Determinants of Weight Loss and Decline in Muscle Strength in Patients with Gastrointestinal Cancer Undergoing Chemotherapy

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Determinantes da Perda de Peso e da Redução da Força Muscular em Pacientes com Câncer do Trato Gastrointestinal Submetidos à Quimioterapia

Determinantes de la Pérdida de Peso y del Deterioro de la Fuerza Muscular en Pacientes con Cáncer Gastrointestinal durante el Tratamiento Quimioterapéutico

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ABSTRACT

Introduction: Gastrointestinal cancers are strongly associated with malnutrition. Additionally, chemotherapy-induced weight loss and declines in muscle strength are significantly linked to adverse clinical outcomes. **Objective:** To evaluate the factors associated with weight loss and decline in muscle strength in patients with gastrointestinal cancer undergoing chemotherapy. **Method:** This prospective observational cohort study included patients diagnosed with gastrointestinal cancer who were scheduled to undergo either neoadjuvant or exclusive chemotherapy. Assessments were conducted before and after the completion of chemotherapy. The Patient-Generated Subjective Global Assessment (PG-SGA), body weight, and handgrip strength (HGS) were measured at both time points. **Results:** Among the 51 patients, 53% had colorectal tumors, 53% were stage III, 76% were malnourished or suspected of being malnourished, and 84% underwent neoadjuvant chemotherapy, with a median follow-up duration of 101 days between pre-treatment consultation and consultation near the end of chemotherapy (interquartile range 58–158 days). A significant reduction in both body weight and HGS was observed in male patients; PG-SGA scores decreased significantly in both sexes. Tumor location and the interval between assessments were independently associated with weight loss. Patients with colorectal and anal canal tumors were nearly three times more likely to maintain or gain weight than those with esophageal or gastric tumors. Sex and treatment duration were significantly associated with changes in HGS. Female patients were 2.3 times more likely to maintain or improve HGS compared to males. **Conclusion:** This study underscores the importance of nutritional monitoring and the assessment of factors related to weight loss and muscle strength to enable the early identification of patients at nutritional risk.

Key words: Nutritional Status/drug effects; Weight Loss/drug effects; Muscle Strength/drug effects; Gastrointestinal Neoplasms/drug therapy; Neoadjuvant Therapy/adverse effects.

RESUMO

Introdução: Tumores do trato gastrointestinal estão associados à alta prevalência de desnutrição, com perda de peso e redução da força muscular associados a pior prognóstico. **Objetivo:** Avaliar determinantes da perda de peso e da força muscular em pacientes com tumores gastrointestinais submetidos à quimioterapia. **Método:** Estudo de coorte prospectivo e observacional com pacientes submetidos à quimioterapia neoadjuvante ou exclusiva, com avaliações antes e após o término do tratamento. A avaliação subjetiva global produzida pelo paciente (ASG-PPP), o peso corporal e a força de preensão manual (FPM) foram mensurados. **Resultados:** Dos 51 pacientes, 53% apresentavam tumor colorretal, 53% estadiamento III, 76% desnutrição ou suspeita de desnutrição e 84% submetidos à quimioterapia neoadjuvante, com mediana de 101 dias entre a consulta pré-tratamento e a consulta próxima ao término da quimioterapia (intervalo interquartil 58–158 dias). Houve redução significativa de peso e FPM em homens e redução do escore da ASG-PPP em ambos os sexos. A localização tumoral e o intervalo entre consultas foram associados à variação de peso. Pacientes com tumor colorretal e de canal anal apresentaram quase 3 vezes mais chance de manutenção/ganho de peso comparado aos tumores de esôfago e estômago. O sexo e a duração do tratamento foram determinantes da FPM. O sexo feminino apresentou 2,3 vezes mais chance de manutenção/ganho de FPM comparado ao sexo masculino. **Conclusão:** Destaca-se a importância do acompanhamento nutricional e da avaliação dos fatores relacionados à perda de peso e à força muscular para a identificação precoce de pacientes em risco nutricional.

Palavras-chave: Estado Nutricional/efeitos dos fármacos; Redução de Peso/efeitos dos fármacos; Força Muscular/efeitos dos fármacos; Neoplasias Gastrointestinais/tratamento farmacológico; Terapia Neoadjuvante/efeitos adversos.

RESUMEN

Introducción: Los cánceres gastrointestinales están estrechamente asociados con la desnutrición. Además, la pérdida de peso y la disminución de la fuerza muscular inducidas por la quimioterapia se asocian significativamente con desenlaces clínicos adversos. **Objetivo:** Evaluar los factores asociados con la pérdida de peso y la disminución de la fuerza muscular en pacientes con cáncer gastrointestinal sometidos a quimioterapia. **Método:** Estudio de cohorte prospectivo y observacional con pacientes sometidos a quimioterapia neoadyuvante o exclusiva, con evaluaciones antes y después del final del tratamiento. Se evaluaron la Valoración Global Subjetiva Generada por el Paciente (VGS-GP), el peso corporal y la fuerza de prensión manual (FPM) en ambos momentos. **Resultados:** De los 51 pacientes, el 53% presentaba tumor colorrectal, el 53% estaba en estadio III, el 76 % presentaba desnutrición o sospecha de desnutrición y el 84% se sometió a quimioterapia neoadyuvante, con una mediana de 101 días entre la consulta pretratamiento y la consulta próxima al término de la quimioterapia (intervalo intercuartílico de 58 a 158 días). Se observó una reducción significativa tanto del peso como de la FPM en los hombres, mientras que la disminución en los puntajes de la VGS-GP se registró en ambos sexos. La localización tumoral y el intervalo entre evaluaciones se asociaron de forma independiente con la pérdida de peso. Los pacientes con tumores colorrectales o del conducto anal tuvieron casi tres veces más probabilidades de mantener o ganar peso en comparación con aquellos con tumores esofágicos y gástricos. El sexo y la duración del tratamiento se asociaron significativamente con los cambios en la FPM. El sexo femenino presentó 2,3 veces más probabilidades de mantener o ganar FPM en comparación con el sexo masculino. **Conclusión:** Este estudio destaca la importancia del monitoreo nutricional y la evaluación de los factores relacionados con la pérdida de peso y la fuerza muscular para permitir la identificación temprana de pacientes en riesgo nutricional.

Palabras clave: Estado Nutricional/efectos de los fármacos; Pérdida de Peso/efectos de los fármacos; Fuerza Muscular/efectos de los fármacos; Neoplasias Gastrointestinales/tratamiento farmacológico; Terapia Neoadyuvante/efectos adversos.

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INTRODUCTION

Cancer incidence and mortality follow an upward trajectory worldwide, being one of the main causes of death in several countries. On a global scale, 10.5 million deaths are expected for men and 8 million for women for the year 2050. Gastrointestinal tumors stand out among the five most frequent types, especially those located in the colon, rectum, and stomach[1,2].

Malnutrition, a condition frequently observed in cancer patients[3], is related to tumor-induced metabolic alterations, but also to treatment's side effects[4]. Chemotherapy, particularly, can worsen the decline in nutritional status by triggering symptoms like anorexia, nausea, vomiting, mucositis, dysgeusia, xerostomia, and alterations to the evacuation pattern, which compromise food intake and depletion of body reserves[5-8].

Weight loss is one of the main clinical signs observed in cancer patients and can be associated with the tumor's location, disease staging, and type of oncological treatment[9,10]. Socioeconomic factors, such as educational level, health access, and occupation, on the other hand, may also impact nutritional status[11]. Tumors located in the upper gastrointestinal tract present a greater risk of weight loss and compromising nutritional status due to associated nutritional impact symptoms[6-9,12-14]. Additionally, the magnitude of weight loss is directly associated with a worse prognosis[15].

During oncological treatment, it is common to observe a decline in hand grip strength (HGS) values – a simple method that helps assess muscle strength[16-18]. Its reduction is associated with negative outcomes, such as an increase in treatment toxicity, higher incidence of postoperative complications, and lower survival[19-22].

In this sense, it is key to conduct early nutritional assessments, especially for those with gastrointestinal tumors, understanding the factors that affect nutritional status, with the goal of promoting nutritional intervention at the right time. Considering that patients with gastrointestinal tumors present a greater risk of malnutrition and that weight loss and HGS are associated with higher toxicity, chemotherapy, and lower survival[6-22], exploring the determinants that affect body weight and muscle strength in this group of patients is highly relevant. Therefore, the objective of this study was to assess determinants for weight loss and decline in muscle strength, in addition to changes to nutritional status, body weight, and HGS in patients with gastrointestinal tumors submitted to chemotherapy.

METHOD

Observational, prospective cohort study, derived from a main research project sub-analysis.

The study included patients from both sexes, aged 20 years or older, who had a primary esophagus, stomach, pancreas, colorectal, and anal canal tumor, recently enrolled in the National Cancer Institute's Cancer Hospital I (*Hospital do Câncer I* – HC I/INCA) to begin chemotherapy treatment, either exclusive or associated with neoadjuvant or exclusive radiotherapy. To be eligible, patients had to have attended at least one nutritional consultation before beginning treatment and one near the end of treatment.

The study excluded individuals with stromal, neuroendocrine tumors, lymphomas, sarcomas, synchronic tumors, patients undergoing palliative chemotherapy, in ongoing oncological treatment at the time of collection, and with a performance status of 4 in the Eastern Cooperative Oncology Group (ECOG)[23] performance scale.

Data collection was conducted between August 2021 and October 2024. The research recruited patients with a gastrointestinal cancer diagnosis and referral for chemotherapy, previously identified as eligible by consulting the institutional enrollment lists, who were later cared for by the HC I/INCA nutrition outpatient clinic.

During the first consultation, the patients were invited to participate in the study, and those who agreed to participate signed a Free and Informed Consent Form. Everyone was informed of the possibility of dropping out of the study at any time and had the opportunity to clear up doubts with the team responsible. They were followed up throughout the chemotherapy treatment and assessed at least twice: in the pre-chemotherapy outpatient clinic consultation and at the end of the chemotherapy and/or radiotherapy protocol. At each consultation, a nutritional status and muscle strength assessment was conducted. The patients received nutritional guidance regarding their comorbidities and specific individual needs[24,25], and those classified as malnourished or at nutritional risk were then referred to oral or enteral support; the criteria used were: Patient-Generated Subjective Global Assessment (PG-SGA) B or C, food intake <75% over the last 2 weeks for adults (<60 years) or <60% for more than 5 days for the elderly (≥60 years); weight loss ≥5% in 1 month or ≥10% in 6 months; nutritional impact symptoms that last more than 3 days; high metabolic demand diseases and/or advanced cancer and large surgeries[24-27].

The nutritional follow-up periodicity was based on nutritional status assessment. Patients who presented moderate or suspected malnutrition returned in 30 days, and those with no malnutrition returned in 60 days.

The nutritional state assessment was conducted by a nutritionist trained in this protocol.

Body weight and stature were measured and used for calculating the body mass index (BMI), through the weight/stature² (kg/m²), and classified according to the World Health Organization (WHO) criteria for adults[28] and the Pan American Health Organization (PAHO) for elders (aged ≥60 years)[29]. Weight (kg) was measured by using an electronic digital scale (Filizola®), with a maximum capacity of 180 kg and 0.1 kg precision. The measurement was conducted with the patient positioned at the center of the scale, standing straight, with arms on the side of the body, eyes fixed on the horizon, barefoot, and wearing light clothes. Next, height (cm) was measured by using a stadiometer attached to the scale, registering the closest centimeter as soon as the horizontal rod touched the top of the patient's head.

PG-SGA is composed of two main sections. The first was answered by the patient or their caregiver and covers information on weight loss (box 1), food intake (box 2), presence of nutritional impact symptoms (box 3), and functional capability (box 4). The second section was filled by the professional in charge, who included clinical data such as comorbidities, diagnosis, and therapies that increase energy expenditure, in addition to a physical exam targeted at analyzing muscle and fat tissue reserves, and hydration status. By the end of the assessment, the scores attributed to each item were added up, and patients were classified according to the following categories: A – well-nourished; B – suspected or moderate malnutrition; and C – severe malnutrition[30,31].

HGS was assessed using a Jamar® (Sammons Preston®, USA) hydraulic dynamometer. The test was conducted with the patient sitting down, elbows flexed at 90°, and using both hands. After three maximum isometric contractions, the highest measure recorded was considered for analysis.

The sociodemographic and clinical information were extracted from the electronic medical chart, and included: age, sex, race, presence of comorbidities, tumor location, performance status, tumor clinical staging, and data related to the established oncological treatment. Next, the variables were divided into categories, considering:

Adult (20-59 years) and elder (≥60 years) age groups, biological sex (masculine and feminine), race/skin color determined by self-declaration, according to the classification established by the Brazilian Institute of Geography and Statistics: white, black, brown, yellow, and indigenous[32], comorbidities according to the most prevalent (systemic arterial hypertension, diabetes *mellitus*, and cardiovascular diseases in general) or presence of multiple comorbidities, tumoral location per anatomical site (stomach, esophagus, colorectal, anal canal), staging following the Union for International Cancer Control's (UICC) Classification of Malignant Tumors (TNM)[33], in addition to ECOG's[23] performance status. Regarding oncological treatment, the categories were divided by treatment protocol and/or chemotherapy combinations most used in the Institution, chemotherapy goal (neoadjuvant or exclusive), and by undergoing concomitant radiotherapy or not.

The statistical analysis was conducted using the SPSS[34] program, version 21 (SPSS for Windows). The normality of numerical variables' distribution was verified by the Kolmogorov-Smirnov test, being expressed as average and standard deviation or median and interquartile range, according to data distribution. The categorical variables were presented as absolute values and frequencies. To compare the values for weight, BMI, HGS, total PG-SGA score, and the four main tool boxes (box 1 – weight loss; box 2 – food intake; box 3 – symptoms of nutritional impact, and box 4 – functional capability) from the first to the second consultation, the Wilcoxon[35] test for paired samples was used. The linear regression test was conducted to define the variation determinants (delta) of weight and muscle strength, such as sex, age, tumoral location and staging, performance status, time between consultations, duration of chemotherapy treatment, concomitant radiotherapy, and type of chemotherapy protocol. (Delta) Variation was obtained from the difference between weight and strength values recorded on the consultation near the end of chemotherapy treatment and on the pre-treatment consultation. Variables with $p<0.20$ in the univariate analysis were selected for multivariate analysis. Statistical significance of $p<0.05$ was considered, with a confidence interval of 95%.

Considering that this study presents preliminary data and uses a convenience sample, we chose not to calculate the sample size. Moreover, no similar studies were identified in the literature that could serve as a basis for estimating the sample power.

This research project has been approved by INCA's Research Ethics Committee, report number 6758988 (CAAE (submission for ethical review): 46304721.4.0000.5274), in compliance with Resolution 466/2012 of the National Health Council[36].

RESULTS

A total of 63 patients were selected, of which 51 met the eligibility criteria, being thus included in the study. The reasons for excluding 12 patients were loss of follow-up (n=3), absent or incomplete data on chemotherapy treatment (n=4), and incomplete nutritional data (n=5).

The main clinical and sociodemographic characteristics and treatment protocols of the studied population are shown in Table 1.

In the first nutritional consultation pre-chemotherapy treatment, despite most patients showing eutrophic and overweight according to the BMI (n=17, 33% and n=16, 31%, respectively), 76% (n=39) of patients presented malnutrition or suspected malnutrition according to the PG-SGA (classification B and C), and 24% (n=12) were well nourished (classification A).

The median of the period between the first pre-treatment consultation and the consultation next to the end of chemotherapy was 101 days (interquartile range: 58–158 days) and chemotherapy duration was 77 days (interquartile range: 48–145 days). The number of nutritional consultations varied from two to six during the period. Individuals who had only two nutritional consultations presented a median of 58 days between appointments (interquartile range: 47–111 days), while the individuals who had five to six appointments presented a median of 170 days (interquartile range: 153–215 days), respectively.

Comparison between nutritional status and HGS of patients between the first consultation (pre-treatment) and the nutritional consultation close to the end of treatment is shown in Table 2. There was a decrease in body weight, BMI, and HGS for men and a decrease in the total PG-SGA score for both sexes ($p<0.05$), with 76% of patients classified as malnourished (classification B or C) at the first appointment and 51% at the second. Additionally, scores from boxes 1, 2, and 3 of the PG-SGA referring to weight loss, food intake, and symptoms, respectively, decreased ($p<0.05$). However, the box 4 (functional capability) score did not show changes between appointments (Table 2).

Table 3 presents the variation determinants in body weight and HGS. Body weight variation determinants were tumoral location and time between consultations (days), while sex and duration of chemotherapy treatment (days) were associated with HGS variation in the multivariate analysis ($p<0.05$). Patients with colorectal and anal canal tumors were nearly three times more likely to maintain or gain weight throughout the treatment than those with tumors in the esophagus or stomach. Regarding HGS, female patients were 2.3 times more likely to maintain or improve HGS compared to males (Table 3).

DISCUSSION

This study observed significant weight, BMI, and HGS reduction in men, while decreasing the PG-SGA score for both sexes. Tumoral location and time between consultations were independently associated with weight variation, while sex and chemotherapy treatment duration were associated with HGS variation.

Table 1. General characteristics of the population and treatment protocols for patients with gastrointestinal tract tumors, between August 2021 and October 2024

Variables	Total (n=51)
Age, years [mean ± SD]	58.6 ± 12.19
Age group [n(%)]	
Adult	25 (49%)
Elder (≥ 60 years)	26 (51%)
Sex [n (%)]	
Man	25 (49%)
Woman	26 (51%)
Race [n (%)]	
Black	11 (22%)
Brown	22 (43%)
White	18 (35%)
Location of tumor [n (%)]	
Esophagus	11 (21%)
Stomach	8 (16%)
Colorectal	27 (53%)
Anal canal	5 (10%)
Initial performance status [n (%)]	
0	10 (20%)
1	38 (74%)
2	2 (4%)
3	1 (2%)
Cancer stage [n (%)][a]	
II	9 (18%)
III	26 (53%)
IV	14 (29%)
Comorbidities [n (%)]	
No comorbidities	26 (51%)
Systemic arterial hypertension	18 (35%)
Cardiovascular diseases	1 (2%)
More than one comorbidity[b]	6 (12%)
Chemotherapy objective	
Neoadjuvant	43 (84%)
Exclusive	8 (16%)
Chemotherapy protocols	
XELOX[c]	18 (36%)
Carboplatin and paclitaxel	8 (16%)
Exclusive capecitabine	7 (14%)
FLOT[d]	7 (14%)
FOLFOXIRI/FOLFIRINOX[e]	3 (6%)
Capecitabine and cisplatin	4 (7%)
Others[f]	4 (7%)
Concomitant radiotherapy	
Yes	37 (73%)
No	14 (27%)

Captions: SD = standard deviation; [a]n=49; [b]Systemic arterial hypertension and cardiovascular disease or systemic arterial hypertension and diabetes *mellitus*; [c]XELOX: oxaliplatin and capecitabine; [d]FLOT: docetaxel, oxaliplatin, and fluoruracil; [e]FOLFOXIRI/FOLFIRINOX: oxaliplatin, fluoruracil, and irinotecan; [f]more than one protocol type or modified protocols.

Table 2. Nutritional status and muscle strength of patients with gastrointestinal tract tumors on pre-treatment and post-treatment, analyzed from August 2021 to October 2024 (n=51)

Variables	Pre-Treatment	Post-Treatment	*p*
Body weight, kg [median (IQR 25; 75)]			
Total	67 (58.8; 73.5)	64.4 (55.2; 71.1)	0.001[a*]
Men	69.9 (60.5; 76.90)	65.7 (57.2; 72.5)	0.001[a*]
Women	64.1 (56.3; 72.4)	61.4 (54.5; 69.2)	0.155[a]
BMI, kg [median (IQR 25; 75)]			
Total	25.1 (21.5; 28.3)	23.8 (20.6; 26.6)	0.001[a*]
Men	24.6 (20.5; 27.9)	22.8 (19.7; 26.4)	0.001[a*]
Women	26.2 (22.6; 28.7)	25.1 (20.92; 28.1)	0.135[a]
HGS, kg [median (IQR 25; 75)]			
Total	29 (20; 40)	25 (20; 38)	0.005[a*]
Men	40 (32.5; 46)	38 (27; 42.5)	0.010[a*]
Women	20 (18; 25)	20 (18; 21.2)	0.257[a]
PG-SGA score, points [median (IQR 25; 75)]			
Total	10 (4; 16)	4 (2; 10)	0.001[a*]
Men	10 (3.5; 15.5)	4 (3; 9)	0.017[a*]
Women	10 (4.7; 17.2)	4 (2; 11.2)	0.011[a*]
Box 1 score: weight loss, points [median (IQR 25; 75)][b]			
Total	1 (0; 3)	0 (0; 1)	<0.001[a*]
Men	1 (0.5; 3)	0 (0; 1)	0.002 [a*]
Women	1 (0; 3)	0 (0; 1)	0.032 [a*]
Box 2 score: food intake, points [median (IQR 25; 75)][b]			
Total	1 (0; 1.2)	0 (0; 1)	<0.001[a*]
Men	1 (0; 1)	0 (0; 1)	0.005[a*]
Women	1 (0; 2)	0 (0; 1)	0.004[a*]
Box 3 score: symptoms, points [median (IQR 25; 75)][b]			
Total	4 (0; 7)	0 (0; 4)	0.002[a*]
Men	4 (0; 6)	1 (0; 4)	0.031[a*]
Women	4 (0; 8.5)	0 (0; 3.5)	0.025[a*]
Box 4 score: functional capability, points [median (IQR 25; 75)][b]			
Total	1 (0; 1)	1 (0; 2)	0.128[a]
Men	1 (0; 1)	1 (0; 1)	0.557[a]
Women	1 (0; 2)	1 (0; 2)	0.177[a]

Captions: PG-SGA = patient-generated subjective global assessment; HGS = hand grip strength; IQR = interquartile range; BMI = body mass index; [a]Wilcoxon Test; [b]n=46; [*]$p<0.05$.

Several studies conducted with patients who present gastrointestinal tumors and were submitted to chemotherapy demonstrate that weight loss and muscle strength are frequent during treatment[6-8,17-22].

Periodical nutritional follow-up is essential for maintaining nutritional status during oncological treatment[27,37]. Freitas et al.[38] demonstrated that patients with colorectal cancer who received nutritional guidance during chemotherapy did not show reduced protein intake and maintained their weight and HGS[38]. Although the presented results showed that weight variation was directly proportional to the time between nutritional consultations, that is, each additional day between consultations resulted in a 0.03 kg body weight increase, individuals who presented a longer interval between consultations had more nutritional appointments. In this sense, the present study corroborates the importance of nutritional follow-up and is in line with the literature findings.

Another weight loss determinant observed in this study is tumor location. Patients with stomach and esophagus tumors presented a higher risk for weight loss compared to patients with colorectal and anal canal tumors. The

Table 3. Linear regression for body weight and muscle strength variation determinants for patients with gastrointestinal tract tumors assessed between August 2021 and October 2024

Variables	Δ body weight (kg)				Δ HGS (kg)			
	Univariate		Multivariate		Univariate		Multivariate	
	β (CI 95%)	*p*	β (CI 95%)	*p*	β (CI 95%)	*p*	β (CI 95%)	*p*
Age (years)	-0.06 (-0.16; 0.04)	0.252			0.01 (-0.08; 0.12)	0.718		
Sex (woman vs. man)	2.2 (-0.31; 4.71)	0.086	0.95 (-1.33; 3.23)	0.415	2.35 (-0.01; 4.72)	0.052	2.39 (0.13; 4.65)	0.038*
Tumor location (colorectal and anal canal vs. esophagus and stomach)	4.18 (1.77; 6.59)	0.001*	2.83 (0.12; 5.55)	0.040*	0.60 (-1.92; 3.14)	0.638		
Cancer stage (II and III vs. IV)[a]	0.06 (-2.86; 2.98)	0.967			-1.51 (-4.26; 1.23)	0.280		
Performance status (0 vs. 1, 2, and 3)	-0.58 (-3.82; 2.66)	0.726			-0.42 (-3.51; 2.67)	0.789		
Time between consultations (days)	0.02 (0.007; 0.04)	0.009*	0.03 (0.001; 0.06)	0.047*	-0.01 (-0.03; 0.008)	0.241		
Chemotherapy treatment duration (days)	0.01 (-0.003; 0.03)	0.094	-0.02 (-0.05; 0.008)	0.158	-0.02 (-0.04; -0.002)	0.030*	-0.02 (-0.04; -0.003)	0.022*
Concomitant radiotherapy (Yes vs. No)	1.33 (-1.53; 4.20)	0.361			0.73 (-2.01; 3.48)	0.60		
Chemotherapy protocol (Xelox[b] vs. others[c])	4.16 (1.72; 6.61)	0.001*	2.27 (-0.57; 5.1)	0.117	-0.63 (-3.2; 1.94)	0.632		

Captions: HGS = hand grip strength; CI = confidence interval; [a]n=49; [b] XELOX: oxaliplatin and capecitabine; [c]carboplatin and paclitaxel, FLOT (docetaxel, oxaliplatin, and fluoruracil), FOLFOXIRI/FOLFIRINOX (oxaliplatin, fluoruracil, and irinotecan), and more than one protocol type or modified protocols; *$p<0.05$

severity of weight loss varies according to the location of the tumor[6-10,12,14]. Upper digestive tract cancers were among the locations at higher risk for malnutrition in a national multicenter study that assessed the nutritional status of 4,783 cancer patients[3]. A study with patients with gastric and colorectal tumors showed a significantly higher risk for malnutrition and muscle depletion in those with gastric tumors when compared to the colorectal location[14].

Regarding weight and muscle strength changes according to sex, a study conducted with 1,500 patients with chronic diseases, including cancer, found reduced muscle strength and body weight for both sexes. However, like the findings of the present study, men presented a greater reduction in muscle strength and weight loss compared to women[39].

The different nutritional states found for men and women are discussed in the literature. Al-Bayyari, Hailat, and Baylin[14] analyzed the risk of malnutrition and muscle mass loss for men and women with gastric and colorectal cancer and observed that men presented a higher risk for malnutrition compared to women. Xie et al.[15] also found severe weight loss associated with males in patients with solid tumors[15]. Another study, which assessed patients with head and neck cancer in healing radiotherapy or chemoradiotherapy, highlighted that men presented a higher caloric deficit and weight loss and a greater risk for malnutrition compared to women[40]. The authors discussed that women possibly presented better adherence to nutritional therapy and sought medical care more frequently than men[40].

Metabolic, hormonal, and genetic differences can help understand how men and women present distinct responses to muscle mass loss during oncological treatment. Men present more muscle mass and less body fat compared to women. However, the male sex responds more exaggeratedly to inflammation and has distinct signaling pathways and regulatory mechanisms, which lead to a greater loss of muscle mass compared to women[40-42]. In addition, there is a reduction in the testosterone serum levels during chemotherapy treatment, which can accelerate the loss of muscle mass and strength in men[42,43].

As previously mentioned, despite the present study showing a reduction in body mass and HGS in men, there is a decrease in the prevalence of malnutrition and suspected malnutrition, according to the PG-SGA, associated with a score reduction in both sexes. Carriço et al.[44] demonstrated that nutritional impact symptoms presented a positive association with the presence of

malnutrition in oncological patients in chemotherapy[44]. Another work also found a reduction in the proportion of malnourished individuals with colorectal and gastric cancer during chemotherapy, from 53% to 21%[7]. The authors discuss that improvement in the nutritional status indicated by the tool may be related to the potential effects of nutritional intervention during the treatment.

The present research hypothesizes that the change in the prevalence of malnutrition indicated by the reduction in the PG-SGA score between consultations may be explained by nutritional guidance, which possibly helped manage the nutritional impact symptoms, alleviating them. Thus, the scores attributed to the boxes referring to weight loss, food intake, and mainly symptoms, decreased, which improved the nutritional status.

This study reinforces the importance of periodical nutritional follow-up and the need for preserving nutritional status during oncological treatment. The obtained results offer relevant support to the clinical practice of professionals who work in oncological care, by identifying the main determinants for loss of weight and muscle strength. These findings allow for early interventions, from the detection of associated factors — like sex, treatment duration, tumoral location, and frequency of nutritional follow-up — to building the basis for more customized therapeutic decisions.

The strong aspects of this study include its prospective character and fresh perspective on the assessment of weight and strength loss in patients with gastrointestinal tract cancer submitted to exclusive or neoadjuvant chemotherapy. However, this work presents some limitations. The reduced sample size and heterogeneity of the sample did not allow us to draw definitive conclusions, since we assessed individuals with different tumoral locations and chemotherapy protocols, which made it unfeasible to stratify them per tumoral sites and chemotherapy protocols. Therefore, it was necessary to group them in the analysis of determinants of variation in body weight and muscle strength. Moreover, the differences in the time range between consultations and chemotherapy duration may affect the generalization of the findings. These results must then be carefully appreciated, since a close nutritional follow-up can improve adherence to guidance and contribute to better symptom control. Treatment duration, in turn, can influence the severity and duration of side effects. Finally, data on food intake was not available, and the assessment of body composition could not be conducted. Information on food intake could help clarify the differences observed in the loss of weight and muscle strength among men, as well as allow for the analysis of its association with these variables. Moreover, the lack of data on body composition impaired the identification of the body compartments most affected by the weight loss and the investigation of its possible associations with the reduction of muscle strength, considering the noteworthy influence of these changes on oncological treatment tolerance.

CONCLUSION

It was demonstrated during chemotherapy that men presented a reduction in weight and HGS, and that both sexes presented a reduction in the PG-SGA score. Weight variation was associated with the time between nutritional consultations and tumor location, while variation in muscle strength was associated with sex and duration of the chemotherapy treatment. We highlight the importance of nutritional follow-up during the whole oncological treatment and the need to assess determinants for loss of weight, HGS, and muscle mass in further studies for early identification of patients with a greater risk of nutritional status decline. Further studies with a larger sample size should address these nutritional changes, with emphasis on the differences between sexes and tumoral location, correlating objective data with nutritional assessment tools to better clarify these findings.

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CONTRIBUTIONS

All the authors have substantially contributed to the study design, data acquisition, analysis, interpretation, wording, and critical review. They approved the final version for publication.

DECLARATION OF CONFLICT OF INTERESTS

There is no conflict of interest to declare.

DATA AVAILABILITY STATEMENT

The data should be requested from the corresponding author due to restrictions related to confidentiality and privacy protection of the study participants.

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