VER
Vascular & Endovascular Review

Nutritional Nursing Interventions: Effects on Knowledge, Taste Function, and Food Preferences in Women Undergoing Chemotherapy for Breast Cancer

Taghreed Hussien Alboelola[1], OHUD RAKA ALANAZI[2], Eman Muktar Mohamed Gabr[3], Fatma Mohamed El swerky[4], Asmaa Hamdy Mohammed Thabet[5], Fayza. M. Mohammed[6], Alshazaly Abdoalghfar Adam[7], Eslam Naseib Moussa Helal[8], Fatma Khalil Abd El hameed[9], Eatdal Balla Eltom Ali[10], Zainab Abd El-Rahim Ali[11], Mona Abd Elhaleem Ebraheem Elagamy[12], Fathia Mahmoud AbdElmenim Sayed[13]

[1]RN, PhD, Public Health Nursing Department, College of Nursing, Northern Border University, Arar, Saudi Arabia. ORCID ID: https://orcid.org/0000-0002-7996-697X, Email: tagreed.mohammed@nbu.edu.sa
[2]Nursing specialist, The Northern border health cluster, North Medical Tower, Arar, Saudi Arabia Ahalanzi@moh.gov.sa
[3]Assistant Professor of Medical Surgical Nursing Department, North private College of Nursing, Arar, Saudi Arabia- emangabr681@gmail.com, ORCID ID: https://orcid.org/0009-0005-5686-6967
[4]Assistant professor of Family and Community Health Nursing, Faculty of Nursing Port Said University, Egypt.
[5]Lecturer in Medical Surgical Nursing Department, Faculty of Nursing, Assuit University, Egypt.
[6]Assistant Professor of Community Health Nursing College of Applied Medical Science , Taibah University-Alula Branch, KSA.
[7]College of Nursing, Onaizah Colleges, Qassim, Saudi Arabia
Email Address: shazalyhran@yahoo.com, ORCID ID: https://orcid.org/0009-0007-8355-1148
[8]Assistant lecturer at the Department of Community Health Nursing, College of Nursing, Misr University for Science and Technology (MUST), P.O.Box 77, Giza, Egypt.
Email Address: eslamnaseb32@gmail.com, ORCID ID: https://orcid.org/0009-0006-4766-8990
[9]Professor of Gerontological Nursing. Misr University for Science and Technology, 6th of October district, Giza 12566, Egypt- fatma.khalil@must.edu.eg
[10]Assistance professor, Nursing Department, AlGhad College for Applied Medical Sciences in Najran. Saudi Arabia , Email: eatali@gc.edu.sa
[11]Lecturer of Obstetrics and Gynecology Nursing, Faculty of Nursing, Sohag University, Egypt
[12]Assistant Professor of Maternal and Neonatal Health Nursing, Faculty of Nursing, Tanta University, Egypt.
[13]Assistant Professor of Nursing, Faculty of Nursing, Middle East University. Jordan and Lecturer of Maternity Gynecology and Obstetrics of Nursing Faculty of Nursing Port- Said University, Egypt.

ABSTRACT

Background: Chemotherapy frequently causes taste alterations, changes in food preferences, decreased appetite, and malnutrition in patients with breast cancer. Adequate nutrition is crucial during cancer treatment.

Objective: This study evaluated the effect of a nutritional nursing intervention on knowledge, taste function, and food preferences in women undergoing chemotherapy for breast cancer.

Methods: A quasi-experimental in pre- and post-design was used. A convenient sample of 200 chemotherapy-treated women with breast cancer were recruited from the Sohag Oncology Outpatient Clinic over a six-month period. The intervention outcomes were assessed using the following instruments: (I) women's structured interviewing questionnaire, which included two parts: (a) demographic characteristics and (b) women's medical data, (II) breast cancer women's nutritional knowledge (pre&post). (III) Chemotherapy-induced taste alteration scale (CiTAS), (IV) Dish preference questionnaire, and (V) Food liking using a 9-point hedonic scale.

Results: Following the intervention, there was a significant improvement in nutritional knowledge, taste function, food liking, and food preferences among participants.

Conclusion: Nutritional nursing interventions are effective in improving nutritional outcomes and quality of life for women undergoing chemotherapy for breast cancer.

Recommendations: Nutritional nursing interventions should be routinely integrated into the care of breast cancer patients receiving chemotherapy. Future research should replicate this study with a larger and more diverse sample and explore the long-term impact of such interventions.

KEYWORDS: Breast cancer, Food liking, Food preferences, Nutritional nursing intervention, Taste function..

How to Cite: Taghreed Hussien Alboelola, OHUD RAKA ALANAZI, Eman Muktar Mohamed Gabr, Fatma Mohamed El swerky, Asmaa Hamdy Mohammed Thabet, Fayza. M. Mohammed, Alshazaly Abdoalghfar Adam, Eslam Naseib Moussa Helal, Fatma Khalil Abd El hameed, Eatdal Balla Eltom Ali, Zainab Abd El-Rahim Ali, Mona Abd Elhaleem Ebraheem

Elagamy, Fathia Mahmoud AbdElmenim Sayed, (2025) Nutritional Nursing Interventions: Effects on Knowledge, Taste Function, and Food Preferences in Women Undergoing Chemotherapy for Breast Cancer, Vascular and Endovascular Review, Vol.8, No.8s, 88-99.

INTRODUCTION

The incidence rate of breast cancer, the most prevalent cancer among women, is increasing each year. To reduce the mortality rate among breast cancer patients, malignant tumors are typically removed through surgery, chemotherapy, and/or radiation therapy. According to the World Health Organization (2020), cancer treatments can be administered either as adjuvant (after surgery) or neoadjuvant (before surgery) therapies [1]. Additionally, adjuvant chemotherapy and/or radiation therapy can help prevent recurrence by destroying any remaining cancer cells. However, patients undergoing chemotherapy for breast cancer often experience side effects such as nausea, fatigue, hair loss, and sleep disturbances [2]. Coa et al. (2019) reported that patients receiving moderate-intensive adjuvant chemotherapy for breast cancer also experience changes in taste perception [3].

Chemotherapy is employed to eradicate malignant growths and reduce mortality rates among individuals with breast cancer. Treatments can be classified as adjuvant (postoperative) or neoadjuvant (preoperative). Adjuvant chemotherapy and/or radiation therapy can prevent recurrence by eliminating any residual cancer cells. Nevertheless, patients undergoing chemotherapy may suffer from side effects, including nausea, fatigue, hair loss, and sleep disturbances [4]. Jensen et al. (2018) found that patients receiving moderate-intensive adjuvant chemotherapy for breast cancer also reported changes in their taste perception. Chemotherapy-induced alterations in taste and smell have been linked to self-reported oral issues, nausea, appetite loss, and depression in cancer patients [5].

Reports of taste changes have emerged even before chemotherapy begins. In a study involving 34 breast cancer patients and 24 lung cancer patients, 26% of participants exhibited alterations in taste and chemosensory function prior to starting chemotherapy [6]. These taste changes can lead to a worse prognosis, weight loss, and malnutrition due to food aversion and decreased oral intake [7].

Various factors may contribute to changes in food intake and/or taste among breast cancer patients. Chemotherapeutic agents that affect gustatory function include doxorubicin, cyclophosphamide, methotrexate, cisplatin, 5-fluorouracil, carboplatin, and levamisole. Additionally, factors such as cytokine activity, anorexia, cachexia, and cancer stage may influence taste perception. Learned Food Aversion (LFA), often acquired through nausea following food consumption during cancer treatment, can lead to reduced palatability and limited meal choices. Furthermore, a decreased desire to cook may impact food intake, resulting in restricted food diversity and altered taste due to the complex interplay of these variables [8].

Taste detection and recognition thresholds are commonly used measures of taste. Taste detection refers to the lowest concentration at which a person can distinguish a solution from pure water, while recognition thresholds indicate the lowest concentrations at which a person can accurately identify the taste of a solution [9]. Lower thresholds for taste detection and recognition indicate increased sensitivity to the relevant taste. A previous cross-sectional study found that during their second round of chemotherapy, patients with malignant neoplasia were less sensitive to bitter flavors compared to non-cancer controls. Chemotherapy was effective in treating 87 individuals with breast cancer or other gynecologic cancers and was associated with significant taste alterations, particularly for salty flavors, rather than sweet, sour, or bitter tastes, which showed elevated thresholds. Patients with altered taste thresholds also demonstrated reduced caloric intake [10].

Moreover, patients with modified taste thresholds exhibited lower calorie consumption. Few studies have investigated how chemotherapy affects food preferences and/or taste changes in breast cancer patients. The present study aims to examine how taste thresholds and food preferences in breast cancer patients change before and after cancer therapy [11].

According to Bernhardson et al. (2020), changes in taste among cancer patients have been associated with negative impacts on quality of life, morbidity, and mortality. These effects include inadequate energy and nutrient intake, weight loss, malnutrition, decreased adherence to treatment regimens, reduced immunity, altered relationships with food, modified food rituals, emotional distress, and interference with daily life [12]. The extent to which actual taste issues contribute to these situations remains unclear. The ability to recognize taste sensations is a crucial aspect of health, influencing dietary choices. Understanding the relative contributions of alterations in appetite, food preferences, and taste function could inform the development of effective interventions in the future [13].

Nurses play a vital role in identifying and detecting individuals at risk of malnutrition in the early stages. To effectively plan nutritional treatment and monitor changes in patients' nutritional status, nurses should conduct nutritional screenings upon admission and throughout the hospital stay [14]. Early nutritional intervention can improve prognosis and enhance recovery while reducing hospital stay duration and complication rates, making it a cost-effective approach. The development and implementation of screening and assessment tools are essential for effective nutritional intervention and cancer patient care [15].

SIGNIFICANCE OF THE STUDY:

Changes in taste have been documented even before the initiation of chemotherapy. In a study involving 24 patients with lung cancer and 34 patients with breast cancer, 26% of the participants exhibited altered taste and chemosensory function prior to receiving chemotherapy. These taste changes can lead to a worse prognosis, weight loss, and malnutrition due to food aversion

and decreased oral intake [6].

Patients with breast cancer may experience changes in their food intake and/or taste due to various factors. Chemotherapeutic agents that impact gustatory function include doxorubicin, cyclophosphamide, methotrexate, cisplatin, 5-fluorouracil, carboplatin, and levamisole [16]. Additionally, factors such as cytokine activity, anorexia, cachexia, and the stage of cancer may influence taste perception. Learned food aversion (LFA), often acquired through nausea following food consumption during cancer treatment, can result in reduced palatability and limited meal choices. Furthermore, a decreased motivation among cancer patients to prepare meals for themselves can also negatively impact food intake [17].

To promote women's health, nutritional education can help them maintain healthy behaviors and manage related health risk factors. The World Health Organization (WHO) recommends that healthcare providers offer clients appropriate and acceptable nutrition-related information throughout their care [15]. Therefore, the researchers conducted this investigation to assess the impact of nutritional nursing interventions on knowledge, taste function, food preferences, and food liking among women with breast cancer undergoing chemotherapy.

Purpose of the study

The purpose of this study is to determine the effect of nutritional nursing interventions on knowledge, taste function, food preferences, and food liking among women with breast cancer undergoing chemotherapy.

Hypotheses:

H1: The mean scores of knowledge regarding nutrition among women with breast cancer will improve after nutritional nursing intervention.

H2: The mean scores of taste function, food liking, and food preferences regarding nutrition among women with breast cancer will improve after nutritional nursing intervention.

Subjects and method

Study design:

A quasi-experimental research design with pre-and post-tests was employed to conduct this investigation.

Study setting:

The study was conducted in the outpatient clinic at Sohag Oncology Institution, Egypt.

2.3 Subject:

A convenience sample of 200 women with breast cancer undergoing chemotherapy was included in the study over a six-month period.

2.4 Data collection tools:

Tool I: A structured interview questionnaire was developed by the researchers after reviewing relevant literature and research studies [4-7]. It consisted of 2 parts:

- **Part (a):** This section included demographic data of women with breast cancer undergoing chemotherapy, such as age, educational level, occupation, and residence.
- **Part (b):** This part contained medical data-related factors, including the type of tumor, family history, duration of the disease, and types of complaints.

Tool II: Nutritional Knowledge Questionnaire for Breast Cancer Women (Pre/Post)

This tool was developed by the researchers after reviewing relevant literature and research studies [7-15] and included 12 questions designed to assess women's knowledge regarding nutrition after breast cancer surgery. Topics covered included dietary habits, common guidelines to avoid obesity, maintaining a balanced weight, recommended foods, and sources of information regarding their nutritional knowledge.

Scoring System:

- Zero points for an incorrect response.
- One point for a correct response.

The scoring system for the nurses' knowledge was divided into two categories: satisfactory and unsatisfactory knowledge. A nurse's knowledge was deemed unsatisfactory if their score was less than 60% and satisfactory if their score was greater than 60%.

Tool III: Chemotherapy-Induced Taste Alteration Scale (CiTAS) [18]

The CiTAS was used to subjectively assess taste alterations and has demonstrated good validity and high reliability (Cronbach's alpha = 0.9) [18]. Originally developed as an 18-item, self-administered survey using a five-point Likert scale [19], a higher score indicates more intense taste alterations [20]. The prevalence of each subscale was determined by counting the number of patients who scored higher than 1 and calculating the total as a percentage of the research population. Larsen et al.'s method was also utilized to assess the overall prevalence of taste alterations [21]. The Arabic version of CiTAS was employed in this study following back-to-back translations, with a Cronbach's alpha of 0.883.

Tool IV: Dish Preference Questionnaire
To explore preferences for food tastes and preparation methods, staple Korean foods with representative cooking methods and flavors were selected. The food questionnaire included seven different groups of 57 dishes. The 2015 Dietary Reference Intakes for Koreans [22] established five food-group-based dish categories (grains, meat/fish/eggs/beans, vegetables, fruit, and dairy products) along with two additional categories (nuts, soup/stew). Each group contained one to seven dish subgroups, depending on the type of food. Each dish subgroup included three to six dishes based on cooking techniques and taste profiles (Supplementary methods). Foods were arranged in order of preference, and dishes that were not favored or not consumed were recorded as "no preference." For the dish preference analysis, participants who provided at least three data points from baseline to the last visit (n = 44) were included.

Tool V: Food Liking Assessment Using a 9-Point Hedonic Scale
A 9-point hedonic scale (Peryam&Pilgrim, 1957) [23] was used to gauge participants' preferences for typical sweet (chocolate) and umami (soup) food items, ranging from"like exceedingly"(9) to"dislike extremely"(1). The highest score was 9, and the lowest score was 1. Participants were instructed to refrain from smoking, chewing gum, using toothpaste or other oral care products, and consuming anything other than water for at least one hour before each taste test.

2.4.1 Validity of the tools
Five specialists in the fields of medical-surgical nursing, oncology, and community health nursing evaluated the content validity, clarity, comprehensiveness, appropriateness, and relevance of the tools and instructional guidelines. Based on the panel's assessment, no changes were necessary to ensure the appropriateness of the content and the clarity of the language used.

2.4.2 Reliability of the tools
The reliability of the questions in Tool I was evaluated using Cronbach's α test, yielding a coefficient of 0.987. Tool II's questions had a reliability coefficient of 0.932, Tool III's was 0.945, Tool IV's was 0.944, and Tool V's was 0.889.

2.4.3 A pilot study
A pilot study was conducted with 30% of the total sample, involving 60 women with breast cancer. The final version of the tools was developed after verifying their feasibility and clarifying the necessary research methods. No changes were made following the pilot study, and the participants were women who later took part in the main study.

2.4.4 Ethical considerations
Approval from the Ethical Research Committee of Sohag Faculty of Nursing was obtained prior to conducting the study with reference number: 148. The researchers met with the nursing and medical directors of the selected settings to secure their agreement and explain the study's objectives. Oral consent was obtained from the women to ensure their cooperation. The purpose of the study, along with the anticipated outcomes, was clearly communicated to the participants. They were informed that participation was entirely voluntary and that they could decline to participate at any time without providing a reason. The women were assured that their information would remain confidential and would be used solely for research purposes.

2.4.5 Administrative design
Administrative permission for the study was obtained through a formal letter issued by the Dean of the Faculty of Nursing at Sohag University to the Directors of the Outpatient Clinic affiliated with Sohag Oncology Institution.

FIELDWORK
A total of 200 women participated in the study. The investigators were present at pre-selected locations twice a week, between 9 a.m. and 12 p.m., for data collection over a six-month period, from November 2023 to the end of April 2024. Each interview questionnaire took approximately 30 to 40 minutes to complete.

Nutritional nursing intervention was conducted through four main phases: assessment, planning, implementation, and evaluation.

A. Assessment Phase
Demographic and medical data were obtained from the medical records of the breast cancer patients and through direct questioning of the participants. Knowledge, taste function, food liking, and food preferences were assessed at two time points: before and after the nutritional nursing intervention, using Tool I (Part b) and Tool II.

B. Planning phase
The researchers reviewed relevant literature to create a nutritional nursing intervention tailored to the needs of the study participants. The objectives of the study were determined based on these needs. The planning phase included preparing the environment and creating an engaging pamphlet to enhance breast cancer patients' understanding of chemotherapy and diet. Three sessions were dedicated to the intervention, ensuring privacy for the patients during physical examinations and maintaining good ventilation as much as possible. The nutritional nursing strategy aimed to improve clinical outcomes and the nutritional status of breast cancer patients undergoing chemotherapy. The curriculum was presented in an attractive booklet, which included lectures and group discussions, and was translated into Arabic. Each session lasted approximately 20 to 30 minutes.

C. Implementation phase

Women with breast cancer receiving chemotherapy had their knowledge, taste function, food liking, and food preferences assessed twice: once before and once after the nutritional nursing intervention. Each assessment was conducted prior to scheduled chemotherapy and meals. The assessment was performed for the control group as well.

After reviewing relevant literature and assessing the actual needs of the women undergoing chemotherapy, the booklet was distributed in simplified Arabic as a supportive resource, covering all aspects of healthy nutrition. Various educational techniques were employed, including talks, discussions, posters, and images.

The implementation phase involved providing a nutritional nursing-led intervention to breast cancer patients undergoing chemotherapy, modified from the Heal Well Cancer Nutrition Guideline. Twenty subgroups were created from the study's participants, with each subgroup consisting of ten breast cancer patients who had completed three sessions of chemotherapy. Each session lasted between 20 and 30 minutes.

First session

Topics covered included an overview of breast cancer, its causes, risk factors, treatment options, and symptoms; maintaining a healthy weight; and consuming nutritious meals that provide the necessary calories and nutrients for energy, repair, recovery, and healing.

Second session

This session focused on the side effects of breast cancer treatment (chemotherapy) that can impact nutritional well-being, such as changes in appetite, unwanted weight loss, nausea and vomiting, fatigue, bowel changes (diarrhea and constipation), alterations in taste and smell, unwanted weight gain, sore mouth or throat, and low white blood cell counts leading to infection.

Third session

The focus was on food safety advice, which is particularly crucial for cancer patients during recovery. Recommendations included avoiding spicy, overly sweet, greasy, or fried foods; eating small, frequent meals; and consuming liquids with ice chips or frozen juice chips. Patients were advised to gently brush and floss their teeth or dentures after meals, use alcohol-free mouthwash, and choose liquid or soft foods like soups, stews, smoothies, and desserts. Sugar-free ice lollies and cubes were suggested to soothe their gums. Fatigue is a common side effect of treatment; therefore, regular eating and as much exercise as manageable were encouraged to help reduce fatigue and improve mood. Patients were advised to rely on ready-to-eat items, such as fruits, vegetables, and frozen dinners, and to drink plenty of water to avoid dehydration, which can exacerbate fatigue.

D. Evaluation Phase

The evaluation phase occurred one month after the intervention. Each woman was re-interviewed to assess the effect of the nutritional nursing-led intervention on knowledge, taste function, food liking, and food preferences among women with breast cancer undergoing chemotherapy. The same tools used in the pre-test were employed for the reassessment.

3.1 Statistical analysis:

Statistical analyses and data entry were performed using SPSS for Windows, version 20. Descriptive statistics for the recruited subjects included means and standard deviations (SDs) for quantitative variables, as well as frequencies and proportions for qualitative variables. The t-test was employed to measure differences between two means. Qualitative factors were analyzed using the chi-squared (χ^2) test. Pearson's correlation coefficient (r) was used to assess relationships between variables. A conventional p-value of less than 0.05 was considered statistically significant.

RESULTS

Table (1): Women with breast cancer undergoing chemotherapy demographic data (n=200)

Items	No.	%
Woman's age in years		
21≤ 40 years	70	35
40 ≤ 60 years	130	65
Women's education		
Illiterate	30.0	15.0
Read and write	40.0	20.0
Secondary education	80.0	40.0
Higher education	50.0	25.0
Occupation		
Working	50.0	25.0
Not working	150.0	75.0
Residence		
-Rural	150	75
-Urban	25	25

Table 1. indicates that 65% of the women in the study were aged between 40 and 60 years. The majority of participants (75%) resided in rural areas, while 75% were unemployed. Additionally, 40% of the women had completed secondary school.

Table (2): Women with breast cancer undergoing chemotherapy medical data (n=200)

Item	No.	%
Duration of disease:		
< one year	170	85
≥ one year	30	15
Spreading of disease		
Spread	50	25
Not spreading	150	75

Table 2. reveals that 85% of the women in the study had been diagnosed with cancer for less than a year, and 75% of the participants had non-spreading tumors.

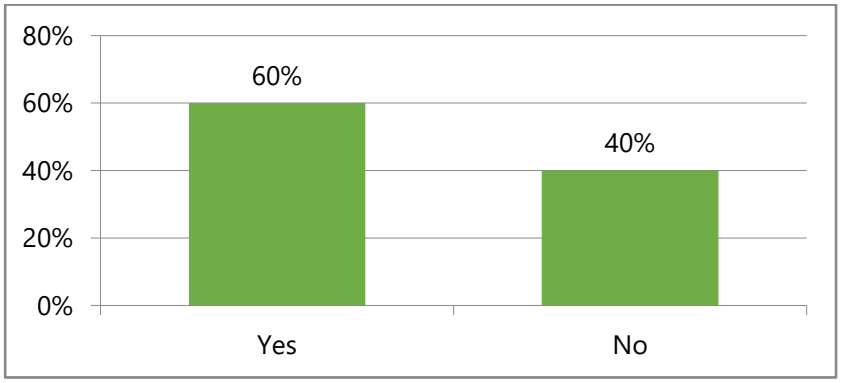

Figure (1): Family history of women with breast cancer undergoing chemotherapy (n=200)

More than half (57%) of the women with breast cancer undergoing chemotherapy had a family history of the disease (**Figure 1**).

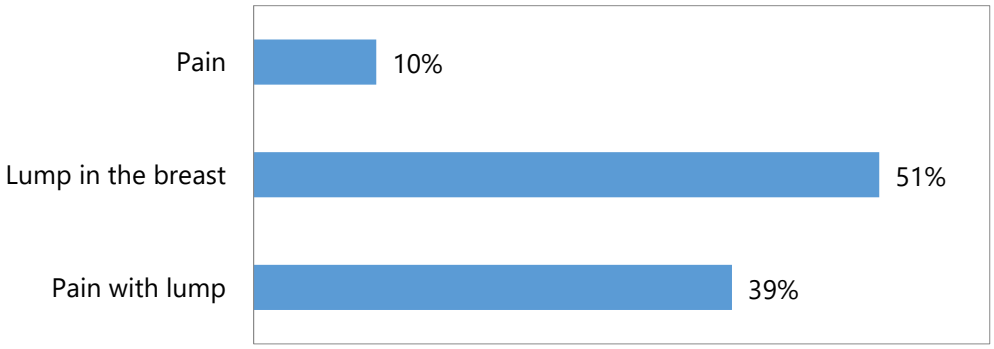

Figure (2): Types of complaints of women with breast cancer undergoing chemotherapy (n=200)
Figure 2. shows that a breast lump was present in 55% of women with breast cancer.

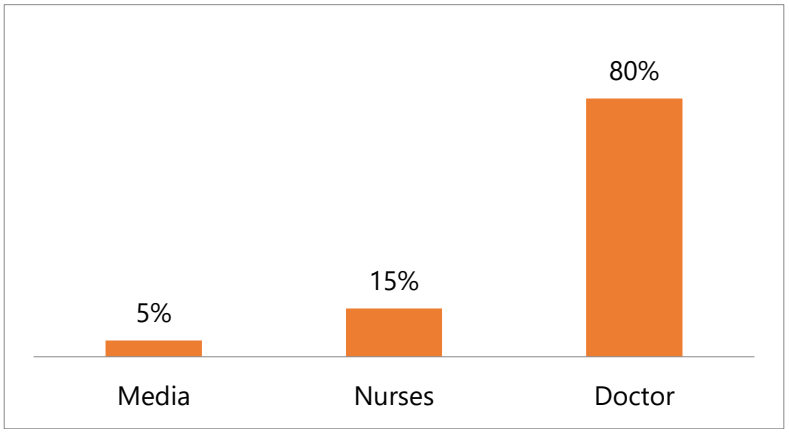

Figure (3): Source of knowledge of women with breast cancer undergoing chemotherapy
Figure 3. shows that 80% of the women with breast cancer undergoing chemotherapy in the study identified their doctors as their main source of knowledge.

Table (3): Total knowledge mean scores of women with breast cancer undergoing chemotherapy pre and post-nutritional nursing intervention (N = 200)

	Study Group (n= 200)				X2	P-value
	Pre- nutritional nursing-led intervention		Post-nutritional nursing-led intervention			
	No	%	No	%		
Total knowledge mean scores	4.33±1.2		10.04±1.5		F=87.7 P=0.001HS	

*Statistically significant level at P < .05

Table 3. indicates that the total knowledge mean scores of women with breast cancer undergoing chemotherapy differed significantly before and after the nutritional nursing intervention (P < 0.001).

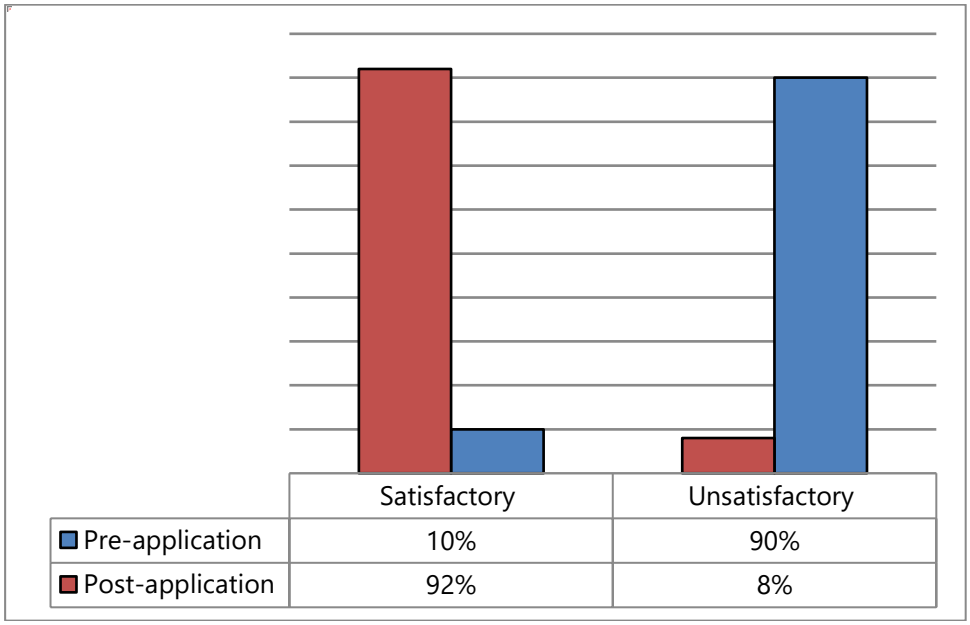

Figure (4): Total knowledge level among the women with breast cancer undergoing chemotherapy pre and post-nutritional nursing intervention (N = 200)

Figure 4. portrays the total knowledge of women pre- and post-nutritional nursing-led intervention. It indicates that 10% of the studied women had a satisfactory level of knowledge before the intervention, while this figure improved to 90% after the intervention.

Table (4): Total mean scores of taste function among women with breast cancer undergoing chemotherapy post-nutritional nursing intervention (N = 200)

Items	Pre	post	P-value
Total Taste function	3.11 ± 0.44	2.05±1.33	0.001-t-56.63

*Statistically significant level at P < .05

Table 4. demonstrates that the total taste function mean scores among women with breast cancer undergoing chemotherapy were highly statistically significant after the nutritional nursing intervention was applied. The mean scores for taste function were significantly higher in the post-test, highlighting the beneficial effects of the intervention (P < 0.001).

Table (5): Total mean scores of food preferences among women with breast cancer undergoing chemotherapy post-nutritional nursing intervention (n = 200)

Items	Pre	post	P-value
Total appetite mean scores	21.4± 2.3	22.67±2.2	0.001-t=34.67

*Statistically significant level at P < .05

As shown in **Table 5**, there was a significant improvement in the mean scores for food preferences in the post-test, indicating the beneficial impact of the nutritional nursing intervention. Additionally, there was a highly statistically significant of a difference in the total food preferences mean scores among women with breast cancer undergoing chemotherapy after the intervention (P<0.001).

DISCUSSION

Breast cancer is the leading cause of cancer-related deaths among women globally. The National Cancer Institute in Brazil reported 14.35 deaths per 100,000 women due to breast cancer in 2013. In Egypt, approximately 89,042 cancer-related fatalities and 134,632 new cancer cases were recorded in 2018. The most prevalent malignancies in terms of incidence and mortality are breast and liver cancers. Providing breast cancer patients with adequate information and practices encourages them to maintain a balanced diet and healthy body weight [1, 24]. Therefore, this study aimed to determine the effect of nutritional nursing intervention on knowledge, taste function, food liking, and food preferences among women with breast cancer undergoing chemotherapy.

Research has increasingly focused on how chemotherapy affects patients' dietary and lifestyle choices, particularly regarding taste changes, which are recognized as a significant issue [25]. Altered taste perceptions in cancer patients can affect appetite and eating patterns, potentially leading to weight loss and nutritional deficiencies. Changes in taste may also increase susceptibility to malnutrition. However, little is known about the exact relationship between starvation and altered taste. While some studies indicate no clear correlation between dietary practices and taste changes during chemotherapy, others highlight the importance of taste changes as a side effect that may lead to deficiencies in macro- and micronutrients [26].

The current study found that the majority of the women were between the ages of 40 and 60. These findings are consistent with those of Bei et al. (2015) [27], who examined factors influencing breast cancer patients' information needs and found that the average age of the women was approximately fifty. Additionally, less than three-quarters of the women lived in metropolitan areas, which aligns with findings from Sayed et al. (2017) [28] regarding the informational needs of newly diagnosed breast cancer patients.

Over half of the women in this study had a family history of breast cancer. This finding supports El-Shinawi et al. (2013) [29], who found that most patients in their study had a family history of breast cancer. Furthermore, this result is consistent with the American Cancer Society's (2016) [30] findings that the risk factors for breast cancer, such as family history, increase with the number of affected relatives.

The study also revealed that over half of the women experienced their first breast lump, consistent with El-Shinawi et al. (2013) [29], who discovered that most patients identified a painless breast lump as a sign of breast cancer. Additionally, the majority of the women reported that their primary source of nutritional knowledge was their doctors, indicating a desire for reliable information from trusted sources.

The present study found a highly statistically significant difference in the total knowledge mean scores of women with breast cancer undergoing chemotherapy pre- and post-nutritional nursing-led intervention. This finding indicates that the application of the nutritional nursing-led intervention was beneficial in meeting the needs of the women and providing them with the knowledge necessary to maintain a healthy and balanced diet.

Most women had satisfactory levels of knowledge before the intervention, which improved significantly afterward. This outcome demonstrates the necessity of enhancing awareness and knowledge among women with breast cancer undergoing chemotherapy and underscores the significance of nutritional nursing-led interventions. The results indicate that the participants effectively applied the program, leading to an increase in their knowledge.

The present study also showed a highly statistically significant difference in total taste function mean scores among the studied women with breast cancer undergoing chemotherapy post-nutritional nursing-led intervention. There was a significant reduction in taste function mean scores during different visits, highlighting the positive effect of the nutritional nursing intervention. Similar findings were reported by Sánchez-Lara et al. (2020) [10], who found that malignant neoplasia patients were more sensitive to bitter flavors than non-cancer participants. In a similar vein, Boltong et al. (2020) [31] demonstrated that cancer patients exhibited heightened sensitivity to harsh flavors and a dislike for meat. Possible explanations for these contradictory results include genetic background, lifelong exposure to varying degrees of sweetness, and the type and/or duration of cancer [32]. Various detection techniques used by Steinbach et al. (2020) [33] could also lead to differing results.

Another study by Ozkan et al. (2022) [34] showed a high prevalence of self-reported taste alterations, with up to 98.3% of cancer patients experiencing changes, consistent with previous studies indicating that taste alterations can occur in up to 69.9% and

76.1% of patients [35, 36]. According to Ozkan et al. (2022) [34], cancer patients experienced more severe taste changes, which significantly impacted their eating habits and may result in nutritional deficits [35]. However, a recent study revealed no statistically significant correlation between malnutrition and weight loss and changes in taste and smell [26]. Another study found no direct correlation between dietary habits and changes in flavor following chemotherapy [37]. Antineoplastic side effects such as anorexia, nausea, and vomiting, as well as metabolic alterations like inflammation, increased catabolism, and anabolic resistance, are all linked to malnutrition during chemotherapy [38].

Taste alterations are one of several contributing factors to malnutrition, according to our findings. However, more research is required for comprehensive results. Taste alterations and weight loss also revealed conflicting results. While some studies [39, 40] reported that individuals with impaired taste lost weight, other studies found no connection between taste alterations and weight changes [41].

The results of the current study revealed a significant improvement in food preferences mean scores in the post-test, indicating the beneficial impact of the nutritional nursing intervention. Additionally, there was a highly statistically significant difference in the total food preferences mean scores among women with breast cancer undergoing chemotherapy after the nutritional nursing intervention. From the researcher's perspective, this reflects the success of the nutritional nursing intervention. Research on taste changes and food preferences in breast cancer patients undergoing chemotherapy has been limited [3, 7]. In this study, we investigated changes in taste thresholds and dish preferences of breast cancer patients prior to and during cancer treatment [11]. Women with breast cancer disliked foods with beany or oily flavors, such as fried eggs and soy milk. Compared to healthy volunteers, women undergoing chemotherapy showed greater sensitivity to salty tastes, which may have influenced their preference for milder or simpler foods. Additionally, even with taste changes, dish preferences may be influenced by the awareness that certain meals could be linked to an increased risk of breast cancer. Previous research has shown that cancer treatment decreases the amount of food that patients consume, with patients reporting a decline in food consumption of 12–20% on average after their first round of chemotherapy.

In comparison to the baseline, 55 out of 57 dish subgroups were not preferred during the visits. Earlier research has demonstrated that chemotherapy decreased cancer patients' calorie intake in terms of total energy, fat, and protein, as they consumed fewer foods, including meats, cheese, beans, biscuits, and pastries. Decreased calorie intake was linked to chemotherapy symptoms, including nausea, dry mouth, difficulty chewing, and low energy [42].

When creating meals specifically for cancer patients undergoing chemotherapy, it may be helpful to consider their preferred cooking methods to enhance food intake. During therapy, we discovered that cold fruit, soft textures, and mild/plain-tasting foods were more popular than strong flavors and sugary or oily foods. Another study found that flavorful, sweet, high-protein, and high-fat diets were less popular among newly diagnosed breast cancer patients undergoing chemotherapy. Thomson found that after receiving a breast cancer diagnosis, women tended to eat healthier and adopt health-conscious eating practices [43].

As a result, it appears that cancer patients tend to dislike foods high in fat and sugar during treatment. Their altered taste thresholds may have contributed to these shifts in food choices. The selection of sweetened foods may also have been influenced by the sensitivity to sweet flavors noted at the initial therapy visit. Additionally, food aversions may impact the dietary choices of cancer patients receiving chemotherapy, potentially leading to decreased food intake [42].

According to the current study's findings, women's knowledge and practices regarding nutrition following breast cancer surgery improved with the adoption of nutritional nursing-led intervention. The purpose and theories of the current investigation align with these findings. These outcomes are consistent with the findings of [44], who investigated"Nutrition education intervention for women with breast cancer: effect on nutritional factors and oxidative stress"and discovered that the intervention improved the dietary practices of the women.

Additionally, the results are corroborated by [45], who conducted a study titled"Beneficial Effect of Educational and Nutritional Intervention on the Nutritional Status and Compliance of Breast Cancer Patients Undergoing Chemotherapy,"finding a positive impact on the nutritional status of women receiving chemotherapy. According to Chang et al. (2018) [46], who studied the"Impacts of Nutrition Education Programs on Cancer Survivors' Nutritional Status,"nutritional counseling can effectively assist cancer patients in maintaining body weight and consuming enough calories to avoid malnutrition by offering nutritional supplement services.

A study by Mohammad Shahi et al. (2014) [47] examined the impact of a three-month nutritional intervention on the diet quality of obese Iranian women and found that the intervention improved their diet quality. These results are comparable to those of the study conducted in the United States by Snyder et al. (2017) [48], which evaluated the efficacy of a nutritional intervention over a 12-month follow-up aimed at improving the diet among women with breast cancer.

CONCLUSION

The findings of this study indicate that the nutritional nursing intervention significantly enhanced the knowledge, taste function, food preferences, and food liking of women with breast cancer undergoing chemotherapy. Additionally, the intervention led to a notable reduction in pain intensity among the patients.

Moreover, there was a significant improvement in the mean score on the Oswestry Disability Index following the intervention, reflecting better performance in daily activities such as personal care, lifting, walking, sitting, standing, sleeping, social interactions, and travel. Implementing these interventions can help reduce the economic burden on patients and improve their overall quality of life, promoting physical well-being, enhancing career satisfaction, and effectively managing stress.

RECOMMENDATIONS

Based on the findings of the current study, the following recommendations are proposed:

- **Conduct Regular Nutritional Education Sessions:** Implement regular sessions to educate breast cancer patients undergoing chemotherapy on various aspects of nutrition.
- **Encourage Participation in Nutritional Education:** Women receiving chemotherapy should actively participate in these educational sessions to enhance their understanding of nutrition-related topics.
- **Expand the Study:** To generalize the results, it is recommended that the current study be repeated with a larger and diverse sample size.

REFERENCES

1. **World Health Organization (WHO).** (2020). Global health estimates: Deaths by cause, age, sex, by country and by region. Available at: who.int/data/gho/data/themes/mortality-and-global-health-estimates/ghe-leading-causes-of-death. Accessed on 27 September 2020.
2. **Allred, D.C.** (2018). Ductal carcinoma in situ: Terminology, classification, and natural history. In Laversanne, M., Weiderpass, E.,&Soerjomataram, I. (Eds.), *Journal of the National Cancer Institute Monographs*, 41, 134–138. DOI: 10.1093/jncimonographs/lgx002.
3. **Coa, K., Epstein, J., Ettinger, D., Jatoi, A., McManus, K., Platek, M.,&Moskowitz, B.** (2019). The impact of cancer treatment on the diets and food preferences of patients receiving outpatient treatment. *Nutrition and Cancer*, 67(3), 339–353. DOI: 10.1080/01635581.2019.1570545.
4. **Andre, F., Mazouni, C., Hortobagyi, G.N.,&Pusztai, L.** (2006). DNA arrays as predictors of efficacy of adjuvant/neoadjuvant chemotherapy in breast cancer patients: Current data and issues on study design. *Biochimica et Biophysica Acta*, 1766(2), 197–204. DOI: 10.1016/j.bbcan.2006.08.002. PubMed: 16962247.
5. **Jensen, S.B., Mouridsen, H.T., Bergmann, O.J., Reibel, J., Brünner, N.,&Nauntofte, B.** (2018). Oral mucosal lesions, microbial changes, and taste disturbances induced by adjuvant chemotherapy in breast cancer patients. *Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology, and Endodontics*, 106(2), 217–226. DOI: 10.1016/j.oooo.2018.05.005.
6. **Capra, S., Ferguson, M.,&Ried, K.** (2021). Cancer: Impact of nutrition intervention outcome—Nutrition issues for patients. *Nutrition*, 17(9), 769–772. DOI: 10.1016/s0899-9007(01)00632-3. PubMed: 11527676.
7. **Epstein, J.B.,&Barasch, A.** (2010). Taste disorders in cancer patients: Pathogenesis, assessment, and management. *Oral Oncology*, 46(2), 77–81. DOI: 10.1016/j.oraloncology.2009.11.008. PubMed: 20036797.
8. **Speck, R.M., DeMichele, A., Farrar, J.T., Hennessy, S., Mao, J.J., Stineman, M.G.,&Barg, F.K.** (2023). Taste alteration in breast cancer patients treated with taxane chemotherapy: Experience, effect, and coping strategies. *Supportive Care in Cancer*, 21(2), 549–555. DOI: 10.1007/s00520-022-06773-5.
9. **Keast, A.,&Roper, S.** (2020). Relationship between sucrose taste detection thresholds and preferences in adults. *Nutrients*, 12(7), 1918. DOI: 10.3390/nu12071918.
10. **Sánchez-Lara, K., Sosa-Sánchez, R., Green-Renner, D., Rodríguez, C., Laviano, A., Motola-Kuba, D.,&Arrieta, O.** (2010). Influence of taste disorders on dietary behaviors in cancer patients undergoing chemotherapy. *Nutrition Journal*, 9, 15. DOI: 10.1186/1475-2891-9-15. PubMed: 20334666.
11. **Gonella, S.** (2013). Taste disorders in cancer patients. *Assistenza Infermieristica e Ricerca*, 32(4), 223–232. DOI: 10.1702/1381.15360. PubMed: 24441467.
12. **Bernhardson, B.M., Tishelman, C.,&Rutqvist, L.E.** (2020). Chemosensory changes experienced by patients undergoing cancer chemotherapy: A qualitative interview study. *Journal of Pain and Symptom Management*, 34(4), 403–412. DOI: 10.1016/j.jpainsymman.2006.12.010. PubMed: 17616338.
13. **McQuestion, M., Fitch, M.,&Howell, D.** (2011). The changed meaning of food: Physical, social, and emotional loss for patients receiving radiation treatment for head and neck cancer. *European Journal of Oncology Nursing*, 15(2), 145–151. DOI: 10.1016/j.ejon.2010.07.006. PubMed: 20864401.
14. **Bahgat, Z., Alaa Elden, S., Atia, N., El Sheik, E.,&Elshemy, M.** (2019). The efficacy of a protocol of care on post-mastectomy women outcomes. *IOSR Journal of Nursing and Health Science*, 5(1), 49–64. DOI: 10.9790/1959-05014964.
15. **Amin, A., Aldin, D., El-Zawahry, H.,&Sherif, G.** (2022). Practice, effectiveness, and factors affecting self-care behaviors in managing chemotherapy side effects in breast cancer patients. *Research Square*, 1–15. DOI: 10.21203/rs.3.rs-1692200/v1.
16. **Comeau, T.B., Epstein, J.B.,&Migas, C.** (2001). Taste and smell dysfunction in patients receiving chemotherapy: A review of current knowledge. *Supportive Care in Cancer*, 9(8), 575–580. DOI: 10.1007/s005200100279. PubMed: 11762967.
17. **Van Cutsem, E.,&Arends, J.** (2005). The causes and consequences of cancer-associated malnutrition. *European Journal of Oncology Nursing*, 9(Suppl 2), S51–S63. DOI: 10.1016/j.ejon.2005.09.007. PubMed: 16437758.
18. **Kano, T.,&Kanda, K.** (2013). Development and validation of a chemotherapy-induced taste alteration scale. *Oncology Nursing Forum*, 40(1), E79–E85. DOI: 10.1188/13.ONF.E79-E85. PubMed: 23448748.

19. **Simeone, S., Esposito, M.R., Gargiulo, G., Lanzuise, A., Botti, S., Serra, N., Continisio, G.I., Rea, T.,&Guillari, A.** (2019). The CiTAS scale for evaluating taste alteration induced by chemotherapy: State of the art on its clinical use. *Acta Bio-Medica: Atenei Parmensis*, 90(6-S), 17–25. DOI: 10.23750/abm.v90i6-S.8278. PubMed: 31292411.
20. **Sozeri, E.,&Kutluturkan, S.** (2018). The validity and reliability of the Turkish version of the Chemotherapy-Induced Taste Alteration Scale (CiTAS). *Clinical Nursing Research*, 27(2), 235–249. DOI: 10.1177/1054773816662436. PubMed: 27514732.
21. **Larsen, A.K., Thomsen, C., Sanden, M., Skadhauge, L.B., Anker, C.B., Mortensen, M.N.,&Bredie, W.L.P.** (2021). Taste alterations and oral discomfort in patients receiving chemotherapy. *Supportive Care in Cancer*, 29(11), 7431–7439. DOI: 10.1007/s00520-021-06316-4. PubMed: 34080053.
22. **Paik, H.** (2008). Dietary Reference Intakes for Koreans (KDRIs). *Asia Pacific Journal of Clinical Nutrition*, 17(Suppl 2), 416–419. DOI: 10.6133/apjcn.2008.17.s2.01.
23. **Peryam, D.&Pilgrim, F.** (1957). Hedonic scale method of measuring food preferences. *Food Technology*, 11(Supplement), 9–14.
24. **Bray, F., Ferlay, J., Soerjomataram, I., Siegel, R.L., Torre, L.A.,&Jemal, A.** (2018). Global cancer statistics 2018: GLOBOCAN estimates of incidence and mortality worldwide for 36 cancers in 185 countries. *CA: A Cancer Journal for Clinicians*, 68(6), 394–424. DOI: 10.3322/caac.21492. PubMed: 30207593.
25. **Campagna, S., Gonella, S., Sperlinga, R., Giuliano, P.L., Marchese, R., Pedersini, R., Berchialla, P.,&Dimonte, V.** (2018). Prevalence, severity, and self-reported characteristics of taste alterations in patients receiving chemotherapy. *Oncology Nursing Forum*, 45(3), 342–353. DOI: 10.1188/18.ONF.342-353. PubMed: 29683116.
26. **McGettigan, N., Dhuibhir, P., Barrett, M., Sui, J., Balding, L.,&Higgins, S.** (2019). Subjective and objective assessment of taste and smell sensation in advanced cancer. *American Journal of Hospice and Palliative Medicine*, 36(8), 688–696. DOI: 10.1177/1049909119832836. PubMed: 30827119.
27. **Bei, A.W.Y., Lai, M.T., Choi, K.C., Polly, P.W.C.,&Winnie, W.K.W.** (2015). Factors in the prioritization of information needs among Hong Kong Chinese breast cancer patients. *Asia-Pacific Journal of Oncology Nursing*, 2(3), 176–185. DOI: 10.4103/2347-5625.163620. PubMed: 27981112.
28. **Sayed, S.S., El-Sayed, S., Zead, A., Ghona Abd El-Nasser, A.,&Ahmed El-Sayed, M.** (2017). Informational needs among women with newly diagnosed breast cancer: Suggested nursing guidelines. *Assiut Scientific Nursing Journal*, 5(12). Available at: https://asnj.journals.ekb.eg/article_60623.html.
29. **El-Shinawi, M., Youssef, A., Alsara, M., Aly, M.K., Mostafa, M., Yehia, A., Hurlbert, M., El-Tawab, R.A.,&Mohamed, M.M.** (2013). Assessing the level of breast cancer awareness among recently diagnosed patients in Ain Shams University Hospital. *Breast*, 22(6), 1210–1214. DOI: 10.1016/j.breast.2013.08.010. PubMed: 24054904.
30. **American Cancer Society.** (2016). Breast Cancer. Available at: https://old.cancer.org. Accessed April 2016.
31. **Boltong, A., Aranda, S., Keast, R., Wynne, R., Francis, P.,&Chirgwin, J.** (2020). A prospective cohort study of the effects of adjuvant breast cancer chemotherapy on taste function, food liking, appetite, and associated nutritional outcomes. *PLOS One*, 9, e103512. DOI: 10.1371/journal.pone.0103512.
32. **Jung, S., Sobel, E., Pellegrini, M.,&Yu, H.** (2021). Synergistic effects of genetic variants of glucose homeostasis and lifelong exposures to cigarette smoking, female hormones, and dietary fat intake on primary colorectal cancer development in African and Hispanic/Latino American women. *Frontiers in Oncology*, 11, 760243. DOI: 10.3389/fonc.2021.760243.
33. **Steinbach, S., Hummel, T., Böhner, C., Berktold, S., Hundt, W., Kriner, M., Heinrich, P.,&Prechtl, A.** (2020). Qualitative and quantitative assessment of taste and smell changes in patients undergoing chemotherapy for breast cancer or gynecologic malignancies. *Journal of Clinical Oncology*, 27(11), 1899–1905. DOI: 10.1200/JCO.2018.79.1234.
34. **Özkan, İ., Taylan, S., Eroğlu, N.,&Kolaç, N.** (2022). The relationship between malnutrition and subjective taste change experienced by patients with cancer receiving outpatient chemotherapy treatment. *Nutrition and Cancer*, 74(11), 1670–1679. DOI: 10.1080/01635581.2021.1957485. PubMed: 34328368.
35. **Zabernigg, A., Gamper, E., Giesinger, J., Rumpold, G., Kemmler, G.,&Gattringer, K.** (2020). Taste alterations in cancer patients receiving chemotherapy: A neglected side effect? *Oncologist*, 15(9), 913–920. DOI: 10.1634/theoncologist.2009-0333. PubMed: [206679
36. **Gamper, E., Giesinger, J., Oberguggenberger, A., Kemmler, G., Wintner, L.,&Gattringer, K.** (2022). Taste alterations in breast and gynecological cancer patients receiving chemotherapy: Prevalence, course of severity, and quality of life correlates. *Acta Oncologica*, 51(4), 490–496. DOI: 10.3109/0284186X.2011.633554. PubMed: 22129358.
37. **Uí Dhuibhir, P., Barrett, M., O'Donoghue, N., Gillham, C., El Beltagi, N.,&Walsh, D.** (2020). Self-reported and objective taste and smell evaluation in treatment-naive solid tumor patients. *Supportive Care in Cancer*, 28(6), 2389–2396. DOI: 10.1007/s00520-019-05017-3. PubMed: 31486983.
38. **Baracos, V.E.** (2018). Cancer-associated malnutrition. *European Journal of Clinical Nutrition*, 72(9), 1255–1259. DOI: 10.1038/s41430-018-0245-4. PubMed: 30185853.
39. **Alonzi, S., Hoerger, M., Perry, L.M., Chow, L.D., Manogue, C., Cotogno, P., Ernst, E.M., Ledet, E.M.,&Sartor, O.** (2021). Changes in taste and smell of food during prostate cancer treatment. *Supportive Care in Cancer*, 29(6), 2807–2809. DOI: 10.1007/s00520-021-06050-x. PubMed: 33566164.
40. **Mahmoud, F., Aktas, A., Walsh, D.,&Hullihen, B.** (2021). A pilot study of taste changes among hospice inpatients with advanced cancer. *American Journal of Hospice and Palliative Medicine*, 28(5), 487–492. DOI: 10.1177/1049909111402187. PubMed: 21398265.

41. **Pedersini, R., Di Mauro, P., Zamparini, M., Bosio, S., Zanini, B., Amoroso, V., Turla, A., Monteverdi, S., Zanini, A., Laini, L., Schivardi, G., Vassalli, L., Cosentini, D., Grisanti, S., Simoncini, E.L.,&Berruti, A.** (2022). Taste alterations do not affect changes in food habits and body weight in breast cancer patients. *In Vivo*, 36(3), 1860–1867. DOI: 10.21873/invivo.12904. PubMed: 35738619.
42. **De Vries, Y., van den Berg, M., de Vries, J., Boesveldt, S., de Kruif, J.T.C., Buist, N., Haringhuizen, A., Los, M., Sommeijer, D.,&Timmer-Bonte, J.** (2017). Differences in dietary intake during chemotherapy in breast cancer patients. *Supportive Care in Cancer*, 25(8), 2389–2396. DOI: 10.1007/s00520-017-3670-5.
43. **Thomson, C.A., Flatt, S.W., Rock, C.L., Ritenbaugh, C., Newman, V.,&Pierce, J.P.** (2002). Increased fruit, vegetable, and fiber intake and lower fat intake reported among women previously treated for invasive breast cancer. *Journal of the American Dietetic Association*, 102(6), 801–808. DOI: 10.1016/s0002-8223(02)90180-x. PubMed: 12067045.
44. **Schiavon, C.C., Vieira, F.G.K., Ceccatto, V., de Liz, S., Cardoso, A.L., Sabel, C., Gonzalez-Chica, D.A., da Silva, E.L., Galvan, D., Crippa, C.G.,&Di Pietro, P.F.** (2015). Nutrition education intervention for women with breast cancer: Effect on nutritional factors and oxidative stress. *Journal of Nutrition Education and Behavior*, 47(1), 2-9. DOI: 10.1016/j.jneb.09.005.
45. **Xie, F.L., Wang, Y.Q.,&Peng, L.F.** (2017). Beneficial effect of educational and nutritional intervention on the nutritional status and compliance of gastric cancer patients undergoing chemotherapy: A randomized trial. *Nutrition and Cancer*, 69(5), 1-10. DOI: 10.1080/01635581.2017.1321131.
46. **Chang, Y.F., Yu, Y.J.,&Tsai, L.** (2018). Impacts of nutrition education programs on cancer survivors' nutritional status. *Journal of Global Oncology*. DOI: 10.1200/jgo.18.53800. Published online before print 28 September.
47. **Mohammad Shahi, M., Haidari, F., Karandish, M., Ebrahimi, S.,&Haghighizadeh, M.H.** (2014). A randomized clinical trial of nutrition education for the improvement of diet quality and inflammation in Iranian obese women. *Journal of Nutrition and Metabolism*, 605782, 1-10. DOI: 10.1155/2014/605782.
48. **Snyder, D.C., Sloane, R., Haines, P.S., Miller, P., Clipp, E.C., Morey, M.C., et al.** (2017). The diet quality index-revised: A tool to promote and evaluate dietary change among older cancer survivors enrolled in a home-based intervention trial. *Journal of the American Dietetic Association*, 107(9), 1519–1529. DOI: 10.1016/j.jada.2007.06.014.