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The Role of Spirituality on Physical Activity and Sleep Among African American Long-Term Breast Cancer Survivors

Ally Goerge[1] · Maureen Sanderson[2] · Cristen Flewellen[2] · Katherine Busen[1] · Sarah Nechuta[1]

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Abstract

Background African Americans with chronic conditions have reported the importance of spirituality in their lives. Aspects of spirituality have been shown to be related to physical activity (PA) and sleep, and PA and sleep affect quality of life (QOL). This study examined the association between spirituality, PA, and sleep in long-term African American breast cancer survivors.

Methods This cross-sectional study included 323 breast cancer survivors who previously participated in a case-only study. During 2015–2016, participants completed a questionnaire focused on survivorship that used validated measures for spirituality, PA, and sleep. Adjusted binary and multinomial logistic regression models estimated odds ratios (aORs) and 95% confidence intervals (CIs) for the associations of spirituality with total PA, meeting PA guidelines, sleep duration, and sleep medication.

Results The mean age at diagnosis was 54.8 (SD = 9.89) years. The range of spirituality scores was 7–48 (median = 44). Among participants who had a score ≥ 44, 59% had high total PA, 61% met PA guidelines, 59% had high sleep duration, and 55% did not use sleep medication. Higher spirituality score was associated with higher total PA (aOR for ≥ 681 min/week: 1.90, 95% CI: 1.03–3.50), meeting PA guidelines (aOR: 1.78, 95% CI: 1.06–2.98), sleep duration ≥ 7 h/night (aOR: 1.72, 95% CI 1.05–2.83), and lack of sleep medication use (aOR: 0.45, 95% CI: 0.24–0.84).

Conclusion In African American long-term breast cancer survivors, a higher spirituality score increased the likelihood of greater PA and high sleep duration. These results indicate that interventions surrounding spirituality may benefit the QOL of African American breast cancer survivors.

Keywords Breast cancer · Cancer survivorship · Minority health · Spirituality · African American · Sleep quality · Physical activity

Abbreviations

SF-36	36-item short form survey
AABL	African American Breast Cancer Long-Term Survivorship Study
BMI	Body mass index
FACIT-Sp-12	Functional Assessment of Chronic Illness Therapy Spiritual Well-Being 12
HR-QOL	Health-related quality of life
PA	Physical activity
PSQI	Pittsburg Sleep Quality Index
QOL	Quality of life

Background

In the USA, in January of 2022, there were over 4 million women who previously had invasive breast cancer, and one-third of women who have survived breast cancer are under the age of 65 years [1, 2]. The incidence of breast cancer increases in the USA each year, but the mortality rate has been decreasing for several years [3]. Thus, there are more breast cancer survivors each year, and the health and quality of life (QOL) of breast cancer survivors is important to study. While cancer death rates are decreasing in the USA overall, racial/ethnic disparities in cancer detection, care, and mortality remain an issue [4–7]. Aggressive breast cancer disproportionately affects the African American

✉ Sarah Nechuta
nechutas@gvsu.edu

[1] College of Health Professions, School of Interdisciplinary Health, Grand Valley State University, 500 Lafayette Street, Grand Rapids, MI 49503, USA

[2] Meharry Medical College, School of Medicine, 1005 Dr. DB Todd Jr. Blvd, Nashville, TN 37208, USA

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community, and African American women have lower survival rates than other ethnicities [5, 7, 8]. According to the most recent American Cancer Society report on breast cancer, the lowest 5-year survival rate for breast cancer among all racial/ethnic groups is among African American women (83%) compared to 92% in White women [1]. This survival disparity persists across all stages of breast cancer. For example, 5-year survival for regional breast cancer is 78% for African American women and 85% or higher for other racial/ethnic groups [1]. Treatments such as surgery, chemotherapy, radiotherapy, and hormonal therapy are used to treat breast cancer and improve survival but also can result in short- and long-term morbidity and reduced QOL due to their side effects [2, 9].

In general, spiritual practices are important within the African American community and can be a means of coping for those with chronic diseases [10–12]. A systematic review of eighteen studies by Schreiber et al. (2012) highlighted several implications of spirituality and psychological well-being, including that the spirituality of women with breast cancer may impact their well-being [13]. Furthermore, self-reported physical health status has been associated with spirituality in breast cancer survivors [10]. Several qualitative studies and small quantitative studies (sample size < 100) have examined spirituality in African American breast cancer survivors [12, 14–17]. In an analysis of African American and White breast cancer survivors by Hurtado-de-Mendoza et al. (2022) [16], 87.3% of the African American women in the study had high spirituality. A study by Bai et al. (2018) showed an association between spirituality and social, emotional, and functional well-being and overall QOL in African American cancer patients receiving pain treatment [12].

Physical activity (PA) is known to increase QOL [18, 19]. We have previously shown in the African American Breast Cancer Long-term Survivorship (AABL) Study that only 40% of African American women met physical activity (PA) guidelines of at least 150 min of moderate PA per week [20]. Therefore, it is important to examine factors that could increase PA participation, such as spirituality. To date, the literature is very limited in this area with only one previous study identified among breast cancer survivors [21] and no studies focusing on African American women.

Sleep disturbance is a commonly reported symptom of African American breast cancer survivors [15, 22]. Among breast cancer survivors, sleep quality has been related to health-related QOL (HR-QOL) [23], and sleep efficiency was associated with longer survival [24]. Breast cancer can cause intrusive thoughts that lead to disrupted sleep in some patients [25]. Researchers have shown that cancer patients' sleep may be improved through mindfulness-based stress reduction including spiritual meditation [26, 27]. A study by Khoramirad et al. (2015) investigated the spiritualty and sleep quality of 80 women with breast cancer who were Muslim [28]. Using the Pittsburg Sleep Quality Index (PSQI), they found no association between the Global PSQI score and religious score, but there were associations between religious score and sleep latency and sleep medications [28]. To our knowledge, no studies have examined the association between spirituality and sleep quality including duration and medication use among African American breast cancer survivors.

While survival from breast cancer has increased, cancer-related lymphedema often results from treatment, and one in five breast cancer patients has lymphedema related to their cancer [29, 30]. Lymphedema can have an impact on breast cancer survivors' QOL, including sleep quality [31]. A study by Gonzalez et al. (2021) showed that lymphedema was a statistically significant risk factor for sleep disturbance in African American breast cancer survivors at 24 months post-diagnosis [22]. Additionally, a review by Shaitelman et al. (2015) reported that women with lymphedema had a higher risk of having difficulty sleeping [31]. PA can also be impacted by lymphedema. Lymphedema can result in pain, reduced mobility, and psychological barriers to PA, which can lead to reduced PA participation [32–34].

Past research has demonstrated the importance of spirituality in African American breast cancer survivors' lives. We aimed to determine if spirituality could have a positive impact on QOL by examining associations with PA and sleep among African American long-term breast cancer survivors. First, we investigated the association of spirituality and PA. Second, we investigated the association of spirituality and sleep quality (measured as sleep duration and sleep medication use). As a secondary aim, we investigated if arm lymphedema was an effect modifier of the above associations. To our knowledge, this is the first study of spirituality in association with PA and sleep quality among long-term African American breast cancer survivors.

Methods

Study Design and Study Population

Data for this project was used from the AABL survivorship study, which was conducted during 2015–2016. This included 323 African American long-term breast cancer survivors from Tennessee, Georgia, and South Carolina, with a mean age of 59.1 years and median time since diagnosis of 4.2 years. The participants were previously part of a breast cancer case-only study not focused on survivorship and noted interested in participating in future research [35].

Study design and recruitment details of the AABL study have been previously described [20]. Briefly, the participants were recruited through mailed consent forms and packets of information about the study. They received emails and

phone calls within 7 days to follow up. Data was collected in Research Electronic Data Capture (REDcap) from online or phone-based questionnaires. All phone-based interviews were conducted by the same person. Questionnaires asked about medical comorbidities, cancer status, medications, cancer treatments, PA, and lifestyle factors. The questionnaire was created based on a review of the literature and prior research and was used in pilot qualitative small-group and individual testing with breast cancer survivors for feedback. Clinical data were used from the case-only study and cancer registries. The current study was an observational epidemiologic cross-sectional study using de-identified AABL data. The Grand Valley State University Institutional Review Board approved this secondary data analysis.

Spirituality

The predictor of interest was spirituality, measured using the Functional Assessment of Chronic Illness Therapy Spiritual Well-Being 12 (FACIT-Sp-12) (Supplemental Content, Figure S1) [36], which has been used previously among African American cancer survivors, including breast cancer survivors [12, 37]. Twelve questions surround three themes: meaning, peace, and faith. The scores in each section (meaning, peace, and faith) were summed, multiplied by four, and divided by how many were answered to produce subscale scores for each section [36]. To produce an overall FACIT-Sp12 score, the three subscale scores were summed [36]. These scores were then dichotomized based on the median (< 44, ≥ 44). The scores were analyzed both as a dichotomous variable and continuous variable. Higher scores indicate better spiritual well-being.

Physical Activity

To measure PA in all participants, a modified version of the Arizona Activity Frequency Questionnaire was used, which is validated [38]. This questionnaire was modified post-pilot testing in the AABL study to be used with African American women. The variables used to measure PA were total PA in minutes per week, including recreational (exercise), household, and transportation PA, categorized based on tertiles (<340.8, 340.8 to >681, ≥681 min/week), and meeting PA guidelines. Meeting PA guidelines was based on the US Department of Health and Human Services' physical activity guidelines for Americans, which is ≥ 150 min/week (yes/no) of recreational PA (exercise) [39].

Sleep

The AABL study initially collected sleep quality data using questions from the Southern Community Cohort Study [40] on number of hours slept in a 24-h period on weekdays and weekends for the first 207 study participants. Sleep medication use was also collected. The PSQI, a validated questionnaire [41], was implemented later in the study, and sleep duration and medication use were available from the PSQI for 119 participants. To enable combination of data on sleep duration between the two questionnaires, information on hours napped was also collected for women who completed the PSQI. Data on sleep duration from the two questionnaires were combined (detailed approach provided in Supplement Figure S2) to create a final standardized sleep variable as sleep duration in hours per 24-h period during the week, which was made into a binary variable of < 7 h and ≥ 7 h, based on the National Institute of Health's recommendations for sleep for adults [42]. There were 208 participants that answered a question in the AABL questionnaire on sleep medication, and 118 answered a question on sleep medication using the PSQI. These variables were combined to form a binary variable (yes/no) for sleep medication use (Supplemental Figure S2).

Lymphedema and Covariates

Breast cancer-related arm lymphedema (ever) was investigated as a possible effect modifier. This was available from the AABL questionnaire, measured using questions from previous studies [43, 44]. Sociodemographic characteristics included age at diagnosis, education, employment status, income, and insurance. Age at diagnosis was used from the case-only study. Insurance (Medicare alone or in combination with other insurance, Medicaid only, and other insurance), education (high school graduate or less, trade school/vocational school/ some college including 2-year degrees, and a bachelor's degree or higher), and annual household income (< $24,999, $25,000–$49,999, $50,000–$99,999, and $100,000 and over) were also used from the case-only study. Employment status in the last 12 months (yes/no) was from the AABL questionnaire. Covariates from the AABL questionnaire included breast cancer surgery type (lumpectomy, mastectomy, or none), chemotherapy (yes/no), and radiotherapy (yes/no). Adjuvant hormonal therapy included aromatase inhibitors (Arimidex, Femara, and Aromasin (yes/no)) and selective estrogen receptor modulators (Evista and Tamoxifen (yes/no)). Tumor characteristics were from cancer registries and included estrogen receptor-positive status, progesterone receptor-positive status, and human epidermal growth factor receptor-2 positive status (yes/no). Post-diagnosis body mass index (BMI) was measured from height that was self-reported in the original case-only study and weight from the AABL questionnaire. Cancer stage was from state cancer registries classified according to the American Joint Cancer Committee stages 0, I, II, III, and IV. Stage III and IV were combined into one category due to small sample sizes.

Statistical Analysis

Frequencies and percentages were used for categorical variables, and means, standard deviations (SD), medians, and interquartile ranges (IQR) were used for continuous variables overall and by total PA in tertiles, PA guidelines, sleep duration, and sleep medication. Pearson chi-square tests were used for binary categorical variables, and Mantel Haenszel chi-square tests were used for PA categorized in tertiles. Multinomial logistic regression was used to estimate odds ratios (ORs) and 95% confidence intervals (CIs) for an association between spirituality (total scores and meaning, peace, and faith subscale scores) and all PA (reference: tertile 1). Binary logistic regression was used to estimate ORs and 95% CIs for an association between spirituality (total scores and meaning, peace, and faith subscale scores) and PA guidelines (reference: not meeting guidelines), sleep duration (reference: < 7 h), and sleep medication (reference: no sleep medication). The logistic regression models were first unadjusted and then adjusted for age and these potential confounders identified from literature review [21, 28]: surgery type, education, income, stage, chemotherapy, and radiotherapy. Missing data ($n = 19$) were excluded from adjusted logistic regression models. For all models, spirituality was shown as both a continuous score and a binary variable (< 44, ≥ 44). SAS version 9.4 was used for all analyses. *P*-values < 0.05 and 95% CIs that did not contain 1.0 were considered statistically significant. To examine lymphedema as a potential effect modifier, the adjusted total spirituality models for meeting PA guidelines, sleep duration, and sleep medication were stratified by arm lymphedema (yes, no) since breast cancer diagnosis. We were interested in whether the associations (ORs and 95% CIs) differed for women with and without arm lymphedema, which could impact the clinical and public health significance of our overall results. Therefore, we did not test for the statistical significance of lymphedema as an effect modifier.

Results

Table S1 (Supplemental Content) displays the overall demographic information and lifestyle factors of the study sample. The mean age at diagnosis was 54.8 years (SD = 9.89). The range of spirituality scores was 7–48 (mean = 40.9 (SD = 8.0), median = 44 (IQR = 10)). Over half of women reported sleep duration < 7 h per night and about 22% reported use of sleep medication. Most participants had education post-high school (36.3% some education after high school, 35.7% bachelor's degree or higher). About half of participants were unemployed in the last year (53.3%), had an income of less than $24,999 (40.8%), and had insurance other than Medicaid or Medicare (53.1%). Over 58% of the sample had a lumpectomy, 57% had chemotherapy, 66.8% had radiotherapy, and 31.9% had lymphedema at some point after breast cancer diagnosis. A majority of the sample had estrogen receptor-positive breast cancer (69.4%), and about 32% reported arm lymphedema since breast cancer diagnosis.

Table S2 (Supplemental Content) displays demographic information and lifestyle factors by PA. For total PA, 58.5% of those in tertile 1 (< 340.75 min/week) had a spirituality score under 44, while 59.1% of those in tertile 3 (≥ 681 min/week) had a score of 44 or higher (*P*-value = 0.01). Over 55% of those who did not meet PA guidelines had a spirituality score under 44, while 60.9% of those who met PA guidelines had a score of 44 or higher (*P*-value = 0.004). A higher percentage of participants with arm lymphedema were in the lowest PA tertile (36.8%) compared to those in highest tertile (27.3%).

Table 1 displays demographic information and lifestyle factors by sleep duration and medication. Close to 56% of those who slept under 7 h had a spirituality score under 44, while 58.6% of those who slept 7 or more hours has a score of 44 or more (*P*-value = 0.01). Of those who have taken sleep medication, 64.3% had a spirituality score of less than 44 (*P*-value = 0.004). A greater percentage of those who had Medicare had 7 or more hours of sleep (40.1%) compared to those who had less than 7 h of sleep (29.3%). Among those who had 7 h of sleep or more, a higher percentage had lumpectomy (64.5%) compared to mastectomy (31.6%). A higher percentage of participants with arm lymphedema had taken sleep medication (41.4%) compared to those who had not (29.3%).

Table 2 shows the association between spirituality and total PA (minutes per week) in tertiles. A higher spirituality score was associated with tertile 3 (≥ 681 min/week) for total PA both when spirituality was a binary variable (aOR: 1.90, 95% CI 1.03–3.50) and as a continuous score (aOR: 1.04, 95% CI 1.00–1.08). Table 3 displays the association between spirituality and meeting PA guidelines. A higher spirituality score was associated with meeting PA guidelines both when spirituality was a binary variable (aOR:1.78, 95% CI 1.06–2.98) and as a continuous score (aOR: 1.03, 95% CI 1.00–1.07).

Table 4 shows the association between spirituality and weekday sleep duration. A higher spirituality score was associated with sleep duration of ≥ 7 h per 24-h period both when spirituality was a binary variable (aOR: 1.72, 95% CI 1.05–2.83) and as a continuous score (aOR: 1.06, 95% CI 1.02–1.10). The adjusted models were run with weekend sleep duration as well as a sensitivity analysis. The results were very similar, except for the lack of statistical significance when spirituality was a binary variable (data not shown). Table 4 also displays the association between spirituality and sleep medication. A higher spirituality score was inversely associated

Table 1 Characteristics of AABL study participants by sleep duration and medication ($n = 323$)

	Sleep duration *n* (%)				Sleep medication *n* (%)			
	< 7 h		≥ 7 h		No		Yes	
FACIT-Sp-12 score								
< 44	92	(55.8)	65	(41.4)	113	(44.7)	45	(64.3)
≥ 44	73	(44.2)	92	(58.6)**	140	(55.3)	25	(35.7)*
Education								
≤ High school	46	(27.9)	43	(27.6)	68	(26.9)	22	(31.9)
Some education after high school	59	(35.8)	58	(37.2)	91	(36.0)	26	(37.7)
≥ Bachelor's degree	60	(36.4)	55	(35.3)	94	(37.2)	21	(30.4)
Missing			*1*				*1*	
Employment status								
Not employed	85	(51.5)	86	(54.8)	137	(54.2)	35	(50.0)
Employed	80	(48.5)	71	(45.2)	116	(45.9)	35	(50.0)
Income								
< $24,999	70	(42.4)	58	(38.7)	101	(40.6)	28	(41.8)
$25,000–$49,999	35	(21.2)	38	(25.3)	55	(22.1)	18	(26.9)
$50,000–$99,999	38	(23.0)	42	(28.0)	66	(26.5)	14	(20.9)
≥ $100,000	22	(13.3)	12	(8.0)	27	(10.8)	7	(10.5)
Missing			*7*		*4*		*3*	
Insurance								
Medicare	48	(29.3)	63	(40.1)	91	(36.0)	21	(30.4)
Medicaid	27	(16.5)	12	(7.6)	28	(11.1)	11	(15.9)
Other	89	(54.3)	82	(52.2)*	134	(53.0)	37	(53.6)
Missing	*1*						*1*	
BMI (kg/m^2)								
< 25.0	21	(12.9)	19	(12.1)	31	(12.4)	9	(12.9)
25.0 to < 30.0	48	(29.5)	47	(29.9)	77	(30.7)	18	(25.7)
≥ 30.0	94	(57.7)	91	(58.0)	143	(57.0)	43	(61.4)
Missing	*2*				*2*			
Surgery type								
Lumpectomy	79	(48.5)	100	(64.5)	142	(57.0)	37	(52.9)
Mastectomy	75	(46.0)	49	(31.6)	94	(37.8)	31	(44.3)
None	9	(5.5)	6	(3.9)*	13	(5.2)	2	(2.9)
Missing	*2*		*2*		*4*			
Chemotherapy								
No	65	(39.4)	74	(47.1)	109	(43.1)	30	(42.9)
Yes	100	(60.6)	83	(52.9)	144	(56.9)	40	(57.1)
Radiotherapy								
No	66	(40.2)	41	(26.1)	81	(32.1)	26	(37.1)
Yes	98	(59.8)	116	(73.9)	171	(67.9)	44	(62.9)
Missing	*1*				*1*			
AI								
No	108	(65.5)	91	(58.7)	153	(61.0)	47	(67.1)
Yes	57	(34.6)	64	(41.3)	98	(39.0)	23	(32.9)
Missing			*2*		*2*			
SERM								
No	104	(63.0)	110	(71.0)	171	(68.1)	44	(62.9)
Yes	61	(37.0)	45	(29.0)	80	(31.9)	26	(37.1)
Missing			*2*		*2*			
Estrogen receptor status								
No	114	(71.3)	102	(68.0)	167	(69.0)	49	(71.0)

Table 1 (continued)

	Sleep duration *n* (%)				Sleep medication *n* (%)			
	< 7 h		≥ 7 h		No		Yes	
Yes	46	(28.8)	48	(32.0)	75	(31.0)	20	(29.0)
Missing	*5*		*7*		*11*		*1*	
Progesterone receptor status								
No	90	(56.3)	94	(62.7)	144	(59.5)	40	(58.0)
Yes	70	(43.8)	56	(37.3)	98	(40.5)	29	(42.0)
Missing	*5*		*7*		*11*		*1*	
AJCC stage, *n* (%)								
0	23	(14.0)	19	(12.4)	32	(12.9)	10	(14.3)
I	61	(37.2)	61	(39.9)	94	(37.9)	28	(40.0)
II	62	(37.8)	51	(33.3)	86	(34.7)	27	(38.6)
III/IV	18	(11.0)	22	(14.4)	36	(14.5)	5	(7.1)
Missing	*1*		*4*		*5*			
Arm lymphedema, *n* (%)								
No	112	(67.9)	108	(68.8)	179	(70.8)	41	(58.6)
Yes	53	(32.1)	49	(31.2)	74	(29.3)	29	(41.4)

BMI body mass index, *AI* aromatase inhibitor, *SERM* selective estrogen receptor modulator, *FACIT-Sp-12* Functional Assessment of Chronic Illness Therapy Spiritual Well-Being 12, *AJCC* American Joint Committee on Cancer, *AABL* African American Long Term Survivorship Study

*P-value < 0.05

**P-value ≤ 0.01

Table 2 Odds ratios and 95% CIs for spirituality and total physical activity in the AABL study ($n = 323$)

	Total physical activity (min/week)							
	Unadjusted				Adjusted[b]			
	T2		T3		T2		T3	
	340.75 to >681		≥681		340.75 to >681		≥681	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Total score[a]	1.04	1.00–1.07	1.05	1.02–1.09	1.02	0.99–1.06	1.04	1.00–1.08
	Total physical activity (min/week)							
	Unadjusted				Adjusted[b]			
	T2		T3		T2		T3	
	340.75 to >681		≥681		340.75 to >681		≥681	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Total score								
Score < 44	1.00	Reference	1.00	Reference	1.00	Reference	1.00	Reference
Score ≥ 44	1.55	0.90–2.66	2.04	1.18–3.50	1.38	0.76–2.52	1.90	1.03–3.50

[a]Spirituality as a continuous variable (FACIT-Sp-12 score)

[b]Adjusted for age at diagnosis, cancer surgery, chemotherapy, radiotherapy, stage, income, and education. Adjusted models exclude participants missing covariates ($n = 19$ missing)

with sleep medication use both when spirituality was a binary variable (aOR: 0.45, 95% CI 0.24–0.84) and as a continuous score (aOR: 0.96, 95% CI 0.92–0.99). All ORs for spirituality and sleep duration and sleep mediation were statistically significant. Figure 1 summarizes findings for spirituality and all outcomes from final adjusted models.

Arm lymphedema was not found to modify the association between total spirituality score and meeting PA guidelines, sleep duration, or sleep medication. Briefly, focusing on results for spirituality as a continuous score, similar associations occurred for women meeting and not meeting PA guidelines (never lymphedema: aOR: 95%

Table 3 Odds ratios and 95% CIs for spirituality and meeting physical activity guidelines in the AABL study ($n = 323$)

	Meeting physical activity guidelines[a]			
	Unadjusted		Adjusted[c]	
	OR	95% CI	OR	95% CI
Total score[b]	1.04	1.01–1.08	1.03	1.00–1.07
	Meeting physical activity guidelines			
	Unadjusted		Adjusted[c]	
	OR	95% CI	OR	95% CI
Total score				
Score < 44	1.00	Reference	1.00	Reference
Score ≥ 44	1.94	1.23–3.05	1.78	1.06–2.98

[a]Physical activity guidelines were defined as ≥150 min/week of recreational physical activity

[b]Spirituality as a continuous variable (FACIT-Sp-12 score)

[c]Adjusted for age at diagnosis, cancer surgery, chemotherapy, radiotherapy, stage, income, and education Adjusted models exclude participants missing covariates ($n = 19$ missing)

Table 4 Odds ratios and 95% CIs for spirituality and sleep duration and medication in the AABL study ($n = 323$)

	Sleep duration ≥ 7 h/night			
	Unadjusted		Adjusted[b]	
	OR	95% CI	OR	95% CI
Total score[a]	1.06	1.03–1.09	1.06	1.02–1.10
	Sleep duration ≥ 7 h/night			
	Unadjusted		Adjusted[b]	
	OR	95% CI	OR	95% CI
Total score				
Score < 44	1.00	Reference	1.00	Reference
Score ≥ 44	1.78	1.15–2.78	1.72	1.05–2.83
	Sleep medication			
	Unadjusted		Adjusted[b]	
	OR	95% CI	OR	95% CI
Total score[a]	0.95	0.92–0.98	0.96	0.92–0.99
	Sleep medication			
	Unadjusted		Adjusted[b]	
	OR	95% CI	OR	95% CI
Total score				
Score < 44	1.00	Reference	1.00	Reference
Score ≥ 44	0.45	0.26–0.78	0.45	0.24–0.84

[a]Spirituality as a continuous variable (FACIT-Sp-12 score)

[b]Adjusted for age at diagnosis, cancer surgery, chemotherapy, radiotherapy, stage, income, and education Adjusted models exclude participants missing covariates ($n = 19$ missing)

CI 1.03, 0.98–1.08; ever lymphedema: aOR: 1.08, 95% CI 0.99–1.17). Similar associations occurred for sleep duration (never lymphedema: aOR 1.08, 1.03–1.13; ever lymphedema: aOR 1.07, 1.00–1.15). Similar associations occurred for sleep medication (never lymphedema: aOR 0.96, 0.91–1.00; ever lymphedema: aOR 0.89, 0.82–0.96). Results were similar for spirituality as a binary score.

Table 5 displays spirituality broken down into the three parts of the total score: meaning, peace, and faith. For PA, the only statistically significant finding was for the faith subscale score, which was associated with tertile 3 for total PA (≥ 681 min/week) (aOR: 1.14, 95% CI 1.01–1.28). For sleep duration, meaning subscale score (aOR: 1.15, 95% CI 1.04–1.27), peace subscale score (aOR: 1.14, 95% CI 1.05–1.23), and faith subscale score (aOR: 1.13, 95% CI 1.03–1.25) all were statistically significantly associated with sleep duration of at least 7 h/night. For sleep medication, peace subscale score (aOR: 0.87, 95% CI 0.80–0.95) and faith subscale score (aOR: 0.91, 95% CI 0.83–0.99) all were statistically significantly associated with lack of sleep medication.

Discussion

In this study of over 300 long-term African American breast cancer survivors, we found that participants with higher spirituality had increased total PA (≥ 681 min/week) and were more likely to meet PA guidelines (≥ 150 min/week of recreational PA). Furthermore, participants with higher spirituality had improved sleep quality, including longer sleep duration (≥ 7 h/night), and reduced use of sleep medication. With increased survivorship of breast cancer, it is important to learn more about factors that can improve health outcomes and QOL in survivors. To our knowledge, spirituality's impact on PA participation and sleep quality in African American long-term breast cancer survivors has not been studied previously.

Past studies have shown that PA is beneficial for breast cancer survivors and improves their QOL [18, 19]. In a study including 96 African American breast cancer survivors, researchers found that PA increased HR-QOL, including physical and mental health [45]. However, this study did not include a measure of spirituality. In our study, we found that spirituality increased participants' likelihood of higher total PA (≥ 681 min/week). Total PA included household PA, recreational PA such as walking for exercise and exercises classes, and transportation PA. Furthermore, meeting weekly PA recommendations of ≥ 150 min/week of exercise was also increased with higher levels of spirituality. When spirituality was broken down into the sub-scores of meaning, peace, and faith, the only statistically significant association for PA was between the faith score and total PA (≥ 681 min/week). This is similar to the results of Park et al. (2018) [21]. In this study, researchers examined spirituality and related factors in association with PA through surveys from 172 breast cancer survivors. Religious identity and private prayer were related to increased PA; however, service

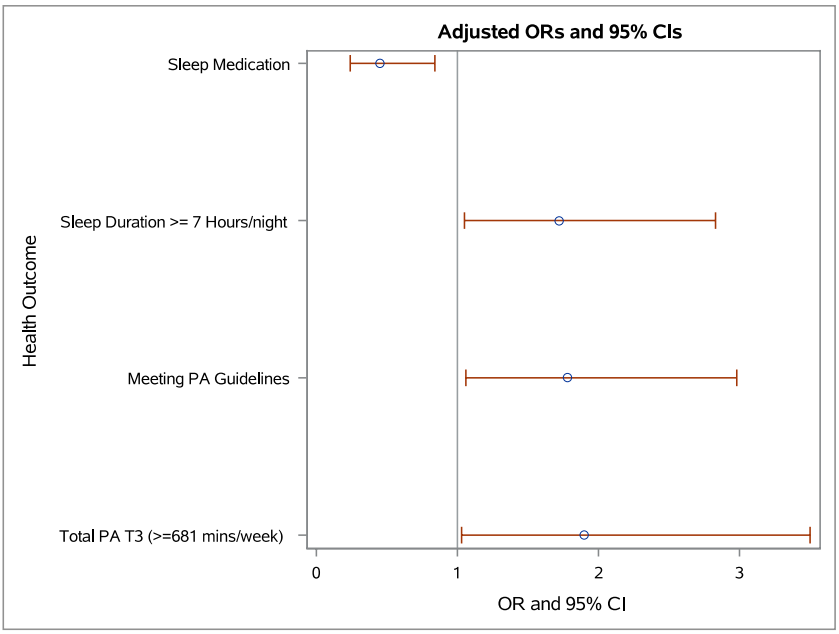

Fig. 1 Adjusted odds ratios and 95% CIs for spirituality and total physical activity, meeting physical activity guidelines, sleep duration, and sleep medication[a]. [a]Meeting physical activity guidelines was defined as ≥ 150 min/week of recreational physical activity. ORs were adjusted for age at diagnosis, cancer surgery, chemotherapy, radiotherapy, stage, income, and education. PA, physical activity; T, tertile

Table 5 Adjusted odds ratios and 95% CIs for spirituality scores, physical activity, and sleep in the AABL study ($n = 323$)

	Total physical activity T3 (≥ 681 min/week)		Meeting physical activity guidelines[a]		Sleep duration ≥ 7 h/night		Sleep medication	
	OR	95% CI	OR	95% CI	OR	95% CI	OR	95% CI
Meaning Score[b]	1.07	0.96–1.19	1.10	0.99–1.22	1.15	1.04–1.27	0.92	0.83–1.01
Peace Score[b]	1.07	0.97–1.17	1.05	0.97–1.14	1.14	1.05–1.23	0.87	0.80–0.95
Faith Score[b]	1.14	1.01–1.28	1.07	0.98–1.18	1.13	1.03–1.25	0.91	0.83–0.99

[a]Physical activity guidelines were defined as ≥ 150 min/week of recreational physical activity

[b]Adjusted for age at diagnosis, cancer surgery, chemotherapy, radiotherapy, stage, income, and education Adjusted models exclude participants missing covariates ($n = 19$ missing). All scores are continuous

attendance was associated with decreased PA [21]. Our findings of the importance of faith in African American breast cancer survivors are supported by previous research [17, 46–48]. Faith is an important coping mechanism for African American breast cancer survivors [49, 50]. Furthermore, our findings that faith had the largest impact on PA participation among African American women should be considered in future work to develop relevant interventions and targeted resources to promote spiritual well-being among African American breast cancer survivors [51, 52].

Regarding sleep, our findings showed that spirituality increased the participants' likelihood of higher sleep duration (≥ 7 h) and lack of sleep medication use. Past studies have shown that sleep can impact QOL and survival in African American breast cancer survivors [23, 24]. One study showed associations between religious score, sleep latency, and sleep medications in a sample of Muslims with breast cancer [28]. While this was not a sample made up of African American breast cancer survivors, our results were similar. In our study, when broken down further into subscale scores, meaning, peace, and faith increased the likelihood of higher sleep duration (≥ 7 h), and peace and faith increased the likelihood of lack of sleep medication use. More studies are needed with larger sample sizes to learn more about spirituality's impact; however, our results suggest the potential importance of the role of spirituality in sleep quality among African American breast cancer survivors, which could improve overall QOL.

Breast cancer-related lymphedema is a common consequence of cancer treatment, which has been shown to impact QOL, sleep, and mobility among breast cancer survivors [22, 31–34]. We therefore examined if findings for the association of spirituality with PA and sleep quality were modified by the presence of self-reported arm lymphedema. Associations were similar among women who ever had arm lymphedema since their breast cancer diagnosis and those who had not reported arm lymphedema since breast cancer diagnosis. Overall, our study results do not support

lymphedema as an effect modifier of the association of spirituality with PA and sleep duration and mediation use. However, our study sample size was small for stratified analyses, and future studies with a larger sample size are warranted.

Strengths of this study include using the total spirituality score in two different ways in the analysis. The continuous score optimized the small sample size, while the score as a binary variable provided important context to the association. Additionally, both PA (total and meeting requirements) and sleep (duration and medication) were analyzed in multiple ways. We also conducted a sensitivity analysis to examine if sleep duration on the weekend (rather than weekday) impacted findings, but results were similar. A key limitation was the small sample size; only 319 participants were included in the adjusted logistic regression models. However, our study is larger than most studies focusing on African American breast cancer survivors. All variables were based on self-report and therefore could be impacted by information bias due to participants claiming to be more spiritual, be more physically active, or sleep longer than is accurate. Furthermore, residual confounding due to unmeasured confounders is a concern in this observational research study. The FACIT-Sp12 spirituality questionnaire provided data on spirituality on one time point on average 4.2 years after cancer diagnosis in this cross-sectional study. We could not evaluate if spirituality changed over time or if spirituality was only associated with PA and sleep in those who had previously been spiritual before cancer diagnosis. Future longitudinal studies of the association of spirituality and the outcomes examined in this study are needed. Finally, this study was cross-sectional, and the results should not be interpreted as causal.

Among African American cancer survivors, spirituality is important [10, 11, 16], and our results show that spirituality could potentially be targeted in African American breast cancer survivors to improve PA and sleep, which affect QOL [19, 23]. The FACIT-Sp12 spirituality score includes more than just faith and religion; it includes meaning, peace, purpose, and productivity (Supplemental Content, Figure S1). This highlights the potential for interventions to enhance meaning, peace, and faith in breast cancer survivors' lives and therefore increase the likelihood of PA and sleep duration which can improve QOL. Voiss et al. (2019) and Park et al. (2020) describe potential interventions for breast cancer patients and survivors, such as mindfulness-based cognitive therapy and mind-body medicine [26, 27]. Our results for PA highlight the importance of faith among African American breast cancer survivors, supporting the need for faith-based programs and educational resources in collaboration with faith-based organizations in local communities [53]. A recent review by Gordon and colleagues found that faith was reported as a coping mechanism in several qualitative studies among African American breast cancer survivors and as providing opportunity for social support [54].

Ashing-Giwa et al. (2013) sought input from African American breast cancer survivors on survivorship care plans, and spirituality was a component mentioned [55]. Survivorship care plans for African American breast cancer survivors should include resources and referrals for care surrounding spirituality [55]. However, access to quality survivorship care across the survivorship continuum is a concern among African American breast cancer survivors who are medically underserved [4, 56]. Importantly, the role of the social determinants of health needs to be comprehensively considered as part of future implications of this work in public health practice and spirituality-based interventions. Social factors and environmental barriers (e.g., lower income, lack of employment, lack of health insurance or inability to afford insurance copays and deductibles, and equitable access to health care and transportation) should be carefully considered in the design of interventions, programs, and support resources to enable long-term improvement in PA, sleep, and QOL among African American breast cancer survivors [4, 54]. While progress has been made in the requirement of survivorship care plans and psychosocial services as part of the Center for Medicare & Medicaid Innovation's Oncology Care Model, more advocacy and education are needed to improve access and care for medically underserved populations [57].

Conclusions

As breast cancer mortality is decreasing, many more women are surviving breast cancer and may encounter adverse outcomes as a result of breast cancer diagnosis and treatment even many years after diagnosis. Thus, it is important to learn what can be done to improve health outcomes among breast cancer survivors. African American women have historically been understudied. As shown in our study, there is potential for spirituality in African American long-term breast cancer survivors to improve QOL by increasing PA and sleep quality. Future research should include a larger sample size and include longitudinal data on spirituality measured at multiple time points both before and after cancer diagnosis, which could provide insight into the role of changes in spirituality in health outcomes among African American breast cancer survivors. Our study supports the critical need to design and implement sustainable spirituality-based interventions grounded in community engaged research that address social and environmental barriers to improve QOL among long-term African American breast cancer survivors.

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Author Contributions Sarah Nechuta and Maureen Sanderson conceived and designed the AABL Survivorship Study. Sarah Nechuta and Ally Goerge conceived the research question and analysis design for this secondary data analysis with AABL Survivorship data. The analysis was performed by Ally Goerge and replicated by Sarah Nechuta. The first draft of the manuscript was written by Ally Goerge. All authors provided comments on the manuscript. All authors read and approved the final manuscript.

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Data Availability The data used for this research study are not available to external researchers at this time.

Code Availability Available upon request.

Declarations

Ethics Approval and Consent to Participate Institutional Review Board (IRB) approval for the AABL study was obtained from Vanderbilt University Medical Center and Meharry Medical College. All study participants provided written informed consent.

Conflict of Interest The authors declare no competing interests.

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