

**SEXUAL HEALTH OUTCOMES OF A YOGA THERAPY INTERVENTION FOR BREAST
CANCER SURVIVORS**

by

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ABSTRACT

Background: Breast cancer treatment has improved survival prognoses; as such, the late effects of breast cancer and its treatment have become an increasingly important field of inquiry. Although the prevalence of sexual health problems among breast cancer survivors (BCSs) varies, they are among the most distressing side effects associated with breast cancer and its treatment. However, effective interventions for sexual health issues within this population have yet to be established. Yoga therapy, a health promoting, non-invasive, and non-pharmaceutical intervention, holds promise as an effective and acceptable approach to sexual health problems after breast cancer and its treatment.

Methods: Using a controlled pre-post design, changes in sexual health outcome scores were assessed for participants in a three-armed yoga therapy intervention (YTI) study (Anusara yoga, Iyengar yoga, or waitlisted control). Multiple linear regression analysis was guided by a modified version of a pre-established framework comprising sexual health predictors in BCSs, in order to assess the strength of the relationship between YTI participation and changes in sexual health outcome scores. A subset analysis of only partnered participants was carried out because of the established importance of partnered relationships to sexual health.

Results: Participation in Anusara yoga was significantly associated with an increase of 14 (of 91) points (p -value<0.05) on the Overall Sexual Health scale in partnered participants ($AR^2=0.43$, $p=0.001$). Both age ($p<0.001$) and physical function ($p<0.05$) were also significant predictors in this model. Participation in Iyengar yoga was significantly associated with an increase in 3 (of 28) points ($p<0.05$) on the Sexual Function scale among all participants ($AR^2=0.23$, $p=0.026$). Both age ($p<0.05$) and physical function ($p<0.05$) were also significant predictors.

Conclusions: This YTI study showed evidence of effect in terms of improved Overall Sexual Health scores among partnered Anusara participants and increased Sexual Function among all Iyengar participants. Although preliminary, these results indicate that yoga therapy may be an effective, gentle, and safe intervention for BCSs who experience sexual health problems. Future interventions with larger, randomized samples, comprised by and designed specifically for BCSs with self-identified sexual health complaints, are recommended based upon our results.

PREFACE

This thesis received ethical approval from the UBC Behavioral Research Ethics Board on April 3, 2012 in a Post Approval Activity (H10-01430-A002). Statistical analyses were carried out by Alden Blair.

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LIST OF ABBREVIATIONS

BCS	Breast Cancer Survivor
BSI	Brief Symptom Inventory
CAM	Complementary and Alternative Medicine
ER+	Estrogen Receptor Positive
FLIC-22	Functional Living Index Cancer-22
HR-QOL	Health Related Quality of Life
MFSQ	McCoy Female Sexuality Questionnaire
MOS-SS	Medical Outcomes Survey-Social Support
PR+	Progesterone Receptor Positive
QOL	Quality of Life
QPR	Quality of Partnered Relationship
SSI	Symptom Severity Index
TSI	Treatment Severity Index
YTI	Yoga Therapy Intervention

GLOSSARY

Adjustment: 'A summarizing procedure for a statistical measure in which the effects of differences in composition of the populations being compared have been minimized by statistical methods. Examples are adjustment by regression analyses and by standardization. Adjustment often is performed on rates or relative risks, commonly because of differing age distributions in populations that are being compared. The mathematical procedure commonly used to adjust rates for age differences is direct or indirect standardization'(p.3) (1)

Clinical significance: 'a difference in effect size considered by experts to be important in clinical or policy decisions, regardless of the level of statistical significance. The term clinical importance may be preferable, as it avoids confusion with statistical significance'(p.31).(1)

Collinearity: 'very high correlation between independent variables'(p.35).(1)

Confounding: 'the association between an exposure and a given outcome is induced, strengthened, weakened or eliminated by a third variable or group of variables. Also, the confounding variable is causally associated with the outcome, and causally or noncausally associated with the exposure but is not an intermediate variable in the causal pathway between exposure and outcome'(p.154).(2)

Goodness of fit: 'degree of agreement between an empirically observed distribution and a mathematical or theoretical distribution'(p.78).(1)

Multicollinearity: 'In multiple regression analysis, a situation in which at least some of the independent variables are highly correlated with each other. Such a situation can result in inaccurate estimates of the parameters in the regression model'(p. 118).(1)

Multiple Causation: (multifactorial etiology) 'This term is used to refer to the concept that a given disease or other outcome may have more than one cause. A combination of causes or alternative combinations of causes may be required to produce the effect'(p.118).(1)

Statistical significance: 'statistical methods allow an estimate to be made of the probability of the observed or greater degree of association between independent and dependent variables under the null hypothesis. From this estimate, in a sample of given size the statistical significance of a result can be stated. Usually, the level of statistical significance is stated by the p-value'(p.173).(1)

Variance: 'a measure of the variation shown by the set of observations, defined by the sum of the squares of deviation from the mean, divided by the number of degrees of freedom in the set of observations'(p.185).(1)

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*For my grandmothers:
Ann, May, Betty, and Marnie.*

CHAPTER 1: INTRODUCTION AND LITERATURE REVIEW

INTRODUCTION

Sexual health has been identified as a major quality of life (QOL) issue among breast cancer survivors (BCSs) that comprises physical, psychological, spiritual, and social domains. Although prevalence rates vary, sexual health concerns among BCSs have been found to be among the most distressing side effects, and these concerns often do not improve with time.(3) While pharmacological trials for female sexual health problems among BCSs have proven ineffective, unacceptable, or unsafe, psychotherapeutic interventions have shown more promise.(4) Yoga therapy, a modality within Complementary and Alternative Medicine (CAM), is adaptable to most ages and physical ability ranges, and holds promise as an effective and acceptable intervention for sexual health problems after a breast cancer diagnosis and conventional oncology treatment. The effectiveness of yoga therapy for improving sexual health among BCSs is unknown. The purpose of this study is to examine the effects of a yoga therapy intervention on sexual health outcomes in a group of BCSs in Vancouver, British Columbia (B.C.).

This chapter provides background information on cancer survivorship and QOL in order to situate the sexual health of BCSs in a broader context. A review of available sexual health treatments for BCSs follows. The known effects of yoga therapy on the QOL of cancer survivors are then reviewed. Each of these fields will be drawn on to explain the rationale for proposing yoga therapy as a treatment for sexual health issues among BCSs who have completed conventional treatment.

BACKGROUND AND RATIONALE

Nationally, breast cancer diagnoses represent 28% of all new cancers in women (n=88,800), and 15% of all cancer deaths in women (n=36,200).(5) In 2009, breast cancer comprised 13.8% of all cancer diagnoses in B.C. (n=23,400), and 6.7% of all provincial cancer mortality (n=8,891).(5) The five year disease-specific survival rate of those women diagnosed with breast cancer in B.C. ranges from 86-92%.(6) High survival rates have necessitated research aimed at understanding the physical, psychological, and social needs of BCSs. Understanding the long-term effects of breast cancer and its treatment on QOL has been a key research focus for the past 20 years.(7–11) As breast cancer survivorship has increased, due to both earlier detection and more effective treatments, evidence-based practice in improving the QOL of BCSs has become increasingly relevant.(9) Research efforts addressing QOL needs among survivors in their transition from treatment back into their 'normal' lives are presently in demand.(9) Among BCSs, the effective management of sexual health problems related to breast cancer and its treatment has been identified as a knowledge gap within the literature.(12,4)

Survivorship research is defined by QOL domain and/or by temporal stage. The most widely accepted survivorship model of QOL for BCSs is based on Ferrel et al.'s (13) four domain model, comprising the physical, social, psychological, and spiritual well-being of cancer survivors. Temporally, survivorship can be divided into three dynamic stages; end of treatment, transition to survivorship, and returning to normal. (12) Knobf (14) reports that upon end of treatment, many BCSs experience increased feelings of vulnerability and a decrease in overall emotional health. Although completion of treatment is positive for most survivors, it also represents a time of increased vulnerability to psychological distress.(15) This transition is known to increase stress levels, which, in turn, decrease the QOL of BCSs. Further, the presence of physical side effects has been found to worsen any psychological symptoms (including distress, depression, and anxiety).(14) Examples of physical symptoms include fatigue, insomnia, weight gain, and menopausal symptoms. Left untreated, these symptoms may lead to significantly decreased physical and psychological health.(16) Cancer survivors can also experience social challenges including changing family structure, changing social support systems, and feelings of isolation in coping with the aftermath of cancer.(13) Finally, within the spiritual domain, many survivors experience increased spiritual distress upon completing treatment.(17,18) The need for effective interventions to address this transition in the BCS's trajectory has been indicated. (19)

1.1 SURVIVORSHIP

DEFINING SURVIVORSHIP

The term 'cancer survivor' is attributed to Fitzhugh Mullan,(20) an American, who wrote an article on the topic from the perspective of someone who experienced cancer both first-hand and second-hand (as a physician). In that paper, Mullan rejected the binary nature of cure and disease among those diagnosed with cancer, suggesting instead that a cancer trajectory passes through multiple stages in a complex and dynamic manner.(20) A year after this article was published, Mullan was among the founding members of the National Coalition for Cancer Survivorship (NCCS). This organization was founded to represent and advocate for cancer survivors.(21) It was at the first meeting of the NCCS that the term 'cancer survivor' was accepted for common usage over either 'cancer victim' or 'cancer patient'.(10) The phrase was intended to empower cancer survivors and to be used when referring to any person diagnosed with cancer through to the end of his or her life.

Recently, literature has emerged indicating disagreement with the use of the term cancer survivor among people who had been diagnosed with cancer in the United Kingdom.(22) Reasons given for disliking the term were varied; themes were summarized as a series of implications that were disagreeable. These included that use of the term 'survivor' implied: 1) a high risk of death when risk was low, 2) a choice surrounding life or death that was not present, 3) a cure, when recurrence is possible, and 4) a changed identity, when some felt that the experience of cancer had not changed them.(22) For these reasons a large number of the people who were interviewed in this study either rejected or disagreed with the use of the term cancer survivor.

However, other authors have suggested that positive health consequences may arise among people who identify with and/or rebuild a personal identity based on the term 'cancer survivor'. (23,24) Use of the term 'cancer survivor' among women diagnosed with breast cancer was associated with better adjustment to treatment side effects as well as increased adjustment to changed sexuality and sexual functioning.(24) Thus, although it is recognized that there are individuals who disagree with the term 'cancer survivor', the term will be used in this thesis.

A cancer survivor is defined in this thesis as an individual who has been diagnosed with cancer. This includes any person living with cancer, from diagnosis through to the end of his or her life.(10,21) Although this definition results in a heterogeneous group with varied experiences who inhabit disparate stages within the cancer trajectory, what is shared among these individuals is highlighted by the use of this term. The experience of diagnosis and the upheaval and complexity that a cancer diagnosis and its treatment carry are some of the shared themes that are common to all cancer survivors, regardless of where they find themselves along that trajectory.(25) By using the term cancer survivors as defined here, those shared experiences, and the resulting complexities introduced into a survivor's physical, social, psychological and spiritual existence are represented.(25) While improved cancer treatments have greatly increased life expectancy among survivors, the complexity of late- and long-term effects of cancer and its treatment, and the impacts across multiple QOL domains, require further research.

CANCER AND COGNITIVE READJUSTMENT

Underlying the conceptual framework of this study is the recognition that exposure to a life-threatening occurrence, such as breast cancer, requires a cognitive readjustment process. Taylor(26) conceptualizes this process as occurring in three broad themes; 1) searching for meaning in the experience, 2) attempting to regain control over both the threatening event and also more generally, within one's life and, 3) trying to improve one's self-esteem despite the setback.

Participation in a yoga therapy intervention represents an opportunity for BCSs to increase their sense of control within their lives by being actively engaged in regaining an improved state of health after breast cancer treatment. As a mind-body practice, yoga may be an ideal therapy for this cognitive readjustment process, as it provides the benefits of exercise combined with breathing techniques that have been shown, together, to be effective in improving both physical and psychological health (see Section 1.4). More specifically, the continued practice of choice carried out in the physical placement of one's own body into a particular form of an asana, or posture, represents the integration of mindfulness into physical practice, and an overall increase in the creation of meaningful participation in improving one's own state of overall health.

The word yoga comes from a Sanskrit word 'yuj', which means to yoke, unite, or integrate, depending on the translation.(27) Although there are a number of ways to define yoga, and yoga has a complex history spanning

thousands of year, the basic tenets of the practice involve striving toward a unity of body, mind, and spirit. In order to achieve this unity, yoga practitioners work through physical ‘asanas’ (postures), ‘pranayama’ (breathing techniques), and meditation.(27) Although there are many different sources recognized as authorities, Patanjali’s Sutras are thought to be the oldest recorded descriptions of the philosophy of yoga.(27) Both types of yoga (Anusara and Iyengar) included in this intervention study fall within the branch of Hatha yoga, which is a form of yoga that emphasizes the physical poses (asanas), but also incorporates breath work and meditation. As such, yoga as practiced within this intervention study can be defined as a type of exercise that incorporates breath work and meditative practices. In Section 1.4 (below), the established benefits of yoga for BCSs in each domain of health (physical, psychological, social, and spiritual) will be discussed.

LATE AND LONG-TERM EFFECTS OF BREAST CANCER AND ITS TREATMENT

The late and long-term effects of cancer and its treatment(s) can be seen across the physical, psychological, social, and spiritual domains of well-being(28); although cancer treatment(s) are necessary to preserve life, the effects of these treatments on the lives of survivors has been described as being “worse than the disease”.(29) Late effects are described as the outcomes of ‘toxicities’ that emerge after primary treatment has been completed, while long term effects can be present throughout the cancer trajectory, from diagnosis, through treatment and beyond.(25) Sexual health problems belong solely to neither of these categories, as they may occur before, during, and after breast cancer treatment. However, it has been recognized that although sexual health may serve as an anchor for women throughout their breast cancer trajectories, sexual health problems become particularly complex once treatment is complete.(30) As such, this thesis will address sexual health issues as late effects following cancer diagnosis and its treatment. Although much progress has been made in treating the late and long-term effects of cancer, many gaps remain. Among cancer survivors undergoing the transition at the end of active treatment, 30% report unmet needs rated as moderate to severe; of these, 60% had not had these needs addressed 6 months later.(31) Further, among cancer survivors, women are more likely than men to report unmet needs.(32) Among the needs that remain unaddressed, one such gap is in our understanding of, and effective interventions for, sexual health problems among cancer survivors.(12) Sexual health is recognized as a fundamental contributor to both psychological well-being and overall QOL.(33,34) Sexual health symptoms have been found to remain unresolved by time alone, and, further, to become more severe up to two years after disease-free status is attained.(3,35) Although prevalence of sexual health problems among BCSs can vary, with estimates ranging from 15-64%; sexual health problems are rated as one of the most distressing effects associated with breast cancer and its treatment.(3) Sexual health will be defined here as comprising four categories; *Sexual Interest*, *Sexual Function*, *Sexual Satisfaction*, and *Overall Sexual Health*. (36)

QUALITY OF LIFE

QOL and Cancer Survivorship

Early discussions on defining QOL within cancer survivorship emphasized the importance of individual subjectivity. For example, Calman (37) suggests that QOL is defined by the gap between a person's overall dreams and aspirations and his or her self-perceived present condition:

'QOL can only be described and measured in individual terms, and depends on present lifestyle, past experience, hopes for the future, dreams, and ambitions. QOL must include all areas of life and experience and take into account the impact of illness and treatment. A good QOL can be said to be present when the hopes of an individual are matched and fulfilled by experience.'

This interpretation of QOL illustrates the complexity faced by researchers aiming to both define and measure QOL within populations of cancer survivors. Another definition is provided by Haas in her attempt to integrate and resolve the multiple concepts associated with QOL:

'QOL is a multidimensional evaluation of an individual's current life circumstances in the context of the culture and values systems in which they live and the values they hold. QOL is primarily a subjective sense of well-being encompassing physical, psychological, social, and spiritual dimensions. In some circumstances, objective indicators may supplement or, in the case of people who are unable to subjectively perceive, serve as a proxy assessment of QOL.'(38)

Haas reiterates the importance of careful language and concept definition for researchers conducting work involving QOL measures.(38) According to Haas' definitions, QOL reporting must include both subjective and objective indicators. If subjective measures are not used, Haas encourages the use of either the phrase *functional status* or *objectively perceived QOL*.(38)

More recently, this issue has been reiterated as being a continued problem in health research related to QOL.(39) These authors suggest that although the importance of subjective measurements of QOL is recognized, there is a continued emphasis on objectivity and its associated measurable outcomes.(39) The influence of social support on psychological health is recognized by these authors as being one of the most important predictive factors for QOL in cancer survivors. As such, they recommend including scales that measure levels of perceived social support in all QOL studies within cancer patient populations.(39)

Day and Jankey (40) state that the phrase 'Quality Of Life' first came into regular use in the 1960s, and its meaning has since undergone multiple interpretations, alterations and additions. Meeberg breaks the phrase down into its components, exploring various definitions of each part to finally present the following definition:

'QOL is a feeling of overall life satisfaction, as determined by the mentally alert individual whose life is being evaluated. Other people, preferably those from outside that person's living situation, must also agree that

the individual's living conditions are not life-threatening and are adequate in meeting that individual's basic needs.'(41)

As evidence accrued to suggest that objectively measured variables could account for only 15% of the observed variance in QOL studies, the importance of subjective measurement of psychological variables was increasingly recognized due to its large contribution to an individual's QOL.(40) The importance of both objective and subjective variables in predicting an individual's QOL has since become established. In integrating multiple definitions of QOL, Haas (38) suggests that there are four agreed upon principles espoused by QOL theorists. These are: 1) a sense of general satisfaction with life, 2) the mental capacity to determine the level of satisfaction felt in one's own life, 3) self-determined physical, mental, social, and emotional levels of health are considered adequate and, 4) objective assessment of adequacy on each of the previous three measures by an outside party. While positive definitions are useful in understanding this complex topic, negative definitions are often of equal use. That is, defining what QOL is not is also a useful exercise in understanding the concept.

QOL and Functional Status

While functional status is sometimes equated with QOL, Leidy (42) differentiates between the two concepts based upon the pure objectivity of functional status. While both concepts include the same general domains (social, emotional, spiritual, and physical), Leidy argues that QOL domains encompass a much broader range of experience than functional status domains.(42) That is, functional status domains are a necessary, but not sufficient, contributor to overall QOL domains.

QOL and Health Status

Differentiating between these two concepts, QOL and Health Status, is a much more difficult task; in part because neither concept is entirely objective nor subjective.(38) In defining health, a negative definition, such as the absence of disease, does not provide a true reflection of lived experience. Health is defined here as 'a state of complete physical, mental, and social well-being' (33) with the additional recognition that even terminally ill persons can achieve a QOL that is satisfactory to them; that is, some may approach illness as a 'health experience'.(43) For some BCSs, viewing their illness as a health experience that allowed personal growth; including themes of personal growth, reordering of life priorities, and an increase in self-knowledge, is important within the cancer trajectory.(26) The importance of subjectivity in understanding a person's view of his or her own health is again highlighted.

Definition of QOL

QOL is defined holistically here as including the physical, psychological, social and spiritual well-being domains.(13) Although there are many QOL models in cancer survivorship research, Ferrel et al. (13) developed a model for QOL in BCSs that shows strong convergence with existing literature on survivorship after breast cancer diagnosis and comprises four domains; physical, psychological, social, and spiritual well-being. This model recognizes both the multidimensional and temporally dynamic nature of QOL. Ganz et al. (36) have constructed a conceptual framework outlining the important demographic, medical, and partner-related predictors of sexual health after a breast cancer diagnosis. These authors have also identified sexual health predictors that have been shown to be modifiable, including health related QOL. (36)

As a form of CAM, yoga therapy presents an intervention that has been shown to have a positive effect on QOL measures within physical and psychological domains. As our study used validated scales to objectively measure variables of interest, using Haas's language, we will report here on the objectively measured QOL of the enrolled participants.(38) For purposes of brevity, QOL will be used to signify objectively measured QOL.

SEXUAL HEALTH OUTCOMES OF CANCER AND ITS TREATMENT

Sexual health is defined here as comprising four categories; 1) Sexual Satisfaction, 2) Sexual Function, 3) Sexual Interest and 4) Overall Sexual Health.(36) Sexual health problems relate to identification of difficulties, or distress, within any of these categories. Previous work has used the term sexual dysfunction.(36) Here, the term Sexual Function will be used to indicate the domain of sexual health that relates to vaginal lubrication and orgasm. The term dysfunction will be avoided, where possible, as it implies a normative approach to what is a highly individual experience.

Sexual health problems after breast cancer are complex; symptoms associated with sexual changes after breast cancer have been identified as being associated with physical, psychological, and social domains.(30) Women's sexuality does not follow a set pattern, with multiple factors affecting a woman's experience of her own sexuality.(44,45) Sexual Interest, function, and satisfaction can be affected by changes in hormone levels (46,47) as well as altered self-image following breast cancer treatment.(48) Further, Sexual Satisfaction and interest are highly correlated with the status of a woman's relationship with her sexual partner.(45,49) Large scale studies looking at sexual health in adults have established that sexual health correlates strongly with both physical and psychological health.(50,51) This interconnection of relationships, mind, and body in contextualizing sexuality adds complexity to the process of understanding and providing effective treatment for sexual problems.

While the importance of sexual health to overall well-being and QOL is generally acknowledged, and available research shows the complexity of sexual health outcomes after breast cancer, only 30% of couples coping with breast cancer reported having discussed sexuality with any health care professional.(52) Thus, while sexual health issues following breast cancer diagnosis and treatment have been acknowledged as both serious and highly

prevalent, recognition of and effective treatment for sexual health issues within this population represent an unmet need.

Understanding Female Sexual Health

Three separate models of female sexual response have been shown to be equally endorsed by women; this suggests that female sexuality is highly individualized with multifactorial and complex pathways.(53) Levels of female sexual 'dysfunction' in the general population are highly variable, depending on how 'dysfunction' is classified. While some reports indicate that the prevalence of female sexual 'dysfunction' ranges from 40-50% of the general population, rates are much lower if the diagnostic of distress is included. That is, if sexual 'dysfunction' is diagnosed it is done only if the symptoms are causing the individual personal distress; with this criteria added, prevalence rates drop to 12-25% of the general population.(54) While age and sexual health have been historically positively correlated, Lindau et al.(51) report that when physical health is also considered, the link between age and sexual health is significantly reduced. That is, physical health is more strongly correlated with sexual health than is increased age.(55)

Sexual health is also strongly correlated with psychological health, and use of medication for managing psychological health conditions. Among people experiencing depression, the prevalence of sexual 'dysfunction' when compared with non-depressed controls was doubled (50% vs. 24%). (56)Further, when users of medication for depressive symptoms, such as selective serotonin uptake inhibitors (SSRIs) were considered, prevalence rates of sexual 'dysfunction' were over 95%.(56) A larger study, which included use of any anti-depressant agent, found lower rates of sexual 'dysfunction' (59.1%).(57) Thus, the relationship between depression, use of anti-depressants, and sexual health has been identified, however, the disentangling of the effect of depression vs. use of anti-depressants on sexual health remains unclear.

Treatment for Sexual 'Dysfunction'

The multi-causal (neurogenic, musclogenetic, hormonal, and psychogenic) nature of female Sexual Function and 'dysfunction', as well as the adverse outcomes on physical, psychological and social domains of QOL create complexity in establishing effective treatments.(58) Berman and colleagues encourage the consideration of the physical, psychological, cultural, and social context of a woman's life in evaluating physical complaints associated with sexual dysfunction. Breast cancer and its treatment add further complexity to sexual health, due to effects on Sexual Function, sexual response, and intimate relationships across physical, social, spiritual, and psychological domains.(3,48) This state of research provided impetus for a mind-body approach to sexual health in BCSs, such as that afforded by yoga therapy.

SEXUAL HEALTH OUTCOMES OF BREAST CANCER AND ITS TREATMENT

Among cancer survivors, sexuality and sexual functioning are impacted by both cancer and its treatment.(35) Although this may be a secondary concern during diagnosis and even through treatment, normalized sexual health can act as an anchor to 'normal life' throughout the cancer trajectory.(59) Upon completion of treatment, many women report a need for support in coping with the changes that they have experienced with their sexuality and their sexual functioning.(35) While other late and long-term effects of cancer and its treatment tend to dissipate with time, sexual health needs, if left unmet, have been found to continue to affect survivors if left untreated.(46) Further, although prevalence rates vary, BCSs have reported that sexual health concerns are among the most distressing side effects of their cancer experience.(3)

In a study measuring frequency of sexual 'dysfunction' among BCSs, 96% reported at least one sexual health problem.(60) The most common symptoms included reduction of sexual desire (65%), absence of sexual desire (48%), anorgasmia (44%), vaginal dryness (42%) and pain (38%).(60) However, as indicated above, a subjective interpretation as to the effect of these symptoms on one's own sexuality is as important to assessing sexual health. When asked to report on the quality of their sexual life before treatment and after treatment the percent change in those reporting a good sex life decreased by 36%, those reporting a fair sex life increased by 18%, and those reporting a poor sex life increased by 18%.(60) Those findings indicate an overall trend to worse sexual health after treatment, based upon subjective reporting.(60)

1.2 SEXUAL HEALTH PREDICTORS

Predictors, or independent variables, are characteristics that are either observed or measured because they are known to influence the variability found in the outcome, or dependent variable, of interest.(1) In this thesis, sexual health predictors among BCSs have been selected based upon a modified version of a framework for BCSs sexual health outcomes; this framework was proposed and tested by Ganz et al.(36) The independent variables that were measured or observed are included because they are known to be associated with the sexual health outcomes of interest in the broader literature base.(36) These predictors may also be confounders in assessing the relationship between participation in a yoga therapy intervention and changes in sexual health outcomes. A confounder is defined as a variable that is associated with both an independent variable and the dependent variable.(1) By including these predictors in our framework, we will be able to adjust our modeling to better understand the effect of yoga therapy (alone) on the changes to sexual health outcomes of BCSs.

DEMOGRAPHIC AND PERSONAL

I. Age

While age has been identified as an important predictor of sexual health in that younger women are more likely to be sexually active than older women,(61) other studies have implicated physical health as being a more relevant predictor of sexual health than age.(51) However, among BCSs, who often experience chemically-induced menopause, the largest negative changes in both Sexual Satisfaction and Sexual Interest were reported in younger women.(62) However, older women also report higher levels of vaginal pain and dryness during intercourse than do younger women.(63) It has been hypothesized that older women are better equipped to cope psychologically with a breast cancer diagnosis and its treatment.(64,65) This has been attributed to both a psychological readiness among older women for coping with chronic illness, as well as more life experience in dealing with hardship.(64,66) Age-cohort differences may also impact upon sexual expectations, as more traditional gender expectations are correlated with lower levels of sexual desire.(63)

II. Ethnicity

Ethnocultural norms and values have been shown in previous work to influence how a woman experiences her own sexuality.(67) However, the influence of ethnocultural normativity on sexual health comprised by social ideals, is indirectly related to ethnicity, and perhaps more associated with age cohort effects.(63) The complexity of this topic ranges beyond the scope of this thesis.

III. Patient Comorbidity

Among BCSs, excess body weight can carry serious implications for both cancer recurrence, as well as for recovery.(19) Weight gain after receiving treatment for breast cancer is strongly associated with increased risk of recurrence.(68) Weight gain is also associated with negative body image, and can impact sexual health due to both physical and psychological side effects. Conversely, activities associated with achieving and maintaining a healthy weight can be an effective tool in reducing the risk of recurrence(19) and countering psychological states associated with fear of recurrence.(26) Further, excess weight can have negative implications for body image (see Body Image, below), which can affect sexual health outcomes.

IV. Body Image

The experience of breast cancer and its treatment have serious consequences for body image and sexual health.(69) Body image, built around self-esteem, is explained as an investment into an aspect of oneself, in this case, one's physical self.(70) Changes to a woman's physical appearance due to breast cancer and its treatment can have serious implications for a woman's psychological well-being, as well as for her body

image and Overall Sexual Health. Breast cancer patients, when compared with healthy women, had significantly lower levels of body image, as well as lower levels of sexual desire, sexual arousal, Sexual Satisfaction, and increased levels of pain during intercourse.(71) In a large study of breast cancer patients over 50% experienced two or more problems with body image.(69) Surgery, chemotherapy and radiation therapy are each associated with distinct implications for body image, which will be discussed below.

BREAST CANCER AND MEDICAL

I. Time since diagnosis

Generally, the longer time a woman has had since diagnosis, the fewer symptoms she experiences. However, sexual health has been shown to deviate from this pattern with unmet sexual health needs worsening or staying the same up to 2 years after conventional treatment has finished.(35,46)

II. Type of Surgery

Women who undergo surgery in the course of their breast cancer treatment often experience body image issues due to both the presence of scars and/or their missing breast(s).(35) When breast conserving surgery (lumpectomy) is compared with mastectomy, issues surrounding body image have been shown to be more problematic for mastectomy patients (72); Sexual Function is also affected more by mastectomy than lumpectomy, although to a lesser extent.(73) Reconstructive surgery is thought to lessen the impact on body image, and, indirectly on sexual health outcomes.(69,73) Because of these distinct outcomes for BCSs who have experienced mastectomy, lumpectomy, or reconstructive surgery, the type of surgery undergone is important to account for when considering sexual health outcomes.

III. Chemotherapy

Receiving chemotherapy in the course of treatment for breast cancer can have negative effects on a woman's overall QOL and sexual health post-treatment.(72) Compared with women who had not received chemotherapy, those who had were more likely to report multiple debilitating symptoms. These included; vaginal dryness (5.7 times more likely), decreased libido (3.0 times), dyspareunia (5.5), and difficulty reaching orgasm (7.1).(74) The inclusion of chemotherapy in a BCS's treatment was significantly associated with increased nausea ($p<0.03$), vaginal problems (pain, dryness) ($p<0.001$), weight problems ($p=0.01$), hot flashes ($p<0.01$) and musculoskeletal problems ($p=0.01$).(16) Chemotherapy may induce menopause prematurely among its recipients; chemotherapy induced menopause is associated with increased sexual health problems including decreased arousal, libido, erotic pleasure, orgasm, satisfaction, and interest, as well as increased vaginal dryness.(49,75) Other symptoms and side-effects of chemotherapy indirectly affect sexual health outcomes: including fatigue (which can lead to loss of desire

and a decrease in the frequency of intercourse) and loss of hair (which can negatively affect body image).(16) Further, chemotherapy induced neuropathies of hands, feet, and genitals can decrease sexual pleasure through loss of sensation.(35) Finally, changes to the gastro-intestinal system of chemotherapy recipients can cause discomfort in sexual encounters due to: alterations in the mucosal membranes of the mouth; senses of smell and taste, which may all affect oral intimacy; and changes in digestions (e.g., diarrhea, anorexia etc.).(69) Together, the symptoms associated with chemotherapy may have an important predictive effect on the changes in sexual health outcomes of BCSs.

IV. Radiation

Radiation therapy can significantly impact the sexual health of BCSs through increased fatigue, and irritation of the gastro-intestinal tract.(35) The effects of both fatigue and gastro-intestinal irritation on sexual health outcomes among BCSs were discussed at length in the section on chemotherapy, above.

V. Endocrine Therapy

There are two main categories of endocrine therapy prescribed to BCSs: tamoxifen and aromatase inhibitors. Endocrine therapy is used when BCSs have had either estrogen receptor positive (ER+) or progesterone receptor positive (PR+) breast cancer.(76) Estrogen receptor positive breast cancer is defined by the presence of cancer cells that have estrogen receptors on their surfaces. This type of cancer cell requires estrogen in order to grow.(76) PR+ cancers are those with cell types reliant on progesterone for growth. Endocrine therapy works by either reducing the amount of estrogen or progesterone available in the body or blocking the hormones from supporting breast cell growth.(76) Both tamoxifen and aromatase inhibitors have side effects for sexual health. Tamoxifen reduces the risk of local cancer recurrence and mortality.(77) Tamoxifen also interacts with selective serotonin uptake inhibitors (SSRIs), in that SSRIs impair the expression of a gene (*CYP2D6*) required to metabolize tamoxifen.(78) Aromatase inhibitors are especially useful in post-menopausal patients with ER+ breast cancer and reduce the risk of local and distant breast cancer recurrence.(78) Both kinds of endocrine therapy increase hot flashes.(78) Tamoxifen is known to have positive effects on the musculoskeletal system, but increases the risk of endometrial cancer and venous thromboembolism (blood clots).(79) Tamoxifen also increases vaginal dryness and is associated with decreased Sexual Interest and Sexual Satisfaction.(80) Aromatase inhibitors have negative impacts on vaginal dryness, joint pain, and loss of bone mass.(81) As such, endocrine therapy (equivalent to hormone therapy) will be included in assessing the relationship between yoga therapy and changes in sexual health outcomes.

VI. Hot flashes

Associated with menopause, both natural and chemotherapy induced, hot flashes can create considerable discomfort for women and can increase sexual health problems.(11,81) Hot flashes can increase irritability, insomnia, and mood swings, all of which can lead to decreased Sexual Interest and Sexual Satisfaction.(82) Behavioural interventions for hot flashes have shown some success, with the postulated pathway of effect being increased relaxation, which in turn decreases sympathetic nervous activity, decreasing both the frequency and strength of hot flashes.(83)

VII. Vaginal Dryness

Vaginal dryness, associated with treatment of breast cancer, can cause significant discomfort during intercourse, leading to decreased sexual arousal, interest, and satisfaction.(80)

VIII. Menopausal status

As discussed previously, menopause and its associated symptoms can have serious impacts on the sexual health outcomes of BCSs. Worse menopausal symptoms are significantly and positively related to increased sexual discomfort (vaginal pain and dryness) and decreased Sexual Interest, arousal, and desire.(61)

PARTNER RELATIONSHIP

I. Intimacy/ Quality of Partnered Relationship

A strong partnered relationship has been shown to be one of the most important contributors to Overall Sexual Health among BCSs.(49,63) The research carried out by Speer and colleagues(63) found that distress in an intimate relationship was the most significant contributor to decreased sexual health outcomes, including; arousal, orgasm, lubrication, satisfaction, and pain during intercourse.

II. New Partner since Breast Cancer Diagnosis

A new sexual partner, regardless of age, increases most measures of sexual health, including interest, arousal, lubrication, orgasm, and satisfaction.(44)

CREATING A FRAMEWORK TO MODEL SEXUAL HEALTH OUTCOME AMONG BCSs

PREDICTORS FOR INCLUSION

Based upon the models designed and then tested for fit on two independent samples of BCSs ($n_1=472$, $n_2=662$) by Ganz et al.(36) for each of Sexual Interest, Sexual Function, and Sexual Satisfaction, the preceding predictors were

shown to account for high rates of variance. The above conceptual framework for sexual health provided a basis for building multivariable regression models to estimate the predictive capacity of each predictor to the four sexual health outcomes. Further, stepwise regression and recursive partitioning was undertaken to determine the relative importance of each predictor to each of the outcomes of interest.(36)

SEXUAL INTEREST

For Sexual Interest, the models designed and tested by Ganz et al.(36) accounted for 33% of the observed variance. The predictors shown to be significant were: having a new partner since diagnosis, mental health, and body image.

SEXUAL FUNCTION

The predictors of most import to Sexual Function in BCSs were: vaginal dryness; chemotherapy use; and having a new partner since cancer diagnosis (33% of variance explained).(36)

SEXUAL SATISFACTION

For Sexual Satisfaction, significant predictors were the quality of the partnered relationship and sexual problems in the partner.(36)

OVERALL SEXUAL HEALTH

Overall Sexual Health is defined here as a variable that combines all of the above categories.

1.3 TREATMENT OF SEXUAL PROBLEMS IN BCSs

Treatment for sexual health issues in general has become highly pharmacological, driven by an interest in the biological basis of male erectile dysfunction.(84) Although sexual health solutions for men have become increasingly pharmacological, safe and effective pharmaceutical treatments for women's sexual health symptoms have not been forthcoming. Further, among BCSs with ER+ tumours, estrogen therapy is contraindicated due to increased rates of breast cancer recurrence.(58) The most effective treatments known for sexual health symptoms in women include cognitive and behavioural therapies, but there are alternative therapies, as yet unexplored, that may provide effective and safe treatment for sexual health issues among BCSs. Support for the theoretical basis of yoga as a therapy for sexual health problems among women is found in a wide array of non-empirical sources.(4) However, yoga for sexual health problems in women has not been researched empirically.(85) Among BCSs, the effective management of sexual health problems related to breast cancer and its treatment has been identified as an important gap in knowledge.(12,4)

EDUCATIONAL AND PSYCHOTHERAPEUTIC APPROACHES

The educational approach to women's sexual health problems consists of providing clear, specific, and evidence-based information throughout the cancer trajectory.(24) By increasing knowledge of the high prevalence of sexual problems among patients undergoing conventional treatment, and offering information regarding possible treatments, there is a positive overall effect on sexual health problems.(86)

Although a large percentage of cancer patients agree that discussing their sexual health problems with their health care provider is important, only 29% of BCSs had received information from their health care provider on this subject.(59) Despite the recognition that BCSs experience problematic sexual health changes, few effective interventions have been identified. Among gynecological cancer patients more interventions for sexual health problems have been carried out.

For example, a study carried out among early stage gynecological cancer patients consisted of three one-hour long sessions and measured physiological feedback using a vaginal pessary. This psychoeducational intervention consisted of behavioral cognitive therapy and mindfulness training, and showed significant positive effects on participant levels of sexual desire, arousal, orgasm, satisfaction, and reduced levels of sexual distress and depression.(87)

PHARMACOLOGICAL APPROACHES

Pharmacological solutions to female sexual health problems have not been highly successful, in either the general population or among BCSs.(58) Estrogen therapy for menopausal symptoms that interfere with Sexual Function are contraindicated in BCSs.(58) Among successful pharmacological interventions are the use of vaginal moisturizers and lubricants to decrease vaginal dryness and pain, respectively, during intercourse.(78) Medications used in managing psychological symptoms often found in BCSs (such as antidepressants, anxiolytics and sedatives) can have negative effects on sexual health outcomes.(58)

1.4 YOGA, QUALITY OF LIFE, AND CANCER

CAM is defined as a diverse group of health care and medical practices, products and systems that exist outside the boundaries of conventional medicine.(88) Yoga therapy is considered a CAM modality and has shown positive results in trials with breast cancer patients in physical, social, and psychological domains.(89–92) However, due to small samples and a relatively small number of trials, further research into yoga therapy as an intervention among BCSs is warranted.(92) What is known about the effects of yoga therapy on each of the physical, psychological, social, and spiritual domains (which are the domains delineated in Ferrel's BCS QOL model) is discussed in this section.(13)

PHYSICAL

Within the physical domain of QOL fall symptoms and side effects such as fatigue, insomnia, nausea, weight gain (or loss), pain and, more recently, molecular and hormonal measures (e.g., DNA damage, cortisol levels). Physical symptoms and sexual health outcomes are highly correlated.(50,51) Yoga therapy interventions for BCSs have measured significant positive changes in levels of fatigue,(93,94) pain,(95) nausea(96) waist circumference reduction, (91) and reduced genotoxic damage (levels of significance not reported).(89) A meta-analysis carried

out by Lin et al.(92) failed to find an overall significant improvement in physical health symptoms among BCSs participating in a yoga therapy intervention, but recommended further research with larger samples.

The Functional Living Index-Cancer (FLIC-22), which is a validated and reliable scale, is commonly used in cancer research to assess overall physical health.(97) For the purposes of this thesis, the FLIC-22 was chosen to represent the physical domain, due to its widespread use, validity, and reliability.

MENOPAUSAL SYMPTOMS

One study carried out a yoga intervention among BCSs that specifically considered physical symptoms associated with menopause.(98) This study used daily telephone diaries to collect information from 37 participants randomized to either a yoga or wait-listed control group on hot flash frequency and severity, fatigue, and joint pain. Significant reductions in hot flash frequency, joint pain, and fatigue were found in the yoga group compared to the controls. Menopausal symptoms have been shown to dramatically reduce sexual health outcomes.(61)

CORTISOL: LINKING PHYSICAL AND PSYCHOLOGICAL MEASURES

A six week yoga intervention carried out in 2009 measured salivary cortisol levels among women receiving radiation treatment for breast cancer.(99) Cortisol is a steroid hormone that is released in response to stress or low blood glucose levels. Significant differences between the yoga and control groups in anxiety, depression, stress, morning salivary cortisol levels and pooled mean cortisol levels were found. The authors hypothesize that yoga may mitigate psychological symptoms associated with survivorship by affecting the circadian patterns of cortisol release. This preliminary study, linking physical measures with psychological outcomes represents an important step in understanding some the physiological mechanisms underlying the physical benefits of participation in yoga. The importance of both physical and psychological factors to overall female sexual health was discussed earlier in this chapter; the study by Vadjiraja et al.(99) provides support to the theoretical foundation for yoga therapy as a plausible intervention for issues with sexual health.

PSYCHOLOGICAL

The psychological benefits of yoga therapy interventions for BCSs are more firmly established than the physical benefits. A meta-analysis carried out by Lin et al.(92) found significant overall improvement for depression ($p=0.002$), anxiety ($p=0.009$), distress ($p=0.003$) and stress ($p=0.006$) among yoga therapy participants compared to controls. Other studies have also found significant improvement in levels of anxiety, (93,96,99) depression, (90,93,96,99,100) and stress.(90,99,101) Psychological health is also highly correlated with sexual health outcomes.(50,51)

To measure the impact of the yoga therapy intervention on the psychological domain of BCSs' QOL, the Brief Symptom Inventory was used.(102) This 53 item scale has high validity and reliability and is often used among

populations with chronic disease, including BCSs.(103) Each of the scales used will be discussed at length in Chapter 2.

SOCIAL

Although fewer in number, some of the yoga interventions carried out among BCSs have also considered measures related to the social domain of overall QOL. Social support, including the support of partners, family members, and others, is linked with better sexual health outcomes.(35,49,63) Measures of social support are relatively rare in yoga interventions for BCSs. One of the few studies that considered a measure of social well-being did find a significant improvement within yoga participants compared with controls. The importance of social support to overall QOL is well established in survivorship research (38,39); the capacity of yoga therapy to aid in addressing the social needs of BCSs presents a field requiring further research. For the purposes of this thesis, the Medical Outcomes Survey-Social Support (MOS-SS) scale was used to assess social support among participants.(104)

SPIRITUAL

The links between spirituality, overall health and sexual health present one of the more tenuous relationships in survivorship research; part of the difficulty lies in establishing a working definition of spirituality that is widely generalizable . Theory provides some definitions, including meaning making and transcendence.(26,37) Within the literature on yoga interventions for BCSs, spirituality has been measured using the FACiT-S, and significant improvement has been found.(90,93) This area of research also requires further work to develop understanding of the links among spirituality, sexual health, and overall QOL.

While religion can have a role in spirituality, many non-religious people may self-identify as spiritual. The tenuous nature of the relationship among sexual health, spirituality, and QOL preclude its inclusion within this analysis of sexual health outcomes in relation to the yoga therapy intervention.

OVERALL QOL

Significant improvement in overall QOL was found in two previous yoga therapy interventions. (90,91) In this thesis, no single scale was used to measure overall QOL. Although two of the scales utilized in the broader project encompass both physical and psychological domains, no single scale included measurements pertaining to each of the four domains of interest. As a result, for the purposes of this thesis, each domain is measured separately using a single scale for each of the three QOL domains (physical, psychological, and social).

1.5 YOGA AND SEXUAL HEALTH PROBLEMS

The multi-faceted complexity of women's sexual health has been discussed widely here. No studies have reported sexual health outcomes of yoga interventions in BCSs to date, aside from a single, uncontrolled, observational

study which found that yoga had a positive effect on Sexual Function.(105) However, it has been suggested that based on non-empirical experience, yoga may be a beneficial treatment for sexual health problems in women. (85)

RATIONALE

Given the evidence surrounding what is known of the experience of BCSs with sexual health issues, the effects of yoga therapy, and literature drawing from both the survivorship and QOL fields, it seems appropriate to examine the relationship between yoga therapy and changes in sexual health outcomes. The effects of breast cancer and its treatment on sexual health have been the focus of numerous studies within the realm of survivorship research. However, the complexity of female sexual health, the serious and prolonged nature of sexual health problems among BCSs, and increasing evidence implicating multiple domains as causal to each of Sexual Interest, Sexual Function, Sexual Satisfaction, and Overall Sexual Health create a compelling rationale for exploring CAM approaches to treatment. Yoga therapy, as a form of CAM, has a non-empirical literature base that supports its use as a treatment for sexual health problems in women; this form of treatment has yet to be empirically examined as an intervention for sexual health problems among BCSs. This thesis will examine the effects of a yoga therapy intervention on the sexual health outcomes in a group of BCSs in Vancouver, B.C.

RESEARCH QUESTIONS:

- 1) Does participation in a yoga therapy intervention improve sexual health outcomes among female BCSs?
- 2) Are there any significant differences in sexual health outcomes between the Anusara and Iyengar intervention groups?

CHAPTER 2: METHODS

This chapter will outline the overall study design, describe the Yoga Therapy Intervention (YTI) study, and provide details on the specific framework and statistical analysis utilized for exploring the effect of a YTI on sexual health outcomes. The data for this thesis was drawn from a larger study that investigated the effect of a YTI on a broad range of health outcomes. It is, therefore, important to first describe the larger study and then situate this thesis within the larger study. To differentiate between the larger study and this thesis, the larger study will be specifically referred to as the larger study, and the background, methods, and results pertaining solely to this thesis will be referred to as this thesis. It is also pertinent to note that although the YTI will be referred to as a single intervention; two yoga modalities were actually carried out within this study: an Anusara modality, and an Iyengar modality. These two modalities of yoga and the structure of each YTI will be described in section 2.2.

2.1 CONCEPTUAL OVERVIEW AND STUDY DESIGN

ETHICS

Ethics approval was provided by the Behavioural Research Ethics Board (BREB) at UBC (H10-01430) on August 24, 2010. Specific approval for this research was given in a Post Approval Activity (PAA) (H10-01430-A002) on April 3, 2012.

YTI STUDY DESIGN AND RATIONALE

Interest in and use of Complementary and Alternative Medicine (CAM) among breast cancer survivors (BCSs) to treat adverse, cancer treatment-related symptoms is growing in Canada.(106–108) After conventional treatment is completed, BCSs in Canada often receive fragmented, uncoordinated care that further contributes to the adverse symptoms experienced.(109) However, the benefits and drawbacks of the use of various CAM modalities, including yoga therapy, within this population, and their interactions with conventional cancer treatments, are not well understood.(106) Due to these factors, a study was designed to examine the relationship between participation in a YTI and changes in overall QOL. For this thesis, we were interested in both the sexual health outcomes relative to yoga as a homogenous entity (both modalities combined) and (if present) the disparate effect of yoga modalities (Anusara and Iyengar), compared to waitlisted controls.

The larger YTI study was designed to be a three group randomized controlled trial, with a minimum of 10 participants randomly allocated to one of the two yoga groups (Anusara or Iyengar) or the wait-listed control group. However, due to recruitment issues (see below), the participants were not formally randomized. As a part of the larger study outlined above, which examined health outcomes across the physical, psychological, social, and spiritual domains, this thesis will explore the sexual health outcomes of the YTI study undertaken.

RECRUITMENT

We recruited participants from three main locations in Vancouver, B.C.: a local cancer centre, an ambulatory breast clinic, and an integrative oncology centre, where both conventional and CAM approaches are facilitated. The study description, eligibility requirements, and a self-report baseline assessment package that included our informed consent form were available at each location. Two research assistants made weekly visits to each of the three above locations to replenish the supply of assessment packages, collect completed assessments, and informed consent forms, and maintain regular communication with administrative and clinical personnel regarding the recruitment process. Regular, in-person interactions with sociobehavioural staff, nursing and administrative staff at the Vancouver Cancer Clinic and Centre, as well as the administrative staff at the integrative oncology centre (Inspire Health) served two purposes: 1) to increase awareness of the intervention, and 2) to pick up completed assessments. These visits were carried out between October 2010 and June 2011. The staff at each of the locations were helpful and interested in the study, and assisted recruitment by informing BCSs about the study, and directing them toward our recruitment information and assessment packages, which we had placed in lobbies and waiting rooms in conspicuous places.

We asked interested participants to complete an assessment package and informed consent only if they met eligibility requirements. Women who heard about the study outside of the contexts described above contacted the Principal Investigator and were screened over the phone for eligibility. Assessment packages were then mailed, emailed, or dropped off as suited the participant. We also checked assessment packages that had been completed by potential participants upon receipt to ensure eligibility requirements were met and informed consent had been given.

To further disseminate information about the intervention, we ran recruitment ads in the classifieds of national and local newspapers. Finally, local and national breast cancer organizations, an office in the local cancer agency that provides information on use of CAM to cancer survivors, and the integrative oncology centre described above, circulated information about the YTI study to their list-serves. Within the email, we encouraged interested and eligible BCSs to contact the team. Participants who we had recruited by either of these methods were screened by phone. If eligible, we asked participants to either pick-up an assessment package at one of the three locations described in the previous paragraph or we emailed, mailed, or dropped off assessment packages in a pre-arranged location as requested by the potential participant.

Despite this effort, recruitment was slow, and the deadline for participation in the study required extension so that adequate numbers could be achieved within each of the three groups. Originally, we had anticipated that the intervention would start at the beginning of September 2010. Instead, the two intervention modalities (Anusara and Iyengar) started classes in February, 2011. We continued the recruitment as described above and we placed all women who were recruited after the February start-date into the wait-listed control group. While randomization

was possible for allocation to one of the two intervention groups, the control group was formed after the initial intervention had begun; as a result, we did not formally randomize the participants in this study. Instead, this intervention study took the form of a controlled, observational study.

ELIGIBILITY

Eligibility requirements for participation in this YTI study required adjustment when it became clear that recruitment was slow. Originally, the requirements included: diagnosis of breast cancer within the preceding 12 months, receipt of at least one form of conventional cancer treatment (surgery, chemotherapy, radiation therapy and/or hormone therapy), a minimum of 4 weeks post-surgery at the start of the intervention, and the ability to commit to attending 12 weeks of yoga classes. In January 2011, we changed the eligibility requirements from diagnosis within the preceding 12 months to diagnosis within the preceding 18 months. This change was necessitated by the long recruitment period, which was extended by 6 months, to a total recruitment period of 9 months. We maintained all other eligibility requirements. We considered participants to be ineligible if they did not have adequate English language skills to complete an assessment package.

POWER

To understand the power of any study, three things must be considered: sample size, effect size, and experimental scatter (p.138).(110) Power is defined by the demonstration of a real association within a study, and mathematically as $1 - \beta$ (or type II error, error that involves a failure to reject a false null hypothesis) (p. 138).(1) Power calculations are carried out to understand the probability that, given an actual difference in the population, a statistically significant difference will be observed in the sample. In this thesis, the objective was twofold: 1) to understand whether a statistically significant difference in sexual health outcomes exists between BCSs who participate in a YTI (Anusara and Iyengar combined) and BCSs who do not participate, and 2) to determine if there is a difference between the two intervention groups (Anusara and Iyengar). However, these specific power calculations were not carried out in the design phase of this YTI study, and post-hoc power calculations are not considered to be useful.(111) Clinical significance, or clinical importance, is arguably more important in a pilot study, as it considers the difference in effect size based on whether or not that effect size is meaningful in a real-life context, based upon expert opinion (p.31).(1) As such, results will be evaluated for statistical significance, and also for the clinical significance of any observed change.

Conducting traditional randomized controlled trials within yoga therapy is difficult for a number of reasons; blinding participants (BCSs) to their intervention group, and blinding therapists (yoga teachers) as to whether or not they are leading a control vs. intervention group is very difficult.(92) Class size limitations are inherent in carrying out an effective YTI study, as the quality of the intervention may be compromised if class size exceeds $n=25$. Very few Anusara teachers are certified to administer an Anusara intervention for cancer survivors (Conversation with John Friend, April 15, 2010), and the same is true for the Iyengar Yoga intervention. Conducting

a full scale power analysis would necessitate a highly co-ordinated, international, multi-site intervention study. At this early stage of understanding the effects of yoga on sexual health outcomes within populations of BCSs, such a large undertaking is neither feasible nor appropriate.

ASSESSMENTS

All participants in the YTI study completed two assessments; one assessment at baseline (completed during recruitment) and a follow-up assessment a minimum of 12 weeks after the baseline assessment. For participants in either the Anusara or Iyengar groups the final assessment was completed within a week of the final yoga class. For wait-listed control group participants, the second assessment was completed a minimum of 12 weeks after completing the first assessment. Assessments were designed to cover multiple domains of QOL among BCSs, as well as pertinent CAM usage, medical history, and demographic information.

2.2 STUDY IMPLEMENTATION

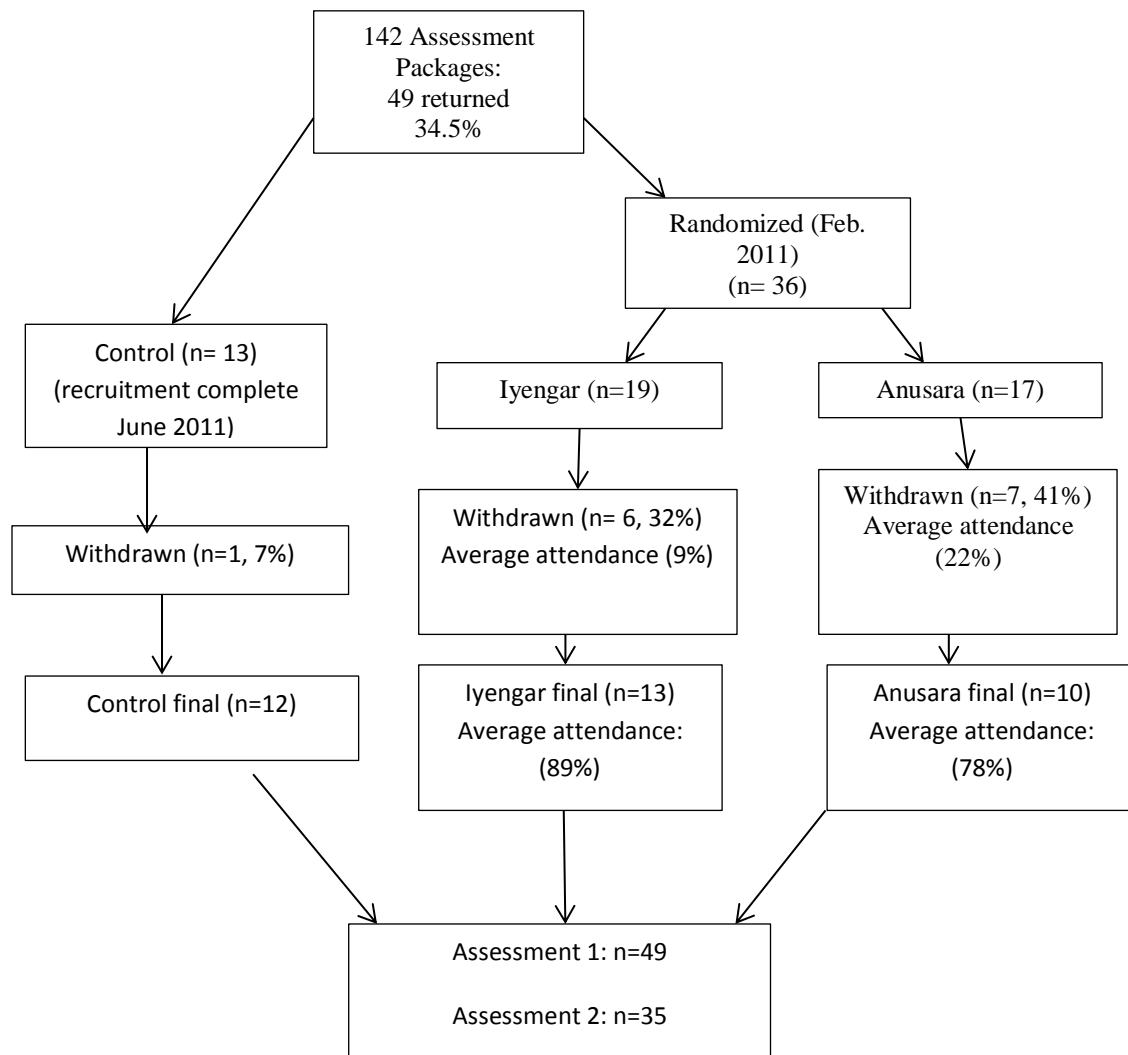


FIGURE 1: PICTORIAL REPRESENTATION OF RECRUITMENT FOR, WITHDRAWAL FROM, AND PARTICIPATION IN YTI STUDY.

We ran the 12-week YTI (both modalities) between February and April 2011, and the wait-listed control group began their yoga classes at the end of July 2011, after completing both assessments. Of the 142 assessments that were distributed, 49 were returned completed (34.5% response rate) (See Figure 1). Of these 49 participants, 36 were randomized using a random number generator, into either the Anusara or Iyengar group (odd=Anusara, even=Iyengar). We assigned participants who returned assessments later than the February start date of the intervention to the wait-listed control group. Of the original Iyengar group (n=19), 6 withdrew (average attendance was 9% of classes among withdrawn). This represents a withdrawal rate of 32%. The final count of Iyengar group

participants was n=13 and the average attendance of classes by this group was 89%. Of the original Anusara group (n=17), 7 withdrew (average attendance was 22% of classes among withdrawn). Withdrawal from the Anusara modality was 42%. The final count of Anusara group participants was n=10 and average attendance in this group was 78% of classes. Reasons for withdrawing from participation in either modality included; having difficulty with scheduling, change in work hours, and not aligning well with the style of the yoga class. In total, 49 baseline assessments were completed while 35 secondary assessments were completed at a minimum spacing of 12 weeks from the initial assessment. Please see Figure 1 above for a pictorial representation of the recruitment for, and participation in, the YTI study.

COMPLIANCE

Due to the small sample size and short duration of the YTI study, it was vital to ensure that barriers to attending all yoga classes were reduced. As cost of yoga was identified as a potential access barrier,(107) all yoga classes were offered free of charge, and all yoga equipment was provided as part of the intervention study. Transportation had been previously identified as an important barrier to attendance by participants in the feasibility study conducted in 2008-2009.(107) Classes were held at locations that were easily accessible by public transit and had parking available within walking distance, and were located outside of the cancer clinics.(107) During the first yoga class, we encouraged and facilitated car-pooling by connecting participants who lived in the same vicinity. For women who required child-care during yoga classes, funding was provided in the form of a reimbursement, drawn from the grant funds. Finally, adverse side effects due to concurrent treatment(s) had been previously described as being an important barrier to attendance.(107) To participate, women needed to be a minimum of 3 weeks post-surgery, and could not be undergoing radiation treatment. Women who were concurrently on adjuvant hormonal therapy or undergoing chemotherapy were included in this intervention study.

ATTENDANCE

Attendance was recorded at each class, and we asked participants to contact the research assistant if a class was missed. Reasons for missing classes included pre-arranged travel plans, family illness, and personal illness, and were communicated to the yoga therapy instructors by the research assistant to maintain an open flow of communication amongst all parties (participants, instructors, and research team). Participants who missed class and did not contact us were contacted by phone or email by the research assistant to ensure continued attendance, engagement, and open communication among participants, yoga therapy instructors, and the research team.

YTI: BACKGROUND AND DESIGN

Both of the YTI modalities employed in this study, Anusara and Iyengar, were designed specifically for BCSs. Each intervention was developed with the knowledge of common symptoms experienced by BCSs, including; pain, fatigue, lymph drainage, physical functioning and psychological distress.

ANUSARA

The meaning of the word Anusara is “to flow with grace”. This form of hatha yoga was founded in 1997 by John Friend and is based upon both a non-dual Tantric philosophy and physical principles of alignment .(112) John Friend was previously an Iyengar certified instructor. Rather than trying to control body and mind in the practice of Anusara yoga, practitioners are encouraged to work from a deeper level, highlighting the importance of the *intention* with which a body posture is entered, over the *form* of the body posture itself.(113) Anusara’s emphasis of *intentionality* separates it from other modalities of yoga that place more emphasis on perfection of form. That is, the emphasis of this yoga modality is not about how you look while doing yoga, but more about how you feel. As such, Anusara is a highly inclusive form of yoga as it is designed to allow each practitioner to move through their yoga practice regardless of level of ability. To date, there has not been a clinical trial conducted utilizing Anusara yoga; however, it has been utilized in a therapeutic environment for chronic illness, including cancer.(114)

The form of the Anusara intervention that was followed in this YTI study was designed by John Friend and senior Anusara-certified instructors based upon knowledge of common symptoms and side effects experienced by BCSs after undergoing conventional treatment. The intervention includes attitudinal and emotional themes (love, compassion with oneself and others) that were embedded directly into postures, breathing and meditation exercises. While attitudinal aims were emphasized, postural objectives were equally important in the design of this intervention. Within the Anusara intervention, two-thirds of each class consisted of being physically active; while the other one-third was *restorative*, which included props (i.e. bolsters, blankets, blocks, and straps).

The team that designed the Anusara YTI included a senior certified Anusara instructor from Canada as well as other senior certified Anusara instructors from the USA. The Canadian instructor is a senior National Yoga Alliance certified instructor, a certified teacher trainer, and has extensive experience working with chronically ill participants. As the most senior Canadian Anusara certified instructor, she helped select local certified teachers and assistants to teach the Anusara intervention, as she does not live in Vancouver. On any given day within the Anusara classes there were two to three assistants as well as the teacher. Anusara classes were held every Friday morning at a private yoga studio in Vancouver, B.C., between February and May 2011.

IYENGAR

Iyengar yoga is a highly utilized form of hatha yoga,(115) created by B.K.S. Iyengar and philosophically aligned with the Krishnamacharya tradition.(116) Iyengar yoga is unique from other forms of yoga based on 3 key elements; namely: *technique* (how you enter, hold, and exit postures or *asanas*), *sequence* (the sequence of postures within a session of yoga), and *timing* (the amount of time you hold each posture).(27) A therapeutic form of Iyengar has been designed by B.K.S Iyengar and utilized in similar cancer interventions (See, for example(95)). This restorative form of Iyengar yoga was designed to alleviate physical and psychological suffering and as a preventive measure for overall health.(116) Iyengar practice relies heavily on a variety of props, including blocks, straps, and blankets, to ensure that each practitioner is properly aligned regardless of their ability level. This approach allows all participants to feel comfortable as they gain strength, stability, stamina, confidence, and flexibility in their practice. The sequence utilized in this intervention was slowly adapted as mobility and strength increased among the participants throughout the 12-week intervention.

Iyengar classes were taught by a senior instructor at a local private yoga studio in Vancouver BC, who is also the director of that studio. She has over 30 years of experience in teaching Iyengar Yoga, and is one of only a few senior instructors certified to teach Iyengar's intervention for cancer survivors. She is also a qualified teacher trainer, registered with the National Yoga Alliance and has extensive experience working with cancer survivors. Classes were held every Thursday afternoon for 12 weeks, from February until May 2011. In this class an average of eight Iyengar teachers were present to assist participants in moving through their practice. As a result, a certified teacher provided individualized support to one or two participants at each session. A research assistant was also present at each class as a non-participant. Notes were taken, and a sequence was recorded. The Iyengar modality was based on a similar clinical trial, conducted in Canada, which explored the effect of Iyengar yoga on BCSs.(117)

WAIT-LISTED CONTROL

The wait-listed control group completed the baseline assessment and informed consent upon recruitment. Participants were screened for eligibility and then contacted to confirm participation. At a minimum of 12 weeks from completing the baseline assessment, participants were asked to complete the second assessment. Ideally, this time frame should have overlapped with the 12 week intervention group classes; however, due to the issues with recruitment (discussed above) this was not possible. Weekly yoga classes were then provided free of charge at a yoga studio. These classes were taught by the Principal Investigator of this study, who is also Co-Owner and Director of the yoga studio, and an Anusara-Inspired yoga teacher.

2.3 ASSESSMENTS

All participants completed two self-report assessments, one at baseline, and another a minimum of 12 weeks later. Each assessment included 13 (baseline) or 12 (follow-up) sections. Participants were asked to complete all sections and return the assessment to the research team. The full assessment comprised 13 sections and included 11 validated scales, a demographic and medical history section, and a CAM usage section; the included scales were selected as they measure distinct aspects of QOL among cancer survivors that fit within the four domains discussed in Chapter 1 of this thesis. As this thesis is specifically concerned with sexual health outcomes, an analytical framework was developed based upon the work of Ganz et al.,(36) the broader literature on sexual health predictors (discussed in Chapter 1), and the available data from the YTI study that was described above (Sections 2.1 and 2.2). Four of the scales, as well as information from the demographic and medical, and CAM utilization sections were used to carry out the analysis for this thesis. The following section will first describe the framework that was constructed to guide the analysis presented in this thesis, and will then present the details of how the available data were utilized within the framework.

2.4 ANALYTICAL FRAMEWORK OF SEXUAL HEALTH OUTCOMES AMONG BCS

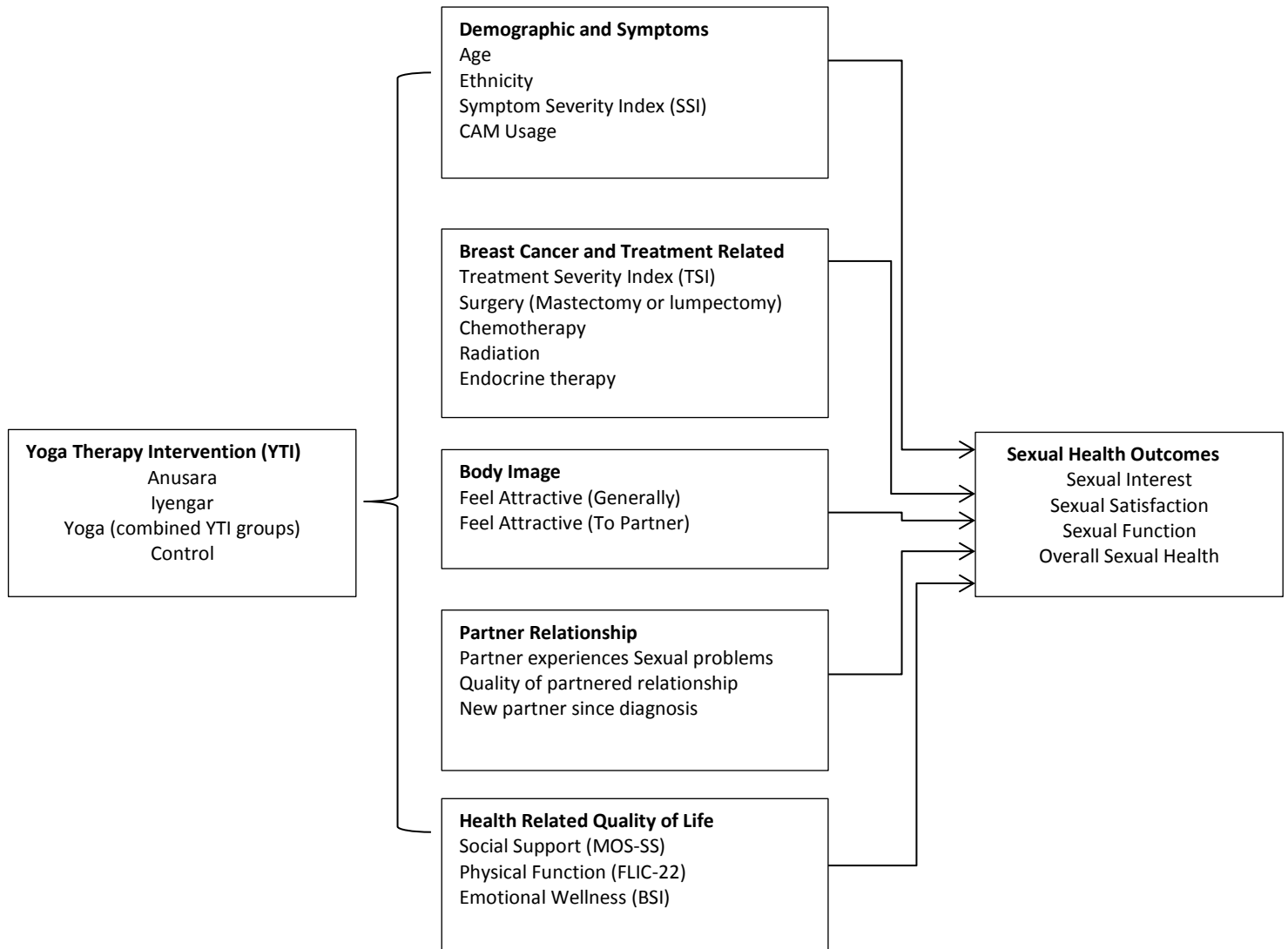


FIGURE 2: ANALYTICAL FRAMEWORK GUIDING INQUIRY INTO THE SEXUAL HEALTH OUTCOMES OF A YTI STUDY AMONG BCSS

Figure 2 depicts the framework used to guide the analysis of sexual health outcomes among the YTI participants. As indicated in this framework, analyses were carried out based upon participation in either of the yoga modalities (combined), participation in Anusara or Iyengar modalities (separate), and participation in the control group. Although the primary objective of this thesis is to explore the change in sexual health outcomes based upon participation in the YTI study, changes to sexual health outcomes are understood to be *multifactorial*, as a combination of factors can influence or cause changes to sexual health outcomes (p.118).(1) Based upon a literature review (See Chapter 1), sexual health predictors (variables) were established. Previous work by Ganz et al. (36) had delineated five domains of sexual health predictors among BCSs and four sexual health outcomes (See Figure 2). The five domains of sexual health predictors include information pertaining to each of the following categories: medical and demographic, breast cancer and treatment related, partner relationship, body image, and health related quality of life. The four sexual health outcomes delineated by Ganz et al.(36) include Sexual Interest, Sexual Satisfaction, Sexual Function, and Overall Sexual Health. The data available from the YTI study differed from that collected by Ganz et al. (36) However, their overall framework was used to guide the organization of our available data such that similar domains and outcomes were constructed. The sexual health covariates hypothesized to affect the three sexual health outcomes of interest are discussed in this section. A covariate is understood here as “a variable that is possibly predictive of the outcome under study. A covariate may be of direct interest to the study or may be a confounding variable or effect modifier” (p.42).(1) A note on predictors, confounders and effect modifiers, and how they will be identified (if possible) and mitigated within this thesis precedes the detailed discussion of the analytical framework presented in Figure 2 (above).

PREDICTORS, CONFOUNDERS, AND EFFECT MODIFIERS

In the framework guiding the analysis plan for this study, there are a number of predictors (covariates) of sexual health that may be considered effect modifiers or confounders. Effect modifiers can be detected using stratification methods and are defined as factors that can modify the effect of a given predictor (p.57).(1) Confounders can be defined in a number of ways; here, confounders are situated outside of the causal pathway, as a third variable that influences the association between independent and dependent variables, are causally related to the outcome *and* associated with the exposure (p.154).(2) Within this thesis, the exposure of interest is participation in a YTI, and the outcomes of interest are changes in sexual health. An example of a predictor (or covariate) is emotional wellness, as measured by the BSI. An effect modifier, based upon the literature review conducted, may be the age of a participant. As confounders may be unknown factors, they are adjusted for at the design stage (through randomization) and, secondarily, through use of adjustment methods (p.154).(2) By conducting multivariate analyses, possible confounders can be adjusted for based upon their influence on the outcome(s) of interest. Effect modifiers are generally addressed using stratification methods.(118) In the following sections, variables will be discussed as predictors, possible confounders, or effect modifiers (as appropriate) in the relationship between participation in the YTI study and sexual health outcomes.

The following section will also describe how each of the independent variables and covariates (sexual health predictors) as well as the dependent variables (sexual health outcomes) were drawn from the available data. First, the sexual health predictors outlined in Table 1 lists the domain, the independent variables, and the independent variables as available from this data set. These predictors will be described in detail. Then, detailed descriptions of the sexual health outcomes, as drawn from the available data set will follow.

2.5 SEXUAL HEALTH PREDICTORS

TABLE 1: SUMMARY OF INDEPENDENT VARIABLES AND COVARIATES¹

Domain	Independent Variables and Covariates	Variable form as Available in Data from YTI
Intervention	Anusara Iyengar Yoga (combined Anusara and Iyengar) Control	Grouping
Medical and Demographic	Age Ethnicity Symptom Severity CAM Use	Date of Birth Caucasian/Other Number of words endorsed Number of words endorsed
Breast Cancer and Treatment Related	Chemo (y/n) Radiation (y/n) Hormone (y/n) Surgery (y/n) Type of surgery Mastectomy Lumpectomy	Number of treatments listed N_Chemotherapy N_Radiation N_Hormone N_Surgery N_Surgery_Detail
Partner Relationship	Sexual Problems Quality of Partnered Relationship New partner since diagnosis Being in a Relationship	MFSQ Item 19 MFSQ items 10 & 11 N6_month N6_year and N2_B
Body Image	Attractive (Generally) Attractive (To partner)	MFSQ Items 7 and 8

¹ Note: Items indicated as N# are items drawn from the assessments, and are provided in Appendix A for reference. MFSQ is the abbreviation of McCoy Female Sexuality Questionnaire, which was used to measure sexual health outcomes in this study.

Domain	Independent Variables and Covariates	Variable form as Available in Data from YTI
HR-QOL	Emotional Wellness Functionality Social Support	BSI Global score FLIC-22 score MOS-SS score

MEDICAL AND DEMOGRAPHIC

Age, self-reported ethnicity, Symptom Severity and CAM usage at baseline are included in this category. In this study, age was considered at the bivariate level as both a continuous and a categorical variable. Previous research has distributed female BCSs into three groups based on age. These groups are: <50, 50-69, >69.(36) By examining age as a categorical variable, the possibility that age acts as an effect modifier on sexual health outcomes can be explored. Ethnicity was reported with a single question that asked participants to self-report their ethnicity. No categories were provided.

COMPLEMENTARY AND ALTERNATIVE MEDICINE USE

The use of other modalities of CAM by participants may have an impact on sexual health outcomes. CAM use may act as a predictor or confounder in the relationship between YTI participation and sexual health outcomes, and so will be included in our multivariate model. This is because the previous use of CAM modalities may be indicative of an unmeasured trait in participants, or may have a direct effect on participants' sexual health. Participants were provided with a list of CAM modalities and asked if any were utilized during the course of treatment. The following list was provided:

Acupuncture
Ayurvedic Medicine
Chiropractic
Dietary Supplements, Vitamins/Minerals
Guided Imagery or Meditation
Massage Therapy
Traditional Chinese Medicine

Reiki/Qi Gong
Tai Chi
Herbal Medicine
Homeopathy
Lifestyle: Exercise, Stress or Sleep Management
Nutrition Therapy
Yoga

Participants could indicate the use of up to 14 CAM modalities; as such, scores ranged from 0-14. CAM usage may have an impact on the change in sexual health outcomes of interest, although it is not clear which directionality the relationship between sexual health and CAM use will display. CAM usage was treated as a continuous variable in model design.

SYMPTOM SEVERITY INDEX

The baseline assessment requested information about comorbidities experienced by participants due to their cancer trajectory, which we labelled as Symptom Severity Index (SSI). The list comprised a total of 16 possible comorbidities including:

Psychological Distress
Depression
Poor Family Functioning
Intimacy Issues
Social Anxiety
Muscle Cramping
Cognitive Dysfunction
Poor Self Esteem

Considerable Fatigue
Insomnia
Loss of Libido
Poor Physical Functioning
Nausea
Chronic Pain
Loss of Appetite
Digestive Imbalances

The SSI associated with this analysis is based on the number of words from the list above that were endorsed by the participant at baseline, with a total score ranging from 0-16. These comorbidities were selected because they are known side effects of a breast cancer diagnosis and its treatment, and are also known to impact an individual's QOL. A higher number on the SSI is indicative of a greater number of comorbidities, and therefore, a lower rate of Overall Sexual Health. The number of comorbidities endorsed by a participant may be a confounder for changes in sexual health outcomes, and so will be adjusted for within the multivariable analysis. The SSI acts as a baseline comparison among participants for the severity of symptoms experienced. It is hypothesized that participants with higher SSI scores will experience lower rates of improvement in sexual health outcomes.

BREAST CANCER TREATMENT RELATED VARIABLES

Predictors of sexual health falling within this category include factors associated with the conventional treatments received. Treatment variables include surgery (lumpectomy or mastectomy), chemotherapy, radiation, and endocrine therapy. Each of these variables was treated as binary, as participants either received the treatment, or they did not. A Treatment Severity Index was also created based upon the number of treatments any single participant received. The number of treatments and type of treatment received by a participant may act as a predictor for sexual health outcomes, and so will be considered for inclusion in the multivariate modeling stage.

TREATMENT SEVERITY INDEX

Participants provided information about the types of treatment they had received over the course of their cancer trajectory. These included: surgery, chemotherapy, radiation, and hormonal therapies. The Treatment Severity Index (TSI) was constructed based upon the number of treatments received by a participant ranging from 1 (all participants underwent surgery) to 4+ (some participants were prescribed, for example, multiple types of hormonal treatments or chemotherapy drugs). Although participants were asked about the type of tumour and level of malignancy in the assessments, the highly varied form of response made it difficult to correctly assess the

relative severity of cancer diagnosis. This index provides a simple measure of the severity of the treatment regimen experienced by each participant and is therefore thought to be highly correlated with tumour type and malignancy level. It is hypothesized that more severe treatment regimens will result in lower baseline levels of sexual health outcomes of interest, and that increased TSI may be inversely correlated with sexual health changes, and act as a confounder in understanding the relationship between a YTI and sexual health outcomes.

PARTNER RELATIONSHIP

The importance of intimate relationships to female sexuality is incorporated into this framework by including this category of predictors. This category includes 4 predictors, being in a relationship, having started a new relationship since being diagnosed with cancer, having a partner with sexual problems, and the quality of the partnered relationship.

RELATIONSHIP STATUS

Participants were asked to report on their relationship status at the time of first assessment (See Appendix A for details). Partnered status is an important predictor of sexual health outcomes (see Section 1.2).

NEW PARTNER SINCE DIAGNOSIS

Having a new intimate partner since diagnosis was significantly associated with increased Sexual Interest.⁽³⁶⁾ This information is available as a compound variable as both date of diagnosis and relationship information were requested in the assessment packages. This predictor is treated as a binary variable for modeling purpose.

PARTNER HAS SEX PROBLEMS

In determining the Sexual Satisfaction of an individual, the importance of acknowledging the presence of Sexual Function issues in a sexual partner was solidified in the model of sexual health created by Ganz et al.⁽³⁶⁾ The McCoy Female Sexuality Questionnaire (MFSQ) also contains an item that asks for information about a partner's Sexual Function (erectile problem, partner).⁽¹¹⁹⁾ This item was employed in the study framework as an indicator of sexual problems experienced by a participant's partner. This predictor was included as a continuous variable, with scores ranging from 1-7.

QUALITY OF PARTNERED RELATIONSHIP

The quality of a participant's intimate relationship (QPR) was measured using two items pertaining to satisfaction with one's partner from the MFSQ. These are satisfaction with one's partner as a friend, and satisfaction with one's partner as a lover. Again, these items are scored on 7-point Likert scales with varied anchors appropriate to answering each item, higher scores correlate with increased satisfaction with one's sexual partner. This predictor was included as a continuous variable, with scores ranging from 2-14. Of interest here is the change in the quality of the partnered relationship. It is hypothesized that participants who have higher satisfaction within their

partnered relationships, have started a new relationship recently, or have partners with fewer sexual health problems, will also have increased positive change in measured sexual health outcomes.

BODY IMAGE

The second to last category of independent variables is based on the participants' body image; feeling sexually attractive correlates well with a woman's positive body image.(120,121) This concept is measured by the MFSQ using two items; feeling sexually attractive in general, and feeling sexually attractive to one's partner. Both of these items are answered using a 7-point Likert scale with anchors ranging from 1 (not at all sexually attractive) to 7 (extremely sexually attractive).(119) The resulting range of scores is between 2 and 14, with higher scores indicating increased sexual attraction. This predictor will also be included as a continuous variable. Higher body image is hypothesized to impact sexual health outcomes positively.

HEALTH RELATED QUALITY OF LIFE

The following variables have been hypothesized to influence the sexual health outcomes of interest, and are scales representing important aspects of health related Quality of Life (HR-QOL). Each of the following scales was included as a continuous variable, and the scores from Assessment 2 were used in models predicting change in the sexual health outcomes of interest.

EMOTIONAL WELLNESS

Emotional wellness was measured using the BSI (Brief Symptom Inventory).(102) Psychological health is an important aspect of overall QOL, as well as a significant predictor of Sexual Interest in BCSs.(36) The Brief Symptom Inventory (BSI) is a 53 item scale with 5 point anchors ranging from 0 (not at all) to 4 (extremely).(103) Although the BSI has been broken down into 9 subscales, not all have been shown to have an acceptable fit, and many are highly sensitive to sample size. As such, only the global score (Global Severity Index or GSI) was utilized in this thesis. The GSI is calculated as the mean of all 53 items and adjusted according to a process described in the BSI Handbook.(102) Scores are interpreted based on established appropriate comparison group scores. GSI T scores are considered to be 'clinical cases' (that is, clinical attention may be required for depression and anxiety) at a value equal to or greater than T=63 (or 0.63).(103) The GSI score has a test-retest reliability of 0.90.(122) This scale was included in both the baseline and 12 week assessment packages. We considered the second assessment mean score for this measure rather than the change in score between assessments. This was decided because the second assessment score holds enough information to compare to the changes in sexual health outcomes, and is a simpler approach than comparing a change in score to another change in score.

FUNCTIONAL WELL BEING

Functionality was measured using the Functional Living Index-Cancer (FLIC-22), which is a 22 item, 7-point Likert scale that measures cancer-specific (based on both cancer and cancer treatment) functional wellbeing.(97) An individual's functional ability based on known effects of cancer and cancer treatments are assessed by this scale.

Physical wellbeing is known to affect sexual health outcomes.(51) This scale is scored such that a meaningful overall score, as well as 5 subscale scores are produced. The five subscales are; physical well-being, psychological well-being, hardship due to cancer, social well-being, and nausea.(123) Scores range from 22 to 154; higher scores represent a better health-related QOL.(123) Estimates of reliability based on linear mixed models produced an average reliability of 0.79 (95% CI: 0.725, 0.846).(124) Here, the overall score from the second assessment was used for analysis.(124)

SOCIAL SUPPORT

Social support is an important contributor to both overall QOL and to sexual health.(36) The MOS -Social Support (MOS-SS) Survey was developed for patients enrolled in a 2 year study examining patients with chronic conditions, and has good construct validity.(104) The scale has 19 items and can be scored on an overall support index as well as on four subscales; emotional/informational (8 items), tangible (4 items), affectionate (3 items) and positive social interaction (3 items), there is also a single additional item that is included in the overall score. This survey uses 5-point Likert scales for each item, with anchors ranging from 1 (none of the time) to 5 (all of the time). Scores for subscales can be found by averaging all items within the subscale. Reliability for the MOS-SS total score and four subscales range from $r = .91$ to $.97$, and are stable over time (12 months).(104) A coefficient alpha of 0.96 was obtained in the present sample. The authors report multi-trait scaling analysis that supports four dimensions of functional support and an overall social support index.(104)

COLLINEARITY

An important consideration in a framework comprising multiple covariates is collinearity. Collinearity occurs when there are high rates of correlation among independent variables (p.35).(53) Correlation is defined as the amount that variables change together, or are related (p.41).(1) The use of the terms relationship or association is also common, and are both synonymous with correlation (p. 7).(1) It is important to note that correlation (or relation or association) are not meant to imply causation. Instead, a form of multiple variable analyses will be used to assess the strength of the relationships between participation in a YTI and changes in sexual health outcomes. Finally, within a study framework where multiple covariates are being considered, the concept of multicollinearity must be taken into account. Multicollinearity occurs when independent variables show high levels of correlation (p. 118).(1) If multicollinearity is present, the multivariable model utilized may give inaccurate estimates. As such, multicollinearity will be addressed by employing Pearson's product-moment correlation tests for suspect variables.

The primary outcomes of interest, those related to sexual health, were measured using the McCoy Female Sexuality Questionnaire (MFSQ).(119) Based upon previous research on the sexual health of BCSs, and the benefits of yoga therapy, a framework was established with hypothesized predictors for each of four domains of sexual health outcomes.(36) Based upon existent literature, social support, physical functioning, and emotional wellness were hypothesized to play a role in Overall Sexual Health.(36) As discussed in Chapter 1, the conceptual framework

(See Fig. 2.3) used to guide this inquiry comprises each of these domains, as well as pre-established predictors of sexual health among BCSs drawn from the literature (see Section 1.2). 2.6 Sexual Health Outcomes

SEXUAL HEALTH OUTCOMES

Sexual health outcomes were categorized into four main groups: Sexual Interest, Sexual Satisfaction, Sexual Function and Overall Sexual Health. The literature, while often including these exact terms, contains a multitude of various constructs. For example, Ganz et al. used the CARES scale⁽¹²⁵⁾ to measure Sexual Interest (4 items) and sexual (dys)function (4 items), and a single item to measure Sexual Satisfaction.⁽³⁶⁾ This thesis drew upon the available data for sexual health outcomes as collected for the YTI study, the McCoy Female Sexuality Questionnaire.⁽¹¹⁹⁾

The McCoy Female Sexuality Questionnaire (MFSQ) is a 19-item scale that has been designed to assess changes in the quality of peri-menopausal women's sexual health. There has been a lack of conformity in utilizing this scale in research.⁽¹¹⁹⁾ Previous studies have used anywhere from 7 to 19 of the items in assessing women's sexual health around menopause.⁽¹¹⁹⁾ Seventeen items from this scale have been grouped into five domains associated with sexual health; Sexual Interest (4 items, 23.1%), Sexual Satisfaction (3 items, 11.1 %), lubrication (3 items, 8.1%), sex partner (3 items, 7.3%), and orgasm (4 items, 7.7%).⁽¹¹⁹⁾ The percentage of variance explained by each domain (given the overall scale) is provided after the number of items in brackets. Two more items which measure 'attractivity' (sexual attraction) are also part of the MFSQ.⁽¹¹⁹⁾ Correlations between the 19 individual items and total scores are highly varied, ranging from 0.12-0.74. This scale has a two-week test-retest correlation (Pearson's R) of 0.83 (reliability) ⁽¹²⁶⁾, an internal consistency $\alpha=0.76$ ⁽¹²⁷⁾, and a standardized item $\alpha=0.80$.⁽¹¹⁹⁾

The Likert scales used are bracketed carefully such that they are answered on a continuum, rather than discretely. Item 12 requires conversion to a 7 point scale, and item 16 must be reverse scored. The range of scores for this 19-item test lies between 19 and 133, with higher scores indicating increased Sexual Functioning. Items 1 to 11 can be answered by all participants, while items 12 to 19 are only answered by those women who have engaged in vaginal intercourse.⁽¹¹⁹⁾ A higher overall score is indicative of better sexual health. No average scores are available in the existent literature. Clinical significance will be determined based upon the approach proposed by Juniper et al.⁽¹²⁸⁾ That is, a difference of 0.5 on a scale of 1-7 is considered to be of clinical significance.

The MFSQ was used to measure changes in sexual health outcomes among participants. Total average scores, as well as subscale scores, for both the baseline and 12 week assessments, as well as mean differences between assessments were calculated for each of the Anusara, Iyengar, and wait-listed control groups. The four sexual health outcomes included in the analytical framework (Figure 2) will be discussed next.

TABLE 2: ITEMS INCLUDED IN MCCOY FEMALE SEXUALITY QUESTIONNAIRE

<u>Item</u>	<u>Item Anchors (1-7)</u>
(1) Enjoyment of sexual activity	Not at all enjoyable - extremely enjoyable
(2) Satisfaction with frequency of sexual activity	Too infrequent - too frequent
(3) Frequency of sexual thoughts and fantasies	Never - more than ten times a day
(4) Excitement/arousal during sexual activity	Not at all excited - extremely excited
(5) Level of Sexual Interest	Extremely low - extremely high
(6) Vaginal lubrication	Absent – excessive
(7) Sexually attractive, generally	Not at all sexually attractive - extremely sexually attractive
(8) Sexually attractive, to partner sexually attractive	Not at all sexually attractive - extremely
(9) Decreased satisfaction due to partner's disinterest	Every time – never
(10) Satisfaction with partner as lover	Not at all satisfied - extremely satisfied
(11) Satisfaction with partner as friend	Not at all satisfied - extremely satisfied
* (12) Frequency Sexual intercourse	(past 4 weeks) (Reported frequency)
(13) Enjoyment of sexual intercourse	Not at all enjoyable - extremely enjoyable
(14) Frequency of orgasm	Never - every time
(15) Pleasure of orgasm	Slightly pleasurable - extremely pleasurable
(16) Additional stimulation needed to reach orgasm	Never - every time
(17) Insufficient lubrication	Every time – never
(18) Painful sexual intercourse	Every time – never
(19) Erectile problems, partner	Every time – never

*This item was excluded in this thesis, as discussed below.

In order to analyze the data to allow meaningful comparisons with the literature, the sexual health outcomes measured by the McCoy Female Sexuality Questionnaire were organized according to the conceptual framework constructed by Ganz et al.(36) This framework separates sexual health outcomes into four categories: Sexual Interest (interest in sexual activity), Sexual Function (difficulties with orgasm, lubrication) Sexual Satisfaction (satisfaction with frequency and quality of sexual activities) and Overall Sexual Health. Table 3 provides a full item list for each of the sexual health outcomes assessed in this study. While the MFSQ items have been kept within the originally designated domains (Interest and Satisfaction), two domains, lubrication and orgasm, have been combined within a single domain of Sexual Function. Item 12 (Frequency of sexual intercourse, see Table 3) has been excluded from our analysis, as it has no counterpart within the methods used by Ganz et al.(36) Finally, four of the items (7 & 8 and 10 & 11) that were conceptualized within the MFSQ as 'attractivity' and 'satisfaction with partner' were not used as outcome measures; rather, these four items were utilized as predictor variables, as indicated in the Analytical Framework (See section 2.4). The two 'attractivity' items were used as a measure of body image (see section 2.4), and the two 'satisfaction with partner' items were used to measure the 'quality of the partnered relationship' (see section 2.4).

TABLE 3: COMPONENTS OF DEPENDENT VARIABLES (ITEM NUMBER PROVIDED IN BRACKETS)

Sexual Interest
(1) Enjoyment of sexual activity
(5) Level of Sexual Interest
(3) Frequency of sexual thoughts and fantasies
(4) Excitement/arousal during sexual activity
Sexual Satisfaction
(2) Satisfaction with frequency of sexual activity
(9) Decreased satisfaction due to partner's disinterest
(13) Enjoyment of sexual intercourse
Sexual Function
<i>Vaginal lubrication</i>
(6) Vaginal lubrication
(17) Insufficient lubrication
(18) Painful sexual intercourse
<i>Orgasm</i>
(16) Additional stimulation needed to reach orgasm
(14) Frequency of orgasm
(15) Pleasure of orgasm
Overall Sexual Health
(includes all items above)

SEXUAL INTEREST

Sexual Interest is operationalized in the MFSQ with four items; these are: enjoyment of sexual activity, level of Sexual Interest, frequency of sexual thoughts and fantasies, and excitement/arousal during sexual activity.(119) The 7-point Likert scales associated with each of these items have varied anchors, appropriate to the wording of the question. These four items contribute to a score for Sexual Interest ranging between the values of 4-28, with higher scores indicating higher levels of Sexual Interest. Change in Sexual Interest was assessed by subtracting the score for Sexual Interest in Assessment 2 from that in Assessment 1. As such, a positive number will indicate a positive change in Sexual Interest, while a negative number will indicate a decrease in Sexual Interest.

SEXUAL SATISFACTION

This section contains three items: satisfaction with frequency of sexual activity, enjoyment of sexual intercourse and decreased satisfaction due to partner's disinterest, each is scored using 7-point Likert scales with appropriate anchors. As such, this section will provide a subscore ranging from 3 to 21, with higher scores reflecting increased satisfaction with the frequency of sexual activity. Again, scores for Sexual Satisfaction in Assessment 2 were subtracted from Sexual Satisfaction scores in Assessment 1, with positive numbers indicating an increase in Sexual Satisfaction and negative numbers indicating a decrease in Sexual Satisfaction.

SEXUAL FUNCTION

Sexual Function is operationalized here utilizing two sets of items from the MFSQ; one for orgasm and one for lubrication.(119) Change in Sexual Function was assessed by subtracting the score for function in Assessment 2 from that in Assessment 1. A positive number indicates an increase in Sexual Function, a negative number will indicate a decrease in Sexual Function.

ORGASM

Four items are used to operationalize orgasm. These are; additional stimulation needed to reach orgasm, frequency of orgasm, pleasure of orgasm, and enjoyment of sexual intercourse. Each item is rated on a 7-point Likert scale with varied anchors appropriate to each question.

LUBRICATION

Three items are available in the MFSQ to measure a respondent's level of lubrication; these are again answered based on a 7-point Likert scale with varied anchors appropriate to each question.(119) The questions are; level of vaginal lubrication, insufficient lubrication, and painful sexual intercourse. Scores for this section range from 3-21, with higher scores indicating better lubrication.

As sexual health is understood to be multifactorial in etiology, a method that can measure the contribution of multiple factors to the change in the outcome of interest, while adjusting for the observed change in outcome, is required. The multivariable approach (multiple linear regression) to account for the multifactorial nature of sexual health is discussed below (Section 2.6).

There are four sexual health outcomes identified within this thesis. These are: 1) Sexual Interest, 2) Sexual Satisfaction, 3) Sexual Function, and 4) Overall Sexual Health. Levels of each were measured twice in all participants. The outcome of interest for each of these measures is the average change in score, between the baseline and second assessment. As each outcome (or independent variable) is a continuous variable, and both continuous and categorical predictors are included in the framework, multiple linear regression was chosen as the most appropriate analysis method.

2.7 STATISTICAL ANALYSES

MISSING DATA

Missing data was handled by using multiple imputation.(129) This method predicts multiple values for every missing cell in a data set, based upon the patterns detected in available data, while creating multiple completed data sets. While the observed values may not be equal across these data sets (reflecting the uncertainty presented by missing values) preparing distributions of imputations allows the researcher to treat the multiply imputed data set as though no data is missing.(129) The data analysis package, R (version 2.15.1), was utilized with an add-on

package, AMELIA II (version 1.6.3), to carry out multiple imputation on both the first and second assessment data. This was repeated 5 times ($m=5$). This method has been proven to retain the validity of the original data, and is an improvement over list-wise deletion, especially when working with small data sets.⁽¹²⁹⁾ Missing data was found to be missing at random (MAR) through comparison of respondents and non-respondents.

Of the 19 questions (total) in the MFSQ, there are 12 questions that can be answered by all participants, while the 7 remaining questions are only answered by those participants who have engaged in sexual intercourse in the preceding 4 weeks. In the baseline assessment, two participants had one missed question each (for a total of 2 missing responses). In the second assessment, of the required 12 questions, a single participant missed one question (for a total of one missing response).

Of the original 49 women, 32 answered zero to the number of times they had engaged in intercourse in the previous 4 weeks. On the second assessment, 17 of the 35 participants had not engaged in sexual intercourse in the preceding 4 weeks. As such, questions 13-19 had a response rate of 35%, while the same questions in the second assessment had a response rate of 51%.

DESCRIPTIVE ANALYSIS

This section describes the statistical analyses that were undertaken to answer three questions. These questions were:

- 1) Improvement Scores: Is there a significant improvement in scores for the control and yoga groups between baseline to Assessment 2 for each the following measures?
 - a. Interest
 - b. Satisfaction
 - c. Function
 - d. Overall

- 2) Comparison Scores: Is there a statistically significant difference between the yoga groups (combined) and control group for the following four measures when adjusted models are employed?
 - a. Interest
 - b. Satisfaction
 - c. Function
 - d. Overall

- 3) Difference Scores: Is there a statistically significant difference between the two yoga groups in the following four measures when adjusted models are employed?
- Interest
 - Satisfaction
 - Function
 - Overall

Based upon the importance of partnered relationships to sexual health (as reported in the literature, see Sections 1.2 and 2.4), each of these questions was considered twice; once based upon all data, and again based upon data limited to only those participants who were in partnered relationships.

One-way ANOVAs were used to assess between-group differences for each of the predictors of interest. The predictors described in this chapter (including those in the Medical and Demographic, Breast Cancer and Treatment, Partner Relationship, Body Image and HR-QOL categories) were examined for significant differences in mean values at baseline between the yoga and control groups. The null hypothesis for each of these tests was that each group (Anusara, Iyengar, and Control) has the same mean value. Any significant differences at baseline ($p < 0.05$) were reported. This level of significance is a commonly accepted and utilized value of significance within epidemiological data, as it is unlikely to be attributable to chance (p. 146.).(1)

The methods undertaken to answer each of the three research questions are described in this final section. To adjust for the large number of covariates identified in the literature, multiple linear regression was used to measure the strength of the relationship among YTI participation and changes in sexual health outcomes.

Raw scores for the four sexual health outcomes were calculated for each of the intervention groups and the waitlisted control group. Both absolute and relative measurements of association between the exposure (YTI) and outcome (change in sexual health scores) were calculated and reported using the method described by Szklo and Nieto for case-control studies (p. 90).(2) The following table (Table 4) guided the calculation:

TABLE 4: CALCULATING ODDS RATIOS FOR RAW SCORES BASED UPON PARTICIPATION WITHIN YTI AND WAITLISTED CONTROLS

Participation in Yoga Intervention	Improved Sexual Health Outcomes	No Improvement in Sexual Health Outcomes
Anusara(exp)	A_A	B_A
Iyengar(exp)	A_I	B_I
Yoga(exp)	A_Y	B_Y
Control(unexp)	C	D

Such that:

$$OR(exp)=(a_x/b_x)/(c/d)$$

To calculate the confidence intervals for these ORs, standard error was first calculated based upon Woolf's method (130):

$$SE(\log OR)=\sqrt{(1/a)+(1/b)+(1/c)+(1/d)}$$

And 95% CI was calculated as follows:

$$95\% CI=\log OR-(1.96 *SE(\log OR))$$

The calculated odds ratio provides a measure of probability; that is, the odds ratio here gave us an unadjusted measure of the odds of improving in sexual health scores given participation in a YTI. The null hypothesis to be tested is that participation in a YTI has no effect on changes to sexual health outcomes. Mean score differences between assessments are also provided, as well as their level of significance. As the outcomes of interest are linear, both Analysis of Variance and Multiple Linear Regression are prescribed statistical methods for this data (p. 289).(2)

To further clarify this question, Analysis of Variance (ANOVA) tests were run to explore the between-group differences in each of the sexual health outcome measures for the three groups of participants. Two-tailed p-values are always an appropriate choice, but especially so when directionality of results are unknown.(110) This question was answered based upon unadjusted scores. That is, the change in score for each of the sexual health outcomes was answered above based only upon participation in a YTI, without adjusting for other known or suspected predictors or confounders (based upon the study framework outlined above in Section 2.4).To account for possible confounders and effect modifiers, multivariate models were employed in responding to the final two research questions.

ADJUSTED MODELS

The question addressed by employing multiple linear regression (MLR) was: is a given independent variable linearly associated with the given outcome *after* controlling for covariates? (p.253).(2) The goal of MLR is to fit the model to the data such that the model comes as close as possible to being able to predict the data, the model that achieves this is known as the best-fit model (p.301).(110)

As discussed earlier in the chapter, previously identified covariates of sexual health may influence sexual health outcomes among BCSs who participated in this study. In responding to the final two research questions, multivariate modeling was employed to account for identified covariates of sexual health. As described above, these covariates were identified based upon the literature review of factors known to influence the sexual health outcomes of BCSs (see Sections 1.2 and 2.4). Adjusted models measure the relationship between an independent

and a dependent variable while simultaneously adjusting for other factors known to influence the dependent variable (p.289).(2) Here, adjustment was achieved using regression-based techniques (rather than stratification). The benefit of utilizing regression in model adjustment is that it allows one to adjust for multiple covariates at once, and can be used for predictive purposes (p.246). (2)

In creating the adjusted models to address the final two research questions, simple, bivariate relationships between predictors and outcomes were assessed. Based upon those intermediary results, multivariable models were built (see Section 2.7). Any predictor found to have a significant relationship with a change in sexual health outcome scores, independently of other covariates, was included in the multivariate model. The same method, presented in greater detail below, was utilized for both of the remaining questions.

BIVARIATE ANALYSES

Bivariate analysis of continuous and categorical covariates was undertaken to test their significance to score changes in each of the sexual health outcomes of interest. These methods tested the significance of relationships between covariates, and provided a basis for deciding which covariates to include in building the multivariate model. Wilcoxon Rank-sum tests were used to assess continuous variables while Pearson's Chi-squared or Fisher's Exact Test (for cell counts of less than 5) was used for categorical variables. Based on the homogeneity of the sample, a cut-off level of $p < 0.2$ was employed at the bivariate level to select which predictors were used to adjust the multivariable models.(131) The null hypothesis for each of the above tests was that there is no relationship between the predictor in question and score change in the sexual health outcome of interest.

MULTIVARIATE ANALYSES

Multivariate analyses were used to address issues of confounding and bias within this study (see definitions in Section 2.4). These forms of mathematical modeling allow statistical adjustments to control for possible confounders and effect modifiers in the process of estimating the association between a given exposure and outcome (p. 227).(2)

Multiple linear regression was used to model the relationship between score change in sexual health scales (outcomes) and participation in a YTI (exposure). This method allowed the construction of a linear equation that modeled the strength of the association between participation in a YTI and change in sexual health outcomes, while simultaneously adjusting for pertinent covariates. This method was an appropriate approach given our continuous dependent variables and multiple covariates which require an adjusted model (p. 253).(2) MLR is structured such that we may test whether an independent variable (x_n) is linearly related to a dependent variable (y_n) while adjusting for other covariates. In this thesis, the dependent variables (y_n) are the sexual health outcomes; Sexual Interest, Sexual Function, Sexual Satisfaction, and Overall Sexual Health. The main independent variable of interest (x_n) is participation in a YTI. Variables (covariates or predictors) included to obtain adjusted

effects models (for each sexual health outcome) were those that were found to be previously important as sexual health predictors in this population, first in the literature, and then also through the bivariate analysis described above.

The general form of the equation used to estimate the strength of the relationship between participation in a YTI and changes in sexual health outcomes is:

$$\text{Equation 2.1: } Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3$$

Where:

- Y: indicates a dependent variable (outcome) and in this case represents a change in sexual health outcome scores;
- β_0 : indicates the intercept: this intercept does not have meaning in the real world context;
- β_1 : indicates a regression coefficient and here represents the average increase in the dependent variable (sexual health outcome scores) based upon a single unit increase in the independent variable (here it is participation in a YTI), this is equivalent to the slope of the linear relationship modeled; and
- X_1 : indicates an independent variable, here it is participation in a YTI.
(Information referenced here from (p.252)(2)

The remaining variables are the covariates that may affect the linear relationship between participation in a YTI and changes to sexual health. These covariates have been discussed above (in section 2.4) and are either continuous or categorical in nature. Each covariate is also associated with a unique regression coefficient. For example, X_2 could represent the mean age of participants.

Based upon the results of the bivariate analyses, the sexual health outcomes were modeled for best fit to the data, using forward, stepwise multiple linear regression (least squares method) for each of the sexual health outcomes of interest; Sexual Interest, Sexual Satisfaction, Sexual Function, and Overall Sexual Health (dependent variables). The least squares method minimizes the sum of the squared vertical distances of the observed data points in order to place the line of best fit for the data. The null hypothesis states that each individual variable included in the model provides no additional information to the model. T-tests were used to test the significance of each predictor within the model, and reported p-values were 2-tailed and considered significant at the $p < 0.05$ level (that is, the null hypothesis is rejected when $p < 0.05$).

Adjusted R^2 values were reported. Unadjusted R^2 values represent, within regression modeling, the proportion of the dependent variable's variation (variance) that is explained by the included predictors. As more predictors are added to a model, each one increases the chance that some of the variance that is 'explained' within the model is actually a chance occurrence. As such, when multivariate modeling is utilized, the best practice is to use an adjusted R^2 , which corrects for the increased explanatory value of including more predictive variables.

The equation used to calculate the adjusted R^2 values is given below:

Equation 2.2: $1 - ((1 - R^2) * (N - 1) / (N - k - 1))$

Where N is the sample size and k is the number of predictors included.

Goodness of fit testing (using partial F-tests) was undertaken to verify the best fit model. Where required (in non-nested models), Akaike's Information Criteria (AIC) was employed to choose the best model.

Based upon the work of Juniper et al.,(128) clinical significance of the findings is also discussed. A change of 0.5 on a scale of 1-7 is of clinical significance according to Juniper et al.(128) As such, a change of 1.5 on the Sexual Satisfaction score (range=3-21), a change of 2.0 on the Sexual Interest scale (range=4-28), a change of 3.0 on the Sexual Function score (range=6-42) and a change of 6.5 on the Overall Sexual Health score (range=13-91) were considered clinically significant.

To address the remaining two study questions, two main multivariable regression analyses were run, as described above; the first was run to compare yoga (combined Anusara and Iyengar) and non-yoga (wait-listed control) groups. The second set of models explored between-group differences for Anusara and Iyengar participants. As noted above, both of these models were examined based upon the full sample and the restricted sample, with only partnered participants.

CHAPTER 3: RESULTS

This chapter presents the results of the analyses described in Chapter 2, with the objective of understanding the strength of the relationships among participation in a yoga therapy intervention (YTI) and changes in sexual health outcomes of breast cancer survivors (BCSs). Known predictors of sexual health outcomes in BCSs were included in the analytic framework guiding this study. A descriptive overview of sexual health predictors (as identified in the literature), measured at baseline, is presented first. Unadjusted results quantifying the relationships between YTI participation and sexual health outcomes are then reported. This is followed by results that adjust for significant predictors that modify the relationships of interest. In order to understand the true effect of the YTI on BCSs sexual health outcomes, regression models that adjust for the identified predictors of sexual health outcomes are required. The significance of relationships between select variables (as outlined in the analytic framework) and changes to sexual health outcomes are reported as the first step to building these regression models. Variables showing significant relationships with sexual health outcomes were included in the multivariable model building phase. Next, best fit models of the relationship between YTI participation and the change in each sexual health outcome, adjusted for significant predictors, are presented. These best-fit models represent the strength of the relationships between participation in a YTI and changes to sexual health outcomes. Results are presented as the percent variance of change in sexual health outcome scores predicted by participation in a YTI, adjusted for identified predictors of sexual health (adjusted R^2). These results are interpreted as the amount of change in sexual health that can be attributed to participation in a YTI.

3.1 ANALYSIS

DESCRIPTIVE BASELINE VARIABLES

Of the original $n=49$ participants who completed the first assessment, $n=35$ participants also completed the second assessment (for an overall completion rate of 71%). Twelve (12) of these women (34.3%) were included in the waitlisted control group. There were $n=10$ Anusara participants and $n=13$ Iyengar participants. All participants had been diagnosed with breast cancer between October 2008 and December 2010; participation required a diagnosis within the 18 months preceding baseline assessment. Attendance in the intervention groups was high. The BCSs in the Iyengar group attended an average of 89% of classes, while BCSs in the Anusara group attended an average of 78% of classes.

This section provides baseline comparisons for each of the variables as outlined in the study analytic framework (see Figure 2). Averages or counts (with percent) are presented in Table 5 (below) for each of the intervention groups, the control group, as well as an overall total that includes all participants. One-way ANOVAs were calculated and p -values reported for the significance of between-group differences.

TABLE 5: OUTLINE OF KEY PREDICTOR VARIABLE FREQUENCIES/ SCORES AMONG INTERVENTION (ANUSARA AND IYENGAR) AND CONTROL GROUPS AT BASELINE

Variable	Total n (%)	Anusara n (%)	Iyengar n (%)	Control n (%)	p- value
Participants	35	10 (28.6)	13 (37.1)	12 (34.3)	-
Medical and Demographic					
Age in years (Mean)	54.03	56.90	55.38	50.17	0.234
Ethnicity Caucasian	23 (65.7)	6 (60.0)	10 (76.9)	7 (58.3)	0.303
CAM usage ¹ (Mean)	3.6	3.8	3	4.1	0.536
Symptom Severity Index ² (SSI) (Mean)	6.1	7.3	3	8.5	<.001
Has Children	26 (74.3)	6 (60)	10 (76.9)	10 (83.3)	0.466
Breast Cancer and Treatment Related Variables					
Treatment Type:					
Surgery n (%)	35 (100)	10 (100)	13 (100)	12 (100)	1
Mastectomy	18 (51.4)	5 (50)	8 (61.5)	5 (41.7)	
Lumpectomy	17 (48.6)	5 (50)	5 (38.5)	7 (58.3)	
Chemotherapy	23 (65.7)	7 (70)	6 (46.2)	10 (83.3)	0.148
Radiation Therapy	27 (77.1)	8 (80)	11 (84.6)	8 (66.7)	0.571
Hormone Therapy	24 (68.6)	7 (70)	10 (76.9)	7 (58.3)	0.625
Treatment Severity Index (TSI)	3.4	3.3	3.5	3.5	0.837
Partner Relationship					
Has a partner n (%)	24 (68.6)	5 (50)	8 (61.5)	11 (91.7)	0.088
New partner since diagnosis	0	0	0	0	1
Partner has Sexual Problems (max. score 7) ³	2.63	1.80	3.77	2.08	0.259
Quality of Partnered Relationship (QPR) (max. score 14)	7.35	4.40	8.40	8.67	0.94
Body Image	5.66	2.9	7.85	5.83	0.02
Health-Related Quality of Life					
BSI GSI ⁴ (range)	0.835 (.06, 1.87)	1.02 (.23, 1.62)	0.675 (0.6,1.04)	0.860 (.26, 1.87)	0.201
MOS-SS total ⁵ (range)	3.31 (2,5)	2.60 (2,5)	3.29 (2, 4.3)	3.91 (2,5)	0.009
FLIC-22 total ⁶ (max. score 154)	86.23	82.02	88.08	87.72	0.333
Sexual Health Outcomes					
MFSQ total (max. score 91)	29.29	17.70	43.69	23.33	0.055
Interest (max. score 28)	10.63	5.70	16.00	8.92	0.008
Satisfaction (max. score 21)	7.03	4.40	9.69	6.33	0.157
Function (max. score 42)	11.63	7.60	18.00	8.08	0.069

¹CAM usage determined by the number of endorsed CAM variables in Assessment 1

²Severity index represents the number of words endorsed in Assessment 1

³Item reads "How often have you been prevented from having sexual intercourse because your primary partner could not achieve or maintain an erection?" with anchors that range from 1 (everytime) to 7 (never) (low mean scores translate to a higher rate of erectile problems in partner that prevent intercourse)

⁴BSI Global Severity Index from Assessment 1

⁵MOS total score from Assessment 1

⁶FLIC-22 total score from Assessment 1

One-way ANOVAs were used to assess between-group differences for each of the variables of interest. The null hypothesis for each test was that each group has equivalent mean values for predictors of interest at baseline.

At baseline, few significant differences were observed among the three groups for the majority of the included variables. The groups were similar in age, ethnicity, CAM usage, and type of treatment received, among others. Four exceptions were observed: the Symptom Severity Index ($p<0.001$), body image ($p=0.02$), MOS-SS overall scores ($p=0.009$), and the Sexual Interest subscale ($p=0.008$) all showed significant differences among groups at baseline. These significant dissimilarities among the groups at baseline may influence the change in sexual health outcomes. The results of baseline comparisons are described in the order shown in Table 5, mirroring the study analytical framework (Figure 2).

MEDICAL AND DEMOGRAPHIC VARIABLES

The average age of participants was 54 years. The majority of the group (65.7%) were Caucasian. Other ethnicities included; Chinese, South Asian descent, as well as First Nations Canadians. CAM usage scores averaged 3.6 (from a score range of 0- 14) with no significant variation between groups. The observed mean of SSI was 6.1 (from a possible range of 0-16). This variable did show a significant between group difference ($p<0.001$). The Iyengar group mean for the SSI score was notably lower (mean =3) compared to either the Anusara (mean=7.3) or the Waitlisted Control group (mean=8.5). This variable, significantly different at baseline, indicates that the Iyengar participants had, on average, less severe symptoms than participants in either the Anusara or control groups.

BREAST CANCER AND TREATMENT RELATED VARIABLES

Both cancer and treatment-related variables were included in this analysis and no significant differences among groups were observed. In terms of treatment received by participants; data on surgery, chemotherapy, radiation therapy, and endocrine therapies was collected at baseline. While all participants underwent surgery, approximately half ($n=18$) had a mastectomy, and half ($n=17$) a lumpectomy. Almost 66% of participants had received some form of chemotherapy, while 77% had received radiation therapy. Finally, 69% of participants took endocrine therapy (either tamoxifen or an aromatase inhibitor) during the intervention.

The Treatment Severity Index (TSI), also included here, is a count of the number of treatments received by each participant. Scores on the TSI ranged from 3.3 to 3.5 from possible score range of 1-4+. No significant difference was observed between groups at baseline.

PARTNER RELATIONSHIP

Approximately 69% of participants were in a partnered relationship when this study was conducted. None of the participants started a new relationship in the time between their diagnosis and the start of the study. Of those in partnerships, the average woman refrained from having sexual intercourse due to a partner's erectile difficulties

less than half the time (mean score=2.63/7). Differences in the quality of the partnered relationship were found to be non-significant between groups at baseline.

BODY IMAGE

Body image was measured using two items from the MFSQ. Body image scores ranged from 2.9 in the Anusara group to 7.85 in the Iyengar group. The range of possible scores was between 2 and 14. Differences in body image were found to be significant ($p=0.02$) across groups at baseline; Anusara participants had the lowest mean value (2.9) for body image scores at baseline, compared to an overall average of 5.66 for all participants. The Iyengar group had the highest overall average score for body image (7.85). Participants in the two intervention groups, as well as the control group, had different scores for body image at baseline.

HEALTH RELATED QUALITY OF LIFE

Three scales of HR-QOL were considered in an effort to provide a measure of emotional, social, and physical QOL. These scales were the BSI-GSI (Emotional QOL), the MOS-SS (Social QOL) and the FLIC-22 (Physical QOL) (described in Chapter 2). There was a significant difference between the two intervention and control groups at baseline in the MOS-SS, with participants in the Anusara group showing a lower mean score than either the Iyengar or Control group participants ($p=0.009$). Scores for the BSI and the FLIC-22 showed no significant differences between groups at baseline.

SEXUAL HEALTH OUTCOMES

The variables; Sexual Interest, Sexual Satisfaction, Sexual Function, and Overall Sexual Health were observed at baseline. Although there were no significant differences between groups for either the Sexual Function or Sexual Satisfaction subscales, Sexual Interest showed significant variation ($p=0.008$). The highest mean Sexual Interest score (16) was in the Iyengar group, while the lowest mean Sexual Interest score (5.70) was in the Anusara group. This may have interesting implications for the combined analyses, as the two interventions have very different baseline Sexual Interest scores. The Overall Sexual Health score showed no significant variation between groups at baseline.

WITHDRAWN PARTICIPANTS

Table 6 presents the means and/or n (%) of the same variables presented in Table 5. These variables are drawn from the thesis conceptual framework. Each of the variables in the conceptual framework, which are also in Tables 5 and 6, are included because they are important in determining the sexual health outcomes of BCSs in the extant literature. *P*-values are based on Student's *t*-tests for continuous variables and either Chi-Square or Fisher's exact test (where observed cell count was less than 1 or expected cell count less than 5) for categorical variables.

There were no variables that differed significantly in any of the included domains of interest between those participants who withdrew from the study prior to completing the second assessment and those who completed both assessments.

TABLE 6: COMPARISON OF BASELINE VARIABLES BETWEEN PARTICIPANTS WHO WITHDREW BEFORE COMPLETING SECOND ASSESSMENT AND PARTICIPANTS WHO COMPLETED BOTH ASSESSMENTS

Variable	Total n (%)	Withdrawn n (%)	p-value
Number	35	14 (29)	-
Medical and Demographic			
Age in years (mean)	54.03	56.43	0.5606
Ethnicity Caucasian	23 (66)	12 (86)	0.2441
CAM usage ¹ (mean)	3.6	2.21	0.4944
Symptom Severity Index ² (SSI) (mean)	6.1	5.36	0.5919
Has Children	26 (74)	8 (57)	0.2321
Breast Cancer and Treatment Related Variables			
Treatment Type:			
Surgery	35 (100)	14(100)	0.3301
Mastectomy	18 (51.4)	5(36)	
Lumpectomy	17 (48.6)	9(64)	
Chemotherapy	23 (65.7)	11(79)	0.5898
Radiation Therapy	27 (77.1)	13(93)	0.3816
Hormone Therapy	24 (68.6)	8(57)	0.6693
Treatment Severity Index (TSI) (mean)	3.4	3.57	0.6186
Partner Relationship			
Has a partner n (%)	24 (68.6)	8(57.1)	0.6693
New partner since diagnosis	0	0	1
Partner has Sexual Problems (max. score 7) ³ (mean)	2.63	1	0.4216
Quality of Partnered Relationship (QPR) (max. score 14) (mean)	7.35	6	0.8629
Body Image	5.66	4.93	0.6881
Health-Related Quality of Life			
BSI GSI ⁴	0.835	0.675	0.2447
MOS-SS total ⁵	3.31	3.83	0.2771
FLIC-22 total ⁶ (max. score 154)	86.23	90.93	0.1259
Sexual Health Outcomes			
MFSQ total (max. score 91)	29.29	30.86	0.1672
Interest (max. score 28)	10.63	6.57	0.0879
Satisfaction (max. score 21)	7.03	6.00	0.6133
Function (max. score 42)	11.63	5.36	0.0690

¹CAM usage determined by the number of endorsed CAM variables in Assessment 1

²Severity index represents the number of words endorsed in Assessment 1

³Item reads "How often have you been prevented from having sexual intercourse because your primary partner could not achieve or maintain an erection?" with anchors that range from 1 (everytime) to 7 (never) (low mean scores translate to a higher rate of erectile problems in partner that prevent intercourse)

⁴BSI Global Severity Index from Assessment 1, assessed using the BSI-GSI scoring key.

⁵MOS total score from Assessment 1, maximum score is 5

⁶FLIC-22 total score from Assessment 1

Although not final, the lack of significant differences between the withdrawn participants and the participants who completed both assessments is a positive sign for this analysis. This lack of significant differences is a signal that those who withdrew were not significantly different from those who completed the study. This may be a favorable sign, as it is more likely that the withdrawn participants would have shown similar outcomes as those who completed both assessments.

3.2 IMPROVEMENT IN SEXUAL HEALTH SCORES AMONG YTI PARTICIPANTS

In Chapter 1, two research questions were posed. The first question was: Does participation in a YTI improve sexual health outcomes among female BCSs? This section addresses this first research question, which was operationalized in Chapter 2 as: Is there an improvement in scores for the control and yoga groups between baseline and Assessment 2 for each of the four measures? The changes in sexual health scores (for each of Interest, Function, Satisfaction, and Overall) were calculated for both groups of YTI participants (Anusara and Iyengar) as well as the waitlisted control group.

This section describes the impact of participation in one of the two YTIs on sexual health outcomes, without considering any other variables. As the MFSQ data was not used in its entirety, the majority of this chapter will be reporting on the sexual health outcomes as outlined by Ganz et al.(36) Odds Ratios are reported based on the number of participants who showed improved Overall Sexual Health scores by group (Anusara, Iyengar, Yoga (combined Anusara and Iyengar modalities), or Control) (See Table 7).

OVERALL IMPROVEMENT IN SEXUAL HEALTH OUTCOMES: ODDS RATIOS

TABLE 7: NUMBER OF PARTICIPANTS IN EACH GROUP BY IMPROVEMENT IN SEXUAL HEALTH OUTCOMES, ODDS RATIOS, AND CONFIDENCE INTERVALS.

Participation in YTI	Improved Sexual Health Outcomes	No Improvement in Sexual Health Outcomes	OR	95% CI
Anusara(exp)	7	3	0.78	(0.12, 5.10)
Iyengar(exp)	5	8	0.21	(0.04, 1.16)
Yoga(exp)	12	11	0.36	(0.08, 1.70)
Control(unexp)	9	3	1.00	(0.16, 6.35)

Sexual health measures drawn from the MFSQ (exp is exposed, unexp is unexposed.)

Unadjusted odds ratios of Anusara, Iyengar, and combined (Yoga) groups improving (compared to Control) are presented in Table 7. Although the odds of improvement is lower in each of the intervention groups (Anusara, Iyengar, and combined (Yoga)), each of the CI includes 1, meaning that the difference in odds may be a chance occurrence. However, as the literature indicates, there are a large number of known predictors of sexual health in BCSs (see analytical framework), and, further, significant differences at baseline between groups, require the use

of methods that adjust for multiple contributing variables. As such, relationships between suspected predictor variables and each of the sexual health outcomes were measured to ascertain which of the suspected predictors should be included in building the adjusted models. The final models predict the changes in each of the sexual health outcomes that can be attributed to participation in a YTI, adjusted for the variables that influence these relationships.

DETAILED BREAKDOWN OF CHANGES IN SEXUAL HEALTH OUTCOMES FOR ALL PARTICIPANTS

TABLE 8: COMPARISON OF PRE- AND POST- INTERVENTION SCORES FOR SEXUAL HEALTH OUTCOMES FOR ALL PARTICIPANTS

All Participants	Pre-intervention Mean				Post-intervention Mean				ANOVA change between assessments by Yoga <i>p-value</i>
	Total	Yoga Modality			Total <i>(diff.)</i>	Yoga Modality			
		Anusara	Iyengar	Control		Anusara <i>(diff.)</i>	Iyengar <i>(diff.)</i>	Control <i>(diff.)</i>	
Total Score	29.29	17.7	43.69	23.33	32.31 <i>(3.02)</i>	19.78 <i>(2.08)</i>	42.54 <i>(-1.15)</i>	31.66 <i>(8.33)</i>	0.129
Interest	10.63	5.70	16.00	8.92	10.6 <i>(-0.03)</i>	6.80 <i>(1.10)</i>	13.54 <i>(-2.46)</i>	10.58 <i>(1.66)</i>	0.067
Satisfaction	7.03	4.40	9.69	6.33	6.66 <i>(-0.37)</i>	4.60 <i>(-0.20)</i>	8.54 <i>(-1.15)</i>	6.33 <i>(0.0)</i>	
Function	11.63	7.60	18.00	8.08	15.05 <i>(3.42)</i>	8.38 <i>(0.78)</i>	20.46 <i>(2.46)</i>	14.75 <i>(6.67)</i>	

Sexual health subscale score ranges: Interest: range=4-28, Satisfaction: range=3-21, Function: range= 6-42.

At baseline, Anusara participants had a mean total score of 17.70, Iyengar participants of 43.69, while the control group had a mean score of 23.33. The second assessment measured mean total scores of 19.78 (Anusara), 42.54 (Iyengar), and 31.66 (Control). A higher score is indicative of better Overall Sexual Health. The differences between scores are given in brackets in Table 8. Significant differences between groups of participants were seen only in the Sexual Interest outcome at a level of $p < 0.1$. It is important to note here that significant between group differences were present at baseline for the Sexual Interest subscale. Differences in scoring among groups are not statistically significant. However, the clinical significance of the change in score will be discussed in Chapter 4.

DETAILED BREAKDOWN OF CHANGES IN SEXUAL HEALTH OUTCOMES AMONG PARTNERED PARTICIPANTS

TABLE 9: COMPARISON OF PRE- AND POST-INTERVENTION SCORES FOR PARTNERED PARTICIPANTS FOR SEXUAL HEALTH OUTCOMES (UNADJUSTED)

Partnered Only	Pre-intervention Mean				Post-intervention Mean				ANOVA change between assessments by Yoga <i>p-value</i>
	Total n=24	Yoga Modality			Total <i>(diff.)</i> ²	Yoga Modality			
		Anusara n=5	Iyengar n=8	Control n=11		Anusara <i>(diff.)</i>	Iyengar <i>(diff.)</i>	Control <i>(diff.)</i>	
Total Score	38.92	36	57.26	26.92	41.34 <i>(2.42)</i>	33.2 <i>(-2.80)</i>	55.87 <i>(-1.39)</i>	34.45 <i>(7.53)</i>	0.256
MFSQ Subscales: ¹									
Interest	11.92	8.80	16.88	9.73	12.42 <i>(0.50)</i>	8.80 <i>(0.00)</i>	16.00 <i>(-0.88)</i>	11.45 <i>(1.72)</i>	0.359
Satisfaction	9.50	10.20	12.38	6.73	8.88 <i>(-0.62)</i>	8.60 <i>(-1.60)</i>	11.75 <i>(-0.63)</i>	6.91 <i>(0.18)</i>	0.750
Function	17.50	17.00	28.00	10.46	20.04 <i>(2.54)</i>	15.80 <i>(-1.2)</i>	28.12 <i>(0.12)</i>	16.09 <i>(5.63)</i>	0.460

¹ Interest: range=4-28, Satisfaction: range=3-21, Function: range=6-42.

² Mean score change is given in italics.

As only n=24 of the n=35 participants reported being in a relationship, a subset analysis, including only partnered participants, was carried out. Of the n=24 partnered participants, n=5 were in the Anusara group, n=8 were in the Iyengar group and n=11 were in the Control group.

The change in overall mean scores (Assessment 2 - Assessment 1) was as follows: Anusara: -2.80, Iyengar: -1.39, Waitlist: 7.53 (*p*-value=0.256). In this partnered-only analysis, baseline sexual health scores were higher for both YTI groups, while less of a change is seen in the control group means between the full and the partnered-only analysis. The differences in overall scores between all participants and partnered-only participants by group are; Anusara mean difference =18.3, Iyengar mean difference =13.57, while the control group mean difference =3.59. Among partnered participants, none of the observed changes were significant based on *p*-values calculated from one-way ANOVA tests. Mean group changes for each sexual health outcome are reported in Table 9. Differences between Assessment 1 and Assessment 2 are reported below the second assessment score (*in italics*).

Surprisingly, the unadjusted relationship between participation in yoga therapy and sexual health outcomes in partnered participants shows a slight decrease in Overall Sexual Health among yoga participants and an increase in Overall Sexual Health among waitlisted controls. When Anusara and Iyengar participants are considered as distinct groups (rather than combined into a single yoga group), there are some differences between Iyengar (who display

a larger decrease in Overall Sexual Health) and Anusara participants overall. However, none of the unadjusted mean score changes were statistically significant.

3.3 RELATIONSHIPS BETWEEN SELECTED PREDICTORS AND SEXUAL HEALTH OUTCOMES

This trial could not be randomized fully due to issues with recruitment. Although randomization is the best approach to reducing bias in intervention research, it is not always feasible, as in this case. To address this lack of randomization, variables that have been shown to influence sexual health in BCSs in existing literature were considered simultaneously with participation in a YTI, using a multivariable modeling technique. To understand if other variables, shown previously in the literature to affect sexual health outcomes in BCSs, influenced the sexual health scores, adjusted models were built using variables that were selected based on bivariate relationships with the independent variables and sexual health outcomes.

The rest of this chapter addresses the remaining two research questions:

- 1) Comparison Scores: Is there a statistically significant difference between the yoga groups (combined) and control group for the following four measures when adjusted models are employed?
 - a. Interest
 - b. Satisfaction
 - c. Function
 - d. Overall Sexual Health

- 2) Difference Scores: Is there a statistically significant difference between the two yoga groups in the following four measures when adjusted models are employed?
 - a. Interest
 - b. Satisfaction
 - c. Function
 - d. Overall Sexual Health

To answer these remaining questions, predictive models adjusting for the variables that the literature includes as having an effect on the sexual health outcomes of BCSs were constructed. These analyses were carried out on both the full sample and on partnered-only participants. Bivariate analyses were conducted to select the predictor variables that were then used in building the multivariate models. Only those predictors (covariates) with a significant level of correlation (set at $p < 0.2$) with the sexual health outcome were included in constructing the model of best-fit.

Bivariate analyses of the continuous and categorical predictors (Table 6) outlined in the analytical framework were carried out to explore the significance of relationships between the predictor variables and sexual health outcomes. Assessing the significance of relationships between the predictors and sexual health outcomes is an important step in determining possible confounders in the relationship between participation in a YTI and changes in sexual health outcomes. Variables that show a significant relationship with sexual health outcomes at the bivariate level were included in building the predictive multivariable models. Categorical variables were compared using either Pearson's chi-squared or Fisher's exact tests if cell counts were less than five. Wilcoxon Rank-sum tests were used to compare continuous variables. All tests were performed using R (version 3.5.5).

The null hypothesis for each test of association assumed no relationship between the predictor variable and the sexual health outcome. Due to the homogenous nature of our sample, a cut-off value of $p < 0.2$ was set for the level of significance at the bivariate level.⁽¹³¹⁾ All reported p -values are two-tailed. Variables that had a significant ($p < 0.02$) relationship with changes in sexual health outcomes at the bivariate level were included in building the final multivariable models, as they may be confounders in the relationship between participation in a YTI and sexual health outcomes. By including these variables in the multivariable analyses, relationships between participation in a YTI and sexual health outcomes are presented, adjusted for possible confounders.

RELATIONSHIPS BETWEEN SELECTED VARIABLES AND OUTCOMES FOR ALL PARTICIPANTS

TABLE 10: BIVARIATE ANALYSIS OF ASSOCIATIONS BETWEEN CONTINUOUS AND CATEGORICAL PREDICTORS AND EACH SEXUAL HEALTH OUTCOME

All Participants	Sexual Interest	Sexual Function	Sexual Satisfaction	Overall Sexual Health
Age	0.944	0.0147 *	0.191	0.0374 *
SSI (NWC) ¹	0.000887 ***	0.286	0.165	0.0341 *
Treatment Severity Index ²	0.805	0.398	0.702	0.884
CAM Usage ³	0.191	0.897	0.799	0.267
MOS-SS ⁴	0.282	0.386	0.638	0.135
BSI- GSI ⁵	0.0946.	0.157	0.100	0.182
FLIC-22 ⁶	0.669	0.0685.	0.545	0.281
Change in Quality of Partnered Relationship (QPR) ⁷	0.00681 **	0.733	0.241	Not meaningful
Change in Body Image ⁸	0.566	0.722	0.506	Not meaningful
Categorical				
Age				
<50	0.597	0.00481 **	0.00234 **	0.00272 **
50-69	0.354	0.0073 **	0.000412 ***	0.00495 **
>69	0.457	0.989	0.402	0.968
Has Partner (yes/no)	0.348	0.636	0.321	0.269
Ethnicity	0.647	0.571	0.663	0.905
Surgery type	0.759	0.0956.	0.919	0.498
Chemotherapy	0.962	0.9	0.895	0.951
Endocrine Therapy	0.731	0.108	0.242	0.383
Radiation	0.639	0.512	0.448	0.269

• $p<.1$ * $p<.05$ ** $p<.01$ *** $p<.001$

¹Severity index represents the number of words endorsed in Assessment 1

²Treatment Severity Index was calculated by summing the number of kinds of treatments

³CAM usage determined by the number of endorsed CAM variables in Assessment 1

⁴MOS total score from Assessment 1

⁵BSI Global Severity Index from Assessment 1

⁶FLIC-22 total score from Assessment 1

⁷This variable was drawn from the MFSQ, and is included as a change in score, rather than the second assessment score. As a result, the significance of the relationship between this variable and the overall change of score is not meaningful, as the two variables (both changes) are linked.

⁸Change in Body Image is also drawn from the MFSQ, the significance of a relationship between change in body image and change in Overall Sexual Health is not meaningful.

SEXUAL INTEREST

Sexual Interest was significantly correlated at the $p<0.2$ bivariate cut-off level with SSI ($p=0.000887$), CAM usage at baseline ($p=0.191$), BSI-GSI Assessment 2 score ($p=0.0946$), and the change in the QPR ($p=0.00681$). These variables were subsequently included in building the multivariable model to explore the relationship between participation in a YTI and changes in Sexual Interest.

SEXUAL SATISFACTION

Sexual Satisfaction was significantly associated with age ($p=0.191$), SSI ($p=0.165$), and BSI-GSI score ($p=0.10$). As such, these three variables were subsequently included in building the multivariable model of the adjusted relationship between participation in a YTI and change in Sexual Satisfaction.

SEXUAL FUNCTION

Sexual Function was significantly associated with each of the following variables at the $p<0.2$ cut-off level: Age ($p=0.0147$), BSI-GSI score ($p=0.157$), FLIC-22 score ($p=0.0685$), surgery type (mastectomy vs. lumpectomy) ($p=0.0956$), and endocrine therapy ($p=0.108$). These variables were subsequently included in building the multivariable model to explore the relationship between participation in a YTI and changes in Sexual Function, adjusted for these possible confounders.

OVERALL SEXUAL HEALTH SCORE

The total sexual health outcome score (comprising the three preceding scales) was significantly associated with age ($p=0.0374$), SSI ($p=0.0341$), MOS-SS score ($p=0.135$), BSI-GSI score ($p=0.182$). Change in the Quality of the Partnered Relationship and Change in Body Image did not yield a statistically significant association with the Overall Sexual Health score. These two variables showed a high correlation with the change in overall MFSQ score ($p<0.05$). As such, they were not included in the multivariable analysis.

RELATIONSHIPS BETWEEN SELECTED PREDICTORS AND OUTCOMES FOR PARTNERED ONLY PARTICIPANTS

Bivariate analyses of the continuous and categorical predictors (Table 11) outlined in the analytical framework were considered to explore the significance of relationships between the dependent and independent variables among partnered participants. P -values presented in Tables 3.4 and 3.5 are the results of tests of significance for each of the bivariate relationships between variables thought to affect sexual health outcomes in BCSs and the measured changes in sexual health outcomes.

TABLE 11: BIVARIATE RELATIONSHIPS AMONG SEXUAL HEALTH OUTCOMES AND CONTINUOUS AND CATEGORICAL PREDICTORS AMONG PARTNERED PARTICIPANTS.

Continuous Variables	Sexual Interest	Sexual Function	Sexual Satisfaction	Overall Sexual Health
Age	0.498	0.00284 **	0.063.	0.000932 ***
SSI(NWC)	0.00858 **	0.48	<i>0.518</i>	<i>0.231</i>
Treatment Severity Index	0.151	0.39	0.927	0.688
CAM Usage	<i>0.501</i>	0.738	0.924	0.655
MOS	0.661	0.377	0.67	<i>0.907</i>
BSI	<i>0.662</i>	0.097.	0.131	0.181
FLIC-22	0.528	0.102	0.532	0.196
Change in Partnered Relationship	<i>0.752</i>	0.883	0.883	-
Change in Body image	0.219	0.969	0.421	-
Categorical				
Age				
<50	0.801	0.0116 *	0.00781 **	0.00314 **
50-69	0.614	0.0127 *	0.00164 **	0.0049 **
>69	0.527	0.968	0.348	0.812
Ethnicity	0.965	0.693	0.446	0.829
Surgery type	0.417	0.0756.	0.928	0.279
Chemotherapy	0.868	0.831	0.646	0.977
Endocrine Therapy	0.782	0.0602.	0.0863.	0.238
Radiation Therapy	0.194	0.642	0.246	0.492

Statistical Significance: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Italicized values indicate where differences were found between the partnered only and full sample bivariate analysis.

SEXUAL INTEREST

Independent variables that were significant at the bivariate level for Sexual Interest among partnered participants were; SSI ($p=0.00858$), TSI ($p=0.151$), and radiation ($p=0.194$). These variables were included in the subsequent building of the predictive model of the relationship between participation in a YTI and changes in Sexual Interest among partnered participants.

SEXUAL SATISFACTION

Predictors of significance for Sexual Satisfaction at the bivariate level ($p<0.02$) included; age ($p=0.000932$), BSI-GSI ($p=0.181$), and FLIC-22 ($p=0.196$). These variables were included in the subsequent building of the predictive model of the relationship between participation in a YTI and changes in Sexual Satisfaction among partnered participants.

SEXUAL FUNCTION

Independent variables found to be significant at the bivariate level (cut-off Of $p<0.2$) for Sexual Function among partnered participants were; age ($p=0.00284$), BSI-GSI ($p=0.097$), FLIC-22(0.102), surgery type ($p=0.0756$) and

endocrine therapy ($p=0.0602$). These variables were included in the subsequent building of the predictive model of the relationship between participation in a YTI and changes in Sexual Function among partnered participants.

OVERALL SEXUAL HEALTH

At the bivariate level, significant relationships were observed between Overall Sexual Health as defined by the MFSQ and the following variables; age ($p=0.00093$), BSI-GSI ($p=0.181$), and FLIC-22 ($p=0.196$). These variables will be included in the subsequent building of the predictive model of the relationship between participation in a YTI and change in Overall Sexual Health among partnered participants.

It is noted here that different variables were found to be significant for building the models that represent the linear relationships between participation in a YTI and change in each of the sexual health outcomes between the full sample and the partnered only sample. These differences, and possible reasons underlying these differences, are discussed in the final chapter.

3.4 ADJUSTED RELATIONSHIPS BETWEEN SELECTED PREDICTORS AND SEXUAL HEALTH

OUTCOMES

Multiple linear regression (least squares) was used to estimate the strength of the association between YTI participation and changes in sexual health outcomes. Models were fit, using the stepwise (forward conditional) method, to the available data by including variables identified in the literature and found to be significant predictors ($p<0.20$ cut-off) at the bivariate level.

To address the study questions, two main analyses were carried out; these were based on 1) Comparison of Yoga vs. Non-Yoga: comparing sexual health outcomes from participants who participated in either of the YTIs to those who were enrolled in the waitlisted control and, 2) Difference by Yoga Modality: comparing sexual health outcomes of participants who participated in the Anusara YTI to those in the Iyengar.

Based on the importance of an intimate partner to sexual health outcomes (see section 1.2, and 2.4), subset analyses were performed using data from only those participants who had a partner for each of the Yoga vs. Non-Yoga and Yoga modality groups.

As discussed previously (Section 2.6), the relationship between participation in a YTI and sexual health outcomes was assumed to be linear. Previous work has shown that other covariates are important predictors of sexual health outcomes in BCSs. As such, the multiple linear regression model utilized here followed the basic form of:

$$\text{Equation 3.1: } Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3$$

The variable X_1 was, in each model, associated with participation in a YTI. The remaining covariates (e.g., age, SSI at baseline, physical function scores, etc.), that were significant at the bivariate level, were added to the model in a stepwise fashion to achieve the most parsimonious best-fit model of the linear relationship between the exposure (YTI participation) and outcome (sexual health outcomes).

As discussed in section 2.6, null hypotheses for each regression model assumed that each independent variable provided no additional information to the model in question. P -values were considered significant at the $p < 0.05$ level and all p -values reported here are two-tailed. All R^2 values reported here are adjusted. Comparison among nested models was carried out using partial F -tests and, in the case of non-nested models, Aikike's Information Criteria (AIC) was used to compare models (See section 2.6 for more detailed description of methods). Nested models were built using forward stepwise regression such that each new iteration contained an extra variable. The following sections provide details for each of the four sexual health outcomes, for all participants and for partnered-only participants.

Best-fit models for each independent variable are presented in this section. In predicting each of the outcomes of interest, the models presented here were found to be the most appropriate, based on both the value and significance of adjusted R^2 values and Goodness of Fit testing (See Appendix B for Model details).

An example of how these models were constructed is given here. Based upon existing literature and the measure of association at the bivariate level, the variables age, SSI, emotional wellness, change in the QPR, and use of hormone therapy were all included in building models of the relationship between YTI participation and Sexual Satisfaction among all participants. Table 12 presents the information for the six models tested to find the best-fit model for the relationship between participation in a YTI and change in Sexual Satisfaction.

TABLE 12: SEXUAL SATISFACTION: STEPWISE FORWARD MODEL BUILDING TO ASSESS LINE OF BEST-FIT IN RELATIONSHIP BETWEEN PARTICIPATION IN YOGA VS. CONTROL GROUP AND CHANGE IN SEXUAL SATISFACTION SCORES FOR ALL PARTICIPANTS

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Intercept	-0.92	-4.22	0.35	1.14	-0.85	-1.73
Yoga	2.22	1.83	1.68	1.89	1.94	2.00
Age	-	0.07	-	-	-	-
SSI	-	-	-0.15	-	-	-
BSI	-	-	-	-2.61	-	-
Δ QPR	-	-	-	-	0.20	-
Endocrine Therapy	-	-	-	-	-	1.40
AR^2	0.044	0.0396	0.0349	0.0725	0.037	0.042

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
p-value	0.119	0.1985	0.215	0.114	0.207	0.191

In Model 1 only yoga participation is included, giving an adjusted $R^2 = 0.044$ (p -value=0.119). R^2 provides a measure of what proportion of the variation in change in sexual health outcomes can be explained by the independent variables included in the model. As multiple predictors were used in constructing these models, the addition of each predictor increases the possibility of explaining variance based upon chance alone. The adjusted R^2 provides a value that helps to decrease the bias of adding multiple predictors by adjusting for the increased chance-based variation of a multiple regression model.

As this model lacks both strength and statistical significance, a second model was tested and age was added as a covariate, along with participation in a YTI. Model 2 shows a decreased $R^2=0.0396$ and increased p -value (0.1985) in comparison to Model 1. This stepwise method of adding covariates one at a time was followed until all variables have been included. In this case, none of the models showed high adjusted R^2 values, and statistical significance was lacking. For other models, depending on if an additional covariate increased or decreased the strength and significance of the relationship, additional covariates were added to the same model. Goodness of fit testing was then carried out to test whether the addition of specific covariates improved the model as a whole, or not. Based upon the highest adjusted R^2 value, the significance level, and the results of goodness of fit testing, the models that best-fit the association between the independent (participation in YTI) and dependent (changes in sexual health scores) variables were selected. Reported associations in this chapter are those of the best-fit models, and the complete information for model building and goodness of fit testing is presented in Appendix B.

3.5 COMPARISON OF SEXUAL HEALTH OUTCOMES BETWEEN YTI PARTICIPANTS AND CONTROL GROUP

COMPARISON OF COMBINED INTERVENTION GROUPS WITH CONTROL GROUP

This section addresses the second research question; it compares sexual health outcomes based upon participation in either of the YTI groups with those of the waitlisted control group, adjusted for other identified predictors of sexual health. Based on the multiple linear regression modeling, no significant association between yoga participation and improvement in sexual health outcomes was observed. Each model tested the null hypothesis that all regression coefficients were equal to zero. Significant predictors of variability in each of the sexual health outcomes modelled are discussed in the sections below.

TABLE 13: SUMMARY TABLE OF BEST-FIT MODELS FOR EACH SEXUAL HEALTH OUTCOME. GROUPING IS BASED UPON ALL PARTICIPANTS' DATA AND YTI VS. CONTROL BEST-FIT MODELS.

All Participants	Sexual Interest	Sexual Satisfaction	Sexual Function	Overall Sexual Health
Adjusted R ²	0.385	0.0725	0.25	0.08
p-value/AIC	0.000398	0.114	0.0082	0.05
Yoga=Yes	-0.47	1.89	2.17	12.05.
Age	-	-	0.15*	-
SSI	-0.59**	-	-	-
BSI_GSI	-	-2.61	0.16*	-
ΔQPR	0.65**	-	-	-

Standardized least-squares ordinary coefficients significant at or below $p=0.05$ level: Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' Positive regression coefficients are indicative of positive changes in scores for each of Sexual Interest, Sexual Satisfaction, Sexual Function, and Overall Sexual Health and are indicative of improved sexual wellbeing. Positively scored predictors are associated with increased sexual wellbeing.

SEXUAL INTEREST

Regressions were run for Sexual Interest, and produced a best-fit model with an $AR^2 = 0.39$. The associated F -test showed a high level of significance ($p=0.000398$). Goodness of Fit testing showed the relative benefit of including both SSI ($F=10.062$, $p=0.003331$) and change in QPR ($F=8.3033$, $p=0.007123$) over a model that includes only Yoga participation. Sexual Interest was measured using a scale with a possible range of scores of 4-28. Units of change were calculated by subtracting Assessment 2 scores from Assessment 1 scores. A positive change was therefore indicative of an increase in Sexual Interest.

SEXUAL SATISFACTION

Based upon the predictors that were significant at the bivariate level, all of the models constructed for Sexual Satisfaction were not significant ($p=0.114$), and had low maximum $AR^2=0.073$.

SEXUAL FUNCTION

The best-fit model for Sexual Function was significant with an $AR^2=0.25$. Significant within this model were age and FLIC-22 scores.(123) For each unit increase in age (1 year), Sexual Function scores were predicted to increase by 0.15. For each unit increase in FLIC-22 scores, Sexual Function scores increase by 0.16. Goodness of fit testing supports the addition of age and FLIC-22 to the model ($p=0.0359$).

OVERALL SEXUAL HEALTH

The model of best-fit for Overall Sexual Health among all participants was significant at $p=0.05$ and $AR^2=0.08$. Only Yoga was included in the best-fit model, and was a significant contributor to Overall Sexual Health at the $p=0.05$ level. Within this model, participation in a YTI, compared to control, was associated with a 12 point increase in the Overall Sexual Health score. However, it is important to note that the AR^2 is low: only 8% of the variation in Overall Sexual Health score change can be attributed to participation in a YTI.

PARTNERED PARTICIPANTS: COMPARING YOGA AND CONTROL GROUPS

Multivariable analyses were run for the partnered data including only those participants who reported having a partner (n=24).

TABLE 14: SUMMARY TABLE FOR EACH OUTCOME BASED UPON PARTICIPATION IN EITHER A YTI GROUP OR THE WAITLISTED CONTROL GROUP FOR PARTNERED PARTICIPANTS (N=24).

Partnered Participants	Sexual Interest	Sexual Satisfaction	Sexual Function	Overall Sexual Health
Adjusted R ²	0.21	0.09	0.40	0.44
p-value	0.032	0.14	0.0043	0.00
Yoga=yes	0.56	1.35	2.30	9.14
Age	-	0.18.	0.31**	1.15**
SSI	-0.43*	-	-	-
FLIC-22	-	-	0.16*	0.46.

*Standardized least-squares ordinary coefficients significant at or below p=0.05 level: Significance codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' Positive changes in scores for each of Sexual Interest, Sexual Satisfaction, Sexual Function, and Overall Sexual Health are indicative of better sexual wellbeing.*

SEXUAL INTEREST

The best-fit model for Sexual Interest has an AR²=0.21 (p= 0.032) for yoga vs. control participants. This model included yoga and SSI. A single unit increase in SSI at baseline was significantly associated with a decrease of 0.43(p<0.05) in the Sexual Interest score. Goodness of fit testing supported the inclusion of SSI (F=5.60, p=0.027) in the overall model.

SEXUAL SATISFACTION

Among yoga and control participants, only 9% (AR²=0.09) of the variation in Sexual Satisfaction scores could be explained by a non-significant model (p=0.14).

SEXUAL FUNCTION

The best-fit model for Sexual Function had an AR²=0.40 (p=0.00428). Within this model both age (p<0.001) and FLIC-22 total (p<0.05) were significant predictors of change in Sexual Function.

Goodness of fit testing indicated that both age and FLIC-22 individually improve the model fit (p=0.00567 and p=0.04475 respectively). When yoga and age are considered alone or yoga and FLIC-22 are considered alone, the addition of either FLIC-22 (F= 4.556, p=0.0474) or age (F=9.18, p=0.0066) respectively, improves the fit.

OVERALL SEXUAL HEALTH

Among partnered participants, a significant (p<0.00) model of best-fit showed an AR²=0.44. Within this model both age and FLIC-22 scores were found to be significant contributors (p<0.001 and p<0.05, respectively) to Overall Sexual Health.

3.6 DIFFERENCE IN SEXUAL HEALTH OUTCOMES BY TYPE OF YTI

To address the final research question, of whether there is a statistically significant difference between the two yoga groups in the four sexual health outcomes measures when adjusted models are employed, multivariable analyses comparing Anusara and Iyengar YTI were run based on the selection of predictors at the bivariate level, as discussed previously.

ANALYSES BY YOGA MODALITY FOR ALL PARTICIPANTS

To examine the effects of the two yoga modalities (Anusara and Iyengar) as distinct interventions, a detailed analysis that differentiated between type of YTI was carried out. The differences between Anusara and Iyengar group outcomes are examined below.

In this section, each of the sexual health outcomes were modeled at the multivariate level using a forward stepwise, least squares method; predictor variables with significant associations observed at the bivariate level (cut-off $p < 0.20$) were included.

TABLE 15: SUMMARY TABLE OF BEST-FIT MODELS FOR EACH SEXUAL HEALTH OUTCOME.

All Participants	Sexual Interest	Sexual Satisfaction	Sexual Function	Overall
AR ²	0.38	0.048	0.228	0.12
p-value/AIC	0.00082	0.215	0.026	301.67
Anusara	-1.20	1.49	1.54	5.794
Iyengar	0.61	2.236	2.88.	11.43
Age	-	-	0.14.	0.52.
SSI	-0.50	-	-	-
BSI_GSI	-	-2.407	-	-
FLIC-22	-	-	0.13.	-
ΔQPR	0.68**	-	-	-
Surgery Type	-	-	1.32	-

Standardized least-squares ordinary coefficients significant at or below $p=0.05$ level: Significance codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' Positive changes in scores for each of Sexual Interest, Sexual Satisfaction, and Sexual Function are indicative of better sexual wellbeing. Positively scored predictors are associated with increased sexual wellbeing. Grouping is based upon all participants' data for yoga modality analyses. Coefficients for each predictor are reported, and level of significance is indicated.

SEXUAL INTEREST

Using a bivariate cut-off of $p < .20$, analysis included SSI, CAM usage, BSI, and change in QPR. The model found to explain the largest percentage of variance comprises SSI and change in the QPR, along with yoga modality. The adjusted R² for this model was 0.38 ($p=0.00082$). In this model, only the change in QPR was significant. For each unit increase in change in QPR, Sexual Interest is predicted to increase by 0.68.

SEXUAL SATISFACTION

Using a bivariate cut-off of $p < 0.20$, the multivariable analysis included age, SSI, and BSI-GSI score. For Sexual Satisfaction no models were found to be significant.

SEXUAL FUNCTION

Using a bivariate cut-off of $p < 0.20$, model building for predicting change in Sexual Function included age, BSI-GSI, FLIC-22, surgery type, and hormone therapy. The final model presented the best-fit to the data; percent variance of Sexual Function explained by the model was 23% ($p = 0.026$). Three of the five variables included in building this model were significant. Of specific interest here is the significance of participation in the Iyengar group to the variance of the best-fit model; based on the best-fit adjusted model for Sexual Function, Iyengar participants could expect a Sexual Function score increase of almost three points ($p < 0.05$). This best-fit model also showed an increase in Sexual Function score based upon Anusara participation; although the predicted score change attributed to Anusara participation is lower 0.14 ($p < 0.05$). Goodness of fit testing showed that addition of age and FLIC-22 to the model resulted in a significantly improved fit ($p = 0.00997$) over a model that included only the yoga modalities.

OVERALL SEXUAL HEALTH

Based on inclusion of yoga modality, age, SSI, MOS-SS score, and BSI-GSI score, an adjusted $R^2 = 0.12$ (AIC=301.67) was calculated for the Overall Sexual Health score best-fit model. In this model, only age was significant, with a unit increase in age (1year), predicting a half unit increase in Overall Sexual Health score change. This result seems erroneous, as it does not seem plausible that a year increase in age could predict a half point increase in Overall Sexual Health. The complexity surrounding the effect of age on sexual health is discussed in the final chapter.

PARTNERED PARTICIPANTS ANALYSIS BY YOGA MODALITY

Here, only partnered participant's data was used in analyzing differences between YTIs for each of the sexual health outcomes of interest.

TABLE 16: SUMMARY TABLE FOR EACH OUTCOME, GROUPINGS BASED UPON YOGA MODALITY FOR PARTNERED PARTICIPANTS (N=24). REGRESSION COEFFICIENTS ARE REPORTED HERE, WITH LEVEL OF SIGNIFICANCE INDICATED.

Partnered Only	Sexual Interest	Sexual Satisfaction	Sexual Function	Overall Sexual Health
AR ²	0.183	0.0494	0.364	0.43
p-value	0.072	0.273	0.012	0.001
Anusara	1.14	1.11	2.22	14.13.
Iyengar	-0.088	1.49	2.34	6.70
Age	-	0.18	0.31**	1.08**
S of S	-0.472	-	-	-
FLIC-22	-	-	0.16.	0.53.

Standardized least-squares ordinary coefficients significant at or below $p = 0.05$ level: Significance codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' Positive changes in scores for each of Sexual Interest, Sexual Satisfaction, and Sexual

Function are indicative of better sexual wellbeing. Positively scored predictors are associated with increased sexual wellbeing.

SEXUAL INTEREST

SSI, TSI, and radiation were all significantly associated with Sexual Interest at the bivariate level. The best-fit model for Sexual Interest included SSI and had an adjusted $R^2=0.183$, but was not significant at the $p<0.05$ level ($p=0.072$).

SEXUAL SATISFACTION

Using a bivariate cut-off of $p<.20$, model building included age, BSI, and endocrine therapy. Four models were built, and the best-fit model explained only 5% of the variance in Sexual Satisfaction and was non-significant ($p=0.273$).

SEXUAL FUNCTION

Using a bivariate cut-off of $p<.20$, model construction included Age, BSI, FLIC-22, Surgery type, and Endocrine therapy. The best-fit model had an $AR^2=0.36$ ($p=0.012$) for Sexual Function scores among partnered participants in either the Anusara or Iyengar intervention groups. The best-fit model included both age ($p<0.001$) and FLIC-22 score ($p<0.05$). For every year of increased age, Sexual Function scores increased by approximately 0.31. This may seem counterintuitive; the complex relationship between age and sexual health is discussed in the final chapter (See Section 4.3). For each unit of change in FLIC-22 scores, a 0.16 increase in Sexual Function score was observed. Goodness of fit testing supported the inclusion of both age and FLIC-22 scores as improvements to the model ($F=8.37$, $p=0.00923$).

OVERALL SEXUAL HEALTH

Among partnered participants, a significant ($p<0.001$) best-fit model with an $AR^2=0.43$ was built. Within this model, Anusara was a significant contributor to variation ($p<0.05$), as was age ($p<0.01$), and FLIC-22 scores ($p<0.05$). Participation within the Anusara intervention group increased Overall Sexual Health score change by 14 points within the adjusted model for partnered participants ($p<0.05$). This finding suggests that among partnered BCSs, if both age and physical functioning are adjusted for, participation in Anusara yoga has a large and significant effect on Overall Sexual Health.

CORRELATION BETWEEN SELECTED VARIABLES AND AGE OF PARTICIPANTS

The relationship between age and sexual health is not clear, and as seen in the yoga modality analyses for the full sample and partnered only sample, the effect that age has on sexual health outcomes in a YTI is also unclear (see section 1.2). To better understand the relationship between age and selected variables, t -tests were run and p -values estimated for all participants. A number of the predictors included in this analysis were suspected of being correlated with age. To test for multicollinearity, Pearson's product-moment correlation tests were carried out for select variables, using baseline data. Of specific interest here was age, as it proved to be a highly significant

predictor in a large number of the best-fit models. The relationship between age and each of the following variables was measured; physical function (as measured by the FLIC-22), Overall Sexual Health (as measured by MFSQ score), Sexual Satisfaction, Sexual Interest, orgasm, and body image.

TABLE 17: THE RELATIONSHIPS BETWEEN AGE AND SELECT VARIABLES AT BASELINE FOR ALL PARTICIPANTS

All Participants	T-test results (df =33)	95% CI	Pearson Product-moment Correlation
Physical Function and Age	$t = -0.52$ p-value = 0.60	(-0.41, 0.25)	-0.09
Overall Sexual Health and Age	$t = -2.03$ p-value = 0.05	(-0.60, -0.00)	-0.33
Sexual Satisfaction and Age	$t = -1.59$ p-value = 0.12	(-0.55, 0.07)	-0.27
Sexual Interest and Age	$t = -2.85$ p-value = 0.01	(-0.68, -0.13)	-0.44
Orgasm and Age	$t = -0.69$ p-value = 0.50	(-0.43, 0.22)	-0.12
Body Image and Age	$t = -3.21$ p-value = 0.001	(-0.71, -0.18)	-0.49

As shown in Table 17, significant correlations were observed for age and Overall Sexual Health, Sexual Interest, and body image, with 95% confidence. The largest significant correlations were observed between body image and age ($p < 0.001$), and Sexual Interest and age ($p = 0.01$). Both showed inverse relationships, which can be interpreted as follows, an increase in age among BCSs is correlated with decreases in both body image and Sexual Interest with 95% confidence. Sexual Satisfaction also showed an inverse relationship with age; as age of BCSs increases, Sexual Satisfaction decreases. However, this relationship was not significant ($p = 0.12$, 95% CI (-0.55, 0.07)). These results are in contrast to earlier results that suggested increased age in participants had a positive effect on Sexual Function. Possible explanations are explored in the final chapter.

3.7 SUMMARY

TABLE 18: COMPARISON OF FULL SAMPLE AND PARTNERED BEST-FIT REGRESSION MODELS FOR BOTH YOGA VS. CONTROL AND ANUSARA / IYENGAR GROUPINGS.

	Full Sample		Partnered Only	
	<i>Yoga vs. Control</i>	<i>Anusara & Iyengar</i>	<i>Yoga vs. Control</i>	<i>Anusara & Iyengar</i>
<u>Sexual Interest</u>				
AR ²	0.39	0.38	0.21	0.18
p-value	0.000398	0.00082	0.032	0.07
<i>Yoga=yes</i>	-0.47	-	-0.47	-
<i>Anusara</i>	-	-1.20	-	1.14
<i>Iyengar</i>	-	0.61	-	-0.09
<i>Age</i>	-	-	-	-
<i>SSI</i>	-0.59**	-0.50	-0.43*	-0.47
<i>BSI-GSI</i>	-	-	-	-
<i>FLIC-22</i>	-	-	-	-
ΔQPR	0.65**	0.68**	-	-
<u>Sexual Satisfaction</u>				
AR ²	0.07	0.05	0.09	0.05
p-value	0.11	0.22	0.14	0.27
<i>Yoga=yes</i>	1.89	-	1.35	-
<i>Anusara</i>	-	1.49	-	1.11
<i>Iyengar</i>	-	2.24	-	1.49
<i>Age</i>	-	-	0.18.	0.18
<i>SSI</i>	-	-	-	-
<i>BSI-GSI</i>	-2.61	-2.41	-	-
<i>FLIC-22</i>	-	-	-	-
ΔQPR	-	-	-	-
<u>Sexual Function</u>				
AR ²	0.25	0.23	0.40	0.36
p-value	0.0082	0.026	0.0043	0.012
<i>Yoga=yes</i>	2.17	-	2.30	-
<i>Anusara</i>	-	1.54	-	2.22
<i>Iyengar</i>	-	2.88 .	-	2.34
<i>Age</i>	0.15*	0.14.	0.31**	0.31**
<i>SSI</i>	-	-	-	-
<i>BSI-GSI</i>	0.16*	-	-	-
<i>FLIC-22</i>	-	0.13.	0.16*	0.16.
<i>Surgery Type</i>	-	1.32	-	-
ΔQPR	-	-	-	-
<u>Overall</u>				
AR ²	0.08	0.12	0.44	0.43
AIC/p-value	0.05	301.67	0.00	0.001
<i>Yoga=yes</i>	12.05.	-	9.14	-
<i>Anusara</i>	-	5.79	-	14.13.
<i>Iyengar</i>	-	11.43	-	6.70
<i>Age</i>	-	0.52.	1.15**	1.08**
<i>SSI</i>	-	-	-	-
<i>BSI-GSI</i>	-	-	-	-
<i>FLIC-22</i>	-	-	0.46.	0.53.
ΔQPR	-	-	-	-

*Shown in this table are Adjusted R^2 values and their associated p -values, regression coefficient values and their significance, Significance codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1*

SEXUAL INTEREST

Best-fit models for Sexual Interest had $AR^2=0.39$ (Y/NY $p<0.001$) and $AR^2=0.38$ (A/I $p<0.001$). In both models, the change in the QPR showed a significant and positive relationship with increased Sexual Interest scores. Within the Yoga vs. No Yoga model, the SSI at baseline was also positively related with an increase in Sexual Interest.

In the Yoga group, for each additional symptom endorsed at baseline, a decrease in Sexual Interest of $0.59(p<0.01)$ is expected. Additionally, for each unit of increase in the QPR scale, an increase in Sexual Interest of $0.65(p<0.01)$ is expected.

In the modality group (Anusara and Iyengar), for each unit of increase in the QPR scale, a significant increase of $0.68(p<0.01)$ in Sexual Interest is predicted.

As indicated by the best-fit models above, SSI at baseline is a significant indicator of Sexual Interest in the Yoga vs. Non-yoga analysis. For each additional symptom endorsed at baseline, Sexual Interest decreased by $0.43(p<0.01)$.

SEXUAL SATISFACTION

Models for Sexual Satisfaction had an adjusted $R^2=0.07$ (Y/NY $p=0.114$) and $AR^2=0.05$ (A/I $p=0.215$) of the variability observed. Both best-fit models were not significant, and independent variables were not individually significant.

SEXUAL FUNCTION

For the Yoga vs. Non-Yoga analysis, the significant ($p=0.0082$) and best-fit model had an adjusted $R^2=0.25$ of the variability in Sexual Function changes. Significant independent variables included age and BSI-GSI scores. After adjustment for age and emotional wellness, participants in a YTI, compared to controls, could expect a 2.17 increase in the Sexual Function score ($p<0.05$).

The best-fit model for Sexual Function score change among all Anusara vs. Iyengar participants had an $AR^2=0.23$ ($p=0.026$). Interestingly, in this model participation in the Iyengar group predicted a significant increase of 2.88 units to Sexual Function scores. Age and physical function scores were also significant at the $p<0.05$ cut-off and included in this model.

Best-fit models for Sexual Function in the partnered only sample showed high adjusted R^2 values; $AR^2=0.40$ ($p=0.0043$) and $AR^2=0.36$ ($p=0.012$) in the yoga vs. non-yoga and Yoga Modality analysis, respectively.

While age and emotional wellness were significant covariates in the full sample, yoga vs. control model, age and physical function were the significant covariates in each of three remaining best-fit models for Sexual Function.

The full sample yoga modality best-fit model showed that Iyengar yoga had a significant positive effect on Sexual Function scores.

OVERALL SEXUAL HEALTH

The best-fit model for the A/I grouping among partnered participants had an $AR^2=0.43$ in overall sexual wellness. Participation in the Anusara group increased Overall Sexual Health change by 14.13 compared to control ($p<0.05$) when significant variables were controlled. Age was a highly significant ($p<0.01$) predictor in this adjusted model of Overall Sexual Health. Physical function scores were also significant ($p<0.1$) predictors in this model. An increase of 1 point on the physical function scale was associated with a 0.53 increase in overall sexual wellness score. The implications of key findings of these analyses are discussed in Chapter 4.

CHAPTER 4: DISCUSSION AND CONCLUSIONS

In this chapter the study findings are discussed and suggestions are made for further avenues of research in the field of sexual health interventions for breast cancer survivors (BCSs). This chapter begins with a review of the results based on the four sexual health outcomes as laid out in the study framework. Emergent themes from this study, including partnered status, age and body image are then explored and, to conclude, recommendations are made for future YTI research in the field of sexual health for BCSs.

4.1 OVERVIEW OF FINDINGS

In this final chapter, the study results are compared to the broader literature about BCSs and sexual health outcomes. The framework that guided this study was based on a review of the literature pertaining to sexual health outcomes among BCSs, but drew heavily from the work of Patricia Ganz et al.(36) These findings are compared with what was expected based on this guiding framework, but also how the results diverged from expectations. Findings are then discussed in greater detail, paying particular attention to the significance of both partnered status and age to sexual health outcomes.

In Chapter 1, two questions were posed:

- 1) Does participation in a YTI improve sexual health outcomes among female BCSs?
- 2) Are there any significant differences in sexual health outcomes between the Anusara and Iyengar intervention groups?

To operationalize these questions, the first was divided into two questions (improvement of scores and comparison with control group), while the second was operationalized with a single question (difference between yoga modalities). Overall, there is some evidence of improvement in sexual health scores for YTI participants, and also of differences between Anusara and Iyengar YTI outcomes.

Results of this study indicate that YTIs may improve sexual health issues among BCSs, and that significant differences between YTI modalities exist. First, a significant association between participation in an Anusara YTI and improvements in Overall Sexual Health among partnered participants was found. The score change in Overall Sexual Health attributed to participation in the Anusara YTI among partnered participants is also considered clinically significant, as it was predictive of a 14 point score increase on the Overall Sexual Health scale (a change of 6.5 is considered significant²). Second, Iyengar yoga was a significant predictor of improved Sexual Function in the full sample. Both of these findings indicate that while evidence of positive effects emerged from both yoga

² Clinical significance was defined by a change of 0.5 on a scale of 1-7. Thus, on the overall score of 91, a change of 6.5 ($91/7 \times 0.5$) is considered clinically significant.(128)

modalities, disparate sexual health outcomes may be expected based upon participation in either Anusara or Iyengar YTIs.

By conducting sub-analyses of partnered only participants, we found disparate outcomes from the full sample. The details of these differences are examined below. In brief, age, emotional wellness, and physical functioning were significant predictors of variation in Sexual Function, and higher levels of predicted variance were seen in the partnered only analysis. Sexual Interest was predicted by disparate variables based on partnered status; severity of symptoms at baseline was a significant predictor of variability among both sets of participants, while quality of the partnered relationship was a significant predictor only in the full sample. In contrast to the Sexual Interest findings, higher rates of explained variance were found in the full sample compared to the partnered only sample for both Sexual Function and Overall Sexual Health. Age was also a significant predictor of Sexual Function and Overall Sexual Health in both the full and partnered only groups.

Finally, Sexual Satisfaction seems to be largely unexplained by our predictive models. This may be attributable to other variables, not included in our analysis, having a larger effect on Sexual Satisfaction. These findings are discussed and our results compared with relevant literature in this chapter. Recommendations for future YTI studies specifically addressing sexual health issues in BCSs are also discussed.

BREAST CANCER SURVIVORSHIP AND SEXUAL HEALTH

Understanding female sexuality is complex; understanding the changes to sexual health as experienced by BCSs after diagnosis and treatment is considerably more complex. The dynamic trajectory proposed by Mullan, in place of a binary concept of having cancer or being cured, adds a temporal aspect, and increased complexity, to our understanding of sexual health in BCSs.(20) Together, both the content and timing of sexual health interventions contribute to their acceptability to and utility for BCSs. Although this topic is not new, effective interventions remain elusive.(132) Among BCSs, interest in receiving information or care with regard to sexual health problems is estimated to be approximately 40% ,(133) but health care providers are often reluctant to begin conversations when there are a dearth of effective interventions for these problems.(134,135) For example, the Canadian Cancer Society has released a guide to sexuality after cancer.(136) While it does provide helpful information, and personal stories of coping with sexual changes after cancer, sources cited consist of six titles, five of which consist of studies involving prostate cancer survivors.(136) The complexity of female sexual health outcomes after breast cancer and its treatment, and current lack of evidence surrounding effective interventions, indicates a continued need for sexual health intervention studies. These studies should build on proven processes and themes while uncovering others that will serve to inform a more representative and comprehensive analytical framework within which to conduct future intervention studies that more effectively address BCSs sexual health needs.

4.2 UNDERSTANDING THE RELATIONSHIP BETWEEN PARTICIPATION IN A YTI AND SEXUAL HEALTH OUTCOMES

UNADJUSTED RELATIONSHIPS BETWEEN SELECTED PREDICTORS AND SEXUAL HEALTH OUTCOMES

At the bivariate level, age was only correlated with Sexual Function when entered as a continuous variable. However, when age was entered as a categorical variable (with age groups <50, 50-69, >69), it was significantly associated with Sexual Function, Sexual Satisfaction, and Overall Sexual Health scores for the two youngest groups. For participants over the age of 69, age was not significantly associated with any of the sexual health outcomes. The interaction(s) between age and sexuality in BCSs is discussed at length below. Compared to these results, a previous study by Ganz and colleagues,(36) from which this research drew strongly, had some disparities in predictors found to be significant at the bivariate level. The differences may be attributed to numerous factors, including the disparate scales used to measure similar domains, or to real differences in the sampled populations. For each of the sexual health outcomes discussed below, comparisons are drawn with the work completed by Ganz et al.,(36) as well as the broader literature.

The unadjusted relationships, among participation in a YTI and sexual health outcomes, showed no significant difference in overall improvement, or for any of Sexual Interest, Satisfaction, or Function measures. The complexity of sexual health, and the large number of variables previously found to contribute to sexual health outcomes among BCSs, necessitated the use of a multivariable approach to our analysis, allowing adjustment for significant predictors of each of the sexual health outcomes.

ADJUSTING FOR SIGNIFICANT PREDICTORS OF SEXUAL HEALTH OUTCOMES

The results of the best fit models for each of the sexual health outcomes are discussed here; a table summarizing these results is included at the end of the previous chapter for reference (Table 18). The best-fit model for *Sexual Interest* is that of the yoga vs. control in the full sample analysis ($AR^2=0.39$, $p=0.0004$). The best fit model for *Sexual Satisfaction* was a result of the partnered only yoga vs. control analysis; this model, however was not statistically significant and has a very low value for variance explained ($AR^2=0.09$, $p=0.14$). The variance in *Sexual Function* was best predicted by the model comparing Anusara and Iyengar yoga among those participants who were partnered ($AR^2=0.36$, $p=0.012$). Finally, the best fit model for explaining the variability in *Overall Sexual Health* among BCSs was that which compares Anusara and Iyengar within the partnered only participants ($AR^2=0.43$, $p\text{-value}=0.012$).

SEXUAL INTEREST

In the full sample models of best fit, almost 40% of the variance of change in Sexual Interest scores was predicted by the yoga modality analyses and the yoga vs. control analyses. In the yoga vs. control model, SSI at baseline was significantly associated with increased Sexual Interest scores; in both models, the change in the quality of the partnered relationship was a significant predictor. None of the best fit models for Sexual Interest had statistically significant regression coefficients associated with YTI participation. Of note, Sexual Interest scores among groups

of participants at baseline did show a significant difference ($p=0.008$). As such, it is plausible that the significant between group differences at baseline may have hampered our ability to measure the relationship between YTI participation and Sexual Interest. These baseline differences may also be indicative of other, unmeasured variables that influence Sexual Interest. Finally, in a larger, randomized sample, it is more likely that if there was a 'real' relationship between YTI participation and change in Sexual Interest, it could be detected.

Symptom severity at baseline is a significant indicator of Sexual Interest in the Yoga vs. Control analysis, as indicated by the best-fit models for partnered only participants. For each additional symptom reported at baseline, Sexual Interest scores are predicted to decrease by 0.43. This finding indicates that women who suffer from more comorbid conditions at baseline are more likely to have lower levels of Sexual Interest than peers who experience fewer comorbid conditions. This finding is similar to that found in existing literature. (36,137)

Having a partner and satisfaction with this relationship also appear to influence Sexual Interest. In a previous study, the variables found to be significant in predicting Sexual Interest among BCSs were: having a new partner since being diagnosed with cancer (increases interest), emotional wellness (better emotional wellness results in higher Sexual Interest), and body image (improved body image is correlated with higher Sexual Interest).(36) This is consistent with the current study wherein satisfaction with the quality of a participant's sexual relationship was measured with two items pertaining to satisfaction with one's partner from the MFSQ and was shown to be a significant predictor of Sexual Interest in both of the full sample analyses.(119) The two items are: satisfaction with one's partner as a friend, and satisfaction with one's partner as a lover.(119)

The explained variance for Sexual Interest score change within the full sample best fit models was much higher than that explained by the partnered-only model (38-39% vs. 18-21%). Although not conclusive, this difference indicates that among partnered participants, there are more factors not accounted for in our model that may influence the level of Sexual Interest when compared with the full sample. The opposite is true for Sexual Function; higher rates of variance are explained in the models using partnered-only data than in the best fit full sample models, as discussed below. This finding is important in future design of YTIs for sexual health in BCSs, as researchers may want to either create more stringent exclusion criteria (e.g., only partnered participants or only un-partnered participants) to clearly trace the relationship between YTI and Sexual Interest.

SEXUAL SATISFACTION

Results for the relationship between participation in a YTI and levels of Sexual Satisfaction were inconclusive. Our constructed models of Sexual Satisfaction, once adjusted for seemingly important predictors as laid out in our framework, did not contribute significantly to predicting changes in Sexual Satisfaction scores. However, both of the best-fit models included emotional wellness as a predictor of Sexual Satisfaction. This finding is supported by previous research on the predictors of Sexual Satisfaction among middle-age women, which indicates that

emotional wellness is a good indicator for Sexual Satisfaction.(138) Sexual Satisfaction among partnered participants was significantly associated with age in the Yoga vs. Non-yoga analysis. However, the percent variability that is explained by this model is also low (9.4%) and non-significant ($p=0.14$).

Dundon and Rellini found that in women between the ages of 40-70 years, predictors of Sexual Satisfaction included psychological well-being (direct), relationship satisfaction (direct) and menopausal symptoms (indirect).(138) Further, among this age demographic, body image was not a significant predictor of Sexual Satisfaction.(138) This is distinct from younger women (age 18-49) for whom body image is a strong predictor of both Sexual Satisfaction and Sexual Function.(139) Both of these studies were carried out in the general population and not cancer survivors. As such, comparisons are difficult to draw as BCSs cope with a compounded set of sexual health issues when compared with the general population. These differences may include additional impacts on sexual health due to sudden changes to one's body, including partial or full mastectomy, loss of hair, weight gain, or weight loss and are known to have a negative impact upon a woman's body-image.(69,71) Older women, however, are thought to be more psychologically prepared for chronic illness and the changes associated with a breast cancer diagnosis and its treatment, based on their increased life experience and ability to cope with unexpected and difficult occurrences.(64,66) This may help to explain the seemingly counterintuitive finding of increased age predicting improvements in Sexual Function in our sample, and is discussed in the next section on Sexual Function.

Our analysis framework did include most of these previously designated predictors of Sexual Satisfaction, with the exception of menopausal symptoms. The importance of controlling for menopausal symptoms in future YTI studies will be discussed in the recommendations section below.

Research in the field has identified two important predictors that were not found to be significant predictors of satisfaction in our sample. These were; having a partner with sex problems and the quality of a partnered relationship.(36) In determining the Sexual Satisfaction of an individual, the importance of acknowledging the presence of Sexual Function issues in a sexual partner was solidified in the model of sexual health of BCSs created by Ganz et al.(36) The MFSQ also contains an item that asks for information about a partner's Sexual Function (erectile problem in partner).(119) This item was employed in the study framework as an indicator of sexual problems in a participant's partner. As both of these predictors presuppose the presence of a sexual partner, of more pertinence to Sexual Satisfaction is our analysis of only partnered participant data. However, at the bivariate level within the partnered only data, these predictors were not found to be associated with Sexual Satisfaction, and so they were not included in our model building step. The small sample size included in our study imposes difficulty on our ability to draw any marked conclusions of the relationship (or lack thereof) between participation in a YTI and changes in Sexual Satisfaction. It is possible that YTIs can have an effect on Sexual Satisfaction, given a larger sample size.

A final consideration in the relationship between participation in a YTI and changes in Sexual Satisfaction is temporal. That is, the 12 week time frame within which the intervention was carried out may have been too short to observe changes in Sexual Satisfaction. Given a longer timeframe, it is possible that yoga therapy has an influence on Sexual Satisfaction among BCSs. Including a follow-up assessment at 6 or 12 months in future YTI studies may improve our understanding of the temporal dynamic associated with the relationship between YTI participation and Sexual Satisfaction.

SEXUAL FUNCTION

Sexual Function is perhaps the most straightforward and least subjective sexual health outcome considered in this analysis. However, its widespread use in existing literature belies a number of different interpretations. At times, the term Sexual Function is used as an equivalent to Overall Sexual Health (with interest and satisfaction classified as domains within Sexual Function, or more often, sexual dysfunction). Here, Sexual Function was operationalized with items considering vaginal lubrication (including pain during intercourse), and orgasm; which may be considered the most objective and quantitative of measures relating to sexual health. However, orgasm in women has been defined in over 23 different ways since 1938; these definitions have included biological, psychological, and biopsychosocial perspectives.(140)

In this intervention study, it was not necessary to define orgasm, rather, each woman responded to the items regarding orgasm based on a subjective understanding of what the term meant to her, and change in any of the domains after the intervention was assessed. While orgasm is privileged as an important indicator of Overall Sexual Health, its importance on an individual level varies; and, among BCSs, other indicators may be of higher personal value. For example, in a study that utilized functional magnetic resonance imaging (MRI), the simple act of hand-holding was shown to decrease brain activity associated with a characteristic stress response.(141) This is not to suggest that orgasm and other traditional measures of sexual health should not be considered, but rather, that the definitions of Sexual Function among BCSs should be broadened to include activities associated with sexual readjustment within the cancer trajectory. This recommendation is based on findings that cancer survivors often redefine what sexual activity means to them.(142)

Couple-based approaches to sexual health among cancer survivors stress the advent of a 'new normal' for sexual partners.(142,143) Sexual activities may be redefined by, for example, cuddling or hand-holding rather than intercourse. For example, the Canadian Cancer Society, in their publication on sexual health, state that 'the brain' is the most important sex organ.(136) The rationale for this statement is that it is via the brain that we both experience and interpret stimuli as being sexual or pleasurable, or not.(136) This again emphasizes the important role of psychological factors in predicting sexual health outcomes.

In both the full sample and the partnered only sample, the unadjusted Sexual Function improvements were the largest in the control group³. Sexual Function comprised two categories, lubrication and orgasm. Of interest, in both the full and partnered only groups the Sexual Function improvement was driven by the increased mean orgasm score of control group participants, which increased from 4.42 to 8.08 in the full sample and from 4.82 to 8.82 in the partnered only sample. Although the ANOVA tests did not show statistical significance of between group (Anusara, Iyengar, and control) score change, this increase in score is clinically significant.(128) Based upon the results of the analyses that adjusted for possible confounders, both age and physical function were significant contributors to the relationship between YTI participation and Sexual Function. It is possible that other unmeasured confounders, that were significantly different among control group participants compared to YTI participants, contributed to these changes. Through the application of a strict randomization protocol in future YTI studies, and increasing the sample size, this association could be better understood.

Vaginal lubrication, which was the second category in the Sexual Function outcome, is used as a proxy for sexual arousal in some sexual health scales. Some authors have objected to this association based on evidence that a woman need not be sexually aroused to become lubricated.(144) As such, the inclusion of vaginal lubrication in Sexual Function measures rather than Sexual Interest measures is supported. Vaginal dryness, although it may cause distress among women, is one of the easier symptoms to treat, as both moisturizers and lubricants are readily available, easily accessible, and associated with increased Sexual Function among women.(145) In this study, we did not ask participants to disclose any use of vaginal lubricants or moisturizers. Inclusion of an item on use of vaginal lubricants or moisturizers in future YTI studies measuring sexual health outcomes of BCSs would be advisable.

Age was a significant predictor of Sexual Function across the four best-fit models. The literature is mixed on whether age is a contributing factor to Sexual Function scores. While some authors state that physical function is a better predictor of sexual health than age,(51) others suggest that increased issues with Sexual Function should be expected with age.(63) Interestingly, for three of our four best fit models, increased age was associated with small, but statistically significant, increases in Sexual Function. Although this may seem counterintuitive in a culture that equates youth with sexuality, evidence suggests that older women are better prepared, psychologically, for the difficulties associated with breast cancer diagnosis and its treatment.(64,66) The importance of emotional wellness to Overall Sexual Health outcomes in women and, specifically, in BCSs has been established in previous work.(36,138) The present state of confusion in the BCS literature with regard to age and sexual health may be a result of not adequately controlling for both physical and psychological domains when measuring the relationship between age and sexual health outcomes.

³ Unadjusted sexual function score changes were as follows; Full sample: Control= 5.16, Anusara=-0.32, Iyengar= 0.69, Partnered only sample: Control= 7.53, Anusara=-2.80, Iyengar=-1.39).

Emotional wellness, as measured by the BSI-GSI score,(102) was a significant predictor of Sexual Function when yoga and control groups were compared in the full sample. Higher BSI-GSI scores were positively associated with increased Sexual Function scores in this sample. The importance of emotional wellness to both arousal and orgasm in women has been widely researched and confirmed.(146–148) Interestingly, among partnered participants, emotional wellness was not a significant indicator of variability in Sexual Function (but age and physical function scores were significant). This finding raises questions regarding the homogeneity of approaches to sexual health among partnered and unpartnered BCSs, and indicates that disparate sexual health intervention strategies may be appropriate based upon whether or not participants are partnered. Although multiple interventions have been designed for addressing sexual health among partnered cancer survivors,(142,143,149) no sexual health interventions have been specifically designed for single BCSs. Future research specifically targeting the sexual health needs of single BCSs, would help to address an important knowledge gap.

As discussed above, when comparing the variance explained by the best-fit models for each of the full and partnered only samples, higher rates of predicted variance were observed in the partnered only sample (40% & 36%) when compared with the full sample (23% & 25%). In this case, our full sample best fit model seems to be missing more contributing variables than the partnered only model. This finding provides further support to targeting future YTI studies for sexual health among BCSs either specifically to partnered or unpartnered participants; our understanding of factors that contribute to BCSs sexual health may be related to whether or not the participant is partnered, and contributing factors may differ for these two populations.

Increased function in everyday life was associated with increased Sexual Function only in the Iyengar vs. Anusara analysis. Although not significant, at baseline there were large differences between the two groups of participants for both lubrication and orgasm scores (which are combined in the Sexual Function subscale). The significant effect of Iyengar group participation on Sexual Function may be an artefact of the initial difference in Sexual Function scores between the two groups of participants.

Previous research has found that significant predictors of Sexual Function in BCSs include vaginal dryness (decrease function), having started a new relationship since diagnosis (increase function), and having had chemotherapy during the course of cancer treatment (decrease function).(36) As vaginal lubrication was included as a component of the Sexual Function outcome score in our study, its use as a predictive variable was precluded. Future studies may address this through careful design. Within our sample, none of the participants had begun a new relationship since date of diagnosis. Chemotherapy was not found to be associated with changes in Sexual Function scores in our sample. These differences between our sample and previous work may be a result of our small sample size, or to real differences in the populations that were sampled. Larger, randomized studies may address these shortcomings in current knowledge.

OVERALL SEXUAL HEALTH

For Overall Sexual Health scores, lower rates of variance were explained by the best fit models in the full sample when compared with partnered only sample (8% and 12% vs. 44% and 43%). The best-fit model for the Anusara vs. Iyengar analysis among partnered participants explains 43% of the variability in Overall Sexual Health ($p=0.001$). Participation in the Anusara group increased the improvement in Overall Sexual Health score by 14.13 ($p<0.1$). Age is also a highly significant ($p<0.01$) predictor of Overall Sexual Health in this model. Physical function scores are also significant ($p<0.1$) predictors within this model. An increase of 1 point on the FLIC-22 scale is associated with a 0.53 increase in Overall Sexual Health scores. A score change of 14.13, in a scale with a maximum total of 91, also represents a clinically significant score change.(128) However, it is important to note that our finding is based on a very small sample, as only 5 participants were partnered in the Anusara group. Despite the preliminary nature of this finding, the large effect size, and the statistical and clinical significance of this result, merit continued research into the effects of Anusara YTIs on the Overall Sexual Health of both partnered and unpartnered BCSs.

4.3 SALIENT FACTORS EMERGING FROM RESULTS

AGING AND BODY IMAGE

Although body image did not appear to significantly explain the level of variance in any of the sexual health domains included in this study, Klaeson et al. discuss an interesting link between age (which was a significant predictor in our study) and body image.(150) As a significant correlation was found between body image and age in our sample ($t=-3.21$, $p=0.00$, 95% CI=-0.71 to -0.18), a discussion on the known relationships between body image and age as they apply to BCSs is warranted here. BCSs who have received treatment for cancer may come to experience their body as unfamiliar, such that they come to feel like an 'outsider within their own bodies'.(150) This experience can be difficult for a BCS to articulate and respond to, and can have negative effects on her sexuality and self-perceived femininity.(150) Although some research supports the idea that the loss of a breast is associated with a loss of femininity,(10) Klaeson et al. discuss an alternative pathway that incorporates ageing; that is, the experience of cancer and its treatment make women feel older. Feeling aged is what was identified by participants as being the source of feeling less feminine.(150)

Among women who have not been diagnosed with breast cancer, feeling sexually attractive correlates well with self-reported positive body image.(120,121) Having a negative body image has been associated with decreased sexual pleasure, which may also have a negative impact on Sexual Interest.(151) Future research in this field could incorporate mixed methods approaches, and will be discussed in Section 4.6, below.

EVIDENCE FOR AND RELEVANCE OF PARTNERED INTERVENTIONS FOR SEXUAL HEALTH

Based on the literature reviewed in Chapter 1, the importance of partnered status to sexual health outcomes was established; as such, we carried out a subset analysis including only partnered participants. As hypothesized, the

results from this analysis showed disparate outcomes based upon partnered status, the details of which were discussed in the preceding section.

Coping with changes to sexual health after a cancer diagnosis and its treatment, has been previously considered based on the experiences of both partners^(142,152) As a result of this research, there is evidence of effect on Sexual Function in the cancer survivor's partner as well as the cancer survivor. However, most evidence has been obtained from prostate cancer survivors and the wives of prostate cancer survivors.⁽¹⁴²⁾ The similarities and differences between BCSs and prostate cancer survivors (and their sexual partners) and their experiences with sexual health after diagnosis and treatment are not apparent, as such, it is difficult to discuss the results of this study within the context of the existing literature on effective sexual health interventions as it pertains to BCSs and their partners.

The relevance of including sexual partners in treating sexual health issues after breast cancer treatment has been confirmed in a recent literature review.⁽¹⁴⁹⁾ These authors found that although there is limited evidence of clinically effective interventions for sexual health issues for this population, there were three shared traits of the most effective interventions. These were; 1) inclusion of sexual partners, 2) psycho-educational approaches, and 3) inclusion of sexual therapy.⁽¹⁴⁹⁾ However, not all BCSs are in relationships, and among those who are, not all are in supportive relationships.⁽¹⁵³⁾ Very little is known about sexual health in unpartnered BCSs and even less is known about sexual health interventions for these women. Previous sexual health intervention studies have by and large excluded unpartnered women.⁽¹⁴³⁾ However, unpartnered BCSs comprise a significant proportion of the population and their sexual health needs may be quite different than partnered BCSs. Our findings support the existence of disparate needs and contributing factors among partnered and unpartnered BCSs as they pertain to sexual health.

4.4 TREATMENT FOR SEXUAL HEALTH DIFFICULTIES IN SURVIVORSHIP CARE

A qualitative study was conducted with four focus groups of middle-aged BCSs and was designed to explore how they viewed their own sexual identities.⁽¹⁵⁰⁾ The main theme that emerged was that of feeling like an outsider; that is, women expressed sentiments of profound unfamiliarity with their own bodies and sexuality, as a process that involved feeling different, having a body that didn't respond how it was 'supposed' to, a decrease in eroticism, and a process of re-evaluating one's own sexual health needs.⁽¹⁵⁰⁾ This research highlights that women's changing sexuality after breast cancer is a unique and complex process, and treating sexual health difficulties within a health care context requires a patient-centered approach.⁽¹⁵⁰⁾ A need for a subjective approach to sexual health after cancer is echoed by Flynn et al.,⁽⁵⁹⁾ who emphasize the disconnect between Sexual Function and Sexual Satisfaction. Information gathered for the PROMIS (Patient Reported Outcomes Measurement Information System) study indicates that correlation between sexual (dys)function and Sexual Satisfaction is low.⁽⁵⁹⁾ This

means that although BCSs may present with symptoms that are considered indicative of Sexual Function issues (e.g., vaginal dryness, lack of orgasm), other factors should be considered in measuring Sexual Satisfaction.

Previous interventions to improve sexual health after breast cancer have also resulted in little improvement among measured sexual health domains. A Korean intervention study, focused on reframing sexual life after breast cancer and including six, 2-hour sessions, did not result in statistically significant improvements in each of marital intimacy, body image, and Sexual Function (including domains of interest, satisfaction, and (dys)function).(154) Carpenter et al. interpreted risk for adverse sexual health outcomes among gynecologic cancer survivors as being a highly predetermined factor.(155) That is, patients who have negative 'sexual self-schemas' are more likely to suffer from adverse changes to sexual health following their diagnosis and treatment. Although treatment ideas are not proffered, this study does provide a possible screening tool, although its validity among BCSs is untested.(155)

A comprehensive menopausal assessment intervention program delivered by a nurse practitioner succeeded in reducing symptoms and improving Sexual Functioning among post-menopausal BCSs.(156) Our study did not specifically measure menopausal symptoms in participants. Future YTI studies for sexual health should incorporate standardized items related to menopausal symptoms in order to account for these effects on sexual health.

4.5 STUDY STRENGTHS AND LIMITATIONS

STRENGTHS

Two aspects of this study are highly innovative. The first is the comparison of two types of yoga therapy: Anusara and Iyengar. Most yoga therapy trials among BCSs have been carried out utilizing only a single kind of yoga; that is, within a single yoga therapy trial two types of yoga have not been compared. This approach is helpful in teasing apart the aspects of yoga that may be beneficial, as each type of yoga carries distinct perspectives, tools, and values; Lin et al. report that although benefits of yoga therapy to BCSs have been confirmed, the mechanisms are not well understood.(92) By comparing two distinct kinds of yoga (Anusara and Iyengar) within this intervention we can contribute to a more nuanced understanding of how yoga therapy is beneficial to survivors. Indeed, while evidence of effectiveness for Overall Sexual Health was found for Anusara participants, the same is not true of participants in the Iyengar YTI. As noted in Chapter 2, these yoga modalities are based upon distinct foundational principles that may have disparate influences on sexual health outcomes. While Anusara yoga encourages an intuitive form of practice in which participants are taught to feel what is most comfortable for their own bodies, Iyengar yoga encourages proper technique above all else, utilizing props (such as blocks, blankets and straps) to ensure that practitioners are in the correct form.

Secondly, reporting on the sexual health outcomes of a YTI study for BCSs has not yet appeared in the published literature. A single uncontrolled study reporting on sexual health outcomes of a yoga therapy trial among women

did find benefits for women's sexual health in all 6 measured domains.(105) These two gaps in available literature suggest the relevance of exploratory research that serves to fill these gaps and promote evidence-based approaches to CAM therapies within conventional oncology treatment trajectories. Further, this research serves to highlight recommendations for future YTI studies that address sexual health issues among BCSs. Finally, the importance of sexual health to BCSs and a long history of non-empirical evidence supporting yoga therapy as a beneficial approach to women's sexual health,(85) suggests that this research provides preliminary empirical evidence in this field. It should also be noted that unlike cancer RCTs with highly stringent inclusion and exclusion criteria, this study was purposefully inclusive, with very limited eligibility criteria imposed upon participants. For example, many studies exclude participants with clinical depression or with physical limitations through pre-screening; this intervention was not limited in this way, as such, the generalizability of presented results is increased.(157)

Validated and reliable scales were used in this study. Although not specifically designed for BCSs, the MFSQ was created to assess changes in sexual health in peri-menopausal women.(119) As such, its usefulness for assessing changes in sexual health domains in BCSs who are peri-menopausal (naturally or due to the effects of chemotherapy) makes it an appropriate choice. Further, the MFSQ includes information about the QPR. The importance of the quality of relationships to Overall Sexual Health is a theme that is recurrent in the literature on sexual health in BCSs.(149) The MFSQ is relatively well designed for the purpose of this study as it does not assume objective definitions for highly subjective phenomena such as orgasm. Participants answered based on their own definition for each of these concepts, allowing each participant to consider her own experiences and rate them, to the extent possible, without external forces that may be influenced by value or normative based social expectations. The other scales used in measuring health-related QOL previously found to be associated with sexual health in BCSs (e.g., MOS-SS and BSI-GSI) also had high validity and reliability (See Chapter 2 for details).

Including a wait-listed control group was an important design feature that is recommended for future interventions. This control provides an important comparison group while not depriving any participant of the possible benefits of participating in a YTI.

LIMITATIONS

DESIGN, METHODOLOGY, AND STATISTICS

The limitations of this study have been discussed in Chapter 2, in terms of recruitment difficulties for CAM interventions in a conventional oncology setting. Although an inclusive approach to participation was undertaken in this study, an important limitation was self-selection bias; that is, participants were women who self-selected to be involved in what could be both a physically demanding and time consuming intervention study. The desire to participate in a yoga class, the ability to commit to 12 weeks of yoga classes, and the willingness to fill out two

extensive assessments may have created a large selection bias in our sample. As such, our results may not be generalizable to all BCSs, but rather to a more limited group of survivors with the time, energy, and capacity (mental, emotional, physical, and social) to both complete long assessments and participate in a weekly yoga class. As the assessment was only available in English, this represents another barrier to inclusion. Further, the city in which this intervention was carried out is known for its large yoga community. The acceptability of a YTI study in other locations with less exposure to yoga may be lower, creating even more difficulty in recruiting adequate numbers.

Due to recruitment issues, the intervention groups and the control group were not recruited simultaneously; as such, randomization was not possible. To understand how these groups may differ from each other and how these differences may influence the analysis based on, for example, demographic and medical history, basic descriptive analyses were undertaken and reported. Results indicated that the three groups of participants had some significant differences in measured variables at baseline. It is also probable that unmeasured differences were present.

A major limitation in our intervention study was the lack of randomization. When considering the unadjusted sexual health scores among groups, baseline levels were higher in the Iyengar group, and lower in the Anusara group when, compared with the control group. Significant differences were observed in social support measure, severity of symptoms, body image, and the Sexual Interest subscale among groups at baseline. These differences may have contributed to bias in measuring the relationship between participation in a YTI and sexual health outcomes. Between-group differences in the measured variables may be indicative of other unmeasured, and therefore uncontrolled, factors that contributed to our failure to detect a significant relationship between the exposure to yoga therapy and improvements to all sexual health outcomes.

These baseline differences in the measured outcomes of interest may be indicative of underlying confounders that also differ among groups, have an effect on the sexual health outcomes, and were not considered or measured in this study. As such, there may be unstudied variables that have an effect on the outcomes of interest and were inherently different among groups. In the full sample, it is important to note that only 50% of Anusara participants had partners, while 92% of the control group were partnered, and 62% of the Iyengar participants were partnered. The effect of having a partner on sexual health outcomes has been discussed throughout this manuscript. The different rates of partnered participants among groups may have affected baseline scores, as well as final outcomes, although between group differences were not statistically significant. Some other possible examples of unmeasured variables that could affect sexual health outcomes include: antidepressant use (specifically SSRI antidepressants), hot flash frequency and strength, socioeconomic status (based on household income), BMI, and weight gain over the cancer trajectory. An example of an unmeasured variable that may have positively affected sexual health outcomes includes the use of either lubricants or vaginal moisturizers.(145,158)

Issues of confounding within the multivariate modeling of this study may take the form of residual confounding (adjustment does not fully address the effect of a particular covariate) or overadjustment (either due to multicollinearity or a variable that is strongly related to the main exposure). Residual confounding can be due to improperly defined variables, imperfect proxies, or important variables left out of the model(s) (p.284).(2) Both of these types of confounding are possibilities, as there were multiple variables and relatively few observations, and the knowledge of factors associated with sexual health outcomes in both partnered and unpartnered BCSs remains incomplete. Possible confounders, based on the literature, were adjusted for within the multivariable models constructed. The adjusted models provided an improved estimate of the strength of the relationship between participation in yoga and changes in sexual health outcomes. However, the complexities of female sexual health, and a lack of uniformity in the literature describing important predictors of sexual health, create difficulty in monitoring whether all important confounders have been accounted for.

In our study, there may have been important confounders excluded from the model. Sexual Satisfaction had the lowest level of predictability of all of the outcomes within our models, indicating that there were likely important confounders and, perhaps predictors, which we missed in our assessment of the association between yoga participation and Sexual Satisfaction. This represents an important future research focus.

Although not randomized, this study did utilize a theoretical framework based upon the existing knowledge of the predictors of sexual health outcomes in BCSs. Although imperfect, it was the best possible solution given our current understanding of the topic. Although much research has been conducted on the sexual health of BCSs, there remains a gap in our understanding of effective interventions for this complex topic.

Sample size was small in this intervention. As such, our ability to estimate effect size was hindered by a lack of power. Due to the pilot status of this research, and constraints beyond our control (e.g., delayed recruitment), this is not unexpected. Further, this intervention study attempted to measure overall QOL changes among women who were not screened for participation based upon sexual health complaints. This implies that while our results are more readily generalizable, they are not specific to BCSs who are experiencing distress due to sexual health issues after cancer diagnosis and treatment. BCSs who are specifically seeking care for sexual health issues may show different outcomes than this sample. We hope lessons learnt from this study will inform future interventions for sexual health issues after breast cancer diagnosis and its treatment that may more accurately explain the effects of a YTI on sexual health domains.

The yoga curricula followed in this study were not designed to focus on sexual health, but, rather, on overall health. While sexual and overall health are highly correlated,(34) they are also distinct entities. A yoga intervention that is designed to target the sexual health of BCSs may be quite different from the interventions that were provided here. Although this makes the study more broadly comparable with existing yoga interventions for BCSs,

it is also likely that a yoga class focused primarily on increasing the sexual health of participants may have a stronger effect on the outcomes of interest. In an uncontrolled trial, Dhikav et al. found that all 6 domains of sexual health measured by the Female Sexual Function Index were improved by a YTI designed to target sexual health issues in women (not cancer survivors).(105)

Survivorship research is challenging: late effects may not emerge for decades, necessitating prolonged follow-up.(159) Sexual health is a highly dynamic entity, and multiple QOL domains contribute to the level of sexual health experienced by an individual at any time. Further, the effects of a YTI may not emerge until after the 12 week period within which participants were assessed here, although most YTIs last between six and twelve weeks.(92) It is possible that significant improvement to sexual health domains is not observable within that time frame. Previous studies have found that both increased length of yoga practice(160) and amount of time spent practicing (161) have a direct and positive relationship with both physical and psychological health outcomes such as weight control. This is evidence of a dose-response gradient, which may also be present in the relationship between participation in a yoga intervention and sexual health outcomes.

CLINICAL AND BIOLOGICAL

The study assessments did not include specific questions about menopausal symptoms or use of any medications or lubricants to mitigate symptoms associated with menopause or vaginal dryness. As such, the use of any medications may be an unknown confounder within our results, and the impact of yoga on these sexual health factors is unknown. Further, as no psychological screening was required of participants, we also did not have information on, for example, use of anti-depressants, which are known to cause sexual health problems.(56) The importance of emotional well-being to Overall Sexual Health has been discussed, and as seen in the results of this study, may play a role in Sexual Function and possibly, Sexual Satisfaction.

Psychosocial outcomes of premature menopause (often experienced by women who have taken chemotherapy) include depression, anxiety, body image problems, and Sexual Function issues.(162) 65% of the women who participated in this study received chemotherapy, and the average age of participants (54 years) indicates a perimenopausal stage. Therefore, it is highly likely that a majority of the women were experiencing menopausal symptoms during this intervention. In future YTI studies for sexual health issues in BCSs, the inclusion of a validated scale that includes commonly experienced menopausal symptoms in each assessment could provide more defined information on the effects of yoga therapy for menopausal symptoms, which are known to influence sexual health domains.

SOCIAL AND STRUCTURAL

Within the literature, the importance of body image to sexual health is emphasized. Anusara participants had significantly lower body image scores than either Iyengar or Control group participants at baseline. It is plausible,

as discussed above, that unmeasured variables created between-group differences and influenced the observed sexual health score changes. This limitation could be addressed by carrying out a similar intervention with a larger group of participants, recruited simultaneously, and following a strict randomization protocol. This is an ideal scenario, and it should be noted that although it was the original design for the overall intervention it was not possible due to recruitment issues.

Our sample was primarily Caucasian, and so the generalizability of these results is limited. Yang et al. suggest that sexual health outcomes among non-western BCSs may be more seriously affected and that they may be subject to more barriers and limitations in improving sexual health outcomes, based upon a sample of Korean women. (163) Our research did not ask for information on the gender of sexual partners, nor the sexual orientation of participants, and the items on used scales assumed a male sexual partner (e.g., erectile problems in partner and penetrative vaginal intercourse were items included in the assessments). These represent limitations in the generalizability of our study.(164) Future studies may consider more explicit items representing sexual orientation in order to unpack sexual health issues encountered by BCSs in a more inclusive way. Finally, our sample did not include any men. However, this is a justifiable exclusion as a much higher incidence of breast cancer is observed in women than in men.

Definitions of sexual health outcomes are still in flux. There is a large amount of variation between scales and studies in what should be measured as proxies for sexual health. As such, although the sexual health outcomes used in this intervention were labeled as Sexual Interest, Satisfaction, Function, and Overall Sexual Health, generalizability to existent literature is not possible in a uniform way. The findings of this study were compared largely to those of Ganz et al., as that study represents the most thorough investigation of sexual health predictors in BCSs to date.(36) The use of each term must still be carefully defined by each researcher to ensure transparency in what is actually being measured. This lack of uniformity was mitigated here by using an established, valid, and reliable scale that allows precise comparison with other definitions through comparison of the operationalized form of the outcome; that is, each outcome was carefully outlined based upon the items included in measurement.

Our assessment tools did not ask for information based on socioeconomic status. Although Canadian universal health insurance assures that necessary medical care is provided to all citizens, breast cancer diagnosis is associated with both direct and indirect out-of-pocket costs. For example, Grunfeld et al. estimate the cost of prescription drugs for women diagnosed with breast cancer to be an average of \$5,756 if they had extended coverage, and \$8,292 without extended coverage over the course of their cancer trajectory.(109) These costs represent an average out-of-pocket amount from across the country. A more recent Canadian study found that a large majority of BCSs (80%) lost on average 10% of their annual income when diagnosed with breast cancer.(165) Further, although breast cancer treatment lasted an average of 38 weeks, Employment Insurance covers a

maximum of 15 weeks of leave. As a result, women diagnosed with breast cancer needed to either use their savings, or take on debt in order to make ends meet during treatment.(165) Finally, over 15% of those sampled (n=446) were fired and 20% quit their jobs because of treatment related side effects.(165) Although these kinds of financial concerns may not directly influence sexual health outcomes, they may have an indirect influence based upon increased level of stress. Information about these financial hardships associated with a breast cancer diagnosis and its treatment were not solicited in our study.

MOVING FORWARD: INTERVENTION ASSESSMENT

The theoretical framework of this study was based on the largest available study of the sexual health outcomes of BCSs,(36) supplemented by knowledge gained from a thorough literature review. Although imperfect, this approach was the best possible given the current state of knowledge on the topic and the secondary analysis of data available for this thesis. A review of two multi-level approaches and an alternative intervention assessment framework is provided below. Future YTI studies for sexual health in BCSs would be served well in considering and following the principles of intervention assessment laid out below in the design stages.

This pilot intervention study was not designed to specifically assess factors from the multiple levels or contexts that influence the health outcomes of participants and allow for general application of findings towards evidence-based practice. This study did not use a formal assessment framework, limiting the complexity of data collected, and, therefore, the possibility of broader implications being drawn from study findings. However, this study was a pilot, primarily exploring the relationship between YTI participation and sexual health outcomes. Future studies that seek to contextualize the sexual health outcomes of BCSs in a broader social, political, economic and practical framework would benefit from drawing upon alternate frameworks, including a Whole System Research (WSR) approach, a multi-level approach applied across the cancer continuum, and a health technology assessment (HTA) framework.

Within the CAM research community, a call for a WSR approach has been sounded to ameliorate the simplistic approach to intervention research within complex systems.(166) Theory supporting this approach presupposes that cancer patients encounter a system of care that comprises multiple sets of interventions with high levels of variation in timing, available choices in conventional and CAM treatments, and contextual factors at both the individual provider as well as institutional levels.(166) As such, current research surrounding interventions involving CAM may exclude the effects of interactions between and among levels of care, resulting in research that is not relevant to the real world experience of cancer patients.(166) WSR utilizes both quantitative and qualitative methods to examine not only the effectiveness of an intervention, but also the context, process, and inherent philosophy of an intervention, as well as an expanded understanding of outcome measures.(166) Context is defined as consisting of factors that are interrelated and 'surround an intervention, giving meaning to it'.(166)

While *process* is concerned with the interaction of health care providers and patients and the activities of providing and accepting services. (166)

Including these factors in intervention research requires a description of how and where the intervention was delivered to allow for generalizability. To undertake WSR, much more time and resources are required than were available for carrying out this intervention research. The current paradigm of intervention research is highly empirical and outcomes based, and obtaining funding for proposals that lie outside this paradigm is complex.

A similar critique of intervention research in cancer care has been leveled by a distinct group of researchers, residing outside the CAM research community, who are championing a multi-level approach to interventions across the cancer continuum. Once again, the simplicity of intervention research is questioned in the face of complex cancer care.(167,168) These researchers propose that each intervention for cancer care is embedded within a much broader, much more complex reality, and again, the generalizability of intervention research is questioned based upon the amount of information that is missing in typical interventions .(167)

While both of these critiques of intervention assessment specifically in CAM and cancer survivor intervention research address a broader range of factors and are, therefore, more suited to assessing the full set of effects of an intervention within this field, both frameworks fail to assess some important kinds of contributors.

The complexity found in the individual fields of survivorship, QOL, and sexual health has been discussed at length in this manuscript. When all three are assessed simultaneously, using an appropriately detailed framework to assess the intervention becomes an increasingly important consideration. While effectiveness evidence is an important piece of the information puzzle in intervention assessment, it is only one piece. Outside of effectiveness, there are many other considerations that may act as facilitators or barriers to an intervention becoming an acceptable form of treatment within a health system.

If YTI for sexual health are to be seriously considered for implementation within health care systems, detailed understanding of effectiveness alongside numerous other factors influencing acceptability (to health care providers, patients, care providers, decision makers etc.), economic feasibility, equity, and cost effectiveness are also required. One framework that draws upon multiple fields of knowledge and evidence, including epidemiology, sociology, economics and considering actors across the domains of policy and practice is a health technology assessment (HTA) framework.(169,170) This framework, although not specific to cancer survivorship or CAM interventions, provides a methodology for assessing intervention studies based upon the field of health technology assessment. This framework has been utilized in assessing a broad range of interventions; its strength lies in both its comprehensive nature and transparency.(169,170) Making use of a comprehensive HTA framework would allow the salient features of a YTI study as it pertains to sexual health in BCSs to be assessed in a thorough and transparent manner.

4.6 RECOMMENDATIONS TO INFORM FUTURE YTIs FOR SEXUAL HEALTH ISSUES AMONG BCSs

Effective interventions for addressing sexual health issues after a breast cancer diagnosis and treatment represents a nascent field.(132) This intervention study presents a primary step in assessing the utility of yoga as an intervention to aid BCSs who are learning to live with changes to their sexual health. While our pilot findings are not without bias, the following recommendations can be made for future YTI studies for BCSs who experience issues with their sexual health.

TIMING AND TARGETING OF INTERVENTION STUDIES

The effects of diagnosis and cancer treatment on sexual health may not be most important to survivors until they are declared cancer free, and have had time to adjust to their new reality.(35) For many cancer survivors, changes to sexuality are not necessarily viewed in a negative light. Flynn et al. discuss how for some female cancer survivors, intimacy increased with partners.(59) However, maintaining a healthy sex life, as it is subjectively defined and redefined by each BCS, can act as an anchor in the tumultuous trajectory following a cancer diagnosis.(59) Therefore, future YTI studies for BCSs that target women who a) have self-identified (through participant screening) as having experienced distress due to changes in one or more domains of sexual health, and b) have been declared cancer free at time of intervention, are warranted. Future YTI research ought to also include a comprehensive list of menopausal symptoms considering the severity of menopausal symptoms reported by BCSs in previous research.(171) Although this study provides evidence of effectiveness of Anusara yoga in improving Overall Sexual Health scores, this evidence is limited by sample size (n=5). The same is true of Iyengar yoga and its effect on Sexual Function; this finding is also of limited value based on the small sample size. At this point, one yoga modality cannot be recommended over another. Rather, focusing on the measurement of sexual health outcomes when designing the YTI itself, regardless of modality, may be a more important consideration.

INTERVENTION STUDY DESIGN

Research shows that BCSs are interested in receiving information on changes to sexual health from their health care practitioner.(133) The experience of assessing sexual health outcomes in this YTI study highlighted the need for analysis of BCSs own understandings of the changes they may or may not experience that pertain to their sexual health in order to create a framework that includes more concrete and meaningful predictors of sexual health in this population. Some researchers have taken up this challenge; the literature also discusses themes of a “new normal”, and broadened views of what constitutes sexuality among BCSs.(30,150,172) However, research bridging this evidence with existing theoretical frameworks of sexual health outcomes is needed. Missing from this thesis, as well as the broader literature, is an understanding of what the sexual health outcomes discussed here meant to the participants in this intervention study. Although we measured changes to sexual health, contextualization of those changes by way of, for example, focus group discussions or in-depth interviews were not included. This limitation is an important one, and in the future researchers may consider a mixed methods

approach to ameliorate study design. A telescoping design, that allows evidence attained through qualitative approaches to inform a theoretical framework that could then be used to assess quantitative intervention studies is recommended. Focus groups and in-depth interviews, with both BCSs and health care providers, could be undertaken to inform the design of a BCS specific sexual health framework which would then be used to assess interventions. In order to allow a better understanding of participants' own perceptions of the interconnections between age, sexual health, and the experience of breast cancer diagnosis and its treatment, would allow the development of a more appropriate and accurate sexual health outcomes for the interpretation of quantitative data.

As an example, score changes in Sexual Satisfaction were not well explicated based on our model building step. Although this could be due to some of the study limitations discussed above, we had incorporated previous research on the subject that found that Sexual Satisfaction in BCSs hinged heavily upon the partner (QPR and erectile problem in the partner explained 27% of the variation in their models).(36) It is possible that unmeasured factors influence Sexual Satisfaction scores; in order to understand those factors further research is needed. Although some progress has already been made in understanding predictors of Sexual Satisfaction among women,(138) BCSs experience different realities that may influence the factors that affect their Sexual Satisfaction. Further qualitative research that develops an understanding of what influences Sexual Satisfaction among BCSs is warranted based on the results of this thesis.

Our results indicate that while age is a significant predictor of improvement in Sexual Function score, its effect(s) on Sexual Satisfaction and Sexual Interest are unclear. Further research into how sexual health and ageing interact in populations of both BCSs and women who have not had breast cancer continue to be important to build a meaningful foundation for effective sexual health interventions.(132) An understanding of how the issues surrounding changing sexuality are similar, and how they differ, for these two populations of women is limited at this time.(132,144) Some researchers have found that while sexual activity remains important to older women, emphasis shifts from physical sexual activity to emotional and intimate connections with a partner.(173) Indeed, the notion of 'normal' sexuality invites critique, for both women affected by cancer and those who are unaffected. Normalcy implies a standard, and fits well within biomedical models of health. Tiefer defines the biomedicalization of sexuality as follows:

'The biomedicalization of sexuality, then, refers to how sexual activity and experience are surveilled and self-disciplined by a public trained to think in terms of sexual norms: proper sex versus sexual perversions, inadequacies versus excesses (i.e., to automatically judge sexual fantasies, desires, object choices, activities, and identities—their own and others'—as normal or unhealthy)'.(174)

This definition emphasizes the individual and societal propensity to compare sexuality (both one's own and others) with some pre-established norm. Stepping away from this pattern of judgement and into a gentle reassessment has been shown to aid in coping with the changes to sexual health that occur as a result of cancer diagnosis and its treatment.(142) Further, the importance of clinical factors to sexual health outcomes after breast cancer has been questioned; some researchers have claimed that psychological factors have a more important role in predicting sexual health outcomes.(137) The importance of both qualitative research that develops and defines theories of inquiry into sexual health domains based upon lived experience and, subsequently, the continued application of a patient-centered approach to medicalized sexual health care are requisite components of a sexual health model of care that serves, rather than dictates the sexual experiences of individuals. The definition of sexual health proffered by the WHO contributes a less medicalized view of sexuality:

'Sexual health is a state of physical, mental, and social well-being in relation to sexuality. It requires a positive and respectful approach to sexuality and sexual relationships, as well as the possibility of having pleasurable and safe sexual experiences, free of coercion, discrimination and violence'.(175)

While this definition is more appropriate in many ways, it is problematized within a paradigm where norms and objective assessments of sexual health may serve as useful clinical tools, such as among BCSs who have expressed an interest in receiving care for sexual health problems.(133) One benefit of the sexuality questionnaire utilized in this intervention (MFSQ)(119) is the focus on score change rather than deviance from established population level norms for each of the sexual health domains. The research community is charged with the difficult task of ensuring that effective interventions for BCSs who experience distressing or uncomfortable sexual health changes are developed, without declaring normative expectations of sexual health that may increase distress in populations of BCSs. Implications behind the use of yoga therapy for sexual health adjustment after breast cancer diagnosis and treatment represent a nascent field. As BCSs continue to seek out CAM approaches for improving their health throughout the cancer trajectory the importance of distributing evidence-based information necessitates further research into the field.

4.7 CONCLUSION

This YTI study showed evidence of effect in terms of improved Overall Sexual Health scores among partnered Anusara participants and increased Sexual Function among all Iyengar participants. Although preliminary, these results indicate that YTI may be an effective, gentle, and safe intervention for BCSs who experience sexual health issues. Future research on the topic remains a priority based on the following rationale. At the nexus of each of the following reasons for pursuing further research on yoga therapy as an intervention for sexual health sequelae is the close relationship between overall QOL and sexual health; this is because an important part of normalizing

life after a breast cancer diagnosis and throughout the cancer trajectory is attributed to satisfactory sexual health.(35)

First, sexual health is a vital contributor to QOL, and BCSs suffer from changes to sexual health that do not improve over time.(12) As such, this topic merits the concerted and careful attention of researchers based on its importance to overall QOL among BCSs and an observed lack of amelioration of symptoms in the absence of intervention. To date, evidence of effectiveness for sexual health interventions among cancer survivors, let alone among BCSs, is lacking.(149)

Second, many BCSs seek out CAM therapies within their cancer trajectory, including yoga, after a breast cancer diagnosis.(106) The lack of concrete information regarding the effectiveness of such approaches continues to limit the ability of BCSs and their health care providers, to make informed decisions to maximize the benefits of CAM therapies for sexual health as well as overall health.(106) As a physical exercise that also is practiced to decrease stress and increase mindfulness, YTIs for sexual health issues represent a gentle intervention that will not cause harm, complicit with long held principles of beneficence in medicine.

Seeking out CAM treatments after a breast cancer diagnosis and its treatment fits with Taylor's conception of cognitive readjustment after a life threatening event, particularly the second and third stages.(26) Cognitive readjustment is explained as; 1) searching for meaning in the experience, 2) attempting to regain control over both the threatening event and also more generally, within one's life and, 3) trying to improve one's self-esteem despite the setback. CAM, and more specifically, yoga, may play an important role in this readjustment as regular yoga practice is widely believed to reduce stress and increase mindfulness, with some physiological explanations currently proffered.(96)

Third, the stress surrounding possibility of recurrence in BCSs may have a negative impact on sexual health.(35) Feuerstein et al. discuss the management of symptoms not related to recurrence, that cause BCSs to experience increased stress and fear, and that can effect physical function and overall wellbeing.(25) Regular yoga practice may be an important contributor to controlling the stress associated with fear of recurrence. Although the exact pathways through which yoga mitigates stress are not clear, some physiological evidence exists that yoga decreases cortisol levels among practitioners, which in turn decreases stress responses.(99) Further, as maintaining a sexual relationship can serve as an important source of comfort for BCSs, understanding if and how a YTI could help BCSs cope with an altered sexuality may contribute to not only improved sexual health outcomes but also improved overall health.

Finally, unlike pharmacological approaches to sexual health issues, yoga therapy has minimal risks and possible side effects are also largely positive; side effects include lowered body fat content,(91) increased psychological

wellness, (92) and lowered rates of fatigue.(93,94) Exercise and meditation (which coexist within a typical yoga practice) have both been successfully utilized within sexual health interventions.(149)

The recognition of breast cancer as survivable and a chronic disease enables women and health care providers to situate short- and long-term cancer related illness and dysfunction in a survivorship trajectory. Yet, evidence is still required to understand how best to mitigate these health issues, including impaired sexual health. Sexual health is a vital contributor to QOL, and BCSs suffer from changes to sexual health that do not improve over time. Research into effective sexual health interventions for BCSs is still in its infancy. Yoga therapy provides a gentle intervention with the capacity to address issues associated with sexual health among BCSs, including body image, psychological health, fatigue, and an approach that can be easily individualized to participant needs and ability. Current knowledge of the effectiveness of yoga therapy for addressing BCSs sexual health is lacking. The preliminary findings from this study indicate that YTIs have potential benefits for BCSs suffering from sexual health issues. As such, further research that incorporates the recommendations highlighted in this thesis, including using a mixed methods approach, and conducting a large, randomized trial of yoga therapy interventions designed to address the sexual health issues common among BCSs, is merited.

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APPENDICES

APPENDIX A: ASSESSMENT INFORMATION

DEMOGRAPHICS AND TREATMENT SECTION:

Please answer the following questions by circling and filling in the blanks.

(Age) N1. What year were you born? _____

(Relationship status) N2. Are you currently married or in a relationship that would constitute common-law?
Yes No

If so, for how long? (months/years) _____

Were you married /common law previous to your current relationship or status? Yes No
If so, for how long? _____

(Ethnicity) N3. What is your ethnicity? _____

(Children) N4. Do you have any children? Yes No

If so, how many? _____

Please provide the year(s) the children were born: _____

(Grandchildren) N5. Do you have any Grandchildren? Yes No

If so, how many? _____

Please provide the year(s) the grandchildren were born: _____

(Diagnosis) N6. Date of diagnosis or diagnoses (month/year): _____

Location of diagnosis or diagnoses (Vancouver, Surrey, etc.): _____

Stage(s): _____

Metastatic: Yes No

If Yes, please provide details: _____

HER2: Yes No
If Yes, please provide details: _____

ER: Yes No
If Yes, please provide details: _____

PR: Yes No
If Yes, please provide details: _____

Any other details on diagnosis? _____

(Treatments)N7. Types of treatment received (check all that apply)

_____ Surgery (e.g., mastectomy, lumpectomy, reconstructive)

Please specify type(s) and dates:

_____ Radiation therapy

Please specify duration or date range of treatment(s): _____

Date of completion for radiation: _____

Any other details on radiation treatment: _____

_____ Chemotherapy

Please specify duration or date range of treatment(s): _____

Date of completion for chemotherapy: _____

Any other details on chemotherapy treatment: _____

_____ Hormone Therapy

Type(s): _____

Please specify start date(s): _____

Please specify end date of hormone therapy if known: _____

Any other details on hormone therapy treatment: _____

_____ Other (please specify): _____

(SSI) N8. Please indicate whether you have experienced any of the symptoms below due to your cancer trajectory: (**NOTE: This section informed the creation of the SSI.**)

(check all that apply)

_____ Psychological Distress

_____ Considerable Fatigue

_____ Depression

_____ Insomnia

_____ Poor Family Functioning

_____ Loss of Libido

_____ Intimacy Issues

_____ Poor Physical Functioning

_____ Social Anxiety

_____ Nausea

_____ Muscle Cramping

_____ Chronic Pain

_____ Cognitive Dysfunction

_____ Loss of Appetite

_____ Poor Self Esteem

_____ Digestive Imbalances

APPENDIX B: MODEL DETAILS (SELECTION AND GOODNESS-OF-FIT TESTING)

YOGA (COMBINED MODALITIES) VS. CONTROL (ALL PARTICIPANTS)

Model Selection for Sexual Interest: Yoga vs. Control (All Participants)								
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Intercept	-1.67	3.51.	-2.23.	-1.44	3.60.	1.91	-1.94	2.83
Yoga	2.58	0.37	4.01*	1.65	-0.47	1.96	3.11.	0.43
SSI	-	-0.61**	-	-	-0.59**	-0.47*	-	-0.53**
CAM	-	-	-	-	-	-	-	-
MOS	-	-	4.57**	-	-	3.27*	3.35.	1.55
BSI	-	-	-	-	-	-	-	-
ΔQPR	-	-	-	0.68*	0.65**	-	0.42	0.54*
AR ²	0.037	0.245	0.22	0.179	0.385	0.318	0.242	0.382
p-value	0.137	0.0043	0.0078	0.0162	0.000398	0.0019	0.0087	0.00088

Goodness of Fit Testing for Sexual Interest Yoga vs. Control (All Participants)					
Test	Residual DF	RSS (DF=1)	Sum of Squares	F-Stat	Pr(>F)
Yoga vs. Yoga + SSI	33 32	746.49 567.92	178.57	10.06	0.00333**
Yoga vs. Yoga +MOS-SS	33 32	746.49 590.10	156.4	8.448	0.00649**
Yoga vs. Yoga+ΔQPR	33 32	746.49 617.51	128.99	6.684	0.01449*
Yoga+ SSI vs. Yoga+ΔQPR+SSI	32 31	567.92 447.94	119.98	8.303	0.00712**
Yoga +ΔQPR vs. Yoga+ΔQPR+SSI	32 31	617.51 447.94	169.56	11.735	0.00175**
Yoga+ΔQPR+SSI vs. Yoga+ MOS-SS+ΔQPR+SSI	31 30	447.94 435.96	11.98	0.825	0.3711
Yoga+MOS-SS vs. Yoga+MOS-SS+SSI	32 31	590.1 497.05	93.04	5.803	0.02213*
Yoga+SSI vs. Yoga+MOS-SS +SSI	32 31	567.92 497.05	70.87	4.420	0.0437*
Yoga+MOS-SS+ SSI vs. Yoga +MOS-S+ΔQPR+SSI	31 30	497.05 435.96	61.09	4.204	0.0492*

Model Selection for Sexual Satisfaction: Yoga vs. Control (All Participants)						
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Intercept	-0.92	-4.22	0.35	1.14	-0.85	-1.73
Yoga	2.22	1.83	1.68	1.89	1.94	2.00
Age	-	0.07	-	-	-	-
SSI	-	-	-0.15	-	-	-
BSI-GSI	-	-	-	-2.61	-	-
Δ QPR	-	-	-	-	0.20	-
Hormone Therapy	-	-	-	-	-	1.40
AR ²	0.044	0.0396	0.0349	0.0725	0.037	0.042
p-value	0.119	0.1985	0.215	0.114	0.207	0.191

Goodness of Fit testing not carried out for Sexual Satisfaction as none of the models predicted variance at a significant level.

Model Selection for Sexual Function: Yoga vs. Control (All Participants)							
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Intercept	-1.50	-9.67*	0.467	-16.60*	-6.00*	-2.81.	-23.18**
Yoga	2.34	1.38	2.015	3.10*	2.76.	1.99	2.17
Age	-	0.16*	-	-	-	-	0.15*
BSI-GSI	-	-	-2.49	-			0.16*
FLIC-22	-	-	-	0.17*			-
Surgery type	-	-	-	-	2.84.	-	-
Endocrine therapy	-	-	-	-	-	2.25	-
AR ²	0.038	0.138	0.051	0.16	0.120	0.0678	0.25
p-value	0.137	0.0355	0.16	0.02	0.0489	0.123	0.0082

Goodness of Fit Testing for Sexual Function Yoga vs. Control (All Participants)					
Test	Residual DF	RSS (DF=1)	Sum of Squares	F-Stat	Pr(>F)
Yoga vs. Yoga+ Age	33 32	609.61 529.72	79.894	4.826	0.035*
Yoga vs. Yoga + FLIC-22	33 32	609.61 517.09	92.522	5.725	0.0228*
Yoga+ Age vs. Yoga + Age+FLIC-22	32 31	529.72 449.11	80.607	5.564	0.0248*
Yoga+FLIC-22 vs. Yoga + Age+FLIC-22	32 31	517.09 449.11	67.979	4.692	0.0381*

YOGA MODALITY (ANUSARA VS. IYENGAR) ALL PARTICIPANTS

Model Selection for Sexual Interest: Yoga Modality (All Participants)									
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9
Intercept	-1.67	2.99	0.33	4.12	1.14	3.04	-1.43	2.83	0.48
Anusara	0.57	-0.09	0.54	-0.08	-	-0.097	-0.67	-1.20	-0.69
Iyengar	4.13*	1.11	3.58	0.89	-	1.13	3.32	0.61	2.80
S of Symptoms	-	-0.55*	-	-0.52*	-	-0.53*	-	-0.50	-
CAM	-	-	-	-	-0.42	-0.05	-	-	-
BSI	-	-	-2.52	-1.74	-	-	-	-	-2.42
ΔQPR	-	-	-	-	-	-	0.72**	0.68**	0.72**
AR^2	0.1026	0.229	0.11	0.22	0.02	0.20	0.275	0.38	0.29
p-value	0.06703	0.011	0.087	0.021	0.191	0.027	0.0046	0.00082	0.0065

Model Selection for Sexual Satisfaction: Yoga Modality (All Participants)				
	Model 1	Model 2	Model 3	Model 4
Intercept	-0.92	-4.413	0.0142	0.0986
Anusara	1.52	1.047	1.385	1.49
Iyengar	2.76	2.3992	2.160	2.236
Age	-	0.0697	-	-
SSI	-	-	-0.1095	-
BSI-GSI	-	-	-	-2.407
AR^2	0.031	0.0295	0.009	0.048
p-value	0.228	0.278	0.362	0.215

Goodness of fit testing was not carried out as none of the models were significantly predictive.

Goodness of Fit Testing for Overall Sexual Health: Yoga Modality (All Participants)					
Test	Residual DF	RSS (DF=1)	Sum of Squares	F-Stat	Pr(>F)
Modality vs.	32	9347.6			
Modality + Age	31	8526.3	821.4	2.987	0.094

Model Selection for Sexual Function: Yoga Modality (All Participants)										
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9	Model 10
Intercept	-1.50	-9.88*	0.30	-16.28*	-6.19	-2.78	-22.93**	-11.94**	-15.86*	-21.97**
Anusara	1.62	0.49	1.60	2.58	1.87	1.37	1.47	0.90	2.51	1.54
Iyengar	2.89	2.01	2.39	3.47*	3.47*	2.48	2.62	2.64	3.79*	2.88.
Age	-	0.17*	-	-	-	-	0.15*	0.14	-	0.14.
BSI-GSI			-2.28	-			-		-	-
FLIC-22			-	0.16*			0.16*		0.13	0.13.
Surgery Type	-	-	-	-	2.96*	-	-	2.30	2.01	1.32
Hormone Therapy	-	-	-	-	-	2.19	-	-	-	-
AR ²	0.022	0.132	0.026	0.138	0.116	0.0495	0.233	0.176	0.161	0.228
p-value	0.264	0.062	0.289	0.055	0.079	0.212	0.0167	0.043	0.054	0.026

YOGA VS. CONTROL PARTNERED ONLY

Model Selection for Sexual Interest: Yoga vs. Control (Partnered Only)				
	Model 1	Model 2	Model 3	Model 4
Intercept	-1.73	1.88	2.28	0.02
Yoga	2.27	0.56	2.59	2.63
SSI	-	-0.43*	-	-
TSI	-	-	-1.22.	-
Radiation	-	-	-	-2.74
AR ²	0.045	0.21	0.127	0.112
P-value	0.163	0.032	0.093	0.111

Goodness of Fit Testing for Sexual Interest Yoga vs. Control (Partnered Only)					
Test	Residual DF	RSS (DF=1)	Sum of Squares	F-Stat	Pr(>F)
Yoga vs. Yoga+SSI	22	323.41			
	21	255.30	68.11	5.602	0.0276*

Model Selection for Sexual Satisfaction: Yoga vs. Control (Partnered Only)				
	Model 1	Model 2	Model 3	Model 4
Intercept	-1.00	-9.79.	2.45	-2.60
Yoga	2.00	1.35	1.63	1.12
Age	-	0.18.	-	-
BSI-GSI	-	-	-4.98	
Endocrine Therapy	-	-	-	2.94
AR ²	0.012	0.094	0.054	0.061
p-value	0.270	0.14	0.215	0.198

Goodness of fit testing not carried out, as none of the models explained the variance well.

Model Selection for Sexual Function: Yoga vs. Control (Partnered Only)							
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Intercept	-1.64	-18.13**	2.85	-18.66*	-7.82*	-3.71.	-31.30**
Yoga	2.64	1.42	2.15	3.56.	2.97	1.49	2.30
Age	-	0.34**	-	-	-	-	0.309**
BSI-GSI	-	-	-6.481	-	-	-	-
FLIC-22	-	-	-	0.19*	-	-	0.16*
Surgery Type	-	-	-	-	3.998.	-	-
Endocrine Therapy	-	-	-	-	-	3.81	-
AR ²	0.025	0.296	0.0842	0.1603	0.147	0.092	0.3958
p-value	0.222	0.0096	0.1528	0.0614	0.073	0.140	0.00428

Goodness of Fit Testing for Sexual Function Yoga vs. Control (Partnered Only)					
Test	Residual DF	RSS (DF=1)	Sum of Squares	F-Stat	Pr(>F)
Yoga vs. Yoga +Age	22 21	576.55 397.09	179.45	9.490	0.0057**
Yoga vs. Yoga +FLIC-22	22 21	576.55 473.76	102.78	4.556	0.0448*
Yoga + Age vs. Yoga + Age + FLIC-22	21 20	397.09 324.66	72.43	4.462	0.0474*
Yoga+FLIC-22 vs. Yoga + Age +FLIC-22	21 20	473.76 324.66	149.1	9.185	0.0066**

YOGA MODALITY (PARTNERED ONLY)

Model Selection for Sexual Interest: Yoga Modality (Partnered Only)				
	Model 1	Model 2	Model 3	Model 4
Intercept	-1.73	2.26	2.97	0.21
Anusara	1.73	1.14	1.34	1.62
Iyengar	2.60	-0.088	3.47	3.33 .
SSI	-	-0.472	-	-
T(x) Severity Index	-	-	-1.43	-
Radiation	-	-	-	-3.04 .
AR ²	0.007	0.183	0.125	0.096
P-value	0.359	0.072	0.1336	0.178

Goodness of fit testing was not carried out as the more parsimonious Model 2 also had higher significance.

Model Selection for Sexual Satisfaction: Yoga Modality (Partnered Only)				
	Model 1	Model 2	Model 3	Model 4
Intercept	-1.00	-9.93.	2.71	-2.62
Anusara	2.20	1.11	2.31	1.44
Iyengar	1.88	1.49	1.16	0.90
Age	-	0.18	-	-
BSI-GSI			-5.36	
Endocrine Therapy	-	-	-	2.97

AR²	-0.034	0.0494	0.017	0.017
p-value	0.548	0.273	0.36	0.36

Goodness of fit testing was not carried out as none of the models showed a significant level of prediction.

Model Selection for Sexual Function: Yoga Modality (Partnered Only)							
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Intercept	-1.64	-18.75**	3.01	-19.93*	-7.82*	-3.71 .	-31.14**
Anusara	2.44	0.34	2.58	4.54	3.02	1.47	2.22
Iyengar	2.76	2.02	1.86	3.06	2.94	1.51	2.34
Age	-	0.35**	-	-	-	-	0.31**
BSI-GSI	-		-6.72	-			-
FLIC-22	-		-	0.21*			0.16 .
Surgery Type	-	-	-	-	4.00.	-	-
Endocrine Therapy	-	-	-	-	-	3.80	-
AR²	-0.0213	0.277	0.04	0.1298	0.104	0.046	0.364
p-value	0.48	0.023	0.293	0.126	0.163	0.280	0.012

Goodness of Fit Testing for Sexual Function Yoga Modality (Partnered Only)					
Test	Residual DF	RSS (DF=1)	Sum of Squares	F-Stat	Pr(>F)
Modality vs. Modality + age	21 20	576.22 388.67	187.55	9.651	0.00556**
Modality vs. Modality + FLIC-22	21 20	576.22 467.60	108.62	4.646	0.0435*
Modality + Age vs. Modality + Age + FLIC-22	20 19	388.67 324.62	64.05	3.749	0.0679.
Modality + FLIC-22 vs. Modality + Age + FLIC 22	20 19	467.60 324.62	142.98	8.369	0.00932**