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Prognostic significance of myopenia and nutritional status in nasopharyngeal cancer: introducing the TEMA index

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► ***Original article***

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ABSTRACT

Background: This study investigates whether temporal muscle thickness (TMT) has prognostic significance in nasopharyngeal cancer (NPC). Additionally, it introduces a novel composite index, TEMA, which integrates TMT and serum albumin levels to enhance prognostic stratification. ***Materials and Methods:*** The study retrospectively encompassed 61 NPC patients receiving definitive therapy during the period January 2014–October 2024. TMT was extracted from computed tomography (CT) scans, and serum albumin (g/dL) was measured from blood specimens collected immediately before definitive treatment commenced. The novel TEMA index was defined as: TEMA = TMT × serum albumin. ***Results:*** Patients were aged 18–88 years (median, 49). The follow-up duration varied from 4 to 129 months with a median of 45 months. In univariate analyses, albumin significantly predicted progression-free survival (PFS) ($p = 0.02$), while overall survival (OS) showed significant associations with albumin ($p = 0.006$), TMT ($p = 0.016$), and TEMA index ($p = 0.017$). ***Conclusion:*** In patients with NPC treated with definitive intent, TMT and serum albumin showed significant associations with OS. A composite index that integrates these biomarkers (e.g., TEMA) may facilitate treatment decision-making and risk/prognostic stratification.

INTRODUCTION

An epithelial malignancy, nasopharyngeal cancer (NPC) typically originates in the mucosal lining of the nasopharynx [1]. In 2018, NPC ranked as the 23rd most common newly diagnosed cancer globally, with 85% of cases reported in Asia. It is listed as the 21st leading cause of death from cancer [2]. Histologically, the World Health Organization (WHO) classifies NPC into three types: type I, keratinizing squamous cell carcinoma (SCC); type II, non-keratinizing SCC (differentiated); and type III, non-keratinizing SCC (undifferentiated). Basaloid SCC, considered a subtype of type III, has been reported to carry a worse prognosis [3]. Environmental and genetic factors, including Epstein-Barr virus (EBV) infection and HLA polymorphism, are implicated in the pathogenesis of NPC [4]. Staging of NPC follows the tumor–node–metastasis (TNM) classification; however, unlike other cancers, this anatomical staging does not fully predict prognosis [1]. Radiotherapy remains the cornerstone of treatment for NPC. For early-stage cases, radiotherapy is administered alone, while chemotherapy is given concurrently with radiotherapy in locally advanced stages. In advanced cases, induction chemotherapy is applied to reduce tumor burden [5, 6].

Sarcopenia is a syndrome defined first by weakness (low muscle strength) and substantiated by deficits in muscle quantity or quality; severe sarcopenia denotes impaired physical performance [7-9]. Sex-specific diagnostic thresholds have therefore been adopted [8, 9]. Myopenia, defined as low skeletal muscle mass, reflects the quantitative domain of the sarcopenia construct and on its own is insufficient for a diagnosis of sarcopenia. In oncology, sarcopenia is linked to poorer quality of life, increased treatment toxicity, and delayed recovery [10]. As a pragmatic imaging-based proxy of muscle quantity (i.e., myopenia), temporal muscle thickness (TMT) has been associated with PFS in head and neck SCC [11], with OS in oral cavity SCC [12], and with both PFS and OS in glioblastoma [13].

Albumin reflects visceral protein stores and serves as a clinically relevant marker of both nutritional and inflammatory states. In cancer patients, factors such as cachexia and increased systemic inflammation often led to reduced serum albumin levels, which can negatively impact prognosis [14-15]. A meta-analysis of immunotherapy for head and neck cancer (HNC) found that higher albumin levels were significantly related to improved PFS and OS, suggesting albumin's potential role as a prognostic marker in this patient population [16]. Additionally, another meta-analysis in HNC patients demonstrated that decreased low serum albumin levels and a reduced geriatric nutritional risk index (GNRI), which combines body weight and albumin concentration, were independently associated with poorer OS outcomes [17].

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Although earlier work has explored myopenia in NPC, the prognostic relevance of TMT, a myopenia metric, in this patient cohort remains unclear. This investigation assesses the prognostic significance of TMT in NPC and introduces a novel composite index, TEMA, integrating TMT and serum albumin. By combining a structural muscle parameter with a biomarker of nutritional and inflammatory status, TEMA index may provide a more comprehensive and precise tool for prognostic stratification in NPC patients.

MATERIALS AND METHODS

Patient selection

The study received approval from the Akdeniz University Medical Scientific Research Ethics Committee (Decision No: 17; Date: 02.01.2025) and was carried out in accordance with the Helsinki Declaration. Owing to the retrospective design, the need for informed consent was waived. Furthermore, the research was designed in accordance with the REMARK guidelines [18].

This retrospective, single-center analysis comprised 61 NPC patients treated with definitive intent at a tertiary care institution accrued from January 2014 through October 2024. Patients were excluded if they had metastatic disease at initial diagnosis, an Eastern Cooperative Oncology Group performance status (ECOG PS) of 3-4, underwent palliative radiotherapy, or were <18 years old at diagnosis. Individuals were also deemed ineligible if they had acute or chronic infection; autoimmune or hematological disease; chronic hepatic or renal disease; or were taking medications capable of affecting complete blood count parameters.

Therapeutic protocols and follow-up procedures

Therapeutic decisions were aligned with international recommendations [19-21]: radiotherapy alone for stage I; CCRT or induction chemotherapy then CCRT for stage II–IVA.

All patients underwent intensity-modulated radiation therapy (IMRT). The sequential boost (SB) technique was used in 42 patients, whereas the simultaneous integrated boost (SIB) technique was used in 19. The total prescribed dose was 66-70 Gy to the primary nasopharyngeal lesion and involved cervical lymph nodes, 60 Gy for the high-risk clinical target volume (CTV), and 54 Gy for the low-risk CTV. Induction chemotherapy typically included agents such as docetaxel, 5-fluorouracil, or gemcitabine, in combination with platinum-based compounds. Weekly cisplatin (40 mg/m^2) or other platinum-based agents were administered concurrently with radiotherapy as part of CCRT.

Following completion of definitive therapy, patients were monitored at 3–6-month intervals during the initial 2 years, at 6-month intervals in years 3–5, and annually thereafter. During surveillance, patients underwent clinical examination, nasopharyngoscopy, magnetic resonance imaging (MRI), and/or positron emission tomography–computed tomography (PET-CT).

Data collection

The clinical and pathological profiles of the patients, alongside muscle measurements and laboratory parameters, were obtained retrospectively. All these parameters were obtained from the patients' medical records before the initiation of definitive treatment.

For TMT measurements, non-contrast CT images acquired for definitive treatment planning were used. These images were obtained in the supine position, with a slice thickness of 2.5 mm and an energy level of 120 kVp. The images were evaluated using window settings of center 45.0 and width 250.0. TMT measurements were acquired at right angles to the temporal muscle long axis, demarcated anteroposteriorly by the Sylvian fissure and craniocaudally by the orbital roof [22]. TMT measurements from both sides were summed and divided by two to obtain the mean TMT for each patient. Examples demonstrating TMT measurement are provided in figure 1. Serum albumin levels (g/dL) were collected from blood samples taken before the initiation of definitive treatment, and the novel TEMA index was defined as: TEMA = TMT × serum albumin.

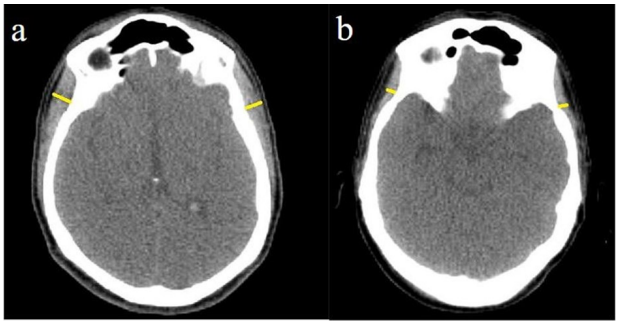


Figure 1. TMT measurements on CT images. **(a)** A 44-year-old male patient with an overall survival of 106 months (Mean TMT = 10.2 mm) and **(b)** a 53-year-old male patient with an overall survival of 15 months (Mean TMT = 3.4 mm).

Inflammatory markers were recorded, namely neutrophil, lymphocyte, platelet, and monocyte concentrations (10^3/mL) and C-reactive protein (CRP, mg/L). We defined the neutrophil-to-lymphocyte ratio (NLR) as the neutrophil value divided by the lymphocyte value; the platelet-to-lymphocyte ratio (PLR) and the monocyte-to-lymphocyte ratio (MLR) were computed analogously. The systemic immune-inflammation index (SII) was defined as (neutrophil × platelet) / lymphocyte, and the pan-immune inflammation value (PIV) was determined as (neutrophil × platelet × monocyte) / lymphocyte. Additionally, the Global Immune-

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Nutrition-Inflammation Index (GINI) was defined as: (neutrophil × platelet × monocyte × CRP) / (lymphocyte × albumin).

Statistical methods

We used SPSS 24.0 (IBM Corp., Armonk, NY, USA) for analyses; p<0.05 denoted significance. Descriptive statistics were calculated for all patients. Correlations between continuous variables were evaluated using Pearson's correlation coefficient. Receiver operating characteristic (ROC) curve analysis was used to identify optimal cut-off values for candidate prognostic factors; the area under the curve (AUC) with 95% confidence intervals (CI) was reported. The cutoff was defined as the threshold minimizing the absolute difference between sensitivity and specificity [23].

PFS was defined as the interval from diagnosis to the first occurrence of disease progression or death. OS was defined as the time from diagnosis to the last follow-up or death. Associations of candidate prognostic factors with PFS and OS were examined via univariate Cox models, and hazard ratios (HR) with 95% CIs were reported. Variables attaining p<0.05 in the univariate stage were subsequently entered into multivariate Cox models. Survival was estimated by the Kaplan–Meier method, and subgroup differences were tested with the log-rank test.

RESULTS

Table 1 presents the baseline characteristics of the study cohort. Patients were aged 18-88 years (median, 49). A total of 95.1% of the patients had an ECOG PS of 0 or 1. One patient (1.6%) was classified as Stage I, 13 patients (21.3%) as Stage II, 37 patients (60.7%) as Stage III, and 10 patients (16.4%) as Stage IVA. A total of 27 patients (44.3%) were administered definitive CCRT following induction chemotherapy, while 33 patients (54.1%) underwent definitive CCRT alone, and 1 patient (1.6%) received definitive radiotherapy. The median TMT value was 6.2 mm (range: 3.4–10.2 mm) overall, with males having a median of 6.4 mm (range: 3.4-10.2 mm) and females 4.9 mm (range: 3.4–8.5 mm). The follow-up duration varied from 4 to 129 months, and the median was 45 months.

The optimal cutoff values were determined through ROC curve analysis, as presented in table 2. For TMT, the optimal cut-off value was 5.72 mm, yielding a sensitivity of 63.2% and a specificity of 66.7% (AUC: 0.71, 95% CI: 0.56–0.85, p=0.008). For albumin, the optimal cut-off value was 4.33 g/dL, with a sensitivity of 68.4% and a specificity of 69% (AUC: 0.71, 95% CI: 0.56–0.85, p=0.009). For TEMA index, a cutoff of 25.21 yielded a sensitivity of 63.2% and a specificity of 64.3% (AUC=0.72; 95% CI, 0.57-0.86; p=0.006). Furthermore, Pearson correlation analysis revealed a positive correlation between TMT and albumin (r=0.555, p<0.001).

Table 1. Baseline characteristics of study cohort.

Characteristic	N = 61	%
Age		
≤50	36	59
>50	25	41
WHO Histology		
Type 1	3	4.9
Type 2	33	54.1
Type 3	25	41
Gender		
Female	21	34.4
Men	40	65.6
Stage		
Stage I	1	1.6
Stage II	13	21.3
Stage III	37	60.7
Stage IVA	10	16.4
ECOG PS		
0	25	41
1	33	54.1
2	3	4.9
Treatment		
IC + CCRT	27	44.3
CCRT	33	54.1
RT	1	1.6
Total RT Dose		
66 Gy	3	4.9
70 Gy	58	95.1
Fractionation Regimen		
SB	42	68.8
SIB	19	31.2

Abbreviations: WHO, World Health Organization; ECOG PS, Eastern Cooperative Oncology Group - Performance Status; IC, induction chemotherapy; CCRT, concurrent chemoradiotherapy; RT, radiotherapy; SB, sequential boost technique; SIB, simultaneous integrated boost technique.

During the follow-up period, disease progression was observed in 20 patients (32.8%), including 5 with distant metastasis only, 7 with local recurrence only, and 8 with both distant metastasis and local recurrence. The 3-year and 5-year PFS rates were 67.5% and 65%, respectively. The impact of potential prognostic factors on PFS is summarized in table 3. Hypoalbuminemia showed a significant association with poorer PFS (HR: 0.33, 95% CI: 0.13–0.85, p = 0.02). No other variables were identified as significant predictors of PFS; however, gender (p=0.10), TMT (p=0.15), and TEMA index (p=0.16) approached statistical significance.

Over the follow-up period, 19 patients (31.1%) died. OS at 3 and 5 years was 78.1% and 71.1%, respectively. The impact of variables on OS is presented in Table 4. In univariate analyses, albumin (HR: 0.24, 95% CI: 0.09-0.66, p=0.006), TMT (HR: 0.31, 95% CI: 0.12-0.80, p=0.016), and the TEMA index (HR: 0.31, 95% CI: 0.12-0.81, p=0.017)

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significantly predicted OS. However, in multivariate analyses, only albumin (HR: 0.32, 95% CI: 0.11-0.93, p=0.03) remained a statistically significant prognostic factor.

Compared with patients with albumin >4.33 (93.7%), those with albumin ≤4.33 exhibited a significantly lower 3-year OS (58.3%)(figure 2). Similarly, patients with TMT values ≤ 5.72 had a 3-year OS rate of 61%, whereas those with TMT values >5.72 had a markedly higher rate of 90.8% (figure 3). Furthermore, the 3-year OS rate in patients with a TEMA index ≤25.21 was 61%, in contrast to 90.8% for those with a TEMA index >25.21 (figure 4).

Table 2. ROC curve analyses for potential prognostic factors in the prediction of OS.

Variable	Cutoff	Sensitivity (%)	Specificity (%)	AUC (%95 CI)	p
Age	50	57.9	61.9	0.63 (0.47-0.78)	0.10
LDH	197.5	57.9	57.1	0.58 (0.43-0.72)	0.30
CRP	4.80	57.9	57.1	0.56 (0.40-0.73)	0.39
NLR	2.47	57.9	54.8	0.57 (0.40-0.73)	0.38
PLR	129.93	47.4	47.6	0.56 (0.41-0.72)	0.40
MLR	0.28	47.4	47.6	0.49 (0.33-0.66)	0.98
SII	644.95	47.4	47.6	0.54 (0.38-0.70)	0.58
PIV	380.85	47.4	47.6	0.51 (0.34-0.68)	0.81
GINI	381.3	57.9	59.5	0.59 (0.42-0.75)	0.26
Albumin	4.33	68.4	69	0.71 (0.56-0.85)	0.009
TMT	5.72	63.2	66.7	0.71 (0.56-0.85)	0.008
TEMA index	25.21	63.2	64.3	0.72 (0.57-0.86)	0.006

Abbreviations: AUC, area under curve; CI, confidence interval; LDH, lactate dehydrogenase; CRP, C-reactive protein; NLR, neutrophil-lymphocyte ratio; PLR, platelet-lymphocyte ratio; MLR, monocyte-lymphocyte ratio; SII, systemic immune-inflammation index; PIV, pan-immune inflammation value; GINI, global immune-nutrition-inflammation index; TMT, temporal muscle thickness.

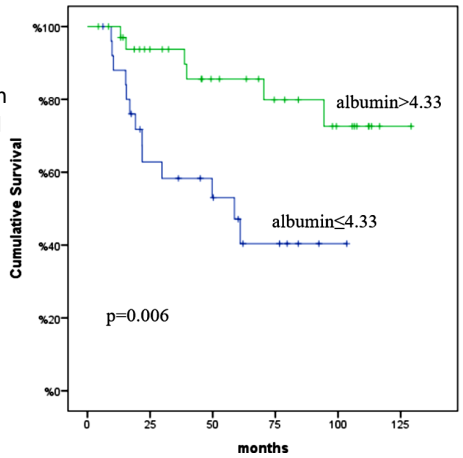


Figure 2. Kaplan-Meier survival curve illustrating the association between albumin and OS, with corresponding p-value.

Table 3. Univariate cox regression analyses for PFS.

Variable	Cutoff	HR (%95 CI)	p
Age	≤50 vs. >50	1.17 (0.48-2.85)	0.71
Gender	Female vs. Men	2.51 (0.83-7.53)	0.10
Stage	I-II vs. III-IV	1.77 (0.51-6.08)	0.36
LDH	≤197.5 vs. >197.5	0.77 (0.31-1.86)	0.56
CRP	≤4.80 vs. >4.80	1.01 (0.41-2.46)	0.97
NLR	≤2.47 vs. >2.47	1.06 (0.44-2.56)	0.88
PLR	≤129.93 vs. >129.93	0.62 (0.25-1.54)	0.31
MLR	≤0.28 vs. >0.28	1.06 (0.44-2.57)	0.88
SII	≤644.95 vs. >644.95	1.01 (0.41-2.42)	0.99
PIV	≤380.85 vs. >380.85	0.88 (0.36-2.14)	0.78
GINI	≤381.3 vs. >381.3	1.46 (0.60-3.56)	0.39
Albumin	≤4.33 vs. >4.33	0.33 (0.13-0.85)	0.02
TMT	≤5.72 vs. >5.72	0.52 (0.21-1.26)	0.15
TEMA index	≤25.21 vs. >25.21	0.53 (0.21-1.29)	0.16

Abbreviations: HR, hazard ratio; CI, confidence interval; LDH, lactate dehydrogenase; CRP, C-reactive protein; NLR, neutrophil-lymphocyte ratio; PLR, platelet-lymphocyte ratio; MLR, monocyte-lymphocyte ratio; SII, systemic immune-inflammation index; PIV, pan-immune inflammation value; GINI, global immune-nutrition-inflammation index; TMT, temporal muscle thickness.

Table 4. Univariate and multivariate cox regression analyses for OS.

Variable	Cutoff	Univariate Analyses		Multivariate Analyses	
		HR (%95 CI)	p	HR (%95 CI)	p
Age	≤50 vs. >50	1.65 (0.67-4.10)	0.27		
Gender	Female vs. Men	1.68 (0.60-4.67)	0.32		
Stage	I-II vs. III-IV	1.08 (0.35-3.26)	0.89		
LDH	≤197.5 vs. >197.5	1.21 (0.48-3.03)	0.67		
CRP	≤4.80 vs. >4.80	1.47 (0.59-3.68)	0.40		
NLR	≤2.47 vs. >2.47	1.48 (0.59-3.69)	0.39		
PLR	≤129.93 vs. >129.93	0.82 (0.33-2.04)	0.68		
MLR	≤0.28 vs. >0.28	1.14 (0.46-2.85)	0.77		
SII	≤644.95 vs. >644.95	0.84 (0.34-2.08)	0.72		
PIV	≤380.85 vs. >380.85	0.99 (0.40-2.45)	0.99		
GINI	≤381.3 vs. >381.3	1.60 (0.64-3.99)	0.31		
Albumin	≤4.33 vs. >4.33	0.24 (0.09-0.66)	0.006	0.32 (0.11-0.93)	0.03
TMT	≤5.72 vs. >5.72	0.31 (0.12-0.80)	0.016	0.39 (0.01-18.91)	0.63
TEMA index	≤25.21 vs. >25.21	0.31 (0.12-0.81)	0.017	1.21 (0.02-62.06)	0.92

Abbreviations: HR, hazard ratio; CI, confidence interval; LDH, lactate dehydrogenase; CRP, C-reactive protein; NLR, neutrophil-lymphocyte ratio; PLR, platelet-lymphocyte ratio; MLR, monocyte-lymphocyte ratio; SII, systemic immune-inflammation index; PIV, pan-immune inflammation value; GINI, global immune-nutrition-inflammation index; TMT, temporal muscle thickness.

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Table 5. Summary of studies examining the prognostic significance of myopenia in patients with nasopharyngeal cancer.

Author	Year	N	Dominant Treatment	Myopenia Criteria	Survival	p
Hua X *et al.* [7]	2021	806	CCRT	SMI	OS	<0.001
Liu S *et al.* [28]	2023	1307	CCRT	SMI	OS	0.01
He WZ *et al.* [29]	2020	1767	IC + CCRT	SMI	OS	0.26
Kim JH *et al.* [40]	2023	27	Surgery	SMM	OS	0.45
Hua X *et al.* [41]	2020	862	CCRT	SMI	OS	<0.001
Liu T *et al.* [42]	2024	545	CCRT	SMI	OS	<0.01
Huang X *et al.* [43]	2019	394	IC + CCRT	SMI	OS	0.36
Huang HY *et al.* [44]	2021	802	CCRT	SMI	OS	<0.001

Abbreviations: N, number of participants in the study; IC, induction chemotherapy; CCRT, concurrent chemoradiotherapy; SMM, skeletal muscle mass; SMI, skeletal muscle index; OS, overall survival.

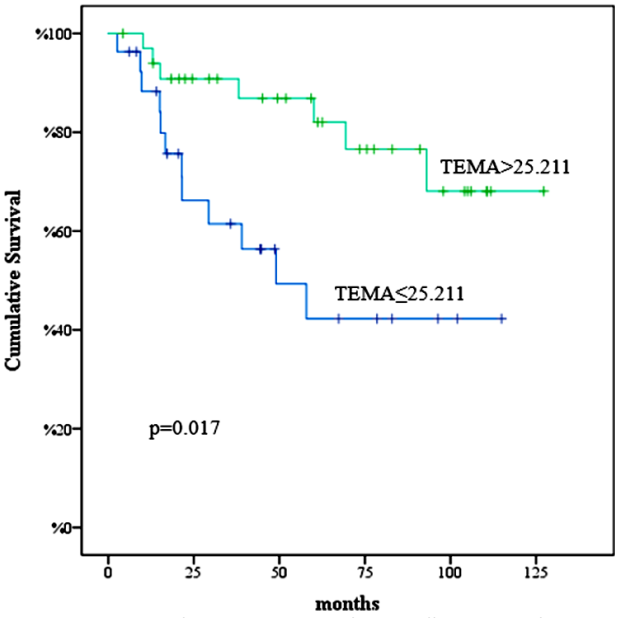


Figure 4. Kaplan-Meier survival curve illustrating the association between TEMA index and OS, with corresponding p-value.

DISCUSSION

Our findings demonstrate the prognostic relevance of TMT, serum albumin, and the TEMA index for OS among NPC. In univariate analyses, all three biomarkers were found to be significant predictors of OS. However, in multivariate analyses, only albumin remained independently associated with the outcome. These findings highlight the potential of combining these biomarkers within an overall evaluation to inform treatment decisions in NPC. Larger, multicenter studies are warranted to validate the clinical utility of these biomarkers and their contribution to improving prognostic stratification.

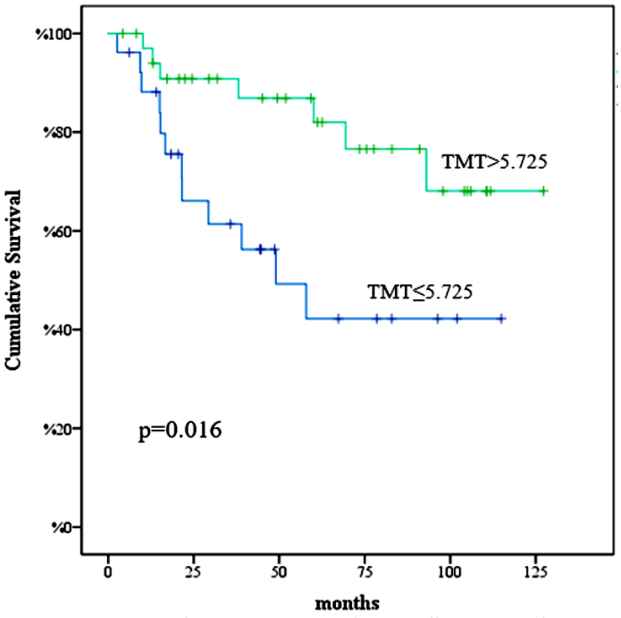


Figure 3. Kaplan-Meier survival curve illustrating the association between TMT and OS, with corresponding p-value.

One of the most well-recognized risk factors in NPC is Epstein-Barr virus (EBV) infection, which has been shown to be associated with better survival outcomes. The pathogenesis of NPC involves several genetic mutations, including TP53, KMT2C, NOTCH2, BRCA1 and 2, PTCH1, IL7R, KDR, EGFR, and PIK3CA [3]. The primary treatment for localized NPC is radiotherapy, often in combination with concurrent cisplatin [5]. However, disease progression occurs in approximately 20-30% of patients after curative treatment. In cases of progression, the gemcitabine-cisplatin regimen is commonly used as the first-line therapy, though the treatment outcomes are frequently suboptimal. Salvage radiotherapy is typically employed in these patients, but its success is limited due to high toxicity and poor survival rates [24].

Patients with HNC are at high risk for the development of myopenia and sarcopenia. Radiotherapy-induced toxicities, particularly reduced oral intake, are significant factors contributing to this increased risk. In this population, sarcopenia is associated with reduced treatment tolerance-manifested by higher chemotherapy toxicity and prolonged radiotherapy interruptions [25]. Various morphometric (myopenia) biomarkers have been utilized to predict survival and toxicity across different cancer types. For example, a study identified the masseter muscle index as a predictor of postoperative pneumonia in esophageal cancer [26]. In a study of patients with NPC, low skeletal muscle was significantly associated with dose-limiting toxicities in male patients treated with CCRT [27].

Studies evaluating myopenia markers in NPC are summarized in table 5. Recent research has predominantly used skeletal muscle index (SMI) as a

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marker of myopenia in NPC, with several studies published in the last five years. Liu et al. found that SMI was a significant predictor of OS in a cohort of 1,307 NPC patients [28]. However, a larger study involving 1,767 patients found no significant effect of myopenia on prognosis [29]. Our study is the first to examine TMT as a marker for myopenia in NPC. We found that TMT, along with a novel index called TEMA, can significantly predict OS. However, neither TMT nor TEMA were able to predict PFS. This suggests that, while these markers are useful for predicting OS, they are limited in monitoring disease progression. The role of TMT has been studied in other cancers, particularly glioblastoma and brain metastases. A meta-analysis of glioblastoma studies revealed a significant association between TMT and both PFS and OS [30]. However, another study did not find a significant effect of TMT on OS in glioblastoma [31]. Similarly, while some studies have identified TMT as a significant predictor of OS in patients with brain metastases, others have failed to establish such an association [32-33]. TMT shows promise as a prognostic marker in various cancers; however, its role in NPC warrants further investigation. Our study suggests that TMT may be a valuable predictor of OS in NPC, but additional research is necessary to validate its effectiveness in clinical practice. Integrating TMT with other parameters, such as albumin, could enhance predictive accuracy and assist in informing treatment decisions.

Numerous studies have examined the impact of nutritional parameters on complications and survival across various cancer types. Due to its anatomical location, NPC often leads to symptoms that impair oral intake. Additionally, nutritional problems are frequently observed in this patient group, particularly due to side effects like mucositis caused by radiotherapy. A meta-analysis has shown a statistically significant difference in albumin levels before and after radiotherapy [34]. A study of 512 NPC patients demonstrated that hypoalbuminemia was associated with poor OS and distant metastasis-free survival (DMFS) [35]. Furthermore, a meta-analysis found a significant association between pre-treatment albumin levels and both OS and DMFS [36]. In our study, consistent with previous research, albumin emerged as a strong predictor of both PFS and OS. These findings underscore the critical role of albumin as a reliable biomarker in NPC patients, reinforcing its inclusion as a key component of the TEMA index in our analysis.

Serving as both a safeguard and a driver, inflammation plays a bifaceted role in cancer development and promotes progression through diverse pathways. As a result, inflammation biomarkers have been extensively studied for their potential to predict cancer survival. Our previous research demonstrated that certain inflammatory biomarkers were associated with oncologic outcomes in laryngeal cancer patients undergoing definitive radiotherapy [37]. In a study involving 377 NPC patients, the PIV was found to significantly impact both PFS and OS [38]. Similarly, among 179 patients with locally advanced NPC, PIV emerged as a significant predictor of DMFS and OS [39]. However, in contrast to these findings, our study revealed that PIV and other inflammatory markers did not significantly predict either PFS or OS. This discrepancy may reflect differences in patient populations, treatment modalities, or tumor biological heterogeneity. Further studies are warranted to delineate the prognostic role of PIV and other inflammatory biomarkers across cancer types and treatment settings.

While this study provides important insights into the prognostic roles of albumin and TMT in NPC treated with definitive intent, several limitations warrant consideration. First, reliance on a retrospective, single-center dataset with 61 patients may reduce the broader applicability of these results. Additionally, although patients with known abnormalities affecting blood parameters were excluded, unmeasured confounding cannot be ruled out, since peripheral blood cell counts are susceptible to influences such as infection and nutritional status. Future prospective, multi-center studies with larger cohorts and more comprehensive data collection could further validate these findings and reduce the impact of these limitations.

CONCLUSION

Myopenia and nutritional status are important prognostic indicators of OS in patients with NPC undergoing definitive treatment. The TEMA index, which integrates TMT and albumin levels, appears to be a promising tool for risk stratification in these patients. Further prospective, multicenter studies are needed to validate its clinical utility and explore its potential incorporation into treatment algorithms.

Ethics approval and consent to participate: The study received approval from the Akdeniz University Medical Scientific Research Ethics Committee (Decision No: 17; Date: 02.01.2025) and was carried out in accordance with the Helsinki Declaration. Owing to the retrospective design, the need for informed consent was waived.

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Conflict of interest: The authors report no conflicts of interest.

Availability of data and materials: The datasets underlying this article are available from the corresponding author on reasonable request.

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-22, 2025. This study is an extension of, and the finalized manuscript for, "The Impact of Sarcopenia and Nutritional Status on Survival in Patients with Nasopharyngeal Cancer Undergoing Definitive Treatment: Proposal of a New Index".

***Author contribution*:** All authors contributed in all aspects of the work equally. All authors read and approved final version of the manuscript for submission.

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