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Alterations in Weight and Body Composition during Neoadjuvant Chemotherapy Treatment

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Abstract

Cancer treatments can significantly affect a patient's nutritional health, with chemotherapy causing changes in weight and body composition that can influence treatment outcomes. This study aims to examine the changes in weight and body composition during the first cycle of neoadjuvant chemotherapy and explore how these changes relate to factors such as gender, age, body fat percentage, tumor location, and time since diagnosis. This study involved 139 patients undergoing cancer treatment, with anthropometric data collected using standard techniques and body composition assessed through bioelectrical impedance analysis. Clinical details were retrieved from hospital records. Across all cancer types and stages, there were significant reductions in body mass index (BMI) and lean mass after four weeks of neoadjuvant chemotherapy (NAC), while fat mass and body fat percentage increased. The proportion of patients with low BMI, reduced muscle mass, and sarcopenic obesity also rose significantly. Approximately 62% of participants lost weight during the study. Men were more likely than women to experience muscle mass loss. Non-overweight individuals were more prone to both weight loss and muscle mass reduction compared to those who were overweight or obese. Patients with colorectal cancer had more than twice the chance of experiencing significant weight loss compared to those with other types of cancer. On the other hand, women with breast or uterine cancer were less likely to lose muscle mass than those with other types of cancer. These findings suggest that NAC can contribute to a higher risk of malnutrition, underlining the importance of early nutritional intervention to address changes in weight and body composition during cancer treatment.

Keywords: Cancer, Chemotherapy, Body composition, Weight loss, Nutritional health

Introduction

Malnutrition is a frequent concern among cancer patients, and it significantly impacts their overall health and treatment outcomes. It is associated with poorer life quality, heightened risks of complications, and a reduced ability to withstand cancer treatments [1, 2].

The Global Leadership Initiative on Malnutrition (GLIM) identifies malnutrition based on three main phenotypic indicators: weight loss, low body mass index (BMI), and muscle mass reduction, alongside two etiological criteria: decreased food intake or absorption, and heightened inflammation or disease burden. For a malnutrition diagnosis, at least one phenotypic and one etiological factor must be present [3].

Between 20-80% of cancer patients experience malnutrition, especially those with gastrointestinal, head,

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and neck cancers. This condition is more prevalent after treatment rather than at the initial diagnosis [2, 4]. Malnourished patients are at greater risk of suffering from weakened immunity, muscle dysfunction, reduced physical abilities, treatment-related toxicities, and slower recovery [1]. Despite its prevalence, cancer-related malnutrition is often underrecognized and insufficiently treated globally [2].

The degree of malnutrition varies across cancer patients depending on tumor type, stage, treatment, and other factors [2]. Tumors and their associated treatments often result in reduced food intake, altered metabolism, inflammation, and disturbances in body processes [5, 6]. These changes can trigger increased glucose production in the liver and elevate the breakdown of proteins and fats to meet the body's energy demands. As a result, cancer patients often lose both muscle and fat mass, due to impaired glucose uptake and increased insulin resistance in key tissues such as the liver, muscles, and fat cells [7]. Chemotherapy, a common cancer treatment, can lead to a range of metabolic and nutritional issues due to side effects like nausea, vomiting, loss of appetite, and involuntary weight loss, all of which can severely affect clinical outcomes [6]. Previous studies have shown that measures like BMI and weight loss percentages are not fully reliable for assessing malnutrition, as weight loss can involve both fat and lean tissue, with varying levels of inflammation [8, 9]. Additionally, BMI and fat-to-lean body mass relationships are complex, and patients with obesity may still develop sarcopenia, which could result in worse clinical outcomes [8, 10, 11]. Although methods like bioelectrical impedance analysis are limited in estimating fat-free mass, the lean body mass index has been suggested as an alternative tool to gauge muscle loss [3].

Changes in weight and body composition are crucial because increases in fat mass or body weight and decreases in muscle mass can raise the risk of cancer recurrence, mortality, and toxicity during treatment [8, 11-13]. However, there is still limited research on the independent prognostic value of weight loss and body composition changes in cancer patients undergoing neoadjuvant chemotherapy, particularly in developing regions.

This study aims to examine the changes in weight and body composition during the first cycle of neoadjuvant chemotherapy and explore how these changes relate to factors such as gender, age, body fat percentage, tumor location, and time since diagnosis.

Materials and Methods

Study design and participants

This observational research was conducted at the Sidi Mohamed Ben Abdellah National Institute of Oncology (NIO) in Rabat, Morocco, from April to July 2022. Cancer patients receiving neoadjuvant chemotherapy at NIO's Day Hospital were invited to participate in the study.

The sample size was calculated following the health study sample size determination guidelines. Considering that cancer-related malnutrition prevalence ranges from 20% to 80% [2], we assumed that at least half of the participants would experience changes in body composition and weight as a result of NAC. With a population proportion of P = 0.50, a confidence level of 95%, and an acceptable margin of error of 10% (d = 0.10), the minimum sample size was estimated to be 96 patients. With a predicted 50% dropout rate by the second NAC cycle, the final number of participants was set to 139.

This study adhered to the ethical standards of the World Medical Association Declaration of Helsinki and was approved by the Biomedical Research Ethics Committee of the Faculty of Medicine and Pharmacy, Rabat (Certificate number: 99/22). All participants were fully informed about the study's objectives and methods, and written consent was obtained. Exclusion criteria included prior chemotherapy treatments, the presence of edema or amputation, and metastatic cancer.

Data collection

Data was gathered at two separate points: during the first round of neoadjuvant chemotherapy and again four weeks later, just before the second chemotherapy cycle. Demographic and clinical details were extracted from the hospital's medical records.

Standardized methods and tools were used to collect anthropometric data. Body weight was measured with a Seca digital scale (150 kg capacity, 100 g accuracy), and height was measured with a portable stadiometer (200 cm capacity, 1 mm accuracy) [14]. BMI was calculated by dividing the weight in kilograms by the square of the height in meters (kg/m^2). According to WHO guidelines, patients were categorized as underweight (BMI < 18.5 kg/m^2), normal weight (18.5 ≤ BMI < 25.0 kg/m^2), overweight (25.0 ≤ BMI < 30.0 kg/m^2), or obese (BMI ≥ 30.0 kg/m^2) [15].

Body composition was assessed using bioelectrical impedance analysis (BIA) with a multifrequency impedance analyzer (Nutriguard-MS; Germany). Measurements were taken with the patient lying down, and electrodes were placed on the right hand and foot, following the manufacturer's instructions. To estimate fat-free mass (FFM), the study used Geneva's equation, which employs resistance (R50) and reactance (Xc50) data measured at 50 kHz. This method is supported by previous research assessing body composition changes in cancer patients using BIA [16-18].

$$FFM\ (Kg) = -4.104 + (0.518 \times (height\ (cm))^2 / R_{50kHz}) + (0.231 \times weight\ (kg)) + (0.130 \times Xc_{50kHz}) + (4.229 \times sex\ [men = 1, women = 0]) \quad (1)$$

Fat mass (FM), body fat percentage (BF%), and fat-free mass index (FFMI) were determined using the following formulas:

$$FM\ (Kg) = Weight\ (Kg) - FFM\ (Kg) \quad (2)$$

$$BF\% = (FM / Weight) \times 100 \quad (3)$$

$$FFMI = FFM/Height^2 \quad (4)$$

Definition of excess body fat and malnutrition criteria

Body fat levels were classified as excessive when the body fat percentage (BF%) exceeded certain thresholds based on age and gender:

- Ages 20–39 years: above 19% for men and 32% for women
- Ages 40–59 years: above 21% for men and 33% for women
- Ages 60–79 years: above 24% for men and 35% for women [19].

Malnutrition was evaluated using the Global Leadership Initiative on Malnutrition (GLIM) guidelines, which include:

1. Low body mass index (BMI), is defined as less than 20 kg/m² for individuals under 70, or below 22 kg/m² for those over 70.
2. Unintentional weight loss in the past 6 months—moderate if over 5%, and severe if over 10%.
3. Reduced muscle mass, is defined as a fat-free mass index (FFMI) of less than 17 kg/m² for men and under 15 kg/m² for women [3].

Participants who showed both high levels of body fat [19] and reduced muscle mass [3] were classified as having sarcopenic obesity.

Statistical methods

All statistical evaluations were conducted using SPSS version 22.0. The Kolmogorov-Smirnov test was applied to check the normal distribution of variables. Descriptive statistics were used to summarize continuous variables (presented as means ± standard deviation) and categorical variables (expressed as percentages). Depending on data type and distribution, comparisons were made using Student's t-test or the Wilcoxon signed-rank test for continuous variables, and the Chi-square test for categorical ones. Logistic regression models (both bivariable and multivariable) were utilized to explore links between weight loss, low muscle mass, and various factors such as sex, age, weight category, fat levels, cancer type, and duration since diagnosis. A p-value of less than 0.05 indicated statistical significance.

Results and Discussion

This cross-sectional study involved 139 cancer patients. The average age of participants was 52.6 years (± 12.1). Based on BMI:

- 3.0% were underweight
- 39.6% were of normal weight
- 30.2% were overweight
- 27.3% were obese

Female patients showed a higher tendency to be overweight, obese, or have excess body fat compared to males. Most participants (66.9%) had breast cancer, followed by colorectal (7.9%), uterine (7.2%), and stomach cancers (3.6%).

Time since cancer diagnosis varied:

- Less than 1 year: 35.3%
- Between 1–2 years: 54.0%
- Over 2 years: 10.8%

Participant characteristics are presented in **Table 1**.

Table 1. Participant characteristics

Variable	Total (n = 139)	Men (n = 21)	Women (n = 118)	P-value
Age (years)	52.62 ± 12.08	60.14 ± 13.74	51.11 ± 10.97	0.001
Weight (kg)	69.94 ± 12.33	65.86 ± 8.35	70.62 ± 12.51	0.026
Height (m)	1.62 ± 0.07	1.71 ± 0.06	1.59 ± 0.06	0.045
BMI (kg/m²)	26.72 ± 5.23	22.01 ± 2.78	27.67 ± 5.10	0.000

BMI Categories

- Underweight: 2.9% total | 14.3% men | 0.8% women (P = 0.000)
- Normal: 39.6% total | 71.4% men | 33.9% women
- Overweight: 30.2% total | 14.3% men | 33.1% women
- Obese: 27.3% total | 0% men | 32.2% women

Cancer site distribution

- Breast: 66.9% overall | 0% men | 78.8% women (P = 0.000)
- Colorectal: 7.9% total | 14.3% men | 6.8% women
- Uterus: 7.2% total | – | 8.5% women
- Stomach: 3.6% total | 9.5% men | 2.5% women
- Lung: 3.6% total | 23.8% men | 0% women
- Others*: 10.8% total | 52.4% men | 3.4% women

Time since diagnosis

- < 1 year: 35.3% total | 42.9% men | 33.9% women (P = 0.000)
- 1–2 years: 54.0% total | 47.6% men | 55.1% women
- 2 years: 10.8% total | 9.5% men | 11.0% women

Body composition

- FFM (kg): 45.56 ± 5.45 | 49.99 ± 6.11 | 44.83 ± 4.91 | 0.010
- FFM%: 66.69 ± 8.19 | 81.06 ± 5.13 | 64.47 ± 6.04 | 0.000
- FFMI (kg/m²): 17.33 ± 1.66 | 16.55 ± 1.22 | 17.45 ± 1.69 | 0.094
- FM (kg): 23.56 ± 8.48 | 11.84 ± 3.83 | 25.47 ± 7.46 | 0.000
- BF%: 33.19 ± 8.22 | 18.93 ± 5.13 | 35.52 ± 6.04 | 0.000
- FMI (kg/m²): 9.13 ± 3.47 | 3.94 ± 1.35 | 9.93 ± 2.94 | 0.000

Body fat categories

- Not excessive: 35% total | 62.5% men | 30.8% women (P = 0.090)
- Excessive: 65% total | 37.5% men | 69.2% women

*Note: Other tumor sites included bladder (n = 4), pancreas (n = 2), prostate (n = 2), kidney (n = 2), gallbladder (n = 1), intestine (n = 1), lymph node (n = 1), and tongue (n = 1).
**Definition for excess fat based on age/gender: 20–39 years (> 19% men, > 32% women), 40–59 years (> 21% men, > 33% women), 60–79 years (> 24% men, > 35% women) [20].

Table 2 outlines the variations in body weight and body composition parameters from the initiation of neoadjuvant chemotherapy (NAC) to four weeks post-treatment. The results indicate a statistically significant increase in fat mass (FM), body fat percentage (BF%), and fat mass index (FMI). In contrast, there was a significant reduction in body weight, body mass index (BMI), fat-free mass (FFM), percentage of fat-free mass (FFM%), and fat-free mass index (FFMI), all with P-values < 0.001.

Table 2. Changes in weight, BMI, and body composition parameters during the first cycle of NAC

Parameter	Mean (SD)	Range	P-value*
Weight (Kg)	Baseline: 69.94 (12.35) Post-treatment: 68.65 (13.35) Change: -1.99% (6.7)	47–106 39–114 -24.2% to 15.1%	0.002
BMI (Kg/m²)	Baseline: 26.72 (5.23) Post-treatment: 26.23 (5.57) Change: -1.99% (6.71)	17.85–44.26 14.87–46.25 -24.24% to 15.07%	0.001

FFM (Kg)	Baseline: 45.56 (5.45) Post-treatment: 42.41 (5.94) Change: -6.98% (4.70)	34.41–58.43 31.42–61.44 -19.23% to 5.15%	< 0.001
FFM%	Baseline: 66.69 (8.19) Post-treatment: 62.85 (8.79) Change: -5.66% (5.51)	54.80–89.59 48.28–89.17 -19.00% to 6.58%	< 0.001
FFMI (Kg/m²)	Baseline: 17.38 (1.67) Post-treatment: 16.16 (1.64) Change: -6.98% (4.70)	14.09–21.35 12.95–19.58 -19.23% to 5.15%	< 0.001
FM (Kg)	Baseline: 23.56 (8.48) Post-treatment: 25.82 (9.04) Change: 11.75% (9.03)	5.37–39.38 6.08–46.54 -34.74% to 59.18%	< 0.001
BF%	Baseline: 33.19 (8.22) Post-treatment: 36.97 (8.82) Change: 12.65% (15.70)	10.41–45.19 10.83–51.71 -30.32% to 56.43%	< 0.001
FMI	Baseline: 9.13 (3.47) Post-treatment: 9.99 (3.67) Change: 11.47% (19.05)	1.86–16.01 1.98–18.88 -34.74% to 59.18%	< 0.001

*P-values were obtained using the Wilcoxon signed-rank test; Abbreviations: BMI = body mass index; FFM = fat-free mass; FFM% = fat-free mass percentage; FFMI = fat-free mass index; FM = fat mass; BF% = body fat percentage; and FMI = fat mass index.

During the first cycle of neoadjuvant chemotherapy, 62% of patients experienced weight loss. Notably, the prevalence of low BMI, low muscle mass, and sarcopenic obesity increased significantly between the start and four weeks after the first cycle, rising from 9.4% to 11.5%, 16.7% to 33.3%, and 5% to 21.7%, respectively, as shown in **Table 3**.

Table 3. Nutritional status of patients before and after the first NAC cycle

Nutritional characteristic	Baseline (%)	Post-treatment (%)	P-value*
BMI categories#	Without low BMI: 90.6 With low BMI: 9.4	Without low BMI: 88.5 With low BMI: 11.5	< 0.001
Weight loss categories†	–	No weight loss: 38.1 Low (< 5%): 38.1 Moderate (5–10%): 12.9 Severe (>10%): 10.8	–
Muscle mass categories§	Normal MM: 83.3 Low MM: 16.7	Normal MM: 66.7 Low MM: 33.3	< 0.001
Sarcopenic obesity‡	Without SO: 95.0 With SO: 5.0	Without SO: 78.3 With SO: 21.7	< 0.001

*P-values are based on the chi-square test.
#Low BMI defined as < 20 kg/m² for individuals < 70 years, or < 22 kg/m² for those > 70 years.
†Weight loss is categorized as low (< 5%), moderate (5–10%), and severe (> 10%).
§Low muscle mass defined as FFMI < 17 kg/m² in men and < 15 kg/m² in women.
‡Sarcopenic obesity is characterized by the presence of both low muscle mass and high body fat.

Men were found to have a significantly higher likelihood of low muscle mass compared to women (OR = 8.14; 95% CI: 1.47–45.18; P = 0.016). Additionally, patients aged 40–59 years were more prone than those aged 60–84 to moderate or severe weight loss and decreased muscle mass, with odds ratios of 1.94 (95% CI: 0.75–5.03) and 2.11 (95% CI: 0.56–7.91), respectively. Individuals with normal weight had greater odds of experiencing moderate to severe weight loss and low muscle mass compared to those who were overweight or obese, with respective ORs of 1.90 (95% CI: 0.86–4.19) and 3.6 (95% CI: 6.89–18.12).

Similarly, patients without excess body fat were at greater risk for moderate to severe weight loss and low muscle mass than those with excess body fat (OR = 3.50; 95% CI: 0.80–15.28 and OR = 6.64; 95% CI: 1.49–29.56, respectively). Concerning tumor sites, patients diagnosed with colorectal cancer were 2.14 times more likely to suffer from moderate to severe weight loss than those with other malignancies. Conversely, women with breast and uterine cancers had a significantly lower risk of low muscle mass compared to individuals with other cancers (OR = 0.07; 95% CI: 0.01–0.64; and OR = 0.06; 95% CI: 0.01–0.82, respectively).

Furthermore, patients diagnosed within the past two years had a slightly reduced risk of experiencing moderate to severe weight loss compared to those with a longer disease duration. However, newly diagnosed patients (< 1 year and 1–2 years) demonstrated higher odds of presenting with low muscle mass relative to those with a cancer history of more than two years (OR = 1.67; 95% CI: 2.29–9.42; and OR = 2.45; 95% CI: 0.39–15.50, respectively) **(Table 4)**.

Table 4. Predictors of moderate/severe weight loss and low muscle mass during the first cycle of neoadjuvant chemotherapy

Variable	% WL	OR (95% CI)	P-value	% LMM	OR (95% CI)	P-value
Sex						
Men	28.6	1.35 (0.48–3.81)	0.573	75.0	8.14 (1.47–45.18)	0.016
Women (Ref.)	22.9	Reference	—	26.9	Reference	—
Age						
27–39 years	20.0	1.14 (0.29–4.45)	0.847	30.0	1.39 (0.24–8.07)	0.712
40–59 years	24.2	1.94 (0.75–5.03)	0.171	39.4	2.11 (0.56–7.91)	0.267
60–84 years (Ref.)	11.8	Reference	—	23.5	Reference	—
Weight status						
Non-overweight	30.5	1.90 (0.86–4.19)	0.110	69.2	3.60 (6.89–18.12)	< 0.001
Overweight/obese (Ref.)	18.8	Reference	—	5.9	Reference	—
Body fat levels						
Without excess fat	40.0	3.50 (0.80–15.28)	0.096	70.0	6.64 (1.49–29.56)	0.013
With excess fat (Ref.)	16.0	Reference	—	26.0	Reference	—
Tumor site						
Breast	19.4	0.62 (0.22–1.70)	0.351	25.0	0.07 (0.01–0.64)	0.019
Colorectal	45.5	2.14 (0.49–9.35)	0.311	60.0	0.30 (0.02–4.91)	0.398
Uterus	30.0	1.10 (0.22–5.51)	0.906	22.2	0.06 (0.01–0.82)	0.035
Other sites (Ref.) e	28.0	Reference	—	83.3	Reference	—
Time since diagnosis						
< 1 year	24.5	0.65 (0.19–2.28)	0.499	32.4	1.67 (0.29–9.42)	0.559
1–2 years	21.3	0.54 (0.16–1.81)	0.321	41.2	2.45 (0.39–15.50)	0.341
> 2 years (Ref.)	33.3	Reference	—	22.2	Reference	—

Notes:

a. Moderate/severe weight loss: ≥ 5% weight loss

b. Low muscle mass (FFMI): < 17 kg/m² for men and < 15 kg/m² for women

c. OR: odds ratio; CI: confidence interval (logistic regression model)

d. Excess body fat defined by age- and sex-specific cutoffs [20]

e. Other tumors include stomach, lung, gallbladder, bladder, intestine, tongue, pancreas, prostate, kidney cancers, and lymphoma

This study aimed to assess the impact of neoadjuvant chemotherapy (NAC) on changes in body weight and composition among cancer patients and to explore which patient characteristics might predict clinically relevant weight loss and muscle depletion during early treatment. Over the four weeks following the first NAC cycle, there

were marked alterations in body composition. Patients experienced an average 7% loss in fat-free mass (FFM) alongside a 12% increase in fat mass (FM), while mean BMI declined by only 2%.

These findings suggest that significant changes in body composition—particularly muscle loss—may occur even when BMI changes appear minimal. This highlights the limitations of BMI as a standalone indicator of nutritional or functional status and supports the value of assessing body composition directly [21]. Although confirmation via advanced imaging techniques such as MRI would enhance precision [22], the results indicate that NAC can promote unfavorable shifts in body composition. Such changes are likely influenced by poor treatment tolerance, reductions in muscle function, and metabolic or hormonal disturbances [23].

The data align with earlier reports demonstrating reductions in FFM and overall weight during NAC among cancer patients [24, 25]. Nonetheless, some prior investigations found no such decline in body composition during similar treatment phases [26, 27]. Our findings reinforce the potential utility of tracking weight and FFM as indicators of nutritional risk. In particular, the early identification of malnourished individuals—using screening protocols shortly after cancer diagnosis—has been shown to enhance nutritional intervention success rates by up to 80%, as reported by Álvaro Sanz *et al.* [28] and Kruizenga *et al.* [29].

Despite increasing evidence that malnutrition in cancer patients negatively impacts clinical outcomes and that nutritional interventions can enhance treatment tolerance, quality of life, and survival rates [2], many malnourished patients go unrecognized and are not referred for nutritional screening and timely dietary intervention [30]. According to Jensen *et al.* [3] and Arends *et al.* [5], the key indicators for diagnosing malnutrition in clinical settings include weight loss, low BMI, and reduced muscle mass. In our study, 86 patients (62%) experienced weight loss between the baseline and four weeks after receiving neoadjuvant chemotherapy, which aligns with prior studies showing a high rate of weight loss among patients undergoing similar treatments [20, 31]. For instance, Fernández López *et al.* [31] reported that 69% of patients lost more than 5% of their body weight within three months of starting chemotherapy, with 43% losing over 10% of their weight.

The percentage of patients with low fat-free mass index (FFMI) increased from 16.7% before chemotherapy to 33.3% after the treatment, while the proportion of those with a low BMI rose by only 2.1%. This suggests that FFMI might provide more precise functional and metabolic insights than BMI alone [32].

Additionally, there was a concerning increase in sarcopenic obesity, where patients have both low muscle mass and high body fat, from 5.0% at baseline to 21.7% four weeks after completing chemotherapy. Previous studies have linked sarcopenic obesity to poorer clinical outcomes and higher mortality rates in cancer patients [10, 33]. Although larger studies are required to explore the effects of changes in fat-free mass (FFM) and sarcopenic obesity in cancer patients, our research underscores the importance of early identification of sarcopenic obesity for implementing appropriate interventions.

Logistic regression analysis showed that men were more likely to experience both weight loss and muscle mass depletion compared to women. This finding is consistent with other studies that suggest male cancer patients are at a higher risk of malnutrition than females [34, 35]. However, some studies have found no significant relationship between sex and muscle mass or weight loss [11, 36]. One possible reason for this is that women undergoing neoadjuvant chemotherapy for breast cancer (which accounted for 66.9% of patients) may have gained weight due to hormone therapy. This could also be influenced by the specific NAC regimen used in this study, including or excluding paclitaxel, and the relatively brief treatment duration. Additionally, a previous study involving breast cancer patients found notable changes in body composition after adjuvant chemotherapy, with an increase in fat mass and a decrease in lean mass [37].

Contrary to earlier studies [25, 38], cancer patients aged 40-59 were found to have a higher risk of weight loss and muscle mass depletion than older patients. Dunne *et al.* [38] reported that cancer cachexia, measured by weight loss, BMI, and muscle mass, is common among older adults. The issue is further compounded by age-related muscle loss and decline in function, a phenomenon known as sarcopenia [39]. While this finding did not reach statistical significance, it is still crucial and should be addressed in larger-scale studies.

We observed that patients who were not overweight were more likely to experience weight loss and a reduction in muscle mass following neoadjuvant chemotherapy (NAC) compared to overweight or obese individuals. Similarly, those with lower body fat percentages had a

higher chance of losing both weight and muscle mass than patients with higher body fat levels. This finding aligns with previous research [40, 41] and reinforces the connection between a higher BMI and better treatment outcomes for cancer patients undergoing chemotherapy [42]. Therefore, it is essential for overweight or mildly obese patients undergoing chemotherapy to focus on maintaining their body weight and increasing lean mass through a healthy diet, exercise, and behavioral therapy [43].

Previous research indicates that the frequency of weight loss and low muscle mass can vary across different cancer types, due to their unique effects on factors such as dietary intake, disease progression, and inflammation [6, 44]. In our study, patients with colorectal cancer were more than twice as likely to experience moderate or severe weight loss compared to those with other cancer types. These results suggest that colorectal cancer patients face a higher risk of both weight loss and muscle mass loss, which are key indicators of malnutrition [45].

Another significant finding was that patients with breast or uterine cancer were less likely to experience low muscle mass. While our study included 139 participants, it is important to note that our sample was diverse, and our conclusions should be interpreted cautiously. Future research should focus on larger groups of cancer patients from specific cancer types to further explore these findings.

In addition, we found that patients who were diagnosed with cancer less than two years ago were less likely to lose weight compared to those diagnosed more than two years ago. This group also had a greater likelihood of experiencing muscle mass loss, likely due to a combination of fat gain and loss of fat-free mass, putting them at an increased risk for sarcopenic obesity [46].

Limitations

There are several limitations to consider in this study. First, the sample size was relatively small, and participants were from a single hospital, with only those who met eligibility criteria and consented to participate included in the analysis. Additionally, this study focused on short-term changes in body weight and composition and did not consider long-term effects in patients undergoing NAC. Furthermore, while bioelectrical impedance is a widely used and practical method to assess body composition, it can introduce measurement bias [47]. Moreover, the study did not collect data on participants' dietary habits or physical activity, both of which can significantly influence body weight and muscle mass [48, 49]. Despite these limitations, our findings contribute valuable insights into cancer-related malnutrition and can aid in the development of effective supportive care for cancer patients [50]. These results may also assist oncologists in better assessing the nutritional status of their patients.

Conclusion

To conclude, our study suggests that NAC may negatively affect nutritional status, with significant weight loss and muscle mass depletion observed in our patient group. These results highlight the importance of early identification and intervention for body composition changes, as timely nutritional support is critical to improving the prognosis and quality of life for cancer patients.

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