Investigating Changes in Weight and Body Composition Among Women in Adjuvant Treatment for Breast Cancer

A Scoping Review

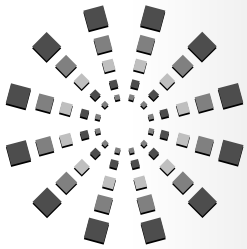
Pedersen, Birgith; Delmar, Charlotte; Lörincz, Tamás; Falkmer, Ursula; Grønkjær, Mette

Published in:
Cancer Nursing

DOI (link to publication from Publisher):
10.1097/NCC.0000000000000590

Publication date:
2019

Document Version
Accepted author manuscript, peer reviewed version



Birgith Pedersen, PhD, MScN, RN
Charlotte Delmar, PhD, MScN, RN
Tamás Lörincz, PhD, MD
Ursula Falkmer, PhD, MD
Mette Grønkjær, PhD, MgN, RN

Investigating Changes in Weight and Body Composition Among Women in Adjuvant Treatment for Breast Cancer

A Scoping Review

KEY WORDS
Breast neoplasm
Chemotherapy
Endocrine Treatment
Review
Weight changes

Background: Despite several investigations, findings on weight changes during and after adjuvant treatment for breast cancer are diverse and point in several directions. **Objective:** The aims of this study were to investigate changes in weight and body composition associated with contemporary anticancer medication and to examine factors that might influence the assessment and diversity of the findings. **Methods:** This article used the method of a scoping review to map the body of literature. From searching the databases PubMed, CINAHL, and EMBASE using MeSH terms, CINAHL terms, and Emtree, as well as free text, 19 articles were selected for further investigation. **Results:** The scoping review illustrates how findings in weight and body composition changes fluctuate over time as illustrated in 4 measure points: short term, 1 year, 18 months/2 years, and long term. The studies displayed differences regarding study designs, sample sizes, treatment regimens, measure points and techniques, and cutoff values for assessing weight changes, which make it difficult to synthesize findings and provide strong evidence for use in clinical practice. **Conclusion:** Synthesizing findings over time illustrates the need for attention on younger premenopausal women given chemotherapy. Weight need to be monitored for at least 2 years as short-term changes may be caused by increased body water, whereas long-term changes seem to be related with increased

Author Affiliations: Department of Oncology and Clinical Cancer Research Center (Drs Pedersen, Lörincz, and Falkmer); Clinical Nursing Research Unit (Drs Pedersen and Grønkjær), Aalborg University Hospital; Department of Clinical Medicine, Aalborg University (Drs Falkmer and Grønkjær); Institute of Public Health, Section of Nursing, Aarhus University and Health Faculty, Aalborg University, Denmark (Dr Delmar); University College Diakonova, Oslo (Dr Delmar); and The Arctic University of Norway Tromsø, Norway (Dr Delmar).

The research did not receive any grants from funding agencies in the public, commercial, or not-for profit sectors.

The authors have no conflicts of interest to disclose.

Correspondence: Birgith Pedersen, PhD, MScN, RN, Clinic for Surgery and Oncology and Clinical Nursing Research Unit, Aalborg University Hospital, Søndre Skovvej 3, 9000 Aalborg, Denmark (Birgith.pedersen@rn.dk).

Accepted for publication November 22, 2017.
DOI: 10.1097/NCC.0000000000000590

fat mass essential for risking recurrence and early death. **Implications for Practice:** The diversity in methods discloses the need for the research community to reach consensus regarding study designs for future research in this area.

The purpose of a scoping review is to map existing literature on a certain topic that may be of complex or heterogeneous nature and describe the volume, nature, and characteristics of the primary research.[1] Thus, a scoping review aims to present an overview of a potentially large and diverse body of literature. This scoping review focuses on weight changes during and after antineoplastic treatment for breast cancer (BC). This are of concern because of the association between fat tissue, BC development, and the increased risk of both recurrence and early death found among breast cancer stricken women with relative weight variations of 5%.[2]

Weight changes in women with BC have been investigated for decades.[2–10] Studies have found that women in current adjuvant chemotherapy (CT) for BC on average gain 2.0 kg during and after adjuvant treatment, and weight gain up to 10.0 kg is not uncommon.[5] A main contributor to weight gain is suggested to be the duration of CT.[6–8,10,11] However, with current antineoplastic agents, for example, anthracycline-based CT (anthracy-CT), weight changes may be overestimated.[12] Nevertheless, Makari-Judson et al[13] found weight gain ranging from 1.6 kg at 1 year to 6.0 kg at 2 years. Adjuvant cancer treatment involves radiotherapy, as well as CT, and endocrine treatment (ET).[14] Some researchers point at ET and menopause status as a contributing factor. For example, Goodwin et al[4] and Ganz[11] found onset of menopause and CT contributed to weight gain. Yet, findings are inconclusive as some studies suggest premenopausal status to be a predictor,[3,8,9] whereas others claim that menopausal status does not influence weight gain.[5,15,16] Recently, a review identified the effect of ET on weight gain including studies that compared estrogen receptor antagonist (ERA), aromatase inhibitors (AIs), and placebo.[17] Although there was no significant difference between the groups, the authors pointed at inconsistent results and the need for further investigations.

Despite investigations for years, findings on weight changes during and after adjuvant treatment for BC are diverse. Thus, the aims of this scoping review was to investigate changes in weight associated with contemporary anticancer medication and examine factors that might influence the assessment and diversity of the findings.

■ Materials and Methods

This scoping review was conducted by a research team consisting of health professionals with clinical and research experience. With inspiration from the original framework by Arksey and O'Malley,[1] the review consisted of 5 steps: identify the research question; find relevant studies; select the studies relevant for the study; chart the data; and collate, summarize, and report the results.

The Research Question

Our research question was: What is known from the existing literature about the extent and patterns of changes in weight among women during and after current adjuvant standard antineoplastic treatment for BC?

Find and Select Relevant Studies

The literature search was conducted in collaboration with a librarian from a university hospital. Although scoping reviews tend to comprehensively search all unpublished and published studies, we selected only published studies sought by means of databases. The literature search was conducted in PubMed, CINAHL, and EMBASE using MeSH terms, CINAHL terms, and Emtree, as well as free text not to exclude relevant literature in the databases search (Table 1). The search in PubMed provided most articles, and the search string from PubMed is shown in Table 2. The titles were initially screened and included for further investigation if they seemed to be relevant to the topic. Review articles and articles without abstract were excluded. During further screenings of abstracts and full-text readings, primary research focusing on women with BC receiving antineoplastic treatment with anthracy-CT and/or endocrine therapy and weight changes was included.

Weight changes have been described in different terms. Thus, we included studies that reported relative weight changes (percent), absolute changes (in kilograms) and body mass index, and body composition terms (fat mass, fat-free mass, and total body water). A flowchart illustrates the selection process of the included studies investigating the associations between weight changes and treatment with anthracy-CT ± ET or ET as a standalone treatment (Figure).

Chart the Data, Collate, and Summarize

A matrix charting detailing information of data was developed and consulted with the research team. The first author, who was familiar with the data in its entirety, extracted and categorized the data. Study design, aim, sample size, treatment, measure points, technique, and cutoff are charted in Table 3 and briefly reported narratively in the text. Subsequently, the specific findings were collated and summarized narratively using a thematic construction regarding weight changes divided into 4 follow-up periods: short-term, after 1 year, after 18 months/2 years, and after more than 2 years (Table 4). Scoping reviews have recently been methodologically developed to also contain a step for "synthesizing findings."[33,34] As such, the findings are continuously synthesized. The optional consultation exercise described by Arksey and O'Malley[1] was not conducted. However, 2 members of the research team, who are considered clinical experts, verified the relevance of the findings. In accordance with the purpose of scoping reviews, we did not appraise the quality of data extracted before inclusion.

■ Results

The review reports findings from 19 studies published from 2004 to 2017 (Table 3). Assessing studies published from 2004 and

Table 1 • Key Words for Databases Searching

Updated January 2017	PubMed (1014 Entries)	CINAHL (226 Entries	EMBASE (1831 Entries)
Breast neoplasms	**MeSH**	**CINAHL Headings**	**Emtree**
	Breast neoplasms	Breast neoplasms	Breast cancer
	Free text:	**Free text:**	**Free text:**
	Breast neoplasms	Breast neoplasms	Breast neoplasms
	Breast cancer	Breast cancer	Breast cancer
Body weight	**MeSH**	**CINAHL Headings**	**Emtree**
	Body weight	Body weight	Body weight
	changes	Body weight changes	Weight change
	Weight gain	Weight gain	Weight gain
	Weight loss	Weight loss	Weight reduction
	Overweight	Obesity	Obesity
	Obesity		
	Free text:	**Free text:**	**Free text:**
	Weight loss	Weight loss	Weight loss
	Weight reduction	Weight reduction	Weight reduction
	Weight gain	Weight gain	Weight gain
	Weight change	Weight change	Weight change
	Overweight	Overweight	Overweight
	Obesity	Obesity	Obesity
	Obese	Obese	Obese
Adjuvant treatment	**MeSH**	**CINAHL Headings**	**Emtree**
	Chemotherapy, adjuvant	Chemotherapy, adjuvant	Adjuvant chemotherapy
	Antineoplastic agents	Antineoplastic agents	Antineoplastic agent
	Aromatase inhibitors	Aromatase inhibitors	Aromatase inhibitor
	Estrogen antagonists	Estrogen antagonists	Antiestrogen
	Free text:	**Free text:**	**Free text:**
	Chemotherapy	Chemotherapy	Chemotherapy
	Antineoplastic agent	Antineoplastic agent	Antineoplastic agent
	Aromatase inhibitors	Aromatase inhibitors	Aromatase inhibitors
	Estrogen antagonists	Estrogen antagonists	Estrogen antagonists

onward, 2 studies report changes in weight associated with ET as the main focus.[20,30] Four studies report findings on CT,[19,23–25] and 13 studies, reporting findings on CT, included the effect of ET.[6,7,10,12,18,21,22,26–29,31,32]

■ Characteristics of Study Design and Data Collection

The studies were conducted almost worldwide displaying findings from Europe (5), North and South America (6 and 2), and Asia (6).

The majority of the studies had a retrospective design[6,10,23–32] and examined BC stages I to III.[6,10,23,24,28] Most of the studies included between 100 and 350 participants, and 2 included more than 3000 women.[6,27] In several studies, the methods used to estimate weight changes were not described[10,24,26,29,31,32] or did not specify the exact CT regimens.[27,32] If the regimens were specified, the women received various regimens,[6,10,23–26,28,29,31] and the descriptions of ET differed. In most studies, ET followed CT. However, in addition to the retrospective study focusing on ET,[30] ET was also given as a standalone treatment and reported separately in 3 studies.[6,10,31] Cutoff points for assessing weight changes were either missing[23,28,30] or defined as absolute weight changes ranging from 1.0 to 2.5 kg,[24,27,30–32] relative weight changes of ±5%,[6,25,29,31] or as the difference between measurements.[10,31]

Of 7 studies with a prospective design,[7,12,18–22] 5 included women with BC in stages I to III,[18–22] and 2 included women in stages I to II.[7,12] The samples consisted of 20 to 272 women, and follow-up time varied from completed CT (approximately 4–6 months) and up to 2 years. Most studies ended measurement after 1 year.[7,18–20] Chemotherapy regimens were specified in 6 studies,[7,12,18–22] and one study reported findings from ET

Table 2 • Search Strategy PubMed

(("Breast Neoplasms"[Mesh] OR breast neoplasms[tw] OR breast cancer[tw]) AND ((((((((((("Body Weight"[Mesh] OR "Body Weight Changes"[Mesh]) OR "Weight Gain"[Mesh]) OR "Weight Loss"[Mesh]) OR weight loss[tw]) OR weight reduction[tw]) OR weight gain[tw]) OR "Overweight"[Mesh]) OR "Obesity"[Mesh]) OR (weight change[tw] OR weight changes[tw])) OR overweight[tw]) OR (obesity[tw] OR obese[tw]))) AND (((((("Chemotherapy, Adjuvant"[Mesh] OR "Antineoplastic Agents"[Mesh]) OR "Aromatase Inhibitors"[Mesh]) OR "Estrogen Antagonists"[Mesh]) OR chemotherapy[tw]) OR antineoplastic agent[tw]) OR aromatase inhibitors[tw]) OR Estrogen Antagonists[tw])

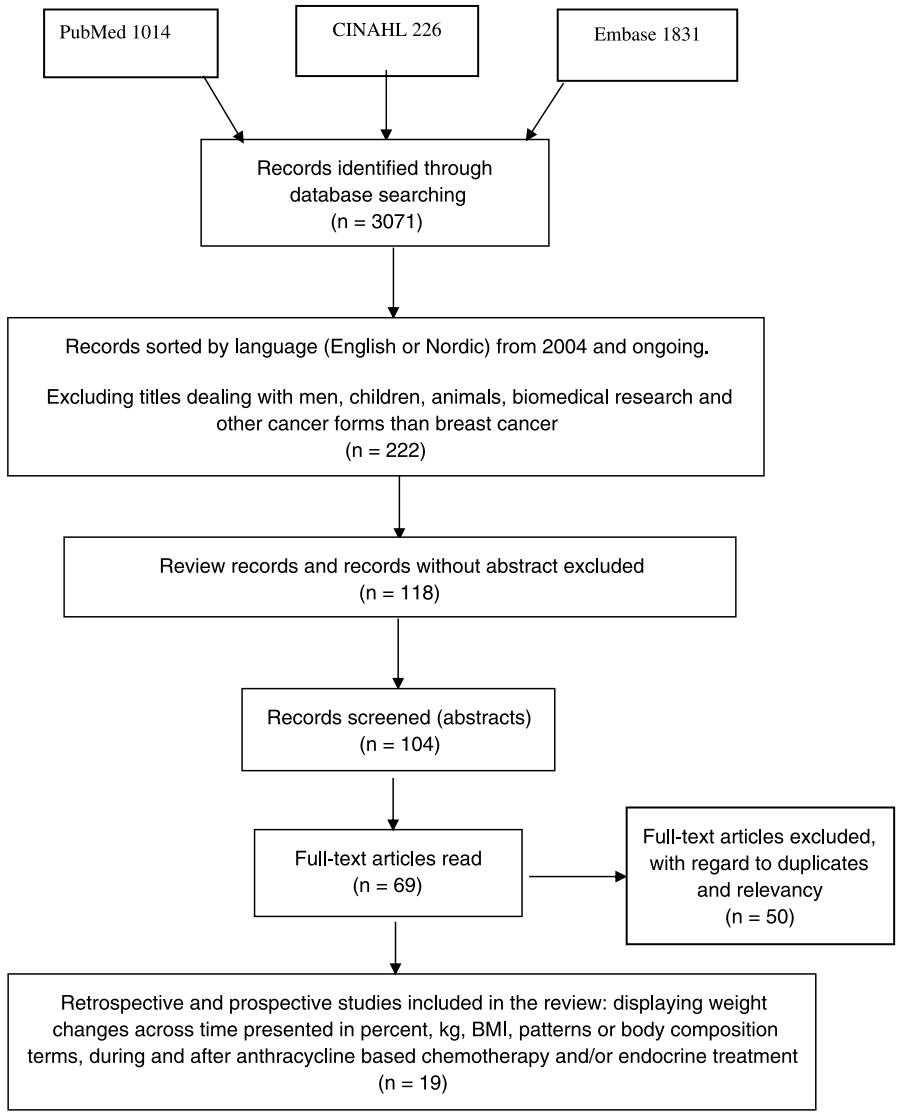


Figure ■ Flowchart selection process.

alone.[20] If cutoff points for assessing weight changes were described, they were defined as absolute weight changes of ±2.5 kg[12] and relative changes of ±2.4%[21] or ±5%.[19] One study applying a retrospective and prospective design included approximately 6000 women, but attrition was 2000 women at the 3-year follow-up.[32]

■ Reviewing and Synthesizing Findings in a Time Perspective

Short-term Follow-up

Reviewing the articles and synthesizing findings from baseline until 10 months after baseline showed that 13 of the studies reported weight changes short term.[10,12,18–25,28,29,32] The changes in weight and body composition were mainly related to CT except in the study of Francini et al.[20] In addition, ET was reported as a standalone treatment in the studies of Pedersen et al[21] and Basaran et al.[10] In the last case, there were only 5 persons in this group; thus, these findings are omitted from this review.

Francini et al[20] evaluated the changes in body composition among postmenopausal women that changed treatment from ERA to AI. They found decreasing weight and fat mass in the AI group and decreasing weight and stable fat mass in the ERA group. The differences were not statistically significant from baseline. However, the changes reported by Pedersen et al[21] among mainly postmenopausal receiving AI displayed no changes in weight or fat mass. Thus, studies reporting short-term follow-up on ET seem not to provide a common direction.

Changes related to CT showed a mean or median weight gain ranging from 1.0 kg to 4.2 kg[12,19,21,22,25,29,32] or a relative weight gain ranging from 2.2% to 7.4%.[10,22,32] Although all included studies applied anthracy-CT, the CT regimens could vary in lengths and numbers of drugs, and some reported findings in a mixed group including non–anthracy-CT.

The unclear findings associated with short-term ET are also manifest with respect to changes in weight and body composition after CT. For example, Han et al[28] reported stable weight but

Table 3 • Characteristics of Study Design and Data Collection

Authors	Design, Purpose	Sample Size, Stage	Treatment	Measure Points	Weight Techniques/ Cutoff Values for Weight Changes
	Prospective studies				
Freedman et al[18]	To evaluate body weight and body composition before, after completed CT, and 6 mo later. Data were compared with data from controls	N = 20 Stage I–IIIA Controls N = 51	Anthracy-CT ± other CT. ET not reported	Baseline, completion of CT, 6 mo after completion of CT	Different devices including DXA, and BIA. Controls only weight; no cutoff values
Ingram and Brown[12]	To describe the extent and patterns of breast cancer associated weight and body composition	N = 76 Stage I–II	Anthracy-CT ± other CT, ± ET	AC; baseline, 1 1/2 mo, 3 mo CEF and CMF; baseline, 2, 4, 6 and 7 mo	Weight: a balance beam scale; BIA cutoff ±2.5 kg
Tredan et al[19]	To investigate changes in body weight from diagnosis to 1 y after completion CT	N = 272 Stage I–III	Anthracy-CT ± other CT, ± ET	One year before diagnosis (self-reported), at diagnosis, 9 and 15 mo (6 and 12 mo after CT completion)	Not reported, cutoff ±5%
Francini et al[20]	To evaluate the changes in body composition and lipid profiles of postmenopausal women switched from tamoxifen to exemestane	N = 60 Stage I–III	ET (ERA and AI) main focus	1 wk before randomization, and 6 and 12 mo later	DXA No cutoff values
Gordon et al[7]	To investigate: what characterize changes in weight and body composition. Were the changes associated with chemotherapy-induced ovarian failure?	N = 43 Stage I and II	Anthracy-CT ± other CT, ET not reported	Baseline and 12 mo later	DXA, no cutoff values
Pedersen et al[21]	To describe the extent and patterns of changes in weight and body composition in women during and after current adjuvant standard antineoplastic treatment for BC	N = 95 Stage I–III	Anthracy-CT ± other CT ± RT, ± ET or antibodies, ET alone	Baseline, 6, 12, and 18 mo later	BIA cutoff ± 2.4%
Liu et al[22]	To investigate the trajectory of weight changes and the impact of chemotherapy regimens	N = 147 Stage I–III	Anthracy-CT ± other CT, ± ET	Preop, 1st day of CT, 2, 3, 4, 5, 6, 8, 10, 12, 18, and 24 mo later	A calibrated electronic weight, no cutoff values
	Retrospective studies				
Ricci et al[23]	To evaluate variation in BMI of Brazilian BC women undergoing adjuvant CT and to relate these changes with age and CT used	N = 196 Stage I–III	Anthracy-CT ± other CT	Baseline and 30 d after completion CT	A digital scale; no cutoff values
Wang et al[24]	To investigate the type of WC in Chinese BC survivors and analyze potential factors contributing to these changes	N = 98 Stage I–III	Anthracy-CT ± other CT	Baseline and after completion CT	Not reported, cutoff ±1 kg

(continues)

Table 3 • Characteristics of Study Design and Data Collection, Continued

Authors	Design, Purpose	Sample Size, Stage	Treatment	Measure Points	Weight Techniques/ Cutoff Values for Weight Changes
Vargas-Meza et al[25]	To analyze changes in the patients' (breast cancer women's) body weight before and after adjuvant chemotherapy	N = 200 Stage I–III	Anthracy-CT ± other CT	Baseline and after 4–6 cycles. (~3–5.5 moths)	Not reported, cutoff values: <5%, 6–10%, > 10%
Basaran et al[10]	To investigate the frequency and magnitude of weight gain and its relation with various social – clinical-pathological factors	N = 176 Stage I–III	Anthracy-CT ± other CT, ± ET, and ET alone (only 5)	Baseline, after completion of CT, and 1-y follow-up	Not reported, cutoff values: difference in kilos between baseline to completion of CT, and completion CT to 1 y
Chaudhary et al[26]	Examine the body weight changes and their association with various factors in a sample of women diagnosed with BC and treated with third-generation CT regimens	N = 246 Stage 0–IV	Anthracy-CT ± other CT ± ET	Baseline, and after 12 mo (measurements 3, 6, 9 mo not reported)	Not reported, cutoff values: difference in percent between diagnosis and 12 mo
Chen et al[27]	To describe an evaluation of weight changes from diagnosis to 18 mo after cancer diagnosis and correlates of weight changes in a population-based cohort study of 4565 Chinese breast cancer survivors	N = 4561 Stage 0–IV	Anthracy-CT (not specified), ± ET	One year before diagnosis, at diagnosis, and after 6 and 18 mo, respectively. Self-reported unless at 6 mo	Not reported, cutoff ±2 kg
Han et al[28]	To characterize WC after adjuvant treatment in Korea in women with early BC and to identify factors associated with these changes	N = 260 Stage I–III	Anthracy-CT ± other CT, ± ET, ET alone	Baseline, and after 3, 6, 12, and 18 mo, respectively	Not reported; no cutoff values
Jeon et al[29]	To characterize weight changes and to analyze its effect on prognosis after adjuvant TAC chemotherapy	N = 108 Stage II–III	Anthracy-CT ± other CT, ± ET	Baseline, and after 4–6, 12, and 24 mo respectively	Not reported, cutoff ≥5%
Nyrop et al[30]	To describe weight trajectories during the first 2 y of endocrine treatment among postmenopausal breast cancer survivors	N =300 Stage 0–III	Anthracy-CT (not specified), ET main focus	Baseline and after 2-y follow-up	Standardized weight scale cutoff ≥2 kg
Saquib et al[6]	1. Associations of CT and/or tamoxifen with relative WG 2. WG compared with type of CT 3. Association between age, stage, precancer BMI, and race with CT and WG 4. Who gained significantly weight on chemotherapy and returned to their precancer weight during follow-up 5. Characteristics of women returning to precancer weight	1. N = 2972 2. N = 2900 3. N = 3045 4. N = 1362 5. N = 868 Stage I–IIIA	Anthracy-CT ± other CT ± ET, ET alone	Self-reported weight 1 y prior to cancer diagnosis. Baseline, and after 1, 4, and 6 y	Not reported, cutoff ±5%

(continues)

Table 3 • Characteristics of Study Design and Data Collection, Continued

Authors	Design, Purpose	Sample Size, Stage	Treatment	Measure Points	Weight Techniques/ Cutoff Values for Weight Changes
Heideman et al[31]	Exploring the frequency and magnitude of post diagnosis body weight gain among BC Retrospective and prospective studies	N = 271 Stage 0–III	Anthracy-CT ± other CT, ± ET, or no medication	At diagnosis, and 1 and 5 y later	Not reported, cutoff ±1 kg
Gu et al[32]	To investigate weight patterns 6, 18, and 36 mo after diagnosis and potential socio-demographic and clinical risk factors in women with BC	N = 6299 Stage 0–III	Anthracy-CT, ± ET	One year before and at diagnosis (self-reported), and after 6, 18, and 36 mo	Not reported, reference ±2 kg, ±5%

Abbreviations: AC, adriamycin, cyclophosphamide; AI, aromatase inhibitor; anthracy-CT, anthracycline based chemotherapy; BC, breast cancer; BIA, bioelectrical impedance analysis; BMI, body mass index; CEF, cyclophosphamide, epirubicin, fluorouracil; CMF, cyclophosphamide, methotrexate, fluorouracil; CT, chemotherapy; DXA, dual-energy x-ray absorptiometry; ERA, estrogen receptor antagonist; ET, endocrine therapy; RT, radiotherapy; TAC, taxanes, adriamycin, cyclophosphamide; WC, weight changes; WG, weight gain.

without body composition data. These details were shown in Freedman and colleagues'[18] study, which found a minimally increased weight of 0.27±4.6 kg (P=.85) at 10 months, but a statistically significant (P=.03) decrease in fat-free mass. Fluctuation in body composition may thus appear despite stable weight. On the contrary, Ingram and Brown[12] and Pedersen et al[21] found a larger mean weight gain (1.4 and 1.6 kg, respectively) with an increase in fat-free mass among women given AC (adriamycin, cyclophosphamide)[12] or AC-T (adriamycin, cyclophosphamide, taxanes) (P<.0001)[21] apparently caused by water retention. In the last case, the women were mainly premenopausal. On the other hand, increasing fat mass was found in a mixed group given CEF (cyclophosphamide, epirubicin, fluorouracil) or CMF (cyclophosphamide, methotrexate, fluorouracil),[12] which was suggested to be caused by the longer duration of treatment with CEF and CMF.[12]

AC treatment has a shorter duration than CEF, CMF, or AC-T, and the duration of CT as a main factor for weight gain is supported by the study of Ricci et al.[23] They found that specifically AC-T regimens had the highest risk of weight gain 1 month after completing CT compared with other regimens. The body mass index changes from 27.4 kg/m^2 to 28.3 kg/m^2 (P<.001). The women in the AC-T group were younger (54.2±11 years) than women in the other regimens (59.3±11.2 years) (P=.007).[23] In this case, it is unknown whether the changes consist of increased body water.

As opposed to Ricci et al,[23] Vargas-Meza et al[25] found no differences in weight whether the regimens were anthracycline based or not. In their study of 200 women, 155 women gained weight, of whom 41 gained between 6% and 10%, and 19 gained more than 10%.[25] Thus, 60 women had serious weight gain of concern for survival and recurrence. Although the weight did not differ between premenopausal and postmenopausal women, a higher percent of premenopausal women gained weight. Finally, Wang et al[24] found an even distribution in stable weight, weight gain, and weight loss. They point at young age at diagnosis (P=.028) and the duration of CT (P=.037) as contributing factors for weight gain, whereas there was no correlation between menopause and weight.

Synthesizing these short-term findings, weight gain after CT is common and may exceed 5% relative weight gain of concern for recurrence and survival. As few studies report body composition changes, it is difficult to provide a common picture of the pattern of the changes in the short term. However, weight gain may be associated with increased fat-free mass due to water retention or increased fat mass due to longer duration of CT. Treatment with ET alone seems to point in different directions showing decreasing weight and fat mass in postmenopausal women given AI or no changes among primarily postmenopausal women given AI.

One-Year Follow-up

Nine studies reported findings at 1-year follow-up.[7,10,19–21,26,28,29,31] The pattern of the changes was centered on weight gain as the main result during and after CT.[7,10,19,21,26,31] The mean weight gain ranged from 0.9 to 3.9 kg,[19,21,31] and relative weight gain ranged from 0.39% to 5.9%.[10,19,26] In some studies, the amount of women gaining weight increased compared with short-term measurement. Basaran et al[10] reported an increase from 67% to 72%. Similarly, Tredan et al[19] showed a difference from 52.1% to 59.7% in a cohort of 272 women, of whom 233 were given anthracy-CT. Forty percent of those who gained weight increased their weight by more than 5% in the short term, increasing to 45% at 1 year. Although Chaudhary et al[26] report a minimal mean weight gain of 0.39%, they found a statistically significant difference when they investigated associations between menopause status and tumor stages.

Body composition changes showed a tendency toward increasing fat mass and decreasing fat-free mass.[7,21] Gordon et al[7] found increased fat mass, especially in the trunk in their study of 43 premenopausal women in different treatment regimens. The

Table 4 • Weight and Body Composition Reported From Baseline to Long Term

				Weight and Body Composition Changes Calculated and Reported From Baseline				
				Short Term	1 year	18–24 mo	>24 mo	
Author	Menopause status	Chemotherapy	ET given and reported alone	Weight/Body Composition	Weight/Body Composition	Weight/Body Composition	Weight/Body Composition	Comments
Freedman et al[18]	Premenopausal and postmenopausal	Mixed	−	Weight →[a] Fat mass ↑[b] Fat-free mass ↓[c] (P=.03)	—	—	—	Recommend long-term follow-up
Ingram and Brown[12]	Premenopausal	Mixed	−	Weight ↑ (mean, 1.4 kg) AC: fat -free mass ↑ CEF/CMF: fat mass ↑	—	—	—	Recommend further investigations of risk factors, but it seems that the duration of CT may be a contributing factor for weight gain.
Ricci et al[23]	Unknown	Anthracy-CT	−	BMI ↑ 0.9 kg/m^2 (P<.001)	—	—	—	Increasing BMI associated with AC-T. Recommend further studies on associations between weight gain and menopause status.
Vargas-Meza et al[25]	Premenopausal and postmenopausal	Mixed, majority anthracy-CT	−	Weight ↑ (mean, 3.4 kg)	—	—	—	No difference between premenopausal and postmenopausal. Daily caloric intake and amount of dexamethasone—a risk factor.
Wang et al[24]	Premenopausal and postmenopausal	Anthracy-CT	−	33.3% weight → 34.6% weight ↑ 32.1% weight ↓	—	—	—	Age and body weight at diagnosis, the duration of chemotherapy, and use of glucocorticoids suggested as a contributing factors for weight gain.
Gordon et al[7]	Premenopausal	Mixed	−	—	Weight ↑ fat mass ↑, fat-free mass ↓	—	—	Premature menopause seems to contribute to decreasing fat-free mass and increasing fat mass in trunk and legs but not statistically significant from women without premature menopause.
Basaran[10] et al	Premenopausal and postmenopausal	Mixed ± ET, majority anthracy-CT	+	Weight ↑ 2.4%, (P=.000)	Weight ↑ (mean, 1.8%, P=.000)	—	—	Age, menopausal status, multiparity and comorbidity contribute to weight gain
Chaudhary et al[26]	Premenopausal and postmenopausal	Mixed ± ET	−	—	Weight ↑ (mean, 0.39%), premenopausal: weight ↑ (mean, 1.67% P=.019), stage III–IV: weight ↓ (mean, −1.64%, P=.018)	—	—	Weight gain associated with being premenopausal; weight loss was associated with stage III and IV.

(continues)

Table 4 • Weight and Body Composition Reported From Baseline to Long Term, Continued

Author	Menopause status	Chemotherapy	ET given and reported alone	Weight and Body Composition Changes Calculated and Reported From Baseline: Short Term — Weight/Body Composition	1 year — Weight/Body Composition	18–24 mo — Weight/Body Composition	>24mo — Weight/Body Composition	Comments
Tredan et al[19]	Premenopausal and postmenopausal	Mixed ± ET	−	52.1% weight ↑ (mean, 3.2 kg; ~4.97%), 29.8% weight ↓	59.7% weight ↑ (mean, 3.9kg; ~5.9%), 29.2% weight ↓	—	—	Breast cancer patients gain weight posttreatment.
Francini et al[20]	Postmenopausal	—	+	AI: weight ↓ and fat mass ↓; ERA: weight ↓, fat mass →	ERA: weight →, fat mass →; AI: weight ↓, fat mass ↓ (P=.06)	—	—	AI treatment may have advantage over treatment with ERA regarding weight and body composition changes.
Pedersen et al[21]	Premenopausal and postmenopausal	Anthracy-CT ± ET	+	Weight ↑ (mean, 1.0 kg, P=.001), fat mass ↓; subgroups: ET weight →, fat mass → AC-T weight ↑ (mean,1.6 kg, P=.002) fat mass ↓ (mean, − 0.7 kg)	Weight ↑ (mean, 0.7 kg), fat mass ↑; subgroups: ET weight →, fat mass →, AC-T weight ↑ (mean, 0.9 kg), fat mass ↑ (mean, 0.8 kg)	Weight ↑ (mean, 0.9 kg, =.001), fat mass ↑; subgroups: ET weight →, fat mass →, AC-T weight ↑ (mean, 1.4 kg, P=.007), fat mass, ↑ (mean, 1.4 kg)	—	Subgroup analysis: women receiving ET remained stable over 18 mo from baseline. Among women given AC-T ± ET, the weight fluctuated, but at 18 mo, their weight gain consisted of increased fat mass. These women were younger and mainly premenopausal compared with the women given ET
Chen et al[27]	Premenopausal and postmenopausal	Anthracy-CT ± ET	+	—	—	Weight ↑ (mean, 1.7 kg) 61%, weight ↑ (37%≥5%, 17%≥10%) 25%, weight → 14%, weight ↓	—	Increased risk for gaining weight is associated with being young and premenopausal, chemotherapy, comorbidity, advanced disease stage, prediagnostic weight loss, underweight and obesity, and unhealthy lifestyle.
Han et al[28]	Premenopausal and postmenopausal	Mixed ± ET, majority anthracy-CT	+	Weight → (mean, 0.16 kg)	Weight → (mean, −0.34 kg) + ET weight → −ET weight ↓ (mean, −1.17 kg)	Weight → (mean, −0.40 kg)	—	Stable weight maybe associated with short duration of chemotherapy (mean, 17 wk). Dexamethasone only given as a single dose on day 1 of each chemo cycle, awareness of keeping a healthy body weight

(continues)

Table 4 • Weight and Body Composition Reported From Baseline to Long Term, Continued

Author	Menopause status	Chemotherapy	ET given and reported alone	Weight and Body Composition Changes Calculated and Reported From Baseline: Short Term Weight/Body Composition	1 year Weight/Body Composition	18–24 mo Weight/Body Composition	>24 mo Weight/Body Composition	Comments
Jeon et al[29]	Premenopausal and postmenopausal	Anthracy-CT±ET	—	Weight ↑ (mean, 3.4 kg) (P=.0001)	Weight→ (mean, −0.19 kg) 70% stable	Weight→ (mean, 0.37 kg) 70% stable	—	Weight changes at 6 mo did not persist. At 12 and 24 mo, the mean weight was back to baseline weight. Weight at 6 mo may be associated with fluid retention.
Liu et al[22]	Premenopausal and postmenopausal	Mixed±ET	—	Subgroups: CMF weight ↑ (mean, 4.2 kg; 7.4%), anthracy-based weight ↑ (mean, 1.3 kg; 2.2%)		Subgroups:CMF weight ↑ (mean, 1.3 kg; 2.2%), anthracy-based weight ↑ (mean, 0.7 kg; 1.2%)	—	Treatment with CMF induces more weight gain than anthracy-CT.
Nyrop et al[30]	Postmenopausal	(Anthracy-CT)	+	—	—	39% weight ↑, 34% weight→, 27% weight ↓	—	Receiving ET posttreatment with CT; not necessarily associated with weight gain. Weight pattern not associated with AI or ERA, but higher disease stage and more intensive treatment.
Saquib et al[6]	Premenopausal and postmenopausal	Mixed±ET, majority anthracy-CT	+	—	—	—	Weight ↑ (significant weight gain ≥5%); OR 1.65 for ET vs CT only (P=.01), OR 1.69 for CT±ET (P=.01), OR 1.63 for anthracy-based (P=.01), OR 1.79 for non-anthrac based CT (P=.03)	Weight gain associated with chemotherapy independent of regimens; no difference whether the women received tamoxifen or not.

(continues)

Table 4 • Weight and Body Composition Reported From Baseline to Long Term, Continued

Author	Menopause status	Chemotherapy	ET given and reported alone	Weight and Body Composition Changes Calculated and Reported From Baseline: Short Term — Weight/Body Composition	1 year — Weight/Body Composition	18–24 mo — Weight/Body Composition	>24mo — Weight/Body Composition	Comments
Heideman et al[31]	Premenopausal and postmenopausal	Mixed±ET, majority anthracy-CT	+	—	Weight ↑ (mean, 2.0kg); subgroups: no treatment weight ↑ (mean, 1.5kg $P<.05$), ET weight ↑ (mean, 1.4kg), CT weight ↑ (mean, 1.0kg), CT+ET weight ↑ (mean, 2.6kg, $P<.05$)	—	Weight ↑ (mean, 2.4kg); subgroups: no treatment weight →, ET weight ↑ (mean, 0.9kg), CT weight ↑ (mean, 2.9kg), CT+ET weight ↑ (mean, 4.7kg, $P<.05$)	Highest body weight gain associated with combined systemic therapy (CT and ET) and being premenopausal.
Gu et al[32]	Premenopausal and postmenopausal	Mixed	(+)	Weight ↑ (median, 1.0kg) 26%, weight ≥5%	—	Weight ↑ (median, 2.0kg) 33%, weight ≥5%	Weight ↑ (median, 1.0kg) 33%, weight ≥5%	More weight gain associated with being young, premenopausal, receiving chemotherapy or radiotherapy, advanced disease stage, lower body mass index at diagnosis; no difference whether the women received tamoxifen or not.

Abbreviations: AC, adriamycin, cyclophosphamide; AC-T, adriamycin, cyclophosphamide, taxanes; AI, aromatase inhibitor; anthracy-CT, anthracycline-based chemotherapy; BC, breast cancer; BMI, body mass index; CEF, cyclophosphamide, epirubicin, fluorouracil; CMF, cyclophosphamide, methotrexate, fluorouracil; CT, chemotherapy; ERA, estrogen receptor antagonist; ET, endocrine therapy; OR, odds ratio.
[a]Symbol ↑ = increasing weight or body composition factors.
[b]Symbol ↓ = decreasing weight or body composition factors.
[c]Symbol → = stable weight or body composition factors.

data were unified and calculated for the whole group. Thus, the analysis does not account for changes in women given anthracy-CT, who provided only one-third of the data.

Heideman et al[31] calculated weight changes in groups receiving no treatment, CT alone, CT ± ET, or ET alone. They found weight gain in all groups with the highest gain when receiving CT ± ET. This is contradictory to the findings of Jeon et al[29] and Han et al,[28] who reported stable weight at 12 months. In addition, Han et al[28] found weight loss of 1.17 kg among women who did not receive ET. These findings suggest that treatment with ET impacts weight development but ambiguously. For example, weight increased among women given ET alone,[31] whereas changes in weight and fat mass associated with ET alone was found stable at 1 year in another study.[21] Investigating the difference between ERA and AI, weight among women receiving ERA remained stable, whereas weight and fat mass decreased in the group receiving AI.[20]

Synthesizing findings at 1 year, weight tended to increase from baseline among women given CT partly as increasing fat mass. The effect of CT still seems essential as CT alone or followed by ET may lead to increasing weight. However, the findings lack unequivocalness as weight was found to be stable or decreased when CT was given alone. Thus, the effect of ET on weight at 1-year follow-up seems ambiguous pointing at weight gain, stable weight, and weight loss.

Eighteen-Month to 2-Year Follow-up

Seven studies reported findings in the time span from 18 to 24 months.[21,22,27–30,32] Weight gain as the main result during and after CT ranged from 0.7 to 2.6 kg.[21,22,32] According to Pedersen et al,[21] the women had an average gain of 1.4 kg consisting of increased fat mass ($P = .007$). Chen et al[27] reported a mean weight gain of 1.7 kg, and with a cutoff of 2 kilos, 61% gained weight, 14% lost weight, and 25% had no weight change. In the weight gain group, 37% gained 5% or greater, and 17% gained more than 10%. These findings were associated with young age and being premenopausal.[27] In support of these findings, Gu et al[32] demonstrated a median weight gain of 2.0 kg showing that 33% had weight gain of 5% or greater. Gu et al[32] and Chen et al[27] reported findings from anthracy-CT, whereas Liu et al[22] reported relative weight changes divided into anthracy-CT and non–anthracy-CT. They found that anthracy-CT regimens showed a slower and milder increase compared with other chemotherapeutic regimens and the highest changes among women in non–anthracy-CT (mean, 2.6 kg [4.7%]) compared with anthracy-CT (mean, 0.7 kg; 1.2%).

Although Heideman et al[31] claimed that a majority of women receiving CT ± ET displayed weight gain, stable weight was present in the studies of Han et al[28] and Jeon et al.[29] Weight also remained stable at 18 months among the women receiving ET (majority AI) alone in the study of Pedersen et al.[21] However, Nyrop et al[30] illustrated that weight changes at 24 months after initial CT involve almost an equal division in weight gain, stable weight, and weight loss. Weight gain in the 39% women was especially noted among women given CT and was not associated with the kind of ET given.

Synthesizing the findings in the time span 18 to 24 months from diagnosis, weight gain appeared commonly and in some cases reported to exceed 5% relative weight gain among a majority of women. The difference between anthracy-CT and non–anthracy-CT with or without ET is not clear. More studies reported stable weight or approximately the same amount of weight gain among women in anthracy-CT than in women receiving non–anthracy-CT. No changes appeared when ET was given alone, and a possible weight gain was associated only with CT and not the kind of ET.

Long-term Follow-up—More Than 2 Years

Three studies reported findings in the time span more than 2 years.[6,31,32] Examining the association between different CT regimens, ERA use, and weight gain, Saquib et al[6] found significant weight gain ≥ 5%. All types of CT were significantly associated with weight gain (odds ratio, 1.65; 95% confidence interval, 1.12–2.43) as opposed to ERA (odds ratio, 1.03; 95% confidence interval, 0.71–1.51).

Heideman et al[31] found a mean weight gain of 2.4 kg in the total group. Weight in the no-treatment group appeared stable. A minimal increase in ET-only group (mean, 0.9 kg) was found, and the highest weight gain among women given CT or CT + ET of 2.9 and 4.7 kg, respectively. The last group displayed the largest weight gain at 5 years as 46.9% gained more than 5% mean 4.7 kg (SD 6.3; $P < .05$). No significant changes were found among women receiving ET alone. Although Gu et al[32] at this time span found decreasing median weight gain equivalent to 1.0 kg compared with 18 months' measurement, 33% of the women still had weight gain of 5% or greater that was associated with being younger, being premenopausal, and receiving CT.

Synthesizing long-term findings shows how women, initially treated with CT, suffer from persistent serious weight gain in the long term compared with baseline. Endocrine therapy induces none or minimal long-term weight.

REVIEWING AND SYNTHESIZING OTHER CONTRIBUTING FACTORS FOR WEIGHT GAIN THAN TREATMENT

In this review, contributing factors for especially weight gain were reported and discussed. A central topic was menopause status, and especially premenopause seems to be an essential topic for further investigation.[23] Although menopause status was suggested not to influence weight,[25] this review showed that independent of time span, being premenopausal seems to induce weight gain.[10,21,26,27,31,32] In addition, premature menopause needs to be observed as a contributing factor that may influence body composition changes.[7] Related to this, age, especially being young, may be a crucial factor.[10,21,27,32] Besides this dominant topic, other contributing factors for weight changes such as comorbidity,[10,27] daily caloric intake,[25] lifestyle,[27,28] prediagnostic weight,[27,32] and disease stage were found.[26,27,30]

■ Discussion

This scoping review reports findings from 19 articles identified through a systematic literature search. The review demonstrated

a diversity of studies regarding changes in weight that might influence the possibility of making synthesis and thus providing useful recommendation for practitioners. In addition, the article has shed light over factors that might influence the assessment and diversity of the findings.

The review shows that several studies have investigated changes in weight, while fewer included body composition measurements.[7,12,18,20,21] In general, the studies display different treatment modalities, the sample sizes in the retrospective studies suffer from dropout, and the prospective studies from small samples. In addition, weight may be self-reported and on different scales if mentioned at all. Although the studies selected for review investigated modern/third-generation chemotherapeutic agents, the specific modalities were not described in all cases. Thus, due to differences regarding study designs, sample sizes, treatment regimens, measure points, and techniques, the option for a clear picture of the changes is troublesome. The same limitations appear in a review on weight changes during adjuvant ET (alone) conducted by Nyrop et al.[30] Investigating 38 studies, they reported that most studies showed no significant difference whether ET was compared with placebo or AI was compared with ERA. However, because of methodological issues, they were not able to draw a firm conclusion, and they recommend further studies.

Research has focused on weight gain as a contributing factor to recurrence and decreased survival among women treated for BC.[5–8,10] Thivat et al[2] point at a weight variation of more than 5% from diagnosis to completed CT as having a negative impact on recurrence and survival assessed during a 20-year follow-up. Furthermore, a relative weight loss of 2.4% may have influenced the survival rate among a mixed group of cancer patients, including women with BC.[35] In both studies, women with stages I to IV BC participated. Stage IV BC is characterized by distant metastases and a severe prognosis that may have influenced the findings. Although some studies in this present review apply a 5% cutoff,[6,19,25,29,32] it may be difficult to evaluate whether the changes in general are more or less than the serious relative changes crucial for recurrence and survival, when most studies apply no cutoff or use factual kilos as cutoff values.[7,10,12,18,20–24,26–28,30,31]

In assessing the studies across, it seems that anthracy-CT regimens given in combination with other chemotherapeutic agents are essential for weight gain due to the duration of the treatment.[12,21,23] Whether the women received ET as follow-up treatment seems not to influence these findings.[6,30] The duration of CT as a main factor and the lack of influence from ET correspond with the findings of Vance et al.[8] In this review, they included studies from 1997 up to 2009 and did not describe the specific CT regimens. Thus, an unknown amount of studies may report findings from former regimens and not anthracy-CT. However, the risk of weight gain needs attention as recently the Danish Breast Cancer Group[14] recommended additional series of taxanes in BC treatment, which may increase the risk of weight gain in the future due to prolonged duration.

In addition, it appears that most studies agree about the risk for weight gain among younger premenopausal women.[7,21,23–27] Although the average weight gain and the association with being young and premenopausal are supported in other studies,[8] the samples consist of women in different stages: I to II,[7] I to III, and[21,23,24] 0 to IV,[26,27] which may influence the findings.

Weight changes after completing CT up to 1 year seem critical,[6,10,12,19,21,22,28,29,31] as more studies reported statistically significant weight gain at this measure point.[21,26,29] Still, after completed CT, weight gain may consist of water retention that disappears over time.[12,21] Nevertheless, some studies demonstrate no changes at 1 year,[28,29] while others claim persistent weight gain.[10,19,31] In some studies, the weight continues to rise or does not return to baseline weight,[6,21,22,31] whereas others conclude no changes at the 2-year follow-up.[28,29] Sheean et al[36] also described this diversity of findings. In contrast to the 2 studies in the present scoping review showing increased weight and decreased fat mass due to increased body water short term, they point at stable or increased fat mass after completed CT. The tendency of increasing fat mass appeared also at later measure points such as 1-, 2-, and 3-y follow-up. However, in this review, there was no description of the specific CT regimens.

Limitations

Only studies from database searching in English or Nordic language were included in this review. Although these limits may have excluded potential relevant literature, we anticipated that this specific topic regarding changes in weight during and after current standard adjuvant antineoplastic treatment for BC would be covered in scientific databases. We were inspired by Arksey and O'Malley's[1] original framework for scoping reviews and followed their recommendations and additionally included synthesizing, as there is an increasing attention on synthesizing and using scoping review for clinical recommendations.[33,34] Despite this, our scoping review must be used with caution due of the diversity in study designs and findings.

■ Conclusion

This scoping review illustrates how findings in weight and body composition changes fluctuate over time and vary dependent on measure points. In addition, the studies apply different cutoffs, which make it difficult to evaluate the changes in relation to the serious relative changes crucial for recurrence and survival. The diversity impacts the synthetization of findings and the possibility to provide clinicians with evidence-based knowledge to use when providing information to women with BC.

Despite these difficulties, synthesizing findings over time illustrates the need for attention on younger premenopausal women given CT. To gain more knowledge about the exact changes in weight and body composition, monitoring these variables for at least 2 years may be essential as short-term changes may be caused by increased body water, whilst long-term changes seem to be related with increased fat mass.

Based on this review, we recommend further investigations applying long-term prospective designs, measurements at certain time points, and assessing weight and body composition changes via the same kind of device. For example, bioelectrical

impedance analysis that is cheap and easy to use could help to standardize measurement. In addition, to show the patterns of weight loss, stable weight, and weight gain requires inclusion of women given the same antineoplastic treatment in relevant numbers for statistical analysis and using the same cutoff, for example, 5%.

Given the association between weight gain and risk for recurrence and increased mortality,[2,37] developing evidence-based knowledge on weight changes during antineoplastic treatment for BC is important. Moreover, weight changes may influence the women's perception of their bodies[38] and quality of life, although mean weight gain may be assessed as modest.[39] Thus, future research may focus on changes in body weight including body composition among women treated for BC as well as the women's experiences of the changes.

ACKNOWLEDGMENTS

The authors acknowledge the Clinic for Surgery and Oncology, Aalborg University Hospital, and Clinical Nursing Research Unit, Aalborg University Hospital, Aalborg, Denmark, for supporting this work.

References

1. Arksey H, O'Malley L. Scoping studies: towards a methodological framework. *Int J Soc Res Methodol*. 2005;8(1).
2. Thivat E, Thérondel S, Lapirot O, et al. Weight change during chemotherapy changes the prognosis in non metastatic breast cancer for the worse. *BMC Cancer*. 2010;10:648.
3. McInnes JA, Knobf MT. Weight gain and quality of life in women treated with adjuvant chemotherapy for early-stage breast cancer. *Oncol Nurs Forum*. 2001;28(4):675–684.
4. Goodwin PJ, Ennis M, Pritchard KI, et al. Adjuvant treatment and onset of menopause predict weight gain after breast cancer diagnosis. *J Clin Oncol*. 1999;17(1):120–129.
5. Lankester KJ, Phillips JE, Lawton PA. Weight gain and quality of life in women treated with adjuvant chemotherapy for early-stage breast cancer. *Clin Oncol*. 2002;14(1):64–67.
6. Saquib N, Flatt SW, Natarajan L, et al. Weight gain and recovery of precancer weight after breast cancer treatments: evidence from the Women's Healthy Eating and Living (WHEL) study. *Breast Cancer Res Treat*. 2007;105(2):177–186.
7. Gordon AM, Hurwitz S, Shapiro CL, LeBoff MS. Premature ovarian failure and body composition changes with adjuvant chemotherapy for breast cancer. *Menopause*. 2011;18(11):1244–1248.
8. Vance V, Mourtzakis M, McCargar L, Hanning R. Weight gain in breast cancer survivors: prevalence, pattern and health consequences. *Obes Rev*. 2011;12(4):282–294.
9. Nissen MJ, Shapiro A, Swenson KK. Changes in weight and body composition in women receiving chemotherapy for breast cancer. *Clin Breast Cancer*. 2011;11(1):52–60.
10. Basaran G, Turhal NS, Cabuk D, et al. Weight gain after adjuvant chemotherapy in patients with early breast cancer in Istanbul Turkey. *Med Oncol*. 2011;28(2):409–415.
11. Ganz PA. Impact of tamoxifen adjuvant therapy on symptoms, functioning, and quality of life. *J Natl Cancer Inst Monogr*. 2001;(30):130–134.
12. Ingram C, Brown JK. Patterns of weight and body composition change in premenopausal women with early stage breast cancer: has weight gain been overestimated? *Cancer Nurs*. 2004;27(6):483–490.
13. Makari-Judson G, Braun B, Jerry DJ, Mertens WC. Weight gain following breast cancer diagnosis: implication and proposed mechanisms. *World J Clin Oncol*. 2014;5(3):272–282.
14. DBCG [Danish Breast Cancer Group]. Medicinsk behandling [Medical treatment]. http://www.dbcg.dk/PDF%20Filer/Kap_6_Medicinsk_behandling-07.04.2017.pdf. Accessed June, 2017.
15. Kroman NT, Lidegaard O, Kvistgaard ME. Breast cancer—a lifestyle disease? *Ugeskr Laeger*. 2005;167(49):4636–4641.
16. Hellmann SS, Thygesen LC, Tolstrup JS, Gronbaek M. Modifiable risk factors and survival in women diagnosed with primary breast cancer: results from a prospective cohort study. *Eur J Cancer Prev*. 2010;19(5):366–373.
17. Sestak I, Harvie M, Howell A, Forbes JF, Dowsett M, Cuzick J. Weight change associated with anastrozole and tamoxifen treatment in postmenopausal women with or at high risk of developing breast cancer. *Breast Cancer Res Treat*. 2012;134(2):727–734.
18. Freedman RJ, Aziz N, Albanes D, et al. Weight and body composition changes during and after adjuvant chemotherapy in women with breast cancer. *J Clin Endocrinol Metab*. 2004;89(5):2248–2253.
19. Tredan O, Bajard A, Meunier A, et al. Body weight change in women receiving adjuvant chemotherapy for breast cancer: a French prospective study. *Clin Nutr*. 2010;29(2):187–191.
20. Francini G, Petrioli R, Montagnani A, et al. Exemestane after tamoxifen as adjuvant hormonal therapy in postmenopausal women with breast cancer: effects on body composition and lipids. *Br J Cancer*. 2006;95(2):153–158.
21. Pedersen B, Delmar C, Bendtsen MD, et al. Changes in weight and body composition among women with breast cancer during and after adjuvant treatment: a prospective follow-up study. *Cancer Nurs*. 2016.
22. Liu LN, Wen FH, Miaskowski C, et al. Weight change trajectory in women with breast cancer receiving chemotherapy and the effect of different regimens. *J Clin Nurs*. 2014;23(19–20):2757–2768.
23. Ricci MD, Formigoni MC, Zuliani LM, et al. Variations in the body mass index in Brazilian women undergoing adjuvant chemotherapy for breast cancer. *Rev Bras Ginecol Obstet*. 2014;36(11):503–508.
24. Wang JS, Cai H, Wang CY, Zhang J, Zhang MX. Body weight changes in breast cancer patients following adjuvant chemotherapy and contributing factors. *Mol Clin Oncol*. 2014;2(1):105–110.
25. Vargas-Meza A, Chavez-Tostado M, Cortes-Flores AO, et al. Body weight changes after adjuvant chemotherapy of patients with breast cancer: results of a Mexican cohort study. *Eur J Cancer Care (Engl)*. 2016.
26. Chaudhary LN, Wen S, Xiao J, Swisher AK, Kurian S, Abraham J. Weight change associated with third-generation adjuvant chemotherapy in breast cancer patients. *J Community Support Oncol*. 2014;12(10):355–360.
27. Chen X, Lu W, Gu K, et al. Weight change and its correlates among breast cancer survivors. *Nutr Cancer*. 2011;63(4):538–548.
28. Han HS, Lee KW, Kim JH, et al. Weight changes after adjuvant treatment in Korean women with early breast cancer. *Breast Cancer Res Treat*. 2009;114(1):147–153.
29. Jeon YW, Lim ST, Choi HJ, Suh YJ. Weight change and its impact on prognosis after adjuvant TAC (docetaxel-doxorubicin-cyclophosphamide) chemotherapy in Korean women with node-positive breast cancer. *Med Oncol*. 2014;31(3):849.
30. Nyrop KA, Deal AM, Lee JT, et al. Weight changes in postmenopausal breast cancer survivors over 2 years of endocrine therapy: a retrospective chart review. *Breast Cancer Res Treat*. 2017;162(2):375–388.
31. Heideman WH, Russell NS, Gundy C, Rookus MA, Voskuil DW. The frequency, magnitude and timing of post-diagnosis body weight gain in Dutch breast cancer survivors. *Eur J Cancer*. 2009;45(1):119–126.
32. Gu K, Chen X, Zheng Y, et al. Weight change patterns among breast cancer survivors: results from the shanghai breast cancer survival study. *Cancer Causes Control*. 2010;21(4):621–629.
33. Colquhoun HL, Levac D, O'Brien KK, et al. Scoping reviews: time for clarity in definition, methods, and reporting. *J Clin Epidemiol*. 2014;67(12):1291–1294.
34. Tricco AC, Cardoso R, Thomas SM, et al. Barriers and facilitators to uptake of systematic reviews by policy makers and health care managers: a scoping review. *Implement Sci*. 2016;11:4.

35. Martin L, Senesse P, Gioulbasanis I, et al. Diagnostic criteria for the classification of cancer-associated weight loss. *J Clin Oncol*. 2015;33(1):90–99.
36. Sheean PM, Hoskins K, Stolley M. Body composition changes in females treated for breast cancer: a review of the evidence. *Breast Cancer Res Treat*. 2012;135(3):663–680.
37. Playdon MC, Bracken MB, Sanft TB, Ligibel JA, Harrigan M, Irwin ML. Weight gain after breast cancer diagnosis and all-cause mortality: systematic review and meta-analysis. *J Natl Cancer Inst*. 2015;107(12):djv275.
38. Pedersen B, Groenkjaer M, Falkmer U, Delmar C. Understanding the essential meaning of measured changes in weight and body composition among women during and after adjuvant treatment for breast cancer: a mixed-methods study. *Cancer Nurs*. 2017;40(6):433–444.
39. Kjaer TK, Johansen C, Ibfelt E, et al. Impact of symptom burden on health related quality of life of cancer survivors in a Danish cancer rehabilitation program: a longitudinal study. *Acta Oncol*. 2011;50(2):223–232.