in individuals with cardiovascular disease

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ABSTRACT

Background: Cardiovascular diseases (CVD) are frequently associated with a high comorbidity burden and nutritional deficiencies, both of which may significantly impair patient well-being. This study aimed to investigate the relationship between nutritional status, comorbidities, and health-related quality of life (HRQoL) in hospitalized cardiology patients.

Methods: This cross-sectional study included 127 patients in a cardiology clinic. In addition to demographic and anthropometric data, nutritional risk was assessed using the Nutritional Risk Screening-2002 (NRS-2002) and the Controlling Nutritional Status (CONUT) score. The Charlson Comorbidity Index (CCI) was used to determine comorbidity severity, and the SF-12 scale was employed to evaluate physical (PCS) and mental (MCS) components of quality of life.

Results: The mean CCI of the participants was 3.96±1.81, and the mean CONUT score was 2.31±2.27. Quality of life scores were relatively low (PCS: 34.70±8.97; MCS: 39.33±9.56). NRS-2002 scores showed a significant positive correlation with CCI (r=0.400) and CONUT scores (r=0.561), while displaying a strong negative correlation with both PCS (r=-0.502) and MCS (r=-0.468) ($p<0.05$). Regression analysis indicated that a 1 SD increase in NRS-2002 score was associated with a decrease in PCS by 0.185 and MCS by 0.215. Furthermore, the CONUT score was found to be significantly associated with lower physical component scores of SF-12 ($p<0.05$).

Conclusion: Our findings indicate that increased nutritional risk and comorbidity burden are closely linked to poorer physical and mental quality of life in patients with CVD. These results suggest that the systematic use of screening tools like NRS-2002 and CONUT in cardiology settings could be beneficial for identifying vulnerable patients and may help in optimizing patient-reported outcomes through early supportive interventions.

Keywords: cardiovascular disease, comorbidity, CONUT score, nutrition, quality of life

Introduction

Cardiovascular diseases include diseases of the heart and blood vessels such as coronary heart disease, peripheral vascular disease, congestive heart failure, stroke, congenital heart disease, rheumatic heart disease, hypertensive disease and arrhythmias.[1] Cardiovascular diseases (CVD) are the most important cause of morbidity and mortality worldwide and constitute a significant portion of the global disease burden.[2,3]

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Malnutrition is frequently encountered in individuals with cardiovascular disease as a result of inadequate energy intake related with anorexia and increased energy expenditure related with the inflammatory process.[4,5] In addition, individuals with heart disease are reported to be affected by cardiac cachexia, defined as 'involuntary weight and muscle loss'. Cachexia is accompanied by malnutrition, systemic nutritional deficiencies, elevated inflammatory cytokines, immune system hyperactivity and neurohormonal changes.[6] Malnutrition and malnutrition-related cardiac cachexia in these patients are associated with prolonged hospital stay, mortality and morbidity.[4,6] Considering the pathophysiology of malnutrition and cachexia, it has been reported that increasing food intake in these patients may reduce catabolic effects and increase lean body mass.[4] In this context, it is emphasised that early identification of patients with malnutrition risk and/or malnutrition is very important to start timely and adequate nutritional support.[7]

Nutritional risk screening, which is a simple and rapid option to identify patients at risk of malnutrition, is recommended to be performed systematically in patients admitted to hospital.[7] Although there are many screening tools to determine the nutritional status of patients receiving treatment in the clinic, it is also reported that there is no 'gold standard' screening tool.[8] The European Society for Clinical Nutrition and Metabolism (ESPEN) recommends the use of the NRS-2002 screening tool in the evaluation of the nutritional status of clinic inpatients.[9] Another screening tool, the Controlling Nutritional Status (CONUT) score, is a relatively new index that screens for nutritional risk through biochemical parameters. Although the CONUT score provides an objective evaluation based on laboratory data, studies to evaluate its effectiveness in individuals with cardiovascular disease are ongoing.[8,10,11]

Main Points

- Nutritional risk was significantly associated with higher comorbidity burden and poorer health-related quality of life in patients with cardiovascular disease.
- Higher NRS-2002 scores were associated with lower physical and mental quality of life scores.
- The CONUT score was independently associated with poorer physical quality of life, highlighting the clinical relevance of biochemical nutritional assessment.
- Routine nutritional screening using NRS-2002 and CONUT may help identify vulnerable cardiovascular patients who could benefit from early nutritional assessment and support.

It is emphasised that it is very important for healthcare professionals to plan the treatment of cardiovascular diseases by considering comorbidities. Because it has been reported that patients with comorbidities have decreased quality of life and increased mortality rates compared to patients without comorbidities.[12] A study evaluating the relationship between mortality and nutrition associated with increased morbidities was published in 2006; however, in this study, the relationship between the risk of malnutrition and comorbidity was not analysed and comorbidity was only evaluated according to the consumption status of food groups.[13] In subsequent studies, the risk of malnutrition was assessed with various screening tools and nutritional status was associated with various clinical outcomes and some comorbidities.[14-16] In the literature, no study was found in which nutritional status was evaluated with two different screening tools and associated with comorbidity index.

Individuals with cardiovascular disease may experience various symptoms such as fatigue, oedema and sleep difficulties, and this leads to a decrease in their quality of life. In this context, it is recommended that quality of life, which is associated with prolonged hospitalisation, morbidity and mortality, should be assessed in every patient with a history of CVD.[17] In various studies conducted in different patient groups, it has been reported that quality of life is associated with nutritional status.[18,19] While the association between nutritional status and quality of life has been well-documented in various chronic disease populations, comprehensive data specifically integrating NRS-2002 and CONUT scores with comorbidity indices in cardiovascular patients remain limited.

In the light of all this information, this study was planned and conducted to evaluate the relationship between nutritional status comorbidities in individuals with cardiovascular disease. In addition, it is also aimed to evaluate the relationship of nutritional status and comorbidity with quality of life.

Materials and methods

Study plan

This cross-sectional and descriptive study was conducted in the cardiology clinic of Erciyes University

Hospitals between August 2021 and June 2022. The study population was defined as conscious patients older than 18 years of age who were receiving treatment in the cardiology clinic due to cardiovascular disease; patients with loss of consciousness and/or communication problems, patients in the terminal period, those with acute gastrointestinal diseases, active cancer, advanced-stage renal failure, and individuals receiving enteral or parenteral nutritional support were not included in the study. The sample size was determined as 125 individuals by using G*Power 3.1 computer programme with Chi-Square test with type 1 error α=0.05, 1-β=0.90 and effect size 0.5. The study was completed with 127 participants.

Ethical considerations

Ethical approval was obtained for this study from the Erciyes University Clinical Research Ethics Committee with the date 07.07.2021 and the decision number 2021/490. In addition, all individuals participating in the study were informed about the study and their written and verbal consents were obtained.

Data collection and assessments

Data were collected through structured questionnaires and standardized clinical measurements, administered on a single occasion during the baseline hospital admission in a specific sequence:

Demographic and anthropometric measurements: Individual demographic characteristics were recorded using a questionnaire form. Body weight, height, waist, hip, mid-upper arm, and neck circumferences were measured by the researchers following standardized techniques. Body mass index (BMI) was calculated as weight divided by height squared (kg/m^2) and evaluated according to the World Health Organization (WHO) adult classification. A neck circumference exceeding 34 cm was defined as an indicator of obesity risk.[20]

Nutritional status screening: NRS-2002 and CONUT score were used to screen the nutritional status of the patients. NRS-2002 is a two-part screening tool that scores the deterioration in the nutritional status of patients and the severity of diseases. In the first part, the severity of the disease, weight loss in three months and decreases in food intake in three months are questioned. The second part of the form is continued in patients who answered 'yes' to any of the questions in the first part. In the second part, patients are evaluated in terms of nutritional deficiency and disease severity, and a total score is determined by adding 1 point to the score obtained when the patient is 70 years of age or older. Patients with a total score of 3 and above are considered at risk of malnutrition.[9] CONUT score is calculated from serum albumin concentration, total cholesterol level and total lymphocyte level. In this assessment, individuals can score between 0 and 12; zero (0) score indicates a normal nutritional status, whereas an increase in the score indicates a deterioration in the nutritional status of the individual. The calculation and evaluation of the CONUT score is given in Table 1.[21]

Comorbidity assessment: Comorbidity status was evaluated using the Charlson Comorbidity Index (CCI), developed by Charlson et al. in 1987 as a mortality predictor. The index accounts for 19 medical conditions (scored 1–6) alongside age adjustment, yielding a total comorbidity score ranging from 0 to 37.[22]

Table 1. Definition of the CONUT score.

Parameters	CONUT			
	Normal	Mild	Medium	Severe
Serum Albumin (g/dl)	3.5–4.5	3.0–3.49	2.5–2.9	<2.5
Albumin score	1	2	4	6
Total lymphocytes (number/mm^3)	≥1600	1200–1599	800–1199	<800
Lymphocyte score	0	1	2	3
Total cholesterol (mg/dl)	>180	140–180	100–139	<100
Total cholesterol score	0	1	2	3
Total CONUT score	0–1	2–4	5–8	9–12
Evaluation	Normal	Mild	Medium	Severe

Quality of life evaluation: Health-related quality of life was assessed using the SF-12 Quality of Life Scale. Comprising 12 items, the scale yields two main summary scores: the Physical Component Score (PCS) and the Mental Component Score (MCS). Scores range from 0 to 100, with higher scores denoting a better quality of life. The Turkish validity and reliability of the scale were established by Soylu and Kütük.[23]

Statistical analysis

All statistical analyses were performed using IBM SPSS Statistics 22.0. Continuous variables were presented as 'mean ± standard deviation', while categorical variables were presented as 'number (n)' and 'percentage (%)'. The normality of continuous variables was evaluated using the Shapiro-Wilk test together with skewness and kurtosis values.

For comparisons between two independent groups, the independent-samples t-test was used for normally distributed data, whereas the Mann-Whitney U test was used for non-normally distributed data. Comparisons among three or more independent groups were performed using One-way analysis of variance (ANOVA) for normally distributed variables and the Kruskal-Wallis H test for variables that did not meet the normality assumption. The homogeneity of variances was assessed using Levene's test. Post-hoc pairwise comparisons were performed using Bonferroni correction following the ANOVA or Kruskal-Wallis H test.

Relationships between numerical variables were evaluated using Spearman and Pearson correlation analysis, as appropriate. Multiple linear regression analyses with the Enter method were conducted to identify the factors independently associated with CCI, PCS, and MCS. Variables included in the regression models were selected based on the study objectives, hypotheses, clinical relevance, and findings reported in the literature. Categorical variables were included in the regression models using dummy coding. For variables with two categories, the category coded as 0 was treated as the reference group. For variables with more than two categories, (k-1) dummy variables were created. The reference categories used in the analysis were 'male' for gender, 'married' for marital status, 'high school or above' for educational status, and 'never smoker' for smoking status. Multicollinearity among the independent variables was assessed by examining pairwise correlation coefficients, variance inflation factors (VIF), and the Condition Index. Pairwise correlation coefficients below 0.80, VIF values below 10, and Condition Index values below 30 were considered indicative of the absence of problematic multicollinearity. The independence of residuals was evaluated using the Durbin-Watson statistics. Model fit was reported using R, R2, adjusted R2, the F statistic, and the overall model p-value.

Statistical significance was set at $p < 0.05$.

Results

Demographic, clinical and anthropometric characteristics

The study was completed with 127 participants (72 male, 55 female) and the average age of the participants was 63.92±12.23 years. The mean CCI value of the participants was 3.96±1.81, CONUT score was 2.31±2.27, SF-12 physical component score was 34.70±8.97 and mental component score was 39.33±9.56.

Table 2 presents the clinical characteristics of patients. The most common primary reason for admission to the cardiology clinic was ischemic heart disease (33.9%), followed by heart failure (25.2%) and angina (18.1%). Hypertension, peripheral vascular diseases, and cardiac rhythm disorders accounted for 7.9%, 5.5%, and 4.7% of admissions, respectively. Most patients (81.1%) had at least one additional comorbidity.

Table 3 illustrates the distribution of CCI, CONUT, and SF-12 scores according to the demographic characteristics of the participants. The mean CCI value was significantly higher in single individuals compared to married individuals (4.64±2.24 vs. 3.77±1.63, respectively; $p = 0.026$). Furthermore, retired individuals (4.11±1.90) and housewives (4.26±1.70) exhibited significantly higher CCI values than those working in other professions (2.95±1.58; $p = 0.011$).

Regarding health-related quality of life, the SF-12 physical component score was significantly higher in males than in females (37.11±9.28 vs. 31.54±7.53, respectively; $p < 0.001$) and in married individuals compared to singles (36.04±8.66 vs. 29.96±8.57, respectively; $p = 0.001$). Similarly, the SF-12 mental component score was higher in males than in females (41.53±9.56 vs. 36.46±8.85, respectively; $p = 0.003$) and in married participants compared to singles (40.67±8.98 vs. 34.61±10.22, respectively; $p = 0.003$). Additionally, participants with a high school education

Table 2. Clinical characteristics of patients.

	n *(%)*
The primary reason for admission to cardiology clinic	
Ischemic heart diseases	43 (33.9)
Heart failure	32 (25.2)
Angina	23 (18.1)
Hypertension	10 (7.9)
Peripheral vascular diseases	7 (5.5)
Cardiac rhythm disorders	6 (4.7)
Other*	6 (4.7)
Presence of additional comorbidity	
Yes	103 (81.1)
No	24 (18.9)

**Other* included stroke (n=3), lymphedema (n=2), and congenital heart disease (n=1).

or higher demonstrated significantly higher mean SF-12 mental component scores (43.38±9.46) compared to illiterate participants (35.89±7.28; p = 0.010) and literate participants (35.54±9.82; p = 0.028).

Nutritional status findings

The evaluations of CCI, CONUT, and SF-12 scores according to the nutritional status of the participants are detailed in Table 4.

Participants who underwent only the preliminary screening in the NRS-2002 tool exhibited higher mean SF-12 mental component scores (40.56±9.58). Among those who proceeded to the main assessment, participants with scores below 3 presented significantly higher SF-12 physical (35.41 ±9.06) and mental (39.50±9.51) component scores (p<0.05). Moreover, the mean CONUT score of participants with a basic assessment score of 3 and above was significantly higher than that of other participants (3.38±2.89 vs. 1.47±1.46, respectively; p = 0.019).

Comorbidity status (Charlson comorbidity index)

Comorbidity evaluations revealed that participants with a CCI score of 3 and above had significantly lower SF-12 physical (33.50±8.48) and mental (38.24±9.48) component scores compared to the remaining participants (p < 0.05).

Correlation and regression analyses

The correlations among nutritional status, CCI, SF-12 scores, and anthropometric measurements are presented in Table 5. Age showed positive correlations with NRS-2002 (r = 0.453) and CCI scores (r = 0.716), while displaying negative correlations with SF-12 physical (r = -0.322) and mental (r = -0.336) component scores (p < 0.05). The NRS-2002 score was positively correlated with CCI (r = 0.400) and CONUT scores (r = 0.561), and negatively correlated with SF-12 physical (r = -0.502) and mental (r = -0.468) component scores. Furthermore, the CCI score demonstrated negative correlations with both the physical (r = -0.309) and mental (r = -0.296) component scores of the SF-12 (p < 0.05).

Table 6 and Table 7 summarize the results of the linear regression analyses regarding the factors affecting comorbidity and quality of life. While gender, marital status, smoking status, NRS-2002, and CONUT scores were not found to be significant predictors of CCI, a 1-SD increase in age was associated with a 0.692-SD increase in CCI. Regarding quality of life, a 1-SD increase in the NRS score was associated with reductions of 0.185 and 0.215 in the physical and mental component scores of the SF-12, respectively. Additionally, gender and CONUT score were identified as significant independent factors associated with lower SF-12 physical component scores (p < 0.05).

Table 3. CCI, CONUT and SF-12 scores according to the demographic characteristics of the participants.

	n *(%)*	CCI *(x ± ss)*	CONUT Score *(x ± ss)*	SF – 12	
				PCS *(x ± ss)*	MCS *(x ± ss)*
Age (year) *(x ± ss)*	63.92 ± 12.23				
Gender					
Male	72 (56.7)	3.80 ± 1.87	2.68 ± 2.52	37.11 ± 9.28	41.53 ± 9.56
Female	55 (43.3)	4.18 ± 1.73	1.83 ± 1.80	31.54 ± 7.53	36.46 ± 8.85
Total	127 (100.0)	3.96 ± 1.81	2.31 ± 2.27	34.70 ± 8.97	39.33 ± 9.56
		p=0.249 α	*p*=0.056 β	***p*<0.001** α	***p*=0.003** α
Marital Status					
Married	99 (78.0)	3.77 ± 1.63	2.11 ± 2.16	36.04 ± 8.66	40.67 ± 8.98
Single	28 (22.0)	4.64 ± 2.24	3.03 ± 2.54	29.96 ± 8.57	34.61 ± 10.22
		***p*=0.026** α	***p*=0.029** β	***p*<0.001** α	***p*=0.003** α
Educational Status					
Illiterate	28 (22.0)	4.42 ± 1.83	2.21 ± 1.96	31.62 ± 7.19	35.89 ± 7.28 a
Literate	12 (9.4)	4.33 ± 1.43	2.00 ± 1.47	30.16 ± 5.31	35.54 ± 9.82 a
Primary school	57 (45.0)	3.96 ± 1.80	2.28 ± 2.45	36.19 ± 9.58	40.06 ± 9.87 ab
Middle school	13 (10.2)	3.30 ± 2.13	2.76 ± 2.48	35.17 ± 8.50	41.75 ± 10.19 ab
High school and above	17 (13.4)	3.47 ± 1.73	2.47 ± 2.57	37.57 ± 10.14	43.38 ± 9.46 b
		p=0.261 #	*p*=0.829 ¶	***p*=0.049** # *	***p*=0.042** #
Job					
Retired	51 (40.2)	4.11 ± 1.90 a	2.80 ± 2.65	36.01 ± 9.47a	40.34 ± 9.30 ab
Housewife	53 (41.7)	4.26 ± 1.70 a	1.86 ± 1.82	31.32 ± 7.35b	36.33 ± 8.92 a
Other	23 (18.1)	2.95 ± 1.58 b	2.26 ± 2.15	39.57 ± 8.55a	44.01 ± 9.60 b
		***p*=0.011** #	p=0.217 ¶	***p*<0.001** #	***p*=0.003** #
Smoking					
Never smoker	71 (55.9)	4.04 ± 1.90 ab	2.12 ± 2.24	32.54 ± 7.91 a	37.23 ± 8.63 a
Former smoker	39 (30.7)	4.28 ± 1.71 a	2.76 ± 2.53	36.29 ± 9.65 ab	40.69 ± 10.14 ab
Smoker	17 (13.4)	2.94 ± 1.29 b	2.05 ± 1.63	40.02 ± 9.08 b	45.00 ± 9.57 b
		***p*=0.034** #	*p*=0.309 ¶	***p*=0.003** #	***p*=0.005** #
Drinking alcohol					
Non-alcoholic	99 (78.0)	4.06 ± 1.94	2.18 ± 2.22	33.66 ± 8.71	38.58 ± 9.58
Ex-alcoholic	23 (18.1)	3.82 ± 1.15	3.13 ± 2.51	37.80 ± 9.37	40.94 ± 9.42
Alcoholic	5 (3.9)	2.80 ± 1.30	1.20 ± 0.83	40.88 ± 8.18	46.85 ± 6.77
		p=0.294 #	*p*=0.101 ¶	***p*=0.039** # *	*p*=0.113 #

αIndependent sample t-test, βMann Whitney U test, #One-way ANOVA, ¶Kruskal Wallis test

a, b Values with different superscript letters within the same column are significantly different according to the post-hoc pairwise comparisons.

* Although the ANOVA was statistically significant, no significant differences were observed in the post-hoc pairwise comparisons.

CCI Charlson Comorbidity Index, CONUT Controlling Nutritional Status, MCS Mental Component Summary, PCS Physical Component Summary, SF-12 Short Form Health Quality Questionnaire.

Table 4. CCI, CONUT and SF-12 scores according to the nutritional status of the participants.

	n (%)	CCI (*x ± ss*)	CONUT (*x ± ss*)	SF – 12	
				PCS (*x ± ss*)	MCS (*x ± ss*)
BMI (kg/m²)					
< 25.0	29 (22.8)	4.31 ± 2.08	2.93 ± 2.89	34.29 ± 10.30	38.52 ± 11.64
25.0–29.99	46 (36.2)	3.76 ± 1.44	2.19 ± 2.19	36.36 ± 9.18	40.39 ± 9.08
≥30.0	52 (40.9)	3.96 ± 1.94	2.07 ± 1.90	33.45 ± 7.88	38.85 ± 8.78
		p=0.446 #	*p*=0.609 ¶	*p*=0.269 #	*p*=0.641 #
NRS evaluation					
Only initial screening	90 (70.9)	3.92 ± 1.76	2.27 ± 2.21	35.66 ± 9.13	40.56 ± 9.58
Final screening	37 (29.1)	4.08 ± 1.94	2.40 ± 2.44	32.34 ± 8.21	36.34 ± 8.94
		p=0.656 α	*p*=0.858 β	**p=0.034** α	**p=0.023** α
NRS final screening score					
<3	19 (51.3)	3.57 ± 1.53	1.47 ± 1.46	35.41 ± 9.06	39.50 ± 9.51
≥3	18 (48.7)	4.61 ± 2.22	3.38 ± 2.89	29.10 ± 5.87	33.00 ± 7.12
		p=0.108 α	**p=0.022** β	**p=0.017** α	**p=0.025** α
CONUT score evaluation					
Normal	58 (45.7)	3.91 ± 1.63	0.58 ± 0.49 a	36.13 ± 8.82 a	39.86 ± 9.28
Mild nutritional deficiency	51 (40.2)	3.74 ± 1.92	2.72 ± 0.89 b	34.97 ± 9.58 ab	40.11 ± 9.78
Moderate and severe malnutrition	18 (14.1)	4.77 ± 1.92	6.72 ± 1.96 c	29.30 ± 5.29 b	35.44 ± 9.41
		p=0.111 #	**p<0.001** ¶	**p=0.017** #	*p*=0.175 #
CCI					
<3	25 (19.7)	1.60± 0.50	1.84 ± 1.31	39.58 ± 9.46	43.77 ± 8.74
≥3	102 (80.3)	4.54 ± 1.52	2.43 ± 2.44	33.50 ± 8.48	38.24 ± 9.48
		p<0.001 α	*p*=0.690 β	**p=0.002** α	**p=0.009** α

α Independent sample t-test, βMann Whitney U test, #One-way ANOVA, ¶Kruskal Wallis test
a, b, c Values with different superscript letters within the same column are significantly different according to the post-hoc pairwise comparisons.
BMI Body Mass Index, CCI Charlson Comorbidity Index, CONUT Controlling Nutritional Status, MCS Mental Component Summary, NRS Nutritional Risk Screening, PCS Physical Component Summary, SF-12 Short Form Health Quality Questionnaire.

Discussion

Cardiovascular diseases are the leading cause of global mortality and cause a decrease in quality of life in individuals with these diseases.[24] Cardiovascular diseases are also among the leading diseases that are significantly affected by nutrition, and deterioration in nutritional status is associated with the clinical status and physical performance of patients. In this context, it is emphasised that the assessment of nutritional status has an important role in the treatment process.

There are different screening tools recommended to assess the nutritional status of patients. It is emphasised that the CONUT score is an important determinant of clinical outcomes in cardiovascular diseases because it evaluates albumin, total cholesterol and lymphocyte levels and is easy and fast to apply.[14,25] Unintended weight loss associated with the disease or weight loss during treatment is emphasised as the most important parameter of health-related malnutrition. The degree of this unintended weight loss and the duration of weight loss are also components that need to be assessed. In this context, the NRS-2002 screening tool developed and recommended by ESPEN is also reported to be associated with hospitalisation duration and complication rates in cardiovascular diseases.[9,15] These results reveal that the age factor has an important effect on the development of comorbidity in patients, as well as nutritional status.

In this study, the nutritional status of the patients was evaluated with the NRS-2002 screening tool and CONUT score. According to NRS-2002, 29.1% of the patients passed from pre-assessment to main assessment and 48.7% of the patients who underwent main assessment were found to have malnutrition risk. CONUT score evaluation revealed that 40.2% of the patients had mild malnutrition and 14.2% had moderate and severe malnutrition (Table 4). It was found that the NRS-2002 score of the patients and the CONUT score were positively correlated; as the NRS-2002 score increased, the comorbidity index score also increased (Table 5). In the regression modelling, it was determined that the increase in age increased the comorbidity (Table 6).

In a study evaluating the nutritional status of individuals over 80 years of age with cardiovascular disease, it was reported that 62.9% of patients had malnutrition according to CONUT score evaluation. It was also noted that patients with severe malnutrition had the worst clinical outcomes.[14] In another study, the nutritional status of 547 coronary artery disease patients was evaluated with the CONUT score; 41% of patients had mild malnutrition and 10% had moderate to severe malnutrition. It was emphasised that patients with malnutrition have a higher risk of cardiovascular death than those without malnutrition; therefore, nutritional interventions should be made in a timely and effective manner.[26] In patients undergoing coronary artery bypass, CONUT score has been reported to be associated with renal complications, haemorrhage and mortality rates.[16] Our findings regarding the high prevalence of malnutrition and its correlation with clinical risk factors align with previous literature emphasizing the adverse impacts of malnutrition in cardiovascular populations; however, our study extends these observations by highlighting how combined screening tools interact with age-related comorbidity development.

Table 5. The relationship between CCI, SF-12, NRS-2002 and anthropometric measurements.

r *p*-value	Age	NRS	CCI	CONUT	PCS	MCS	BW	BMI	NC
NRS	0.496 **0.002***								
CCI	0.716[α] **<0.001***	0.379 **0.021***							
CONUT	0.108 0.226	0.491 **0.002***	0.090 0.312						
PCS	-0.311 **<0.001***	-0.484 **0.002***	-0.297 **0.001***	-0.256 **0.004***					
MCS	-0.276 **0.002***	-0.441 **0.006***	-0.304 **0.001***	-0.157 0.078	0.552 **<0.001***				
BW	-0.096[α] 0.284	-0.132 0.436	-0.116[α] 0.193	0.024 0.787	0.072 0.420	0.113 0.205			
BMI	0.065[α] 0.467	0.033 0.844	-0.021[α] 0.816	-0.022 0.804	-0.098 0.272	-0.053 0.552	0.860[α] **<0.001***		
NC	0.029[α] 0.748	0.008 0.961	-0.013[α] 0.883	-0.064 0.475	0.148 0.096	0.088 0.323	0.523[α] **<0.001***	0.361[α] **<0.001***	
MAC	-0.049 0.583	-0.139 0.411	-0.053 0.556	0.013 0.882	0.039 0.666	0.159 0.074	0.657 **<0.001***	0.656 **<0.001***	0.519 **<0.001***

Spearman correlation analysis, [α]Pearson correlation analysis.
BMI Body Mass Index, BW body weight, CCI Charlson Comorbidity Index, CONUT Controlling Nutritional Status, MCS Mental Component Summary, NC neck circumference, NRS Nutritional Risk Screening, PCS Physical Component Summary, **MAC** mid-arm circumference, SF-12 Short Form Health Quality Questionnaire.

Table 6. Factors **associated with** Charlson comorbidity index.

	Beta	t	*p*-value	95% CI	
				Lower	Upper
Age	0.694	10.224	**<0.001**	0.083	0.123
Gender					
Reference (Male)					
Female	-0.061	-0.646	0.519	-0.905	0.460
Marital status					
Reference (Married)					
Single	0.103	1.496	0.137	-0.145	1.041
Smoking					
Reference (Never smoker)					
Former smoker	-0.082	-0.943	0.348	-1.002	0.356
Current smoker	-0.108	-1.357	0.177	-1.414	0.264
NRS Score	-0.011	-0.165	0.870	-0.198	0.168
CONUT Score	0.043	0.641	0.523	-0.072	0.141
$R=0.729$; $R^2=0.531$; Adjusted $R^2=0.504$; $F= 19.280$; $p<0.001$; Durbin-Watson: 2.105.					

Multiple linear regression analysis.

Anthropometric measurements, defined as non-invasive quantitative measurements of the body, have an important place in evaluating the prognosis of diseases and guiding medical intervention. It is recommended that these measurements should be used in determining the disease risks of individuals as well as in the evaluation of nutritional status. Body weight, height, body mass index (BMI) and circumference measurements (waist, hip, neck, etc.) are the basic elements of anthropometric measurements and it is of great importance that these measurements are performed by trained health personnel. In this way, it is emphasised that it will provide more reliable results in assessing nutritional status compared to methods that are complicated and costly to use.[27,28]

In this study, body weight, height, waist, hip, upper middle arm and neck circumference measurements were taken. Body weight was positively correlated with neck circumference and upper middle arm circumference (Table 5). While no significant correlation was found between BMI and comorbidity scores of the patients, it was observed that patients with malnutrition risk had a higher risk of comorbidity (Table 4). These results show that anthropometric measurements alone are not sufficient in the assessment of nutritional status and the risk of comorbidity; it is important to perform the assessment together with screening tools that also evaluate disease status and various biochemical data.

Quality of life is recognised as an important indicator for clinical outcomes in individuals with cardiovascular disease.[29] In studies conducted with various patient groups, it has been reported that quality of life decreases as comorbidities increase in patients.[30,31] In addition, it is emphasised that nutritional status is also an important marker for quality of life; it is reported that significant improvements in quality of life occur with improvements in nutritional status.[18,19] In this study, it was observed that as the comorbidity score of the patients increased, both physical and mental sub-dimension scores of quality of life decreased. Similarly, it was determined that the quality of life of the patients decreased as the risk of malnutrition increased (Table 4, Table 5). In the regression analysis, an increase of 1 SD in the NRS score was associated with lower physical and mental component scores of SF-12 by 0.185 and 0.215, respectively. The CONUT score was also associated with lower physical component scores of SF-12 (Table 7).

In this study, we observed that nutritional risk was associated with the physical component scores (PCS) of quality of life, whereas its direct relationship with the

Table 7. Factors associated with quality of life.

	Beta	t	p-value	95% CI	
				Lower	Upper
SF-12 (PCS)					
Age	-0.153	-1.351	0.179	-0.278	0.053
Gender					
Reference (Male)					
Female	-0.188	-1.531	0.128	-7.777	0.995
Marital status					
Reference (Married)					
Single	-0.116	-1.359	0.177	-6.147	1.143
Educational status					
Reference (High school and above)					
Illiterate/literate	-0.039	-0.288	0.774	-5.945	4.436
Primary/middle school	0.006	0.055	0.957	-4.119	4.353
Smoking					
Reference (Never smoker)					
Former smoker	0.130	1.227	0.222	-1.545	6.578
Current smoker	0.133	1.358	0.177	-1.600	8.578
NRS Score	-0.182	-2.289	0.024	-2.354	-0.170
CCI	-0.066	-0.600	0.549	-1.413	0.755
CONUT Score	-0.244	-3.008	0.003	-1.599	-0.329
$R= 0.579$; $R^2 = 0.336$; Adjusted $R^2 =0.278$; $F=5.860$; $p<0.001$; Durbin-Watson: 2.042					
SF-12 (MCS)					
Age	-0.201	-1.715	0.089	-0.338	0.024
Gender					
Reference (Male)					
Female	-0.088	-0.697	0.487	-6.509	3.121
Marital status					
Reference (Married)					
Single	-0.122	-1.393	0.166	-6.817	1.187
Educational status					
Reference (High school and above)					
Illitarete/literate	-0.111	-0.795	0.428	-7.985	3.411
Primary/middle school	-0.067	-0.546	0.586	-5.931	3.369
Smoking					
Reference (Never smoker)					
Former smoker	0.153	1.407	0.162	-1.291	7.626
Current smoker	0.161	1.596	0.113	-1.084	10.090
NRS Score	-0.212	-2.595	0.011	-2.769	-0,372
CCI	-0.033	-0.294	0.770	-1.366	1.014
CONUT Score	-0.141	-1.686	0.095	-1.291	0.104
$R= 0.543$; $R^2 = 0.295$; Adjusted $R^2 =0.234$; $F= 4.848$; $p<0.001$; Durbin-Watson: 2.029					

Multiple linear regression analysis.

mental component scores (MCS) was less pronounced. From a clinical standpoint, malnutrition and high nutritional risk in cardiovascular disease (CVD) directly accelerate skeletal muscle catabolism, sarcopenia, and functional decline, leading to severe fatigue and reduced exercise tolerance, which manifest directly as diminished physical performance and lower PCS.[32,33] Conversely, we interpret that the mental component of quality of life (MCS) in chronic cardiac patients is governed by a broader multifactorial matrix—such as psychological resilience, emotional adaptation, and social support networks—which may buffer the immediate psychological toll, rendering MCS less directly tethered to short-term nutritional fluctuations. Therefore, this distinction highlights the clinical necessity of integrating multi-dimensional assessments into routine cardiac care, ensuring that therapeutic interventions address not only physical rehabilitation but also the holistic well-being of the patients.

In this study, the patients' SF-12 scores were observed to be at lower levels than anticipated. This outcome can be attributed primarily to the acute symptom burden, functional limitations, and psychological distress experienced by patients during active hospitalization in a cardiology clinic. Acute exacerbations of cardiovascular diseases, unfamiliar hospital environments, and the immediate apprehension regarding prognosis collectively impair both the physical and mental well-being of patients, resulting in markedly reduced quality of life scores during the baseline admission phase.

Although there are studies evaluating the relationship between nutritional status and comorbidities and quality of life in different patient groups in the literature, no studies investigating these relationships in cardiovascular diseases have been found. In this context, this study is important in terms of examining these parameters, which have been investigated in other patient groups, in cardiovascular diseases.

Conclusion

This study demonstrates a high prevalence of malnutrition risk among hospitalized patients with cardiovascular diseases, highlighting its critical role in exacerbating comorbidity burdens and degrading health-related quality of life, as summarized in Figure 1. The significant correlations observed between the CONUT score and the NRS-2002 framework underscore the clinical utility of combining biochemical-based and risk-screening tools for comprehensive nutritional evaluations in cardiac care settings. Furthermore, our findings establish that nutritional status is intricately linked to both the physical and mental well-being of patients. Consequently, routine clinical protocols should prioritize early, multi-dimensional nutritional assessments alongside standard management to mitigate complication risks, prevent adverse health outcomes, and enhance the overall quality of life in this vulnerable population.

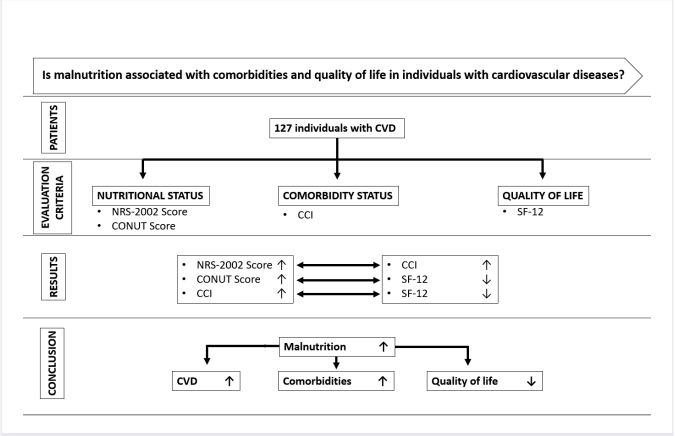

Figure 1. Relationship between cardiovascular diseases, malnutrition, and quality of life.

Strengths and limitations

To the best of our knowledge, the present study is among the few studies to comprehensively examine the relationships among nutritional status, comorbidity burden, and health-related quality of life in patients admitted to a cardiology clinic. Nutritional status was evaluated using the NRS-2002 and CONUT scores, while comorbidity burden and quality of life were assessed using the CCI and SF-12, respectively. The combined use of these tools provides a multidimensional assessment of patients' nutritional and clinical status.

However, several limitations should be acknowledged. First, the study was designed as a cross-sectional analysis, which precludes establishing definitive causal relationships between malnutrition, comorbidities, and diminished quality of life. Second, the study population included patients with heterogeneous reasons for admission to the cardiology clinic. Because some clinical subgroups were small and unevenly distributed, reliable diagnosis-specific analyses could not be performed. In addition, detailed information regarding the specific types of additional comorbidities could not be presented.

Therefore, the potential relationships between individual comorbid diseases and nutritional status could not be evaluated. Finally, the study was conducted in a single tertiary care center in Türkiye and included 127 patients, which may limit the generalizability of the findings to other populations and healthcare settings. Future multicenter longitudinal studies with larger and clinically more homogeneous samples are needed to confirm these associations and evaluate the effects of nutritional interventions on long-term clinical outcomes.

Ethics committee approval

The study was approved by the Erciyes University Clinical Research Ethics Committee (Date: June 7, 2021; Decision / Protocol Number: 2021/490).

Informed consent

Written informed consent was obtained from the patient(s) or their legal guardians for the publication of this study and any accompanying images.

Author contributions

Conception of the study: S.Ç.; Study design: S.Ç., A.O.C.; Data acquisition: A.O.C., B.B.; Data analysis: S.Ç., A.O.C., B.B., H.T.B.; Data interpretation: S.Ç., A.O.C., B.B., H.T.B.; Drafting the manuscript: S.Ç.; Revising the manuscript for important intellectual content: S.Ç., A.O.C., B.B., H.T.B.; Final approval and agreeing to be accountable for all aspects of the work: S.Ç., A.O.C., B.B., H.T.B.

Conflict of interest

The authors declare that there is no conflict of interest to disclose.

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Data availability statement

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

Generative AI statement

The authors declare that no generative AI or AI-assisted technologies were used in the writing or preparation of this manuscript.

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