World Journal of Surgical Oncology

RESEARCH

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Prognostic and clinicopathological value of fibrinogen-to-albumin ratio in non-small cell lung cancer: a meta-analysis

Ling Tong[1†], Hui Hu[2†], Jiashan Li[3] and Lihai Pan[2*]

Abstract

Background The fibrinogen-to-albumin ratio (FAR) has been explored for its role in predicting non-small cell lung cancer (NSCLC) prognosis, but findings remain inconsistent. This study aimed to determine the exact impact of FAR on predicting NSCLC prognosis through a meta-analysis.

Methods This study conducted a comprehensive search of PubMed, Web of Science, Embase, Cochrane Library, and CNKI up to April 2, 2025, and determined pooled hazard ratios (HRs) and 95% confidence intervals (CIs) to evaluate the prognostic value of FAR in NSCLC.

Results This meta-analysis included seven studies with a total of 2,655 cases. The pooled analysis revealed that an elevated FAR significantly predicted poor overall survival (OS) (HR = 1.82, 95% CI = 1.56–2.14, $p < 0.001$) and poor progression-free survival (PFS) (HR = 1.50, 95% CI = 1.29–1.74, $p < 0.001$) in patients with NSCLC, which was strongly associated with male sex (OR = 1.53, 95% CI = 1.12–2.08, $p = 0.008$) and tumor size ≥ 5 cm (OR = 1.52, 95% CI = 1.08–2.14, $p = 0.017$). However, FAR showed no significant correlation with smoking history (OR = 1.44, 95% CI = 0.80–2.59, $p = 0.218$) or Eastern Cooperative Oncology Group performance status (OR = 1.60, 95% CI = 0.74–3.45, $p = 0.230$).

Conclusion This meta-analysis suggests that elevated FAR is a strong predictor of OS and PFS in patients with Chinese NSCLC and correlates with larger tumor size.

Keywords Fibrinogen-to-albumin ratio, Meta-analysis, Non-small cell lung cancer, Prognosis, Evidence-based medicine

Introduction

Lung cancer is a prevalent malignant tumor and a leading cause of cancer-related deaths worldwide [1]. In 2022, an estimated 2,480,301 new lung cancer cases were diagnosed, with 1,817,172 lung cancer-related deaths globally [2]. Non-small cell lung cancer (NSCLC) accounts for approximately 85% of all lung cancer cases [3]. Despite significant advancements in multidisciplinary treatments, including surgery, radiotherapy, immunotherapy, and chemotherapy, the prognosis for patients with NSCLC remains poor [4]. The 5-year survival rate for NSCLC is approximately 17.4%, whereas for metastatic NSCLC, it

†Ling Tong and Hui Hu contributed equally to this work.

*Correspondence:
Lihai Pan
Panlihai1110@163.com
[1]Operating Room, Huzhou Central Hospital, Affiliated Central Hospital of Huzhou University, Huzhou 313000, Zhejiang, China
[2]Department of Cardiology, Huzhou Central Hospital, Affiliated Central Hospital of Huzhou University, Huzhou 313000, Zhejiang, China
[3]Clinical Laboratory, Huzhou Central Hospital, Affiliated Central Hospital of Huzhou University, Huzhou 313000, Zhejiang, China

is significantly lower, dropping to approximately 4% [5]. This poor prognosis may be linked to the lack of effective prognostic biomarkers for NSCLC [6]. Therefore, identifying novel and reliable prognostic biomarkers related to NSCLC is crucial to improving survival outcomes.

Recently, the relationship between serum markers and cancer progression or prognosis has gained significant attention [7–10]. Blood-based parameters, such as albumin-to-globulin ratio [7], lymphocyte-to-monocyte ratio (LMR) [11], systemic immune-inflammation index [12], prognostic nutritional index (PNI) [10], and the fibrinogen-to-albumin ratio (FAR) [13], have been widely recognized for their significant prognostic value across various cancer types. FAR is calculated as the ratio of fibrinogen to albumin (FAR = fibrinogen/albumin). Previous studies have demonstrated a strong correlation between FAR and the prognosis of various cancers, including laryngeal cancer [14], diffuse large B-cell lymphoma [15], colorectal cancer [16], pancreatic cancer [17], and osteosarcoma [18]. Although FAR has been extensively explored for its prognostic value in NSCLC, findings remain inconsistent [19–25]. For example, some studies suggest that an elevated FAR significantly predicts poor NSCLC prognosis [19, 20, 23–25], whereas others report no clear association [22]. To address these discrepancies, we collected the most recent data to conduct this analysis and assess the precise role of FAR in predicting NSCLC survival.

Materials and methods

Study guideline

This study was conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (Supplymental file 1) [26]. This meta-analysis was registered in INPLASY (ID: INPLASY202540010). The link of this protocol is available at https://inplasy.com/inplasy-2025-4-0010/.

Literature search

A comprehensive search of PubMed, Web of Science, Embase, Cochrane Library, and CNKI was performed up to April 2, 2025, using the following search strategies: (fibrinogen-to-albumin OR fibrinogen/albumin OR albumin-to-fibrinogen OR albumin/fibrinogen) AND (lung cancer OR lung carcinoma OR lung tumor OR lung neoplasm OR lung adenocarcinoma). The detailed search strategies for each database were provided in Supplymental file 2. No language restrictions were applied, and additional studies were identified by manually screening the reference lists of eligible publications for potentially relevant studies.

Inclusion and exclusion criteria

The following studies were included: (1) studies in which NSCLC was diagnosed based on pathological confirmation; (2) studies that investigated the correlation between FAR and NSCLC prognosis; (3) those with derivable hazard ratios (HRs) with 95% confidence intervals (CIs); (4) those with defined threshold for classifying low and high FAR; and (5) studies with no language restriction. The following studies were excluded: (1) reviews, case reports, conference abstracts, letters, and comments; (2) studies that involved patients with immune-related diseases, such as infections or autoimmune disorders; (3) studies that included duplicate cases; and (4) animal studies.

Data extraction and quality assessment

Two independent reviewers (L.T. and H.H.) collected data from eligible studies, and any disagreements were resolved through discussion with a third reviewer (J.L.). The extracted data included the first author, publication year, country, sample size, gender, age, study duration, study design, TNM stage, treatment, FAR threshold, method of threshold determination, survival outcomes, follow-up period, type of survival analysis, and HRs with 95% CIs. Overall survival (OS) was the primary outcome, while progression-free survival (PFS) was the secondary outcome. Study quality was assessed using the Newcastle–Ottawa Scale (NOS) for cohort studies [27]. The NOS scores range from 0 to 9, with a score ≥ 6 indicating high-quality studies.

Statistical analysis

We calculated HRs with 95% CIs to evaluate the prognostic value of FAR in NSCLC. Heterogeneity among studies was assessed using the I^2 statistics and Q test. When substantial heterogeneity was found ($I^2 > 50\%$ and $p < 0.10$), a random-effects model was applied; otherwise, a fixed-effects model was adopted. Subgroup analyses were performed to investigate FAR's prognostic value across different NSCLC populations. Meta-regression was performed to detect the source of heterogeneity. A sensitivity analysis was conducted to identify sources of heterogeneity and evaluate the robustness of the results. The association between FAR and NSCLC clinicopathological factors was examined by pooling odds ratios (ORs) with 95% CIs. Publication bias was assessed using Begg's and Egger's tests. All statistical analyses were conducted using Stata software version 12.0 (Stata Corp, College Station, TX, USA), with $p < 0.05$ considered statistically significant.

Results

Study retrieval process

Through an initial search, a total of 71 articles were identified, with 56 retained after removing duplicates (Fig. 1). Following a review of titles and abstracts, 46 records were further excluded due to irrelevance. Consequently, the

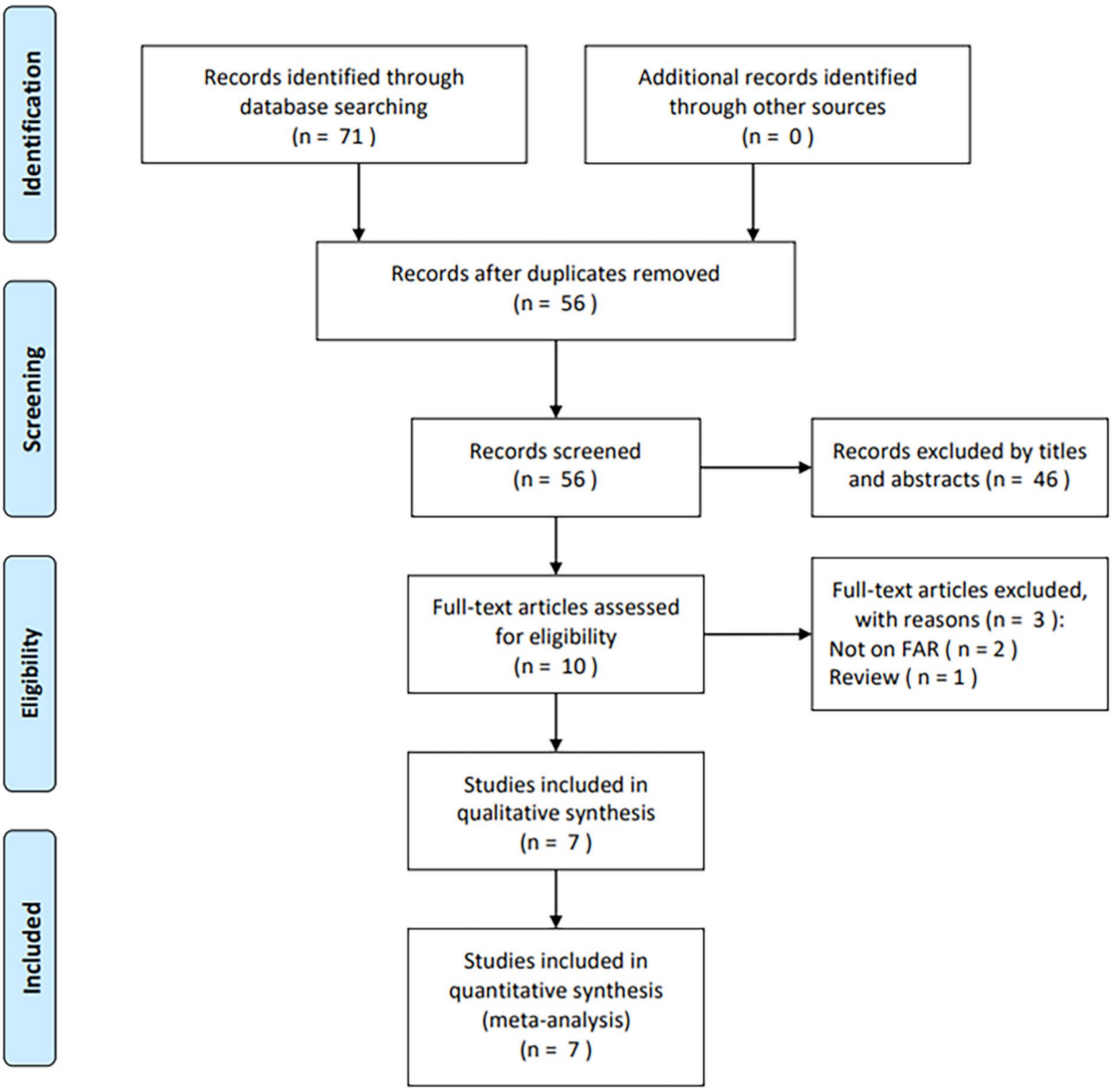

Fig. 1 PRISMA flow diagram of the literature retrieval and selection for this study

full-texts of 10 articles were evaluated, with three being excluded for not focusing on FAR ($n = 2$) and one for being a review ($n = 1$). Ultimately, seven articles comprising 2,655 cases were included in the final analysis [19–25] (Fig. 1).

Characteristics of included studies

Table 1 presents the characteristics of the included studies. The publication year ranged from 2018 to 2024, with all studies conducted in China [19–25]. The median sample size was 270 (range: 91–899). All included studies were retrospective in design, with six published in English [19–23, 25] and one in Chinese [24]. Among them, six were single-center studies [19, 21–25], while one was a multicenter study [20]. Regarding NSCLC stages, three studies included patients with stage III-IV disease [21, 23, 24], two focused on stage I-III cases [19, 25], while two covered stage I-IV cases [20, 22]. The median FAR threshold was 0.119 (range: 0.079–0.145). Therefore, we selected 0.120 to identify low/high FAR in subgroup analysis of this meta-analysis. Six studies determined the threshold using receiver operating characteristic curve analysis [19, 21–25], while one used X-tile software [20]. All seven articles reported the correlation between FAR and OS [19–25], while five studies assessed the relationship with PFS [19, 21–24]. HRs with 95% CIs were

Table 1 Basic characteristics of included studies in this meta-analysis

Study	Year	Country	Sample size	Age (year) Median(range)	Gender (M/F)	Study period	Study center	TNM stage	Treatment	Cut-off value	Cut-off value determination	Timing of FAR measurement	Survival endpoint	Follow-up (month) Median(range)	Survival analysis	NOS score
Chen, S.	2018	China	529	62(28–82)	312/217	2010–2015	Single center	I-III	Surgical resection	0.103	ROC curve	1 month before surgery	OS, PFS	35.0(1-78.5)	Multivariate	8
Li, S. Q.	2018	China	412	60.3	317/95	2005–2014	Multi-center	I-IV	Mixed	0.128	X-tile	7 days prior to treatment	OS	1–36	Multivariate	9
Ying, J.	2019	China	270	59.4	173/97	2011–2015	Single center	III-IV	Chemo-therapy	0.125	ROC curve	1 day prior to chemotherapy	OS, PFS	1–60	Multivariate	8
Zhao, X.	2020	China	194	60(28–88)	88/106	2016–2018	Single center	I-IV	Targeted therapy	0.08	ROC curve	7 days prior to treatment	OS, PFS	1–60	Multivariate	8
Yuan, C.	2022	China	91	61(32–80)	68/23	2019–2021	Single center	III-IV	Immuno-therapy+ chemo-therapy	0.145	ROC curve	Pretreatment	OS, PFS	1–25	Multivariate	7
Huang, Q.	2023	China	260	≤60y: 118 >60y: 142	192/68	2017–2021	Single center	III-IV	Chemo-therapy	0.119	ROC curve	7 days prior to treatment	OS, PFS	1–60	Univariate	8
Ma, S.	2024	China	899	61.4	413/486	2017–2021	Single center	I-III	Surgical resection	0.079	ROC curve	Pretreatment	OS	1–80	Univariate	8

M, male; F, female; OS, overall survival; PFS, progression-free survival; ROC, receiver operating characteristic; TNM, tumor-node-metastasis;

NOS, Newcastle-Ottawa Scale

obtained through multivariate regression in five studies [19–23] and univariate regression in two studies [24, 25]. All included studies had NOS scores between 7 and 9, indicating high quality (Table 1).

FAR and OS

Seven studies involving 2,655 patients [19–25] evaluated the prognostic value of FAR in predicting OS for NSCLC. Given the low heterogeneity ($I^2 = 36.2\%$, $p = 0.152$; Table 2), a fixed-effects model was applied. The pooled analysis demonstrated that a high FAR was significantly associated with poor OS in NSCLC (HR = 1.82, 95% CI = 1.56–2.14, $p < 0.001$) (Table 2; Fig. 2). These results suggested that NSCLC patients with high FAR (> 0.120) have an 82% increased risk of death compared those with low FAR levels. Subgroup analyses further confirmed that FAR remained a significant predictor of OS regardless of sample size, study center, TNM stage, treatment, threshold, threshold determination method, or survival analysis type ($p < 0.05$; Table 2).

FAR and PFS

Five studies comprising 1,344 patients [19, 21–24] examined the association between FAR and PFS in NSCLC. A fixed-effects model was used due to insignificant heterogeneity ($I^2 = 37.5\%$, $p = 0.171$; Table 3). The pooled findings (HR = 1.50, 95% CI = 1.29–1.74, $p < 0.001$) indicated a significant correlation between elevated FAR and poorer PFS in NSCLC (Fig. 3; Table 3). These results suggested that NSCLC patients with high FAR (> 0.120) have an 50% increased risk of disease progression compared those with low FAR levels. Subgroup analyses further confirmed that FAR remained a significant predictor of shorter PFS regardless of sample size, TNM stage, treatment, threshold, or survival analysis type ($p < 0.05$; Table 3).

Correlation between FAR and clinicopathological characteristics

Three studies involving 724 patients [21, 22, 24] explored the relationship between FAR and clinicopathological factors in NSCLC. The pooled analysis revealed that higher FAR significantly correlated with male sex (OR = 1.53, 95% CI = 1.12–2.08, $p = 0.008$) and tumor size ≥ 5 cm (OR = 1.52, 95% CI = 1.08–2.14, $p = 0.017$) (Fig. 4; Table 4). However, no significant relationship was observed with smoking history (OR = 1.44, 95% CI = 0.80–2.59, $p = 0.218$) and Eastern Cooperative Oncology Group performance status (OR = 1.60, 95% CI = 0.74–3.45, $p = 0.230$) in NSCLC (Fig. 4; Table 4).

Table 2 Subgroup analysis of the prognostic value of FAR for OS in patients with NSCLC

Subgroups	No. of studies	No. of patients	Effects model	HR (95%CI)	*p*	Heterogeneity I^2(%) Ph		Meta-regression *p*-value
Total	7	2655	Fixed	1.82(1.56–2.14)	< 0.001	36.2	0.152	
Sample size								0.357
< 270	3	545	Random	1.79(1.09–2.92)	0.021	66.1	0.053	
≥ 270	4	2110	Fixed	1.99(1.62–2.46)	< 0.001	0	0.591	
Study center								0.826
Single center	6	2243	Fixed	1.83(1.54–2.18)	< 0.001	48.6	0.094	
Multicenter	1	412	-	1.79(1.23–2.61)	0.002	-	-	
TNM stage								0.196
I-III	2	1428	Fixed	2.28(1.66–3.11)	< 0.001	0	0.414	
III-IV	3	621	Fixed	1.82(1.43–2.32)	< 0.001	48.4	0.144	
I-IV	2	606	Fixed	1.53(1.16–2.03)	0.003	31.9	0.226	
Treatment								0.604
Surgical resection	2	1428	Fixed	2.28(1.66–3.11)	< 0.001	0	0.414	
Chemotherapy	2	530	Fixed	1.72(1.34–2.20)	< 0.001	0	0.809	
Others	3	697	Random	1.87(1.09–3.18)	0.022	67.1	0.048	
Cut-off value								0.489
< 0.120	4	1882	Fixed	1.77(1.46–2.16)	< 0.001	47.6	0.126	
≥ 0.120	3	773	Fixed	1.92(1.46–2.52)	< 0.001	42.3	0.177	
Cut-off determination								0.501
ROC curve	6	2243	Fixed	1.83(1.54–2.18)	< 0.001	46.8	0.094	
X-tile	1	412	-	1.79(1.23–2.61)	0.002	-	-	
Survival analysis								0.287
Univariate	2	1496	Random	2.02(1.35–3.03)	0.001	60.1	0.113	
Multivariate	5	1159	Fixed	1.74(1.42–2.14)	< 0.001	37.8	0.169	

FAR, fibrinogen-to-albumin ratio; NSCLC, non-small cell lung cancer; OS, overall survival; ROC, receiver operating characteristic; TNM, tumor-node-metastasis

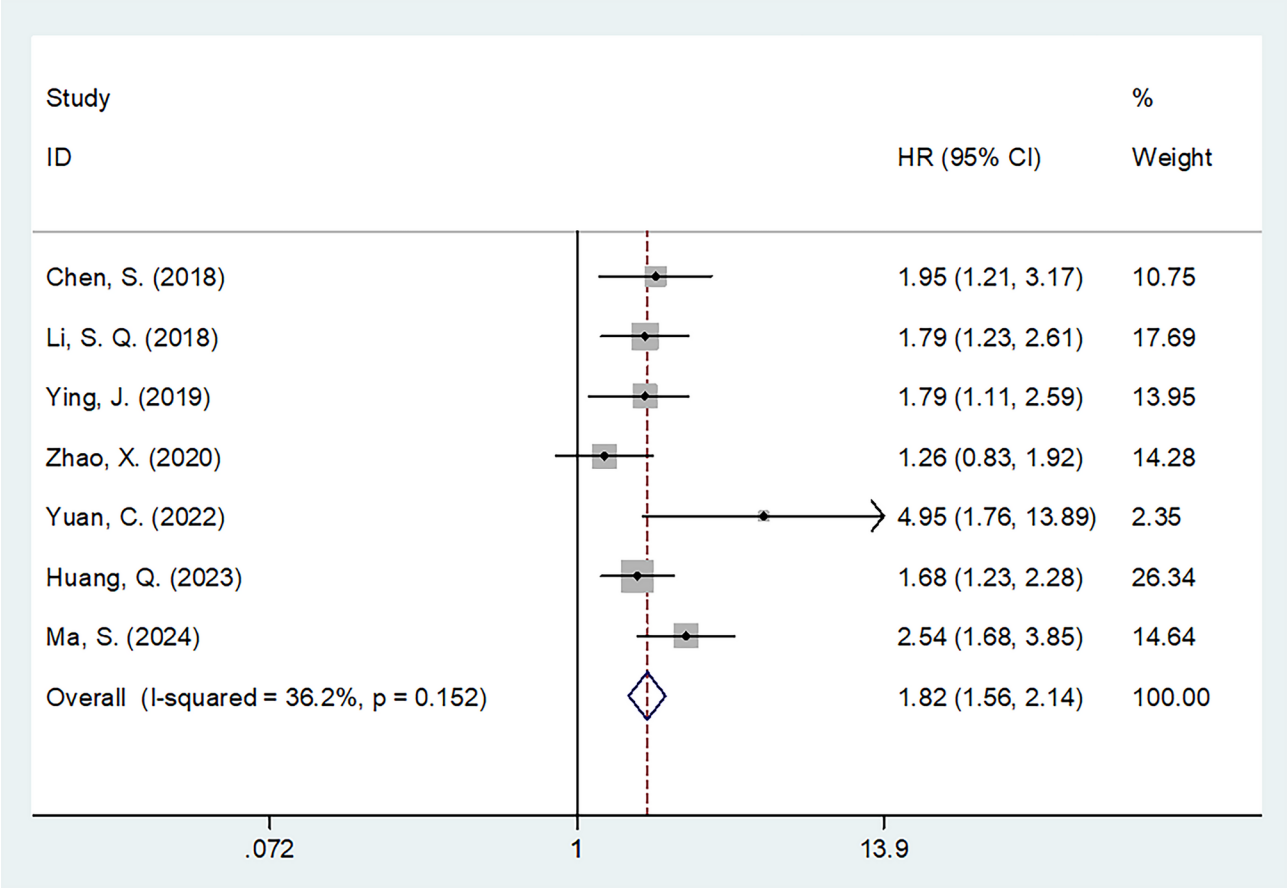

Fig. 2 Forest plots of the prognostic value of FAR for OS in patients with NSCLC

Table 3 Subgroup analysis of the prognostic value of FAR for PFS in patients with NSCLC

Subgroups	No. of studies	No. of patients	Effects model	HR (95%CI)	*p*	Heterogeneity I^2(%)	Ph	Meta-regression *p* value
Total	5	1344	Fixed	1.50(1.29–1.74)	< 0.001	37.5	0.171	
Sample size								0.752
< 270	3	545	Random	1.51(1.10–2.07)	0.010	51.3	0.129	
≥ 270	2	799	Fixed	1.79(1.36–2.35)	< 0.001	0	0.974	
TNM stage								0.306
I-III	1	529	-	1.78(1.27–2.50)	0.001	-	-	
III-IV	3	621	Random	1.65(1.11–2.40)	0.013	60.6	0.079	
I-IV	1	194	-	1.50(1.03–2.17)	0.034	-	-	
Treatment								0.833
Surgical resection	1	529	-	1.78(1.27–2.50)	0.001	-	-	
Chemotherapy	2	530	Fixed	1.35(1.12–1.64)	0.002	41.4	0.191	
Others	2	285	Random	1.85(1.07–3.20)	0.028	51.5	0.151	
Cut-off value								0.493
< 0.120	3	983	Fixed	1.42(1.21–1.67)	< 0.001	27.5	0.252	
≥ 0.120	2	361	Fixed	2.03(1.38-3.00)	< 0.001	0	0.356	
Survival analysis								0.278
Univariate	1	260	-	1.28(1.03–1.58)	0.023	-	-	
Multivariate	4	1084	Fixed	1.75(1.42–2.16)	< 0.001	0	0.549	

FAR, fibrinogen-to-albumin ratio; NSCLC, non-small cell lung cancer; PFS, progression-free survival; ROC, receiver operating characteristic; TNM, tumor-node-metastasis

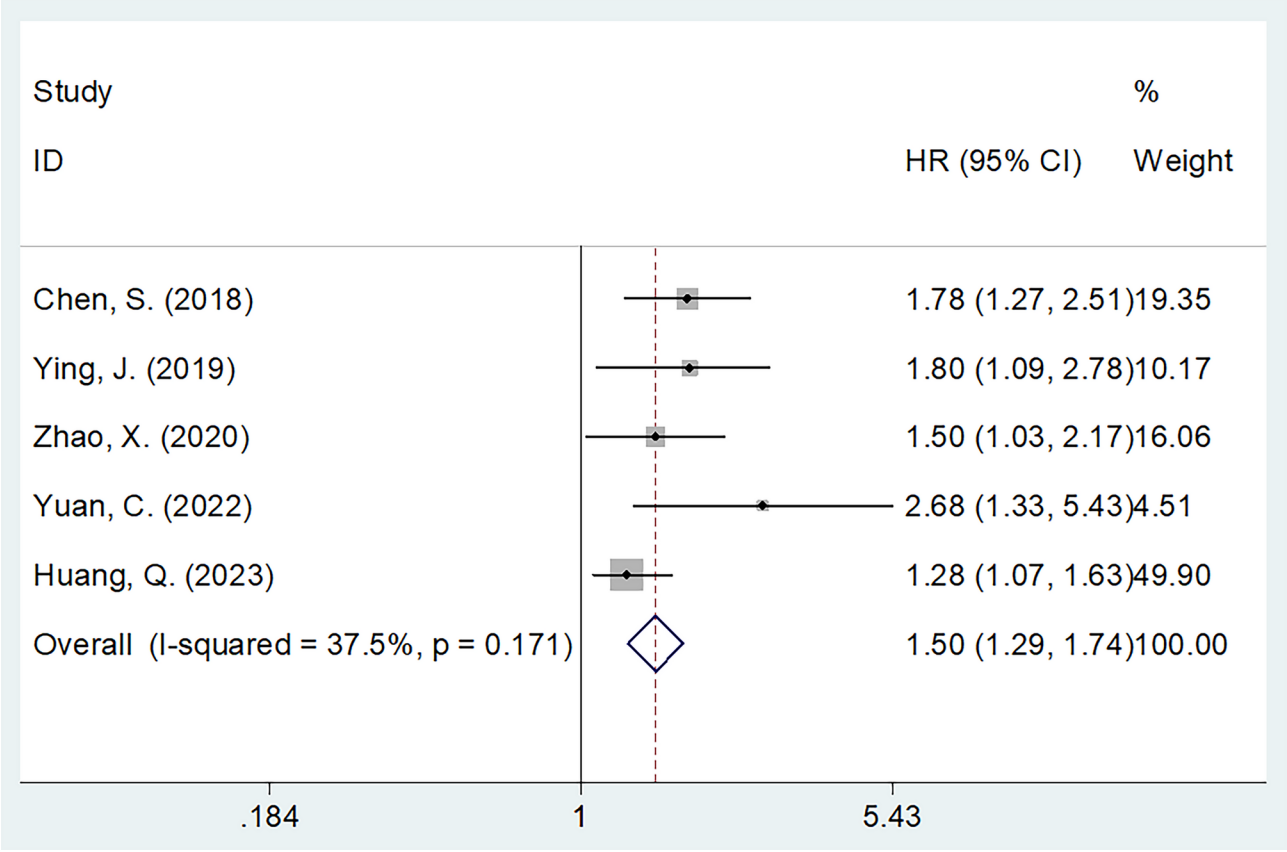

Fig. 3 Forest plots of the prognostic value of FAR for PFS in patients with NSCLC

Sensitivity analysis

A sensitivity analysis was performed by systematically removing each study one at a time. The HRs derived from the pooled results of the remaining studies in each analysis remained within the expected range, as shown in Fig. 5. These findings confirm the reliability of our meta-analysis for OS and PFS.

Publication bias

Begg's and Egger's tests were used to examine potential publication bias in this study. The results indicated no significant publication bias for OS ($p = 0.133$ and 0.140 in Begg's and Egger's tests, respectively) or PFS ($p = 0.221$ and 0.183 in Begg's and Egger's tests, respectively) (Fig. 6).

Discussion

FAR has been previously studied for its effectiveness in predicting NSCLC prognosis, but the findings have been inconsistent. This meta-analysis included data from seven studies involving 2,655 patients [19–25] to clarify this issue. Our results indicate that high FAR significantly correlates with shorter OS and worse PFS in NSCLC. Moreover, its prognostic value remained consistent across various subgroups of patients with NSCLC. This study also found a relationship between elevated FAR and larger tumor size. Publication bias and sensitivity analyses confirmed the reliability of our findings. Overall, FAR serves as a strong predictor of short- and long-time NSCLC prognosis. To the best of our knowledge, this meta-analysis is the first to investigate the prognostic value of FAR in NSCLC.

FAR is derived from fibrinogen and albumin levels, meaning that elevated FAR can result from increased fibrinogen and/or decreased albumin levels. Although the mechanisms underlying FAR's prognostic value in NSCLC are not fully understood, several explanations have been proposed. First, elevated plasma fibrinogen is often observed in conditions such as infectious diseases, rheumatic conditions, diabetes, thrombotic disorders, and malignancies [28]. Produced in the liver and released into the bloodstream, fibrinogen levels increase in response to tissue damage, infection, or inflammation [29]. Fibrinogen can inhibit macrophage movement and interfere with fibrinogen-leukocyte interactions by altering leukocyte integrin binding sites, thereby impairing the host's immune response against tumors [30]. Moreover, fibrinogen facilitates platelet adhesion to tumor cells, shielding them from natural killer cell attacks [31]. Beyond its role in acute-phase reactions and

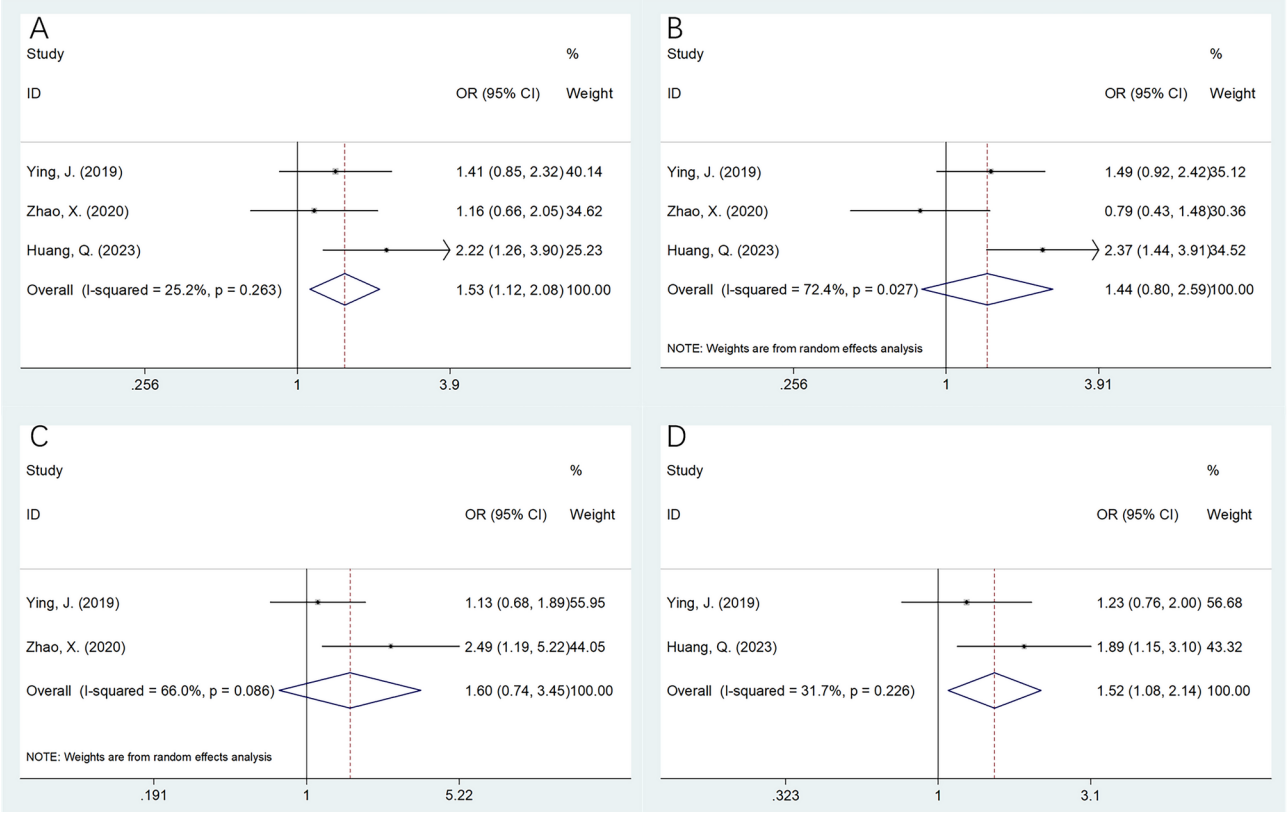

Fig. 4 The correlation between FAR and clinicopathological factors of NSCLC. (**A**) Gender (male vs. female); (**B**) Smoking history (yes vs. no); (**C**) ECOG PS (≥ 1 vs. 0); and (**D**) Tumor size (cm) (≥ 5 vs. < 5)

Table 4 The association between FAR and clinicopathological features in patients with NSCLC

Clinicopathological variables	No. of studies	No. of patients	Effects model	OR (95%CI)	*p*	Heterogeneity I2(%)	Ph
Gender (male vs. female)	3	724	Fixed	1.53(1.12–2.08)	0.008	25.2	0.263
Smoking history (yes vs. no)	3	724	Random	1.44(0.80–2.59)	0.218	72.4	0.027
ECOG PS (≥ 1 vs. 0)	2	464	Random	1.60(0.74–3.45)	0.230	66.0	0.086
Tumor size (cm) (≥ 5 vs. < 5)	2	530	Fixed	1.52(1.08–2.14)	0.017	31.7	0.226

FAR, fibrinogen-to-albumin ratio; NSCLC, non-small cell lung cancer; ECOG PS, Eastern Cooperative Oncology Group performance status

inflammation, fibrinogen also promotes tumor growth through epithelial-mesenchymal transition, angiogenesis, and cell proliferation [32, 33]. Furthermore, malnutrition is prevalent in individuals with cancer, and albumin is a key laboratory marker of nutritional status [34]. Serum albumin levels are influenced by numerous factors, including cytokines such as interleukin-6 and tumor necrosis factor-α. Additionally, conditions like ascites and liver cell damage can lead to hypoproteinemia [35]. Lower albumin levels may impair immune function, decreasing the body's ability to combat cancer cells, thereby aiding tumor growth [36]. Additionally, albumin deficiency is connected to a compromised immune response through macrophage activation [37]. Given these biological roles, FAR serves as a logical and meaningful prognostic marker based on fibrinogen and albumin levels.

Notably, all included studies were from China, although we did not restrict the region of eligible studies. This phenomenon can be explained as follows. First, based on the 2015 national cancer statistics from China's National Central Cancer Registry, approximately 733,300 Chinese individuals were newly diagnosed with lung cancer, and 610,200 died from the disease [38]. Therefore, about one-thirds of global NSCLC cases occur in China [2, 38]. Second, we searched the literature in any language. One study in Chinses was included and other six studies were published in English. Third, we searched the most recent literature up to April 2, 2025 and no additional eligible studies were identified.

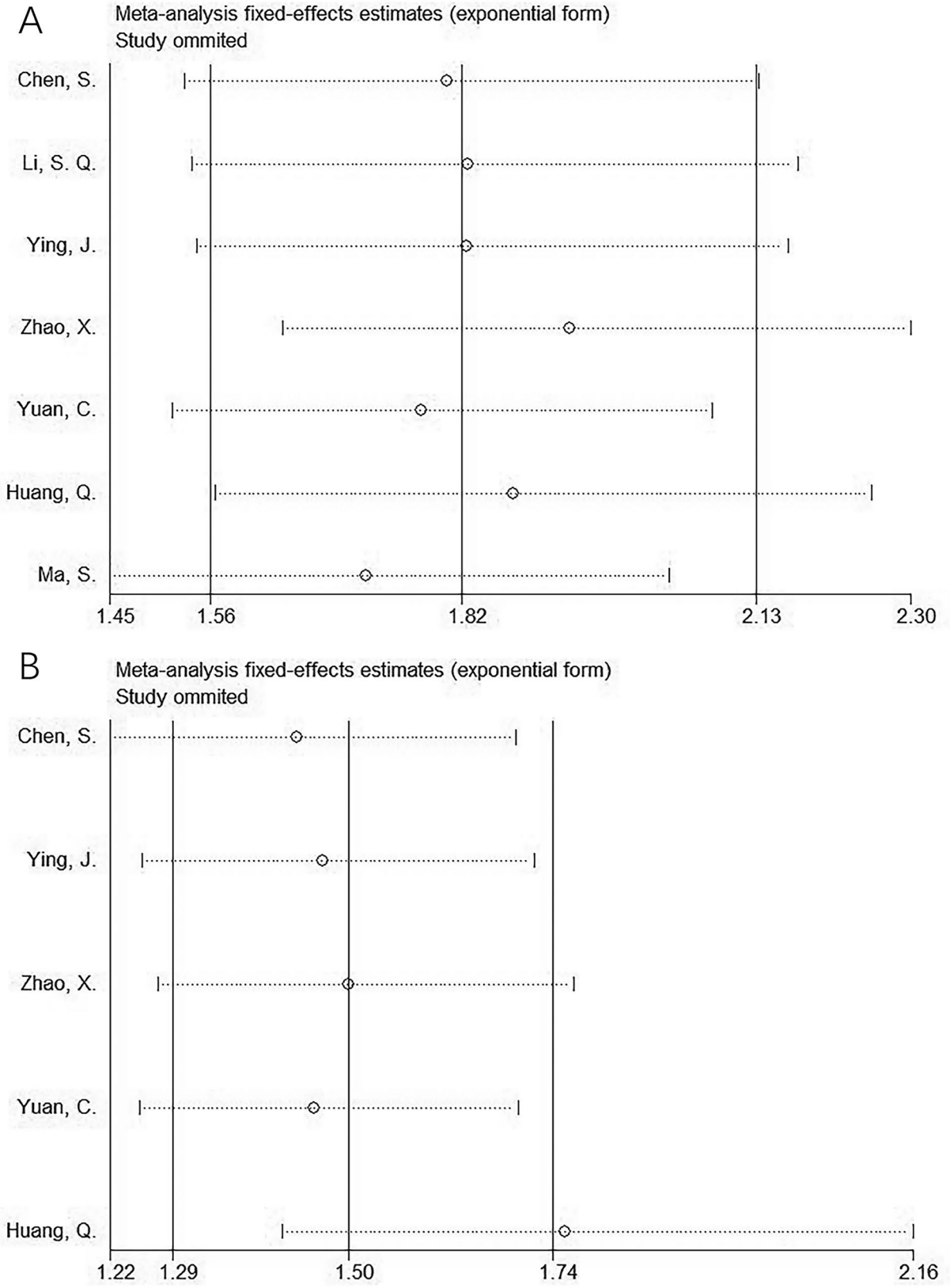

Fig. 5 Sensitivity analysis. (**A**) OS and (**B**) PFS

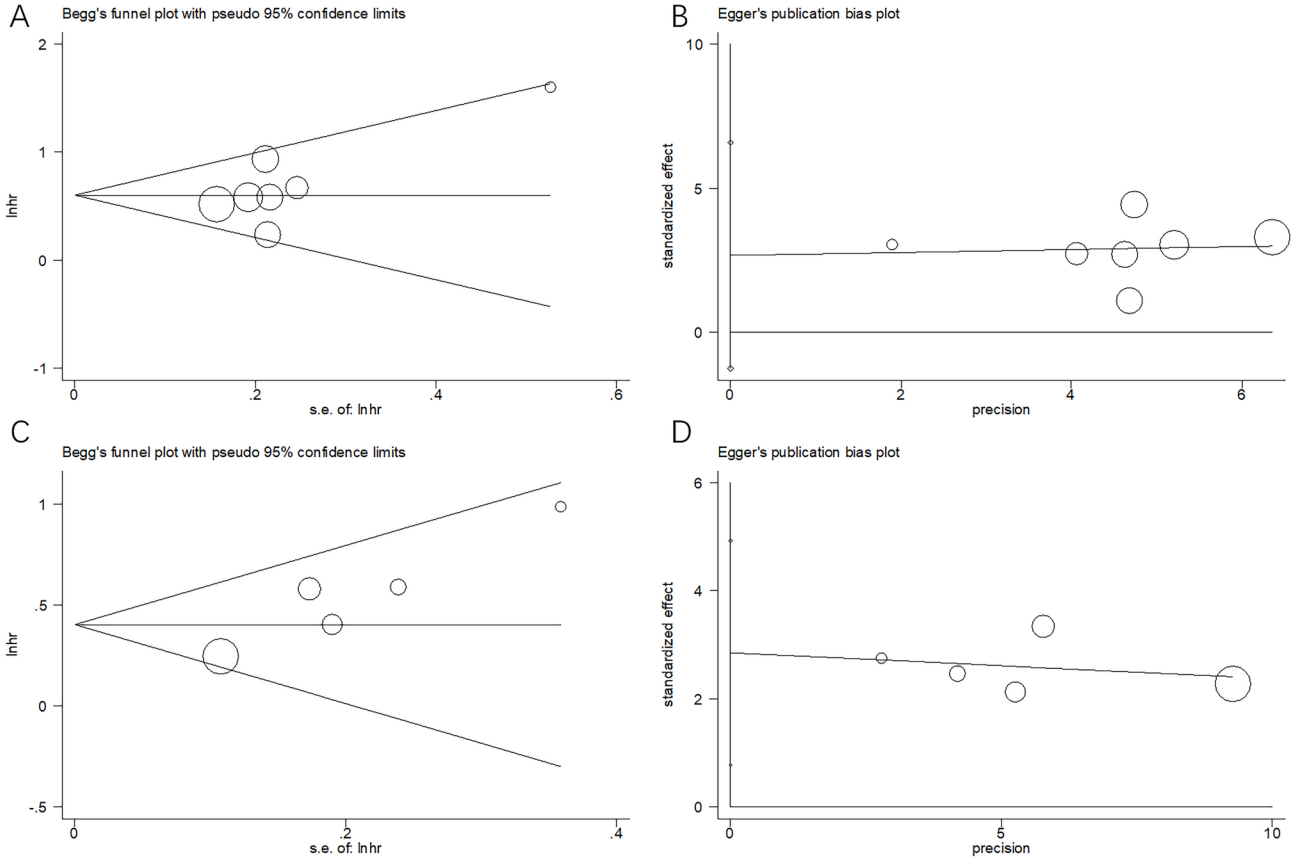

Fig. 6 Publication bias by Begg's test and Egger's test. (**A**) Begg's test for OS, $p=0.133$; (**B**) Egger's test for OS, $p=0.140$; (**C**) Begg's test for PFS, $p=0.221$; and (**D**) Egger's test for PFS, $p=0.183$

The treatment strategies are various among included studies. We conducted subgroup analysis based on treatment methods. The results indicated that FAR remained a significant prognostic marker for OS and PFS in spite of diverse treatment methods (Tables 2 and 3). The cut-off values of FAR are not uniform in included studies. The median FAR threshold was 0.119 (range: 0.079–0.145). Therefore, we selected 0.120 to identify low/high FAR in subgroup analysis of this meta-analysis. Subgroup analysis suggested that cut-off value did not affect the prognostic role of FAR for OS and PFS in NSCLC. We suggested a standard FAR cut-off value could be applied in future studies. Based on the results in this meta-analysis, we suggested the cut-off value as 0.120.

This meta-analysis showed that FAR was a significant prognostic marker for patients with NSCLC. Previous studies have demonstrated that some hematological indexes were also significant for NSCLC prognosis, such as neutrophil-to-lymphocyte ratio (NLR) [39], LMR [40], and PNI [41]. Compared with these established prognostic biomarkers, FAR has the following similarities and differences. Similarities: First, FAR is a blood-test derived biomarker and is easily available. Second, FAR is based on the nutritional and immunological status of patients. Differences: FAR is relatively easy to calculated, because it is based on just two values: fibrinogen and albumin.

Recent meta-analyses have highlighted the significant impact of FAR in predicting the prognosis of various cancers [42–45]. Wang et al., in a meta-analysis involving 4,094 patients, demonstrated a strong correlation between high FAR and unfavorable OS and disease-free survival (DFS) in breast cancer [42]. Li et al. revealed that elevated FAR correlated with poorer OS, recurrence-free survival, PFS, and DFS in malignant tumors through an analysis of 19 studies [43]. A more recent meta-analysis, including 7,282 cases, further confirmed that higher FAR was linked to an increased risk of cancer recurrence and mortality [44]. Additionally, Zhang et al. reported that high FAR was a significant predictor of unfavorable OS and DFS in human malignancies, as evidenced by a meta-analysis involving 5,088 patients [45]. Our findings are consistent with these reports on FAR in other cancer types.

This study has some limitations. First, all the included studies were conducted in China, despite no restrictions on the origin or language of eligible articles. Although we performed a comprehensive search of major electronic databases, our findings remain geographically restricted.

Second, all included studies was retrospective in design, which may introduce inherent heterogeneity. Third, the FAR threshold varied across the included studies, potentially leading to selection bias. Fourth, the sample size was relatively small, with only seven studies meeting the inclusion criteria despite our extensive literature search. Given these limitations, further large-scale multi-regional prospective studies are necessary to validate our findings.

Conclusions

This meta-analysis suggests that elevated FAR is a potent biomarker for predicting OS and PFS in Chinese patients with NSCLC and is associated with larger tumor size.

Abbreviations

FAR	Fibrinogen-to-albumin ratio
NSCLC	Non-small cell lung cancer
HR	Hazard ratio
CI	Confidence interval
OS	Overall survival
PFS	Progression-free survival
ECOG PS	Eastern Cooperative Oncology Group performance status
PNI	Prognostic nutritional index
PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analyses
NOS	Newcastle–Ottawa Scale
OR	Odds ratio
ROC	Receiver operating characteristic
DFS	Disease-free survival
RFS	Recurrence-free survival

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12957-025-03832-z.

Supplementary Material 1: The PRISMA checklist for this meta-analysis.

Supplementary Material 2: The detailed search strategies for each database.

Acknowledgements

None.

Author contributions

L.T. and H.H. designed the study. L.T., H.H., and J.L. prepared figures and tables, interpreted the data and wrote the main manuscript. H.H. and J.L. participated in the research of the study and performed the statistical analysis. L.T. and J.L. confirm the authenticity of the raw data. L.P. revised the manuscript. All authors have approved the final version of the manuscript.

Funding

This research received no external funding.

Data availability

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

Declarations

Ethics approval and consent to participate

Not applicable.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

Received: 8 January 2025 / Accepted: 1 May 2025
Published online: 16 May 2025

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