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JOURNAL CLUB

Impact of Diabetes on the Symptoms of Breast Cancer Survivors

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OBJECTIVES: To examine the impact of diabetes on the symptoms of women with breast cancer.

SAMPLE & SETTING: 121 women with breast cancer who self-identified as having a diabetes diagnosis and 1,006 women with breast cancer without diabetes from 97 sites across the United States.

METHODS & VARIABLES: Symptom scores for depression, anxiety, sexual function, peripheral neuropathy, physical function, attention function, sleep disturbance, and fatigue were compared between women with breast cancer and diabetes and women with breast cancer without diabetes, controlling for age, education, income, marital status, and body mass index (BMI).

RESULTS: Women with breast cancer and diabetes who were three to eight years postdiagnosis reported poorer physical and attention function, more sleep disturbance, and greater fatigue than women with breast cancer without diabetes. Age, education, income, and BMI were independent predictors of symptoms experienced by women with breast cancer.

IMPLICATIONS FOR NURSING: Oncology nurses can assess and monitor women with breast cancer and diabetes for increased post-treatment sequelae. If problematic symptoms are identified, implementing treatment plans can decrease symptom burden and increase quality of life for women with breast cancer and diabetes.

KEYWORDS breast cancer survivors; diabetes; symptom burden; quality of life
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According to the Centers for Disease Control and Prevention (2017), cancer and diabetes are leading causes of death in the United States. Breast cancer is the most common cancer diagnosed among women in the United States, with an estimated 268,600 new cases in 2019 (National Cancer Institute Surveillance, Epidemiology, and End Results Program, 2019). Women with diabetes have a 23% higher risk for developing breast cancer than women without diabetes (De Bruijn et al., 2013), and a preexisting diagnosis of diabetes is associated with a 37% risk for all-cause mortality among women with breast cancer (Shao et al, 2018; Zhou, Zhang, Gu, & Xia, 2015). In addition, the symptoms experienced by women with diabetes may be similar to those experienced by women with breast cancer, and diabetes can exacerbate breast cancer symptoms.

Because women with breast cancer are living longer, focusing on the role of comorbidities on long-term outcomes is important. Breast cancer and diabetes share common symptoms that affect quality of life (Fu et al., 2015), such as depression, anxiety, sexual dysfunction, decreased physical function, fatigue, and pain (Doong et al. 2015; Ferreira et al., 2014; Hershey, Given, Given, Von Eye, & You, 2012; Young-Hyman et al., 2016). Poor cognitive function, poor attention function (Ferreira et al., 2014; Von Ah, Habermann, Carpenter, & Schneider, 2013), and peripheral neuropathy are central nervous system complications that are also common to both diseases (Hershey, Given, et al., 2012; Tang et al., 2016; Vissers et al., 2014). Although these symptoms result from different etiologies in diabetes and breast cancer, they can be exacerbated when coexistence occurs.

Although the literature describes increased symptoms and poorer outcomes for patients with diabetes and prostate or colorectal cancer (Vissers et al., 2014; Vissers, Falzon, va de Poll-Franse, Pouwer, & Thong, 2016), research on women with breast cancer who have diabetes is limited. Researching the effect of diabetes on the symptom experience of women with breast cancer can facilitate the implementation of preemptive and ongoing assessment and intervention strategies, which can better address symptom management for dual diagnoses. The purpose of this secondary analysis was to examine the impact of diabetes on the symptoms of women with breast cancer compared to women with breast cancer only. Depression, anxiety, sexual function, peripheral neuropathy, physical function, attention function, sleep disturbance, and fatigue were examined. To address whether women with breast cancer and diabetes report more symptoms than women without diabetes, this study used a two-phase analysis approach. Symptom scores were compared among women with breast cancer with and without a diabetes diagnosis. In addition, researchers examined whether diabetes is a significant predictor of symptoms in women with breast cancer, controlling for demographic variables, such as age, education, income, marital status, and body mass index (BMI) variables (overweight and obese).

Methods

Sample and Setting

Data from a cross-sectional quality-of-life study by Champion et al. (2014) were collected through the Eastern Cooperative Oncology Group–American College of Radiology Imaging Network (ECOG-ACRIN) Cancer Research Group. Results of the primary study are reported elsewhere (Champion et al., 2014). In the ECOG-ACRIN trial, breast cancer survivors received chemotherapy or combination chemotherapy and endocrine therapy regimens. Some women were also treated with surgical intervention, including mastectomy, lumpectomy, or radiation therapy. Eligibility for the primary study included being (a) diagnosed with breast cancer, (b) three to eight years post-treatment without recurrence at the time of recruitment, and (c) treated with a chemotherapy regimen of doxorubicin, paclitaxel, and cyclophosphamide. Women receiving surgical intervention or radiation therapy were also eligible. Additional criteria included residing in the United States, being aged 18 years or older, being able to speak and read English, and being able to complete a background questionnaire on their health history. Information on the study, including all study materials, was mailed to potential participants. Women were enrolled once they completed the background questionnaire and provided informed consent to participate.

Measures

Demographic variables and medical history were assessed through self-reported measures and confirmed by review of electronic health records. BMI was calculated from the self-reported height and weight measurements on participants' questionnaires. The questionnaire assessed multiple aspects of quality of life, including physical, social, psychological, spiritual, and overall well-being. This study was approved by the Institutional Review Board (IRB) at Indiana University—Purdue University in Indianapolis and by IRBs for all 97 ECOG-ACRIN sites.

Sociodemographic variables, including age, race, income, education, marital status, self-reported BMI, and comorbidities, were collected. Participants were also asked to identify whether they had a diabetes diagnosis. Because of the retrospective nature of the study, the type of diabetes (type 1 or 2) was not captured.

Depression was measured using the Center for Epidemiologic Studies–Depression (CES-D) Scale (Radloff, 1977). This 20-item instrument measures the presence and severity of depressive symptoms. Validity and reliability of the CES-D have been reported as 0.9 (Cosco, Prina, Stubbs, & Wu, 2017; Radloff, 1977). Breast cancer survivors rated how often they experienced symptoms associated with depression on a scale of 0 to 3 (0 = rarely or none of the time, 1 = some or little of the time, 2 = moderately or much of the time, and 3 = most or almost all of the time) for each item. Scores ranged from 0 to 60, with higher scores indicating greater depressive symptoms. The Cronbach alpha for this sample was 0.89.

Anxiety was measured using the State–Trait Anxiety Inventory (Spielberger, Gorsuch, & Lushene, 1970). This 40-item scale measures the intensity of anxious feelings. Internal consistency and reliability have been reported as ranging from 0.86 to 0.95 (Julian, 2011; Spielberger, Gorsuch, Lushene, Vagg, & Jacobs, 1983). Higher scores indicate higher anxiety. The Cronbach alpha was 0.93.

The Index of Sexual Satisfaction is a 10-item scale that measures sexual interest, enjoyment, and function. A higher score indicates better sexual function (Hudson, Harrison, & Crosscup, 1981). Internal consistency and reliability have been reported as 0.89 (Santos Iglesias et al., 2009). The Cronbach alpha for this sample was 0.78.

The Symptom Survivor Checklist was used to assess peripheral neuropathy. This researcher-derived checklist is based on symptoms commonly associated with peripheral neuropathy. The scale includes three subsets of questions related to sensations on the side of the body where the women had cancer treatment. Higher scores indicate more symptoms. The Cronbach alpha coefficient for this sample was 0.78.

Physical functioning was measured using the 10-item Physical Functioning Scale (PF-10) (McHorney, Ware, Rogers, Raczek, & Lu, 1992). Internal consistency coefficients for this instrument were reported as ranging from 0.84 to 0.89 (Champion et al., 2014). The PF-10 is comprised of 10 items that ask participants to rank how their health limits their activities on a three-point scale of "yes, limited a lot" (1 point), "some limitations" (2 points), or "no, not limited at all" (3 points). Total scores ranged from 0 to 30, with higher scores indicating better physical functioning. The Cronbach alpha coefficient for this sample was 0.89.

The Attention Function Index is a 16-item scale that asks questions related to cognitive function during the past four weeks. Questions focus on planning and following through with daily activities or plans, as well as the time and effort that is involved (Cimprich, 1992, 1993). Internal consistency and reliability have been reported as 0.92 (Cimprich, Visovatti, & Ronis, 2011). Responses to each question range from 0 (lower capacity) to 10 (higher capacity), with higher total mean scores indicating better attention functioning. The Cronbach alpha coefficient for this sample was 0.933.

The Pittsburgh Sleep Quality Index (PSQI) is a 19-item self-report measure that asks survivors to rate seven aspects of sleep during a one-month interval. Each item is weighted on a 0 (not during the last month) to 3 (three or more times per week) scale. The

TABLE 1. Breast Cancer Survivor Characteristics by Diabetes Status

	Diabetes (N = 121)		No Diabetes (N = 1,006)			
Characteristic	$\bar{X}$	**SD**	$\bar{X}$	**SD**	**t**	**Sample t**
Age (years)	62	9.8	57	11.6	–6.02	< 0.001
Body mass index	32.1	6.2	27.7	5.8	–7.7	< 0.001
Education (years)	14.06	2.53	14.5	2.68	1.699	0.09
Characteristic	**n**	**%**	**n**	**%**	**t**	**Sample t**
Race					0.263[a]	0.792
Caucasian	110	91	931	93		
African American	8	7	35	3		
Asian	–	–	10	1		
American Indian/Alaskan Native	–	–	1	–		
More than one	3	2	29	3		
Cancer stage					0.608[a]	–
I	21	17	223	22		
II	82	68	647	64		
III	14	12	113	11		
Missing data	4	3	23	3		
Income ($)					4.306	< 0.001
Less than 75,000	87	72	564	56		
75,000 or greater	29	24	409	41		
Missing data	5	4	33	3		
Marital status					3.48	0.001
Married	74	61	762	76		
Not married	45	37	228	23		
Missing data	2	2	16	2		

[a] Chi-square

Note. Because of rounding, percentages may not total 100.

global PSQI score is calculated by totaling the seven component scores and one composite score into an overall score ranging from 0 (healthy sleep quality) to 21 (poor sleep quality), with higher scores denoting poorer sleep quality (Buysse et al., 1991; Singh, Teel, Sabus, McGinis, & Kluding, 2016). Internal consistency and reliability have been reported as 0.83 (Smyth, 2012). A total score of 5 or greater indicates sleep disturbance (Zhu et al., 2018). The Cronbach alpha coefficient for this sample was 0.6.

The Functional Assessment of Cancer Therapy–Fatigue (FACT-F) is a 13-item scale that measures participants' self-reported energy for daily activities in the past four weeks (Cella et al., 1993). An internal consistency of 0.95 has been previously reported (Yellen, Cella, Webster, Blendowski, & Kaplan, 1997). Responses to each question ranged from 0 (not at all) to 4 (very much so) and were reverse-scored so that higher scores indicated less fatigue. The Cronbach alpha coefficient for this sample was 0.94.

Data Analysis

Data analysis was conducted using IBM SPSS Statistics, version 24.0, and results were considered significant at $p < 0.05$. Normality of the data was confirmed in the primary study (Champion et al., 2014). Descriptive analyses of the means of the symptoms (depression, anxiety, sexual function, peripheral neuropathy, physical function, attention function, sleep disturbance, and fatigue) for women with breast cancer with and without a diabetes diagnosis were compared using t tests. Significant symptoms (physical function, attention function, sleep disturbance, and fatigue) were analyzed using linear regressions,

TABLE 2. Self-Reported Mean Scores of Symptoms of Breast Cancer Survivors by Diabetes Status

	Total (N = 1,127)		Diabetes (N = 121)			No Diabetes (N = 1,006)				
Variable	$\bar{X}$	SD	$\bar{X}$	SD	Range	$\bar{X}$	SD	Range	t	p
Anxiety	34.31	9.94	34.44	10.38	0–80	34.3	9.9	0–80	–0.147	0.883
Attention function	6.86	1.79	6.45	1.8	2.19–10	6.91	1.78	1.56–10	2.672	0.008
Depression	9.78	9.03	10.5	9.07	0–60	9.68	8.7	0–60	–1.017	0.309
Fatigue	40.1	10.1	37.81	10.9	4–52	40.25	10	6–52	2.499	0.013
Peripheral neuropathy	3.37	2.26	3.21	2.24	–	3.39	2.26	–	0.687	0.492
Physical function	2.57	0.43	2.26	0.46	0–30	2.6	0.41	0–30	7.815	< 0.001
Sexual function	19.84	5.58	19.97	4.78	–	19.83	5.66	–	–0.204	0.839
Sleep disturbance	6.42	3.73	7.2	3.96	1–20	6.33	3.69	1–20	–2.355	0.019

Note. Anxiety was measured using the State-Trait Anxiety Inventory (T-Anxiety). Each item was rated on a scale from 0 (almost never) to 4 (almost always). The total scores ranged from 20 to 80, with higher scores indicating greater feelings of anxiety. Attention function was measured using the Attention Function Index. Each item was rated on a scale from 0 (lower capacity) to 10 (higher capacity), with higher total mean scores indicating better attention functioning. Depression was measured using the Center for Epidemiologic Studies—Depression Scale. Each item was rated on a scale from 0 (rarely or none of the time) to 3 (most or almost all of the time). The total scores ranged from 0 to 60, with higher scores indicating greater depressive symptoms. Fatigue was measured using the Functional Assessment of Cancer Therapy—Fatigue. Each item was rated on a scale from 0 (not at all) to 4 (very much so). The total scores ranged from 0 to 52, with higher scores indicating less fatigue. Peripheral neuropathy was measured using the Symptom Survivor Checklist. The total scores ranged from 0 to 4, with higher scores indicating more symptoms. Physical function was measured using the Physical Functioning Scale. Each item was rated on a scale of "yes, limited a lot" (1 point), "some limitations" (2 points), or "no, not limited at all" (3 points). The total scores ranged from 0 to 30, with higher scores indicating better physical functioning. Sexual function was measured using the Index of Sexual Satisfaction. Each item was rated on a scale from 1 (none of the time) to 7 (all of the time). The total scores ranged from 7 to 35, with higher scores indicating better sexual function. Sleep disturbance was measured using the Pittsburgh Sleep Quality Index. The total scores ranged from 0 (healthy sleep quality) to 21 (poor sleep quality), with higher scores denoting poorer sleep quality.

which examined the relationship between diabetic status and potential covariates (age, BMI, education, income, and marital status) on each of the dependent variables.

BMI was categorized as normal (less than 25) overweight, (from 25 to 30) and obese (greater than 30) (World Health Organization, 2017). Two dummy variables were computed to enter the BMI classifications into regressions (normal versus overweight and normal versus obese). Interaction effects on symptom outcomes between diabetes and BMI were investigated with additional models. Two interaction terms were computed by multiplying the variables normal versus overweight and normal versus obese by diabetes status.

Results

Descriptive Statistics

The dataset for this analysis included women with breast cancer (N = 1,127), 11% (n = 121) of whom self-reported a comorbid diabetes diagnosis. Women with breast cancer were primarily Caucasian, married, middle-aged, and well educated, with an income level of less than $75,000. Sample characteristics are listed in Table 1. Variables that were significantly different between diabetics and nondiabetics were used as covariates.

Independent sample t tests indicated significantly different mean scores among women with breast cancer and diabetes for four of the eight symptoms. Women with breast cancer and diabetes reported poorer physical function ($p < 0.001$), lower attention function ($p = 0.008$), greater sleep disturbance ($p = 0.019$), and greater fatigue ($p = 0.013$) compared to breast cancer survivors without diabetes. No significant differences among depression, anxiety, sexual function, and peripheral neuropathy were indicated. Mean symptom scores are listed in Table 2. Physical function, attention function, sleep disturbance, and fatigue were regressed on diabetic status while controlling for significantly different variables between diabetics and nondiabetics, including age, BMI, marital status, and income (see Table 3).

Women with breast cancer and diabetes had poorer physical function than those without diabetes ($p < 0.001$). As age increased, physical function decreased ($p < 0.001$). Better education ($p < 0.001$) and greater income ($p < 0.001$) were positively related to physical function. Marital status was not a significant predictor of physical function ($p = 0.97$). Women with breast cancer who were obese compared to those of normal weight reported poorer physical function ($p < 0.001$).

Attention function scores were significantly lower in women with breast cancer and diabetes compared to those without diabetes ($p = 0.003$). Age ($p < 0.001$), education ($p < 0.001$), and income ($p = 0.004$) were positively related to attention function, indicating that women with breast cancer with more years of

TABLE 3. Regression Analysis of Breast Cancer Survivor Symptoms

Variable	SE	β	t	p
Physical function[a]				
Diabetes	0.04	−0.149	−5.182	< 0.001
Age	0.001	−0.163	−5.574	< 0.001
Education	0.005	0.107	3.628	< 0.001
Income	0.027	0.171	5.476	< 0.001
Marital status	0.029	−0.001	−0.038	0.97
BMI (overweight)	0.03	−0.036	−1.211	0.226
BMI (obese)	0.03	−0.148	−4.869	< 0.001
Attention function[b]				
Diabetes	0.177	−0.091	−2.999	0.003
Age	0.005	0.238	7.675	< 0.001
Education	0.021	0.12	3.839	< 0.001
Income	0.12	0.094	2.851	0.004
Marital status	0.128	0.019	0.602	0.547
BMI (overweight)	0.132	−0.071	−2.264	0.024
BMI (obese)	0.132	−0.065	−2.024	0.043
Sleep[c]				
Diabetes	0.386	0.071	2.229	0.026
Age	0.01	−0.145	−4.511	< 0.001
Education	0.045	−0.098	−3.009	0.003
Income	0.258	−0.095	−2.768	0.006
Marital status	0.279	−0.016	−0.501	0.616
BMI (overweight)	0.283	0.041	1.271	0.204
BMI (obese)	0.285	0.053	1.587	0.113
Fatigue[d]				
Diabetes	1.011	−0.066	−2.137	0.033
Age	0.027	0.184	5.896	< 0.001
Education	0.12	0.06	2.04	0.042
Income	0.687	0.13	3.9	< 0.001
Marital status	0.732	−0.017	−0.535	0.593
BMI (overweight)	0.752	−0.064	−2.032	0.042
BMI (obese)	0.754	−0.132	−4.059	< 0.001

[a] $F = 33.08$, df = 7,1076, $R^2 = 0.178$, $p \leq 0.001$
[b] $F = 13.25$, df = 7,1076, $R^2 = 0.074$, $p \leq 0.001$
[c] $F = 6.704$, df = 7,1033, $R^2 = 0.037$, $p \leq 0.001$
[d] $F = 10.85$, df = 7,1074, $R^2 = 0.06$, $p \leq 0.001$
β—standard beta; BMI—body mass index; df—degrees of freedom; SE—standard error

education and higher income had greater attention function. Marital status was not a significant predictor ($p = 0.547$). Attention function was significantly lower in women with breast cancer who were overweight ($p = 0.024$) or obese ($p = 0.043$).

In this sample, women with breast cancer and diabetes reported experiencing more sleep disturbance than those without diabetes ($p = 0.026$). Age ($p < 0.001$), education ($p = 0.003$), and income ($p = 0.006$) were negatively related to sleep disturbance. Marital status did not predict sleep disturbance ($p = 0.616$). BMI was not a significant predictor of sleep disturbance among women with breast cancer.

Women with breast cancer and diabetes reported significantly greater fatigue ($p = 0.033$) than those without diabetes. Those who were older ($p < 0.001$), with more years of education ($p = 0.042$), and with higher income ($p < 0.001$) reported less fatigue. Marital status was not significant ($p = 0.593$). BMI predicted fatigue among the women with breast cancer who were overweight ($p = 0.042$) or obese ($p < 0.001$).

Because women with breast cancer and diabetes had a significantly higher BMI than those without diabetes the interaction between diabetes and BMI was tested as an additional variable in predicting each of the four symptoms. No significant interaction effects between BMI status (overweight or obese) and diabetes on the symptoms were determined.

Discussion

Although some studies found the prevalence of diabetes among women with breast cancer to be as high as 33% (Srokowski, Fang, Hortobagyi, & Giordano, 2009), the prevalence of breast cancer survivors with diabetes (11%) in this study is similar to other researchers who found that 12% of breast cancer survivors reported a diagnosis of diabetes (Fu et al., 2015; Tang et al., 2016). The results of this study indicated that the presence of diabetes in women with breast cancer was associated with poorer physical and attention function and greater sleep disturbance and fatigue.

In this study, the presence of diabetes negatively influenced physical function. These results are consistent with researchers who noted that women with breast cancer with comorbid diabetes reported significantly poorer physical function than women without diabetes following active treatment (Tang et al., 2016). In a study by Hershey, Tipton, Given, and Davis (2012), women with breast cancer and diabetes reported poorer physical function than those without diabetes. However, physical function was measured during treatment with chemotherapy, which may have influenced the results (Hershey, Tipton, et al., 2012). Chemotherapy treatment regimens may exacerbate symptoms in women with breast cancer and diabetes. In addition, the acute side effects of treatment were shown to reduce diabetes self-management activities (Hershey, Tipton, et al., 2012). Additional research is needed to determine whether physical function is more severely affected in women with breast cancer and diabetes.

As age increased, women with breast cancer reported poorer physical function. Increasing age is accompanied by an overall decline in physical function, affecting the ability to complete activities of daily living (Brady & Straight, 2014). Women with breast cancer who had higher education and income reported higher physical function. Higher education and income have been associated with an increased ability to engage in physical activity and healthy living activities, as well as better access to health care, which aids in sustaining physical function (Chetty et al., 2016). As expected, increased BMI (obesity only) was associated with poorer physical function. Higher amounts of body fat were associated with poorer physical performance, as well as greater limitations in functional ability and disability among community-dwelling older women (Rolland et al., 2009). Increased adiposity and obesity often occur concurrently with aging and are contributing factors to decreased muscle mass, capacity, and strength, which can result in poorer physical function (Brady & Straight, 2014; Schaap, Koster & Visser, 2013).

Although insignificant, women with breast cancer and diabetes reported fewer symptoms of peripheral neuropathy than women with breast cancer. Because people with diabetes can present with baseline peripheral sensory impairment, making them less sensitive to additional sensory loss, patients without diabetes are more likely to recognize and be affected by sensory changes. Additional studies examining peripheral neuropathy in women with breast cancer and without diabetes are warranted.

This is the first study to examine attention function in the context of women with breast cancer and diabetes. Women with breast cancer and diabetes reported poorer attention function than their counterparts without diabetes. Women with breast cancer frequently report changes in cognitive function and attention as a troublesome symptom (Frank, Vance, Jukkala, & Meneses, 2014; Von Ah et al., 2009; Von Ah, Storey, Crouch, et al. 2016; Von Ah, Storey, Tallman, et al. 2016), which can persist for as many as 20 years after completing treatment for breast cancer

(Koppelmans et al., 2012). Cancer treatment and hormonal changes are contributing factors to poorer attention function among women with breast cancer. Independent of a cancer diagnosis, patients with diabetes also reported decreased cognitive function (Feinkohl, Price, Strachan, & Frier, 2015; Koekkoek, Kappelle, van den Berg, Rutten, & Biessels, 2015; Mansur et al., 2014; Zilliox, Chadreasekaran, Kwan, & Russell, 2016), particularly in the domains of memory, processing speed, executive function (Koekkoek, et al., 2015), and attention function (Monette, Baird, & Jackson, 2014; Zilliox et al., 2016). In a meta-analysis of 25 studies on people with diabetes, researchers found statistically significantly poorer cognitive function (including attention function) among those with diabetes ($p < 0.05$) (Monette et al., 2014). Lack of glycemic control (hypoglycemia or hyperglycemia) suggests a contributing factor to these cognitive symptoms (Feinkohl et al., 2015; Seetharaman et al., 2015). Future studies can help to identify women with breast cancer who may be at a higher risk for impaired attention function. A better understanding of the impact of diabetes in women with breast cancer and its influence on attention function is important so that baseline and ongoing cognitive assessments can be conducted throughout the cancer trajectory.

Although previous research has demonstrated that increasing age is associated with poorer attention function, this study found that age was positively associated with attention function. In particular, younger women with breast cancer perceived poorer attention function than older women with breast cancer. This finding was also noted in the primary study that consisted of an equal sample of younger and older women with breast cancer. Champion et al. (2014) suggest that younger women with breast cancer are engaged in activities that require higher cognitive demands than older women with breast cancer; therefore, their perception of attention function is based on their higher demands. In a study by Von Ah et al. (2013) attention function in younger women with breast cancer was worse than it was in older women.

Similar to the findings of this study, higher education and income was associated with better cognition and attention function throughout the aging continuum (Lyu & Burr, 2016). In addition, researchers have noted the negative effect of higher BMI on cognitive abilities (Gunstad et al., 2007).

Women with breast cancer and diabetes reported more sleep disturbance than those without diabetes. This is the second report examining the impact of diabetes on sleep disturbance in women with breast cancer (Tang et al., 2016). Among women with breast cancer, sleep disturbance is reported with symptom onset from initial diagnosis throughout the cancer trajectory (Ancoli-Israel et al., 2014; Otte, Carpenter, Russell, Bigatti, & Champion, 2010). According to a study by Otte et al. (2010), women with breast cancer scored higher on the PSQI, indicating poorer sleep quality and greater sleep disturbance than women without breast cancer ($p < 0.05$). Similarly, in a longitudinal study by Ancoli-Israel et al. (2014), women with breast cancer had poorer sleep quality and more sleep disturbance than the noncancer controls ($p < 0.05$). Patients with diabetes reported poorer sleep quality and more sleep disturbance than people without diabetes (Barnard et al., 2016; Reutrakul et al., 2016; Zhu et al., 2018). Sleep disturbance in people with diabetes is linked to glucose metabolism (Spiegel, Tasali, Leproult, & Van Cauter, 2009) and subsequent suboptimal glycemic control (Reutrakul et al., 2016). Alterations in blood glucose can result in hypoglycemia, polydipsia, and polyuria, which can contribute to interrupted sleep patterns. Additional research is needed to examine the role of diabetes on the sleep patterns of women with breast cancer because sleep disturbance may exacerbate the severity of other symptoms, such as fatigue and depression.

In this study, younger women with breast cancer reported more sleep disturbance than older women with breast cancer. This is consistent with findings from the primary study that noted that younger women with breast cancer reported more sleep disturbance than older women with breast cancer (Champion et al., 2014). Similarly, in a study of 492 younger women with breast cancer ($\bar{X}$ age = 48 years), researchers found that sleep disturbance was associated with postmenopausal symptoms, poorer physical

KNOWLEDGE TRANSLATION

- Women with breast cancer and diabetes report poorer physical function and attention function and more sleep disturbance, and fatigue than women with breast cancer without diabetes.
- Oncology nurses should be knowledgeable about the symptoms experienced by women with breast cancer and how these symptoms may be affected by diabetes and be able to educate the women about self-management strategies that can mitigate these symptoms.
- Additional research can lead to the development of interventions to alleviate the symptoms experienced by women with breast cancer and diabetes and improve quality of life.

function, and comorbid conditions (Otte et al., 2010). As education and income increased, sleep disturbance decreased. Similar findings were noted by researchers who found that those with higher socioeconomic status reported less sleep disturbances than those with lower socioeconomic status (Grandner et al., 2010; Mezick et al., 2008). In the current study, BMI was not associated with sleep disturbance. Although this finding differs from other research that links BMI to poorer sleep, this study used the PSQI to measure sleep disturbance specifically, whereas the others measured the duration of sleep, rapid eye movement sleep, obstructive sleep apnea, and daytime sleepiness in relation to BMI (Drager, Togeiro, Polotsky, & Lorenzi-Filho, 2013; Ford et al., 2014; Moraes et al., 2013).

Women with breast cancer and diabetes reported greater fatigue than those without diabetes. Only one existing study assessed fatigue in women with breast cancer with and without diabetes (Tang et al., 2016). Using the European Organisation for Research and Treatment of Cancer Quality of Life Questionnaire-Core 30, researchers noted higher fatigue scores ($p < 0.05$) among women with breast cancer and diabetes than in women with breast cancer only (Tang et al., 2016). Fatigue is a multidimensional symptom experienced by women with breast cancer and patients diagnosed with diabetes. Similar factors that contribute to fatigue were identified among women with breast cancer and diabetes, including poor physical function, poor sleep, cognitive dysfunction, anxiety, and depression (Champion et al., 2014; Otte et al., 2010; Park, Park, Quinn, & Fritschi, 2015; Singh et al., 2016). In addition, the physiologic demands of cancer, cancer treatment, and diabetes may decrease energy production in the body and worsen fatigue.

In this study, age was inversely associated with fatigue ($p < 0.001$). This is congruous with the primary study, which found that younger women with breast cancer reported more fatigue than older women (Champion et al., 2014). In a study by Garabeli Cavalli Klutcovsky et al. (2012) of 202 women with breast cancer (stage III) who were two to five years post-treatment, younger women reported higher levels of fatigue than older women. Similar to other studies, education was inversely related to fatigue ($p = 0.037$). Being overweight ($p = 0.041$) or obese ($p < 0.001$) also increased fatigue levels. Higher levels of fatigue and decreased physical function and activity have been found in women with breast cancer with higher BMI (Herath, Peswani, & Chitambar, 2016; Sheng, Sharma, Jerome, & Santa-Maria, 2019). In a study of primarily urban African American women, those with a higher BMI (30 kg/m^2 or greater) reported more severe fatigue than women with a normal BMI (Jarosz et al., 2014). Because women with diabetes tend to have a higher BMI, women with breast cancer and a diagnosis of diabetes are at an increased risk for fatigue.

Strengths and Limitations

This study was the first to assess the impact of diabetes on eight symptoms commonly experienced by breast cancer survivors and patients with diabetes. The strength of the study was a robust sample size, with similar disease staging and treatment for breast cancer. This study relied on a self-report of diabetes, which limited the ability to determine whether the women were diagnosed with type 1 or 2 diabetes. Different pathologies are associated with each type, which may influence the symptoms experienced and their severity. The diabetes status of the women with breast cancer may have been underreported because estimates indicate that 7.2 million Americans do not know they have the condition (Centers for Disease Control and Prevention, 2017). Because of the retrospective study design, whether blood glucose levels influenced the type and severity of symptoms reported was not assessed. Because of the lack of diversity in this study, the findings cannot be generalized to women with breast cancer with diabetes of other ethnicities. Additional prospective studies with larger sample sizes are needed to confirm these findings and to identify the most prevalent symptoms experienced by women with breast cancer and diabetes. These findings can lead to the development of self-management strategies and interventions to mitigate symptoms and improve quality of life for women with breast cancer and diabetes.

Implications for Nursing

This study provides preliminary evidence that women with breast cancer and diabetes experience a greater symptom profile than women with breast cancer without diabetes. As women with breast cancer are living longer with comorbid conditions, it is important for oncology nurses to educate themselves on diabetes and breast cancer, as well as the potential effects that coexisting conditions can have on symptoms during the cancer trajectory. Oncology nurses can assess and identify women with breast cancer and diabetes as being at a higher risk for poor post-treatment sequelae. Diabetes status in women with breast cancer should be considered a risk factor for increased symptoms following treatment, and patients with diabetes should be closely monitored for symptoms. Baseline assessments of these symptoms at diagnosis and prior to the initiation of the treatment regimen, as well as ongoing assessment throughout the survivorship trajectory, are important to determine the unique impact of diabetes.

Conclusion

This study reported the effect of diabetes on four prominent symptoms experienced by breast cancer survivors who were three to eight years post-treatment and in remission. According to the findings in this study, women with breast cancer and diabetes are vulnerable to a greater symptom profile during the cancer trajectory than women without diabetes. Additional research on the impact of diabetes on symptoms experienced by women with breast cancer can help to develop and implement tailored interventions that can mitigate these symptoms.

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Storey, Gathirua-Mwangi, Cella, and Champion contributed to the conceptualization and design. Storey, Cohee, and Champion completed the data collection. Storey, Cohee, Monahan, Stump, and Champion provided statistical support. Storey, Gathirua-Mwangi, Vachon, Monahan, Otte, Stump, and Champion provided the analysis. All authors contributed to the manuscript preparation.

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QUESTION GUIDE FOR A JOURNAL CLUB

Journal clubs can help to increase and translate findings to clinical practice, education, administration, and research. Use the following questions to start discussion at your next journal club meeting. Then, take time to recap the discussion and make plans to proceed with suggested strategies.

1. What factors can influence the development of diabetes in women, and how can nurses educate women on these?
2. According to this study, women with breast cancer and diabetes have poorer attention function. This is a stressor for many survivors of breast cancer and those who have had chemotherapy treatment. What strategies can nurses suggest to mitigate this side effect?
3. Sleep disturbance and fatigue were also associated with diabetes in the women in this study. What strategies might help to alleviate these symptoms?
4. In this study, younger women tended to fare worse than older women regarding fatigue and sleep disturbance. What factors may influence this?

Visit https://bit.ly/1vUqbVj for details on creating and participating in a journal club. Contact pubONF@ons.org for assistance or feedback. Photocopying of the article for discussion purposes is permitted.