

Prognostic Nutritional Index Predicts Overall Survival Better than Geriatric Nutritional Risk Index in Patients with Metastatic Gastric Cancer

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ABSTRACT Objective: Malnutrition, which is frequently seen in patients with gastrointestinal system cancer; affects prognosis, quality of life, and survival. In this study, the prognostic value of the Prognostic Nutritional Index (PNI) and Geriatric Nutritional Risk Index (GNRI) based on malnutrition and systemic inflammatory response were compared to determine which index was more predictive for survival. **Material and Methods:** A total of 124 patients were included in the study. Statistical analysis was done with SPSS program. Kaplan-Meier analysis and Log-Rank test were used for survival analysis. Factors affecting overall survival (OS) were analyzed with univariate and multivariate Cox regression analysis. The values of the indices in predicting the cutoff point and OS were recorded by calculating area under the curve by receiver operating characteristic analysis. **Results:** In univariate analysis; primary tumor location at the cardioesophageal junction, increased CRP, decreased lymphocyte count, and low PNI (≤ 44.05) significantly decreased OS ($p < 0.05$). Only the primary tumor location at the cardioesophageal junction was an independent prognostic factor for mortality (hazard ratio: 2.717; 95% confidence interval: 1.292-5.711; $p = 0.008$). **Conclusion:** Although PNI is not an independent risk factor for OS in patients with metastatic gastric cancer, it can be an indicator of survival. In addition, PNI was found to be a better prognostic marker in predicting OS than GNRI.

Keywords: Gastric cancer; prognostic Nutritional Index; Geriatric Nutritional Risk Index; prognostic factors

Gastric cancer is the fifth most common cancer type worldwide. Despite the decline in incidence and mortality in the last five years worldwide, it remains the fourth most common cause of cancer-related deaths.¹ Many factors affect the prognosis and survival of cancer patients. The prevalence of malnutrition, a major contributing factor, is higher in patients with gastrointestinal cancer and advanced stages of the illness. Moreover, It is estimated that 10%-20% of deaths of cancer patients could be related to malnutrition rather than the malignancy itself.

Indices based on malnutrition and systemic inflammatory response have been proposed to better understand the relationship between cancer and nutrition.² Based on recent research, strong prognostic indicators for various cancers include nutritional

markers, such as the Prognosis Nutritional Index (PNI), body mass index (BMI), serum albumin, and preoperative body weight reduction.³ Onodera's PNI is considered a practical index that reflects preoperative nutritional and immunological status. It may be easily estimated using peripheral blood lymphocyte count and serum albumin level.⁴ PNI was initially used to assess postoperative complications and mortality risk in patients with gastrointestinal malignancies, and it has become a powerful predictive indicator for various cancer types.⁵⁻⁸ Unlike PNI, the Geriatric Nutritional Risk Index (GNRI) is derived using the ratio of serum albumin and current weight to the optimal weight determined using the Lorentz formula.⁹ Recently, the GNRI is a valuable and simplified tool for predicting prognosis and mortality in geriatric patients.¹⁰

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Peer review under responsibility of Journal of Oncological Sciences.

Received: 02 Mar 2023

Received in revised form: 12 Jun 2023

Accepted: 06 Jul 2023

Available online: 14 Jul 2023

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To the best of our knowledge, no study has been conducted to compare PNI and GNRI on metastatic gastric cancer. This descriptive study aimed to investigate the predictive significance of PNI and GNRI and its impact on the overall survival (OS) of patients with metastatic gastric cancer.

MATERIAL AND METHODS

This study is a retrospective and single-center study. The medical data system was used to obtain information on 597 patients treated for gastric cancer between 2009 and 2020. We excluded patients without metastatic disease and whose data were unavailable for prognostic index calculations (Figure 1).

By scanning patient files and using the patient data system, age at diagnosis, sex, height, weight, BMI, ideal weight, comorbidity, Eastern Cooperative Oncology Group, histology, primary tumor location, albumin, lymphocyte, acid status, C-reactive protein (CRP), carcinoembryonic antigen (CEA), CA 19-9, megestrol acetate intake, nutritional support, primary care treatment, last control/death date information were recorded in the patient identification form based on the study purpose. Any infection or chronic inflammatory condition affecting laboratory parameters, such as lymphocytes and albumin, to calculate nutritional indices was ruled out by examining the patient files and system. Therefore, this study included 124 patients eligible for the study sample group.

PROGNOSTIC INDICES

PNI is determined using peripheral blood total lymphocyte count and serum albumin level.⁴ The receiver operating characteristic (ROC) curve yielded a cut-off point of 44.05. Patients with low (44.05) or high PNI (>44.05) were divided into two groups. PNI was calculated using the following equation:

$$\text{PNI} = [10 \times \text{serum albumin (g/dL)}] + [0.005 \times \text{total lymphocyte count (per mm}^3\text{)}].$$

Instead of using actual body weight for calculating the nutritional risk index, GNRI uses the ideal weight determined using the Lorentz formula.⁹ The patients were divided into groups with low (≤ 98) and high GNRI (> 98). The Lorentz formula is computed as follows:

$$\text{Height (cm)} - 100 - [(\text{Height (cm)} - 150) / 4] \text{ for men.}$$

$$\text{Height (cm)} - 100 [(\text{Height (cm)} - 150) / 2.5] \text{ for women.}$$

GNRI was determined as follows:

$$\text{GNRI} = [1.489 \times \text{albumin (g/L)}] + [41.7 \times (\text{body weight} / \text{ideal body weight})]$$

STATISTICAL ANALYSIS

The IBM SPSS 23.0 package application (IBM Corp., Armonk, NY, USA) was used for statistical analyses. Associations between categorical variables were examined using Fisher's exact and Pearson's

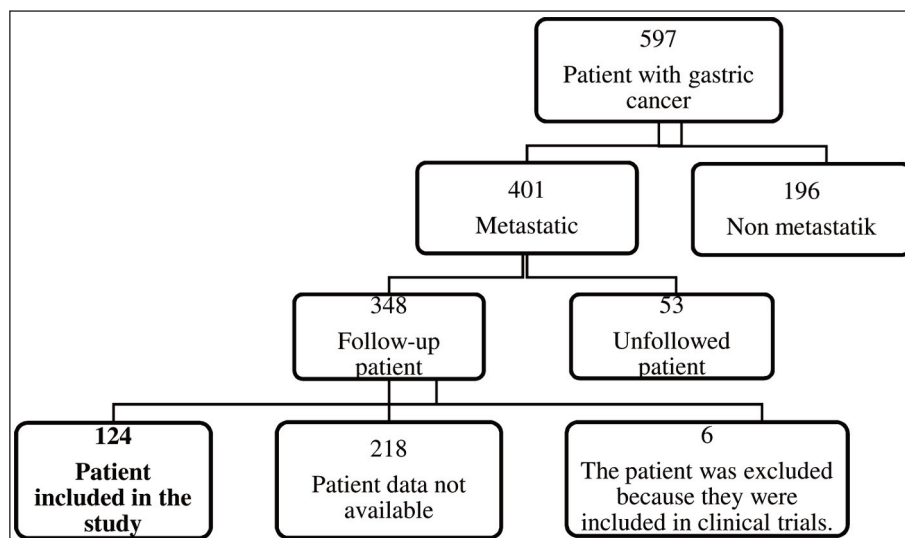


FIGURE 1: Flow chart showing patient selection.

chi-square tests, with Bonferroni correction applied for pairwise comparisons. The Shapiro-Wilk test was used to examine the assumption of normality. The Mann-Whitney U test and Student's t-test were used to examine the difference between the measurement values of the two groups with non-normal and normal distribution, respectively. The findings were provided with the area under the curve (AUC), cutoff points, sensitivity, and selectivity values. ROC analysis was used to distinguish patients based on their GNRI and PNI values and identify the cutoff point in predicting OS. The log-rank test was used to compare the groups' survival rates, whereas the Kaplan-Meier analysis was used for the survival analysis. Uni- and multivariate Cox regression analyses were used to examine factors influencing OS. A multivariate regression model was created with $p < 0.1$ in the univariate analysis and research parameters. Risk ratios [hazard ratio (HR) and 95% confidence interval (CI)] were used to show the results. Statistical significance was determined with $p < 0.05$. Time from diagnosis until death or final evaluation was used for computing OS.

The study was conducted following the 1964 Helsinki Declaration and authorized by the Akdeniz University Faculty of Medicine Clinical Research Ethics Committee (date: February 5, 2020, no: KAEK-94).

RESULTS

CHARACTERISTICS OF PATIENTS AND FINDINGS BASED ON GNRI AND PNI

Table 1 shows the patients' overall features. The cutoff values of GNRI and PNI were ≤ 98 and ≤ 44.05 , respectively. Based on the cutoff values, patients were divided into low and high groups. Patients with low PNI and GNRI had lower BMI and body weight ($p < 0.05$). Patients with high PNI had a higher possibility of developing cardiovascular illness ($p = 0.015$).

Table 2 shows the patients' clinical characteristics. Patients with low PNI and GNRI had lower albumin and lymphocyte counts ($p < 0.05$). Those with poor PNI had greater prevalence of acid and CRP levels during diagnosis ($p < 0.05$).

TABLE 1: General characteristics of patients according to GNRI and PNI groups.

Variable	ALL(n=124)	High-GNRI(n=71)	Low-GNRI(n=53)	p value	High-PNI (n=81)	Low-PNI (n=43)	p value
Age	58.16±11.04	57.45±9.38	59.11±12.97	0.409	58.75±10.05	57.05±12.76	0.415
Gender							
Female/Male	41/83	28/43	13/40	0.081	25/56	16/27	0.475
Body weight (kg)	63.97±12.43	70.15±10.42	55.68±9.85	<0.001	66.46±12.48	59.29±11.01	0.002
Height (cm)	166.2±8.22	166.23±8.85	166.17±7.39	0.971	166.64±8.39	165.37±7.93	0.415
Body mass index	23.21±4.62	25.52±4.27	20.12±3.01	<0.001	24±4.72	21.71±4.07	0.008
Ideal weight (kg)	61.34±6.58	61.11±6.98	61.66±6.04	0.646	61.65±6.63	60.76±6.51	0.474
Comorbidity							
Yes/No	29/95	20/51	9/44	0.145	22/59	7/36	0.173
Diabetes							
Yes/No	17/107	11/60	6/47	0.504	12/69	5/38	0.623
Hypertension							
Yes/No	13/111	10/61	3/50	0.130	10/71	3/40	0.540
Cardiovascular disease							
Yes/No	10/114	8/63	2/51	0.186	10/71	0/43	0.015
ECOG-PS							
0/1/2/3	28/40/7/8	20/19/3/3	8/21/4/5	0.173	21/27/2/5	7/13/5/3	0.261
Histology							
AC/SRC/NT	68/32/1	37/18/0	31/14/1	0.375	44/21/1	24/11/0	0.999
Primary tumor location							
CJ/C/AP	11/52/26	8/28/16	3/24/10	0.649	6/33/19	5/19/7	0.721

Results are shown as mean±standard deviation or n; GNRI: Geriatric Nutritional Risk Index; PNI: Prognostic Nutritional Index; ECOG-PS: Eastern Cooperative Oncology Group performance status; AC: Adenocancer; SRC: Signet ring cell; NT: Neuroendocrine tumor; CJ: Cardiaesophageal junction; C: Corpus; AP: Antrum and pylorus.

TABLE 2: Clinical characteristics of patients according to GNRI and PNI groups.

Variable	ALL (n=124)	High-GNRI (n=71)	Low-GNRI (n=53)	p value	High-PNI (n=81)	Low-PNI (n=43)	p value
Albumin	3.83±0.54	4.12±0.39	3.44±0.45	<0.001	4.13±0.33	3.26±0.35	<0.001
Lymphocyte	1.73±0.7	1.76 (0.64-3.79)	1.42 (0.32-4.1)	0.005	1.89 (0.83-4.1)	1.29 (0.32-2.32)	<0.001
Acid							
Yes/No	16/24	7/10	9/14	0.072	6a/16a	10b/8a	0.041
CRP							
Level<1/Level≥1	58/66	37/34	21/32	0.168	44/37	14/29	0.021
CEA							
Level<5/Level≥5	70/29	44/16	26/13	0.476	52/19	18/10	0.378
CA 19-9	22.76 (0.01-319800)	25.56 (0.01-319800)	18.19 (0.6-4014)	0.614	17.67 (0.01-319800)	27.65 (0.6-1478.69)	0.284
Nutritional support							
No/Oral/IV	29/35/60	39/13/19	21/16/16	0.180	41/18/22	19/11/13	0.791
Use of megestrol acetate							
Yes/No	60/64	31/40	29/24	0.223	39/42	21/22	0.942
Type of chemotherapy							
mDCF/DCF/Other	45/40/39	26/25/20	19/15/19	0.682	29/25/27	16/15/12	0.241
Latest status							
Alive/Dead	14/110	9/62	5/48	0.573	13/68	1/42	0.033

Results are shown as mean±standard deviation, median (minimum-maximum), or n. Different lowercase bases in a row indicate a statistically significant difference between groups; GNRI: Geriatric Nutritional Risk Index; PNI: Prognostic Nutritional Index; CRP: C-reactive protein; CEA: Carcinoembryonic antigen; CA 19-9: Cancer antigen; IV: Intravenous; mDCF: modified Docetaxel, Cisplatin, and Fluorouracil.

UNI- AND MULTIVARIATE ANALYSES OF FACTORS AFFECTING OS

Table 3 lists the results of the uni- and multivariate analyses to identify the determinants of OS for all patients. The univariate analysis showed that primary tumors in the cardioesophageal junction, CRP value, lymphocyte count, and low PNI were significantly correlated with worse OS. The multivariate analysis revealed that patients with metastatic gastric cancer whose initial tumor was at the cardioesophageal junction had an increased mortality risk (HR, 2.717; 95% CI, 1.292-5.711; p=0.008).

The age of 35 patients in this study was ≥65 years. **Table 4** shows the uni- and multivariate analyses for the patient group aged ≥65 years. The univariate analysis showed that primary tumors in the cardioesophageal junction and antrum-pylorus, CRP, and CEA values, those receiving modified Docetaxel, Cisplatin, and Fluorouracil treatment, and low PNI were significantly correlated with worse OS. These increased the mortality risk when these factors were considered in the multivariate analysis (HR, 1.027; 95% CI, 1.01-1.044; p=0.002).

EFFECT OF GNRI AND PNI ON OS

The median OS was 10 (8.983-11.017) months in all patients. The median OS was longer in patients with higher GNRI (11 vs. 10 months, p=0.906) and higher PNI (11 vs. 8 months, p=0.003). Moreover, patients with low PNI had considerably poorer survival rates. The median OS was 11 (8.752-13.248) months in patients aged ≥65 years. In this patient group, the median OS was longer in patients with higher GNRI (12 vs. 10 months, p=0.955) and higher PNI (12 vs. 6 months, p=0.008). The survival rates of the patients aged ≥65 years in the low PNI group were significantly lower (**Figure 2**).

Table 5 shows the ROC analysis results to identify the differentiating characteristic of GNRI and PNI in identifying OS. The ideal GNRI was ≤103.59, with an AUC, sensitivity, and specificity of 0.605 (95% CI=0.513-0.692; p=0.183), 60.9%, and 64.3%, respectively. In PNI, the AUC, sensitivity, and selectivity were 0.600 (95% CI=0.508-0.687; p=0.156), 38.2%, and 92.9%, respectively, for the optimal value of ≤44.05. The AUC of PNI and GNRI were similar (p=0.937; **Figure 3**).

TABLE 3: Univariate and multivariate Cox regression analysis of factors affecting overall survival in all patients.

Variable	Univariate		Multivariate	
	HR (95% CI)	p value	HR (95% CI)	p value
Age	0.989 (0.972-1.006)	0.215	-	-
Male gender	0.931 (0.621-1.395)	0.729	-	-
Body mass index	0.992 (0.952-1.033)	0.688	-	-
Primary tumor location				
CJ	3.056 (1.484-6.293)	0.002	2.717 (1.292-5.711)	0.008
Corpus	1.426 (0.890-2.284)	0.140	1.275 (0.789-2.061)	0.320
Antrum and pylorus	1.208 (0.693-2.106)	0.504	1.167 (0.662-2.057)	0.594
CRP	1.048 (1.001-1.098)	0.047	1.032 (0.978-1.089)	0.254
CEA	0.997 (0.996-1.003)	0.625	-	-
CA19-9	0.996 (0.995-1.002)	0.586	-	-
Albumin	0.730 (0.509-1.046)	0.106	-	-
Lymphocyte	0.706 (0.544-0.916)	0.009	0.803 (0.597-1.079)	0.145
Nutritional support				
Oral	0.945 (0.586-1.523)	0.817	-	-
Intravenous	1.266 (0.818-1.957)	0.290	-	-
mDCF therapy	1.016 (0.686-1.505)	0.936	-	-
DCF therapy	1.090 (0.737-1.613)	0.665	-	-
Low-GNRI	1.022 (0.700-1.493)	0.910	-	-
Low-PNI	1.741 (1.180-2.569)	0.005	1.239 (0.753-2.037)	0.399

Factors with $p < 0.1$ in univariate analysis were included in the multivariate model; HR: Hazard ratio; CI: Confidence interval; CJ: Cardiaesophageal junction; CRP: C-reactive protein; CEA: Carcinoembryonic antigen; CA 19-9: Cancer antigen; GNRI: Geriatric Nutritional Risk Index; PNI: Prognostic Nutritional Index; mDCF: modified Docetaxel, Cisplatin, and Fluorouracil.

TABLE 4: Univariate and multivariate Cox regression analysis of factors affecting overall survival in patients aged 65 and over.

Variable	Univariate		Multivariate	
	HR (95% CI)	p value	HR (95% CI)	p value
Age	0.997 (0.921-1.079)	0.943	-	-
Male gender	0.555 (0.247-1.247)	0.154	-	-
Body mass index	0.97 (0.894-1.052)	0.458	-	-
Primary tumor location				
CJ	4.952 (1.202-20.403)	0.027	5.447 (0.645-45.98)	0.119
Corpus	2.776 (0.914-8.432)	0.072	3.326 (0.732-15.114)	0.120
Antrum and pylorus	4.482 (1.199-16.75)	0.026	6.094 (0.736-50.442)	0.094
CRP	1.166 (1.008-1.348)	0.038	0.993 (0.681-1.448)	0.970
CEA	1.02 (1.007-1.033)	0.003	1.027 (1.01-1.044)	0.002
CA19-9	0.998 (0.996-1.001)	0.773	-	-
Albumin	0.456 (0.206-1.01)	0.053	1.594 (0.25-10.147)	0.622
Lymphocyte	0.7 (0.459-1.069)	0.101	-	-
Nutritional support				
Oral	1.058 (0.346-3.231)	0.922	-	-
Intravenous	1.511 (0.674-3.388)	0.316	-	-
mDCF therapy	2.195 (1.008-4.778)	0.048	1.784 (0.473-6.728)	0.393
DCF therapy	0.762 (0.338-1.72)	0.514	-	-
Low-GNRI	0.979 (0.469-2.044)	0.956	-	-
Low-PNI	2.601 (1.225-5.523)	0.013	2.04 (0.288-14.468)	0.476

Factors with $p < 0.1$ in univariate analysis were included in the multivariate model; HR: Hazard ratio; CI: Confidence interval; CJ: Cardiaesophageal junction; CRP: C-reactive protein; CEA: Carcinoembryonic antigen; CA 19-9: Cancer antigen; GNRI: Geriatric Nutritional Risk Index; PNI: Prognostic Nutritional Index; mDCF: modified Docetaxel, Cisplatin, and Fluorouracil.

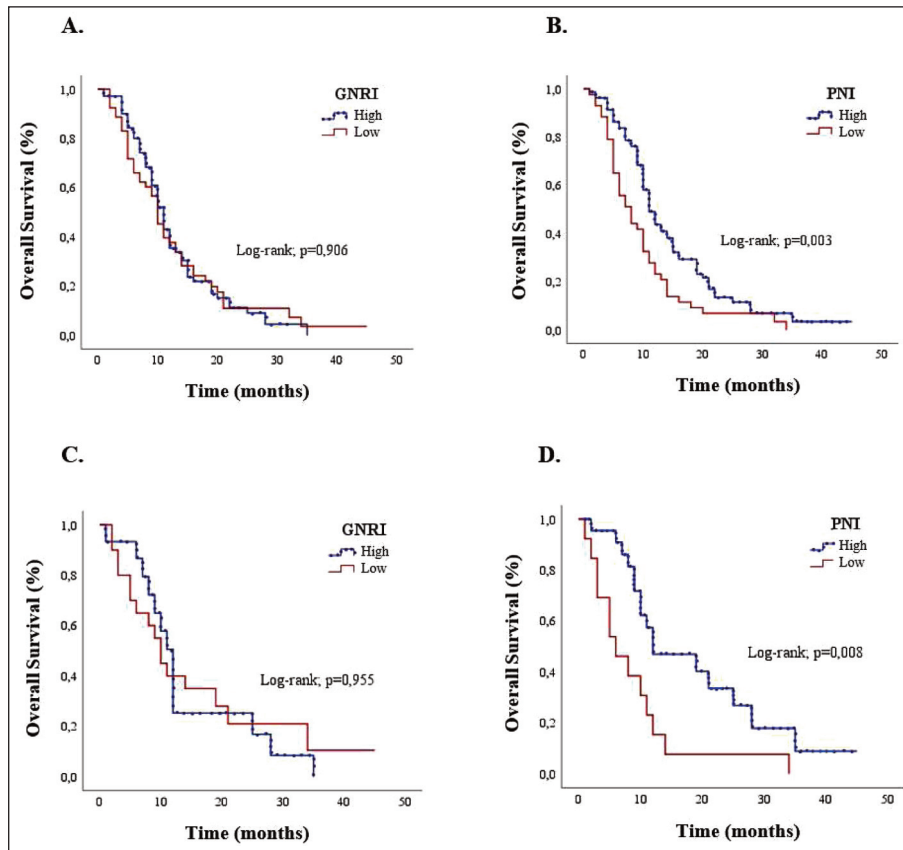


FIGURE 2: Overall survival by GNRI and PNI groups.

A) OS based on GNRI in all patients; B) OS based on PNI in all patients; C) OS based on GNRI in patients aged 65 and older; D) OS based on PNI in patients aged 65 and older; GNRI: Geriatric Nutritional Risk Index; PNI: Prognostic Nutritional Index; OS: Overall survival.

TABLE 5: ROC analysis results for GNRI and PNI in determining overall survival.

	AUC (95% CI)	p value	Cut-off	Sensitivity	Specificity
GNRI	0.605 (0.513-0.692)	0.183	≤103.59	60.9	64.3
PNI	0.600 (0.508-0.687)	0.156	≤44.05	38.2	92.9

ROC: Receiver operating characteristic; GNRI: Geriatric Nutritional Risk Index; PNI: Prognostic Nutritional Index; AUC: Area under the curve; CI: Confidence interval.

DISCUSSION

Cancer patients commonly have malnutrition which accounts for 10%-20% of cancer-related deaths rather than malignancy.¹¹ Detecting malnutrition during diagnosis and providing the necessary nutritional support can change the prognosis and mortality rates. Therefore, clinically applicable and practical methods and parameters are required. Currently, anemia, low preoperative albumin levels, BMI≤18.5, preoperative hemoglobin, albumin, lymphocyte and

platelet combination, body weight loss, and PNI were independent predictive markers for survival in patients with Stage IV gastric cancer.¹²

Studies showed that patients with gastric cancer whose pre- and postoperative low blood albumin levels were less likely to survive.¹³⁻¹⁵ Our study showed that albumin level did not affect survival. However, the low GNRI and PNI groups had lower albumin levels.

Previous studies reported that patients with metastatic gastric cancer with high absolute lymphocyte counts had longer OS than those with low abso-

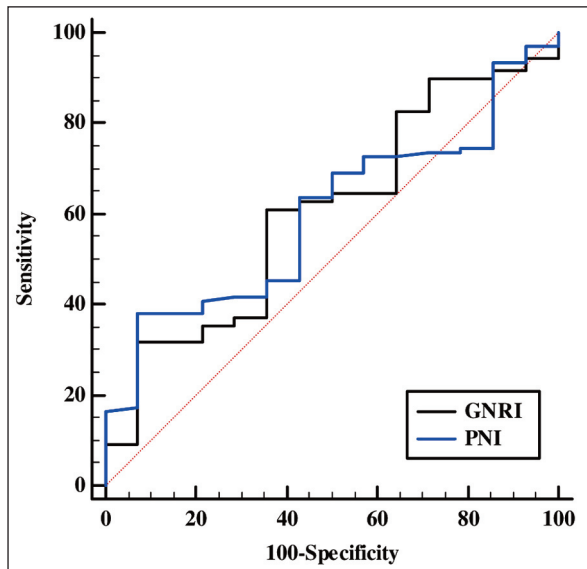


FIGURE 3: Receiver operating characteristic curve for GNRI and PNI in determining overall survival.

GNRI: Geriatric Nutritional Risk Index; PNI: Prognostic Nutritional Index

lute lymphocyte counts.¹⁶ In our study, decreased lymphocyte counts negatively affected OS, but it was not an independent prognostic predictor. Moreover, low GNRI and PNI groups had reduced lymphocyte counts. The outcome may be statistically significant because the PNI in our study was based on serum albumin level and total lymphocyte count. Although GNRI was based on albumin level only, it was also statistically significant with lymphocyte count.

The patient's dietary state might influence their prognosis for gastric cancer. BMI is considered a useful method to assess a patient's weight to predict nutritional status. Lee et al. indicated that the OS was shorter in patients with curative gastric cancer and low body weight, which was consistent with the study by Han et al.^{17,18} Low BMI was strongly linked to an increased risk of gastric cancer mortality in patients aged ≥ 60 years.¹⁹ Additionally, other studies showed that BMI and body weight did not have a significant relationship with mortality in gastric cancer, which was also confirmed in our study.^{20,21} Some studies examined the correlation of BMI and body weight with nutritional indices in patients with gastric cancer. Park et al. reported that preoperative low body weight and PNI were linked to a poor prognosis in patients with Stage II/III gastric cancer. They also demonstrated a positive association between preoperative

BMI and PNI and that patients with low PNI and GNRI had reduced BMI and body weights.²² According to this study, patients with low PNI and low GNRI had reduced BMI and body weights.

Pro-inflammatory cytokines affect survival, growth, mutation, differentiation, and metastasis of tumor cells by stimulating CRP production from the liver.²³ Additionally, CRP level was increased in patients with metastatic gastric cancer, and high CRP levels were correlated with OS.^{24,25} In our study, increased CRP level was associated with lower survival, but it was not an independent prognostic factor.

Patients with gastric cancer at various stages may have higher blood levels of CEA, CA19-9, and CA72-4. CEA is an independent risk factor for the prognosis of liver metastases recurrence.²⁶ CEA level, an independent risk factor for early-stage gastric cancer, is linked to poor prognosis if elevated.²⁷ Jo et al. showed that high blood CEA and CA19-9 levels were strongly related to poor prognosis in patients with metastatic gastric cancer; however, elevated serum CA19-9 concentrations were an independent negative predictor for prognosis.²⁸ Nevertheless, our study showed no link between OS, CEA, or CA 19-9 levels. However, older patients had elevated CEA values.

In the past decade, the number of cases of gastric cancer from the upper portion of the gastric, including the cardia and gastroesophageal junction, has increased. The main tumor's position in the cardia and gastroesophageal junction was a significant prognostic factor in a meta-analysis, including 50 studies assessing the predictive effect of the primary tumor site in non-metastatic gastric cancer.²⁹ Our study showed that a primary tumor at the cardioesophageal junction has a strong prognostic impact and increases the mortality risk in patients with metastatic gastric cancer.

The PNI was initially used to time surgery, assess the risk of mortality and postoperative complications in patients with gastrointestinal cancer. However, it has developed into a potent prognostic factor for different cancer types. Previous studies reported that low PNI was associated with poor survival.⁵⁻⁸ However, some studies contradict these results.^{30,31} Based on statistical analysis, the cutoff point for PNI in this study was 44.05. PNI was not a

reliable predictor. However, patients with high PNI (>44.05) had considerably longer survival rates than those with poor PNI, who were at greater risk of mortality (Log-rank, $p=0.003$).

PNI has typically been used in patients with early-stage gastric cancer, and few studies reported its prognostic value in patients aged ≥ 65 years. Elderly patients with gastric cancer with low PNI were related to poor survival and linked to short- and long-term outcomes following gastrectomy.³²⁻³⁴ Therefore, our study was the first to investigate the use of PNI in older patients with metastatic gastric cancer. PNI was not a reliable predictor. However, patients aged ≥ 65 years with high PNI had considerably longer survival, and those with low PNI were associated with a greater mortality risk (Log-rank, $p=0.008$).

Recently, the GNRI is a valuable and simplified tool for estimating mortality.³⁵ Although it is mostly recommended for geriatric patients, its effectiveness in all age groups is unclear. Low GNRI was linked to shorter survival and a higher risk of postoperative complications in cancer patients in a comprehensive evaluation of the literature, including studies from the previous year.¹⁰ In a meta-analysis of nine studies, patients with gastrointestinal malignancies with low GNRI had worse OS and higher complication risk.³⁶ Most studies accepted the cutoff value of GNRI as 98. This is the critical value for the GNRI and can be considered the reference value for the cutoff value in clinical practice. Our study also accepted the same cutoff value and showed no discernible distinction between GNRI and OS, and GNRI was not identified as a separate prognostic factor.

Finally, similar rates were found when the GNRI and PNI values in predicting mortality were compared in ROC analysis and AUC. However, our survival analysis results showed that low PNI was associated with poor OS in adults and patients aged ≥ 65 years.

The most important study limitation was the lack of data specific to retrospective studies. The inability to reach the required tests and information for index calculations may have caused a reduction in the total number of research participants, which may have led to a decrease in the effectiveness of statistical results.

Selection bias may be possible in our study due to the high percentage of cases with missing values. The cutoff value to better predict OS is unknown. Although we used the cutoff value for GNRI following the literature, we used the optimal cutoff value for PNI. A comparison of studies could be more accurate if a precise cutoff value had been defined and verified. Therefore, a prospective study should be conducted to validate these data.

CONCLUSION

PNI is still a survival predictor in patients with metastatic gastric cancer, even if it is not an independent risk factor for OS. The use of PNI clinically and the administration of palliative chemotherapy to suitable patients may be beneficial due to its ease of use and easy access to necessary parameters. Larger prospective randomized studies are required to fully grasp the predictive significance of indices and support our findings.

This study is the first research to compare the prognostic effect of GNRI and PNI in adults and patients aged ≥ 65 years with metastatic gastric cancer.

Acknowledgments

We would like to thank our professors and friends in the Department of Medical Oncology for their support during this study and present our respects.

Source of Finance

During this study, no financial or spiritual support was received neither from any pharmaceutical company that has a direct connection with the research subject, nor from a company that provides or produces medical instruments and materials which may negatively affect the evaluation process of this study.

Conflict of Interest

No conflicts of interest between the authors and / or family members of the scientific and medical committee members or members of the potential conflicts of interest, counseling, expertise, working conditions, share holding and similar situations in any firm.

Authorship Contributions

Idea/Concept: Sümeyye Tekin, Ali Murat Tatlı; **Design:** Sümeyye Tekin, Ali Murat Tatlı; **Control/Supervision:** Ali Murat Tatlı, Sema Sezgin Göksu, Hasan Şenol Coşkun; **Data Collection and/or Pro-**

cessing: Sümeyye Tekin, Ali Murat Tatlı; **Analysis and/or Interpretation:** Sümeyye Tekin, Ali Murat Tatlı, Sema Sezgin Göksu, Hasan Şenol Coşkun; **Literature Review:** Sümeyye Tekin; **Writing**

the Article: Sümeyye Tekin, Ali Murat Tatlı; **Critical Review:** Sema Sezgin Göksu, Hasan Şenol Coşkun; **References and Fundings:** Sümeyye Tekin; **Materials:** Sümeyye Tekin, Ali Murat Tatlı.

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