Analysis of 24-h dietary intake in patients with ovarian cancer undergoing chemotherapy: A descriptive cross-sectional study

HUONG THI LE[1,2], BACH VIET HOANG[1] and THINH PHUC THI DAO[3]

[1]Department of Clinical Nutrition, Vietnam National Cancer Hospital, Hanoi 100000, Vietnam; [2]School of Preventive Medicine and Public Health, Hanoi Medical University, Hanoi 100000, Vietnam [3]National Institute of Nutrition, Hanoi 100000, Vietnam

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Abstract. Nutritional status and dietary intake play vital roles in the treatment outcomes and quality of life of patients with cancer. The present study investigated the 24-h dietary intake patterns of patients with ovarian cancer undergoing chemotherapy. The present cross-sectional study enrolled 125 patients aged ≥18 years and the analysis was performed using the patient-generated subjective global assessment tool alongside anthropometric measurements. Dietary data were collected through 24-h dietary recall interviews, and intake levels of energy, macro- and micronutrient intake were compared against recommended dietary allowances. The mean daily energy intake was 1,433.3±488.5 kcal, with only 38.4% of participants meeting the recommended energy requirements. The macronutrient distribution comprised 17.9% protein, 23.0% lipids and 59.1% carbohydrates. The mean protein intake was 65.6±35.0 g/day. All the participants (100%) exhibited suboptimal animal-to-total protein ratios, while 93% of the participants exhibited an inadequate plant-to-total lipid ratios compared with the dietary guidelines. On the whole, the findings of the present study revealed that the majority of the patients with ovarian cancer failed to achieve the recommended dietary requirements for both energy and protein intake. Moreover, marked imbalances were observed between animal and plant-based food sources. These results highlight the critical importance of implementing systematic nutritional assessment and counseling as essential components of supportive care for patients with cancer undergoing chemotherapy.

Correspondence to: Ms. Thinh Phuc Thi Dao, National Institute of Nutrition, 48B Tang Bat Ho Street, Hai Ba Trung, Hanoi 100000, Vietnam
E-mail: daothiphucthinh@gmail.com

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Introduction

Ovarian cancer represents the third most prevalent gynecological malignancy affecting the female population, following cervical and endometrial cancers (1). GLOBOCAN 2020 reported 313,959 new cases worldwide, with 207,252 associated deaths. In Vietnam, ovarian cancer ranks as the 11th most common type of cancer among females, with ~1,200 cases diagnosed annually (2) and a relatively poor 5-year survival rate <45% (3). While established risk factors include BRCA1 and BRCA2 gene mutations (4), histopathological characteristics (5) and menopausal hormone therapy (6), dietary factors emerge as a modifiable component with a potential significant influence on mortality rates and survival outcomes (7,8). The study by Playdon *et al* (9) demonstrated that an increased intake of dietary fiber was associated with an improved survival rate [hazard ratio (HR), 0.69; 95% confidence interval (CI), 0.53-0.90; P=0.002], while an elevated glycemic index was associated with poorer outcomes (HR, 1.28; 95% CI, 1.01-1.65; P=0.03).

The 2020 National Comprehensive Cancer Network (NCCN) Clinical Practice Guidelines establish surgical tumor resection combined with adjuvant chemotherapy as the standard treatment protocol for ovarian cancer (10). Although chemotherapy has proven to be effective in prolonging survival and enhancing clinical outcomes (11,12), it can simultaneously damage healthy cells, leading to adverse effects. These complications typically manifest as symptom clusters, including fatigue, nausea, vomiting and the numbness or tingling in the hands and feet, markedly affecting the quality of life of patients and promoting chemotherapeutic tolerance (13,14). Ferreira *et al* (15) examined 20 patients with breast cancer undergoing chemotherapy and reported a mean daily energy intake of 1191.7±458.3 kcal, with an average protein and lipid consumption of 48.5±21.9 and 38.5±19.1 g/day, respectively. The macronutrient distribution comprised 16.3% protein, 29.1% lipids and 57.7% carbohydrates, with the majority of patients exhibiting deficiencies in vitamins A, B1, B3 and B6, as well as in minerals, including calcium, iron, magnesium and fiber (15). Similarly, the study by Matcek (16) on women >70 years of age with stage III and IV ovarian cancer documented a mean energy intake of 1189±508 kcal/day, with <50% of patients meeting recommended intake levels for vitamins C, B1, B9 and B6. The analysis of five consecutive

NHANES surveys (2007-2016) by Zhu *et al* (17), revealed that patients with ovarian cancer averaged 56.7 g/day of protein intake, with a mean lipid and carbohydrate consumption of 55.7 and 77.2 g/day, respectively.

Current global research has largely focused on food frequency across different food groups without detailed quantification of actual consumption patterns, thereby limiting the accuracy of dietary intake assessments. The 24-h recall method provides distinct advantages, including the identification of food combinations affecting micronutrient absorption, insights into food preparation methods, and the documentation of commonly consumed processed food brands. However, studies specifically examining dietary patterns among patients with ovarian cancer remain limited. Therefore, the present study aimed to evaluate the dietary intake of patients with ovarian cancer undergoing chemotherapy using a 24-h dietary recall methodology.

Materials and methods

Study design and setting. The present cross-sectional study was conducted between July, 2023 and February, 2024 at the Departments of Internal Medicine 5 and 6 of Vietnam National Cancer Hospital (Hanoi, Vietnam). The present study was approved by the Hanoi Medical University (Hanoi, Vietnam) under Decision no. 2031/QD-DHYHN dated May 27, 2024, concerning the establishment of the Bachelor of Nutrition Thesis Evaluation Committee for the 2020-2024 cohort. All participants provided written informed consent after receiving detailed information about the study's objectives, procedures and potential implications.

Table I. General characteristics of the study participants.

Characteristic	Frequency	Percentage
Age		
18-39 years	16	12.8
40-59 years	71	56.8
≥60 years	38	30.4
Disease stage		
Stage I	14	11.2
Stage II	17	13.6
Stage III	80	64.0
Stage IV	14	11.2
PG-SGA		
PG-SGA A	60	48.0
PG-SGA B	50	40.0
PG-SGA C	15	12.0
BMI		
Malnourished (<18.5)	15	12.0
Normal (≥18.5 and ≤24.9)	102	81.6
Overweight/obese (≥25)	8	6.4
MUAC		
Malnourished (<23 cm)	26	20.8
Normal	99	79.2

PG-SGA, patient-generated subjective global assessment; BMI, body mass index; MUAC, mid-upper arm circumference.

Study population. The present study enrolled 125 patients with ovarian cancer aged ≥18 years who were undergoing chemotherapy. Eligible participants included newly admitted patients, interdepartmental transfers and those returning for scheduled treatment follow-ups. The exclusion criteria comprised patients unable to provide information (due to dementia or psychiatric disorders), and those with edema, physical deformities, spinal curvature, or pregnancy.

Study procedures. Participants were recruited through convenience sampling. Following medical record verification and eligibility confirmation, patients were invited to participate. Data collection encompassed general information and dietary intake assessment through 24-h dietary recall interviews. Dietary intake was estimated using a standardized questionnaire and the National Institute of Nutrition's photo book (https://drive.google.com/drive/folders/1tKkm4H9O8fLWRrO1rdc0m_Yp2poN_n93?usp=sharing). To ensure the representation of typical dietary patterns, data collection was not conducted during special occasions such as festivals or feasts.

24-h dietary recall protocol. Dietary recall was conducted following a structured five-step protocol as follows: i) Initial listing of all foods and beverages consumed within the previous 24 h; ii) systematic probing for potentially forgotten items; iii) documentation of consumption time and location for each item; iv) detailed recording of portion sizes and quantities, including condiments; and v) sfinal verification of additional food or beverage consumption.

Data collection and assessment methods. Patient data were collected in-hospital using standardized questionnaires. Nutritional status assessment incorporated three validated tools aa follows: i) Patient-generated subjective global assessment (PG-SGA), categorizing patients as well-nourished (PG-SGA A), mildly to moderately malnourished (PG-SGA B), or severely malnourished (PG-SGA C) (18); ii) body mass index (BMI), classified according to the WHO criteria: Overweight/obese, ≥25; normal weight, 18.5-24.9; and chronic energy deficiency, ≤18.5 (19); iii) mid-upper arm circumference (MUAC), with malnutrition defined as <23 cm for adult females as per the National Institute of Nutrition guidelines (20).

Dietary requirements were established based on the ESPEN 2021 guidelines for cancer patients, specifying 25-30 kcal/kg/day for energy and 1-1.5 g/kg/day for protein (21). This present study applied standards of 30 kcal/kg/day for energy and 1.2 g/kg/day for protein, with animal protein constituting 30-35% of total protein intake (22). Recommended macronutrient distribution comprised 20-25% of total energy from lipids (>60% from plant sources) and 55-65% from carbohydrates (22). Weight calculations were adjusted according to the nutritional status as follows: i) Patients with a normal BMI: Current weight used; ii) malnourished patients: Ideal weight calculated as [ideal BMI ($22\ kg/m^2$) x height^2] (23); iii) overweight/obese patients: Adjusted weight=(current weight-ideal weight) x0.33 + ideal weight (21).

Table II. Nutritional values from the 24-h dietary intake of the study participants.

Nutrient	Mean ± SD	Meets the recommended intake, n (%)
Energy (kcal/day)	1433.3±488.5	48 (38.4)
Protein		
Total protein (g/day)	65.6±35.0	56 (44.8)
Animal-to-total protein ratio (%)	58.9±9.8	0 (0)
Lipids		
Total lipids (g/day)	37.7±21.5	25 (20.0)
Plant-to-total lipid ratio	42.9±12.9	9 (7.0)
Carbohydrates (g/day)	208.5±77.7	36 (28.8)
Dietary fiber (g/day)	9.1±7.8	10 (8.0)
Protein:lipid:carbohydrate (%)	(17.9±5.8: 23.0±8.9: 59.1±12.1)	

Statistical analysis. Data processing was performed using EpiData 3.1 software for entry and cleaning. Statistical analyses were conducted using Jamovi 2.3.18 software. Dietary recall data were converted to gram equivalents and analyzed using Eiyokun software for macro- and micronutrient calculations. Data were analyzed using the Kruskal-Wallis test followed by the Dwass-Steel-Crichtlow-Fligner test. A P-value <0.05 was considered to indicate a statistically significant difference.

Results

Of the 125 enrolled patients with ovarian cancer, 56.8% were aged 40-59 years, and 75.2% presented with advanced-stage disease (stages III and IV). Nutritional risk assessment using the PG-SGA tool identified malnutrition in 52.0% of the patients, with 40.0% of the patients were classified as being mild to moderately malnourished (PG-SGA B) and 12.0% as severely malnourished (PG-SGA C). BMI classification indicated malnutrition in 12.0% of the patients and overweight/obesity in 6.4% of the patients. MUAC measurements revealed malnutrition in 20.8% of the study population (Table I).

As regards symptoms affecting dietary intake, appetite loss was predominant (69.6%), followed by fatigue (50.4%), nausea (43.2%), constipation (41.6%), dry mouth (36.0%), taste alterations (33.6%) and smell sensitivity (33.6%). Notably, 23.2% of the participants reported no dietary intake difficulties during the 2-week observation period (Fig. 1).

Weight change analysis revealed that 44.2% of the participants experienced weight loss over a period of 6 months, with 11.6% losing >10% of their body weight. During the most recent month, 17.8% reported weight loss (10.1% experiencing >5% reduction), while 34.1% demonstrated weight gain (Fig. 2).

Dietary assessment revealed a mean daily energy intake of 1,433.3±488.5 kcal, with only 38.4% of the participants meeting the recommended requirements. The mean protein consumption was 65.6±35.0 g/day, with 44.8% achieving recommended levels. Notably, no participants met the recommended animal-to-total protein ratio. The mean lipid intake was 37.7±21.5 g/day, with 20.0% meeting recommendations, while only 7.0% achieved the target plant-to-total liquid ratio. Daily carbohydrate and dietary fiber intake averaged at 208.5±77.7 g and 9.1±7.8 g, respectively, with a compliance rate of 28.8 and 8.0%. The macronutrient distribution exhibited a ratio of 17.9:23.0:59.1 for protein:lipid:carbohydrate percentages of the total energy intake (Table II).

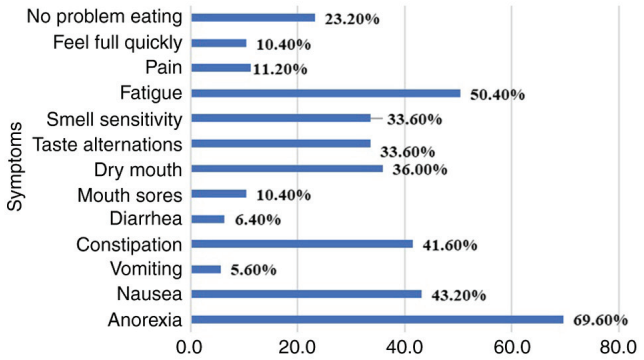

Figure 1. Symptoms affecting dietary intake over the period of 2 weeks.

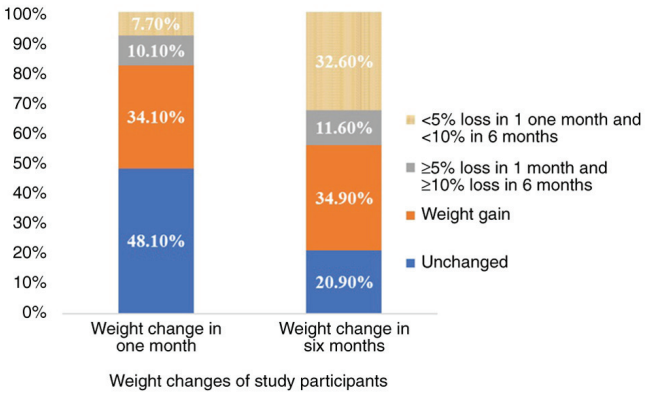

Figure 2. Weight change patterns in the study participants.

As regards vitamins, the proportion of patients meeting the recommended intake was lowest for vitamins A and B2, at 29.6 and 28.0%, respectively. Calcium, iron and magnesium had the lowest rates of meeting the recommended intake (Table III).

Age-stratified analysis revealed declining macronutrient intake with an advancing age. Protein consumption exhibited

Table III. Micronutrient levels in the 24-h dietary intake of the study participants.

Value	Vitamin A (μg)	Vitamin B1 (mg)	Vitamin B2 (mg)	Vitamin PP (mg)	Vitamin C (mg)	Iron (mg)	Calcium (mg)	Calcium/ phosphorus ratio	Magnesium (mg)	Copper (μg)	Zinc (mg)
Mean ± SD	539.4±662.6	2.2±11.3	1.8±9.8	14.9±12.8	166.5±146.1	13.9±13.9	819.5±992.9	0.9±0.8	208.4±188.7	1,134.2±930.5	11.2±38.8
Recommended intake	650-700	1.1	1.2	14	100	17.4-26.1[a]; 6.7-10[b]; 6.3-9.4[c]	800-1,000	0.8-1.5	260-300	900	4.8-16[d]; 4.2-14[e]
Meeting recommendations, n (%)	37 (29.6)	66 (52.8)	35 (28.0)	58 (46.4)	79 (63.2)	23 (18.4)	34 (27.2)	33 (26.4)	30 (24.0)	66 (52.8)	40 (32.0)

Patients aged [a]20-49 years; [b]50-69 years; [c]≥70 years; [d]19-69 years; [e]≥70 years.

the most significant variation, with the youngest age group (18-39 years) consuming higher amounts (91.6±31.5 g/day) compared with the middle-aged (64.1±38.7 g/day) and elderly (59.7±23.6 g/day) participants ($P<0.009$). While disease progression demonstrated a trend toward a decreased nutrient intake across all macronutrients, these differences did not achieve statistical significance ($P>0.05$) across disease stages (Table IV).

Discussion

The present study on 125 patients with ovarian cancer revealed a 52% malnutrition risk based on PG-SGA assessment, substantially higher than the 31% reported in the study by Lieu *et al* (24) on 100 Vietnamese patients with gynecological cancer undergoing chemotherapy at the National Hospital of Obstetrics and Gynecology. The disparity likely reflects the heterogeneous nature of their study population, which included various gynecological malignancies rather than focusing specifically on ovarian cancer.

The findings of the present study demonstrate strong concordance with international data, particularly with those in the study by Terlikowska *et al* (25) on 136 patients with ovarian cancer, which reported a 55.1% malnutrition risk using PG-SGA. This alignment is further supported by the study by Chantragwe and Achariyapota (26) on 97 patients with gynecological cancers in Thailand, documenting a 53.5% overall malnutrition rate, with patients with ovarian cancer exhibiting a high vulnerability at 44.2%. The findings of the study by Laky *et al* (27) reinforce this pattern, demonstrating significantly a compromised nutritional status among patients with ovarian cancer compared with other gynecological malignancies.

Using BMI as an assessment criterion, the present study identified malnutrition in 12% of the patients, consistent with previous studies on Vietnamese patients by Linh *et al* (28) (12% in 50 patients) and Phuong *et al* (29) (15.5% in 129 patients). BMI-based assessment revealed lower malnutrition rates compared to the PG-SGA method, as BMI relies solely on anthropometric measurements. Moreover, the comprehensive evaluation of PG-SGA encompasses gastrointestinal symptoms and clinical parameters, enabling the earlier detection of nutritional risk before notable weight changes manifest.

Dietary analysis revealed a mean daily energy intake of 1,433.3 kcal, with only 38.4% of the patients meeting recommended requirements. This is lower than the 1,536.72 kcal/day reported in the study by Thuy *et al* (30) on patients with gynecological cancers. This difference may be attributed to the superior nutritional status of their cohort, with 88% classified as PG-SGA A, suggesting fewer dietary intake barriers. The findings of the present study also fall below international benchmarks, as evidenced in the Polish study by Surwillo and Wawrzyniak (31) on patients with various types of cancers (lung, breast, bone and soft tissue), which reported a mean intake of 1,608 kcal/day; notably however, only 10% achieved their recommended energy requirements. These variations likely reflect differences in recommended energy intake guidelines and baseline BMI distributions, influencing ideal and adjusted body weight calculations.

Table IV. 24-h dietary values by age group and disease stage.

	Nutrient			
Age group	Energy	Protein	Lipid	Glucide
18-39 years	1740.5±551.4	91.6±31.5	54.0±26.7	222.6±107.1
40-59 years	1390.4±493.7	64.1±38.7	35.4±20.6	210.2±77.0
≥60 years	1366.5±479.0	59.7±23.6	36.6±19.3	200.4±70.2
P-value[a]	0.109	**0.009**	0.076	0.699
Post-hoc test[b]	18-39 group vs. the 40-59 group (P=0.258); 18-39 group vs. ≥60 group (P=0.161); 40-59 group vs. the ≥60 group (P=0.869)	18-39 group vs. the 40-59 group (**P=0.006**); 18-39 group vs. ≥60 group (**P=0.006**); 40-59 group vs. the ≥60 group (P=0.976)	18-39 group vs. the 40-59 group (P=0.079); 18-39 group vs. ≥60 group (P=0.097); 40-59 group vs. ≥60 group (P=0.822)	18-39 group vs. the 40-59 group (P=0.969); 18-39 group vs. ≥60 group (P=0.857); 40-59 group vs. ≥60 group (P=0.848)
Disease stage				
Stage I	1675.1±630.0	74.4±38.9	48.2±28.0	236.6±87.2
Stage II	1420.0±523.7	69.3±34.6	33.2±19.3	212.2±100.3
Stage III	1397.4±461.9	64.1±36.5	36.1±20.0	204.5±72.6
Stage IV	1412.2±416.3	60.8±22.8	41.9±23.1	198.7±17.9
P-value[a]	0.508	0.676	0.334	0.605
Post-hoc test[b]	Stage I vs. stage II (P=0.633); Stage I vs. stage III (P=0.492); Stage I vs. stage IV (P=0.769); Stage II vs. stage III: NS; Stage II vs. stage IV (P=0.999); Stage III vs. stage IV (P=0.965)	Stage I vs. stage II (P=0.999); Stage I vs. stage III (P=0.803); Stage I vs. stage IV (P=0.863); Stage II vs. stage III (P=0.927); Stage II vs. stage IV (P=0.984); Stage III vs. stage IV: NS	Stage I vs. stage II (P=0.320); Stage I vs. stage III (P=0.499); Stage I vs. stage IV (P=0.946); Stage II vs. stage III (P=0.865); Stage II vs. stage IV (P=0.798); Stage III vs. stage IV (P=0.772)	Stage I vs. stage II (P=0.683); Stage I vs. stage III (P=0.706); Stage I vs. stage IV (P=0.842); Stage II vs. stage III (P=0.993); Stage II vs. stage IV (P=0.999); Stage III vs. stage IV (P=0.996)

[a]Data analyzed using the Kruskal-Wallis test followed by [b]the Dwass-Steel-Crichtlow-Fligner test; NS: not significant. Values in bold font indicate statistically significant differences (P<0.05).

The present study demonstrated a mean daily protein intake of 65.6 g, closely corresponding with the findings of the study by Surwillo and Wawrzyniak (31) of 62.7 g per day. Despite a mean animal protein consumption of 58.9 g/day, none of the participants achieved the recommended animal-to-total protein ratio. This deficiency may stem from the misconception of patients that protein is exclusively derived from animal sources, leading to the prioritization of animal proteins, while overlooking plant-based protein sources, such as legumes. Although >50% of the patients met the overall recommended protein intake, the imbalance between animal and plant-based proteins could potentially precipitate digestive complications, particularly constipation due to inadequate fiber intake, as well as deficiencies in essential vitamins, minerals, and antioxidants. The prolonged persistence of this imbalance may elevate the risk of developing metabolic disorders.

The mean daily lipid intake was 37.7 g, with only 20% of the patients achieving the recommended requirement, the lowest compliance rate among macronutrients. This observation aligns with the findings of previous studies on dietary patterns in patients with cancer, which documented similarly low adherence to lipid intake recommendations (24,32). This pattern may reflect traditional Vietnamese dietary preferences, which emphasize natural flavors rather than the butter and cheese-rich preparations common in Western cuisine. Furthermore, the ratio of plant-based to total lipids was suboptimal, likely influenced by high animal protein consumption, which naturally affects the proportion of animal-derived lipids in the diet.

Carbohydrate consumption averaged at 208.5 g daily, exceeding both the findings reported in the study by Surwillo and Wawrzyniak (31) pf 203.1 g and those reported by Byun and Kim (33) of 141.8 g. This elevated intake reflects

characteristic Vietnamese dietary patterns, where carbohydrate-rich staples, rice, corn and sweet potatoes, serve as primary energy sources. The observed macronutrient distribution ratio (protein:lipid:carbohydrate) of 17.9:23.0:59.1 largely aligns with the National Institute of Nutrition's guidelines for adults (22), which recommend proportions of 13-20% protein, 20-25% lipids and 55-65% carbohydrates.

Dietary fiber intake averaged at 9.1 g/day, markedly below the recommended 20-22 g/day for Vietnamese adults (22). The majority of patients exhibited deficiencies in certain vitamins, including vitamin C (85%), vitamin B2 (72%) and vitamin A (70.4%). Mineral deficiencies were similarly prevalent, with inadequate intake of iron (81.6%), magnesium (76%) and calcium (72.8%). These nutritional gaps may stem from disproportionate animal protein consumption, potentially creating imbalances in essential nutrient intake. Research has demonstrated that high fiber intake significantly reduces the risk of developing ovarian cancer compared to a low fiber intake, with consistent findings across American, European and Asian studies (34,35). These results emphasize the importance of dietary guidance focused on enhancing fiber and micronutrient intake among these patients.

The principal strength of the present study lies in its detailed assessment of dietary intake among patients with ovarian cancer undergoing chemotherapy using the 24-h recall method, contributing valuable data to an understudied field. However, certain limitations merit attention. The study population was confined to patients receiving chemotherapy, potentially limiting generalizability. Additionally, while the 24-h dietary recall method provides valuable insights, it may not fully capture long-term dietary patterns, as nutritional status typically reflects cumulative dietary habits. Future studies would benefit from implementing 48-to 72-h dietary assessment to provide more comprehensive evaluations of the nutritional status and eating behaviors of patients.

In conclusion, the present study reveals that patients with ovarian cancer undergoing chemotherapy face substantial malnutrition risks, characterized by inadequate and imbalanced intake of plant and animal-based foods, vitamins, minerals and fiber.

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Availability of data and materials

The data generated in the present study may be requested from the corresponding author.

Authors' contributions

HTL, BVH and TPTD conceptualized and designed the study. HTL, BVH and TPTD performed the statistical analysis. HTL and BVH interpreted the data and drafted the original manuscript. All authors contributed substantially to manuscript revision, critically reviewed the content, and approved the final version. HTL and BVH confirm the authenticity of all the raw data.

Ethics approval and consent to participate

The present study was approved by Hanoi Medical University (Hanoi, Vietnam) under Decision No. 2031/QD-DHYHN dated May 27, 2024, concerning the establishment of the Bachelor of Nutrition Thesis Evaluation Committee for the 2020-2024 cohort. All participants provided written informed consent after receiving detailed information about the study's objectives, procedures, and potential implications.

Patient consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

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