Body Mass Index and Serum Markers Associated with Progression Free Survival in Lung Cancer Patients Treated with Immune Checkpoint Inhibitors

Zhenzhen Liu
Cancer Hospital of China Medical University, Liaoning Cancer Institute and Hospital
Yuzhu Diao
Cancer Hospital of China Medical University, Liaoning Cancer Institute and Hospital
Xiaoling Li (xiaolingli001@163.com)
Cancer Hospital of China Medical University, Liaoning Cancer Institute and Hospital

Research Article

Keywords: lung cancer, clinical pathology, chi-squared test, BMI

Posted Date: November 8th, 2021

DOI: https://doi.org/10.21203/rs.3.rs-957218/v1

Abstract

Background: ICIs have remarkably affected the treatment strategies for numerous malignancies, including lung cancer. However, only a fraction of patients experiences durable responses to ICIs, thus there is an urgent need to identify the parameters related to ICIs therapeutic effect. In this study, we investigated nutritional status surrogates and several serum markers to estimate the efficacy of ICIs.

Materials and methods: The records of 66 patients with stage Ⅲ/Ⅳ lung cancer who received ICIs were retrospectively analyzed. Features of patients' clinical pathology, including age, sex, histology, line of treatment, BMI, serum albumin, serum creatinine, and serum inflammatory markers such as LMR and PLR, were examined. Progression-free survival was primary endpoints. Relationships among categorical variables were assessed by the chi-squared test. Survival analysis was performed using Kaplan–Meier method followed by log-rank test. Cox multivariate analysis was performed to analyze the association between each variable and the survival time of patients.

Results: The patients with BMI≥25(kg/m2)、serum ALB≥37(g/dL)、serum creatinine≥61.8(μmol/L), LMR≥2.12 had a significantly prolonged PFS in comparison with BMI＜25(kg/m2)、ALB＜37(g/dL)、creatinine＜61.8(μmol/L)、LMR＜2.12 ($p < 0.05$). No statistically significant difference was detected between patients with PLR＜135 and PLR≥135 (p=0.612).The multivariate analysis revealed that ALB≥37(g/dL) and creatinine≥61.8(μmol/L) were associated with prolonged PFS, while statistical significance was not achieved in BMI groups.

Conclusions: The current results indicated that high BMI is related to longer PFS in lung cancer patients treated with ICIs, which may be correlated with high levels of serum albumin and creatinine.

1. Introduction

Lung cancer is the world's leading cause of cancer morbidity and mortality [1]. Immune checkpoint inhibitors, such as anti-PD-1/PD-L1 antibodies, have remarkably affected the therapeutic strategies for a variety of malignancies, including lung cancer, could inhibit the tumor for a long time and even cure it [2,3]. However, only a fraction of patients experiences durable responses to ICIs, and there is an urgent need to identify the parameters related to ICIs therapeutic effect.

Up to now, for the response of checkpoint inhibitors, the most researched predictive biomarkers including tumor mutation burden, PD-1 expression, CD4/CD8 lymphocyte ratio, the percentage of tumor-infiltrating lymphocytes, and several methods of establishing immune scores [4,5,6].

Lately, a few demographic features of patients are being studied to appraise the influence on ICIs [7]. One of such feature, body mass index (BMI) or obesity, encountered a lot of attentions. In addition, serum markers, such as albumin, creatinine, lymphocyte-to-monocyte ratio (LMR), and platelet-to-lymphocyte ratio (PLR), can be easily assessed because they can be measured from routine clinical laboratory tests.

Historically, BMI is regarded as the major substitute for nutritional status, but its association with clinical outcomes of patients with advanced stage tumors remains indeterminacy [8,9,10,11]. A meta-analysis indicated that higher BMI level before treatment of ICIs was remarkably correlated with improvement in OS and PFS in tumor patients treated with ICIs, regardless of whether there were differences in the comparison models of BMI classifications [12]. However, one recent study showed that the 287 melanoma patients who received ICIs, BMI were not related to clinical benefit or toxicity [13].

Serum albumin (ALB) level is also often considered an indicator for patients' nutritional condition in clinical environment. Cachexia and sarcopenia are negative prognostic factors [14,15]. Creatinine is usually used as a surrogate marker for sarcopenia, thus we chose creatinine as a decisive variable. Using serum creatinine level as an indirect assessment of skeletal muscle mass is an easy alternative when kidney function is accounted for [16,17,18]. Patients' nutritional condition might be influenced with the tumor microenvironment. The occurrence and progression of tumor are strongly associated with inflammatory response, as inflammatory cells stimulate tumor cell multiplication, angiogensis promotion, favor tumor invasion, and even affect some anticancer drugs' efficacy [19].

In the retrospective research, we assessed the effect of BMI, ALB, serum creatinine and serum inflammatory markers such as LMR and PLR on survival outcomes in lung cancer patients receiving ICIs treatments.

2. Materials And Methods

2.1 Patients selection

The study was approved by the Ethics Committee of the Liaoning Cancer Institute and Hospital. A retrospective review of 66 patients with stage □/□ lung cancer between June 2018 and March 2021 in the Liaoning Cancer Hospital & Institute the first ward of thoracic oncology who received at least 1 dose of ICIs therapy. The staging of lung cancer was based on the seventh or eighth edition TNM stage classification. Features of patients' clinical pathology, including age, sex, histology, line of treatment, BMI (kg/m2), serum ALB (g/dL), serum creatinine (μmol/L), and serum inflammatory markers such as LMR and PLR, were examined. The above indicators were determined at the time of ICIs therapy initiation. BMI was calculated according to the formula of weight/height2 (kilograms per square meter) and classified base on the WHO categories. For the purpose of this study, we use BMI </≥ 25 as the binomial cut-off. All patients were divided into two groups, non-overweight(BMI<25) and overweight/obese (BMI≥ 25), for the final analysis. At the same time, we included underweight patients in the non-overweight group. Progression-free survival (PFS) were determined by investigator on the basis of review of electronic medical records, and defined as time of treatment start to progression. RECIST V.1.1 was used to define objective response.

2.2 Statistical analysis

Descriptive statistics or contingency tables were used to summarize the demographics and baseline characteristics of patients. The cutoff value for LMR was 2.12 based on previous studies [20], and the cutoff value for PLR was 135[21]. According to peripheral laboratory reference range, the binomial cut-off for Alb </≥ 37g/dL was used. The cutoff value for serum creatinine was 61.8μmol/L(approximately equal to 0.7mg/dl)[22]. Relationships among categorical variables were assessed by the chi-squared test. Survival analysis was performed by Kaplan–Meier method followed by log-rank test. Cox multivariate analysis was performed to analyze the association between each variable and the survival time of patients. $P < 0.05$ was considered statistically significant. All statistical analysis were carried out by SPSS v24.0 (SPSS, Inc.).

3. Results

3.1 Patient characteristics

66 patients with lung cancer were included in the research, and their clinical features were listed in Table 1. There were 19 women (28.8%) and 47 men (71.2%). There were 23 patients (34.8%) with age≥65 years and 43 patients(65.2%) with age□65 years. 52 patients (78.8%) were treated by anti-PD-1 agent, and 14 patients (21.2%) were treated by anti-PD-L1 agent. ICIs were administered as first-line treatment in 29 patients (43.9%) and second or higher treatment in 37 patients (56.1%). According to the classification of histology type, non-small cell was accounted for 77.3%, while small cell was accounted for 22.7%. For the study purpose, 44 patients (66.7%) were divided into non-overweight group and 22 patients (33.3%) in overweight/obese group. There were no significant differences between BMI, any serum marker group and age, sex, treatment line or immune checkpoint inhibitors type. However, a statistically significant difference was found between PLR and histology(p=0.013).

3.2 Association of high and low BMI with PFS time

In the study, all 66 patients were classified into non-overweight and overweight/obese groups based on the BMI cutoff value. Statistical analysis on the PFS time of patients was performed for different BMI groups. The mean PFS time of non-overweight and overweight/obese groups respectively were 3.81months (95%CI 2.606-5.019months) and 6.25months (95%CI 4.446-8.054months), and the difference was statistical significance(p=0.04) (Figure1).

3.3 Association of serum ALB with PFS time

Patients with baseline serum ALB≥37g/dL had a longer PFS than those with ALB□37g/dL(the mean PFS was 5.32 months [95%CI:4.120-6.519] vs. 1.85 months [95%CI: 0.675-3.017]), and we found the difference is significant (p□0.001).

3.4 Association of serum creatinine with PFS time

There were also differences in PFS in patients with baseline creatinine over 61.8μmol/L when compared with under 61.8μmol/L as Figure3 reveals. Mean PFS in the first group was 5.99months (95%CI: 4.181-7.806) vs. 3.51months (95%CI: 2.501-4.526), *p*=0.024.

3.5 Association of serum markers with PFS time

Patients with baseline LMR≥2.12 had a longer PFS than those with LMR<2.12(mean PFS was 5.15months [95%CI: 3.938-6.356] vs. 2.33months [95%CI: 1.168-3.499]), *p*=0.011 (Figure4). However, no significant difference was found between patients with PLR<135 (mean PFS was 5.05months [95%CI: 3.187-6.903]) and PLR≥135 (mean PFS was 4.40months [95%CI: 3.177-5.615]), P value was 0.612 (Figure5).

In addition, association of each variable with PFS time, using the Kaplan–Meier method with the log-rank test, was summarized to the table2.

3.6 Association between PFS and clinical factors in lung cancer patients treated with ICIs therapy

Subsequently, we researched the relationships between PFS and clinical factors in lung cancer patients who were treated with anti-PD-L1 or anti-PD-1 therapy. According to multivariate analyses including sex, age, histology, treatment line, ICIs type, serum ALB, BMI and creatinine, the results showed that serum ALB and creatinine were independent influence factors for PFS, while sex, age, histology, treatment line, ICIs type and BMI were not significantly related to PFS (Table 3).

4. Discussion

A large retrospective research supported that melanoma patients with a BMI of 18.5–24.9 had a significantly shorter PFS than those with a BMI of 25.0–29.9 or ≥ 30 after therapy with pembrolizumab, nivolumab, or atezolizumab (median PFS: 19.9 vs. 27.2 or 28.8 months) [23]. However, one recent study showed that among 287 melanoma patients treated by ICIs, BMI was not related to clinical benefit or toxicity [13]. Another retrospective research indicated that solid malignant tumor patients, including NSCLC, melanoma, and renal cell carcinoma, with a BMI of ≥ 25.0 had a significantly longer PFS after ICIs treatment, compared with a BMI of <25.0 (11.7 vs. 3.7 months; HR: 0.46; 95% CI: 0.39–0.54; p < 0.0001) [24]. So far, it remains to be seen whether BMI was related to clinical benefit in lung cancer patients who had received ICIs. In this study, we found that lung cancer patients with a BMI of≥25 had a longer PFS compared with a BMI of<25. There was a positive association with overweight and better clinical outcomes with ICIs.

Overweight and obese patients have improved survival outcomes when comparing with patients with a normal body weight, which is known as “obesity paradox” [9]. At present, the mechanism of the influence of BMI on survival outcomes after ICIs therapy is just beginning to be understood. Obesity causes

dysregulation of the immune response by promoting the formation of a systemic meta-inflammation may be the potential interpretation. A recent research indicated that adipose cells in the human obese subcutaneous adipose tissues could secrete a few of pro-inflammatory cytokines and chemokines, which contribute to establish and maintain inflammation, and consequence may enhance influence on immune checkpoint inhibitors [25]. Furthermore, part of the explanation of how BMI impact the efficacy of ICIs is that obesity increases T cell aging leading to higher PD-1 expression and dysfunction or the PD-1-mediated T cell dysfunction in obesity significantly leaves tumors markedly more responsive to ICIs according to basic experimental study [26].

Body composition is complicated, only BMI may not be enough to fully reflect it. BMI is not an accurate indicator of lean figure or adiposity [27]. In clinical practice, serum albumin level is usually chosen as an indicator for patients' nutritional status. One retrospective study was pointed out that serum albumin level was not an independent predictable marker for overall response, but it was an important predictive and prognostic marker for anti-PD-1 treatment with NSCLC patients [20]. In our research, we found that the PFS of high ALB group was much longer than that of low ALB group, and the difference was significant. When renal function is considered, selecting serum creatinine as an indirect assessment of skeletal muscle mass represents a simple selection [16,17,18]. Cancers are highly proliferating and energy-demanding tissues. Especially in advanced malignant tumor, the increasing metabolic needs result in nutrient mobilization from skeletal muscle [28]. Low level of serum creatinine (< 0.7 mg/dL) is an indicator for weakness and sarcopenia especially for the older people; it is a powerful predictor of mortality in patients with chronic diseases who has a normal BMI [22]. Cachexia and sarcopenia are negative prognostic factors [14,15]. Our results also confirm this point, it showed that PFS time of low creatinine group was shorter than that of high creatinine group, and the difference was statistically significant. Low muscle mass is related to poor immunologic function, because skeletal muscle provides essential nutrients for the function of lymphocytes and monocytes [29,30;31] which probably related to the setting of immunotherapy based on checkpoint [32].

According to multivariate analyses including sex, age, histology, treatment line, ICIs type, serum ALB, BMI and creatinine, the results showed that serum ALB and creatinine were independent on influence factors for PFS, while sex, age, histology, treatment line, ICIs type and BMI were not significantly related to PFS. We suspect that the effects of BMI on PFS may be related to levels of serum albumin and creatinine. The above results indicated that nutritional status may be an important predictor of immunotherapy for the lung cancer patients. Nutrition is regarded as an important determining factor of immunoreaction, and dystrophy is the most common reason of immunodeficiency. The nutritional status of patients may influence the tumor microenvironment.

Myeloid-derived suppressor cells (MDSCs) are a marker of tumor-related inflammation and mediate the inhibition of T cell responses in lymphoma [33]. MDSCs are viewed as a heterogeneous population of cells at different differentiation stages. MDSCs can be differentiated into polymorphonuclear and monocyte MDSCs, which are respectively similar in morphologically and phenotypically to neutrophils and

monocytes [34]. Studies showed that accumulate monocyte MDSCs resulted in reduced tumor infiltrating lymphocytes and increased tumorigenicity, aggravating immunosuppression [35]. Additionally, increasing evidence shows that there is a negative correlation between raised lymphocyte counts and tumor proliferation and invasion [36]. Platelets induce the migration of circulating cancer cells from epithelium to mesenchyme and promote the extravasation and metastasis of tumor cells [37,38]. It was found that PLR was significantly connected with the appearance of irAEs in NSCLC [39]. Thus, we evaluated the influence of LMR and PLR on overall survival in lung cancer patients with ICIs therapy. The results suggest that patients with baseline LMR≥2.12 had a longer PFS than those with LMR＜2.12, while no significant difference was found between patients with PLR＜135 and PLR≥135. LMR could serve as predictive biomarker for the efficacy of anti-PD-1 therapy to advanced lung cancer.

At present, one of the 'hottest topic' is about the complex relationship between body composition and immune reaction, and some studies have attempted to explain that point [40]. The biological basis remains indistinct, therefore further researches are needed to illustrate these mechanisms. Furthermore, we consider that in prospective randomized research with non-ICIs control arm, BMI should be regarded as a stratification factor to better define its role in the treatment of checkpoint inhibitors. At the same time, further subgroup analysis is needed to confirm whether the impact of BMI on ICIs therapeutic effect is determined by serum albumin and creatinine levels.

This study is a real-word clinical study. Of course, there are several shortcomings in this study. As a retrospective study, there are inevitable selection bias. What's more, a total of 66 patients were enrolled in the study, and small sample sizes may lead to the deviation of results. Further prospective researches on larger queues are needed to verify these results.

Abbreviations

ICIs: immune checkpoint inhibitors;

BMI: body mass index;

ALB: albumin;

LMR: lymphocyte-to-monocyte ratio

PLR: platelet-to-lymphocyte ratio

PFS: progression-free survival

OS：overall survival

NSCLC：non-small cell lung cancer

Declarations

Ethics approval and consent to participate It was a retrospective study. The study was approved by the Ethics Committee of the Liaoning Cancer Institute and Hospital. The data are anonymous, and the requirement for informed consent was therefore walved. All procedures performed in this study involving human participants were in accordance with the Declaration of Helsinki (as revised in 2013).

Consent for publication Not Applicable.

Availability of data and material All data generated or analysed during this study are included in this published article and its supplementary information files.

Competing interests There was no financial or non-financial competing interests.

Funding No funding was obtained for this study.

Authors' contributions Authors' contributions: ZL is the first author, and design of the work, analysis, interpretation, have drafted the work. YD made contribution to acquisition. XL is the corresponding anthor.

Acknowledgements: Not applicable in this section.

References

1. Bray F, Ferlay J, Soerjomataram I, et al. Global cancer statistics 2018: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries. CA Cancer J Clin. 2018 Nov;68(6):394-424.
2. Borghaei H, Paz-Ares L, Horn L, et al. Nivolumab versus docetaxel in advanced nonsquamous non-small-cell lung cancer. N Engl J Med. 2015 Oct 22;373(17):1627-39.
3. Brahmer J, Reckamp K.L, Baas P, et al. Nivolumab versus docetaxel in advanced squamous-cell non-small-cell lung cancer. N Engl J Med. 2015 Jul 9;373(2):123-35.
4. Hugo W, Zaretsky J.M, Sun L, et al. Genomic and transcriptomic features of response to anti-PD-1 therapy in metastatic melanoma. Cell. 2016 Mar 24;165(1):35-44.
5. Riaz N, Havel J.J, Makarov V, et al. Tumor and microenvironment evolution during immunotherapy with nivolumab. Cell. 2017 Nov 2;171(4):934-949.
6. Weber J.S, Kudchadkar R.R, Gibney G.T, et al. Updated survival, toxicity and biomarkers of nivolumab with/without peptide vaccine in patients naive to, or progressed on ipilimumab. J. Clin. Oncol. 2014, 32, 3009.
7. Conforti F, Pala L, Bagnardi V, et al. Cancer immunotherapy efficacy and patients' sex: a systematic review and meta-analysis. Lancet Oncol. 2018 Jun;19(6):737-746.
8. Taghizadeh N, Boezen H.M, Schouten J.P, et al. BMI and lifetime changes in BMI and cancer mortality risk. PLoS One. 2015 Apr 16;10(4):e0125261.

9. Lennon H, Sperrin M, Badrick E, et al. The obesity paradox in cancer: a review. Curr Oncol Rep. 2016 Sep;18(9):56.
10. Albiges L, Hakimi A.A, Xie W, et al. Body mass index and metastatic renal cell carcinoma: clinical and biological correlations. J Clin Oncol. 2016 Oct 20;34(30):3655-3663.
11. Antoun S, Bayar A, Ileana E, et al. High subcutaneous adipose tissue predicts the prognosis in metastatic castration-resistant prostate cancer patients in post chemotherapy setting. Eur J Cancer. 2015 Nov;51(17):2570-7.
12. Chen H, Wang D, Zhong Q, et al. Pretreatment body mass index and clinical outcomes in cancer patients following immune checkpoint inhibitors: a systematic review and meta-analysis. Cancer Immunol Immunother. 2020 Dec;69(12):2413-2424.
13. Young A.C, Quach H.T, Song H, et al. Impact of body composition on outcomes from anti-PD1 +/− antiCTLA-4 treatment in melanoma. J Immunother Cancer. 2020 Jul;8(2):e000821.
14. Heymsfield S.B, McManus C, Stevens V; et al. Muscle mass: reliable indicator of protein-energy malnutrition severity and outcome. Am J Clin Nutr. 1982 May;35(5 Suppl):1192-9.
15. Shachar S.S, Williams G.R, Muss H.B, et al. Prognostic value of sarcopenia in adults with solid tumours: A meta-analysis and systematic review. Eur J Cancer. 2016 Apr;57:58-67.
16. Patel S.S, Molnar M.Z, Tayek J.A, et al. Serum creatinine as a marker of muscle mass in chronic kidney disease: results of a cross-sectional study and review of literature. J Cachexia Sarcopenia Muscle. 2013 Mar;4(1):19-29.
17. Kim S.W, Jung H.W, Kim C.H, et al. A new equation to estimate muscle mass from creatinine and cystatin C. PLoS One. 2016 Feb 5;11(2):e0148495.
18. Drescher C, Konishi M, Ebner N, et al. Loss of muscle mass: current developments in cachexia and sarcopenia focused on biomarkers and treatment. J Cachexia Sarcopenia Muscle. 2015 Dec;6(4):303-11.
19. Qian S, Golubnitschaja O, Zhan X. Chronic inflammation: Key player and biomarker-set to predict and prevent cancer development and progression based on individualized patient profiles. EPMA J. 2019 Nov 20;10(4):365-381.
20. Takada K, Takamori S, Yoneshima Y, et al. Serum markers associated with treatment response and survival in non-small cell lung cancer patients treated with anti-PD-1 therapy. Lung Cancer. 2020 Jul;145:18-26.
21. Fan X, Wang D, Zhang W, et al. Inflammatory markers predict survival in patients with advanced gastric and colorectal cancers receiving anti–PD-1 therapy. Front Cell Dev Biol. 2021 Mar 15;9:638312.
22. Goel K, Gulati R, Reeder G.S, et al. Low body mass index, serum creatinine, and cause of death in patients undergoing percutaneous coronary intervention. J Am Heart Assoc. 2016 Oct 31;5(11):e003633.
23. McQuade J.L, Daniel C.R, Hess K.R, et al. Association of body-mass index and outcomes in patients with metastatic melanoma treated with targeted therapy, immunotherapy, or chemotherapy: a

retrospective, multicohort analysis. Lancet Oncol. 2018 Mar;19(3):310-322.

24. Cortellini A, Bersanelli M, Buti S, et al. A multicenter study of body mass index in cancer patients treated with anti-PD-1/PD-L1 immune checkpoint inhibitors: when overweight becomes favorable. J Immunother Cancer. 2019 Feb 27;7(1):57.
25. Frasca D, Diaz A, Romero M, et al. Secretion of autoimmune antibodies in the human subcutaneous adipose tissue. PLoS One. 2018 May 16;13(5):e0197472.
26. Wang Z, Aguilar E.G, Luna J.I, et al. Paradoxical effects of obesity on T cell function during tumor progression and PD-1 checkpoint blockade. Nat Med. 2019 Jan;25(1):141-151.
27. Prado C.M.M, Heymsfield S.B. Lean tissue imaging: a new era for nutritional assessment and intervention. JPEN J Parenter Enteral Nutr. 2014 Nov;38(8):940-53.
28. Porporato P.E. Understanding cachexia as a cancer metabolism syndrome. Oncogene.2016;5:e200.
29. Juretic A, Spagnoli G.C, Hörig H, et al. Glutamine requirements in the generation of lymphokine-activated killer cells. Clin Nutr. 1994 Feb;13(1):42-9.
30. Spittler A, Winkler S, Götzinger P, et al. Influence of glutamine on the phenotype and function of human monocytes. Blood. 1995 Aug 15;86(4):1564-9.
31. Lightfoot A, McArdle A, Griffiths R.D. Muscle in defense. Crit Care Med. 2009;37(10 Suppl):S384-90.
32. Jiang Y, Li Y, Zhu B. T-cell exhaustion in the tumor microenvironment. Cell Death Dis. 2015 Jun 18;6(6):e1792.
33. Raber P.L, Thevenot P, Sierra R, et al. Subpopulations of myeloid-derived suppressor cells impair T cell responses through independent nitric oxide-related pathways. Int J Cancer. 2014 Jun 15;134(12):2853-64.
34. Wu L, Saxena S, Singh R.K. Neutrophils in the tumor microenvironment. Adv Exp Med Biol. 2020;1224:1-20.
35. Liu M, Zhou J, Liu X, et al. Targeting monocyte-intrinsic enhancer reprogramming improves immunotherapy efficacy in hepatocellular carcinoma. Gut. 2020 Feb;69(2):365-379.
36. Liang L, Zhu J, Jia H, et al. Predictive value of pretreatment lymphocyte count in stage II colorectal cancer and in high-risk patients treated with adjuvant chemotherapy. Oncotarget. 2016 Jan 5;7(1):1014-28.
37. Schumacher D, Strilic B, Sivaraj K.K, et al. Platelet-derived nucleotides promote tumor-cell transendothelial migration and metastasis via P2Y2 receptor. Cancer Cell. 2013 Jul 8;24(1):130-7.
38. Copija A, Nowakowska-Zajdel E, Janion K, et al. Clinical characteristics of colorectal cancer patients in terms of selected platelet indices. Dis Markers. 2020 Oct 8;2020:6145604.
39. Pavan A, Calvetti L, Maso A.D, et al. Peripheral blood markers identify risk of immune-related toxicity in advanced non-small cell lung cancer treated with immune-checkpoint inhibitors. Oncologist. 2019 Aug;24(8):1128-1136.
40. Warner A.B, McQuade J.L. Modifiable host factors in melanoma: emerging evidence for obesity, diet, exercise, and the microbiome. Curr Oncol Rep. 2019 Jul 1;21(8):72.

Tables

Due to technical limitations, tables are only available as a download in the Supplemental Files section.

Figures

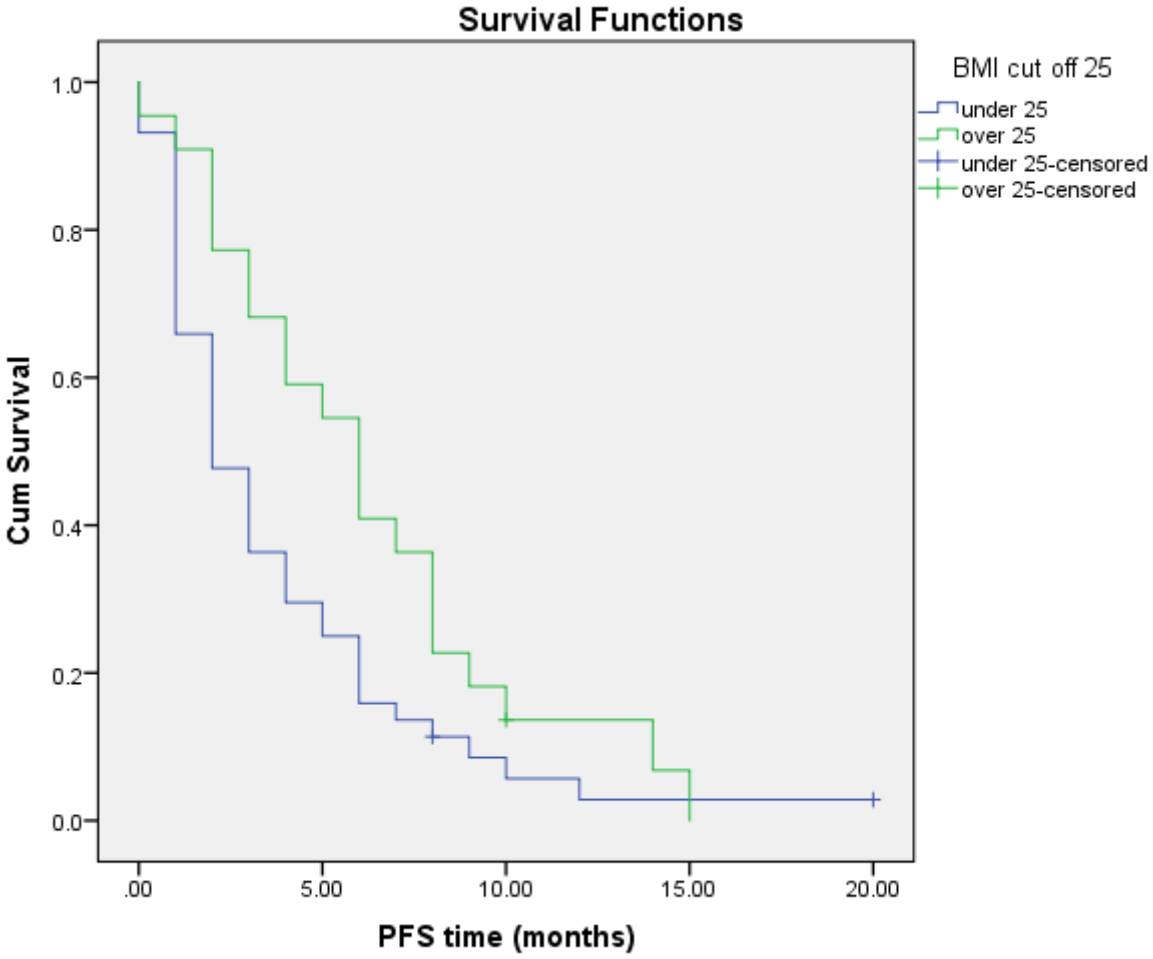

Figure 1

Progression-free survival in the non-overweight and overweight/obese groups.

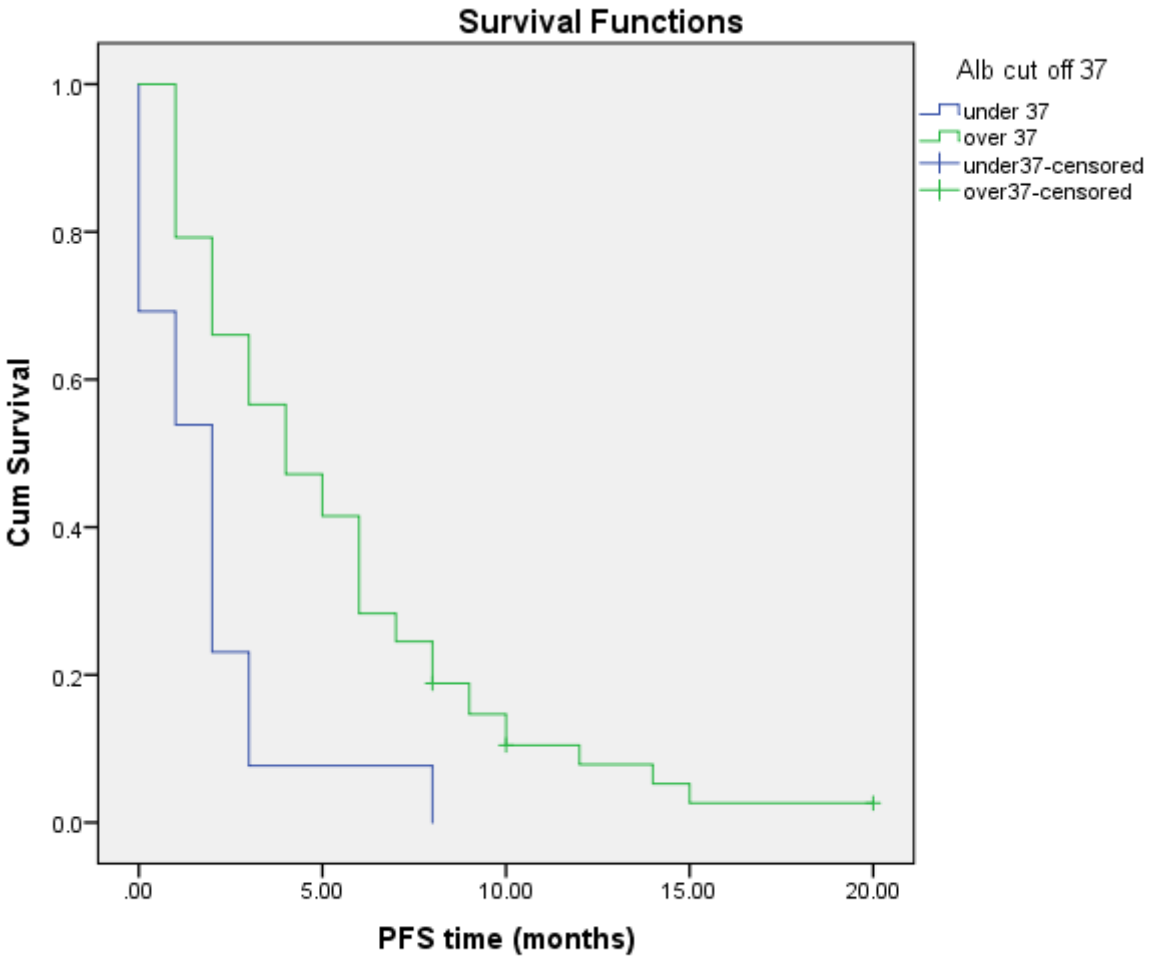

Figure 2

Progression-free survival in the high and low serum albumin (ALB) groups.

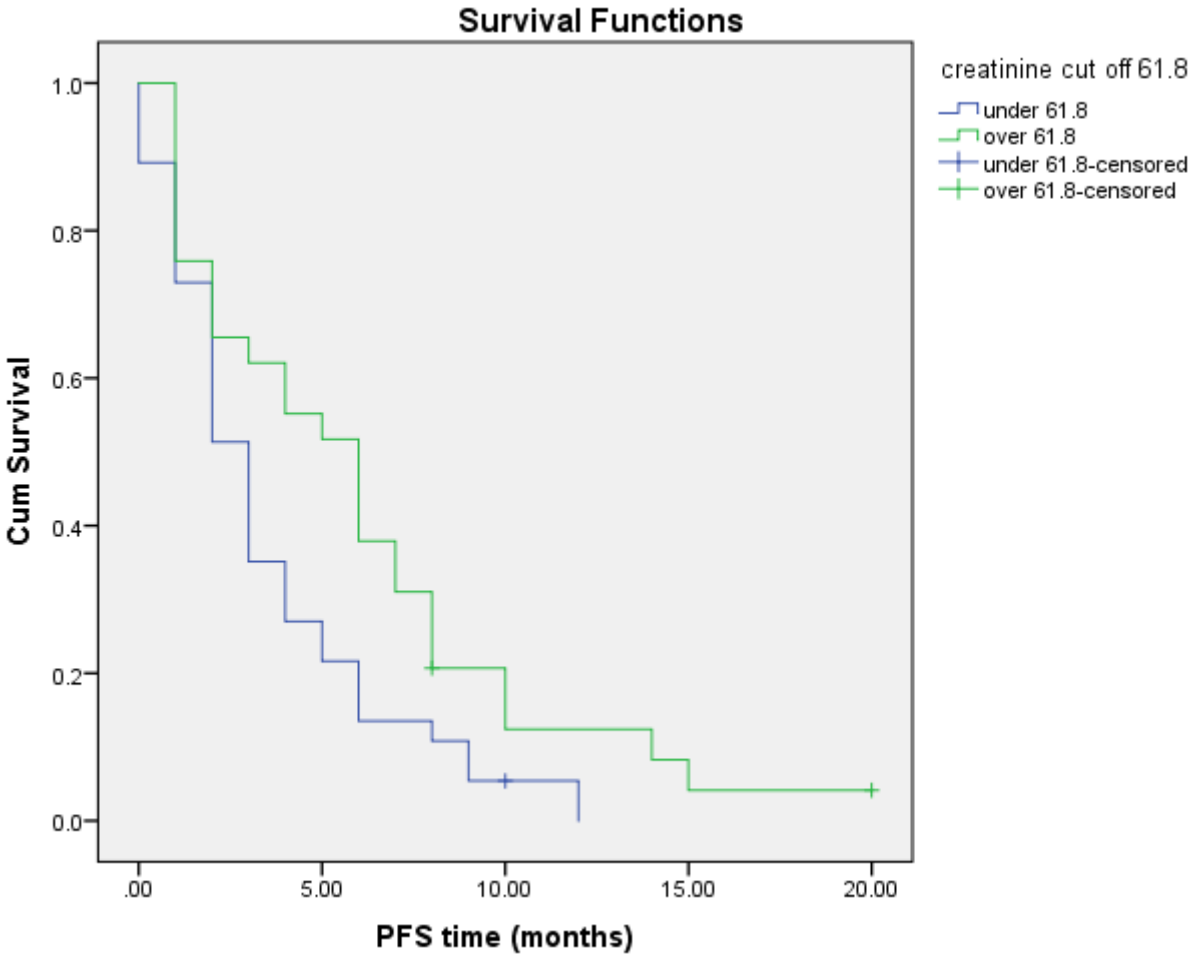

Figure 3

Progression-free survival in the high and low serum creatinine groups.

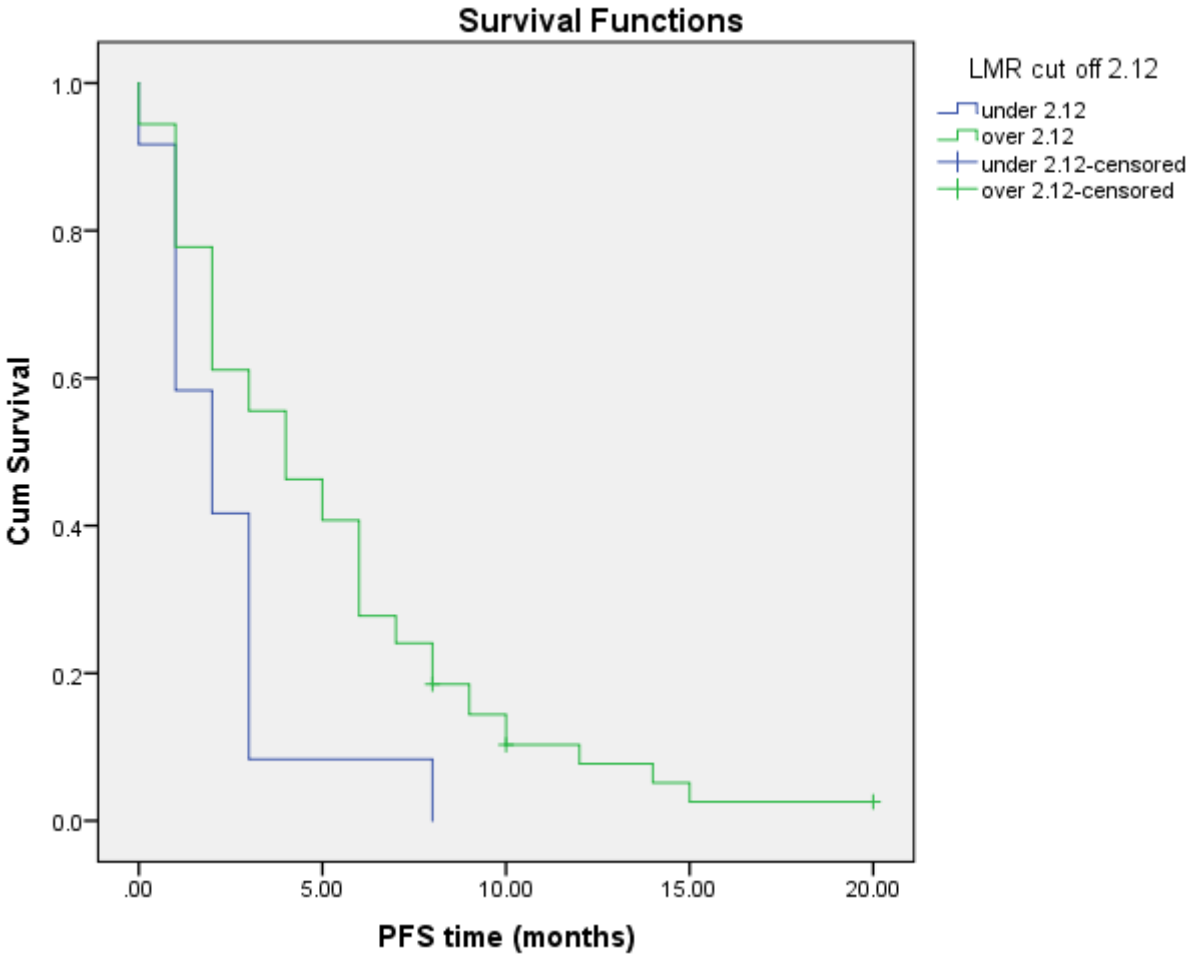

Figure 4

Progression-free survival in the high and low LMR groups.

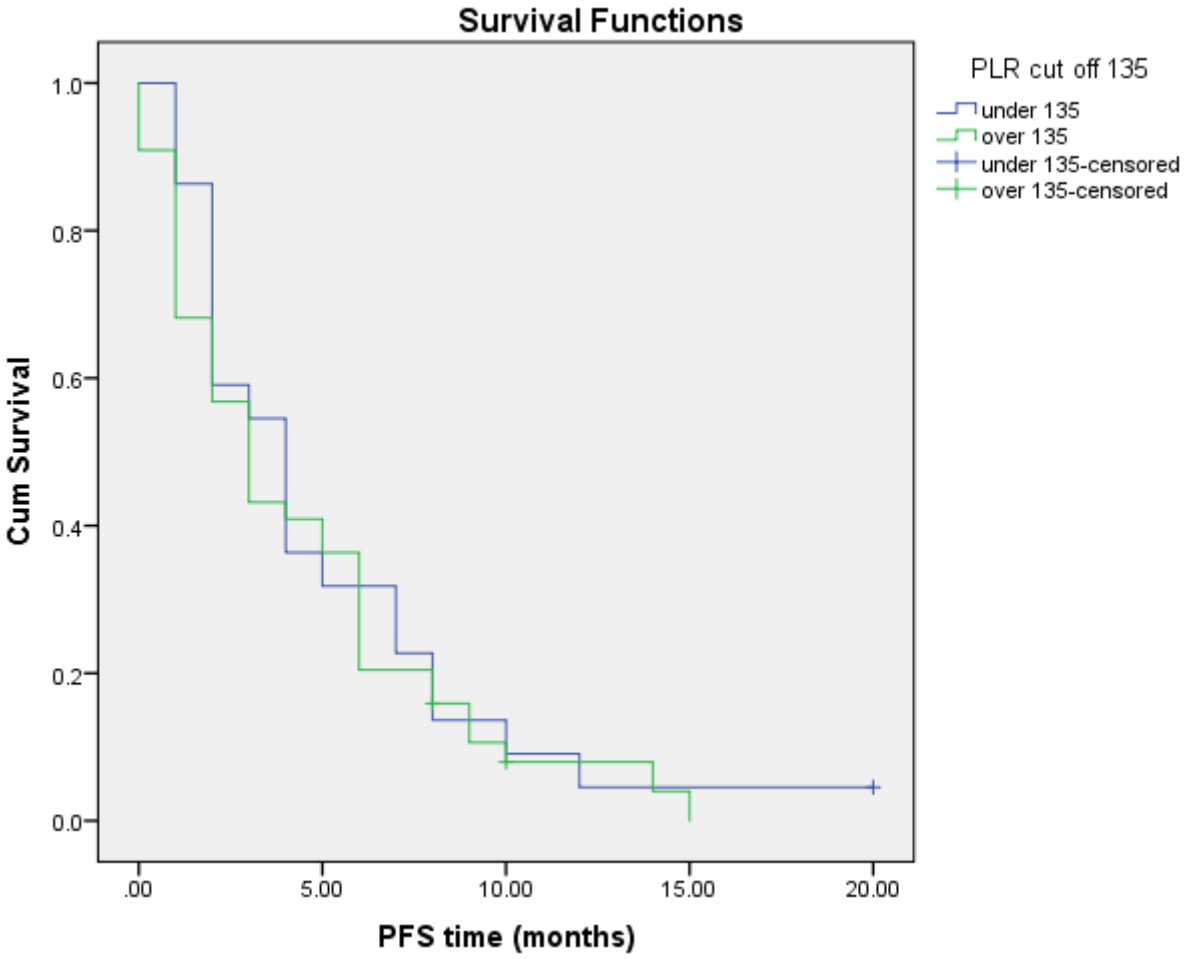

Figure 5

Progression-free survival in the high and low PLR groups. No significant difference was found between patients with PLR135 and PLR≥135, p=0.612.

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- Tables.docx