ORIGINAL ARTICLE

Association Between Body Composition and Protein Intake Among Patients With Breast Cancer in Klang Valley

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ABSTRACT

Introduction: Cancer is a catabolic disease that can significantly impact dietary intake and body composition of the patients. This study aimed to evaluate the association between dietary intake and body composition of patients with breast cancer. **Materials and Methods:** This cross-sectional study involved patients with breast cancer stage I-III visiting a state hospital and a cancer support centre. Socio-demographic, medical history, anthropometric, and dietary data were collected. Body composition was evaluated using a bioimpedance analyser and handgrip strength was assessed using a hand dynamometer. Sarcopenia was defined by low appendicular skeletal muscle index and low handgrip strength according to the cutoff values recommended by the Asian Working Group for Sarcopenia. The associations between the parameters were analysed. **Results:** A total of 71 patients with median age of 60.7 (50.6 - 67.1) years were recruited. The median BMI of the patients was 25.1 (21.8 – 29.8) kg/m with majority being obese (55%). About one-third were sarcopenic. The mean energy and protein intake adjusted by body weight were 20 ± 8 kcal/kg/day and 0.9 ± 0.4 g/kg/day, respectively. While no correlation was found between protein intake and skeletal muscle mass, protein intake was negatively correlated with fat mass (r = -0.247, p = 0.038) and fat mass index (r = -0.275, p = 0.020). **Conclusion:** Sarcopenia was prevalent among patients living with breast cancer and most patients did not meet their nutrition requirements. Protein intake potentially influences body composition, particularly fat mass. These findings warrant the importance of individualised nutritional care for cancer.
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Keywords: Breast cancer, Body composition, Sarcopenia, Nutritional intake, Dietary Protein

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INTRODUCTION

Breast cancer is the 2nd most frequently diagnosed cancer and amongst the leading cause of cancer deaths in the globe (1). In Malaysia, there were 26,758 new cases of cancer reported among the female population in 2020 and about one-third were breast cancer (2). The incidence of breast cancer can be observed among women of all age groups after puberty and is on an increasing trend (2). Cancer patients are susceptible to malnutrition owing to the metabolic alteration brought by the primary tumours and the damages of body cells from the anticancer treatments such as surgery, chemotherapy, radiotherapy, and pharmacological therapies (3). Cancer patients could present with a diversity of nutrition status where obesity was more likely associated with breast and prostate cancers while undernutrition was more pronounced in lung, colorectal, and head-and-neck cancers (4). With this, current literature was reporting a range of malnutrition between 20 and 70% among various cancer types including breast cancer. Of those, 10 to 20% of cancer deaths were attributed to malnutrition (5). In the absence of nutrition intervention, the nutritional status of the cancer patients could be exacerbated, and this poses negative effects on clinical outcomes, including infectious and non-infectious complications, poorer disease prognosis, longer length of hospital stays, more frequent hospital readmission, and increased risk of mortality (6).

Unlike patients with cancers involving metabolically

demanding organs, breast cancer patients are often presented with high body mass index which is classified as overweight or obesity (7). Body mass index does not depict body composition and is not sufficient to reflect the nutrition status of the patients (8). As the cancer disease progresses, the patients could experience body composition changes such as increased fat mass and decreased skeletal muscle mass regardless of weight status (9,10). It is noteworthy that low muscle mass was found to be prevalent among patients with cancer including those who were newly diagnosed (11). One study published in the Italian population compared the body composition of patients with stage 0-3 breast cancer to the healthy counterparts (9). It was reported that sarcopenia was prevalent in patients with breast cancer and sarcopenic patients had significantly lower fat-free mass than non-sarcopenic patients (9). A systematic review published by Roberto et al (2024) reported that 33% of breast cancer patients were sarcopenic and most of them were with non-metastatic breast cancer (12). The changes in body composition following disease trajectories have gained interest in clinical settings over the years. Nevertheless, existing literature used different tools such as the computed tomography (CT) for skeletal muscle index and the dual-energy x-ray absorptiometry (DEXA) or bioimpedance analyser (BIA) for appendicular lean mass index to evaluate body composition and various criteria to define the presence of sarcopenia and sarcopenic obesity in cancer setting (10,12). More studies are thus needed to provide data on the prevalence of muscle loss or reduced muscle mass and strength in the local population using the appropriate ethnic-specific criteria to ascertain the needs of nutrition intervention for the intended population.

A local study further reported that breast cancer survivors were overweight or obese after being diagnosed for 3 years despite having suboptimal dietary intake (13). Decreased food intake or appetite is one of the major components in determining malnutrition and it is associated with reduced muscle strength, mobility, and physical performance, leading to increased hospital mortality (14,15). The European Society of Clinical Nutrition and Metabolism (ESPEN) recommended energy intake that is similar to a healthy population for the cancer patients in view of increased metabolism but reduced physical activity among them (16). As for protein requirement, an increased need above 1g/kg/day up to 1.5g/kg/day is recommended for patients living with cancer to minimise muscle protein breakdown and preserve muscle mass (16). While protein is a building block of muscle, current recommendations are guided by net muscle protein balance but not adjusted to body composition or lean muscle mass (11). It is thus essential to conduct more research to substantiate the association of protein intake with body composition which help to improve outcomes of patients living with cancer.

Malnutrition and sarcopenia in cancer are multifactorial and can occur prior to diagnosis of disease or develop along the disease trajectory. A robust understanding of the nutrition status and body composition of the cancer population are warranted in maintaining patients' nutrition status leading to better clinical outcomes, better quality of life and eventually lesser healthcare costs. Therefore, this study aimed to determine dietary intake and body composition of patients with breast cancer as well as the association between these parameters.

MATERIALS AND METHODS

Study design

This cross-sectional study was conducted at Hospital Kuala Lumpur (HKL) and the National Cancer Society Malaysia (NCSM) from December 2023 to March 2024. This study was approved by the Malaysian Medical Research and Ethics Committee (Project number: NMRR ID-23-02909-O6k (IIR)) and the IMU University Joint Committee on Research and Ethics (Study number: BDN I2023 (04)).

Sample size calculation

The sample size calculation was based on a moderate correlation coefficient of r = 0.30 (17). With a significance level at 5% and a power of 80%, a minimum of 67 participants was required. A total of 80 participants would be enrolled after accounting for a 20% dropout rate.

Study setting and participants

The screening of patient, recruitment of subject and study data collection were conducted at the surgical outpatient clinic of Hospital Kuala Lumpur (HKL) and the Resources & Wellness Centre of the National Cancer Society Malaysia (NCSM). Potential patients were approached with a study information sheet detailing the objectives, benefits and risks of the study prior to obtaining informed consent. Patients who provided written informed consent was screened for eligibility. Patients who were diagnosed with stage 1-3 breast cancer, female from all ethnicities, and aged 18 years and above were included. Patients who had metastasized breast cancer, were primarily diagnosed with other types of cancers, currently undergoing chemotherapy and/or radiotherapy, pregnant or lactating, diagnosed with any type of mental illnesses, liver or kidney disease, or critically ill were excluded from this study.

Data collection and outcomes measures

Sociodemographic and medical data

Sociodemographic data including age, ethnicity, and household income was obtained through structured interviews using a questionnaire. Medical data such as cancer staging, previous treatment received including surgery, chemotherapy, radiotherapy and

hormonal therapy, and underlying comorbidities such as the presence of diabetes mellitus, hypertension and hypercholesterolemia were extracted from medical records.

Anthropometric measurements

Body weight (kilograms) was measured using a calibrated digital scale (Tanita HD-325, Tanita Corporation, Japan) with a graduation of 0.1kg. Prior to measurement, patients were asked to void and remove their accessories, belts, jackets, and shoes. The reading was taken with patients standing upright on the weighing scale. Height (centimetres) was measured with a portable stadiometer (Seca 213, Seca, Germany) with a graduation of 0.1cm. Patients were positioned with the head in the Frankfurt plane and the back forming a straight line to the hip while leaning against the stadiometer. The reading was taken with the measurer positioned at eye level with the ruler. Both weight and height were measured twice. The average weight and height were used to calculate body mass index (BMI) using the formula of weight in kilograms divided by height in metres squared and further categorised according to the World Health Organization (WHO) BMI Classification in Asian population (18).

Body composition

Body composition data were measured using a bioelectrical impedance analyser (SECA mBCA 525, Seca, Germany). Body composition data being measured were total skeletal muscle mass, regional muscle mass including both arms, both legs and torso, fat mass, and total body fat percentage. Before measuring, patients were asked to be properly hydrated and empty their bladder. Patients would require lying flat for a minimum of 10 minutes in order to achieve body fluid equilibrium. Patients' upper and lower extremities were not touching each other or their bodies. Two electrodes were then placed on each extremity, and each was connected to a cable that would send current through the eight electrodes to generate the data on body composition based on the impedance. The measurement took about 20 seconds to complete. The data on muscle mass was categorised based on the criteria of the Asian Working Group on Sarcopenia (AWGS) for women (below 5.7 kg/m2) (19).

Muscle strength

Muscle strength in terms of handgrip strength (kilograms) was measured using a hand dynamometer (JAMAR, Roylan, UK) that measures up to 90 kgF with a graduation of 1kgF. Patients were seated upright, and the elbow of their dominant hand was kept at 90°. Upon measurement, they were encouraged to squeeze the handle with maximum strength on the count of three. The measurement was repeated twice with a one-minute interval between attempts to prevent fatigue. The highest value was used for analysis. The reading of handgrip strength was classified based on the criteria of the Asian Working Group on Sarcopenia (AWGS) for women (below 18kgF) (19).

Presence of Sarcopenia

The assessment of sarcopenia was based on the criteria of the Asian Working Group on Sarcopenia (AWGS) (19). Patients with hand grip strength below 18 kg indicated probable sarcopenia. Loss of muscle mass defined by height-adjusted muscle mass of below 5.7 kg/m2 when using a bioimpedance analysis for body composition assessment confirmed the presence of sarcopenia.

Dietary intake

Dietary intake was collected through structured interviews using a 7-day diet history. Patients were probed to provide the descriptions and portion sizes of food and beverages consumed in a week. Household measurement tools were used to aid in recalling during the dietary assessment. The intake of each food and beverages was then converted to grams with reference to the Nutrient Composition of Malaysian Food (20) or the Singapore Energy and Nutrients Composition of Food (21) to be used in analysis. For commercial food items, nutrition information panel was referred to obtain the nutrient composition of the portion consumed. The dietary data were analysed using a nutrient analysis software (NutriPro™, Axxya, USA) to derive the daily energy and macronutrient intake. The energy and protein intake of the patients were evaluated against the recommendations of ESPEN guidelines on clinical nutrition in cancer (16,22).

Misreporting of energy intake (EI) was assessed by calculating the ratio of reported EI to estimated basal metabolic rate (BMR), referred to as the EI:BMR ratio. Estimated BMR for participants in this study was derived using the Mifflin St. Jeor (1990) equation (23) with physical activity level of 1.4. Patients with EI:BMR ratio of less than 1.00 was regarded as under-reporters, 1.00 to 2.39 was acceptable and above 2.39 was considered as over-reporters (24). However, under- and over-reporters were not excluded from the analysis, as this study aimed to evaluate the dietary intake of all recruited patients with breast cancer.

Statistical analysis

Data were analysed using the Statistical Package for the Social Sciences (SPSS, version 28.0; IBM, U.S.). The normality of baseline data distribution was evaluated with the Kolmogorov-Smirnov test. Data that were normally distributed were presented in means ± standard deviations (SD), while non-parametric data were presented in medians with interquartile ranges. Categorical data were presented in counts and percentages. Spearman's correlation test was used to examine the associations between protein intake, body composition, and handgrip strength. P value of < 0.05 was considered statistically significant for all analyses.

RESULTS

A total of 90 patients were invited for the study. Among them, 16 patients were ineligible as they did not meet the inclusion criteria (n=2) or declined to participate (n=14). There were 74 patients enrolled in the study. However, 3 patients were excluded in the final analysis due to incomplete data.

Table I describes the characteristics of patients. The median age of the patients was 60.7 (50.6 - 67.1) years with cancer staging I to III. One patient was diagnosed clinically with early-staged breast cancer that was amenable to curative surgical treatment. Most patients underwent surgery such as mastectomy and axillary clearance, mastectomy alone, and lumpectomy owing to the cancer staging. Other cancer treatments undergone by patients included chemotherapy (63.4%), hormonal therapy (57.7%), and radiotherapy (45.1%). The most common comorbidities among the patients were hypertension (31.0%), hypercholesterolemia (28.2%), and diabetes mellitus (19.7%).

Table I: Characteristics of patients with breast cancer (n=71)

Variables	Total N = 71
Age (years)	60.7 (50.6 - 67.1)
Cancer stage	
Stage I	16 (22.5)
Stage II	35 (49.3)
Stage III	19 (26.8)
Not staged	1 (1.4)
Previous Treatment Received	
Surgery	50 (70.4)
Chemotherapy	45 (63.4)
Radiotherapy	32 (45.1)
Hormonal therapy	41 (57.7)
Comorbidities	
Diabetes mellitus	14 (19.7)
Hypertension	22 (31.0)
Hypercholesterolemia	20 (28.2)
Others [a]	17 (23.9)

All values are expressed as n (%), except for age, which is presented as median (Q1–Q3).

[a] Other comorbidities include hyperthyroidism, asthma, osteoarthritis, osteoporosis and gastroesophageal reflux disease.

Table II presents the anthropometry, body composition, handgrip strength and dietary intake of the patients. Most patients were classified as obese (54.9%), followed by normal weight (29.6%) and overweight (11.3%). In terms of body composition, almost all patients (97.2%) had low muscle mass indicated by appendicular muscle mass index below the cut-off value recommended for female Asian population (19). The fat mass of the patients was 26.5 (19.8 - 31.3) and the fat mass percentage was 42.4 ± 9.2%. For muscle strength, about one-third of the patients (26.8%) reported low handgrip strength. When appendicular skeletal muscle index and handgrip strength were evaluated for the presence of sarcopenia (19), about one-third (27%) of the patients met the criteria of being sarcopenic. In terms of dietary intake of the patients, about 38% of patients under-reported their energy intake and none was over-reporter. The mean energy intake of the patients was 1210 ± 318 kcal/day. After adjusting to body weight, the mean energy intake was 20 ± 8 kcal/kg body weight/day. The carbohydrate, protein and fat intakes constituted 47.8%, 17.3% and 33.4% of total energy intake, respectively. The patients had a mean protein intake of 52 ± 18 g/day which corresponded to 0.9 ± 0.4 g/kg body weight/day. When the dietary intake of the patients was evaluated against the nutrition recommendations of ESPEN on clinical nutrition in cancer (16) , most patients were found to have energy (85%) and protein intake (86%) below the recommended ranges.

Table II: Anthropometry, body composition, handgrip strength and dietary intake of patients (n= 71)

Variable	Total N = 71
Weight (kg)	61.5 (52.6 – 71.9)
Height (cm)	155.4 ± 5.3
Body Mass Index (kg/m²)	25.1 (21.8 – 29.8)
Underweight, < 18.5	3 (4.2)
Normal, 18.5 – 22.9	21 (29.6)
Overweight, 23.0 – 24.9	8 (11.3)
Obese, ≥ 25.0	39 (54.9)
Total muscle mass (kg)	15.1 ± 4.4
Appendicular skeletal muscle mass (kg)	9.2 ± 2.4
Appendicular skeletal muscle index (kg/m²)	3.8 ± 0.9
Low [a]	69 (97.2)
Body fat mass	
Fat mass (kg)	26.5 (19.8 - 31.3)
Fat mass percentage (%)	42.4 ± 9.2
High [b]	58 (83.1)
Fat mass index (kg/m²)	10.6 (8.0 - 13.6)
Handgrip strength (kgF)	21 ± 4
Low [a]	19 (26.8)
Energy intake (kcal/day)	1210 ± 318
Energy intake (kcal/ kg body weight/ day)	20 ± 8
Carbohydrate intake (g/day)	144 ± 49
%Total energy intake	48 ± 10
Protein intake (g/day)	52 ± 18
Protein intake (g/ kg body weight/ day)	0.9 ± 0.4
%Total energy intake	17 ± 4
Fat intake (g/day)	45 ± 18
%Total energy intake	33 ± 8

All values are expressed as mean ± SD, except for weight, body mass index (BMI), body fat mass, and fat mass index, which are presented as median (Q1–Q3), and for categorical variables such as BMI category, low appendicular skeletal muscle mass, high fat mass percentage, and low handgrip strength, which are expressed as n (%).

[a] Classification was based on the cutoff values established by AWGS: appendicular skeletal muscle index < 5.7kg/m² and handgrip strength <18kgF for women.

[b] Classification was based on the American Journal of Clinical Nutrition for women aged 20–39 years (21–32%), 40–59 years (23–33%), and 60–79 years (24% -35%)

Table III presents the comparison of muscle mass and handgrip strength across patient characteristics. Muscle mass did not differ significantly across any of the patient characteristics. In contrast, handgrip strength showed significant differences for several variables. A one-way ANOVA revealed a significant difference in mean handgrip strength across cancer stages ($F(2, 67) = 3.42$, $p = 0.039$, $\eta^2 = 0.093$). However, post hoc comparisons did not identify any significant differences between individual stages (all $p > 0.05$). Patients with diabetes mellitus had significantly lower handgrip strength compared to those without diabetes (18 ± 5 kgF vs. 22 ± 4 kgF, $p = 0.006$). Interestingly, patients who had previously received chemotherapy exhibited significantly higher handgrip strength than those who had not (22 ± 4 kgF vs. 19 ± 5 kgF, $p = 0.013$).

Table III: Comparison of total muscle mass and handgrip strength with patients' characteristics (n=71)

Variables	Total Muscle Mass		Handgrip Strength	
	Mean ± SD	*p value*	*Mean ± SD*	*p value*
Cancer Stage		0.229		0.039*
Stage I	14.4 ± 3.5		20 ± 5	
Stage II	15.9 ± 4.7		22 ± 4	
Stage III	13.9 ± 4.3		19 ± 4	
Comorbidities				
Diabetes Mellitus		0.676		0.006*
Yes	14.6 ± 3.8		18 ± 5	
No	15.2 ± 4.5		22 ± 4	
Hypertension		0.957		0.739
Yes	15.1 ± 3.3		21 ± 5	
No	15.1 ± 4.8		21 ± 4	
Hypercholesterolemia		0.942		0.555
Yes	15.0 ± 3.7		20 ± 5	
No	15.1 ± 4.6		21 ± 4	
Past Treatment Received				
Surgery		0.105		0.521
Yes	14.5 ± 4.0		21 ± 5	
No	16.4 ± 4.9		21 ± 4	
Chemotherapy		0.250		0.013*
Yes	15.5 ± 4.6		22 ± 4	
No	14.3 ± 3.8		19 ± 5	
Radiotherapy		0.911		0.216
Yes	15.1 ± 4.4		22 ± 4	
No	15.0 ± 4.4		20 ± 5	
Hormonal Therapy		0.593		0.170
Yes	15.3 ± 4.8		20 ± 4	
No	14.8 ± 3.7		22 ± 5	

Differences between groups were analysed using independent t-tests for two groups and one-way ANOVA for three or more groups. Post hoc comparisons were performed using the Bonferroni test. * p value < 0.05 was considered statistically significant.

Table IV reports the associations between protein intake, body composition and handgrip strength. It was observed that protein intake was not significantly correlated with total muscle mass and appendicular skeletal muscle index. Nevertheless, statistically significant negative correlations were shown between protein intake and fat mass ($r = -0.247$, $p = 0.038$) and fat mass index ($r = -0.275$, $p = 0.020$). In terms of handgrip strength, no significant correlation was found between protein intake and handgrip strength ($r = 0.136$, $p = 0.260$).

Table IV: Association between protein intake, body composition and handgrip strength (n=71)

Variables	*r value*	*p value*
Total muscle mass (kg)	-0.065	0.589
Appendicular skeletal muscle index (kg/m^2)	-0.086	0.478
Fat mass (kg)	-0.247	0.038*
Fat mass index (kg/m^2)	-0.275	0.020*
Fat mass percentage (%)	-0.173	0.148
Handgrip strength (kgF)	0.136	0.260

Correlations between variables were analysed using the Pearson correlation test. *p value < 0.05 was considered statistically significant.

DISCUSSION

This study provided insight into the body composition of patients with breast cancer and contributed to the limited evidence on the association between body composition and dietary intake among them. Despite high BMI, sarcopenia and inadequate dietary intake were prevalent among patients with breast cancer. Dietary protein intake plays a potential role in influencing body composition, particularly fat mass. These findings highlighted the needs of nutritional assessment in cancer and could guide personalised nutritional care to optimise the nutritional status of breast cancer patients for better health outcomes.

Our study demonstrated that the majority (66.2%) of breast cancer patients were overweight or obese. This finding was similar to local studies conducted among breast cancer survivors in Klang Valley (66.5%) (25) and the East Cost of Peninsular Malaysia (75.8%) (26). Obesity is a major risk factor of breast cancer, and it is associated with poorer health outcomes, increased risk of cancer mortality, and recurrence (27–29). For patients who are undergoing anticancer treatment, obesity may impose a higher risk for postoperative complications, adverse effects of radiotherapy or chemotherapy, and reduced efficacy in endocrine therapy (30). However, it is crucial to note that significant weight loss for patients undergoing treatment is significantly associated with mortality and obesity shows a paradoxical protective effect to improve cancer prognosis and survival (31,32). It is interesting to note that some chemotherapy regimens could induce weight gain in breast cancer patients (33). When the body composition of breast cancer patients undergoing chemotherapy was evaluated, there was a marked increase in total and central adiposity with significant loss of appendicular skeletal muscle mass

(34). This strongly suggests a need to assess the body composition of breast cancer patients regardless of their weight status in addition to routine nutrition assessment for individualised nutrition care.

Our study reported that almost all of patients (97.2%) exhibited low skeletal muscle mass. When handgrip strength was taken into account for sarcopenia assessment based on the recommendation of the Asian Working Group for Sarcopenia (AWGS), approximately one-third of the patients were classified as sarcopenic. Jang et al (2024) systematically reviewed 12 studies and found a mean sarcopenia prevalence of 32.5% among women with stage I-III breast cancer (35), which is similar to our study. Assessment of sarcopenia has gained interest in clinical setting over the years due to its prognostic value in cancer (36). Although our study did not observe significant difference in muscle mass across different cancer staging and past cancer treatments received, studies consistently reported that reduced muscle mass and impaired muscle strength could occur to cancer patients before and after anticancer treatment, exacerbating their nutritional and functional status without causing weight change (37–39). The mobilisation of skeletal muscle in the presence of cancer tumours could be mediated by cytokines, such as interleukin-6 (IL-6) and tumour necrosis factor-α (TNF- α) (40). These cytokines are pro-inflammatory and could promote muscle proteolysis, creating a more favourable environment for tumour growth (40). In addition to that, cancer treatments including surgery, chemotherapy, radiation, and long-term oestrogen suppression have shown to be associated with muscle loss (41,42). Breast cancer patients were also found to have low physical activity level since diagnosis of cancer (43) and limited studies demonstrated that reduced physical activity level could potentially play a role in negative change in body composition of breast cancer patients (44). Ongoing muscle loss in cancer could negatively impact on cancer survival by increasing the risk of adverse clinical outcomes, reducing treatment efficacy, increasing chemotherapy toxicity, increasing postoperative complications, and cancer mortality (9,36). The unfavourable changes in body composition could persist for years after completion of treatment, adversely affecting long-term prognosis and increasing the risk of developing other comorbidities (42). Hence, it is essential to monitor the change in body composition and presence of sarcopenia in breast cancer patients during the disease trajectory for a holistic care to improve treatment outcomes. Besides that, more studies are also needed to understand the implications of body composition on patients' treatment outcomes to determine optimal strategies to minimise the deterioration of muscle mass for better survival and quality of life of breast cancer patients.

In the present study, cancer patients having diabetes mellitus as their comorbidity exhibited significantly lower handgrip strength compared to those without diabetes. Previous literature suggested that patients with diabetes had significantly reduced muscle strength and quality compared to their counterparts after adjustment with sex and age (45). Although the underlying mechanisms linking handgrip strength and diabetes has not yet fully understood, cohort studies suggest that this could be partially mediated by chronic inflammation in diabetes disease (46). Notably, diminished handgrip strength has been associated with increased risk of developing diabetes and its complication such as diabetic nephropathy (47). Interestingly, our study reported a debatable finding that patients who had previously undergone chemotherapy demonstrated significantly higher handgrip strength than those who had not. While chemotherapy is often associated with catabolism in terms of muscle loss and functional decline (48), our result needs to be interpreted with caution as a greater proportion of recruited patients had received chemotherapy. Additionally, it is possible that patients who completed chemotherapy had recovered some degree of physical function by the time of assessment. These findings underscore the complexity of cancer nutrition care and the importance of considering treatment status, timing, and functional reserve when evaluating muscle strength in breast cancer.

Besides that, the majority of breast cancer patients in our study reported poor dietary intake that did not meet the energy and protein recommendations by the European Society on Clinical Nutrition and Metabolism (ESPEN) (16). Similar findings could be observed in other studies published locally. Jamhuri et al (2017) studied on patients with cancer upon admission to a national institute for treatment and reported that their energy and protein intake were 1463 ± 577 kcal/day and 54 ± 22 g/day, respectively, which were below the recommended intake (49). Similarly, Menon et al (2014) reported energy and protein intake of 1296-1498 (1088-1927) kcal/day and 55-57 (26-60) g/day, respectively, among newly diagnosed patients receiving treatment at a university hospital (50). Patients could experience changes in dietary intake following cancer diagnosis owing to the effects of tumour and its treatments including reduced appetite and taste alteration (51,52). Limited access to high-quality protein sources further contributes to low protein intake in these patients (51,53). Achieving energy and protein requirements are crucial for cancer. Research has shown that muscle protein synthesis is not blunted in cancer (16) and adequate protein could support muscle anabolism, preserve muscle mass, and regulate physiological functions, which are essential for maintaining nutritional status and immune function (10,53). Hence, ESPEN guidelines recommended nutrition intervention in the form of dietary advise and oral nutritional supplements to be provided to malnourished patients or those at risk of malnutrition in order to improve their oral intake (16). Nevertheless, this study did not observe significant differences in dietary

protein intake between patients with and without sarcopenia. This is likely due to the overall poor protein intake of the patients, indicating the importance of early provision of nutritional care and subsequent follow up to optimise patients' nutrition status in cancer.

Studies on dietary intake and muscle protein synthesis in cancer are generally scarce. It is necessary to understand the relationship between protein intake and body composition in cancer to ascertain the amount required to increase or preserve muscle mass. A systematic review published by Capitao et al (2022) revealed that cancer patients undergoing chemo- and radiotherapy were experiencing muscle wasting when having protein intakes below 1.2 g/kg body weight, despite the recommended intake of protein being at least 1.0g/kg body weight by ESPEN. It was noteworthy that only those with protein intakes above 1.4 g/kg body weight showed muscle maintenance (54). Another study on stage III ovarian cancer receiving chemotherapy also found that skeletal muscle mass improvement was more pronounced among underweight patients with protein intake above 1.2g/kg body weight (55). The patients in our study generally had low protein intake (0.9 g/kg body weight) which may explain the insignificant correlation between protein intake and skeletal muscle mass demonstrated. However, the finding on significant negative correlation between protein intake and fat mass in our study could support the potential of dietary intake in optimising body composition of cancer patients. It also adds to the evidence in supporting the ESPEN and local nutritional recommendations for protein intake of at least 1.0g/kg body weight and up to 1.5 g/kg body weight (16,56).

Several strengths were identified in this study. Firstly, this study objectively and robustly assessed body composition using bioimpedance analyser which is a validated tool. Secondly, the identification of sarcopenia was based on ethnic-specific criteria. It was indicated by handgrip strength and height-adjusted muscle mass using the gender-specific cutoff values established by the Asian Working Group for Sarcopenia (19). Despite the limited existing literature for direct comparison, the findings of this study provide valuable insights into the muscle status of patients with stage I–III breast cancer and may serve as a useful reference for future research. Meanwhile, the authors acknowledged some limitations of this study. Dietary data collected using a 7-day diet history may potentially introduce recalling bias which may cause misreporting and about one-third of the patients under-reported their dietary intake according to Goldberg cutoff criteria. Although we employed multiple strategies including detailed probing and the use of household measurement tools to minimise this, under-reporting remains a common limitation in dietary assessment. Future studies may consider objective biomarkers or technology-assisted dietary assessment methods to further improve accuracy. Besides that, our study did not find significant difference in protein intake between patients with and without sarcopenia given that all patients had low protein intake. However, there were some potential correlations between protein intake and body composition, especially fat mass. In addition to that, although our study did not observe significant differences in body composition across patients' characteristics, we did observe significant associations between previous chemotherapy treatment, diabetes mellitus and handgrip strength. These findings should be interpreted with cautions as the sample size may not have been sufficiently powered to support subgroup analyses. Future research could include a larger sample size that allow subgroup analyses for various patients' characteristics to ascertain their relationship with nutrition status.

CONCLUSION

Patients with breast cancer exhibited a high BMI and a high prevalence of sarcopenia. The majority of these patients do not meet their nutritional requirements. Protein intake correlated with body composition, particularly with fat mass, highlighting the potential of dietary intake to improve body composition. These findings underscore the importance of routine nutrition assessment and provision of individualised nutritional care to optimise nutritional status following breast cancer diagnosis and treatment.

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