Original Research

SARCOPENIA AND ASSOCIATED FACTORS IN HEAD AND NECK CANCER PATIENTS UNDERGOING CHEMOTHERAPY

Pham Duc Minh[1,✉], Tạ Thị Trang [1,2], Vũ Anh Hải[3]

[1] *Department of Nutrition, Military Hospital 103, Vietnam*
[2] *Department of Nutrition, Thai Binh Pediatric Hospital*
[3] *Oncology center, Military Hospital 103, Vietnam*

ABSTRACT

Aims: This study aimed to explore the relationship between sarcopenia and clinical, biochemical factors in head and neck cancer (HNC) patients undergoing chemotherapy. Specifically, the study focused on the role of BMI in assessing sarcopenia risk in this patient population.

Methods: A cross-sectional study was conducted on 68 patients with HNC undergoing chemotherapy at a tertiary hospital. Inclusion criteria included confirmed diagnosis of HNC, active chemotherapy treatment, availability of clinical and biochemical data, and voluntary consent to participate. Data were collected on clinical factors (age, gender, BMI, ECOG status), Complete Blood Count and biochemical markers (lymphocytes, hemoglobin, albumin, potassium, sodium, chloride, creatinine, AST, ALT). Sarcopenia was assessed using the AWGS 2019 criteria. Logistic regression analysis was performed to identify associations between sarcopenia and clinical/biochemical variables.

Results: The mean age of participants was 58.12 ± 12.25 years, with males comprising 76.5% of the cohort. The average BMI was 21.13 ± 3.44 kg/m². Sarcopenia prevalence was 51.5% overall, with rates of 100% in patients with BMI < 18.5, 54.1% in those with BMI 18.5–23, and 5.9% in BMI ≥ 23. Logistic regression revealed a significant inverse association between BMI and sarcopenia (p = 0.005, OR = 0.60), indicating that lower BMI strongly predicts sarcopenia. Other factors such as age, gender, and albumin levels showed no significant association.

Conclusion: The study underscores that BMI, while unable to differentiate fat mass from lean mass, remains a practical and valuable tool for monitoring sarcopenia in HNC patients undergoing chemotherapy. Nutritional interventions to maintain an optimal BMI could mitigate sarcopenia risk, thereby improving treatment outcomes and overall prognosis in this vulnerable population.

Keywords: *sarcopenia, BMI, head and neck cancer, chemotherapy.*

I. INTRODUCTION

Head and neck cancer (HNC) is a significant public health concern worldwide, with an estimated 660,000 new cases and 325,000 deaths reported annually [1]. Despite advancements in treatment, HNC patients are particularly vulnerable to complications related to malnutrition, muscle depletion, and cancer cachexia due to the anatomical location of the tumors, treatment side effects, and systemic inflammation associated with malignancies [2]. Sarcopenia, characterized by the loss of skeletal muscle mass, strength, and function, is increasingly recognized as a critical condition affecting cancer patients, particularly those undergoing chemotherapy.

✉ Corresponding author: Pham Duc Minh
Email: drminh103@yahoo.com
Doi: 10.56283/1859-0381/880
Submitted: 23/1/2025 Revised: 10/2/2025
Accepted: 12/2/2025
Published online: 14/2/2025

Studies indicate that sarcopenia is prevalent in 30-50% of HNC patients receiving chemotherapy, significantly impacting treatment outcomes, quality of life, and overall survival [3]. Notably, sarcopenia is associated with increased toxicity to chemotherapy, reduced physical performance, and poorer prognosis, underscoring the need for early identification and management [4].

In Vietnam, head and neck cancer (HNC) poses a significant health burden, with a high prevalence of malnutrition and cachexia among patients. Studies indicate that 50–70% of HNC patients in Vietnam experience malnutrition due to factors such as tumor location, treatment side effects, and systemic inflammation associated with cancer progression. Cachexia, a syndrome characterized by severe muscle wasting and weight loss, is also prevalent, further exacerbating treatment complications and reducing survival rates [5], [6].

In clinical practice, body mass index (BMI) is commonly used as a simple and cost-effective measure to evaluate nutritional status and track muscle changes. While BMI cannot differentiate between fat mass and lean muscle mass, it remains a valuable surrogate marker for assessing sarcopenia risk in resource-limited settings [2]. Understanding the relationship between BMI, clinical characteristics, and sarcopenia in HNC patients undergoing chemotherapy is critical for optimizing treatment strategies, improving nutritional interventions, and enhancing overall outcomes.

This study aims to explore the prevalence of sarcopenia in HNC patients receiving chemotherapy and its association with BMI and other parameters, contributing to a better understanding of sarcopenia's impact on this vulnerable population.

II. METHODS

2.1. Study design

This cross-sectional study was conducted on 68 patients diagnosed with head and neck cancer (HNC) who were undergoing chemotherapy at the Oncology Center of Military Hospital 103, from October 2023 to December 2024.

2.2. Subjects

The subjects were recruited according to the criteria as following:

Inclusion criteria: Patients diagnosed with head and neck cancer confirmed by histopathological examination and undergoing chemotherapy; Availability of complete clinical and biochemical records for analysis; Patients who provided informed consent and voluntarily participated in the study; Absence of severe comorbidities that could interfere with the results, such as advanced cardiovascular disease, severe liver dysfunction, or end-stage renal failure.

Exclusion criteria: Patients unable to undergo performance status evaluation due to physical or mental limitations; Patients incapable of providing valid responses during direct interviews due to cognitive or communication issues.

Participants were categorized into subgroups based on their BMI and sarcopenia status, aiming to explore the relationship between BMI, clinical and biochemical factors, and the development of sarcopenia during chemotherapy.

2.3. Data collection methods

Clinical data collection

Patient interviews were conducted using a structured questionnaire to obtain demographic and medical history information, including age, gender, and lifestyle factors. Clinical parameters such as height, weight, and performance status were measured and recorded. BMI was calculated as weight (kg)/height² (m²). ECOG (Eastern Cooperative Oncology Group) performance status was used to assess the overall functional capacity of patients.

Hematology and biochemical data collection

Blood samples were collected in the morning after overnight fasting. Complete blood count (CBC) analysis was performed using the UniCel DxH 600 hematology analyzer, based on flow cytometry and morphological analysis utilizing laser technology. Biochemical parameters, including albumin, potassium, sodium, chloride, creatinine, GOT, GPT were analyzed using the AU5800 – Beckman Coulter, which employs the turbidimetric immunoassay method. All laboratory tests were conducted in the hospital's central laboratory to ensure consistency and reliability.

Sarcopenia assessment

Sarcopenia status was evaluated according to the Asian Working Group for Sarcopenia (AWGS) 2019 criteria. These involved measurements of muscle mass (via bioelectrical impedance analysis), muscle strength (handgrip strength using a dynamometer), and physical performance (gait speed test).

Muscle Mass Measurement – Bioelectrical Impedance Analysis (BIA) using InBody S10 (InBody Co., Ltd, Korea). Subjects fast for at least 2 hours before testing. Avoid intensive exercise, alcohol, and excessive water intake before measurement. Remove metal accessories and ensure clean, dry skin for proper electrode placement. Subjects lie in a supine position for at least 5 minutes before measurement. Low appendicular skeletal muscle mass (ASM): Men: <7.0 kg/m²; Women: <5.7 kg/m².

Muscle Strength Measurement – Handgrip Strength (HGS) using Camry EH101 (Camry, China). Reduced muscle strength (HS): Men: <28 kg; Women: <18 kg.

Physical Performance Assessment – 6-Meter Walk Test (Gait Speed Measurement).

Conducted on a flat, non-slip surface with a clearly marked 6-meter distance. A walking time of ≥6 seconds indicates reduced physical performance.

Sarcopenia diagnosed when low muscle mass is present along with either low muscle strength or low physical performance [7].

2.4. Ethical considerations

This study adhered to the principles outlined in the Declaration of Helsinki for biomedical research involving human participants. The study protocol was reviewed and approved by the Ethics Committee of Military Hospital 103. Patients were informed about the purpose, procedures, potential risks, and benefits of the study. Written informed consent was obtained from all participants prior to data collection. Participants were assured of the confidentiality of their data, which

was anonymized for analysis. Patients retained the right to withdraw from the study at any point without affecting their ongoing treatment.

2.5. Statistical analysis

All collected data were analyzed using SPSS software version 26.0. Descriptive statistics were used to summarize demographic and clinical characteristics. Categorical variables were expressed as frequencies and percentages, while continuous variables were reported as means ± standard deviations or medians (interquartile ranges), depending on data distribution.

Logistic regression analysis was performed to assess the association between clinical and biochemical factors and the presence of sarcopenia. A p-value of < 0.05 was considered statistically significant.

III. RESULTS

Table 1. *Characteristics of the study population (n=68).*

Factors	Mean ± SD or median (25^{th}-75^{th} percentile)
Age (years)	58.12 ± 12.25
Age ≥ 60 years, *n* (%)	35 (51.5%)
Male, *n* (%)	52 (76.5%)
Education (>high school), *n* (%)	34 (50%)
Income stability, *n* (%)	18 (26.5%)
Advanced cancer, *n* (%)	44 (64.7%)
Weight (kg)	55.45 ± 10.15
Height (m)	1.62 ± 0.08
BMI (kg/m²)	21.13 ± 3.44
ECOG	1.04 ± 1.10
Lymphocytes (G/L) [#]	0.92 (1.70–18.28)
Albumin (g/L)	38.32 ± 4.35
Potassium (mmol/L)	3.69 ± 0.44
Sodium (mmol/L) [#]	135.13 (137.92–141.25)
Chloride (mmol/L) [#]	99.28 (101.30–104.18)
Creatinine (µmol/L) [#]	72.21 (85.31–92.47)
AST (U/L) [#]	20.26 (25.50–33.73)
ALT (U/L) [#]	14.41 (21.09–36.95)
Hemoglobin (HGB, g/L)	119.19 ± 18.56

[#] *Median (25^{th}-75^{th} percentile)*

BMI: body mass index; ECOG: Eastern Cooperative Oncology Group performance status; AST (GOT): Aspartate aminotransferase; ALT (GPT): Alanine aminotransferase; HGB: hemoglobin.

Table 1 shows characteristics of the subjects. The mean age of the patients was 58.12 ± 12.25 years, with 51.5% being over 60, indicating that the study population primarily consisted of middle-aged to elderly individuals. The mean BMI was 21.13 ± 3.44, within the normal range. However, a notable proportion of patients had a BMI below 18.5, placing them at higher risk of developing sarcopenia.

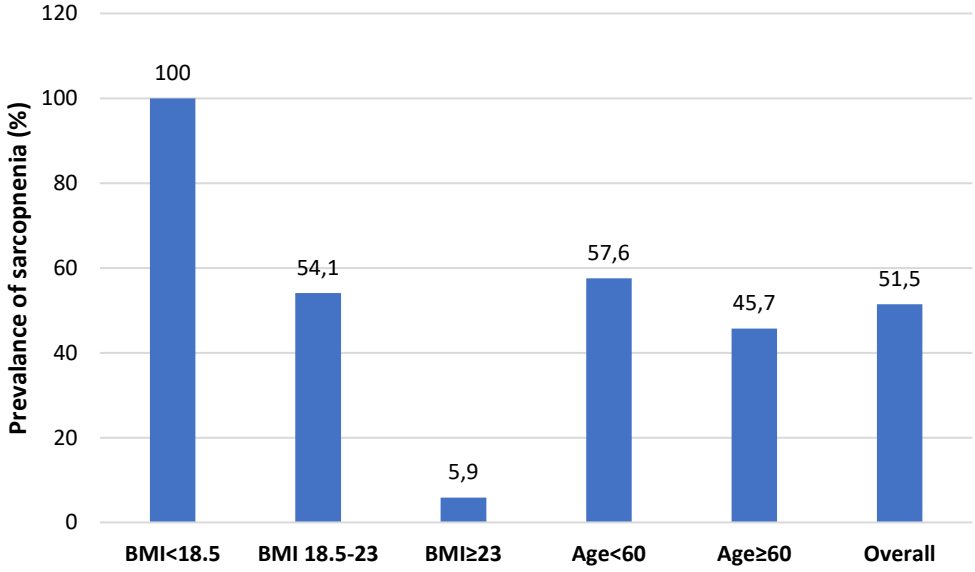

Figure 1. *Sarcopenia Prevalence by BMI Categories (n = 68).* BMI: Body Mass Index.

Figure 1 shows higher prevalence of sarcopenia among those with a BMI lower than 18.5 and those under 60 years old. The condition is less common in people with higher BMI (≥23 kg/m^2) and older individuals (≥60 years). The overall prevalence of sarcopenia among the studied population was 51.5%.

Biochemical parameters such as albumin, potassium, sodium, chloride, and creatinine were within normal ranges, suggesting that most patients did not exhibit severe malnutrition or significant metabolic disturbances.

Logistic regression analysis in Table 2 revealed BMI was the strongest factor associated with sarcopenia (p = 0.005, OR = 0.60). This result indicates that lower BMI significantly increases the risk of sarcopenia; patients with lower BMI were more likely to develop sarcopenia.

Other factors, including age, gender, albumin, and ECOG status, did not show a statistically significant association with sarcopenia.

Table 2. *Association between clinical/biochemical factors and sarcopenia (n = 68).*

Variable	β	P	OR	95% CI for OR
Age	0.03	0.413	1.03	0.96–1.11
Gender (male)	-0.265	0.805	0.77	0.09–6.27
Education (high school)	-0.214	0.785	0.81	0.17–3.74
Income stability	-0.371	0.696	0.69	0.11–4.43

Variable	β	P	OR	95% CI for OR
Cancer stage (advanced)	0.824	0.295	2.28	0.49–10.68
Body mass index	-0.516	0.005	0.60	0.42–0.85
ECOG Performance Status	-0.045	0.894	0.96	0.49–1.85
Lymphocyte count (G/L)	0.012	0.711	1.01	0.95–1.08
Albumin (g/L)	-0.163	0.120	0.85	0.69–1.04
Potassium (mmol/L)	-0.006	0.994	0.99	0.22–4.55
Sodium (mmol/L)	-0.13	0.267	0.88	0.70–1.11
Chloride (mmol/L)	0.094	0.402	1.10	0.88–1.37
Creatinine (µmol/L)	-0.012	0.611	0.99	0.94–1.04
Hemoglobin (g/L)	0.018	0.464	1.02	0.97–1.07
Constant	22.542	0.053	6.17E+09	

BMI: body mass index; ECOG: Eastern Cooperative Oncology Group Performance Status.

IV. DISCUSSION

Sarcopenia is a prevalent complication in cancer patients, particularly in those with head and neck cancer (HNC), due to factors such as malnutrition, chronic inflammation, and the impact of aggressive treatment modalities like chemotherapy. In this study, we identified that the overall prevalence of sarcopenia in HNC patients undergoing chemotherapy was 51.5%, consistent with findings from previous research that reported rates ranging from 40% to 60% in similar populations [8, 9]. These studies also demonstrated that sarcopenia is associated with worse treatment outcomes, including increased chemotherapy toxicity, reduced quality of life, and shorter survival [9].

While age-related sarcopenia occurs gradually, cancer-related factors can significantly exacerbate muscle loss and functional decline at all age. The systemic inflammatory response induced by cancer and the effects of chemotherapy can exacerbate muscle loss [10, 11]. In this study, the BMI of the age < 60 group (20.6 kg/m²) was lower than that of the age ≥60 group (21.6 kg/m²), which may partly explain why the prevalence of sarcopenia in the older group was lower than that in the younger group (Figure 1).

In this study, the average BMI of the participants was 21.13 ± 3.44 kg/m², falling within the normal range for the general population. The stratification of sarcopenia prevalence by BMI subgroups revealed a striking trend: patients with a BMI < 18.5 exhibited a 100% prevalence of sarcopenia, those with BMI 18.5–23 had a prevalence of 54.1%, while only 5.9% of patients with BMI ≥ 23 were sarcopenic. Despite its limitations in distinguishing between muscle and fat mass, BMI was found to have a significant inverse relationship with the presence of sarcopenia (p = 0.005, OR = 0.60). The results of this study align with previous research, where low BMI has been identified as a critical risk factor for sarcopenia in cancer patients. A study by Fearon et al. (2011) demonstrated that low BMI and reduced caloric intake were strongly linked to muscle mass loss in cancer cachexia [12]. Research by Prado

et al. (2020) [3] emphasized that sarcopenia in cancer patients was more prevalent among those with lower body weights and poorer nutritional status. Tap et al. (2023) in Asian cancer patients undergoing chemotherapy reported that low BMI (<18.5 kg/m²) was strongly associated with an increased risk of malnutrition and sarcopenia [6]. Similarly, a study by Martin et al. (2013) in gastrointestinal cancer patients found that even in individuals with normal BMI, those with sarcopenia had significantly poorer clinical outcomes compared to non-sarcopenic patients [2].

Patients with HNC face unique challenges, such as chewing pain, swallowing difficulties, and unintentional weight loss, which exacerbate the risk of sarcopenia. Low BMI not only reflects poor nutritional status but also indicates accelerated muscle mass depletion, contributing significantly to sarcopenia development during chemotherapy [12].

Importantly, the high prevalence of sarcopenia in patients with low BMI underscores the critical need for early nutritional interventions. Maintaining an adequate nutritional status not only supports lean body mass but may also enhance chemotherapy tolerance and improve clinical outcomes. Several studies have suggested that nutritional supplementation, combined with physical exercise, may mitigate muscle wasting and improve overall survival in sarcopenic cancer patients [3, 13].

Contrary to expectations, other clinical and biochemical factors, such as age, gender, albumin levels, and hemoglobin, were not significantly associated with sarcopenia in our study population. This finding may reflect the predominant influence of nutritional status and BMI on muscle mass in HNC patients. However, low albumin levels, observed in some patients, indicate a risk of poor nutritional reserves, aligning with studies suggesting that hypoalbuminemia is a marker of systemic inflammation and malnutrition in cancer patients [9].

Clinical implications

Despite its limitations, BMI remains a valuable tool in resource-limited settings where advanced body composition analyses may not be readily available. Monitoring BMI over the course of chemotherapy can provide an early warning signal for sarcopenia, prompting further assessment with tools like handgrip strength or gait speed tests as recommended by AWGS 2019 guidelines

Maintaining a stable BMI is pivotal in preventing and managing sarcopenia in HNC patients. This underscores the importance of early nutritional intervention and dietary support, particularly for high-risk patients. Addressing these nutritional challenges may improve overall treatment outcomes and reduce sarcopenia-associated complications.

Study limitations: This study had a small sample size (n = 68) and was conducted at a single treatment center, potentially limiting the generalizability of the findings. Furthermore, the study did not evaluate inflammatory markers or cytokines, which are known contributors to sarcopenia.

Future directions: Future research should involve larger sample sizes and explore the role of inflammatory markers and metabolic factors in sarcopenia. Additionally, studies should assess the effectiveness of nutritional interventions and physical activity in mitigating sarcopenia in this patient population.

V. CONCLUSION

Body mass index, while limited in assessing body composition, is a valuable and accessible tool for monitoring sarcopenia in HNC patients undergoing chemotherapy. Integrating regular BMI assessments with other functional and biochemical evaluations can help clinicians identify at-risk patients and implement timely interventions. Further studies with larger sample sizes and advanced imaging techniques are needed to validate these findings and optimize sarcopenia management in this population.

References

1. Gormley M, Creaney G, Schache A, Ingarfield K, Conway DI. Reviewing the epidemiology of head and neck cancer: definitions, trends and risk factors. *Br Dent J*. 2022;233(9):780-786. doi: 10.1038/s41415-022-5166-x.
2. Martin L, Birdsell L, Macdonald N, et al. Cancer cachexia in the age of obesity: skeletal muscle depletion is a powerful prognostic factor, independent of body mass index. *J Clin Oncol*. 2013;31(12):1539-1547.
3. Prado CM, Purcell SA, and Laviano A. Nutrition interventions to treat low muscle mass in cancer. *J Cachexia Sarcopenia Muscle,* 2020;11(2):366-380.
4. Cruz-Jentoft AJ, Bahat G, Bauer J, et al. Sarcopenia: revised European consensus on definition and diagnosis. *Age Ageing*. 2019; 48(1):16-31.
5. Pham KH, Tran VL, Nguyen TL, et al. Describe the nutritional status of patients with head - face - neck cancer at Nghe An Cancer Hospital in 2020. *Journal of Nursing Science*. 2020;3(3): 28-32.
6. Van Tap N, Bang HT, Huong DT, et al. Malnutrition in hospitalized cancer patients: A single-center, cross-sectional study in Southern Vietnam. *SAGE Open Med.* 2023;11: 20503121231171491.
7. Chen LK, Woo J, Assantachai P, et al. Asian Working Group for Sarcopenia: 2019 Consensus Update on Sarcopenia Diagnosis and Treatment. *J Am Med Dir Assoc*. 2020; 21(3):300-307 e2.
8. Jovanovic N, Chinnery T, Mattonen SA, et al. Sarcopenia in head and neck cancer: A scoping review. *PLoS One*. 2022;17(11): e0278135.
9. Endo K, Ichinose M, Kobayashi E, et al. Head and Neck Cancer and Sarcopenia: An Integrative Clinical and Functional. *Review. Cancers* (Basel), 2024.16(20):3460. doi:10.3390/cancers16203460.
10. VanderVeen BN, Fix SK, and Carson JA, Disrupted Skeletal Muscle Mitochondrial Dynamics, Mitophagy, and Biogenesis during Cancer Cachexia: A Role for Inflammation. *Oxid Med Cell Longev.* 2017;2017: 3292087.
11. Gilliam LA and St Clair SK. Chemotherapy-induced weakness and fatigue in skeletal muscle: the role of oxidative stress. *Antioxid Redox Signal*. 2011;15(9): 2543-2563.
12. Fearon K, Strasser F, Anker SD, et al. Definition and classification of cancer cachexia: an international consensus. *Lancet Oncol*. 2011;12(5):489-495.
13. Baracos VE and Arribas L. Sarcopenic obesity: hidden muscle wasting and its impact for survival and complications of cancer therapy. *Annals of Oncology.* 2018;29: ii1-ii9.