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Research Article

Nutritional Status of Women Diagnosed With Breast Cancer

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Background and Objectives: Breast cancer patients are at high risk of malnourishment. However, data concerning the nutritional status of breast cancer patients are very limited. We aimed to assess the nutritional status and diet of women diagnosed with breast cancer.
Methods: A total of 32 women diagnosed with breast cancer were included in this cross-sectional study. Patients were recruited via an online survey that was distributed in multiple social media applications as well as shared in oncology clinics. Demographic data were collected via the online survey, while dietary data were collected during a phone interview.
Results: Prevalence of overweight and obesity among study samples was 18.8% and 56.3%, respectively. Only 18.8% of the patients reported visiting a dietitian, while 59.4% of the patients met the recommendation of free sugar intake of < 5%. Most of the patients (81%) did not meet their energy requirements, whereas none of the patients met their protein requirement. Diet quality score and dietary intake were not associated with dietitian visit or stages of breast cancer. Stepwise regression analysis indicated significant association between iron intake and weight status ($B = -1.56$, SE = 0.69, and [95% confidence interval (CI): −2.97–−0.15]). Results also indicated that age and percentage of free sugar from total energy predicted BMI of patients (age: $B = 0.20$, SE = 0.08, and [95% CI: 0.06–035]; percent of free sugar: $B = 0.66$, SE = 0.24, and [95% CI: 0.18–1.15]). Weight status was significantly associated with adequacy of energy intake.
Conclusions: High prevalence of overweight and obesity, high intake of free sugar, and limited intake of protein were observed among women diagnosed with breast cancer. There is an urgent need to provide nutritional care for breast cancer patients in Saudi Arabia that is delivered by experienced dietitian to improve the nutritional status of these patients.

Keywords: breast cancer patients; diet quality; dietary intake; nutritional status; women

1. Introduction

Breast cancer is the most diagnosed cancer in women worldwide. It accounts for 25.2% of total female cancer cases, and it is the leading cause of death among all other female cancers [1]. The incidence of breast cancer cases among Saudi women increased significantly from 545 cases in 2001 to 2460 cases in 2017. This increase could be attributed to several factors, including changes in dietary habits and lifestyle, increasing rates of obesity, delayed childbearing, and the expansion of national screening programs [2]. Multiple treatments options are available for breast cancer patients including adjuvant and/or neoadjuvant chemotherapy, radiotherapy, and hormonal therapy [3]. These treatments could cause loss of appetite and may affect food intake due to their side effects such as nausea, vomiting, constipation, diarrhea, mouth sores, and dysphagia. Thus, breast cancer patients are at a high risk of malnutrition, which could affect the efficacy of their treatment and the disease prognosis [4].

Previous studies showed high prevalence of overweight and obesity among breast cancer patients [5, 6]. In fact, the body composition of these patients contains less muscles and more fat, and this increased weight at the time of diagnosis is associated with poor prognosis [7, 8]. Healthy nutrition plays an important role in disease progression, as diet low in fat and high in fiber, vegetables, fruit, and other nutrient improves overall survival for breast cancer patients [9–13]. Therefore, the European Society for Clinical Nutrition (ESPEN) guidelines recommends performing a comprehensive nutritional assessment after cancer diagnosis, with continuous monitoring and implementation of nutritional interventions as needed [14]. Limiting added/free sugar intake is recommended due to its direct link with increased risk of cancer as well as increase the development and progression of the disease [15]. Specific recommendations were also developed concerning energy and protein requirements for breast cancer patients that are important in fighting infections and heal tissues after surgery, radiation therapy, or chemotherapy [16].

Breast cancer patients experience psychological issues like anxiety, distress, fear of recurrence, depression, and sexual dysfunction that can impact appetite, quality of life, and treatment compliance [17–19]. Additionally, cancer treatments such as chemotherapy may affect body metabolism and appetite, consequently leading to malnutrition and poor health outcomes [20]. Thus, it is important to assess nutritional status and monitor breast cancer patients during their treatment to provide proper nutrition management plans that aim to optimize the nutritional health of these patients and increase their chance of survival. However, data concerning the nutritional status of breast cancer female patients are lacking in Saudi Arabia. We aimed in the current study to assess the nutritional status and diet of female patients diagnosed with breast cancer in Madinah, Saudi Arabia.

2. Methods

2.1. Study Design and Population. A cross-sectional study that recruited Saudi breast cancer female patients 18 years or older who live currently in Madinah, Saudi Arabia. Online consent was obtained from each participant before the data were collected. Ethical approval was obtained from the College of Applied Medical Sciences Ethical Committee at Taibah University, Madinah, Saudi Arabia (2023/156/107 MLT), and from the Academic, Training and Research Affairs Administration at Al-Madinah Health Cluster (IRB23-022).

2.2. Data Collection. The study participants were recruited using an online survey which was distributed via social media platforms such as *X* and WhatsApp. Additionally, posts with a barcode to the survey link were distributed in the oncology clinic at King Salman General Hospital in Madinah to invite breast cancer patients to participate in the study. The survey collected sociodemographic data, height, and weight, sleeping hours, medical history, number of dietitian visits, and patients' phone numbers. A phone interview was later conducted to collect dietary data (dietary intake and diet quality).

2.3. Assessment of Weight Status. Women diagnosed with breast cancer were asked to report their height and weight via the online survey. Height and weight were used to calculate the body mass index (BMI). The World Health Organization (WHO) cutoff points were used to identify weight status of patients (underweight BMI: $< 18.5\,kg/m^2$; healthy weight BMI: $18.5–24.9\,kg/m^2$; overweight BMI: $25–29.9\,kg/m^2$; and obesity BMI: $\geq 30\,kg/m^2$) [21].

2.4. Assessment of Dietary Intake. Dietary intake data, not considering the use of supplements, were assessed using multiple 24-h dietary recalls for at least two nonconsecutive days during a phone interviews. A trained data collector asked breast cancer female patients to recall all food items consumed in the previous 24 h. To further aid the determination of the food amounts, patients were asked to choose a picture from the food-serving size guide shared earlier via WhatsApp that represents the amount consumed of each food item. Food items consumed were recorded in a hard copy for each patient then were entered into the Nutritics software (Version 5.64, Dublin) to analyze dietary data. Numerous Middle Eastern recipes are available in the Nutritics database; when a particular food recipe was unavailable, the ingredients were manually entered into the system based on a standard recipe. Two experts in the field of nutritional assessment provided training on dietary data collection and oversaw the data entry of the 24- hour dietary recalls.

Dietary adequacy for energy was calculated based on minimum energy requirement of 25 kcal/kg/day for each patient, while dietary adequacy for protein was calculated based on minimum protein requirement of 1.2 g/kg/day [14]. Fiber intake was compared with the minimum recommendation of 24 g/day [22] whereas free sugar intake was assessed based on the recent recommendation developed by the WHO which limit free sugar intake to $< 5\%$ from total energy intake per day [23]. Groups were later created to identify groups for energy, protein, and fiber with adequate and inadequate intake, while free sugar intake was categorized into two groups (not exceed the WHO recommendation of free sugar intake of $< 5\%$ of total energy intake vs. exceeded the WHO recommendation of free sugar intake of $\geq 5\%$ of total energy per day).

2.5. Assessment of Dietary Quality. The short-form food frequency questionnaire (SFFFQ) was used to evaluate the diet quality of each breast cancer female patient. The SFFFQ tool was developed by Cleghorn [24] and used among healthy individuals and cancer patients of Saudi Arabia [25, 26]. During the phone interview, the data collection team member directed patients to correctly response to items included in the SFFFQ. The SFFFQ included 20 food items: "1) fruits, 2) fruit juice, 3) salad, 4) cooked vegetables,

5) fried potatoes/chips, 6) beans or legumes, 7) fiber-rich breakfast cereal, 8) whole wheat bread, 9) cheese/yoghurt, 10) crisps/savory snacks, 11) sweet biscuits, 12) ice cream/cream, 13) fizzy drinks/pop, 14) beef or lamb, 15) chicken or turkey, 16) processed meats/meat product, 17) processed chicken/turkey, 18) fried white fish, 19) white fish, and 20) oily fish." Food frequencies for items 1–13 were as follows: "Never or Rarely," "< 1 time per week," "1 time per week," "2–3 times per week," "4–6 times per week," "1–2 times per day," "3–4 times per day," and "≥ 5 times per day." Food frequencies for items 14–20 were as follows: "Never or Rarely," "< 1 time per week," "1 time per week," "2–3 times per week," "4–6 times per week," and "≥ 7 times per week." The frequency of consumption was recorded in a hard copy then entered into an Excel sheet, and an automatic calculation was made of the overall score for diet quality.

2.6. Statistical Analysis. Data were presented as the frequency and percentage (%) for categorical variables while for continues variables were presented as mean ± standard deviation (SD) and median and interquartile range (IQR). The Shapiro–Wilk test was used to assess the normality of distribution of all continues variables. Fisher's Exact test was used to assess the association between two categorical variables, whereas the Mann–Whitney and Kruskal–Wallis tests were used to compare the median across the different groups. Stepwise regression analysis was conducted to further explore association found using univariate analysis. All tests were done with a significance level of $p < 0.05$. Data analysis presented in this study was performed using SPSS Version 20 (IBM Corp., Armonk, N.Y., USA).

3. Results

3.1. Sample Characteristics. A total of 32 female breast cancer patients were included in the final analysis of this study after excluding 56 responses for living outside Madinah ($n = 4$), provided wrong phone numbers, or did not respond to calls ($n = 50$), and did not complete at least two 24-h dietary recalls ($n = 2$). Seventy-two percent of patients ($n = 23$) self-reported the requested information for this study, whereas 28.1% ($n = 9$) of the patients had a family member or other caregiver to provide the information for them. Most patients were over the age of 40 years 84.4% ($n = 27$), while 65.6% ($n = 21$) of patients were married. Half of the sample reported an education level of less than high school ($n = 16$), whereas 53.1% ($n = 17$) of the patients were housewives. Over three-quarters of the sample included in the study reported a family income of less than SR 6000 (65.6%, $n = 21$). Sixty-six percent of patients reported less than 8 hours of sleep per day ($n = 21$), while 81.3% ($n = 26$) reported never visiting a dietitian. Seventy-five percent ($n = 24$) of the patients were overweight or obese, while 40.6% ($n = 13$) of the patients exceeded the recommendation of free sugar of < 5% from total energy intake per day. Nineteen percent ($n = 6$) and 29.1% ($n = 9$) of the patients reported having hypertension and diabetes, respectively. Eighty-eight percent ($n = 28$) reported living with a family member, whereas 65.6% ($n = 21$) reported preparing food for themselves. Over two-thirds of the patients (68.8%, $n = 22$) were diagnosed less than 2 years ago, while 93.8% ($n = 30$) reported no previous history of breast cancer. Forty-four percent ($n = 14$) were in stage one, and 56.3% ($n = 18$) had unknown receptor status. The most frequent type of therapy used was chemotherapy (28.1%, $n = 9$), followed by hormonal therapy (18.8%, $n = 6$). A detailed description of the sample characteristics is provided in Table 1.

3.2. Factors Associated With Diet Quality and Dietary Intake. Mean diet quality score of women diagnosed with breast cancer included in the current study was 10.0 ± 1.16 (median: 10.00 (9.00–11.0)). Median diet quality score of women diagnosed with breast cancer was similar across the different weight status groups ($p = 0.798$). Median intake of iron was different across the weight status groups ($p = 0.026$). Median intake of all macro- and micronutrients among women diagnosed with breast cancer was similar across the different weight status groups (Table 2).

Data obtained from the stepwise regression analysis performed between iron intake (dependent variable) and weight status as well as age, sleeping time, education level, cancer stage, and dietitian visit (independent variables) and results indicated significant association between iron intake and weight status (Beta (B) = −1.56, standard error (SE) = 0.69, [95% confidence interval (CI): −2.97––0.15], and $p = 0.031$). Weight status explained 15% of the change in iron intake. Additional stepwise regression model was performed to explore the association between BMI (dependent variable) and age, sleeping time, education level, cancer stage, dietitian visit, percent of free sugar from total energy intake, diet quality score, energy intake, and intake of all macro- and micronutrients (independent variables). Results indicated that age and percent of free sugar from total energy predicted BMI of patients (age: $B = 0.20$, SE = 0.08, [95% CI: 0.06–035], and $p = 0.007$ and percent of free sugar: $B = 0.66$, SE = 0.24, [95% CI: 0.18–1.15], and $p = 0.009$). Age and percent of free sugar from total energy intake explained 35% of the change in BMI.

Median diet quality score was similar in women diagnosed with breast cancer who never visited a dietitian compared to patients who visited a dietitian (10.0 (9.00–11.0) versus 9.50 (9.00–10.3), respectively, $p = 0.524$). Median intake of all macro- and micronutrients were similar among patients who never visited a dietitian compared to patients who visited a dietitian (Table 3).

Median diet quality score was similar in all patients despite their cancer stage (10.0 (9.00–10.3), 9.00 (9.00–10.0), and 10.0 (9.00–11.0) for stages I, II, and III, respectively, $p = 0.374$). Median intake of all macro- and micronutrients was similar among patients in all cancer stages (Table 4).

Median diet quality score among patients who did not exceed the recommendation of free sugar intake of < 5% of total energy intake compared to patients who exceeded the recommendation (10.0 (9.00–11.0) versus (10.0 (9.00–10.0), $p = 0.343$). Median intake of all macro- and micronutrients was similar among patients who did not exceed the

Table 1: Sample characteristics.

Variables	n (32)	%
Data provider		
Patient	23	72.0
Family member	9	28.1
Age group		
≤ 40 years	5	15.6
41–50 years	14	43.8
> 50 years	13	40.6
Marital status		
Single	3	9.40
Married	21	65.6
Divorced/Widowed	8	25.1
Education level		
< High school	16	50.0
High school/Diploma	5	15.6
Undergraduate degree	9	28.1
Postgraduate degree	2	6.30
Employment status		
Employed	11	34.4
Housewife	17	53.1
Other	4	12.5
Monthly family income[a]		
< SR 6000	21	65.6
SR 6000–10,999	5	15.6
SR 11,000–15,999	3	9.40
≥ SR 16,000	3	9.40
Sleeping hours		
< 8 h/day	21	65.6
≥ 8 h/day	11	34.4
Visited a dietitian		
Yes	6	18.8
No	26	81.3
Weight status		
Underweight (BMI: < 18.5 kg/m^2)	2	6.30
Healthy weight (BMI: 18.5–24.9 kg/m^2)	6	18.8
Overweight (BMI: 25–29.9 kg/m^2)	6	18.8
Obesity (BMI: ≥ 30 kg/m^2)	18	56.3
Free sugar intake		
< 5% of total energy per day	19	59.4
≥ 5% of total energy per day	13	40.6
Chronic diseases		
Hypertension	6	18.8
Diabetes mellitus	9	28.1
Other diseases	17	53.1
Living status		
Living with family	28	87.5
Living with others	4	12.5
Food preparation		
Patients themselves	21	65.6
Family member	9	28.1
Others	2	6.30
Year of diagnosis		
< 2 years	22	68.8
2–5 years	5	15.6
≥ 6 years	5	15.6
Previous history of breast cancer		
Yes	30	93.8
No	2	6.30
Cancer stage		
Stage I	14	43.8
Stage II	7	21.9

Table 1: Continued.

Variables	n (32)	%
Stage III	8	25.0
Stage IV	3	9.40
Hormonal receptor status		
Positive	11	34.4
Negative	3	9.38
Unknown	18	56.3
Type of therapy		
Surgery/removal	3	9.40
Hormonal therapy	6	18.8
Chemotherapy	9	28.1
Surgery + hormonal	3	9.40
Surgery + chemotherapy	3	9.40
Chemotherapy + hormonal	2	6.30
Surgery + chemotherapy + hormonal	2	6.30
Surgery + hormonal + radiotherapy + chemotherapy	4	12.5

[a]1$ = 3.75 Saudi Riyal.

Table 2: Dietary intake stratified by weight status ($n = 32$).

Variables	Underweight ($n = 2$)	Healthy weight ($n = 6$)	Overweight ($n = 6$)	Obesity ($n = 18$)	p value[a]
Diet quality score	10.0 ± 1.41 10.0 (9.00–10.0)	9.83 ± 1.84 9.00 (8.75–11.5)	10.2 ± 1.17 10.0 (9.00–11.3)	10.0 ± 0.97 10.0 (9.00–10.3)	0.838
Energy, kcal	1125 ± 59.0 1125 (1084-NA)	1727 ± 417 1911 (1260–2007)	1021 ± 241 974 (861–1135)	1251 ± 533 1212 (1754–1694)	0.104
Carbohydrates, g	185 ± 7.66 185 (180-NA)	234 ± 51.5 219 (194–270)	144 ± 43.2 142 (103–178)	165 ± 65.0 143 (121–236)	0.075
Protein, g	43.1 ± 3.24 43.1 (40.9-NA)	65.0 ± 30.0 60.5 (40.8–84.8)	41.4 ± 8.61 39.4 (35.3–48.1)	43.3 ± 16.3 40.0 (31.5–57.5)	0.299
Fiber, g	24.7 ± 6.32 24.7 (20.2-NA)	20.5 ± 11.4 19.6 (9.31–32.6)	13.8 ± 5.46 13.0 (10.6–17.1)	14.8 ± 6.24 13.5 (11.6–17.9)	0.266
Sugar, g	69.3 ± 13.2 69.3 (60.0-NA)	92.6 ± 49.5 93.0 (47.2–118)	53.5 ± 24.1 48.7 (31.2–80.8)	70.3 ± 42.9 53.7 (40.2–96.7)	0.291
Free sugar, g	5.05 ± 1.48 5.05 (4.00-NA)	17.7 ± 10.6 16.9 (8.97–29.2)	6.77 ± 5.05 5.34 (2.84–11.3)	18.6 ± 11.2 16.4 (9.65–29.2)	0.074
Saturated fat, g	6.23 ± 1.79 6.23 (4.97-NA)	16.6 ± 9.62 13.7 (8.98–28.0)	7.84 ± 5.79 6.00 (3.65–12.2)	14.2 ± 10.6 12.3 (5.53–20.3)	0.273
Monounsaturated fat, g	3.73 ± 2.31 3.73 (2.10-NA)	14.0 ± 7.71 13.5 (6.36–20.7)	7.46 ± 4.44 5.60 (4.46–10.8)	11.3 ± 7.16 9.50 (4.79–14.7)	0.152
Polyunsaturated fat, g	3.03 ± 1.66 3.03 (1.85-NA)	6.49 ± 5.93 4.18 (2.93–9.87)	4.13 ± 1.65 3.42 (2.99–6.15)	5.51 ± 3.77 4.88 (2.62–7.64)	0.799
Trans-fatty acids, g	0.39 ± 0.16 0.39 (0.27-NA)	2.02 ± 4.04 0.48 (0.02–3.22)	0.27 ± 0.19 0.34 (0.05–0.41)	0.82 ± 1.51 0.39 (0.04–0.61)	0.860
Cholesterol, mg	164 ± 19.8 164 (150-NA)	155 ± 84.4 112 (92.1–261)	167 ± 136 140 (65.8–243)	143 ± 87.5 125 (82.5–174)	0.843
Sodium, mg	6315 ± 5063 6315 (2735-NA)	3659 ± 3596 2275 (1769–5104)	2491 ± 2454 1762 (1144–3253)	2251 ± 1289 2211 (1202–2955)	0.276
Potassium, mg	3142 ± 644 3142 (2687-NA)	2319 ± 1162 1978 (1488–3300)	1771 ± 722 1792 (1178–2339)	1647 ± 618 1750 (1239–2043)	0.155
Chloride, mg	5158 ± 7121 5158 (123-NA)	2724 ± 4019 1678 (227–4094)	1707 ± 2950 581 (124–2855)	994 ± 1400 418 (134–1124)	0.646
Calcium, mg	420 ± 223 420 (263-NA)	471 ± 197 450 (303–609)	358 ± 156 338 (225–484)	419 ± 179 401 (306–511)	0.704
Phosphorus, mg	674 ± 216 674 (521-NA)	884 ± 449 751 (539–1209)	576 ± 184 529 (429–727)	600 ± 194 585 (495–733)	0.350
Magnesium, mg	223 ± 120 223 (138-NA)	222 ± 120 213 (115–301)	163 ± 57.0 151 (120–218)	161 ± 47.2 170 (132–195)	0.625
Iron, mg	12.4 ± 0.05 12.4 (12.3-NA)	13.6 ± 4.09 12.6 (9.98–18.6)	8.18 ± 1.78 8.06 (6.84–10.0)	9.13 ± 4.04 8.47 (6.63–11.3)	0.026*

Table 2: Continued.

Variables	Underweight ($n=2$)	Healthy weight ($n=6$)	Overweight ($n=6$)	Obesity ($n=18$)	p value[a]
Zinc, mg	4.53 ± 1.24 4.53 (3.65-NA)	6.96 ± 2.82 6.68 (4.27–9.68)	3.78 ± 0.65 3.68 (3.33–4.45)	4.52 ± 1.73 4.10 (3.39–5.84)	0.115
Copper, mg	1.0 ± 0.37 1.00 (0.74-NA)	1.19 ± 0.80 0.96 (0.62–1.68)	1.33 ± 1.58 0.69 (0.55–1.87)	1.04 ± 0.97 0.75 (0.63–0.99)	0.695
Manganese, mg	4.09 ± 1.61 4.09 (2.95-NA)	3.23 ± 1.37 3.01 (1.89–4.58)	2.37 ± 0.95 2.13 (1.78–2.85)	2.79 ± 1.52 2.55 (2.22–3.14)	0.241
Selenium, μg	57.0 ± 21.3 57.0 (41.9-NA)	80.0 ± 18.6 78.9 (65.1–97.5)	58.6 ± 21.0 59.1 (39.9–76.5)	49.0 ± 19.6 50.3 (32.8–60.3)	0.051
Iodine, μg	12.9 ± 3.79 12.9 (10.2-NA)	4.98 ± 4.82 4.31 (1.33–7.78)	8.80 ± 9.57 6.35 (0.70–16.6)	4.58 ± 4.42 3.35 (1.11–7.78)	0.273
Vitamin D, μg	1.17 ± 0.85 1.17 (0.57-NA)	9.90 ± 19.8 1.71 (0.56–16.3)	0.83 ± 0.91 0.55 (0.06–1.71)	9.89 ± 21.7 0.99 (0.05–3.29)	0.638
Vitamin E, mg	4.25 ± 3.32 4.25 (1.90-NA)	5.00 ± 5.34 3.53 (2.10–6.87)	2.96 ± 1.39 2.74 (1.67–4.24)	3.41 ± 2.13 2.88 (1.56–5.32)	0.920
Vitamin B12, μg	0.67 ± 0.37 0.67 (0.40-NA)	1.91 ± 1.14 140 (1.05–3.05)	3.97 ± 6.17 1.58 (0.67–6.47)	2.42 ± 4.32 0.97 (0.69–1.52)	0.238
Vitamin C, mg	142 ± 89.8 142 (78.7-NA)	94.7 ± 80.5 78.2 (38.2–141)	99.8 ± 73.5 104 (19.8–166)	67.7 ± 35.2 67.3 (42.9–93.5)	0.496

Note: The numbers presented in the table are the mean ± SD and median (IQR). Data presented in table were obtained using the Kruskal–Wallis test.
*Statistically significant.
[a]Alpha = 0.05.

Table 3: Dietary intake stratified by dietitian visit ($n=32$).

	Never visited a dietitian ($n=26$)	Visited a dietitian ($n=6$)	p value[a]
Diet quality score	10.1 ± 1.30 10.0 (9.00–11.0)	9.70 ± 0.80 9.50 (9.00–10.3)	0.524
Energy, kcal	1310 ± 497 1212 (961–1763)	1198 ± 532 1006 (745–1767)	0.464
Carbohydrate, g	177 ± 66.1 164 (127–241)	167 ± 51.3 162 (121–215)	0.724
Protein, g	48.1 ± 20.1 42.9 (36.6–56.3)	42.3 ± 17.6 35.7 (27.5–61.6)	0.308
Fat, g	41.5 ± 25.0 34.3 (17.8–63.7)	36.5 ± 32.3 24.1 (11.2–66.6)	0.464
Fiber, g	16.4 ± 8.50 13.3 (11.3–21.5)	15.9 ± 2.8 16.2 (13.6–18.3)	0.724
Sugar, g	71.2 ± 43.3 61.2 (39.2–89.5)	71.9 ± 30.6 64.1 (46.0–101)	0.655
Free sugar, g	13.6 ± 9.90 12.3 (4.70–20.8)	23.2 ± 12.7 24.2 (13.3–35.3)	0.055
Saturated fat, g	12.9 ± 8.60 11.1 (6.90–18.3)	12.9 ± 14.3 5.80 (3.20–25.5)	0.588
Monounsaturated fat, g	9.80 ± 6.90 7.90 (5.00–13.3)	11.1 ± 7.80 10.7 (3.40–19.1)	0.796
Polyunsaturated fat, g	5.40 ± 4.00 3.80 (3.10–6.40)	4.70 ± 3.40 4.10 (2.00–7.60)	0.588
Trans-fatty acids, g	0.9 ± 2.2 0.4 (0.04–0.6)	1.00 ± 1.70 0.40 (0.20–1.60)	0.760
Cholesterol, mg	157 ± 97.3 136 (91.6–186)	123 ± 62.0 104 (74.9–175)	0.408
Sodium, mg	2796 ± 2612 2058 (1407–2955)	2891 ± 1628 2492 (1616–4742)	0.524
Potassium, mg	1912 ± 910 1893 (1321–2325)	1792 ± 423 1893 (1525–2059)	1.000
Chloride, mg	1834 ± 3010 683 (119–1773)	1183 ± 1941 392 (247–1856)	0.796

Table 3: Continued.

	Never visited a dietitian ($n = 26$)	Visited a dietitian ($n = 6$)	p value[a]
Calcium, mg	435 ± 186 435 (276–552)	342 ± 92.6 351 (245–415)	0.173
Phosphorus, mg	673 ± 287 585 (501–827)	568 ± 181 597 (388–733)	0.524
Magnesium, mg	180 ± 79.5 176 (127–221)	160 ± 26.1 166 (137–183)	0.621
Iron, mg	10.3 ± 4.30 10.1 (7.60–12.4)	8.70 ± 2.00 8.30 (7.00–10.1)	0.308
Zinc, mg	5.00 ± 2.10 4.30 (3.60–5.80)	4.00 ± 1.40 3.60 (2.90–4.90)	0.207
Copper, mg	1.20 ± 1.10 0.80 (0.60–1.10)	0.80 ± 0.10 0.80 (0.70–0.90)	1.00
Manganese, mg	2.90 ± 1.50 2.50 (1.90–3.50)	2.70 ± 0.50 2.70 (2.40–3.20)	0.494
Selenium, µg	57.3 ± 21.9 58.3 (41.0–69.8)	56.1 ± 25.8 56.9 (36.8–81.9)	1.000
Iodine, µg	6.10 ± 6.40 3.40 (0.70–9.60)	5.60 ± 3.70 4.90 (2.20–8.70)	0.760
Vitamin D, µg	6.30 ± 14.6 1.20 (0.10–2.50)	13.5 ± 31.3 0.80 (0.10–20.8)	0.724
Vitamin E, mg	3.70 ± 3.10 3.00 (1.70–4.30)	3.50 ± 1.70 3.20 (2.10–5.30)	0.796
Vitamin B12, µg	2.90 ± 4.50 1.30 (0.90–2.50)	0.70 ± 0.50 0.70 (0.30–1.20)	0.033
Vitamin C, mg	87.3 ± 62.5 80.4 (41.4–119)	66.6 ± 23.3 67.3 (44.8–84.3)	0.464

Note: Numbers presented in the table are the mean ± SD and median (IQR). The Mann–Whitney *U* test was used to compare the median across the different groups.
[a]Alpha = 0.05.

recommendation of free sugar intake of < 5% of total energy intake compared with patients who exceeded the recommendation (Table 5).

3.3. Factors Associated With Dietary Adequacy. Table 6 illustrates data concerning dietary adequacy for energy, protein, and fiber intake. Eighty-one percent ($n = 26$) of women diagnosed with breast cancer did not meet their energy requirements, while none of them met their protein requirements (100%, $n = 32$). Weight status was significantly associated with adequacy of energy intake ($p = 0.003$), where high proportion of patients experiencing overweight, and obesity were not consuming adequate energy. Weight status was not linked to adequacy of fiber intake ($p = 0.146$). There is no association between dietary adequacy for energy and fiber intake in relation to dietitian visits ($p = 0.564$ and $p = 0.555$, respectively). Furthermore, no association was found between dietary adequacy for energy and fiber intake and cancer stage ($p = 0.309$ and $p = 1.000$, respectively). No association was found between dietary adequacy for energy and fiber intake in relation to free sugar intake cancer stage ($p = 1.000$ and $p = 0.064$, respectively).

4. Discussion

Findings of this study indicated high prevalence of overweight and obesity among women diagnosed with breast cancer. Additionally, most women included in this study reported never visiting a dietitian, while large proportion of patients exceeded the recommendation of free sugar intake of < 5%. Most of the patients did not meet their energy requirements, whereas none of the patients met their protein requirement. Diet quality score and dietary intake were not associated with dietitian visit or stages of breast cancer. Stepwise regression analysis indicated a significant association between iron intake and weight status. Additionally, the age and percent of free sugar from total energy predicted BMI of patients. Weight status was significantly associated with adequacy of energy intake.

Our findings indicate high prevalence of overweight and obesity among women diagnosed with breast cancer. This could be due to the impact of chemotherapy, radiotherapy, and hormonal therapy on body composition. Multiple studies reported a decrease in lean body mass and an increase in central adiposity and fat mass index in breast cancer patients undergoing different therapy regimens [27, 28]. Additionally, number of studies showed that obese breast cancer patients had worse disease free survival and overall survival compared with nonobese patients [29]. This could be explained by understanding the effect of obesity on tumor microenvironment as obesity promotes low-grade chronic inflammation in breast adipose tissue, which increase the aromatase, the enzyme that converts androgens into estrogens, a known mitogen for breast cancer which

Table 4: Dietary intake stratified by cancer stage ($n = 32$).

Variables	Stage I	Stage II	Stage III and IV	p value[a]
Diet quality score	9.93 ± 1.07	Diet quality score	9.93 ± 1.07	Diet quality score
Energy, kcal	1241 ± 492 1095 (876–1597)	1381 ± 576 1167 (884–2012)	1292 ± 492 1336 (989–1685)	0.808
Carbohydrate, g	167 ± 58.9 156 (118–207)	193 ± 79.8 190 (127–242)	175 ± 60.3 192 (128–214)	0.702
Protein, g	44.2 ± 13.6 39.8 (35.0–53.1)	42.8 ± 11.6 42.8 (31.8–55.5)	53.3 ± 28.1 51.5 (36.5–69.0)	0.481
Fat, g	40.1 ± 27.8 31.2 (17.3–66.1)	45.6 ± 30 36.3 (17.8–74.3)	37.9 ± 22.8 31.6 (17.8–61.5)	0.825
Fiber, g	17.9 ± 7.34 17.2 (13.3–21.0)	13.8 ± 7.20 11.8 (10.2–14.8)	16.0 ± 8.60 12.8 (11.6–20.9)	0.753
Sugar, g	65.3 ± 31.5 59.3 (40.0–89.8)	92.6 ± 60.3 78.7 (39.8–155)	65.4 ± 35.5 65.8 (40.3–81.7)	0.295
Free sugar, g	14.1 ± 10.3 15.0 (3.96–24.9)	17.9 ± 11 13.5 (10–30.1)	15.5 ± 12.4 15.3 (3.3–28.9)	0.710
Saturated fat, g	11.5 ± 7.86 10.8 (5.02–16.1)	16 ± 13.4 10.3 (5–27.7)	12.8 ± 9.6 10.2 (4–21.1)	0.870
Monounsaturated fat, g	9.46 ± 6.82 8.08 (4.47–12.6)	10.5 ± 7.00 6.8 (5.2–18.7)	10.6 ± 7.6 9.10 (4.50–14.8)	0.904
Polyunsaturated fat, g	4.71 ± 3.14 3.87 (2.61–5.67)	6.1 ± 3.5 6.3 (2.4–10.2)	5.50 ± 5.00 3.40 (3.20–6.80)	0.645
Trans-fatty acids, g	0.70 ± 1.32 0.38 (0.25–0.51)	2.40 ± 3.80 0.5 (0–4.5)	0.30 ± 0.30 0.10 (0.00–0.60)	0.163
Cholesterol, mg	136 ± 61.3 130 (90.6–159)	112 ± 81.6 87.5 (43.3–178)	195 ± 117 135 (109–265)	0.273
Sodium, mg	2710 ± 1875 2300 (1202–3496)	3447 ± 2920 2782 (1683–3170)	2553 ± 2884 1857 (1226–2490)	0.373
Potassium, mg	1730 ± 589 1758 (1321–2005)	1933 ± 866 1808 (1581–2205)	2067 ± 1092 2043 (1039–2935)	0.554
Chloride, mg	1755 ± 2285 975 (119–2511)	2030 ± 3646 590 (372–1868)	1457 ± 3137 418 (143–1254)	0.806
Calcium, mg	418 ± 172 399 (276–502)	378 ± 117 387 (256–459)	443 ± 215 471 (249–596)	0.686
Phosphorus, mg	599 ± 160 585 (510–687)	595 ± 137 552 (498–723)	760 ± 404 764 (483–941)	0.593
Magnesium, mg	170 ± 50.6 176 (135–200)	170 ± 69.1 157 (121–196)	190 ± 99.2 184 (117–233)	0.854
Iron, mg	10.4 ± 4.60 9.00 (7.20–12.7)	8.90 ± 2.80 9.40 (5.60–12.2)	10.2 ± 4.01 10.3 (7.97–12.2)	0.744
Zinc, mg	4.50 ± 1.50 4.20 (3.40–5.70)	4.2 ± 0.7 4 (3.8–5)	5.70 ± 2.89 5.30 (3.60–8.65)	0.446
Copper, mg	1.0 ± 0.9 0.8 (0.6–1)	0.80 ± 0.30 0.70 (0.60–1.00)	1.58 ± 1.3 3 0.87 (0.64–2.72)	0.416
Manganese, mg	2.80 ± 1.00 2.70 (2.20–3.40)	3.50 ± 2.40 2.50 (1.90–5.20)	2.60 ± 1.10 2.40 (1.90–3.30)	0.818
Selenium, μg	48.8 ± 19.5 49.9 (30.7–60.3)	60.4 ± 15.9 60 (49–72)	65.5 ± 26.5 68.5 (43.7–88.5)	0.170
Iodine, μg	4.71 ± 4.81 3.20 (0.36–8.75)	6.10 ± 4.90 4.70 (2.10–9.50)	7.60 ± 7.80 4.30 (1.80–13.7)	0.532
Vitamin D, μg	3.26 ± 8.82 0.91 (0.07–2.02)	0.90 ± 1.20 0.20 (0–1.80)	17.5 ± 27.9 2.30 (0.70–50.1)	0.700
Vitamin E, mg	3.15 ± 1.80 2.68 (1.80–4.00)	4.30 ± 2.00 4.00 (3.00–6.60)	4.00 ± 4.20 2.70 (1.20–4.00)	0.380
Vitamin B12, μg	2.09 ± 4.3 1 0.92 (0.59–1.37)	1.00 ± 0.30 1 (0.7–1.3)	4.00 ± 5.00 1.80 (1.30–3.80)	0.062
Vitamin C, mg	74.4 ± 33.8 74.6 (47.9–93.5)	90.8 ± 65.1 70.3 (25–127)	90.3 ± 77.5 84 (21.9–120)	0.940

Note: The numbers presented in the table are the mean ± SD and median (IQR). Data presented in table were obtained using the Kruskal–Wallis test.
[a]Alpha = 0.05.

Table 5: Dietary intake stratified by free sugar intake ($n = 32$).

	Met the recommendation of free sugar (< 5% of total energy per day) ($n = 19$)	Exceeded the recommendation of free sugar (≥ 5% of total energy per day) ($n = 13$)	p value[a]
Diet quality score	10.2 ± 1.36 10.0 (9.00–11.0)	9.69 ± 0.751 10.0 (9.00–10.00)	0.343
Energy, kcal	1302 ± 497 1246 (958–1722)	1270 ± 515 1107 (830–1819)	0.734
Carbohydrate, g	177 ± 63.3 180 (122–242)	173 ± 65.0 151 (128–221)	0.734
Protein, g	49.1 ± 22.0 45.4 (36.6–56.0)	44.0 ± 15.5 36.9 (33.7–58.0)	0.383
Fiber, g	18.2 ± 9.02 16.7 (11.7–24.9)	13.5 ± 3.97 12.8 (10.9–16.6)	0.209
Sugar, g	68.7 ± 41.7 60.0 (37.0–88.5)	75.1 ± 40.6 65.8 (41.9–93.0)	0.404
Saturated fat, g	11.4 ± 7.47 10.3 (4.97–16.0)	15.2 ± 12.1 9.40 (4.65–27.4)	0.623
Monounsaturated fat, g	9.42 ± 7.39 6.65 (4.55–11.1)	11.0 ± 6.38 12.4 (5.40–16.8)	0.323
Polyunsaturated fat, g	5.56 ± 4.26 3.45 (2.70–6.10)	5.61 ± 3.33 5.45 (2.85–8.65)	0.426
Trans-fatty acids, g	0.58 ± 1.16 0.38 (0.02–0.54)	1.40 ± 2.91 0.39 (0.14–0.63)	0.596
Cholesterol, mg	151 ± 81.7 137 (109–168)	150 ± 109 93.7 (71.6–246)	0.495
Sodium, mg	2787 ± 2346 2173 (1574–2905)	2853 ± 2657 2201 (1247–3137)	0.940
Potassium, mg	1948 ± 988 1963 (1325–2687)	1805 ± 572 1808 (1446–2196)	1.000
Chloride, mg	2006 ± 2816 906 (123–2046)	1283 ± 2896 367 (153–905)	0.254
Calcium, mg	439 ± 180 457 (314–543)	386 ± 170 359 (252–436)	0.174
Phosphorus, mg	688 ± 312 614 (518–826)	603 ± 196 533 (485–744)	0.362
Magnesium, mg	193 ± 83.8 190 (138–233)	153 ± 45.3 151 (119–179)	0.117
Iron, mg	10.5 ± 4.88 10.3 (7.30–12.4)	9.26 ± 2.24 9.17 (7.43–11.6)	0.520
Zinc, mg	4.85 ± 2.09 4.41 (3.50–5.80)	4.81 ± 2.08 4.05 (3.50–5.77)	0.791
Copper, mg	0.87 ± 0.52 0.78 (0.58–1.03)	1.49 ± 1.40 0.84 (0.65–2.12)	0.495
Manganese, mg	3.25 ± 1.66 2.67 (2.15–4.20)	2.32 ± 0.66 2.37 (1.88–2.74)	0.117
Selenium, µg	59.3 ± 21.7 59.0 (44.6–62.0)	53.8 ± 23.4 49.0 (35.8–75.1)	0.426
Iodine, µg	6.61 ± 6.64 3.40 (1.30–10.2)	5.02 ± 4.92 4.27 (1.27–6.75)	0.677
Vitamin D, µg	5.67 ± 13.1 1.51 (0.57–2.30)	10.5 ± 24.5 0.08 (0.03–3.48)	0.071
Vitamin E, mg	3.63 ± 3.41 3.05 (1.45–3.95)	3.74 ± 1.85 2.90 (2.45–5.41)	0.362
Vitamin B12, µg	1.33 ± 0.79 1.25 (0.79–1.60)	4.22 ± 6.20 1.00 (0.71–7.28)	0.970
Vitamin C, mg	85.8 ± 65.5 82.0 (28.7–119)	80.1 ± 45.4 71.0 (46.3–94.9)	0.821

Note: The numbers presented in the table are the mean ± SD and median (IQR). The Mann–Whitney test was used to compare the median across the different groups.
[a]Alpha = 0.05.

Table 6: Dietary adequacy for energy, protein, and fiber intake ($n = 32$).

Energy intake n (%)		Protein intake n (%)		Fiber intake n (%)	
Adequate	**Not adequate**	**Adequate**	**Not adequate**	**Adequate**	**Not adequate**
6 (18.8)	26 (81.3)	0 (0.00)	32 (100)	5 (15.6)	27 (84.4)

Note: The numbers presented in the table are frequencies (%).

promotes cancer cell proliferation [30]. Lifestyle interventions to reduce weight such as caloric restriction and exercise showed improvement in weight, body fat, inflammation, estrogen levels, and overall prognosis [31, 32].

Despite the differences in cancer stage and weight status, our results showed a large proportion of patients included in this study with inadequate energy intake in addition to inadequate protein intake for all of them. These findings are supported by previous studies conducted in Malaysia and the Netherlands among breast cancer patients [33, 34]. The inadequacy or reduction in energy and protein intake is suggested to reflect the disease symptoms, especially those occurring after radiotherapy and chemotherapy such as metallic taste, nausea, and vomiting. It also has a major effect on muscle wasting, inflammation, and delayed wound healing, which could negatively impact the cancer treatment, patients' quality of life, and long-term survival.

Previous research conducted among different populations confirmed the association between added/free sugar intake and increased risk of breast cancer [35–37]. Research also suggests an association between the intake of added/free sugar and increased risk of cancer-specific mortality and overall mortality [38, 39]. Several molecular pathways are implicated in the relationship between sugar and tumor progression. For instance, the mammalian target of rapamycin (mTOR) pathway is activated by high sugar intake, and it enhances tumor growth and chemotherapy resistance [40, 41]. Additionally, the Warburg effect or aerobic glycolysis which can result from high glucose availability encouraging cancer cells to shift from oxidative phosphorylation to glycolysis which lead to the accumulation of lactate in the tumor microenvironment promoting the cancer progression [42]. In the present study, a large proportion of patients exceeded the recommendation of free sugar intake of < 5% and without appropriate guidance, they will continue with the same consumption unknowingly of the sugar harmful effect.

In the current study, a limited number of patients visited a dietitian. This demonstrates that nutritional care is not consistently prioritized in cancer treatment protocols, which could be due to limited resources such as insufficient funding for hiring a dietitian or the lack of qualified dietitians. Additionally, poor understanding of the dietitian crucial role from the oncologist [43, 44]. However, a recent study found that following an awareness initiative to integrate nutritional care in the cancer care team, the presence of clinical nutrition program was reported in 80.8% of the institutions and 72.6% of the nutritional prescriptions were written by a nutritional specialist [45], which highlights the importance of awareness programs in improving the treatment regimen and incorporating more team members to create a multidisciplinary team to enhance patients' recovery, treatment tolerance, and overall health outcomes. A few nutritional interventions have been implemented among cancer patients in different settings. A study conducted among breast cancer patients undergoing chemotherapy revealed that an individualized diet plan reduced nausea/vomiting, abdominal pain, and loss of appetite compared with a control group [46]. Additionally, counseling by a dietitian, food fortification, and oral nutritional supplements showed significantly higher average energy and protein intake in cancer outpatients [47]. Nutrition education intervention to improve the intake of protein and to limit the intake of free sugar among breast cancer patients are essential to improve the quality of diet and overall health of these patients. Additionally, educating the healthcare team working with breast cancer patients about the role of dietitians is important to allow dietitians to help in monitoring and improving the nutritional status of breast cancer patients.

To our knowledge, this is the first study investigating the nutritional status and associated factors in breast cancer female patients in Saudi Arabia. However, the generalizability of the study's findings could be limited as the data were collected only from one city. Another limitation of this study is the low response rate that was due to poor patients' health after therapy sessions and their limited ability to participate in the study. Although stratifying patients by the treatment type or disease severity could provide deeper insights, however, due to the limited sample size and the small number of patients in each treatment category, such stratified analyses would lack statistical power and could lead to misleading or non-generalizable results. Additionally, body weight was not measured upon diagnosis and body composition was not included in this study, which may limit the ability to assess the treatment effect on body weight and composition. Thus, future studies with larger and more balanced samples are recommended to explore these associations in greater depth.

5. Conclusion

High prevalence of overweight and obesity, high intake of free sugar, and limited intake of protein were observed among breast cancer female patients. There is an urgent need to provide nutritional care for breast cancer patients in Saudi Arabia that is delivered by experienced dietitians. Monitoring the nutritional status for breast cancer patients is important to provide tailored interventions to improve their nutritional and overall health. Future research should be conducted at the national level to explore the nutritional status of breast cancer female patients in Saudi Arabia and to explore factors that may influence the risk of malnourishment among these patients.

Data Availability Statement

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

Ethics Statement

Online consent was obtained from each participant before the data were collected. Ethical approval was obtained from the College of Applied Medical Sciences Ethical Committee at Taibah University, Madinah, Saudi Arabia (2023/156/107 MLT), and from the Academic, Training and Research Affairs Administration at Al-Madinah Health Cluster (IRB23-022).

Consent

Please see the Ethics Statement.

Disclosure

This work was conducted using the short form FFQ tool developed by Cleghorn as reported in https://doi.org/10.1017/S1368980016001099 and listed in the Nutritools (https://www.nutritools.org) library.

Conflicts of Interest

The authors declare no conflicts of interest.

Author Contributions

Heba M. Zahid and Walaa A. Mumena: conceptualization, methodology, supervision, formal analysis, and writing the original draft. Lujain Y. Alqulayti, Manar M. Alharbi, Maram S. Alzahrani, and Raghad A. Alansari: data collection, formal analysis, and writing the original draft. Maram S. Albadi: supervision of data collection.

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