Personality and Spirituality as Predictors of Mental Health and Salivary Alpha-Amylase Activity in Breast Cancer Survivors

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OBJECTIVES: To determine the relative predictive validity of personality and spirituality for mental health and salivary alpha-amylase (sAA) in breast cancer (BC) survivors.

SAMPLE & SETTING: 23 BC survivors participated in a single-group, cross-sectional study.

METHODS & VARIABLES: Predictor variables included personality and spiritual variables. Outcome variables included subjective physical and mental health outcomes and sAA, a neuroimmune biomarker.

RESULTS: Hierarchical regressions indicated that (a) conscientiousness and forgiveness independently predict 38% and 11% of variance in mental health scores, respectively; and (b) conscientiousness and forgiveness independently predict 15% and 24% of the variance in sAA, respectively. Consistent with psychoneuroimmunology theory, personality and spiritual variables independently influence subjective mental health and neuroimmune activity in BC survivors.

IMPLICATIONS FOR NURSING: Nurses should be aware of BC survivors' personality characteristics and spiritual dispositions so that distinct interventions can be offered to promote mental health and reduce stress-related neuroimmune inflammation.

Breast cancer (BC) survivors experience chronic stress and poorer mental and physical health because of ongoing psychosocial and physical symptom burdens associated with BC treatment (Eaton et al., 2020; Harrington et al., 2010). Chronic psychosocial stress in BC survivors is associated with neuroimmune inflammation, BC recurrence, and mortality (Dai et al., 2020; Mundy-Bosse et al., 2011; Witek-Janusek et al., 2007). Data suggest that BC survivors are at a 15% risk of BC recurrence in the first two years after initial diagnosis (Colleoni et al., 2016). As a result, researchers are interested in interventions that reduce stress and buffer the inflammatory neuroimmune changes that are associated with poor BC survivorship (Lengacher et al., 2019; Witek-Janusek et al., 2019).

Stress reduction is associated with better mental health in BC survivors; however, the effect of stress reduction interventions on physiologic health (e.g., neuroimmune inflammation) remains unclear (Carlson et al., 2017; Greenlee et al., 2017). Furthermore, the influence of spiritual factors (e.g., spiritual beliefs) on neuroimmune biomarkers is also unclear (Hulett & Armer, 2016). Understanding personality and spiritual variables may help explain diverse responses to stress among individuals (Soliemanifar et al., 2018).

Psychoneuroimmunology Theory

Psychoneuroimmunology theorists posit that the brain's perception of stress is filtered through behavioral and psychosocial-spiritual variables (e.g., personality, spirituality) and communicated to the immune system via neuroimmune pathways, which results in a state of well-being or disease (Ader & Cohen, 1975; Lutgendorf & Costanzo, 2003). In short, during acute stress, the sympathetic-adrenal-medullary axis

activates the sympathetic nervous system to release norepinephrine, which induces the fight-or-flight response. Following sympathetic nervous system activation, the hypothalamic-pituitary-adrenocortical axis releases endocrine-based hormones, including cortisol, which activate inflammatory protein cellular messengers (i.e., cytokines) (McEwen, 1998). The prolonged cortisol release that occurs with chronic stress is associated with dysregulation of immune cytokines such as interleukin-6, which is linked to greater susceptibility to disease and mortality (Kiecolt-Glaser et al., 2003).

Spirituality and Neuroimmune Activity

Spiritual variables refer to an individual's emotional connection to a divine or higher power (e.g., beliefs in a loving higher power) (Johnstone, Franklin, et al., 2008). Differentiating religious and spiritual constructs is challenging because of overlapping definitions (e.g., searching for the divine). Discussions regarding the distinctions between religious versus spiritual constructs are well described in the extant literature and are beyond the scope of this article.

Spiritual variables (e.g., positive spiritual beliefs) are associated with better perceptions of general health and adjustment to illness in individuals with chronic disease (Campbell et al., 2008; Cohen et al., 2009). Jones et al. (2015) reported that positive spiritual beliefs were associated with better mental health in 199 individuals with heterogeneous health conditions (e.g., cancer, stroke, traumatic brain injury). In addition, Jones et al. (2015) noted that those who held any degree of negative spiritual beliefs (i.e., beliefs in a punishing higher power) reported poorer physical and mental health.

In a feasibility study with 41 breast cancer survivors, on which the current study is based, Hulett et al. (2018, 2021) reported that spiritual variables were associated with neuroimmune activity and self-reported mental and physical health. Specifically, salivary cortisol (i.e., the cortisol awakening response) was moderately and directly associated with positive spiritual experiences (Hulett et al., 2018). Salivary alpha-amylase (sAA) activity was directly associated with spiritual self-rank (i.e., the strength of one's convictions) and inversely associated with forgiveness and mental and physical health (Hulett et al., 2021). Interleukin-6 was inversely associated with spiritual self-rank but directly associated with positive congregational support and mental health measures of social function and vitality (Hulett et al., 2021). These findings suggested that positive spiritual beliefs, positive support from one's religious community, and strength of one's convictions are associated with stronger neuroimmune activity and better mental health outcomes in BC survivors (Hulett et al., 2021).

Personality and Neuroimmune Activity

Personality is described by the Five-Factor model (also called the Big Five model), which features five dimensions: (a) neuroticism, tendency toward worries and negative affect, (b) extraversion, preference for social engagement, (c) openness, receptivity to new experiences, (d) agreeableness, sympathy toward others, and (e) conscientiousness, tendency to be responsible (McCrae & Costa, 2010). Previous data suggest that personality traits are primary predictors of health outcomes and that behavioral patterns and worldviews influence overall health (Vollrath, 2006).

In a systematic review, Soliemanifar et al. (2018) examined 26 studies, reporting mixed findings on the associations between five-factor personality traits and stress biomarkers in heterogeneous samples. The majority (19 studies) examined associations between personality and cortisol (blood, plasma, salivary, urine, or hair), but only two studies examined sAA. Inukai et al. (2010) found that sAA was positively associated with neuroticism and inversely associated with agreeableness, extraversion, and openness in healthy adults. Afrisham et al. (2015) reported that sAA was positively associated with neuroticism and agreeableness in medical students.

Few studies have examined the association between personality and psychoneuroimmunologic variables in BC survivors. In their feasibility study, Hulett et al. (2018) determined that BC survivors were not burdened by the addition of an exploratory aim to evaluate the hypothesis that personality and spirituality are associated with better mental health, physical health, and neuroimmune activity. Therefore, participants who enrolled during the latter half of the rolling recruitment period (n = 23) were invited to complete a personality inventory. This article reports the associations among personality traits, spiritual variables, mental and physical health outcomes, and neuroimmune biomarkers in the sample subset of 23 BC survivors.

Methods
Sample and Setting

The sample (N = 23) is based on a previous feasibility study (single-group, cross-sectional design) (Hulett et al., 2018). The study was approved by the University of Missouri Institutional Research Board

and conducted by the Sinclair School of Nursing in collaboration with Ellis Fischel Cancer Center. Participants provided informed consent. Given the rural, Midwestern demographic, participants were offered a mail-back option for completing self-report measures to minimize travel burden. Salivary specimens were self-collected in participants' home settings. To reduce the risk of confounding influences of treatment-related neuroimmune changes, adult women at least three months post-BC treatment were included in the study. Exclusion criteria included acute illness, steroid medication use, nicotine use, recreational drug misuse, and oral inflammation. Complete details from the parent study are reported in Hulett et al. (2018).

Variables

Self-reported measures included demographics, personality traits, spiritual variables, and mental and physical health outcomes. BC treatment histories were self-reported.

Personality: The NEO Five-Factor Inventory-3 is a 60-item measure of the five domains of personality: neuroticism, extraversion, openness, agreeableness, and conscientiousness (McCrae & Costa, 2010). For the five personality domains, Cronbach's alpha ranges from 0.79 to 0.91 (Johnstone et al., 2012). A higher score for any given personality characteristic indicates a higher level of that characteristic.

Spirituality: Spiritual variables were measured using the Brief Multidimensional Measure of Religiousness and Spirituality (BMMRS) (Fetzer Institute & National Institute on Aging Working Group, 1999). This study used general indices of spirituality identified in a previous factor analysis of the BMMRS, including positive spirituality (i.e., belief in a loving higher power), negative spirituality (i.e., belief in a punishing higher power), and forgiveness (Johnstone, Yoon, et al., 2008). Cronbach's alpha for the BMMRS spirituality subscales ranges from 0.72 to 0.85 (Johnstone et al., 2012). In this study, lower mean scores indicate a higher degree of the given attribute.

Health survey: The Medical Outcomes Short Form–Version 2 Health Survey is a 36-item general physical and mental health measure. Its internal consistency ranges from 0.83 to 0.95 (Ware et al., 2007). Scores were calculated using Quality Metrics scoring software and compared to 2009 general population normative data (Saris-Baglama et al., 2010; Ware et al., 2007). Physical health and mental health composite scores were used as the primary outcome measures, with higher scores equaling better health.

TABLE 1. Sample Characteristics (N = 23)

Characteristic	$\overline{X}$	SD	Range
Age (years)	66	8.1	51–80
Post-treatment for breast cancer (years)	9.2	3.9	4–17

Characteristic	n
Faith preference	
Protestant	15
Catholic	5
None	3
Breast cancer stage	
0	4
I	3
II	8
III	2
Unknown	6
Recurrence of breast cancer	
No	20
Yes	3
Lymphedema	
No	18
Yes	5
History of radiation and chemotherapy	
Yes	15
No	8

sAA: This protein enzyme is released by salivary glands during sympathetic nervous system responses to acute stress and correlates with plasma norepinephrine ($r = 0.64$) (Nater & Rohleder, 2009). SAA is an established biomarker of autonomic nervous system activity in behavioral medicine and stress research (Nater et al., 2013). Reference ranges for sAA in BC survivors have not been established (Hulett et al., 2021). Data suggest that higher levels of sAA and blunted diurnal sAA slopes indicate autonomic nervous system dysregulation in BC survivors (Wan et al., 2016).

Data Collection and Procedures

Participants were given verbal and written instructions for the self-collection of passive drool salivary specimens. Specimens were collected three times per day for two consecutive days at the three diurnal timepoints of awakening, 30–45 minutes after awakening, and evening (bedtime). The collection protocol instructed on oral intake, oral hygiene, physical

TABLE 2. Sample Scores on Study Instruments (N = 23)			
Characteristic	X̄	SD	Range
Salivary sAA (U/ml)			
Total daily production	101.4	64.4	17.9–305.7
Slope	4.5	3.7	–0.29–14.7
sAAR	59	64.3	2.6–211.4
NEO-FFI-3			
Neuroticism	27.8	9.7	–
Extraversion	40.4	6.3	–
Openness	42.6	5.8	–
Agreeableness	48.7	5.1	–
Conscientiousness	46.8	6.4	–
BMMRS			
Positive spiritual experiences	15.4	6.2	–
Negative spiritual experiences	7.8	0.5	–
Forgiveness	4.4	1.5	–
SF36v2 health outcomes			
Overall physical health component score	49.9	10	–
Overall mental health component score	54.3	10	–

BMMRS—the Brief Multidimensional Measure of Religiousness and Spirituality; NEO-FFI-3—NEO Five-Factor Inventory-3; sAA—salivary alpha-amylase; sAAR—salivary alpha-amylase awakening response; SF36v2—Medical Outcomes Short Form–Version 2 Health Survey
Note. sAA awakening response reflects the dynamic change in concentrations from awakening (eyes open) to 30–45 minutes post-awakening.
Note. NEO-FFI-3 subscale scores range from 12 to 60, with higher scores reflecting more of a specific personality trait. Lower BMMRS subscale scores indicate a higher degree of the attribute and subscale score ranges vary from 6 to 36 for positive spiritual experiences, 2 to 8 for negative spiritual experiences, and 3 to 12 for forgiveness. SF36v2 scores range from 0 to 100, with higher scores reflecting better perceptions of health.

statistical analyses, including descriptive statistics and correlations. Hierarchical regressions were conducted to explore associations between personality, spiritual variables, SF-36v2® health variables, and sAA. Statistical significance for all analyses was set at < 0.05. Because of the small sample size, statistical analyses were limited to one personality predictor (i.e., conscientiousness) and one spirituality predictor (i.e., forgiveness), based on Pearson's correlation findings and data from previous studies that showed both conscientiousness and forgiveness are associated with health outcomes (Hulett et al., 2021; Johnstone et al., 2012). The neuroimmune biomarker sAA, was selected for hierarchical regression analysis based on previous findings that the association between sAA and forgiveness is statistically significant (Hulett et al., 2021).

Results

Descriptive statistics are presented in Tables 1 and 2. Pearson correlations between personality traits and demographics, spiritual variables, and physical and mental health are presented in Table 3. Spearman's rho correlations between personality traits and sAA were not statistically significant; however, a near statistical significance was observed between neuroticism and sAA ($r_s = -0.34$, $p = 0.11$) and between conscientiousness and sAA ($r_s = 0.37$, $p = 0.09$).

Hierarchical Regressions

For each hierarchical regression, the first regression examined the degree to which the personality trait (i.e., conscientiousness) predicted a given outcome (i.e., mental health, sAA). The second regression determined the degree to which the spiritual variable (i.e., forgiveness) significantly predicted the given outcome after considering personality. The normal assumptions of multicollinearity, normal probability plots, and residual statistics were met.

Personality and spiritual variables as predictors of general mental health: In the first model, conscientiousness accounted for 38% of the variation in general mental health ($p < 0.01$). In the second model, forgiveness explained an additional 11% of the variation in general mental health after the consideration of the variance predicted by conscientiousness ($p = 0.001$). The total model explained 49% of the variance in general mental health ($R^2 = 0.49$, $F[2, 20] = 9.57$, $p = 0.001$) with conscientiousness ($\beta = 0.64$, $p < 0.001$) offering a greater contribution than forgiveness ($\beta = -0.34$, $p < 0.05$).

Personality and spiritual variables as predictors of sAA activity: In the first model, conscientiousness

activity two hours before collection, and cold storage and transport to the laboratory. BC survivors were provided with commercial sAA enzymatic kits and protocol from Salimetrics for testing sAA. Details of the enzyme immunoassay procedures and sAA parameter reporting can be found in Hulett et al. (2020).

Statistical Analyses

Concentrations of sAA demonstrated positive skewness on a histogram and Shapiro-Wilk testing ($p < 0.01$); therefore, sAA values were logarithmically transformed for statistical analyses. IBM Statistics SPSS software version 26 was used to perform

accounted for 15% of the variance (p = 0.07). In the second model, forgiveness explained 24% of the variation in sAA after the consideration of conscientiousness (p < 0.05). The overall regression was significant (R^2 = 0.39, $F[2, 20]$ = 6.47, p < 0.05). The total model explained 39% of the variation in sAA activity with forgiveness (β = −0.49, p < 0.05), predicting a greater contribution than conscientiousness (β = 0.43, p < 0.05).

Discussion

The results from this pilot study indicate that personality (i.e., conscientiousness) and spirituality (i.e., forgiveness) independently predict subjective and objective health (i.e., mental health and sAA) in BC survivors, providing important information regarding the psychoneuroimmunologic variables that influence BC survivorship. Personality is a stronger predictor of mental health than spirituality, a finding that supports earlier studies (Johnstone et al., 2012; Lockenhoff et al., 2009). Specifically, less neuroticism, greater extraversion, and greater conscientiousness are the personality traits most strongly associated with mental health scores. The current study's findings are similar to those from Lai et al. (2019), who reported that neuroticism and conscientiousness predicted mental health and quality of life in BC survivors (N = 207).

Previous research has found that, in individuals treated for cancer, those who report greater expression of positive spiritual variables (i.e., forgiveness)

KNOWLEDGE TRANSLATION

- Personality (i.e., conscientiousness) and spirituality (i.e., forgiveness) independently predict subjective mental health and neuroimmune-mediated salivary alpha-amylase (sAA) activity in breast cancer (BC) survivors.
- Personality is a stronger predictor of mental health than spirituality, and spirituality is a stronger predictor of neuroimmune-mediated sAA activity.
- Nursing interventions that consider personality and spirituality may have a beneficial effect on mental health and stress-related neuroimmune inflammation in BC survivors.

are less likely to experience adverse psychological symptoms (e.g., depression) (Vespa et al., 2011). The current study's findings that forgiveness independently predicts subjective mental health support those of Smith et al. (2021), who reported that positive spiritual variables, including forgiveness, are associated with mental health but not with self-reported physical health. A scoping review demonstrated that few studies had reported the relationships between forgiveness and physiologic health (Kim et al., 2020). Consequently, the finding that forgiveness predicts an objective measure of neuroimmune (i.e., sAA) activity beyond that predicted by personality is novel. Positive correlations indicate that increased spiritual scores are associated with better mental and physical health. In short, individuals who are more likely to forgive

TABLE 3. Pearson Correlations by Personality and Spiritual Variables (N = 23)

Measure	NEO-FFI-3 Personality Traits				
	Neuroticism	Extraversion	Openness	Agreeableness	Conscientiousness
BMMRS					
Positive spiritual experiences	0.14	−0.1	0.27	0.12	0.07
Negative spiritual experiences	−0.62**	0.28	0.25	−0.28	0.37
Forgiveness	0.3	−0.1	0.34	−0.04	0.08
SF36v2 health outcomes					
Physical health composite score	−0.37	0.3	−0.01	−0.21	0.39
Mental health composite score	−0.75**	0.47*	0.17	−0.13	0.61**

*p < 0.05; ** p < 0.01
BMMRS—Brief Multidimensional Measure of Religiousness and Spirituality; NEO-FFI-3—NEO Five-Factor Inventory-3; SF36v2—Medical Outcomes Short Form–Version 2 Health Survey

others are more likely to have better mental health and stronger neuroimmune activity, which suggests that lower stress and less resentment are associated with better mental health.

This study's findings suggest that personality and spirituality are distinct constructs (Piedmont, 1999) that should be identified for treatment by behavioral health specialists, including nurses, and by spiritual advisors, including chaplains or clergy, for behavioral and spiritual issues, respectively. In BC survivors, positive spiritual beliefs aid in the self-management of stress and symptoms occurring during the recovery from BC treatment, which suggests that spiritual interventions may benefit BC survivors (Hulett, 2015; Sterba et al., 2014).

Few studies have investigated the association between personality, spirituality, and sAA biomarker activity. The findings of this study extend previous spirituality research by offering new empirical evidence supporting relationships between personality, spiritual variables, mental health, and sAA. Although more evidence is required, the study's data suggest that interventions designed with consideration of personality and spirituality may have a beneficial effect on mental health and stress-related neuroimmune activity in BC survivors.

Limitations

These findings are exploratory and based on an underpowered sample. A full-scale study is necessary to better establish these associations.

Implications for Nursing and Conclusion

Personality and spirituality are theoretically and statistically distinct constructs, and they should be treated independently as such. The results of this study suggest the need for nursing clinicians to be aware of the personality characteristics and spiritual dispositions of their clients with BC so that distinct behavioral and spiritual interventions can be offered. Nurse-led behavioral interventions that consider personality and spirituality may have a beneficial effect on mental health and stress-related neuroimmune inflammation in BC survivors.

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