The Impact of Multidisciplinary Weight Management on Body Weight and Body Mass Composition in Women with Breast Cancer Post-Adjuvant Chemotherapy: A Retrospective Chart Review

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**Keywords**
Multidisciplinary weight management · Breast cancer · Metabolic syndrome · Menopause

**Abstract**

**Introduction:** Weight gain during chemotherapy for breast cancer is a well-documented adverse effect. The purpose of this study was to investigate how multidisciplinary weight management involving endocrinology, dietitian, and exercise physiology care, in a real-life healthy weight clinic (HWC) would impact body weight and mass composition in breast cancer women post-adjuvant chemotherapy compared to a cohort of non-cancer women who have been matched by age, ethnicity, smoking, and menopausal status.

**Methods:** Body weight (kg), BMI (kg/m\(^2\)), skeletal muscle mass (SMM %), fat mass (FM %), and waist circumference (cm) were collected at baseline of the first HWC appointment, 3 months after baseline, and 6 months after baseline. A total of 32 women were included, 11 in the breast cancer cohort and 21 in the control cohort, that matched inclusion and exclusion criteria based on a retrospective chart review from 28 July 2017 to 19 July 2021. **Results:** By 6 months, the breast cancer women had a mean weight change of \(-6.99\) kg (SD = 3.87, \(p = 0.003, n = 11\)) and change in BMI by \(-2.72\) kg/m\(^2\) (SD = 1.62, \(p = 0.004, n = 11\)). There was a change in SMM of \(1.21\) % (SD = 0.73, \(p = 0.005, n = 11\)), a change in FM of \(-2.76\) % (SD = 1.33, \(p = 0.002, n = 11\)), and a change in waist circumference of \(-8.13\) cm (SD = 4.21, \(p = 0.031, n = 3\)). By 6 months in the breast cancer cohort, there was a larger change in body weight in women who did not have MetS (\(-8.72\) kg, SD = 2.41, \(n = 6\)) in comparison to women with MetS (\(-2.65\) kg, SD = 3.75 kg, \(n = 3\)) (\(p = 0.045\)). **Conclusion:** Findings indicate that multidisciplinary weight management has a positive role in early-stage breast cancer survival through improving body weight and mass composition. These results can add to the development of long-term treatment plans for survivors in order to shine a light on ways to reduce risk recurrence and chronic disease mortality.

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Introduction and Background

Weight gain during chemotherapy for breast cancer is a well-documented adverse side effect [1–5]. The drug-related toxicity alters body composition by causing muscle depletion due to reduced protein anabolism and proteolysis mechanisms [6]. The literature recognizes the negative consequences of weight gain that increases risks of cardiovascular disease, diabetes, and chronic conditions related to obesity [5, 7–13]. The results from the large prospective Health, Eating, Activity and Lifestyle (HEAL) study showed a significant association between sarcopenia and obesity, with an increased mortality hazard ratio of 2.86 in breast cancer survivors [8]. Patients who underwent radiotherapy plus adjuvant chemotherapy were also at a higher risk of congestive heart failure, with smoking further increasing the risk of myocardial infarction [14–16]. The prevalence of metabolic syndrome (MetS), glucose intolerance, hypertension, and dyslipidaemia in breast cancer patients are further exacerbated by postmenopausal changes and changes in oestradiol levels [17–19]. This impact on mortality is relevant as many women with early-stage disease may potentially be cured however experience a greater risk in developing chronic metabolic disease, higher rates of cancer recurrence, and post-diagnosis death [8, 9, 11, 12].

For patients receiving chemotherapy, the amount of weight gain is influenced by treatment duration, the type of agents used, and whether hormonal treatment is involved [3–5, 20]. Contrastingly, a 2-year prospective review by Arpino et al. [1] concluded that weight gain was unrelated to the type of systemic therapy delivered. Although there is conflicting evidence on the impact that chemotherapy has on weight alone, there is a common hypothesis that body composition changes do occur, more specifically, a decrease in skeletal muscle mass (SMM) and an increase in fat mass (FM) [1, 3, 5, 20]. Intentional weight loss of 5–10% body weight, with a focus on muscle mass preservation, have been found to improve inflammatory and hormonal biomarkers, insulin resistance, and serum leptin levels in a non-cancer population [21]. As a result, there is ongoing research investigating the impact that exercise intervention has on weight change in breast cancer patients and how this intervention may improve overall morbidity and mortality. Combination of weight loss regimens of diet and exercise targeted to breast cancer patients with body mass index (BMI) ≥30 kg/m² achieved greater reductions in weight, BMI, and waist circumference (WC) when compared to standard care [21–23].

Previous studies investigating the weight change in breast cancer women had limitations. Firstly, BMI and body weight were often used as endpoint measurements and however did not accurately represent changes in SMM and FM [3, 5, 20, 24]. This meant that any body composition changes that occurred were not statistically reflected [24, 25]. Secondly, many studies commented on the lack of non-breast cancer controls and stratification of weight-dependent variables such as menopausal status, ethnicity, and cancer treatment type, which resulted in significant clinical heterogeneity [1, 2, 20, 24, 26–29]. In addition, there has been no evidence of multidisciplinary weight intervention in breast cancer patients that looked at other disciplines involved in weight loss besides from the perspective of physical activity [24, 28–30]. Systematic reviews by Chlebowski et al. [30] and Ingram et al. [24] identified no studies which included comprehensive weight loss programs that focus on a multidisciplinary approach of dietary change, exercise, and lifestyle intervention.

To address these limitations, the study upon which this paper reports aimed to evaluate how multidisciplinary weight management in a real-life clinic could affect body weight outcomes and mass composition distribution in breast cancer women receiving adjuvant chemotherapy compared to a cohort of non-cancer women who have been matched by age, ethnicity, smoking status, menopausal status, and MetS status. This study aimed to add to the knowledge-base, which has been identified in the literature of weight loss intervention and its role in early-stage breast cancer survival.

Methods

Study Design, Population, and Settings

Retrospective data were obtained from women undergoing multidisciplinary weight management at the Macquarie University (MQ) Health Healthy Weight Clinic (HWC), based in Sydney, Australia, between 28 July 2017 and 19 July 2021. The MQ Health HWC consists of a team of endocrinologists, dietitians, and exercise physiologists that coordinates an individualized plan of weight management on a dietary, medical, and physical activity level. From the clinic, women with breast cancer who had received adjuvant chemotherapy and women without cancer were recruited into the study via convenience sampling. A total of 414 women were identified as HWC patients, with 341 participants being excluded after inclusion and exclusion criterion were applied, with an additional 41 participants being excluded due to missing follow-up data. The remaining number of participants included in the study was 11 women in the breast cancer cohort and 21 women in the control cohort.

All study participants had to be at least 18 years old. Women with primary stage I–IIIB breast cancer who had received adjuvant...
| Characteristics               | Categories | N (%) or mean ± SD (range) |
|------------------------------|------------|-----------------------------|
|                              | breast cancer (n = 11) | control (n = 21)           |
| Age, year                    | 18–29      | 0                           | 1 (4.8)                      |
|                              | 30–39      | 0                           | 2 (9.5)                      |
|                              | 40–49      | 5 (45.5)                    | 2 (9.5)                      |
|                              | 50–59      | 4 (36.4)                    | 12 (57.1)                    |
|                              | 60–69      | 1 (9.1)                     | 2 (9.5)                      |
|                              | 70–79      | 1 (9.1)                     | 2 (9.5)                      |
|                              |            | 52.6±8.2 (42–70)            | 53.2±11.4 (27–71)            |
| Ethnicity                    | Caucasian  | 9 (81.9)                    | 17 (77.3)                    |
|                              | Non-Caucasian | 2 (18.2)                  | 4 (22.7)                     |
| Smoking status               | Current smoker | 2 (18.2)                   | 0                           |
|                              | Non-smoker  | 9 (81.9)                    | 20 (100)                     |
| Menopausal status            | Pre        | 5 (45.5)                    | 5 (23.8)                     |
|                              | Peri       | 2 (18.2)                    | 2 (9.5)                      |
|                              | Post       | 4 (36.4)                    | 14 (66.7)                    |
| MetS status                  | Yes        | 8 (72.7)                    | 8 (38.1)                     |
|                              | No         | 3 (27.3)                    | 13 (61.9)                    |
| Cancer grade                 | 1          | 0                           |                             |
|                              | 2          | 3 (27.3)                    |                             |
|                              | 3          | 8 (72.7)                    |                             |
| Cancer stage                 | I          | 2 (18.2)                    |                             |
|                              | II         | 9 (81.8)                    |                             |
|                              | III        | 0                           |                             |
| Receptor status              | ER+        | 10 (90.1)                   |                             |
|                              | PR+        | 8 (72.7)                    |                             |
|                              | HER+       | 2 (18.2)                    |                             |
| Surgery                      | Yes        | 11 (100)                    |                             |
|                              | No         | 0                           |                             |
| Radiotherapy                 | Yes        | 11 (100)                    |                             |
|                              | No         | 0                           |                             |
| Hormone therapy              | AI         | 3 (27.3)                    |                             |
|                              | SERM       | 7 (63.6)                    |                             |
|                              | None       | 1 (9.1)                     |                             |
| Chemotherapy regimen         | AC         | 2 (18.2)                    |                             |
|                              | AC-T       | 4 (36.3)                    |                             |
|                              | Docetaxel  | 2 (18.2)                    |                             |
|                              | Paclitaxel + herceptin | 1 (9.1)                   |                             |
|                              | TC + herceptin | 1 (9.1)                   |                             |
|                              | FEC        | 1 (9.1)                     |                             |

ER, oestrogen receptor status; PR, progesterone receptor status; HER2, human epidermal growth factor receptor-2 status; AC, cyclophosphamide and doxorubicin; AC-T, cyclophosphamide, doxorubicin, and taxol; TC, docetaxel and cyclophosphamide; FEC, 5FU, epirubicin, and cyclophosphamide.
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BMI, body mass index; SMM, skeletal muscle mass; FM, fat mass; WC, waist circumference; BC, breast cancer. *WC data for breast cancer (n = 3) and control (n = 7).

Table 2. Mean weight, BMI, and body mass composition for breast cancer (n = 11) and control (n = 21) cohorts in the HWC at baseline, 3-month, and 6-month visits, adjusted for baseline weight differences

| Variables | Baseline | Three months | Six months |
|-----------|----------|--------------|------------|
|           | BC, control, | p value | BC, control, | p value | BC, control, | p value |
| M ± SD | M ± SD | | M ± SD | M ± SD | | M ± SD | M ± SD |
| Weight (kg) | 88.69±9.85 | 103.11±21.1 | 0.045 | 84.49±12.65 | 99.79±19.84 | 0.355 | 80.99±12.49 | 98.71±18.14 | 0.100 |
| BMI (kg/m²) | 34.15±3.92 | 38.41±7.94 | 0.600 | 32.56±5.12 | 37.14±7.72 | 0.920 | 31.37±4.79 | 36.72±6.61 | 0.403 |
| SMM (%) | 21.36±2.68 | 20.89±3.58 | 0.448 | 22.22±2.69 | 21.09±3.34 | 0.737 | 22.14±2.08 | 21.12±3.17 | 0.878 |
| FM (%) | 43.64±4.60 | 43.96±6.35 | 0.546 | 42.07±3.99 | 43.75±6.02 | 0.790 | 41.87±4.20 | 43.15±5.95 | 0.797 |
| WC (cm) | 109.43±10.85 | 124.93±14.79 | 0.728 | 105.21±12.47 | 119.36±11.37 | 0.325 | 96.88±8.87 | 115.36±11.37 | 0.411 |

BMI was calculated from weight measures taken on bariatric digital weighing scales in the clinic, and baseline height was taken using a calibrated stadiometer, to ensure consistent measurements. WC was measured at the umbilicus in centimetres (cm) using a flexible plastic tape, with participants in the standing position. Body mass composition was assessed from non-invasive bioimpedance spectroscopy, a method used to accurately measure total body water and fluid volumes, using the ImpediMed SOZO device to calculate SMM and FM.

Data Analyses

The collected data were analysed using IBM SPSS Statistics programme version 27. Descriptive statistics were generated for the population demographics and body mass composition variables of interest. These variables include weight (kg), BMI (kg/m²), SMM (%), FM (%), and WC (cm). The changes in these variables were analysed using repeated measures ANOVA with a Greenhouse-Geisser correction to account for sphericity. A two-sided p value <0.05 was considered statistically significant. Differences in these changes according to baseline weight, ethnicity, smoking status, menopausal status, and MetS status were analysed as covariate variables, given the potential impact these factors have on body weight and mass composition.

Results

Participants’ Demographic and Clinical Characteristics

A total of 32 women were included in the study, 11 in the breast cancer cohort and 21 in the control cohort. There was no significant difference in baseline characteristics between the two cohorts. The mean age in the breast cancer cohort was 52.6 years old and 53.2 years old in the control cohort. The majority of participants were Caucasian women and non-smokers in both cohorts. Regarding menopausal status, most breast cancer women were premenopausal (45.5%), while most control women were postmenopausal (66.7%). In terms of cancer characteristics, 18.2% were stage I, and 81.8% were in stage II (TNM system). A total of 90.1% of participants were oestrogen chemotherapy were eligible for the study. Exclusion criteria for both groups included medical conditions or medications that may affect weight loss, such as Cushing’s syndrome, untreated thyroid disease, severe cardiorespiratory disease, movement limiting arthritis, antidepressants, corticosteroids and sulfonyleureas, and history of other cancers. Women with breast cancer who had had recurrent disease, distant metastases, or no chemotherapy were also excluded.

In all participants, body mass composition measurements were collected at three time points: baseline 0 months at the first HWC appointment (0 M), 3 months after baseline (3 M), and 6 months after baseline (6 M). In this study, changes in body mass composition will be defined over time intervals: baseline to 3 months referred to as “immediate effect,” baseline to 6 months to evaluate “longer term effect,” and data from 3 months to 6 months classified as “later effect.” The demographic and clinical characteristics were collected via electronic medical records (EMRs), de-identified, and stored in a 2-factor authentication server. Ethics approval for the study was granted by the Institutional Human Research Ethics Committee (MQCRC2020053). Informed consent was obtained on the standard MQ Health proforma of patient consent at time of registration. All aspects of this study were kept confidential, and only the researchers in this study had authorized access.

Study Measures

Demographic and Clinical Characteristics

Demographic information, age, smoking status, menopausal status, MetS status, and past medical history was obtained from the patient’s HWC EMR, pathology orders, reports, and referral letters. MetS status was determined using the National Cholesterol Education Program (NCEP) Adult Treatment Panel III criteria due to its clinical and epidemiological application [31]. Information on tumour stage, grade, characteristics, and treatment was obtained from Odyssey, an EMR platform used specifically for oncology care at MQ Health.

Body Weight and Mass Composition

BMI was calculated from weight measures taken on bariatric digital weighing scales in the clinic, and baseline height was taken using a calibrated stadiometer, to ensure consistent measurements. WC was measured at the umbilicus in centimetres (cm)
receptor positive, 72.7% of participants were progesterone receptive positive, and 18.2% of participants were HER2 receptor positive (Table 1).

**Body Weight and Mass Composition Comparison between Breast Cancer and Control Cohorts**

The mean body weight of the control cohort was higher than the breast cancer cohort at baseline ($p = 0.045$) of multidisciplinary weight management at the HWC; however, there was no overall significant difference between the two cohorts at 3 months and 6 months once their mean body weight had been adjusted for baseline body weight differences. There were also no differences in mean BMI, SMM, FM, and WC measurements between the two cohorts at all time intervals when adjusted for baseline body weight differences (Table 2).

**Changes in Body Weight and Mass Composition**

For the breast cancer cohort, a repeated measure ANOVA with a Greenhouse-Geisser correction determined that weight ($F(1.410, 8.459) = 9.290, p = 0.011$), BMI ($F(1.488, 8.926) = 9.057, p = 0.010$), SMM ($F(1.956, 11.734) = 9.893, p = 0.003$), FM ($F(1.569, 9.417) = 10.391, p = 0.006$), and WC ($F(1.269, 3.807) = 9.450, p = 0.037$) were statistically significantly between time points. By 6 months, the breast cancer women had a mean weight change of $-6.99 \pm 3.87$ kg ($p = 0.003$) and change in BMI by $-2.72 \pm 1.62$ kg/m$^2$ ($p = 0.004$), equivalent to a weight change of $-8.13\%$. There was a change in SMM of $1.21 \pm 0.73\%$ ($p = 0.004$), a change in WC of $-8.13 \pm 4.21$ cm ($p = 0.037$) (Table 3). The control cohort had significant changes in weight ($F(1.241, 24.826) = 4.977, p = 0.028$), BMI ($F(1.218, 24.351) = 4.675, p = 0.034$), and WC between time points ($F(1.309, 7.854) = 20.402, p = 0.001$); however, there were no statistically significant change in SMM ($F(1.517, 30.345) = 0.271, p = 0.703$) or FM ($F(1.959, 39.183) = 0.994, p = 0.378$) over time.

**Changes in Body Weight and Mass Composition according to Participant Characteristics**

For the breast cancer cohort, body weight and body mass composition were not significantly influenced by ethnicity, smoking status or menopausal status, but body weight was significant for MetS status. By 6 months, there was a larger change in body weight in participants who did not have MetS ($-8.72 \pm 2.41$ kg) in comparison to participants with MetS ($-2.65 \pm 3.75$ kg) ($p = 0.045$). This was also reflected in a change in BMI ($p = 0.039$); how-
Table 4. Changes in weight, BMI, SMM, FM, and WC according to characteristics of breast cancer participants during HWC between baseline and 6 months (longer term effect)

| Breast cancer group characteristics | Categories (n) | ∆ Weight (kg) | ∆ BMI (kg/m²) | ∆ SMM (%) | ∆ FM (%) | ∆ WC (cm) |
|------------------------------------|----------------|---------------|---------------|-----------|----------|-----------|
|                                    |                | M ± SD        | p value       | M ± SD    | p value  | M ± SD    | p value  |
| Ethnicity                          | Caucasian (7)  | −6.60±4.61    | 0.715         | −2.62±1.96| 0.827    | 1.12±0.83| 0.634    |
|                                    | Non-Caucasian (2) | −7.95±1.48    |               | −2.96±0.38|          | 1.45±0.50|          |
|                                    | Smoking status  | Non-smoker (8) | −7.27±4.16   | 0.680     | −2.88±1.71| 0.567    | 1.17±0.79| 0.711    |
|                                    |                | Smoker (1)    | −5.30         |           | −1.75     |          | 1.50     |          |
|                                    | MetS status     | No (6)        | −8.72±2.41   | 0.045     | −3.46±1.08| 0.039    | 1.40±0.60| 0.329    |
|                                    |                | Yes (3)       | −2.65±3.75   |           | −0.88±1.24|          | 0.75±1.06|          |
|                                    | Menopausal status | Pre (5)      | −7.28±5.37   | 0.980     | −2.83±1.19| 0.981    | 1.18±0.87| 0.742    |
|                                    |                | Peri (1)      | −6.90         |           | −2.69±1.06|          | 1.80     |          |
|                                    |                | Post (3)      | −1.59±0.81   |           | −2.50±1.06|          | 1.00±0.71|          |

BMI, body mass index; SMM, skeletal muscle mass; FM, fat mass; WC, waist circumference; BC, breast cancer. * Insufficient data for analysis.

Table 5. Changes in weight, BMI, SMM, FM, and WC according to characteristics of control participants during HWC between baseline and 6 months (longer term effect)

| Control group characteristics | Categories (n) | ∆ Weight (kg) | ∆ BMI (kg/m²) | ∆ SMM (%) | ∆ FM (%) | ∆ WC (cm) |
|------------------------------|----------------|---------------|---------------|-----------|----------|-----------|
|                              |                | M ± SD        | p value       | M ± SD    | p value  | M ± SD    | p value  |
| Ethnicity                    | Caucasian (17) | −3.5±3.01     | 0.349         | −1.29±3.53| 0.318    | 0.05±1.97| 0.358    |
|                              | Non-Caucasian (4) | −8.10±5.26    |               | −3.19±1.98|          | 1.03±1.16|          |
| Smoking status               | Non-smoker (21)| −4.4±8.55     | −*            | −1.65±3.39| −*       | 0.23±1.86| −*       |
|                              | Smoker (0)     |               | −*            |          | −*       |          | −*       |
| MetS status                  | No (13)        | −4.2±10.08    | 0.903         | −1.56±3.97| 0.882    | 0.55±2.13| 0.441    |
|                              | Yes (8)        | −4.7±5.90     |              | −1.79±2.19|          | −0.28±1.29|          |
| Menopausal status            | Pre (5)        | −5.22±4.33    | 0.714         | −1.90±1.51| 0.736    | 0.50±0.76| 0.716    |
|                              | Peri (2)       | 0.50±1.98     | 0.19±0.72     | 0.80±1.27|          | −0.70±1.70|          |
|                              | Post (14)      | −4.81±10.12   |              | −1.82±3.98|          | 0.29±2.20| −0.94±3.47|

BMI, body mass index; SMM, skeletal muscle mass; FM, fat mass; WC, waist circumference; BC, breast cancer. * Insufficient data for analysis.
ever, there were no changes to SMM, FM, or WC according to MetS status (Table 4).

For the control cohort, there were no differences in body weight, BMI, SMM, FM, or WC according to ethnicity, menopausal status, or MetS status. There were no smokers in the control group; therefore, smoking status could not be analysed (Table 5).

**Discussion**

In the reported study, we assessed the impact that multidisciplinary weight management has on body weight and body mass composition in women with breast cancer compared to a control cohort of women without cancer, who were matched by age, ethnicity, smoking status, menopausal status, and MetS status. Multidisciplinary weight management was shown to improve anthropometric outcomes at all time intervals for the breast cancer cohort. By 6 months, the breast cancer cohort showed a significant reduction in mean weight, BMI, WC, and FM and a significant gain in SMM. Ethnicity, smoking status, and menopausal status did not significantly affect body weight or body mass composition; however, there was a greater reduction in body weight in breast cancer women who did not have MetS in comparison to breast cancer women with MetS. Although this study had a small sample size, the consideration of the past literature and these favourable body composition changes may prove to be of benefit to those wishing to consider early-stage breast cancer survival rates. The reported data may support other researchers wishing to examine opportunities to reduce the risk of cancer recurrence or how to consider the relationship between the growth in the number of women suffering from chronic disease related to breast cancer-related weight gain.

Weight gain is a well-documented side effect of chemotherapy [2–4, 7, 10]. A meta-analysis revealed significant weight gain during chemotherapy treatment for 2,620 breast cancer women, which was greater in patients receiving cyclophosphamide, methotrexate, and 5-fluorouracil regimes [5]. Weight gain of 1.4–5.0 kg has also been reported in therapies involving taxane [9]. A randomized study investigating 102 postmenopausal breast cancer women during a weight loss programme focussing on caloric restriction found a median weight loss of −6.0 kg after 1 year of intervention [32]. A recent systematic review by LeVasseur et al. [23] found that diet management alone and diet with exercise management in adult cancer patients survivors were both associated with greater weight loss than standard cancer care. Both strategies also demonstrated greater reductions in BMI and WC than standard cancer care. By 6 months, our study showed a significant mean weight change of −6.99 ± 3.87 kg in the breast cancer cohort and −4.40 ± 8.55 kg in the control cohort. Goodwin et al. [33] similarly investigated the impact of a multidisciplinary weight program incorporating psychology support, exercise programs, and dietary sessions on 61 breast cancer patients over 1 year. There was a weight reduction of −1.63 kg ± 4.22 kg in women who were overweight or obese, and aerobic exercise was found to be a positive predictor of weight loss. More than 90% of breast cancers are localized at their time of diagnosis; thus, therapeutic goals involve tumour eradication, preventing metastasis and disease recurrence [34]. The mean weight change in our study, alongside the previous literature, therefore suggests that multidisciplinary weight management has a potential role in restoring the weight gain from breast cancer treatment. Contrastingly, a systematic review by Markes et al. [26] showed a non-significant reduction in weight in exercise intervention cohorts compared to non-exercising control cohorts. This may suggest that effective “weight loss” programs should adopt a multidisciplinary approach that extends past just exercise intervention. In addition, the clinical heterogeneity amongst studies investigating exercise management and adjuvant cancer treatment are believed to be due to different measurements of exercise effect and anthropometric outcomes [26].

As a result, our study investigated additional changes in body composition such as SMM, FM and WC. Our results are comparable to that of the literature. Orsatti et al. [35] investigated a group of 43 postmenopausal women and confirmed significant muscle gain and fat loss after 16 weeks of twice-weekly resistance training. Another study found positive impact with a similar exercise programme with increased muscle growth and reduced FM in a cohort of 85 breast cancer survivors [36]. A randomized control trial of 242 breast cancer patients showed that aerobic exercise was significantly superior to “standard care” for improving body fat percentage, aerobic fitness, and improving self-esteem, while resistance exercise was superior to “standard care” for chemotherapy complete rate, lean body mass, muscular strength, and improving self-esteem [37]. Their results support the significance of exercise type on the pattern of body composition change, with aerobic exercise preventing fat gain and resistance exercise increasing lean body mass. Hojan et al.
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In the reported study, body weight and body mass composition were not significantly influenced by ethnicity, smoking status, or menopausal status in both cohorts. In the breast cancer cohort, premenopausal women had greater reductions in body weight and BMI and a greater increase in SMM in comparison to postmenopausal women; however, these changes were not significant. This is in contrast to the previous literature which showed significant percentage differences in total body water and muscle mass according to menopausal status, with increased body fat in postmenopausal breast cancer women [20]. This difference to the existing literature may be due to this study’s small sample size distribution amongst the menopausal status subgroups. On the other hand, it could indicate that the impact of weight management on body weight and mass composition is beneficial for pre- and postmenopausal women, and thus, there is no difference between the menopausal status groups.

A recent meta-analysis evaluating the association between MetS and risks of cancer recurrence or death in breast cancer women showed an increased risk in both breast cancer recurrence and all-cause deaths in these patients [18]. In our study, MetS status was a significant indicator for body weight change in the breast cancer cohort. By 6 months, there was a greater change in body weight in women who did not have MetS in comparison to participants with MetS. This was also reflected in a change in BMI. There were however no changes to SMM, FM, or WC according to MetS status in both cohorts. These results suggest that metabolic risk profiles should be considered in weight loss intervention and its impact on survivorship outcomes. This is supported by a prospective study by Cespedes Feliciano et al. [15] on 3,109 early-stage breast cancer survivors and their risk of cardiovascular incidence, morbidity, and mortality. Moderate elevations in WC were strongly significant for cardiovascular risk that was independent of pre-existing risk factors [15]. Their results concluded that visceral adiposity is an important factor for cardiovascular risk and is not adequately represented solely by non-specific measurements such as body weight. Although the study reported in this paper found no changes to body mass composition outcomes according to MetS status, future research could investigate the impact on lipid blood profiles and other metabolic health measures.

There are high levels of concern regarding weight gain after breast cancer; however, prevention and management are hindered by significant gaps in service provision, fatigue associated with disease, and difficulty with maintaining weight [22]. Factors such as a structured exercise regime, prescribed dietary plans, and accountability are significant facilitators to weight management in breast cancer women [22, 38]. Hojan et al. [27] investigated the effects of an exercise program in a cohort of premenopausal breast cancer patients undergoing endocrine therapy. Results showed an overall improvement to quality of life and functional scale measures and a reduction in therapy related side effects such as fatigue and dyspnoea [27]. It would be beneficial to consider the impact that multidisciplinary weight management may have on qualitative measures such as self-esteem, mood, and quality of life on breast cancer women and survivors.

Strengths and Limitations

The strengths of this study include having a control arm constituted by non-cancer women receiving multidisciplinary weight management at the same clinic, with analysis into anthropometric confounders such as ethnicity, smoking status, menopausal status, and MetS status. A limitation of this study is the small sample size of breast cancer and non-cancer women, with the former group having ten less participants than the latter. This difference in numbers may be due to weight loss barriers such as fatigue associated with breast cancer and/or systemic treatment. Many women were also excluded due to missing follow-up data, which again draws attention to barriers that may require addressing such as behavioural change and psychosocial support. The participants in this study were not ethnically diverse, and there was only one smoker out of all the participants. Ethnicity was therefore only split into two categories of Caucasian and non-Caucasian, and there was insufficient data to analyse the impact of smoking status on the cohorts involved. Consequently, the results may not be generalizable to all early-stage breast cancer survivors in different socioeconomic and geographic areas. This however draws attention for further research into these factors that may have not shown statistically significant results due to a small sample size. The data from this study also indicated statistically significant changes in body weight and body mass composition that substantiates further research. Larger samples should investigate the impact that MetS status and meno-
pausal status has on these anthropometric measurements. These results can add to the development of long-term treatment plans for breast cancer survivors in order shine a light on ways to reduce risk recurrence, cancer mortality, and chronic disease mortality. Future research should also consider the psychosocial impact that multidisciplinary weight management may have in early-stage breast cancer survivors.

**Conclusion**

Multidisciplinary weight management improves body weight and body mass composition in breast cancer women undergoing adjuvant chemotherapy. Although these findings are in a small sample size, it appears that multidisciplinary weight management has a positive role to play in early-stage breast cancer survival by minimizing weight gain and improving body mass composition. Targeting pre-existing MetS status through lifestyle changes is also an important consideration, beyond a specific weight focus.

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