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Research Article

Association of Nutritional Status with Quality of Life in Breast Cancer Patients on Chemotherapy

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ABSTRACT

Background: Cancer patients often experience a decline in their nutritional status due to chemotherapy, which can result in malnutrition and negatively impact their quality of life. However, there has been limited research on the prevalence of these conditions in breast cancer patients undergoing chemotherapy in Indonesia. **Purposes:** This research aims to explore the connection between the quality of life and the nutritional status of breast cancer patients receiving chemotherapy treatment. **Methods:** A cross-sectional study was conducted in a private hospital in Pekanbaru using non-probability sampling. Demographic profile, nutritional status assessment by PG-SGA, and quality of life assessment by the EORTC QLQ C-30 module were obtained. Mann-Whitney and Spearman's tests analyzed the association between nutritional status and QoL. **Results:** The average age of breast cancer patients was 45.46±14.375. The prevalence of overweight and obesity was 64.1%. According to the PG-SGA score, the vast majority of patients, approximately 91%, were discovered to be well-nourished. The nutritional status was significantly associated with most functional and symptom scales ($p<0.05$). Improved nutritional status is associated with increased functionality and a reduction in symptoms, while malnutrition has been linked to decreased quality of life across multiple dimensions. **Conclusion:** The nutritional status of breast cancer patients affects some dimensions of quality of life. Well-nourished patients had better function and fewer symptoms.

Keywords: breast cancer, chemotherapy, nutritional status, quality of life

INTRODUCTION

Cancer is the leading cause of mortality worldwide, as per the GLOBOCAN 2020 data. Breast cancer ranks among the most frequently diagnosed cancers, with an estimated 2.3 million new cases reported worldwide, equivalent to about 11.7% of all cases. Cancer is the fifth leading cause of death globally, with an estimated 685,000 fatalities each year. The frequency of breast cancer among women accounts for approximately one-fourth of all cancer cases and one-sixth of cancer-related fatalities (1). Breast cancer is the most common type of cancer among women in Indonesia and also the most prevalent form of cancer in the country (2). There are 65,858 new cases and 22,430 deaths from breast cancer in Indonesia, based on GLOBOCAN 2020 estimates conducted by the International Agency for Research on Cancer (1).

Breast cancer patients have a reduced risk of malnutrition compared to individuals with tumors in the head-neck, gastrointestinal tract, lung, or hematologic areas (a high-risk group) (3). One of the primary concerns in breast cancer treatment is weight gain, which has been consistently linked to anti-neoplastic chemotherapy in most studies. Despite acquiring fat and losing muscle mass, this group maintained their overall weight in most studies (4–6). Breast cancer patients often report excessive energy intake and reduced physical activity during treatment, leading to predictable weight gain (4,7). Even though malnutrition can occur from either a deficit or an excess, it has significant implications and carries an unfavorable prognosis in cancer (7).

Chemotherapy is a prevalent treatment option for breast cancer, and it has proven to be highly effective in reducing tumor size and eliminating cancer cells (8). The choice of chemotherapy must be made by considering the need for a rapid and significant response and quality of life considerations. Several studies (8–10) have shown that chemotherapy can reduce the QoL of patients with cancer, including those with breast cancer. The impact on patients' quality of life might be in the form of physical and psychological changes (such as depression and anxiety), social and sexual functioning, and disruption of daily activities also occur in patients with chemotherapy treatment (8,9,11–13).

Chemotherapy administration can indirectly impact an individual's food intake, absorption, or utilization by causing severe gastrointestinal side effects (7). Individuals may choose to restrict their food consumption to avoid experiencing these symptoms, which can ultimately decrease their overall dietary intake and potentially result in a deficiency of essential nutrients (5,7). Cancer can disrupt the nutritional requirements of patients for carbohydrates, proteins, fats, vitamins, and minerals, altering their metabolic and physiological aspects (14,15). In comparison, tumor growth or the negative consequences of chemotherapy can result in various nutritional issues, including nausea, vomiting, a lack of appetite, loss of taste, mouth sores, difficulty swallowing, discomfort in the stomach, constipation, and diarrhea. Those symptoms adversely affect energy and dietary intake, increasing malnutrition risk (16,17).

Multiple studies (3,5,18–22) have demonstrated a connection between malnutrition and a low quality of life in cancer patients. Patients who are malnourished often experience weakness and are unable to participate in their regular activities, which, in turn, has a negative impact on their overall quality of life (22). Chemotherapy-induced weight loss can negatively impact physical and social functioning, while weight gain resulting from specific treatment regimens can have unfavorable consequences on emotional and social aspects (21). The research implied that cancer patients who have a healthy nutritional state tend to have a better quality of life during chemotherapy compared to those who are malnourished.

In Indonesia, just a few studies have explored this field of clinical research. Additionally, precise information on dietary health among breast cancer patients is noticeably limited (23). Additionally, precise information on dietary health among breast cancer patients is noticeably limited. In general, no evidence suggests an association between nutrition status and quality of life in this population, particularly concerning claims of being overweight. However, poor nutrition is connected with decreased well-being and can increase morbidity (7,24). It is the study of breast cancer patients, especially those receiving chemotherapy; the primary objective is to assess the connection between dietary status and overall quality of life.

METHODS

Design and *Subjects*

This study was conducted using convenience sampling and cross-sectional design in a private hospital in Pekanbaru from March to May 2023. Seventy-eight women who had been diagnosed with breast cancer at any stage and were receiving chemotherapy treatment were recruited through non-probability sampling. This included all females aged 18 years and above who were part of the study. The study included the following criteria: participants must provide consent, comprehend the study's procedure, and fulfill the necessary requirements. Exclusion criteria were patients with other malignancies or undergoing concurrent radiotherapy and those with an illness that prevented them from fully participating in the study.

Instrument

The Patient-Generated Subjective Global Assessment (PG-SGA) and anthropometric measurements explicitly created for individuals with cancer evaluated patients' nutritional condition. The Patient-Generated Subjective Global Assessment (PG-SGA) evaluates seven aspects: body weight, symptoms, dietary intake, daily activities and functional abilities, metabolic demands, the relationship between disease and nutritional requirements, and a physical examination. These factors determine whether an individual is well-nourished, anabolic, moderately or suspected, or severely malnourished. The global and functional scales measured physical and global functioning, where a higher score indicated improved functioning. Conversely, a higher score on the symptom scale indicated a worsening of symptoms. The European Organization for the Research and Treatment of Cancer Quality of Life Questionnaire (EORTC QLQ-C30) was utilized in Indonesia to evaluate the quality of life (25). This tool is a cancer-specific questionnaire comprising 30 items that assess the QoL of breast cancer patients in multiple aspects, including functionals, symptoms, global, and single items.

Data analysis

The Statistical Package for Social Sciences (SPSS) version 20 was employed to analyze the data. The subjects' patient demographic information, QoL, and PG-SGA scores were presented using descriptive statistics such as means, ranges, and standard deviations. The Mann-Whitney test was employed to analyze the disparities in QoL between the various groups based on their nutritional status, which was determined by the PG-SGA questionnaire. The Spearman test was used for non-parametric data to investigate the relationship between the PG-SGA score and the overall QoL score. A significance level of $P<0.05$ was adopted for this analysis.

RESULTS

The descriptive statistics for the demographic features of breast cancer patients are provided in Table 1. The majority of breast cancer patients are within the age range of 46 to 65 years old, with an average age of 45.46 years and a standard deviation of 14.375 years. The majority were stadium III, had completed senior high school, unemployed, and unmarried. Patients were predominantly in the third stadium of disease and had completed 3-5 cycles of chemotherapy.

Table 1. Demographic Features of Breast Cancer Patients

Characteristics	N	%
Age		
18-25 years	10	12.8
26-45 years	30	38.5
46-65 years	32	41.0
>65 years	6	7.7
Stadium		
Stage I	7	9.0
Stage II	32	41.0
Stage III	39	50.0
Stage IV	0	0
Education		
Never went to school	1	1.3
Elementary School	7	9.0
High School	7	9.0
Senior High School	59	75.6
College	4	5.1
Employment Status		
Employed	18	23.1
Unemployed	60	76.9
Marital status		
Married	27	34.6
Unmarried	46	59.0
Divorced	5	6.4
Monthly income		
<Rp3.500.000	68	87.2
>Rp3.500.000	10	12.8
Cycle of chemotherapy		
<3	26	33.3
3-5	29	37.2
>5	23	29.5

The average BMI before cancer diagnosis was 26.8±3.4 kg/m2 and 27.4±2.3 kg/m2 after a cancer diagnosis. Figure 1 displays breast cancer survivors' Body Mass Index (BMI) classifications before and after cancer treatment. Based on the data shown in this graph, it can be observed that 37.2% of individuals had an average weight, defined as a BMI of 18.5-24.9 kg/m2, while 53.8% were classified as overweight, with a BMI of 25-29.9 kg/m2. Additionally, 9% of the subjects had an obese BMI of 30 kg/m2 or higher before their cancer diagnosis. At the beginning of the study, it was found that 11.5% of the participants were underweight, 24.4% had an average weight, 35.9% were overweight, and 28.2% were obese.

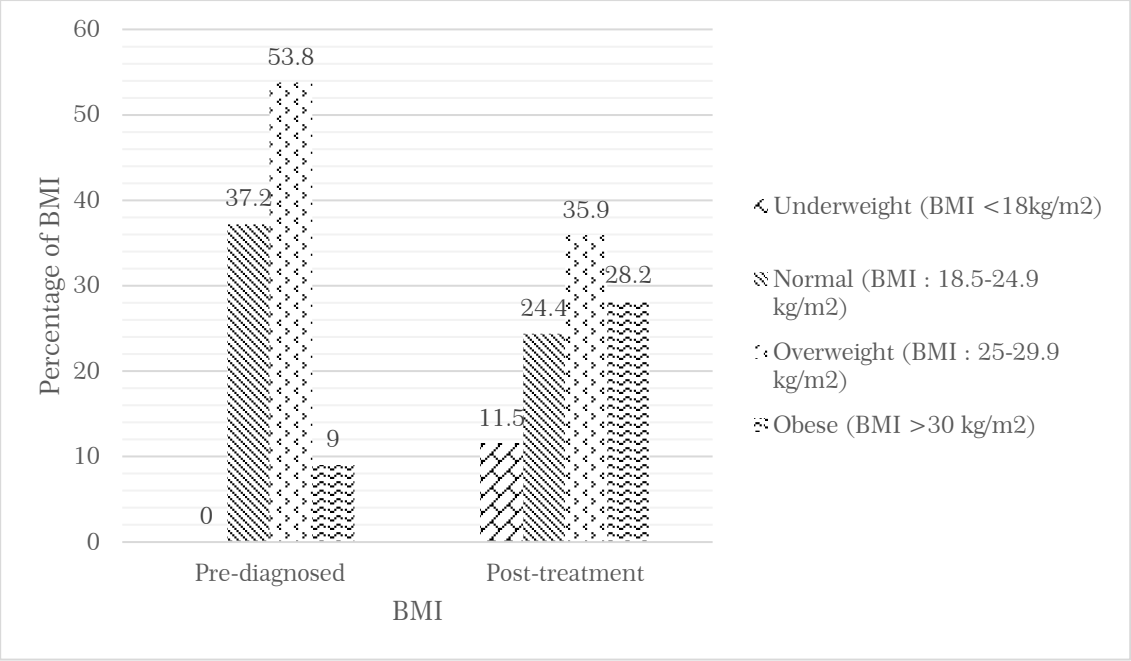

Figure 1. The BMI classifications of 78 breast cancer patients pre-diagnosis and post-treatment

The weight changes in women from a year before breast cancer diagnosis were 65.09 ± 9.313 kg and 69.95 ± 12.296 kg at the beginning of the study. Approximately two-thirds of women experienced weight gain, while the remaining third experienced weight loss. According to the data, approximately 37.2% of the subjects experienced a weight gain of 5% or more, with 2.6% experiencing an increase of 10% or more. Conversely, 24.4% of the subjects had less than 5% weight gain. Table 2 presents information on the weight changes that occur from before a breast cancer diagnosis to after treatment, considering the length of the chemotherapy cycle.

Table 2. The Changes In Weight From Before The Diagnosis To After The Treatment Of Breast Cancer Based On The Cycle Of Chemotherapy

Cycle of Chemotherapy	Weight		Overall (n=78)
	Gain (n=50)	Loss (n=28)	
<3	17	9	26
3-5	21	8	29
>5	14	9	23

After conducting a statistical analysis, it was determined that roughly 91% of the subjects were categorized as well-nourished (PG-SGA-A). Only 9% were classified as mildly to moderately malnourished (PG-SGA-B). Notably, no cases of severe malnutrition were identified among the subjects with breast cancer. Table 3 displays the average life quality variances among different PG-SGA classifications. The overall results showed a substantial distinction between the QoL scales for cancer patients at varying levels of nutritional status. This indicates significant differences in physical, social, role, cognitive, and global QoL scales. Additionally, a similar pattern was observed for symptom scales in this area.

Table 3. The Average Variances in The Quality of Life Aspects Among Different PG-SGA Classifications (n=78)

EORTC QLQ-C30	PG-SGA Mean±SD		*p*-value
	Well-nourished (n=71)	Moderately-malnourished (n=7)	
Functional scales†			
Physical	72.95 ± 17.271	37.08 ± 3.125	0.002*
Role	75.77 ± 20.162	36.54 ± 4.928	0.000*
Emotional	70.27 ± 18.369	37.53 ± 2.654	0.008*
Cognitive	85.62 ± 15.532	38.54 ± 1.275	0.202*
Social	83.40 ± 12.100	39.20 ± 0.426	0.670
Symptoms scales‡			
Fatigue	30.86 ± 18.247	40.35 ± 1.083	0.279*
Nausea/vomiting	28.00 ± 20.296	40.63 ± 1.465	0.143*
Pain	38.70 ± 22.226	47.64 ± 1.030	0.303*
Dyspnoea	24.00 ± 36.439	41.03 ± 2.156	0.031*
Insomnia	25.00 ± 37.520	40.93 ± 2.055	0.040*
Appetite loss	19.00 ± 38.390	41.52 ± 2.681	0.007*
Constipation	23.50 ± 35.336	41.08 ± 2.208	0.027*
Diarrhea	37.88 ± 27.392	55.93 ± 2.248	0.025*
Financial difficulties	22.50 ± 37.415	41.18 ± 2.311	0.021*
Global QoL	73.51 ± 8.186	37.71 ± 2.443	0.015*

* p<0.5; The Mann-Whitney U test produced values when measuring nutritional status with PG-SGA;
† Higher scores imply better function (min: 0-max: 100);
‡ Higher scores suggest more symptoms (min: 0-max: 100)

Table 4 depicts the relationship between nutritional status parameters and QoL. The relationship between nutritional status classification and QoL dimensions was investigated, and it was found that SGA was strongly linked to the functions and symptoms scales.

DISCUSSION

The objective of this study was to evaluate the current nutritional status and quality of life for a cohort of breast cancer patients who received chemotherapy. Consistent with prior research among breast cancer patients (7,24) the average body weight of our sample was comparable, with more than half of the participants being overweight or obese. A study among Malaysian breast cancer patients found a high prevalence of overweight and obesity, with almost 40% of patients being overweight and 12.2% being obese. This is consistent with the current findings (7). According to an examination of Iranian breast cancer survivors, the outcomes were consistent, revealing that 67% of the women were either overweight or obese, and they exhibited a 90% prevalence of abdominal obesity, as determined by waist circumference.

Table 4. Nutritional Status Relationship with QoL Among Breast Cancer Patients

EORTC QLQ-C30		PG-SGA	
		R	**p value**
Functional scales	Physical	-0.35	0.001*
	Role	-0.56	0.000*
	Emotional	-0.30	0.007*
	Cognitive	-0.14	0.004*
	Social	-0.49	0.673
Symptoms scales	Fatigue	0.12	0.028*
	Nausea/vomiting	0.16	0.014*
	Pain	0.11	0.030*
	Dyspnoea	0.24	0.030*
	Insomnia	0.23	0.039*
	Appetite loss	0.30	0.007*
	Constipation	0.25	0.026*
	Diarrhea	0.25	0.024*
	Financial difficulties	0.26	0.204
Global QoL		0.27	0.014*

*p<0.05; The Spearman test produced values when significant relationship between nutritional status and quality of life.

Several studies have uncovered the connection between obesity and the increased risk of breast cancer recurrence (7,24). Additionally, it was associated with decreased physical performance and diminished QoL among breast cancer patients (7,24,27). In this study, it was found that 53.8% of breast cancer patients were overweight, and 9% were obese based on their BMI classification by the WHO prior to their diagnosis. Approximately two-thirds of women experienced an increase in weight after breast cancer treatment, while the remaining portion experienced a decrease in weight in contrast to their pre-diagnosis state. The outcomes of a research project that focused on breast cancer patients in Malaysia who were undergoing chemotherapy are consistent with this study (7). This finding aligns with previous research, which has shown that women often experience weight gain following a breast cancer diagnosis. In contrast, the outcome of this study differed from the research conducted at Karawaci General Hospital in Indonesia, as no obese or overweight patients were reported in that study (23).

The occurrence of weight gain in cancer patients undergoing chemotherapy was initially documented in 1978. Reviews of literature conducted in the middle of the 1990s revealed that a substantial proportion of breast cancer patients who underwent chemotherapy experienced notable weight gain, with estimates ranging between 50% and 96% (28,29). The reported weight gain ranged between 2.5 and 6.2 kilograms and gains exceeding 10 kilograms were not uncommon (28). Newer research suggests a reduced incidence of weight gain, with the percentage ranging from 35% to 85% and the amount of weight gained varying between 1.4 and 5.0 kilograms (29). Weight gain during treatment has been found to impact a person's quality of life and self-esteem negatively (28). According to a narrative review, women who had a normal body mass index (BMI) at the beginning were found to be more likely to gain weight than women who were overweight at the time of diagnosis (29). According to Berg et

al., just one study in their meta-analysis provided weight change results that were stratified by the baseline BMI category (28).

A mixed methods study investigated the changes in breast cancer and found that women with weight gain experienced a lower energy intake during chemotherapy, resulting in increased inactivity and fatigue compared to women who lost weight. On the other hand, 61% of women with weight gain showed higher dietary intake, particularly during the mid-treatment cycles. This observation may be influenced by our sample population, consisting primarily of women in the third to fifth chemotherapy cycles (42% of respondents). Chemotherapy-associated hunger, increased sense of well-being, or increased snacking to offset nausea were thought to be the contributory factors for such patterns (30). In line with a study that reported that diminished physical activity is one of the primary factors responsible for further weight gain during adjuvant chemotherapy (27).

According to the PG-SGA method used to evaluate the nutritional status of patients in this study, a substantial portion of breast cancer patients, precisely 91%, were well-nourished. In comparison, only 9% were identified as moderately malnourished. At the same time, severe malnutrition was not identified among them. A similar finding was reported in Iran regarding breast cancer patients, indicating that they did not experience severe malnutrition (24). Although Karawaci General Hospital's breast cancer patients showed a relatively high rate of moderate malnutrition (68.2%) when assessed using the SGA assessment (23).

Cancer survivors with different nutritional status levels have a notable discrepancy in their quality of life (QoL) scales, as they exhibit distinct variations in physical, social, role, cognitive, and global quality of life aspects. On the same side, a comparable pattern was revealed in the symptom scales. The PG-SGA-based nutritional status categorization exposed substantial dissimilarities in QoL scores between groups, signifying that cancer patients deviate significantly in all functional scales except for social functioning. The results from the symptom scales indicated that well-nourished breast cancer patients generally experienced fewer symptoms compared to malnourished patients. The outcomes of this study are consistent with those of another research (4,24), which showed that well-nourished patients experienced better function and fewer symptoms. The relationship between poor nutritional status and myosteatosis was linked to several factors, including inadequate dietary protein consumption, inactive lifestyle, heightened levels of anxiety and depression, and diminished quality of life and physical function (4).

The relationship between nutritional status, as measured by PG-SGA, and quality of life, as assessed by EORTC QLQ-C30, was significantly correlated with most functional and symptom scales, except for financial difficulty scales and social functioning. The relationship between malnutrition status and functioning scales was negative. On the other hand, there was a positive relationship with symptom scales. Individuals with better nutrition showed improved functionality and experienced fewer symptoms. In comparison, malnourished individuals showed lower scores on the functional scale and experienced more severe symptoms. Research conducted on cancer patients (7,24) they were revealed that malnutrition was linked to a lower quality of life and its various aspects. It was observed that patients with a better nutritional status displayed superior functional ability. A study in the Philippines uncovered significant

disparities in global quality of life scores across all SGA groups and deduced that individuals with superior nutritional status typically experienced a higher quality of life (6).

Unlike previous research (23), the current study highlighted a considerable number of breast cancer patients who received chemotherapy and experienced weight gain. Still, it is essential to note that obesity remains a concern since almost half of these patients were overweight or obese. Intensive weight management to maintain a healthy weight, comprehensive nutritional assessment, and follow-up for malnutrition risk identification are particularly required. Patients' quality of life is influenced by their nutritional status, as demonstrated through research. Further investigation is necessary to explore the relationship between this nutritional status and QoL. Larger scale studies could be the next forward, hence providing patient-centered solutions for optimal nutritional treatments for breast cancer patients on chemotherapy in the future.

CONCLUSION

Nutritional health influences certain aspects of breast cancer patients' quality of life. Furthermore, body weight status plays a significant role in health-related quality of life measurements, emphasizing the need for practical nutritional evaluations and screenings to prevent the development of chronic diseases in cancer survivors. In addition, implementing an educational and nutritional skinning program may be a viable solution to enhance breast cancer patients' quality of life.

CONFLICT OF INTEREST

The authors declare that they do not have a conflict of interest, affiliations, or relationships with any organization or entity that could raise biased questions or statements in the discussion and conclusion sections of the paper.

REFERENCES

1. Sung H, Ferlay J, Siegel RL, Laversanne M, Soerjomataram I, Jemal A, et al. Global cancer statistics 2020: globocan estimates of incidence and mortality worldwide for 36 cancers in 185 countries. CA Cancer J Clin. 2021 May;71(3):209–49.
2. Kementerian Kesehatan Republik Indonesia. Info Datin Bulan Peduli Kanker Payudara. Kementerian Kesehatan Republik Indonesia; 2016.
3. Hébuterne X, Lemarié E, Michallet M, de Montreuil CB, Schneider SM, Goldwasser F. Prevalence of malnutrition and current use of nutrition support in patients with cancer. JPEN J Parenter Enteral Nutr. 2014 Feb;38(2):196–204.
4. Parkinson J, Bandera A, Crichton M, Shannon C, Woodward N, Hodgkinson A, et al. Poor Muscle Status, Dietary Protein Intake, Exercise Levels, Quality of Life and Physical Function in Women with Metastatic Breast Cancer at Chemotherapy Commencement and during Follow-Up. Curr Oncol. 2023 Jan;30(1):688–703.
5. Badrasawi M, Al-Adhame A, Doufish A. Association of malnutrition and low quality of life among cancer patients receiving chemotherapy, Palestine. East Mediterr Heal J. 2021 May;27(5):459–66.
6. Vergara N, Montoya JE, Luna HG, Amparo JR, Cristal-Luna G. Quality of life and

nutritional status among cancer patients on chemotherapy. Oman Med J. 2013 Jul;28(4):270–4.
7. Lua PL, Salihah NZ, Mazlan N. Nutritional status and health-related quality of life of breast cancer patients on chemotherapy. Malays J Nutr. 2012 Aug;18(2):173–84.
8. Afifah VA, Sarwoko. Faktor-faktor yang mempengaruhi kualitas hidup pasien kanker payudara yang menjalani kemoterapi. J Komun Kesehat [Internet]. 2020 Apr 22;11(1 SE-Artikel).
9. Juwita DAYU, Afdila R. Penilaian Kualitas Hidup Terkait Kesehatan Pasien Kanker Payudara di RSUP Dr. M. Djamil Padang, Indonesia (The Assessment of Health Related Quality of Life for Patients with Breast Cancer in Dr. M. Djamil Hospital Padang, Indonesia). J Ilmu Kefarmasian Indones. 2019;17(1):114–9.
10. Marwin M, Perwitasari DA, Candradewi SF, Septiantoro BP, Purba FD. Kualitas Hidup Pasien Kanker Payudara Di Rsup Dr. Kariadi Semarang Menggunakan Kuisioner Eortc Qlq-C30. J Ilmu Farm dan Farm Klin. 2021;18(01):16.
11. Eisenbraun J, Scheer R, Kröz M, Schad F, Huber R. Quality of life in breast cancer patients during chemotherapy and concurrent therapy with a mistletoe extract. Phytomedicine. 2011 Jan;18(2–3):151–7.
12. Hassen AM, Taye G, Gizaw M, Hussien FM. Quality of life and associated factors among patients with breast cancer under chemotherapy at Tikur Anbessa specialized hospital, Addis Ababa, Ethiopia. PLoS One. 2019;14(9):e0222629.
13. Wang H, Zhu L, Lu W, Xu H, Yu Y, Yang Y. Clinicopathological risk factors for recurrence after neoadjuvant chemotherapy and radical hysterectomy in cervical cancer. World J Surg Oncol. 2013;11:1–5.
14. Prado CM, Purcell SA, Laviano A. Nutrition interventions to treat low muscle mass in cancer. J Cachexia Sarcopenia Muscle. 2020 Apr;11(2):366–80.
15. Arends J, Bachmann P, Baracos V, Barthelemy N, Bertz H, Bozzetti F, et al. ESPEN guidelines on nutrition in cancer patients. Clin Nutr. 2017 Feb;36(1):11–48.
16. Foucaut A-M, Morelle M, Kempf-Lépine A-S, Baudinet C, Meyrand R, Guillemaut S, et al. Feasibility of an exercise and nutritional intervention for weight management during adjuvant treatment for localized breast cancer: the PASAPAS randomized controlled trial. Support care cancer Off J Multinatl Assoc Support Care Cancer. 2019 Sep;27(9):3449–61.
17. Tang F, Wang J, Tang Z, Kang M, Deng Q, Yu J. Quality of Life and Its Association with Physical Activity among Different Types of Cancer Survivors. PLoS One [Internet]. 2016 Nov 3;11(11):e0164971.
18. Muscaritoli M, Lucia S, Farcomeni A, Lorusso V, Saracino V, Barone C, et al. Prevalence of malnutrition in patients at first medical oncology visit: the PreMiO study. Oncotarget. 2017 Oct;8(45):79884–96.
19. Muscaritoli M, Corsaro E, Molfino A. Awareness of Cancer-Related Malnutrition and Its Management: Analysis of the Results From a Survey Conducted Among Medical Oncologists. Front Oncol. 2021;11:682999.
20. Jager-Wittenaar H, Ottery FD. Assessing nutritional status in cancer: role of the Patient-Generated Subjective Global Assessment. Curr Opin Clin Nutr Metab Care. 2017

Sep;20(5):322–9.
21. Brinksma A, Sanderman R, Roodbol PF, Sulkers E, Burgerhof JGM, de Bont ESJM, et al. Malnutrition is associated with worse health-related quality of life in children with cancer. Support care cancer Off J Multinatl Assoc Support Care Cancer. 2015 Oct;23(10):3043–52.
22. Gellrich N-C, Handschel J, Holtmann H, Krüskemper G. Oral cancer malnutrition impacts weight and quality of life. Nutrients. 2015 Mar;7(4):2145–60.
23. Kurniawan A, Lugito NPH. Nutritional Status and Quality of Life in Breast Cancer Patients in Karawaci General Hospital. Indones J Cancer. 2016;10(1):1.
24. Mohammadi S, Sulaiman S, Koon PB, Amani R, Hosseini SM. Association of nutritional status with quality of life in breast cancer survivors. Asian Pac J Cancer Prev. 2013;14(12):7749–55.
25. Perwitasari DA, Atthobari J, Dwiprahasto I, Hakimi M, Gelderblom H, Putter H, et al. Translation and validation of EORTC QLQ-C30 into Indonesian version for cancer patients in Indonesia. Jpn J Clin Oncol. 2011 Apr;41(4):519–29.
26. World Health Organization (WHO). Appropriate body-mass index for Asian populations and its implications for policy and intervention strategies. Lancet (London, England). 2004 Jan;363(9403):157–63.
27. Elme A, Utriainen M, Kellokumpu-Lehtinen P, Palva T, Luoto R, Nikander R, et al. Obesity and physical inactivity are related to impaired physical health of breast cancer survivors. Anticancer Res. 2013 Apr;33(4):1595–602.
28. van den Berg MMGA, Winkels RM, de Kruif JTCM, van Laarhoven HWM, Visser M, de Vries JHM, et al. Weight change during chemotherapy in breast cancer patients: a meta-analysis. BMC Cancer. 2017 Apr;17(1):259.
29. Makari-Judson G, Braun B, Jerry DJ, Mertens WC. Weight gain following breast cancer diagnosis: Implication and proposed mechanisms. World J Clin Oncol. 2014 Aug;5(3):272–82.
30. de Kruif AJt, Westerman MJ, Winkels RM, Koster MS, van der Staaij IM, van den Berg MMGA, et al. Exploring changes in dietary intake, physical activity and body weight during chemotherapy in women with breast cancer: A Mixed-Methods Study. J Hum Nutr Diet Off J Br Diet Assoc. 2021 Jun;34(3):550–61.