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Orbital fat as an imaging biomarker of nutritional status and systemic inflammation in patients with non-small cell lung cancer

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Orbital fat has recently attracted attention as a unique adipose tissue compartment with potential metabolic and inflammatory significance. However, its relationship with nutritional status and systemic inflammation in patients with non-small cell lung cancer (NSCLC) remains poorly understood. This study aimed to evaluate orbital fat volume and radiological density on computed tomography (CT) and to investigate their associations with body mass index (BMI) and systemic inflammatory markers in patients with NSCLC. A retrospective study included 86 patients with histologically confirmed NSCLC. Orbital fat was semiautomatically segmented on CT images using the 3D Slicer software. Total orbital fat volume and mean radiological density expressed in Hounsfield units (HU) were calculated for each patient. Clinical data and complete blood-count-derived inflammatory markers, including neutrophil-to-lymphocyte ratio (NLR), platelet-to-lymphocyte ratio (PLR), and systemic immune-inflammation index (SII), were collected from medical records. Associations between orbital fat parameters and clinicopathological characteristics were assessed using Pearson's chi-square test, Spearman's correlation analysis, and multivariable linear regression models. The mean orbital fat volume was 9.7 ± 1.4 cm^3, while the mean radiological density was 77.0 ± 6.9 HU. Patients with larger orbital fat volume demonstrated significantly higher BMI and lower levels of NLR, PLR, and SII. Orbital fat volume showed a positive correlation with BMI ($\rho = 0.561$, $P < 0.001$) and negative correlations with NLR ($\rho = -0.242$, $P = 0.025$), PLR ($\rho = -0.361$, $P < 0.001$), and SII ($\rho = -0.335$, $P = 0.002$). Radiological density was positively associated with BMI ($\rho = 0.689$, $P < 0.001$) and inversely correlated with PLR ($\rho = -0.412$, $P < 0.001$) and SII ($\rho = -0.220$, $P = 0.042$). In multivariable analyses adjusted for BMI, the associations between orbital fat volume and inflammatory markers lost statistical significance. By contrast, radiological density remained independently associated with PLR ($\beta = -0.013$, $P = 0.007$). These findings suggest that orbital fat volume primarily reflects nutritional status in patients with NSCLC, whereas radiological density may provide additional information regarding systemic inflammation. Quantitative CT assessment of orbital fat represents a promising noninvasive imaging biomarker of metabolic and inflammatory alterations in this patient population.

Keywords: non-small cell lung cancer; orbital fat; computed tomography; body mass index; systemic inflammation.

Introduction

Body composition assessment has emerged as a promising tool for risk stratification in patients with non-small cell lung cancer (NSCLC), as the characteristics of adipose and skeletal muscle tissues reflect not only nutritional status but also systemic metabolic and inflammatory alterations (Jo et al., 2022; Al-Sawaf et al., 2023).

Adipose tissue is currently recognized not merely as an energy storage depot but also as an active endocrine and immunometabolic organ capable of modulating systemic inflammatory responses through the production of adipokines, cytokines, and other bioactive molecules (Fisk et al., 2022; Wang et al., 2025). Previous studies have demonstrated that both adipose tissue distribution and its morphological characteristics are associated with circulating inflammatory biomarkers, while alterations in adipose depots may reflect systemic pathological processes long before the onset of overt clinical manifestations (González-Gil et al., 2024).

Orbital fat represents a specialized subtype of white adipose tissue characterized by unique anatomical, metabolic, and molecular features (Zhang et al., 2023). Nevertheless, accumulating evidence suggests that orbital fat remains responsive to systemic metabolic alterations and may undergo adipogenesis, adipocyte hypertrophy, and inflammatory remodeling in response to physiological and pathological stimuli (Kim et al., 2021; Cheng et al., 2025). In particular, several studies have reported significant associations between obesity, body mass index (BMI), and increased orbital fat volume (Kuo et al., 2025; Solmaz & Ertan, 2025).

Advances in medical imaging have enabled the noninvasive quantitative assessment of orbital fat. Computed tomography (CT) combined with contemporary segmentation techniques allows the evaluation of both orbital fat volume and radiological density, the latter potentially reflecting tissue microstructural alterations and biological activity (Alkhadrawi et al., 2024; Xiong et al., 2024). More recently, radiomic and quantitative imaging approaches have gained increasing attention as valuable tools for characterizing orbital tissues, assessing disease-related changes, and predicting clinical outcomes (Zhang et al., 2024; Huang et al., 2025).

Of particular interest is the potential relationship between orbital fat characteristics and systemic inflammation. Complete blood count-derived inflammatory biomarkers, including the neutrophil-to-lymphocyte ratio (NLR), platelet-to-lymphocyte ratio (PLR), and systemic immune-inflammation index (SII), are widely used as indicators of systemic inflammatory status and have demonstrated prognostic significance across a variety of malignancies (Peng et al., 2025; Zhang et al., 2025). However, data regarding their association with orbital fat characteristics remain extremely limited.

Despite growing interest in the role of orbital fat in ophthalmology and endocrinology, its potential value as a marker of nutritional status and systemic inflammation in oncology patients remains poorly understood. In particular, it is unknown whether CT-derived quantitative parameters of orbital fat can reflect systemic inflammatory status independently of body mass index.

We hypothesized that quantitative orbital fat parameters, specifically orbital fat volume and radiological density, are associated with body mass index and systemic inflammatory markers in patients with metastatic non-small cell lung cancer.

Therefore, the objective of this study was to determine orbital fat volume and radiological density using computed tomography in patients with NSCLC and to evaluate their associations with indicators of nutritional status and systemic inflammation.

Materials and methods

Study design and bioethics approval. The study was conducted in accordance with the principles of the Declaration of Helsinki and was approved by the Bioethics Committee of the Educational and Scientific Medical Institute of Sumy State University (Protocol No. 5/04, dated April 20, 2026).

Patients and study design. This retrospective single-center study included patients with NSCLC who underwent treatment and follow-up at the Sumy Regional Clinical Oncology Center. Eligibility criteria comprised age ≥18 years, histologically confirmed NSCLC, stage IV disease, availability of head CT images of sufficient quality for orbital fat segmentation, and access to relevant clinical and laboratory data at the time of CT examination. Patients with stage I–III NSCLC, concurrent acute or chronic infectious diseases, or other conditions potentially affecting systemic inflammatory biomarkers were excluded from the analysis. According to the predefined inclusion and exclusion criteria, a total of 86 patients were enrolled in the study.

Assessment of orbital fat parameters. Quantitative assessment of orbital fat was performed on CT images using 3D Slicer software (version 5.8.1; Brigham and Women's Hospital, Boston, MA, USA). For each patient, semiautomated segmentation of retrobulbar fat from both orbits was conducted on axial CT images using the Segment Editor module, followed by manual contour refinement when necessary.

The region of interest included orbital adipose tissue located within the bony orbital boundaries. Non-adipose intraorbital structures were excluded from the segmented volume, including the globe, optic nerve, extraocular muscles, lacrimal gland, neurovascular structures, and other soft-tissue components of the orbit. Segmentation boundaries were reviewed and adjusted on consecutive slices with verification in all three orthogonal planes.

Following segmentation, a three-dimensional orbital fat mask was generated, from which total orbital fat volume (cm^3) and mean radiological density expressed in Hounsfield units (HU) were automatically calculated. For subsequent statistical analyses, the combined orbital fat volume of both orbits and the mean radiological density were used.

To investigate the associations between orbital fat parameters and clinicopathological characteristics, the patients were stratified according to the median values of total orbital fat volume (9.8 cm^3) and radiological density (−77 HU).

Clinical data collection and statistical analysis. Data regarding age, sex, histological subtype, smoking status, and body mass index (BMI) were obtained from patients' medical records. Systemic inflammatory markers were calculated using routine complete blood count results obtained as part of standard clinical evaluation. The inflammatory indices were calculated as follows: systemic inflammation response index (SIRI) = neutrophil count × monocyte count / lymphocyte count; systemic immune-inflammation index (SII) = platelet count × neutrophil count / lymphocyte count; neutrophil-to-lymphocyte ratio (NLR) = neutrophil count / lymphocyte count; platelet-to-lymphocyte ratio (PLR) = platelet count / lymphocyte count; lymphocyte-to-monocyte ratio (LMR) = lymphocyte count / monocyte count; and monocyte-to-lymphocyte ratio (MLR) = monocyte count / lymphocyte count.

Statistical analyses were performed using the Stata software, version 19.5 (StataCorp, College Station, TX, USA). Continuous variables were summarized as mean ± standard deviation (SD), whereas categorical variables were presented as frequencies and percentages. Associations between categorical variables were evaluated using Pearson's chi-square test. Correlations between continuous variables were assessed using Spearman's rank correlation coefficient. The independence of identified associations was further evaluated using multivariable linear regression analysis. A two-sided P-value <0.05 was considered statistically significant.

Results

Characteristics of the study cohort and orbital fat parameters. A total of 86 patients with NSCLC were included in the study. Quantitative assessment of orbital fat was performed on CT images through segmentation of retrobulbar adipose tissue, followed by calculation of total orbital fat volume and mean radiological density expressed in HU. A representative example of orbital fat segmentation is shown in Fig. 1.

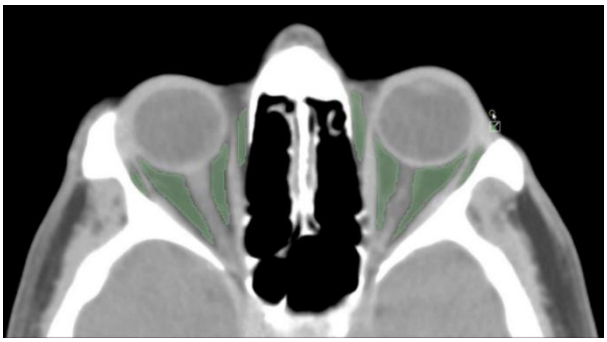

Fig. 1. Representative example of orbital fat segmentation on computed tomography images: retrobulbar adipose tissue of both orbits was segmented using semiautomated contouring in the 3D Slicer software, allowing calculation of total orbital fat volume and mean radiological density (HU)

Axial CT images were used to perform orbital fat segmentation by delineating the region of interest within the orbital cavity. The resulting segmentation masks were subsequently used to calculate total orbital fat volume and mean radiological density. A representative example of the segmentation procedure is presented in Figure 1.

The study cohort comprised 86 patients with non-small cell lung cancer. The mean age of the patients was 61.1 ± 8.0 years, and the mean BMI was 25.9 ± 5.3 kg/m^2. The mean orbital fat volume was 9.7 ± 1.4 cm^3, whereas the mean radiological density of orbital fat was −77.0 ± 6.9 HU.

Based on the median values of total orbital fat volume and radiological density, the patients were stratified into groups for subsequent analyses of associations with clinicopathological characteristics. Forty-seven and 39 patients were assigned to the groups with orbital fat volumes of <9.8 cm^3 and ≥9.8 cm^3, respectively. Regarding radiological density, 40 patients had values <−77 HU, whereas 46 patients had values ≥−77 HU. The characteristics of the study population according to orbital fat parameters are summarized in Table 1.

The analysis of factors associated with total orbital fat volume revealed significant differences with respect to BMI, SII, NLR, and PLR. The patients with larger orbital fat volumes (≥9.8 cm^3) were significantly more likely to be overweight or obese than the patients with lower orbital fat volumes (<9.8 cm^3, P = 0.001). Similarly, elevated SII values (≥1243) were more frequently observed in the patients with lower orbital fat volumes than in those with higher volumes (38.3% vs. 17.9%, P = 0.039).

In addition, high NLR values (≥3.7) were significantly more common among the patients with lower orbital fat volumes compared with those with higher volumes (46.8% vs. 23.1%, P = 0.022). The strongest association was observed for PLR. The proportion of the patients with PLR ≥196 was 51.1% in the lower-volume group compared with only 15.4% in the higher-volume group (P = 0.001). No significant associations were found between orbital fat volume and age (P = 0.433), sex (P = 0.209), histological subtype (P = 0.419), smoking status (P = 0.780), systemic inflammation response index (SIRI; P = 0.111), lymphocyte-to-monocyte ratio (LMR; P = 0.621), or monocyte-to-lymphocyte ratio (MLR; P = 0.733). The analysis of factors associated with orbital fat radiological density demonstrated significant relationships only with BMI and PLR. The patients with lower radiological density (≥−77 HU) were significantly more likely to be overweight or obese than those with higher density (<−77 HU, P = 0.001). In particular, obesity (BMI ≥30 kg/m^2) was observed in 43.5% of the patients with lower radiological density compared with 2.5% of the patients with higher density. Conversely, elevated PLR values (≥196) were significantly more frequent among the patients with higher orbital fat radiological density (<−77 HU) than among those with lower density (52.5% against 19.6%, P = 0.001). No significant associations were identified between orbital fat radiological density and age (P = 0.991), sex (P = 0.757), histological subtype (P = 0.545), smoking status (P = 0.883), SIRI (P = 0.514), SII (P = 0.108), NLR (P = 0.245), LMR (P = 0.487), or MLR (P = 0.730).

Table 1
Clinicopathological characteristics of the patients stratified according to orbital fat volume and radiological density (n = 86)

Variables	Total volume of orbital fat, sm³		P	Radiological density of orbital fat, HU		P
	<9.8, n = 47	≥9.8, n = 39		<–77, n = 40	≥–77, n = 46	
Age (years), n (%)						
m ± SD	60.6 ± 8.64	61.5 ± 7.22	0.433	60.3 ± 8.65	61.7 ± 7.41	0.991
<65 years	30 (63.8)	28 (71.8)		27 (67.5)	31 (67.4)	
≥65 years	17 (36.2)	11 (28.2)		13 (32.5)	15 (32.6)	
Sex, n (%)						
Male	36 (76.6)	34 (87.2)	0.209	32 (80.0)	38 (82.6)	0.757
Female	11 (23.4)	5 (12.8)		8 (20.0)	8 (17.4)	
Histology, n (%)						
Adenocarcinoma	20 (42.6)	20 (51.3)	0.419	20 (50.0)	20 (43.5)	0.545
Squamous cell carcinoma	27 (57.4)	19 (48.7)		20 (50.0)	26 (56.5)	
Smoking history, n (%)						
Non-smokers	12 (25.5)	11 (28.2)	0.780	11 (27.5)	12 (26.1)	0.883
Former or current smokers	35 (74.5)	28 (71.8)		29 (72.5)	34 (73.9)	
BMI, n (%)						
m ± SD	24.1 ± 4.45	27.9 ± 5.44		22.7 ± 2.94	28.6 ± 5.33	
<24.9	33 (70.2)	10 (25.6)	0.001	33 (82.5)	10 (21.7)	0.001
25≤IMT<29.9	8 (17.0)	14 (35.9)		6 (15.0)	16 (34.8)	
≥30.0	6 (12.8)	15 (38.5)		1 (2.5)	20 (43.5)	
SIRI, n (%)						
<2.3	30 (63.8)	31 (79.5)	0.111	27 (67.5)	34 (73.9)	0.514
≥2.3	17 (36.2)	8 (20.5)		13 (32.5)	12 (26.1)	
SII, n (%)						
<1243	29 (61.7)	32 (85.1)	0.039	25 (62.5)	36 (78.3)	0.108
≥1243	18 (38.3)	7 (17.9)		15 (37.5)	10 (21.7)	
NLR, n (%)						
<3.7	25 (53.2)	30 (76.9)	0.022	23 (57.5)	32 (69.6)	0.245
≥3.7	22 (46.8)	9 (23.1)		17 (42.5)	14 (30.4)	
PLR, n (%)						
<196	23 (48.9)	33 (84.6)	0.001	19 (47.5)	37 (80.4)	0.001
≥196	24 (51.1)	6 (15.4)		21 (52.5)	9 (19.6)	
LMR, n (%)						
<3.8	24 (51.1)	22 (56.4)	0.621	23 (57.5)	23 (50.0)	0.487
≥3.8	23 (48.9)	17 (43.6)		17 (42.5)	23 (50.0)	
MLR, n (%)						
<0.3	26 (55.3)	23 (59.0)	0.733	22 (55.0)	27 (58.7)	0.730
≥0.3	21 (44.7)	16 (41.0)		18 (45.0)	19 (41.3)	

Note: Associations between categorical variables were assessed using Pearson's chi-square test.

Overall, larger orbital fat volume was associated with higher BMI and a less pronounced systemic inflammatory profile, as reflected by lower SII, NLR, and PLR values. By contrast, lower orbital fat radiological density was significantly associated only with BMI and PLR.

Correlation analysis between orbital fat parameters and markers of nutritional status and systemic inflammation. Spearman correlation analysis demonstrated a significant positive association between orbital fat volume and body mass index (BMI) ($\rho = 0.561$, $P < 0.001$). Meanwhile, orbital fat volume showed significant inverse correlations with markers of systemic inflammation, including NLR ($\rho = -0.242$, $P = 0.025$), PLR ($\rho = -0.361$, $P < 0.001$), and SII ($\rho = -0.335$, $P = 0.002$).

Table 2
Correlation analysis between orbital fat parameters and markers of nutritional status and systemic inflammation in the patients with non-small cell lung cancer (n = 86)

Parameters	Total volume of orbital fat (ρ)	P	Radiological density of orbital fat (ρ)	P
BMI	0.561	<0.001	0.689	<0.001
NLR	–0.242	0.025	–0.201	0.064
PLR	–0.361	<0.001	–0.412	<0.001
SII	–0.335	0.002	–0.220	0.042

Note: ρ – Spearman's rank correlation coefficient; BMI – body mass index; NLR – neutrophil-to-lymphocyte ratio; PLR – platelet-to-lymphocyte ratio; SII – systemic immune-inflammation index.

Similar patterns were observed for orbital fat radiological density. Radiological density was significantly correlated with BMI ($\rho = 0.689$, $P < 0.001$) and demonstrated inverse correlations with PLR ($\rho = -0.412$, $P < 0.001$) and SII ($\rho = -0.220$, $P = 0.042$). No statistically significant correlation was found between orbital fat radiological density and NLR ($\rho = -0.201$, $P = 0.064$).

Multivariable regression analysis of orbital fat parameters. To evaluate whether the observed associations between orbital fat parameters and systemic inflammatory markers were independent of nutritional status, multivariable linear regression analyses were performed with body mass index (BMI) included as a potential confounding factor. Separate models were constructed for each inflammatory marker (PLR, SII, and NLR). The results of the multivariable analyses are presented in Table 3.

In the multivariable analyses, BMI remained an independent factor associated with both orbital fat volume and radiological density across all constructed models (all $P < 0.001$). By contrast, the associations between orbital fat volume and systemic inflammatory markers (NLR, PLR, and SII) lost statistical significance after adjustment for BMI. For orbital fat radiological density, an independent association remained significant only for PLR ($\beta = -0.013$, $P = 0.007$), whereas the associations with NLR and SII did not reach statistical significance.

Taken together, these findings suggest that orbital fat volume primarily reflects the nutritional status of patients, whereas its radiological density may provide additional information regarding systemic inflammation beyond that captured by BMI alone.

Discussion

In the present study, we performed the first comprehensive evaluation of the relationships between quantitative orbital fat parameters and nutritional status and systemic inflammatory markers in patients with non-small cell lung cancer. The findings demonstrated that both total orbital fat volume and its radiological density were significantly associated with BMI. In addition, greater orbital fat volume was associated with lower NLR, PLR, and SII values; however, these associations lost statistical significance after adjustment for BMI. By contrast, for orbital

fat radiological density, an independent association remained significant only for PLR. Collectively, these findings suggest that orbital fat volume primarily reflects the nutritional status of patients, whereas radiological density may provide additional information regarding systemic inflammation.

Table 3
Multivariable linear regression analysis of associations between orbital fat parameters, body mass index, and systemic inflammatory markers (n = 86)

Model	Independent variable	β	Standard error	95% CI Lower Bound	95% CI Upper Bound	P
Total volume of orbital fat						
IMT +	IMT	0.136	0.026	0.084	0.188	<0.001
PLR	PLR	–0.001	0.001	–0.004	0.001	0.219
IMT +	IMT	0.139	0.026	0.088	0.190	<0.001
SII	SII	–0.0001	0.0001	–0.0003	0.0001	0.288
IMT +	IMT	0.145	0.025	0.096	0.193	<0.001
NLR	NLR	–0.032	0.041	–0.114	0.050	0.440
Radiological density of orbital fat						
IMT +	IMT	0.750	0.114	0.523	0.976	<0.001
PLR	PLR	–0.013	0.005	–0.022	–0.004	0.007
IMT +	IMT	0.807	0.114	0.580	1.033	<0.001
SII	SII	–0.0009	0.0005	–0.0019	0.0001	0.074
IMT +	IMT	0.830	0.109	0.614	1.047	<0.001
NLR	NLR	–0.350	0.183	–0.715	0.015	0.060

Note: β – regression coefficient; CI – confidence interval; BMI – body mass index; NLR – neutrophil-to-lymphocyte ratio; PLR – platelet-to-lymphocyte ratio; SII – systemic immune-inflammation index.

In recent years, orbital fat has attracted increasing attention as a distinct anatomical and functional adipose tissue compartment. Traditionally, it was regarded primarily as a mechanical structure providing support and cushioning for the globe and other intraorbital contents. However, accumulating evidence indicates that orbital fat possesses unique metabolic and transcriptomic characteristics that distinguish it from both subcutaneous and visceral adipose tissue (Kim et al., 2021; Zhang et al., 2023). In particular, Zhang et al. (2023) demonstrated substantial differences in lipidomic composition between orbital and subcutaneous fat, supporting the concept that orbital adipose tissue represents a biologically distinct fat depot. Furthermore, Cheng et al. (2025) proposed orbital fat as a useful model for investigating adipocyte hypertrophy and hyperplasia during expansion of white adipose tissue.

The strong positive correlations observed in our study between BMI and orbital fat volume ($\rho = 0.561$, $P < 0.001$), as well as between BMI and orbital fat radiological density ($\rho = 0.689$, $P < 0.001$), are consistent with previous reports. In a study of 100 patients undergoing lower eyelid blepharoplasty, Solmaz & Ertan (2025) demonstrated a significant increase in orbital fat volume with increasing BMI, with a highly significant association between these parameters ($P < 0.001$). Similar findings were reported by Kuo et al. (2025) in patients with thyroid eye disease, where obesity was independently associated with orbital fat expansion. Earlier, Erkoç et al. (2015) analyzed magnetic resonance imaging data from 109 individuals and found that orbital fat volume correlated with anthropometric characteristics, including body weight and BMI. Taken together, these observations support the concept that orbital fat participates in systemic fat accumulation processes in a manner similar to other adipose tissue depots.

Particular interest arises from the findings regarding systemic inflammation. In the univariable analysis, a greater volume of orbital adipose tissue was associated with lower NLR, PLR, and SII values. At first glance, this observation may appear paradoxical, as obesity is traditionally regarded as a state of chronic low-grade inflammation (Fisk et al., 2022; Wang et al., 2025). However, the specific characteristics of the study population should be taken into account. Unlike the general population, loss of adipose tissue in patients with NSCLC is frequently a manifestation of cancer cachexia, a condition characterized by systemic inflammatory activation and enhanced catabolic processes (Vagnildhaug et al., 2025). In this context, a smaller volume of orbital adipose tissue may reflect not the absence of obesity, but rather more pronounced nutritional depletion and systemic inflammation.

This assumption is further supported by the results of the multivariable analysis. After adjustment for BMI, the associations between volume of orbital adipose tissue and all investigated inflammatory markers lost statistical significance. These findings suggest that the observed relationships were largely mediated by patients' nutritional status. Such results are consistent with current evidence highlighting the close interplay between body composition, systemic inflammation, and clinical outcomes in NSCLC (Huang et al., 2026; Sankar et al., 2026).

In contrast to orbital adipose tissue volume, radiological density demonstrated somewhat different patterns of association. Although most relationships with inflammatory markers also lost significance after adjustment for BMI, the association with PLR remained independent. This observation deserves particular attention. Radiological density of adipose tissue may reflect not only the quantity of fat but also its microstructural characteristics, including adipocyte size, extracellular fluid content, degree of fibrosis, and cellular infiltration (Landau et al., 2024). Studies of orbital diseases have shown that alterations in orbital fat density may accompany inflammatory processes and reflect pathological tissue remodeling (Dadson et al., 2025).

Our findings suggest that radiological density may capture biologically relevant changes within orbital adipose tissue more sensitively than its absolute volume. Similar observations have been reported for other adipose tissue depots. For example, CT attenuation characteristics of visceral adipose tissue have frequently shown stronger associations with inflammatory and metabolic abnormalities than total fat volume alone (Ma et al., 2024; Moskalenko et al., 2025). These results suggest that analogous mechanisms may also operate within orbital adipose tissue.

The potential of quantitative assessment of orbital adipose tissue as a novel source of imaging biomarkers also warrants consideration. Advances in segmentation techniques and radiomics have enabled detailed evaluation of orbital structures using routinely acquired CT examinations (Li et al., 2022; Abbas et al., 2026). Recently, Alkhadrawi et al. (2024) developed a deep-learning-based algorithm for automated segmentation of orbital fat and extraocular muscles, demonstrating high accuracy for quantitative analysis. Similarly, Zhang et al. (2024) reported that orbital radiomic features could be used to predict treatment response in thyroid eye disease. Huang et al. (2025) further demonstrated the diagnostic utility of radiomic signatures for differentiating benign from malignant orbital lesions. In this context, our findings may represent one of the first steps toward the use of quantitative characteristics of orbital adipose tissue as potential imaging biomarkers of the systemic condition of cancer patients.

Several limitations of the present study should be acknowledged. First, the retrospective single-center design may limit the generalizability of the findings. Second, the relatively small sample size (86 patients) may have reduced the statistical power to detect weaker associations. Third, assessment of systemic inflammation was based exclusively on complete blood-count-derived inflammatory indices, whereas circulating biomarkers such as C-reactive protein, interleukin-6, and other cytokines were not evaluated. Fourth, other body composition parameters, including skeletal muscle area and visceral adipose tissue, were not assessed, which might have provided a more comprehensive understanding of the relationships between orbital fat, nutritional status, and systemic inflammation. Finally, the absence of histological or molecular characterization of orbital adipose tissue precludes direct explanation of the mechanisms underlying the observed changes in radiological density.

Conclusions

In the patients with non-small cell lung cancer, CT-derived quantitative orbital adipose tissue parameters were significantly associated with body mass index. Greater orbital adipose tissue volume was associated with lower NLR, PLR, and SII values; however, these associations lost statistical significance after adjustment for body mass index, suggesting that they were largely driven by nutritional status.

By contrast, radiological density of orbital adipose tissue remained independently associated with PLR after adjustment for body mass index. These findings indicate that quantitative assessment of orbital adipose tissue may serve as a noninvasive imaging approach for evaluating metabolic and inflammatory alterations in patients with non-small cell lung cancer.

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The authors declare no conflict of interest.

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