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The Impact of Diabetes on the Symptoms of Breast Cancer Survivors

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Abstract

Purpose/Objectives: To examine the impact of diabetes on the symptoms (physical function, attention function, sleep disturbance and fatigue) of women with breast cancer compared to those without diabetes.

Design: Secondary analysis of data from a cross-sectional quality of life study collected through the Eastern Cooperative Oncology Group-American College of Radiology Imaging Network Cancer Research Group 97.

Setting: Women with breast cancer from 97 sites across the US.

Sample: 121 (11%) women with breast cancer self-identified as also having a diagnosis of diabetes and 1,006 women with breast cancer without diabetes.

Methods and 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 concurrently diagnosed with diabetes and 3 to 8 years from diagnosis 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 are in a key position to assess and monitor women with breast cancer and diabetes for increased post-treatment sequelae. If problematic symptoms are identified, treatment plans can be implemented to decrease symptom burden and increase quality of life for women with breast cancer and diabetes.

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Cancer and diabetes rank as leading causes of death in the United States (Center for Disease Control and Prevention, 2017). Breast cancer is the most common cancer diagnosed among women in the US with an estimated 266,120 new cases diagnosed in 2018 (National Cancer Institute SEER data). Women with diabetes have a 23% higher risk of developing breast cancer than women without diabetes (DeBruijn et al., 2013) and pre-existing diagnosis of diabetes is associated with a 37% risk for all-cause mortality among women with breast cancer (Zhou et al., 2015). Furthermore, the symptoms experienced by women with diabetes may be similar to those experienced by women with breast cancer, and diabetes may exacerbate the symptoms of women diagnosed with breast cancer.

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

Research describes increased symptoms and poorer outcomes for patients with both diabetes and primarily prostate and colorectal cancer (Vissers et al., 2014; Vissers, Falzon, va de Poll-Franse, Pouwer, & Thong, 2016), but research with women with breast cancer who also have diabetes is sparse. This lack of research places the subgroup of women with breast cancer and diabetes at a potentially higher risk for exacerbation of symptoms and poorer quality of life. Identifying the contribution of diabetes to the symptom experience of women with breast cancer is important to study as this will facilitate clinicians in implementing pre-emptive and ongoing assessment and intervention strategies to better address diabetes management and potentially mitigate symptoms exacerbated by dual diagnoses. Therefore, 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. Symptoms examined were depression, anxiety, sexual function, peripheral neuropathy, physical function, attention function, sleep disturbance and fatigue. To address the research question of whether women with breast cancer and diabetes report more symptoms than those without diabetes, our study used a two-phase analysis approach. First, we compared the symptom's scores (depression, anxiety, sexual function, peripheral neuropathy, physical function, attention function, sleep disturbance and fatigue) in women with breast cancer with and without a diabetes diagnosis. Second, we examined if diabetes is significant predictor of symptoms in women with breast cancer controlling for demographic variables (age, education, income, marital status) and BMI variables (overweight and obese).

Methods and Variables

Sample and Setting

Data from a cross-sectional quality of life study were collected through an Eastern Cooperative Oncology Group-American College of Radiology Imaging Network (ECOG-ACRIN) Cancer Research Group 97. Results of the primary study are reported elsewhere (Champion et al., 2014). BCS in the ECOG-ACRIN trials had received chemotherapy or combined chemotherapy and hormonal therapy regimens. Some women were also treated with surgical intervention including mastectomy or lumpectomy and/or radiotherapy. Cancer-specific eligibility for this study included: 1) diagnosed with breast cancer 2) 3 to 8 years post diagnosis of treatment without a recurrence at the time of recruitment; and 3) treated with a chemotherapy regimen of Adriamycin, Paclitaxel, and Cyclophosphamide. Eligibility was open to those receiving surgical intervention or radiotherapy. Additional criteria included residing in the United States, being 18 years of age or older, speaking and reading English, and being able to complete the background questionnaire. Information about the study along with all study materials were mailed to potential participants. Women were enrolled once they completed all forms and provided informed consent to participate.

The overall aim of the *primary study* was to examine the quality of life of women with breast cancer who were diagnosed as younger women (ages 45 years and younger) compared to both older women (ages 55–70) and age-matched acquaintance controls who had not had cancer of any type (Champion et al., 2014).

Measures

Demographic variables.—Demographic variables and medical history were assessed through self-report measures and confirmed by medical records. BMI was calculated using self-reported height and weight measurements while completing the questionnaire. Scales assessing multiple aspects of quality of life, defined as physical, social, psychological, spiritual and overall well-being were answered through self-report. The original study was approved by the coordinating university's Institutional Review Board (IRB) and IRBs for all 97 ECOG-ACRIN sites.

Sociodemographic variables, including: age, race, income, education and marital status; self-reported body mass index (BMI) and comorbidities including a self-report diagnosis of diabetes (yes/no), and were collected. Due to the retrospective nature of the study the type of diabetes (Type 1 or Type 2) was unable to be ascertained.

Depression.—The Center for Epidemiologic Studies Depression scale (CES-D) was used to measure depression (Radloff, 1977). This 20-item instrument measures the presence and severity of depressive symptoms. BCS rated (0–3) 0 to 3 for each item (0 = Rarely or None of the Time, 1= Some or Little of the Time, 2= Moderately or Much of the time, 3= Most or Almost All of the Time) how often they experienced symptoms associated with depression. Scores ranged from 0 to 60, with high scores indicating greater depressive symptoms. The Cronbach alpha was .89.

Anxiety.—The State-Trait Anxiety Inventory was used to measure anxiety (Spielberger, Gorsuch, & Lushene, 1970). This is a 40-item scale measuring the intensity of feelings of anxiety. Higher scores are indicative of higher anxiety. The Cronbach alpha is .93.

Sexual function.—Sexual function is a 10-item scale that measures sexual interest, enjoyment, and function. A higher score indicates better sexual function (Hudson, Harrison & Crosscup, 1981). The Cronbach alpha was .78.

Peripheral neuropathy.—The Symptom Survivor Checklist was used to assess peripheral neuropathy: This is a researcher-derived checklist based on symptoms commonly associated with peripheral neuropathy. The scale includes 3 subsets of questions related to sensations on the side of the body where the women had cancer treatment. Higher score indicate more symptoms. Cronbach alpha for this study was .78.

Physical function.—Physical functioning was measured by the *Physical Functioning* 10-item index (PF10) (McHorney, Ware, Rogers, Raczek, & Lu, 1992). The scale is composed of 10 items, asking survivors to respond how their current health limited their activities on a 3-point scale of “yes, limited a lot,” (1 point), “some limitations” (2 points) or “no, not limited at all,” (3 point). The total scores ranged 0–30, with higher scores indicating better physical functioning. The Cronbach alpha coefficient was .89 for this sample.

Attention function.—The *Attention Function Index* is a 16-item scale that asks questions related to cognitive function in the last four weeks through questions such as, “Planning your daily activities,” “following through on your plans,” and “doing things that take time and effort” (Cimprich, 1992; Cimprich, 1993). Responses to each question range 0–10. A total mean score of the scale is taken with higher scores indicating better attention function. The Cronbach alpha coefficient was .93 for this sample.

Sleep.—The *Pittsburg Sleep Quality Index* is a 19-item self-report measure that asks survivors to rate 7 aspects of sleep over a one-month interval. The global PSQI score is then calculated by totaling the seven component scores, providing an overall score ranging from 0 to 21, where higher scores denote poorer sleep quality (Buysse et al., 1991; Singh, Teel, Sabus, McGinis, & Kluding, 2016). A total score over 5 indicates sleep disturbance (Zhu et al., 2018). The Cronbach alpha coefficient was .60 for this sample.

Fatigue.—The *Functional Assessment of Cancer Therapy Fatigue Subscale* (FACT-F) measures self-reported energy for daily activities in the past 4 weeks with 13 items (Cella et al., 1993). Responses to each question range from 0 (“not at all”) to 4 (“very much so”) and were reverse scored so that higher totaled scores indicated less fatigue. The Cronbach alpha coefficient was .94 for this sample.

Data analysis

The dataset used for this analysis included women with breast cancer ($n = 1,127$), of which 11% ($n = 121$) self-report a comorbid diagnosis of diabetes. Data analysis was conducted using SPSS version 24.0 and significance was considered at the $p < .05$ level. Normality of the data was confirmed in the original study (Champion et al., 2014). For research question

1, descriptive analyses using *t*-tests compared the means of the symptoms (depression, anxiety, sexual function, peripheral neuropathy, physical function, attention function, sleep and fatigue) for women with breast cancer with and without a diabetes diagnosis. Symptoms found to be significant (physical function, attention function, sleep and fatigue) were analyzed using linear regressions to examine the relationship of diabetic status and potential covariates (age, BMI, education, income, and marital status) on each of the dependent variables. BMI was categorized as normal (BMI < 25) overweight, (25 > and > 30) and obese (< 30) (World Health Organization, 2017). Two dummy variables were computed to enter these BMI classifications into regressions (normal versus overweight and normal versus obese). Interaction effects between diabetes and BMI on the symptom outcomes were also investigated with additional models. Two interaction terms were computed and added to the models by multiplying the variable normal versus overweight and normal versus obese by diabetes status.

Results

Descriptive statistics

A total of 1,127 women with breast cancer were included in the analysis, and 121(11%) self-identified as having diabetes. Women with breast cancer were primarily Caucasian, married, middle-aged, well-educated, with an income level <\$75,000. Women with breast cancer and diabetes were significantly older (62 versus 57 years of age; $p < .001$), had a higher BMI (33 versus 27.6; $p < .001$), and lower income ($p < .001$) compared to those living without diabetes. See Table 1 for sample characteristics. The variables that were significantly different between diabetics and non-diabetics were used as co-variables in the analyses for research question 2.

Independent-sample *t*-tests noted women with breast cancer and diabetes had significantly different mean scores for four of the eight symptoms. Women with breast cancer and diabetes reported poorer physical function ($p < .001$), lower scores on attention function ($p = .008$), more sleep disturbance ($p = .019$), and greater fatigue ($p = .013$) compared to BCS without diabetes. The symptoms of depression, anxiety, sexual function and peripheral neuropathy were not significantly different between the two groups. See Table 2 for the mean symptom scores. These symptoms were then regressed on diabetic status while controlling for variables that were significantly different between diabetics and non-diabetics (age, BMI, marital status and income).

Physical function.—Women with breast cancer and diabetes had poorer physical function than those without diabetes ($p < .001$). Age was inversely associated with physical function ($p < .001$); as age increased, physical function decreased. Education ($p < .001$) and income ($p < .001$) were positively related to physical function, that is, as education and income increased, physical function improved. Marital status was not a significant predictor of physical function ($p = .970$). women with breast cancer who were obese compared to those of normal weight reported poorer physical function ($p < .001$).

Attention function.—Attention function scores were significantly lower in women with breast cancer and diabetes compared to those without diabetes ($p = .003$). Age ($p < .001$),

education ($p<.001$) and income ($p=.004$) were positively related to attention function, meaning that women with breast cancer with more years of education and higher income had greater attention function. Marital status was not a significant predictor ($p = .547$). Attention function was significantly lower in women with breast cancer who are overweight compared to normal ($p = .024$) or for those obese compared to normal ($p = .043$).

Sleep disturbance.—In this sample, women with breast cancer and diabetes reported experiencing more sleep disturbance than those without diabetes ($p=.026$). Age ($p<.001$), education ($p=.003$), and income ($p=.006$) were negatively related to sleep disturbance; that is, as age, education and income increased, women with breast cancer reported less sleep disturbance. Marital status did not predict sleep disturbance ($p = .616$). BMI was not a significant predictor of sleep disturbance among the women with breast cancer in this study sample.

Fatigue.—Women with breast cancer and diabetes reported significantly greater fatigue ($p=.033$) than those without diabetes. Those who were older ($p<.001$), with more years of education ($p = .042$) and higher income ($p<.001$) reported less fatigue. Marital status was not significant ($p = .593$). BMI predicted fatigue among the women with breast cancer—both for those overweight compared to normal ($p = .042$) and for those obese compared to normal ($p<.001$).

Because women with breast cancer and diabetes had a significantly higher BMI than those without diabetes (33 versus 27.6; $p<.001$) we tested for the interaction of diabetes and BMI as an additional variable in predicting each of the eight symptoms. Results showed there were no significant interaction effects between BMI status (overweight or obese) and diabetes on the symptoms.

Discussion

Although some studies found the prevalence of diabetes among women with breast cancer to be as high as 33% (Srokowski et al., 2009), the prevalence of BCS with diabetes (11%) in our study is similar to other researchers who found 12% of BCS reporting a diagnosis of diabetes (Tang et al., 2016; Fu et al., 2015). Our results indicated that the presence of diabetes in women with breast cancer was associated with the symptoms of physical function, attention function, sleep disturbance, and fatigue.

In this study of women with breast cancer, the presence of diabetes negatively influenced physical function. These results are consistent with researchers who noted that women with breast cancer with comorbid diabetes post active treatment reported significantly poorer physical function measured by the EORTC-QLQ-C30 than did their breast cancer only counterparts (Tang et al., 2016). Hershey et al., (2012b) also found that 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 finding (Hershey et al., 2012). Chemotherapy treatment regimens may exacerbate symptoms in women with breast cancer and diabetes. Additionally, the acute side effects of treatment were shown to reduce diabetes self-management activities (Hershey et

al., 2012). More research is required to determine if physical function is more severely affected in women with breast cancer and diabetes.

Not surprisingly, we found as age increased, women with breast cancer report poorer physical function. Increasing age is accompanied by an overall decline in physical function, influencing the ability to complete daily activities of living (Brady & Straight, 2014). We found women with breast cancer who had higher education and income reported higher physical function. Higher education and income have been associated with increased ability to engage in physical activity, healthy living activities and access healthcare (Chetty et al., 2016) which aids in sustaining physical function. As expected, we found increasing BMI (obesity only) was associated with poorer physical function. Higher amounts of body fat were associated with poor physical performance, more limitations in functional ability and ensuing disability among community dwelling elderly women (Rolland et al., 2009). Changes in body compensation such as (increased adiposity and obesity) often occur concurrently in the aging; and are contributing factors to decreases in muscle mass, capacity and strength resulting in poorer physical function (Brady & Straight, 2014; Schaap, Koster & Vissers, 2013).

Although not significant, we found women with breast cancer and diabetes reported fewer symptoms of peripheral neuropathy than women with breast cancer only. This interesting finding may be due to the fact that people with diabetes could present with baseline peripheral sensory impairment making them less sensitive to the impact of additional sensory loss, whereas those without diabetes would be more likely notice and be disturbed by the sensory changes. More studies are warranted to examine the symptom of peripheral neuropathy in women with breast cancer with and without diabetes.

To our knowledge, this is the first study to examine *attention function* in the context of women with breast cancer and diabetes. We found 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 (Von Ah et al., 2009; Von Ah et al., 2016a Von Ah 2016b; Frank et al., 2014), which can persist up to 20 years post completion of treatment for breast cancer (Koppelmans, Breteler, Tasca, Scherling, & Smith, 2012). Cancer treatment and hormonal changes are contributing factors to poorer attention function among women with breast cancer. Independent of a cancer diagnosis, people with diabetes also reported decreased cognitive function (Mansur et al., 2014; Koekkoek, Kappelle, Van Den Berg, Rutten, & Biessels, 2015; Feinkohl, Price, Strachan, & Frier, 2015; Zilliox, Chadrasekaran, Kwan, & Russell, 2017), specifically, in the domains of memory, processing speed, executive function (Koekkoek, et al., 2015) and attention function (Monette, Baird & Jackson, 2014; Zilliox et al., 2017). In a recent meta-analysis of studies ($n = 25$) among 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 examining key contributors to impaired attention function should be conducted to identify women with breast cancer who may be at higher risk for this troubling symptom. A better understanding

of the impact of diabetes in women with breast cancer and its influence on attention function is important so baseline and ongoing cognitive assessments can be conducted throughout the cancer trajectory.

Previous research has demonstrated that increasing age is associated with poorer attention function. However, our study found age was positively associated with attention function. Specifically, younger women with breast cancer perceived poorer attention function than older women with breast cancer. This finding albeit counter intuitive, was also noted in the primary study that consisted of an equal sample of younger and older women with breast cancer. In that study, researchers noted younger women with breast cancer reported poorer attention function than older women with breast cancer (Champion et al., 2014). Those researchers suggest younger women with breast cancer are engaged in activities requiring higher cognitive demands, than older women with breast cancer, thus, their perception of attention function is based on their higher demands. Additionally, other researchers found that attention function in younger women with breast cancer is worse than their older counterparts (Von Ah et al., 2013).

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

We found women with breast cancer and diabetes reported more sleep disturbance than those without diabetes. To our knowledge, 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 and well into survivorship (Otte, Carpenter, Russell, Bigatti, & Champion, 2010; Ancoli-Israel et al., 2014). Otte et al. (2010) noted that women with breast cancer scored higher on the Pittsburgh Sleep Quality Index, indicating poorer sleep quality and more sleep disturbance than women without breast cancer ($p < 0.05$). Similarly, in a longitudinal study, researchers found that women with breast cancer had poorer sleep quality and more sleep disturbance than the non-cancer controls ($p < 0.05$) (Ancoli-Israel et al., 2014). People with diabetes reported poorer sleep quality and more sleep disturbance than people without diabetes (Reutrakul et al., 2016; Barnard et al., 2016; Zhu et al., 2018). Sleep disturbance in people with diabetes is linked to glucose metabolism (Spiegel et al., 2009) and subsequent suboptimal glycemic control (Reutrakul et al., 2016). Alterations in blood glucose can result in hypoglycemia, polydipsia and polyuria all of which may contribute to interrupted sleep patterns. It is plausible the presence of diabetes in women with breast cancer affects sleep. More research is needed to examine the role of diabetes on the sleep patterns of women with breast cancer, as sleep disturbance may exacerbate the severity of other symptoms such as fatigue and depression.

We found age inversely associated with sleep, younger women with breast cancer reported more sleep disturbance than older women with breast cancer. Our findings are consistent with those from the primary study that noted 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 (mean age of 48), researchers found sleep disturbance to be associated with post-menopausal symptoms, poor physical function and comorbid conditions (Otte et al., 2010). As expected, as education and income increased, sleep disturbance decreased. Similar findings were noted by researchers who found those with higher socioeconomic status reported less sleep disturbances than those with lower socioeconomic status (Grandner et al., 2010; Mezick et al., 2008). In this study, BMI was not associated with sleep disturbance. This finding may seem to contrast with other research linking BMI to poorer sleep. However, our study used the PSQI to measure sleep disturbance specifically, whereas the others focused on measuring duration of sleep, rapid eye movement (REM) sleep, obstructive sleep apnea and daytime sleepiness in relationship BMI (Moraes et al., 2012; Ford, Wheaton, Chapman, Perry, & Croft, 2014; Drager, Togeiro, Polotsky, & Lorenzi-Filho, 2013).

Women with breast cancer and diabetes reported more fatigue than those without diabetes. Only one existing study assessed fatigue in women with breast cancer with and without diabetes. Using the European Organization for Research and Treatment of Cancer Quality of Life Questionnaire-Cancer 30 (EORTC QLQ-C30) researchers noted higher fatigue scores ($p < 0.05$) among women with breast cancer and diabetes than in the breast cancer only counterparts (Tang et al., 2016). Fatigue is a multi-dimensional symptom experienced by both women with breast cancer and people diagnosed with diabetes. Similar factors were identified among women with breast cancer and diabetes to contribute to fatigue and include poor physical function, poor sleep, cognitive dysfunction, anxiety and depression as factors contributing to fatigue (Singh et al., 2016; Park, Park, Quinn, & Fritschi, 2015; Otte et al., 2010; Champion et al., 2014). In addition, it is possible that the physiological demands of cancer, cancer treatment, and diabetes deplete the body's necessary energy production to worsen fatigue.

We found that age was inversely associated with fatigue ($p < .001$), meaning that younger women with breast cancer reported more fatigue than older women with breast cancer. This finding is congruous with the primary study that found younger women with breast cancer reported more fatigue than the older age group (Champion et al., 2014). This finding was also noted by researchers who studied 202 women with breast cancer (stage III) 2–5 years post cancer therapy and found that younger women with breast cancer reported higher levels of fatigue than older women with breast cancer (Kluthcovsky et al., 2012). Education was inversely related to fatigue, similar to other studies ($p = .037$). Lastly, in our study, being overweight ($p = .041$) and obese ($p < .001$) compared to normal weight 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, 2018). Similarly, in a study of primarily urban African American women, those with higher BMI ($> 30\text{kg/m}^2$) reported more severe fatigue than women with 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.

Implications for Nursing

This 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 imperative that oncology nurses educate themselves and these about the common link between diabetes and breast cancer and the potential nefarious impacts these co-existing conditions can have on symptoms over the cancer trajectory. Oncology nurses are in a key position to 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 those 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 throughout the survivorship trajectory are important to determine the unique impact of diabetes.

Strengths and Limitations

Our study was the first to assess the impact of diabetes among women with breast cancer on eight symptoms commonly experienced independently by BCS and people with diabetes. The strengths of the study include a robust sample size and the similarity in disease staging and treatment for breast cancer. This study relied on the self-report of diabetes, thereby limiting the ability to ascertain if women reporting the diagnosis were diagnosed with Type 1 or Type 2 diabetes. Different pathologies are associated with the types of diabetes and they may influence the type and severity of symptoms experienced. It is possible the diabetes status of the women with breast cancer was under reported as estimates indicate that 7.2 million Americans do not know they have the condition (CDC, 2017). Additionally, due to the retrospective study design, we were unable to assess if blood glucose levels influenced the type and severity of symptoms reported. It is possible that some of the women may not have known their diabetes status and the number could have been higher. Lastly, the subjects in the study lacked diversity in race and findings cannot be generalized to women with breast cancer with diabetes of other ethnicities. Future prospective studies with larger samples sizes are needed to confirm these findings and 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.

Conclusion

This study reported the effect of diabetes on four prominent symptoms in BCS, 3–8 years post-treatment who were in remission. These findings indicate that women with breast cancer and diabetes are vulnerable to a greater symptom profile over the trajectory of cancer than those without diabetes. Further exploration of the impact of diabetes on the symptoms experienced by women with breast cancer, will inform efforts to develop and implement tailored interventions to mitigate the synergistic effects of having both breast cancer and diabetes on these symptoms.

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Knowledge Translation

- Women living with diabetes are at increased risk for developing breast cancer.
- Women with breast cancer and diabetes report poorer physical function, attention function, more sleep disturbance, and fatigue than women with breast cancer without diabetes.
- Diabetes is a risk factor for increased symptoms. Oncology nurses should be knowledgeable about the symptoms experienced by women with breast cancer and how these may be impacted by diabetes in order to educate them on the importance of self-management strategies to mitigate these symptoms at baseline and throughout survivorship.

Table 1.**Breast Cancer Survivor Characteristics by Diabetes Status**

Covariates	All (<i>n</i> = 1127)	Diabetes (<i>n</i> = 121)	No Diabetes (<i>n</i> = 1006)	<i>t</i>	Independent <i>t</i> -test
<i>p</i> -value			Mean (SD)		
Age	57 (11.6)	62 (9.8)	57 (11.6)	-6.02	< .001
Body Mass Index	28.2 (6.2)	32.1 (6.2)	27.7 (5.8)	-7.70	< .001
<i>n</i> (%)					
Race				.263 *	.792
Caucasian		110 (90.9)	931 (92.5)		
Black or African American		8 (6.6)	35 (3.5)		
Asian		0 (0)	10 (1.0)		
American Indian/Alaskan Native		0 (0)	1 (.1)		
More than one race		3 (2.5)	29 (2.9)		
Stage of breast cancer					
I		21 (8.6)	223 (91)	.608 *	
II		82 (11.2)	647 (89)		
III		14 (11)	113 (89)		
Education (years)	14.4 (2.67)	14.06 (2.53)	14.50 (2.68)	1.699	.090
Income				4.306	< .001
< 75, 000		87 (71.9)	564 (56.1)		
75,000		29 (24)	409 (40.7)		
Marital Status					
Married	836 (74.2)	74 (61.2)	762(75.7)	3.480	.001
Other	273(24.2)	45 (37.1)	228 (22.8)		
Missing	18(1.6)	2 (1.7)	16 (1.6)		

* Chi-square

Table 2

Breast Cancer Survivor Symptom Severity by Diabetes Status

Outcome Variables	All <i>n</i> = 1127	Diabetes <i>n</i> = 121	No Diabetes <i>n</i> = 1006		
		Mean (SD) [Range]		t	p-value
Depression	9.78 (9.03)	10.5 (9.07) [0–60]	9.68 (8.70) [0–60]	−1.017	.309
Anxiety	34.31 (9.94)	34.44 (10.38) [0–80]	34.30 (9.90) [0–80]	−.147	.883
Sexual function	19.84 (5.58)	19.97 (4.78)	19.83 (5.66)	−.204	.839
Peripheral neuropathy	3.37 (2.26)	3.21 (2.24)	3.39 (2.26)	.687	.492
Physical function (PF mean) score	2.57 (.430)	2.26 (.456), [0–10]	2.60 (.414), [0–10]	7.815	< .001
Attention function index score	6.86 (1.79)	6.45 (1.81), [2.19–10.0]	6.91 (1.78), [1.56–10.0]	2.672	.008
Pittsburgh Sleep Quality (PSQI) Global sleep score	6.42 (3.73)	7.20 (3.96), [1–20]	6.33 (3.69), [1–20]	−2.355	.019
Fatigue score-FACT-F	40.1 (10.1)	37.81 (10.9), [4–52]	40.25 (10.0), [6–52]	2.499	.013

Table 3.**Regression Analysis of Breast Cancer Survivor Symptoms**

Physical Function, F=33.08, DF (7, 1076), R²=.178, p=<.001				
Variable	SE Beta	Standard Beta	t	p-value
Diabetes	.040	-.149	-5.182	< .001
Age	.001	-.163	-5.574	< .001
Education	.005	.107	3.628	< .001
Income	.027	.171	5.476	<.001
Marital status	.029	-.001	-.038	.970
BMI Overweight	.030	-.036	-1.211	.226
BMI Obese	.030	-.148	-4.869	< .001
Attention Function F=13.25, DF (7, 1076), R²=.074 p=<.001				
Variable	SE Beta	Standard Beta	t	p-value
Diabetes	.177	-.091	-2.999	.003
Age	.005	.238	7.675	<.001
Education	.021	.120	3.839	<.001
Income	.120	.094	2.851	.004
Marital status	.128	.019	.602	.547
BMI Overweight	.132	-.071	-2.264	.024
BMI Obese	.132	-.065	-2.024	.043
Sleep F=6.704, DF (7, 1033), R²=.037, p=<.001				
Variable	SE Beta	Standard Beta	t	p-value
Diabetes	.386	.071	2.229	.026
Age	.010	-.145	-4.511	<.001
Education	.045	-.098	-3.009	.003
Income	.258	-.095	-2.768	.006
Marital status	.279	-.016	-.501	.616
BMI Overweight	.283	.041	1.271	.204
BMI Obese	.285	.053	1.587	.113
Fatigue F = 10.85, DF (7, 1074), R² = .060, p = <.001				
Variable	SE Beta	Standard Beta	t	p-value
Diabetes	1.011	-.066	-2.137	.033
Age	.027	.184	5.896	<.001
Education	.120	.06	2.040	.042
Income	.687	.130	3.900	<.001
Marital status	.732	-.017	-.535	.593
BMI Overweight	.752	-.064	-2.032	.042
BMI Obese	.754	-.132	-4.059	<.001