Characterization of Metabolic Syndrome Risk Factors and Health-Related Behaviors in Korean Patients With Breast Cancer by Abdominal Obesity Status

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ABSTRACT

Background: Breast cancer is the second most prevalent malignancy among Korean women. Changes in lifestyle during and after remission of breast cancer tend to increase abdominal visceral fat, leading to increased risks of metabolic syndrome and chronic diseases.

Purpose: This cross-sectional study examined the differences in metabolic syndrome risk factors and health-related behaviors between abdominally obese and nonabdominally obese groups of Korean patients with breast cancer.

Methods: The participants were assigned to nonabdominal obesity (waist circumference < 85 cm, \( n = 77 \)) and abdominal obesity (waist circumference \( \geq 85 \) cm, \( n = 59 \)) groups, and a questionnaire was used to assess the prevalence of risk factors of metabolic syndrome and health-related behaviors in each. The chi-square test and \( t \) test were used to analyze the data.

Results: The average age was 54.2 years in the abdominal obesity group and 51.3 years in the nonabdominal obesity group. The average blood pressure and fasting blood glucose levels were higher in the abdominal obesity than the nonabdominal obesity group (117.3/76.3 vs. 108.9/70.4 mmHg, respectively \( p = .001 \); 96.9 and 90.1 mg/dl, respectively \( p = .007 \)). High-density lipoprotein cholesterol was lower in the abdominal obesity than the nonabdominal obesity group (55.4 and 62.5 mg/dl, respectively \( p = .005 \)), whereas triglycerides were higher in the abdominal obesity than the nonabdominal obesity group (151.6 and 111.3 mg/dl, respectively \( p = .006 \)). The prevalence of metabolic syndrome in the abdominal obesity and nonabdominal obesity groups were 42.4% and 9.1%, respectively \( p = .001 \). Moreover, eating habits differed between the two groups, with the frequency of vegetable consumption lower in the abdominal obesity group than the nonabdominal obesity group \( (p = .040) \) and the frequencies of salty and sweet food consumption and of overeating higher in the abdominal obesity than the nonabdominal obesity group. The percentage of participants who exercised for 30 minutes three times per week was 52.5% in the abdominal obesity group and 71.4% in the nonabdominal obesity group \( (p = .024) \).

Conclusions/Implications for Practice: This observational study found more metabolic syndrome risk factors in the abdominal obesity group than the nonabdominal obesity group. Consumption of sweet foods and overeating were higher and the frequencies of vegetable intake and exercise were lower in the abdominal obesity group. These findings suggest that female abdominally obese patients with breast cancer exhibit health-related behaviors that require improvement and better management. Interventional programs should be developed based on the findings of this study to reduce cancer recurrence and mortality in patients with breast cancer.

KEY WORDS: breast cancer, abdominal obesity, metabolic syndrome, dietary habits, exercise.

Introduction

The existing healthcare systems are being continuously challenged because of the rapidly increasing number of cancer survivors worldwide. Moreover, the current acute treatment and care-oriented healthcare models are being challenged by the different requirements of cancer survivors in different survivor phases (Lai, 2016).

On the basis of statistical data from 2012, breast cancer is the most prevalent cancer in women worldwide, with a rate of occurrence of 25.2% (Stewart & Wild, 2014). Breast cancer is the second most prevalent malignancy (after thyroid cancer) among Korean women, with approximately 45.7 per 100,000 Korean women diagnosed with breast cancer annually (Oh
et al., 2016). Although its etiology is not well understood, postmenopausal weight gain and obesity have been implicated (Cheraghi, Poorolajal, Hashem, Esmailnasab, & Doosti, 2012). According to U.S. National Institutes of Health data for 2008–2014, the 5-year survival rate of female patients with breast cancer in the United States is 89.7% (National Cancer Institute, 2015). The 5-year overall survival rate of Korean female patients with breast cancer is over 90% (Oh et al., 2016). Whereas the highest percentage of new breast cancer diagnoses occurs in women in their 60s in most countries, in Korea, the highest percentage occurs in women in their 40s (Park et al., 2017), which raises significant concerns related to posttherapeutic morbidities and quality-of-life issues (Maurea et al., 2010). Thus, actively managing the disease- and treatment-related health problems of patients with breast cancer is one of the goals of healthcare professionals (Kim, Chung, Kim, Byun, & Choi, 2013).

Antiestrogen therapy for patients with breast cancer is associated with the development of metabolic syndrome (Redig & Munshi, 2010), and chemotherapy in premenopausal patients with breast cancer may increase the incidence of metabolic syndrome (Li et al., 2018). Moreover, chemotherapy-associated pain, fatigue, and weakness may cause inactivity, leading to abdominal obesity (Demark-Wahnefried et al., 2001). Furthermore, an unhealthy diet and lack of exercise increase abdominal visceral fat, ultimately leading to metabolic syndrome and chronic diseases such as obesity, hypertension, and diabetes (Patterson et al., 2010). Central adiposity after the diagnosis of breast cancer may cause various diseases and adversely affects the prognosis of women with breast cancer (George et al., 2014). Asian women show more abdominal and visceral adiposity than White women with similar body mass index (BMI) levels (Lim et al., 2011). Previous studies have reported that the mortality rate associated with breast cancer increases as the waist–hip ratio of Asian American women increases (Kwan et al., 2014). The National Health and Nutritional Survey performed between 2007 and 2011 in Korea found that 44.7% of female patients with breast cancer exhibited abdominal obesity (waist circumference > 85 cm; Seo et al., 2014).

Metabolic syndrome refers to a cluster of metabolic conditions, including abdominal obesity caused by insulin resistance, hypertriglyceridemia, low-density hypercholesterolemia, hyperglycemia, or hypertension (O’Neill & O’Driscoll, 2015). The progression of three or more of these metabolic conditions increases the risk of cardiovascular diseases and mortality (Mottillo et al., 2010). Postmenopausal patients with breast cancer who are diagnosed with metabolic syndrome face a heightened risk of developing cardiovascular diseases or metabolic disorders (Healy et al., 2010). Moreover, these patients experience higher breast cancer recurrence, ultimately leading to a worse prognosis than patients with breast cancer and without metabolic syndrome (Berrino et al., 2014).

Although several Korean studies have investigated the associations between breast cancer and both obesity and metabolic syndrome (Kim, Cui, Shin, Kim, & Jung, 2014; Seo et al., 2014), the effects of abdominal obesity on metabolic syndrome risk factors and health-related behaviors in this patient population have rarely been addressed. Thus, examining the effects of abdominal obesity on the incidence of metabolic syndrome in patients with breast cancer and the health-related behaviors of these patients is important. Moreover, it is critical to improve lifestyle habits such as diet and exercise to inhibit the onset/exacerbation of abdominal obesity and metabolic syndrome (Dieli-Conwright et al., 2014).

This study investigated the differences between abdominally obese and nonabdominally obese patients with cancer in terms of the risk factors of metabolic syndrome and health-related behaviors in an attempt to provide fundamental data for the development of management programs for abdominal obesity in this vulnerable patient population. In this study, we hypothesized that obesity, blood pressure, blood sugar, and blood lipid levels would differ in patients with breast cancer according to their abdominal obesity status. In addition, we hypothesized that the incidence of metabolic syndrome and dietary and exercise habits would differ based on abdominal obesity status.

Methods

Study Design

This observational descriptive study was designed to investigate the differences in patient characteristics, metabolic syndrome risk factors, and health-related behaviors between two groups of patients with breast cancer who were, respectively, abdominally obese and nonabdominally obese.

Participants

The participants were recruited from outpatient clinics of the Breast Center in Seoul St. Mary’s Hospital and from among patients with breast cancer who attended a support group hosted by this hospital from August 2015 to April 2016. The inclusion criteria were as follows: (a) women between 18 and 69 years old, (b) being diagnosed with breast cancer (between Grades 0 and III), and (c) currently or previously receiving anticancer therapy for breast cancer (surgery, chemotherapy, radiotherapy, or antihormone therapy).

The exclusion criteria were as follows: (a) currently participating in another clinical trial or (b) being diagnosed with a mental disorder or alcohol or drug addiction.

During recruitment, the author provided detailed explanations of the aims and procedures involved in the study to all patients. An initial sample of 200 participants was recruited, and 136 participated in the study. The reasons for participant withdrawal before study completion included being unable to visit the hospital for data collection and refusing to provide blood samples. This study was approved by the institutional review board of the Catholic University of Korea (IRB No. MC15SENS0084), and informed consent was obtained from all of the participants.
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Using the G*power program (Version 3.1.9.2, Heinrich-Heine-Universität Düsseldorf, Düsseldorf, Germany; Faul, Erdfelder, Lang, & Buchner, 2007), a sample size of 102 participants, with 51 in each group, was calculated as necessary to obtain a medium effect size of 0.50, a significance level of .05, and a power of 0.80 (Cohen, 1988). In this study, the effect size was estimated as “medium” because no similar studies are available to estimate the effect size (Nahm, 2015).

A previous study confirmed waist circumference as a stronger index for potential health risk than BMI (Zhu et al., 2002). Therefore, the final sample in this study was composed of 136 participants, with 77 in the nonabdominal obesity group and 59 in the abdominal obesity group. Abdominal obesity was determined based on a waist circumference of 85 cm or greater, in accordance with the obesity group and 59 in the abdominal obesity group. Abdominal obesity was determined based on a waist circumference of 85 cm or greater, in accordance with the obesity treatment guidelines developed by the Korean Society for the Study of Obesity (2012).

Outcomes Measured
Data collection was performed between September 2015 and April 2016. An experienced nurse with 6 years of nursing experience collected data between 7:30 and 8:30 a.m. on weekdays at the outpatient examination room in the Department of Endocrinology, Seoul St. Mary’s Hospital. Blood pressure was measured after the participants had filled out a structured questionnaire. After measuring height, weight, and body fat, the investigator obtained 5 ml of venous blood.

Obesity index, blood pressure, fasting blood glucose, and lipid levels
Height and weight were measured using the automatic height and weight scale DS-102 (Jenix, Seoul, Korea). Skeletal muscle mass, body fat mass, and body fat percentage were measured using Inbody 720 (Biospace, Seoul, Korea). BMI was calculated by dividing weight (kilograms) by the square of the height (square meters). BMI cutoff values were as follows: 18.5–22.9 kg/m² was normal, 23.0–24.9 kg/m² was overweight, and > 25 kg/m² was obese (Kim, Lee, et al., 2014).

Waist and hip circumferences were measured using a tape measure (Höchstmaß Balzer GmbH, Hessen, Germany). In an examination room with private curtains, the same investigator asked each participant to lift up her shirt and made waist and hip circumference measurements. This investigator took two consecutive readings of each measurement to confirm the consistency of results and, if the results were not in agreement, performed an additional third measurement. Waist circumference was measured horizontally at the midpoint between the lowest rib and iliac crest in an upright position. Hip circumference was measured at the point of maximum protrusion of the hip in an upright position.

The patients were instructed to rest before measuring blood pressure, which was measured three consecutive times at 5-minute intervals using an automated blood pressure measuring device (TM2655P by A&D, Tokyo, Japan) in a seated position. The mean value of the second and third measurements was recorded and used in the data analysis.

The participants were instructed to fast for 8 hours before measuring fasting blood glucose and blood lipid levels. The investigator collected their blood samples from a peripheral vein and measured fasting blood glucose by the glucose oxidase method using a Hitachi 7600-110 (Roche, Basel, Switzerland). Insulin was measured using a Dream Gamma Counter-10 (Shinjin Medics, Goyangsi, Korea). High-density lipoprotein cholesterol (HDL-C), low-density lipoprotein cholesterol (LDL-C), and triglycerides were measured using a DDP Modular System Chemistry Analyzer (Roche, Basel, Switzerland).

Metabolic syndrome risk factors
Metabolic syndrome was diagnosed when a patient had at least three of the five risk factors suggested by the National Cholesterol Education Program Adult Treatment Panel III (2002), as follows:

1. Waist circumference ≥ 85 cm (Kim, Lee, et al., 2014)
2. Systolic blood pressure ≥ 130 mmHg or diastolic blood pressure ≥ 85 mmHg
3. Fasting blood glucose ≥ 100 mg/dl (Genuth et al., 2003)
4. HDL-C < 50 mg/dl
5. Triglyceride level ≥ 150 mg/dl

Health-related behaviors
The dietary habits and food intake frequency scale developed by Oh et al. (2008) and modified and adapted by Kim and Kim (2013) was used to analyze the dietary habits and food intake patterns of the participants. This 11-item scale comprises three items for dietary habits and eight items for food intake patterns. We surveyed the weekly frequencies of overeating, dining out, and eating breakfast to determine dietary habits and the weekly frequency of consuming major food categories (vegetables, fruits, dairy products, vegetable oils, high-fat and high-calorie snacks, and high-sodium and high-sugar foods) to determine food intake patterns. The response of participants to the question “Do you currently consume alcohol or smoke” was used to determine their alcohol and smoking statuses. The response of participants to whether they engaged in at least 30 minutes of moderate exercise (3–6 metabolic equivalents of energy expenditure) three times a week was used to determine their exercise habit status. Participants who performed walking exercises were instructed to write down the weekly frequency and length of each session.

Data Analysis
The collected data were analyzed using SPSS PASW Version 18 (IBM, Armonk, NY, USA). Continuous variables were expressed as mean ± standard deviation (SD). Percentage and mean differences in general characteristics, breast cancer features, and health-related behaviors between the two groups were analyzed using the chi-square test and t test. Mean differences in cardiometabolic risk factors were analyzed using the
t test, and metabolic syndrome risk factors were analyzed using the chi-square test. Statistical significance was set at \( p < .05 \).

Results

Patient and Tumor-Related Characteristics

The mean ages of the abdominal obesity and nonabdominal obesity groups were 54.2 and 51.3 years, respectively. There was no difference in menopausal status between the two groups. A significantly higher percentage of patients in the abdominal obesity group than the nonabdominal obesity group (22.0% vs. 7.8%, \( p = .018 \)) was taking hypertension medications. However, no significant intergroup differences were found in terms of taking diabetes or hyperlipidemia medications. The duration of breast cancer was significantly longer in the abdominal obesity group (mean = 4.7 years) than in the nonabdominal obesity group (mean = 3.2 years; \( p = .036 \)). There were no differences in other breast cancer features between the two groups. With respect to clinical stage status, 15.3% were in Stage 0, 28.8% were in Stage I, 37.3% were in Stage II, and 18.6% were in Stage III in the abdominal obesity group, whereas 6.5% were in Stage 0, 36.4% were in Stage I, 44.2% were in Stage II, and 11.7% were in Stage III in the nonabdominal obesity group, showing no difference between the groups. About 20.3% of the abdominal obesity group and 13.0% of the nonabdominal obesity group reported a history of recurrence, with no significant intergroup difference. Around 27.1% of the abdominal obesity group and 24.7% of the nonabdominal obesity group were currently undergoing chemotherapy, with a respective 10.2% and 15.6% undergoing radiation therapy and a respective 30.5% and 28.6% undergoing hormone therapy, revealing no significant differences in treatment status between the two groups (Table 1).

### TABLE 1.
**Patient and Tumor-Related Characteristics**

| Characteristic                              | Nonabdominal Obesity Group (\( n = 77 \)) | Abdominal Obesity Group (\( n = 59 \)) | \( t/\chi^2 \) | \( p \) |
|--------------------------------------------|------------------------------------------|----------------------------------------|----------------|-------|
| Age (years; \( M \) and SD)                | 51.3 (9.3)                               | 54.2 (8.3)                             | 1.90           | .059  |
| Menopausal status                          |                                          |                                        | 1.59           | .208  |
| Premenopausal                              | 23 (29.9)                                | 12 (20.3)                              |                |       |
| Postmenopausal                             | 54 (70.1)                                | 47 (79.7)                              |                |       |
| Age at menopause\(^a\) (years; \( M \) and SD) | 48.0 (5.4)                               | 48.4 (5.8)                             | 0.33           | .746  |
| Currently taking medication for            |                                          |                                        |                |       |
| Hypertension                               | 6 (7.8)                                  | 13 (22.0)                              | 5.64           | .018  |
| Diabetes                                   | 3 (3.9)                                  | 3 (5.1)                                | 1.00^b         | .366  |
| Hyperlipidemia                             | 10 (13.0)                                | 11 (18.6)                              | 0.82           | .366  |
| Tumor characteristics                      |                                          |                                        |                |       |
| Time since diagnosis (years; \( M \) and SD) | 3.2 (3.3)                                | 4.7 (4.8)                              | 2.12           | .036  |
| Range                                      | 0–6.5                                    | 0–9.5                                  |                |       |
| Clinical stage                             |                                          |                                        | 5.31           | .257  |
| 0                                         | 5 (6.5)                                  | 9 (15.3)                               |                |       |
| I                                         | 28 (36.4)                                | 17 (28.8)                              |                |       |
| II                                        | 34 (44.2)                                | 22 (37.3)                              |                |       |
| III                                       | 10 (12.9)                                | 11 (18.6)                              |                |       |
| Breast cancer recurrence                   |                                          |                                        | 1.33           | .249  |
| Yes                                       | 10 (13.0)                                | 12 (20.3)                              |                |       |
| No                                        | 67 (87.0)                                | 47 (79.7)                              |                |       |
| Time elapsed since last treatment (years; \( M \) and SD) | 1.0 (0.8)                              | 1.3 (1.1)                             | 1.88           | .063  |
| Current treatment status                   |                                          |                                        |                |       |
| Chemotherapy                               | 19 (24.7)                                | 16 (27.1)                              | 0.10           | .747  |
| Radiation therapy                          | 12 (15.6)                                | 6 (10.2)                               | 0.85           | .356  |
| Antihormone therapy                        | 22 (28.6)                                | 18 (30.5)                              | 0.06           | .806  |

Note. Abdominal obesity group: waist circumference \( \geq 85 \) cm.

\(^a\)Nonabdominal obesity group: \( n = 54 \); abdominal obesity group: \( n = 47 \).

\(^b\)Fisher’s exact test.
Obesity Index, Blood Pressure, Fasting Blood Glucose, and Lipid Levels

Body weight was higher in the abdominal obesity group (68.1 kg) than the nonabdominal obesity group (53.4 kg; \( p = .001 \)). Consequently, BMI was also higher in the abdominal obesity group (27.2 kg/m\(^2\)) than the nonabdominal obesity group (21.6 kg/m\(^2\); \( p = .001 \)).

In addition, skeletal muscle mass was higher in the abdominal obesity group (22.4 kg) than in the nonabdominal obesity group (20.0 kg; \( p = .001 \)), body fat mass and percentage values were higher in the abdominal obesity group (26.6 kg and 38.6%, respectively) than in the nonabdominal obesity group (16.2 kg and 30.1%, respectively; \( p = .001 \)), and hip circumference was greater in the abdominal obesity group (102.1 cm) than in the nonabdominal obesity group (92.4 cm; \( p = .001 \)).

Furthermore, blood pressure was higher in the abdominal obesity group (117.3/76.3 mmHg) than in the nonabdominal obesity group (108.9/70.4 mmHg; \( p = .001 \)), and fasting blood glucose was higher in the abdominal obesity group (96.9 mg/dl) than in the nonabdominal obesity group (90.1 mg/dl; \( p = .007 \)). With respect to lipid profiles, mean HDL-C levels were lower in the abdominal obesity group (55.4 mg/dl) than the nonabdominal obesity group (62.5 mg/dl; \( p = .005 \)), whereas triglyceride levels were higher in the abdominal obesity group (151.6 mg/dl) than in the nonabdominal obesity group (111.3 mg/dl; \( p = .006 \); Table 2).

**Metabolic Syndrome Risk Factors**

The prevalence of metabolic syndrome was higher in the abdominal obesity group (42.4%) than in the nonabdominal obesity group (9.1%; \( p = .001 \)).

With respect to specific metabolic syndrome risk factors, the proportion of participants with blood pressure higher than 130/85 mmHg and fasting blood glucose higher than 100 mg/dl was higher in the abdominal obesity group (39.0% and 28.8%, respectively) than in the nonabdominal obesity group (15.6% and 9.1%, respectively; \( p < .05 \) for both; Table 3).

**Health-Related Behavior**

The frequency of vegetable intake was lower in the abdominal obesity group (4.9 times/week) than in the nonabdominal obesity group (5.6 times/week; \( p = .040 \)), the frequency of salty foods intake was higher in the abdominal obesity group (1.6 times/week) than in the nonabdominal obesity group (1.1 times/week; \( p = .033 \)), and the frequency of sweet foods intake was higher in the abdominal obesity group (1.5 times/week) than in the nonabdominal obesity group (1.0 times/week; \( p = .022 \)). Furthermore, the frequency of overeating

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**TABLE 2. Obesity Index, Blood Pressure, Fasting Blood Glucose, and Lipid Levels**

| Variable                        | Nonabdominal Obesity Group (\( n = 77 \)) | Abdominal Obesity Group (\( n = 59 \)) |
|--------------------------------|------------------------------------------|----------------------------------------|
|                                | M   | SD    | M    | SD    | t    | p    |
| Height (cm)                    | 157.4 | 5.6   | 158.5 | 5.1   | 1.20 | .231 |
| Weight (kg)                    | 53.4  | 4.9   | 68.1  | 8.9   | 11.44 | .001 |
| Body mass index (kg/m\(^2\))   | 21.6  | 1.9   | 27.2  | 3.2   | 11.81 | .001 |
| Skeletal muscle mass (kg)      | 20.0  | 2.4   | 22.4  | 2.5   | 5.74  | .001 |
| Body fat mass (kg)             | 16.2  | 4.2   | 26.6  | 6.3   | 10.98 | .001 |
| Percent body fat (%)           | 30.1  | 6.5   | 38.6  | 5.1   | 8.29  | .001 |
| Waist circumference (cm)       | 78.6  | 4.0   | 93.7  | 7.4   | 14.22 | .001 |
| Hip circumference (cm)         | 92.4  | 4.1   | 102.1 | 6.0   | 10.71 | .001 |
| Blood pressure (mmHg)          |      |       |       |       |       |       |
| Systolic                       | 108.9 | 13.8  | 117.3 | 14.0  | 3.49  | .001 |
| Diastolic                      | 70.4  | 10.9  | 76.3  | 8.7   | 3.40  | .001 |
| Fasting blood glucose (mg/dl)  | 90.1  | 13.5  | 96.9  | 15.1  | 2.76  | .007 |
| Insulin (\( \mu \)U/ml)        | 4.1   | 2.7   | 7.1   | 4.3   | 4.64  | .001 |
| Lipid profiles                 |      |       |       |       |       |       |
| HDL-C (mg/dl)                  | 62.5  | 14.5  | 55.4  | 13.8  | 2.86  | .005 |
| LDL-C (mg/dl)                  | 123.8 | 42.6  | 122.4 | 30.0  | 0.22  | .824 |
| Triglycerides (mg/dl)          | 111.3 | 60.7  | 151.6 | 97.0  | 2.80  | .006 |

Note. Abdominal obesity group: waist circumference \( \geq \) 85 cm. HDL-C = high-density lipoprotein cholesterol; LDL-C = low-density lipoprotein cholesterol.
was higher in the abdominal obesity group (1.8 times/week) than in the nonabdominal obesity group (1.2 times/week; \( p = .013 \)). The proportion of participants who exercised at least three times a week for at least 30 minutes per session was lower in the abdominal obesity group (52.5%) than in the nonabdominal obesity group (71.4%; \( p = .024 \); Table 4).

### TABLE 3.  
**Metabolic Syndrome Risk Factors**

| Variable                          | Nonabdominal Obesity Group \((n = 77)\) | Abdominal Obesity Group \((n = 59)\) | \( \chi^2 \) | \( p \) |
|-----------------------------------|----------------------------------------|--------------------------------------|--------------|--------|
| Metabolic syndrome                |                                        |                                      |              |        |
| Yes                               | 7                                      | 25                                   | 20.56        | .001   |
| No                                | 70                                     | 34                                   |              |        |
| Hypertension (BP ≥ 130/85 mmHg)   |                                        |                                      |              |        |
| Yes                               | 12                                     | 23                                   | 9.57         | .002   |
| No                                | 65                                     | 36                                   |              |        |
| Impaired fasting glucose (≥ 100 mg/dl) |                                      |                                      |              |        |
| Yes                               | 7                                      | 17                                   | 8.94         | .003   |
| No                                | 70                                     | 42                                   |              |        |
| Low HDL-C (< 50 mg/dl)            |                                        |                                      |              |        |
| Yes                               | 24                                     | 25                                   | 1.82         | .177   |
| No                                | 53                                     | 34                                   |              |        |
| Hypertriglyceridemia (≥ 150 mg/dl) |                                        |                                      |              |        |
| Yes                               | 20                                     | 24                                   | 3.30         | .069   |
| No                                | 57                                     | 35                                   |              |        |

Note. Abdominal obesity group: waist circumference ≥ 85 cm. HDL-C = high-density lipoprotein cholesterol; BP = blood pressure.

### TABLE 4.  
**Health-Related Behaviors**

| Variable                          | Nonabdominal Obesity Group \((n = 77)\) | Abdominal Obesity Group \((n = 59)\) | \( t/\chi^2 \) | \( p \) |
|-----------------------------------|----------------------------------------|--------------------------------------|----------------|--------|
| Dietary habits                    |                                        |                                      |                |        |
| Breakfast\(^a\)                   | 5.9                                    | 5.5                                  | 1.20           | .234   |
| Vegetable intake\(^a\)            | 5.6                                    | 4.9                                  | 2.08           | .040   |
| Fruit intake\(^a\)                | 5.9                                    | 5.6                                  | 1.21           | .228   |
| Dairy product intake\(^a\)        | 3.4                                    | 3.1                                  | 0.96           | .338   |
| Vegetable oil intake\(^a\)        | 4.6                                    | 4.4                                  | 0.56           | .575   |
| High-fat diet\(^a\)               | 1.3                                    | 1.4                                  | 0.69           | .492   |
| High-calorie snacks intake\(^a\)  | 1.0                                    | 1.2                                  | 0.94           | .352   |
| High-salt diet\(^a\)              | 1.1                                    | 1.6                                  | 2.15           | .033   |
| Sweet foods intake\(^a\)          | 1.0                                    | 1.5                                  | 2.31           | .022   |
| Overeating\(^a\)                  | 1.2                                    | 1.8                                  | 2.51           | .013   |
| Eating out\(^a\)                  | 2.0                                    | 1.9                                  | 0.40           | .689   |
| Drinking (n and %)                | 9                                      | 13                                   | 2.64           | .104   |
| Smoking (n and %)                 | 0                                      | 0                                    |                |        |
| Physical activity                 |                                        |                                      |                |        |
| Regular exercise\(^b\) (n and %)  | 55                                     | 31                                   | 5.13           | .024   |
| Walking time (hours/week)         | 2.8                                    | 2.3                                  | 1.06           | .291   |

Note. Abdominal obesity group: waist circumference ≥ 85 cm.  
\(^a\)Weekly frequency.  
\(^b\)More than 3 days per week.
**Discussion**

This study aimed to assess the differences in risk of metabolic syndrome and health-related behaviors between female breast cancer patients with abdominal obesity and those without abdominal obesity.

The results show that the abdominal obesity group exhibited higher mean weight, BMI, body fat mass, waist and hip circumferences, blood pressure, fasting blood sugar, triglyceride, and insulin levels and a lower mean HDL-C level than the nonabdominal obesity group. In terms of dietary habits, the abdominal obesity group consumed fewer vegetables and more sweet and salty foods and exhibited a greater frequency of excessive food consumption than the nonabdominal obesity group. Finally, the participants in the abdominal obesity group performed regular exercise less frequently than their nonabdominally obese counterparts.

The cohort in this study included 59 (43.4%) abdominally obese participants and 77 (56.6%) nonabdominally obese participants. These numbers are similar to previously reported proportions of Korean female abdominally obese patients with breast cancer (44.7%; Seo et al., 2014). The values for body weight, BMI, skeletal muscle mass, body fat percentage, waist circumference, and hip circumference were all consistently and significantly higher in the abdominal obesity group than in the nonabdominal obesity group. Moreover, the mean BMI, body fat percentage, and waist circumference values were higher (for the abdominal obesity group) and lower (for the nonabdominal obesity group) than the mean values for 125 breast cancer survivors in the 2011 National Health and Nutrition Survey (Seo et al., 2014; 24.8 kg/m², 34.9%, and 82.8 cm, respectively).

The results found that increased waist circumference increased the prevalence of obesity, indicating that abdominal obesity resulted in obese body compositions overall, rather than only an increase in waist circumference. Furthermore, as suggested in a study that showed a 1.18-fold higher cancer recurrence rate in patients with breast cancer with a waist circumference ≥ 85 cm (Berrino et al., 2014), abdominal obesity is also related to breast cancer recurrence. Thus, patients with breast cancer with concurrent abdominal obesity should take precautions against breast cancer relapse and against metabolic-syndrome-related cardiovascular diseases. Overall, obesity, as indicated by parameters such as BMI, should also be noted because postmenopausal obesity is strongly associated with the development of breast cancer (Lahmann et al., 2004). In fact, a previous study on Korean breast cancer survivors reported a high overall rate of obesity, with 48.4% obese survivors, 44.7% survivors with abdominal obesity, and 89.2% survivors having greater than 30% body fat (Seo et al., 2014). This is because breast cancer is more common in obese postmenopausal women than in normal-weight postmenopausal women and because obese patients with breast cancer face a heightened risk of recurrence.

Our results showed that the abdominal obesity group had higher fasting blood glucose and triglyceride levels but lower HDL-C levels than the nonabdominal obesity group, which is similar to the results of a previous study that found the odds ratios for fasting blood glucose (1.17), triglyceride (1.17), and LDL-C (1.10) levels to be high in the abdominal obesity group (Fan et al., 2016). This may be explained by the finding that waist circumference correlates positively with increased fasting blood glucose, triglyceride, and LDL-C levels but negatively with HDL-C levels (Bering, Mauricio, Silva, & Correia, 2015). The rate of breast cancer recurrence is 1.58 times higher in patients with a triglyceride level of > 150 mg/dl and 1.83 times higher in patients with HDL-C of < 50 mg/dl (Berrino et al., 2014), highlighting the importance of managing dyslipidemia in patients with breast cancer to reduce the risks of cardiovascular diseases and to prevent the recurrence of cancer.

A higher proportion of patients in the abdominal obesity group consumed hypertension medications and had higher blood pressure at the time of measurement than those in the nonabdominal obesity group. The higher morbidity rate for hypertension in the abdominal obesity group may be because of the role of obesity as a major cause of hypertension (Seo et al., 2014). Moreover, higher numbers of metabolic syndrome risk factors were associated with a higher risk of breast cancer recurrence. Indeed, patients who present three or more metabolic syndrome risk factors are 2.17 times more likely to experience a relapse (Berrino et al., 2014).

With respect to dietary habits, the abdominal obesity group consumed vegetables less frequently, ate salty and sweet foods, and overate more often than the nonabdominal obesity group. These findings are similar to those obtained in a previous analysis of the National Health and Nutrition Survey, wherein Korean obese women showed less diversity in food intake but more sodium intake than normal-weight Korean women (Bae, 2012). These findings also echo a previous report that correlated larger waist and hip circumferences with enjoying saltier seasonings (Chang, 2010). A previous study that analyzed the dietary habits of Korean survivors of breast cancer found that the participants consumed more carbohydrates and less fiber than the general population (Seo et al., 2014). As a diet high in vegetable, fruit, and fiber is recommended to patients with cancer (Rock et al., 2012) to reduce the risks of relapse and mortality (Kwan et al., 2009), it is critical to educate patients and provide interventions that promote appropriate dietary habits.

The proportion of participants who engaged in moderate-intensity exercises three times a week for at least 30 minutes each session was lower in the abdominal obesity group than in the nonabdominal obesity group. This was similar to a previous study that found a lower percentage of obese middle-aged women engaging in regular exercise compared with their normal-weight and overweight counterparts (Chang, 2010). The efficacy of regular exercise in reducing waist circumference has been well documented. For instance, extending moderate- to high-intensity exercise for 30 minutes was shown to reduce waist circumference by 2.22 cm (Boyle, Vallance, Buman, & Lynch, 2017), and the rate of abdominal obesity was found to be lower among older adults who...
engaged in more health-related behaviors (Bulló et al., 2011). Thus, education on and the promotion of consistent adherence to health-related behaviors such as increased vegetable intake, a low-fat diet, and regular moderate- to high-intensity exercise (Rock et al., 2012) should be directed to patients with breast cancer to improve their prognoses.

This study found that, compared with their peers in the nonabdominal obesity group, the abdominally obese participants had higher body weight, BMI, body fat mass, body fat percentage, waist circumference, hip circumference, blood pressure, fasting blood glucose, triglyceride, and insulin values as well as lower HDL-C levels. Furthermore, the abdominal obesity group ate vegetables and exercised less frequently as well as overate and consumed sweet and salty foods more frequently. This comparison of metabolic syndrome risk factors and health-related behaviors between patients with breast cancer with and without abdominal obesity has produced meaningful results that shed light on the perils of abdominal obesity and present an objective standard for achieving desired changes in lifestyle habits.

**Limitations**

This study is affected by several limitations. First, actual parallels and odds/hazard ratios could not be obtained because of the small number of participants. Moreover, the obese group could not be further distinguished into mediates and moderates for additional statistical analysis to assess the differences in variables because of the small cohort size. A larger sample should be examined in the future to confirm the prevalence of relevant lifestyle habits in patients with breast cancer of different abdominal obesity statuses.

Second, although a structured questionnaire was used in this study to investigate health-related behaviors, the self-report format introduced the risk of data bias. In particular, abdominally obese patients may underate or overate their diet patterns and exercise habits. Thus, in the future, instruments that are able to objectively measure health-related behaviors such as diet and exercise habits should be developed.

Third, this study used a cross-sectional approach. Thus, the strength of relationships between independent and dependent variables could not be determined. Furthermore, whether abdominal obesity occurred before or after the diagnosis of breast cancer remains unclear. Therefore, we suggest conducting further cohort studies that assess the health condition and behaviors of female patients with breast cancer based on their abdominal obesity status to further investigate potential associations.

Despite these limitations, this study is meaningful as it is the first to investigate the prevalence of metabolic syndrome risk factors and health-related behaviors in Korean patients with breast cancer of different abdominal obesity statuses. The results showed that the abdominal obesity group was affected by more metabolic syndrome risk factors than the nonabdominal obesity group. Therefore, abdominally obese patients with breast cancer face a greater need to improve their health-related behavior, calling for an effective intervention program, guided by these results, to reduce relapse and mortality.

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**Author Contributions**

Study conception and design: HSK
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