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# Sex after Gray Hair? Association between Sexual Activity, Hugging, and Health among older Adults?

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Sex after Gray Hair? Association between Sexual Activity, Hugging, and Health among Older Adults

by

Chantelle Sharpe

A dissertation submitted in partial fulfillment  
of the requirements for the degree of  
Doctor of Philosophy with a concentration in Aging Studies  
School of Aging Studies  
College of Behavior and Community Sciences  
University of South Florida

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## DEDICATION

Tremendous thanks and appreciation to all who supported me through this journey. The different types of support from all the people in my life who helped me through this process definitely helped me see the light at the end of the tunnel.

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## TABLE OF CONTENTS

List of Tables .....	iv
List of Figures .....	vii
Abstract .....	viii
Chapter One: Introduction .....	1
Chapter Two: Literature Review .....	3
Sexual behavior in late life .....	3
Associations between sexual behavior and physical health.....	5
Physical health influencing/predicting sexual behavior .....	8
Sexual behavior influencing/predicting physical health .....	10
Chronic illness and the role of biomarkers: Connecting the relationships between sexual behavior and health.....	11
The role of individual biomarkers.....	13
Social support as it relates to physical health and sexual behavior .....	16
Theoretical framework.....	17
The present study .....	20
Research question 1 .....	20
Hypothesis 1.....	20
Research question 2 .....	20
Hypothesis 2.....	20
Research question 3 .....	21
Hypothesis 3.....	21
Chapter Three: Method .....	22
Participants.....	22
Measures .....	23
Dependent variables.....	23
Biomeasures .....	23
Self-reported health diagnosis.....	24
Independent variables and covariates .....	24
Sexual activity variable.....	24
Hugging variable.....	25
Sociodemographic variables .....	26
Health and functioning variables .....	27
Social support.....	28
Statistical analysis.....	28

Chapter Four: Results .....	31
Research Question 1: Is sexual activity or hugging associated with health among older adults? .....	32
Cross-sectional Results: Overview of regression analyses for self-reported health outcomes .....	32
Outcome of arthritis .....	33
Outcome of diabetes .....	33
Overview of regression analyses for biomarker outcomes .....	34
Outcome of CRP .....	34
Outcome of HbA1c .....	35
Research Question 1: Longitudinal Results .....	35
Outcome of arthritis .....	36
Outcome of diabetes .....	36
Outcome of CRP .....	36
Outcome of HbA1c .....	37
Research Question 2: Does the presence of social support modify the relationship between sexual activity or hugging and health? .....	37
Cross-sectional Results: Overview of moderation analyses for self-reported health outcomes .....	37
Outcome of arthritis .....	37
Outcomes of diabetes .....	38
Overview of moderation analyses for biomarker outcomes .....	39
Outcome of CRP .....	39
Outcome of HbA1c .....	39
Research Question 2: Longitudinal Results .....	40
Outcome of arthritis .....	40
Outcome of diabetes .....	41
Outcome of CRP .....	42
Outcome of HbA1c .....	42
Research Question 3: Does age, race, gender, or socioeconomic status, or Function (i.e., sleep) influence the relationship between sexual activity or hugging and health? .....	43
Cross-sectional Results: Overview of moderation analyses for self-reported health outcomes .....	43
Outcome of arthritis .....	43
Outcome of diabetes .....	44
Overview of moderation analyses for biomarker outcomes .....	45
Outcome of CRP .....	45
Outcome of HbA1c .....	46
Research Question 3: Longitudinal Results .....	46
Outcome of arthritis .....	47
Outcome of diabetes .....	48
Outcome of CRP .....	49
Outcome of HbA1c .....	50

Chapter Five: Discussion .....	51
Research Question 1 .....	52
Cross-sectional Findings .....	52
Longitudinal Findings .....	54
Research Question 2 .....	55
Social support and health .....	55
Research Question 3 .....	56
Cross-sectional Findings .....	56
Longitudinal Findings .....	58
Influential factors in the biopsychosocial model .....	59
Strengths .....	61
Limitations .....	61
Future research directions .....	65
Chapter Six: Conclusion .....	68
Tables and Figures .....	72
References .....	108
Appendices .....	123
Appendix A: Email response for copyright material .....	124
Appendix B: Email response from Research Integrity and Compliance .....	126

## LIST OF TABLES

Table 1:	Characteristics for NSHAP Wave 1 Sample Participants.....	75
Table 2:	Baseline Sexual Activity or Hugging Characteristics for NSHAP Sample: Grouped by Responses to Sexual Behavior Variables.....	76
Table 3:	Cross-sectional Association of Sexual Activity or Hugging with Self-Reported Arthritis in Wave 1 of NSHAP: Odds Ratios and Confidence Intervals (CI) for Logistic Regression Models .....	78
Table 4:	Cross-sectional Association of Sexual Activity or Hugging with Self-Reported Diabetes in Wave 1 of NSHAP: Odds Ratios and Confidence Intervals (CI) for Logistic Regression Models .....	79
Table 5:	Cross-sectional Association of Sexual Activity or Hugging with C-reactive Protein (CRP) level in Wave 1 of NSHAP: Odds Ratios and Confidence Intervals (CI) for Logistic Regression Models .....	80
Table 6:	Cross-sectional Association of Sexual Activity or Hugging with Glycosylated Hemoglobin (HbA1c) levels in Wave 1 of NSHAP: Odds Ratios and Confidence Intervals (CI) for Logistic Regression Models.....	81
Table 7:	Longitudinal Analysis of the Association of Sexual Activity or Hugging with Self-Reported Health Diagnosis: Odds Ratios and Confidence Intervals (CI) for Logistic Regression Models .....	82
Table 8:	Longitudinal Analysis of the Association of Sexual Activity or Hugging with C-reactive Protein (CRP) level: Odds Ratios and Confidence Intervals (CI) for Logistic Regression Models .....	83
Table 9:	Longitudinal Analysis of the Association of Sexual Activity or Hugging and Glycosylated Hemoglobin (HbA1c): Odds Ratios and Confidence Intervals (CI) for Logistic Regression Models .....	84
Table 10:	Cross-sectional Results for Social Support Moderating the Relationship between Sexual Activity or Hugging and Self-Reported Health Diagnoses in Wave 1 of NSHAP: Odds Ratios and Confidence Intervals (CI) for Logistic Regression Models .....	85

Table 11:	Cross-sectional Results for Social Support Moderating the Relationship between Sexual Activity or Hugging and C-reactive Protein (CRP) in Wave 1 of NSHAP: Odds Ratios and Confidence Intervals (CI) for Logistic Regression Models.....	86
Table 12:	Cross-sectional Results for Social Support Moderating the Relationship between Sexual Activity or Hugging and Glycosylated Hemoglobin (HbA1c) in Wave 1 of NSHAP: Odds Ratios and Confidence Intervals (CI) for Logistic Regression Models.....	87
Table 13:	Longitudinal Analysis for Social Support Moderating the Relationship between Sexual Activity or Hugging and Self-Reported Health Diagnoses: Odds Ratios and Confidence Intervals (CI) for Logistic Regression Models.....	88
Table 14:	Longitudinal Analysis for Social Support Moderating the Relationship between Sexual Activity or Hugging and C-reactive Protein (CRP): Odds Ratios and Confidence Intervals (CI) for Logistic Regression Models.....	89
Table 15:	Longitudinal Analysis for Social Support Moderating the Relationship between Sexual Activity or Hugging and Glycosylated Hemoglobin (HbA1c): Odds Ratios and Confidence Intervals (CI) for Logistic Regression Models.....	90
Table 16:	Cross-sectional Results for Moderators and the Relationship between Sexual Activity or Hugging and Self-reported Arthritis in Wave 1 of NSHAP: Odds Ratios and Confidence Intervals (CI) for Logistic Regression Models.....	91
Table 17:	Cross-sectional Results for Moderators and the Relationship between Sexual Activity or Hugging and Self-reported Diabetes in Wave 1 of NSHAP: Odds Ratios and Confidence Intervals (CI) for Logistic Regression Models.....	92
Table 18:	Cross-sectional Results for Moderators and the Relationship between Sexual Activity or Hugging and C-reactive Protein (CRP) in Wave 1 of NSHAP: Odds Ratios and Confidence Intervals (CI) for Logistic Regression Models.....	93
Table 19:	Cross-sectional Results for Moderators and the Relationship between Sexual Activity or Hugging and Glycosylated Hemoglobin (HbA1c) in Wave 1 of NSHAP: Odds Ratios and Confidence Intervals (CI) for Logistic Regression Models.....	94



Table 20:	Longitudinal Analysis for Moderators and the Relationship between Sexual Activity or Hugging and Self-Reported Arthritis: Odds Ratios and Confidence Intervals (CI) for Logistic Regression Models .....	95
Table 21:	Longitudinal Analysis for Moderators and the Relationship between Sexual Activity or Hugging and Self-Reported Diabetes: Odds Ratios and Confidence Intervals (CI) for Logistic Regression Models .....	96
Table 22:	Longitudinal Analysis for Moderators and the Relationship between Sexual Activity or Hugging and C-reactive Protein (CRP): Odds Ratios and Confidence Intervals (CI) for Logistic Regression Models .....	97
Table 23:	Longitudinal Analysis for Moderators and the Relationship between Sexual Activity or Hugging and Glycosylated Hemoglobin (HbA1c): Odds Ratios and Confidence Intervals (CI) for Logistic Regression Models.....	98

## LIST OF FIGURES

Figure 1:	A detailed depiction of the interactions in the biopsychosocial model .....	72
Figure 2:	An adapted version of the proposed SCT model analyzing the relationship between sexual behavior and health .....	73
Figure 3:	Flow chart of remaining participants with valid health outcome measures.....	74
Figure 4:	Association of sexual activity and diabetes by age group in NSHAP Wave 1 .....	99
Figure 5:	Association of hugging and diabetes by race category in NSHAP Wave 1 .....	100
Figure 6:	Association of sexual activity and HbA1c by gender in NSHAP Wave 1 .....	101
Figure 7:	Association of sexual activity and diabetes by gender in NSHAP Wave 2 .....	102
Figure 8:	Association of sexual activity and diabetes by race category in NSHAP Wave 2 .....	103
Figure 9:	Association of hugging and diabetes by sleep in NSHAP Wave 2.....	104
Figure 10:	Association of hugging and diabetes by race category in NSHAP Wave 2 .....	105
Figure 11:	Association of sexual activity and CRP by education in NSHAP Wave 2 .....	106
Figure 12:	Association of hugging and HbA1c by gender in NSHAP Wave 2 .....	107

## ABSTRACT

Research on sexual behavior in late life is limited but is growing. Despite ageist stereotypes associating old age with asexuality, older adults continue to desire and engage in sexual behavior. Previous studies have examined the relationship between health and the ability to engage in sexual behavior, sexual satisfaction, desire, or interest in sex. Research has yet to examine the potential reverse of this relationship, where sexual behavior may serve as a protective factor against health outcomes.

This dissertation examined three research questions to test the relationship between sexual activity or hugging and self-reported health outcomes (e.g., arthritis and diabetes) and biomarkers (e.g., C-reactive protein (CRP) and hemoglobin (HbA1c)). The first question explored whether sexual activity or hugging is associated health outcomes. The second question explored whether social support modifies the relationship between sexual activity or hugging and health outcomes. The final question explored whether sexual activity or hugging and demographic or health variables interact as moderators to health outcomes.

This study examined data of older adults between 57 and 85 years, from two waves of the National Social Life, Health, and Aging Project (NSHAP). The subjective health outcomes were self-reported arthritis and self-reported diabetes diagnoses. Objective health measures were analyzed using biomarkers. Both C-reactive protein and HbA1c were collected from dried blood spots. The main independent variables of interest were sexual activity and hugging. Sexual activity was assessed by combining participant responses to frequency of intercourse, foreplay

and masturbation in the last 12 months. Hugging was assessed by participant responses to frequency of close physical contact over the last 12 months.

Results from question one indicated at wave 1, engaging in hugging was associated with higher likelihood of self-reported arthritis ( $OR = 1.23, p = 0.029$ ), while sexual activity was associated with decreased likelihood of diabetes ( $OR = 0.61, p < 0.001$ ). Examining objective markers of health, sexual activity was associated with 0.25 points lower HbA1c level ( $p < 0.001$ ). Although some significant results were found at wave 1, none of the associations remained significant when examining change in health at wave 2.

The findings from question two examined the interaction of social support and sexual activity or hugging on health outcomes. The interactions between social support and sexual activity or social support and hugging did not significantly influence health at wave 1 or change in health at 2.

Question three examined potential moderators of the relationship between sexual activity or hugging and health, including age, race, education, income, gender, and hours of sleep. At wave 1, the findings showed a significant interaction between race and sexual activity associated with a decreased likelihood of reporting arthritis ( $OR = 0.79, p = 0.021$ ). A significant interaction of age and sexual activity was associated with an increased likelihood of diabetes ( $OR = 1.04, p = 0.008$ ). At wave 2, a significant interaction between age and hugging was associated with decreased likelihood of arthritis ( $OR = 0.97, p = 0.006$ ), while the interaction term of sleep and hugging was associated with increased likelihood of diabetes ( $OR = 1.19, p = 0.015$ ).

The results from this study show some support for the exploration of a potential bi-directional pathway between sexual activity or hugging and health. This study provides some evidence indicating the importance of understanding the role of sexual activity or hugging in the

lives of older adults, and the possible influence on physical health. Future studies should continue exploring this pathway indicating possible benefits of engaging in sexual activity or hugging on health, and a larger impact on quality of life for older adults who desire to maintain intimate relationships in late life.

## **CHAPTER ONE: INTRODUCTION**

Sexuality shapes the lives of adolescents, but also remains intrinsic to the identity of an individual well into older adulthood (Gott & Hinchliff, 2003; Sharpe, 2004). The literature on older adults engaging in sexual behavior is somewhat sparse. Although research has shown declines in sexual activity as age increases (Karraker, DeLamater, & Schwartz, 2011; Lindau & Gavrilova, 2010), older adults remain sexually active. Current literature has focused on the benefits of physical and psychological health and the ability or interest to engage in sexual behavior ("Brief sexuality-related communication: Recommendations for a public health approach," 2015; DeLamater & Moorman, 2007). Less work, however, has tested whether sexual behavior impacts health, and the influence of social interactions on the relationship between sexual behavior and health.

As previously mentioned, older age is followed by decreased sexual activity, such as intercourse. Much like younger adults, sexual intercourse is not the sole means for expressing one's sexuality in late life. For instance, more intimate activities beyond intercourse (i.e., physical touching, masturbation and/or mutual masturbation, hugging, and feelings of closeness) (Lindau, Surawska, Paice, & Baron, 2011) may either be directly or indirectly linked to physical and emotional health. Following the principles of a biopsychosocial framework and the interconnectedness of biological, psychological, and social factors influencing an individual as well as a partner's health, the intimate social relationships maintained and expressed via sexual

activity throughout older adulthood can potentially impact health (Lindau, Laumann, Levinson, & Waite, 2003). Therefore, the objective of this research is to examine whether ongoing sexual behavior into late life can influence the development of chronic illness and poor physical health, and to explore the role of social support on relationship between sexual behavior and health.

The sample for the study will be extracted from Wave 1 and 2 of the National Social Life, Health, and Aging Project (NSHAP) collected between 2005-2006 and 2010-2011, respectively. Analyses include multiple regression models to determine the impact of sexual behavior on health, and moderation analyses to examine the influence of social support on the relationship between sexual behavior and health. The study will contribute to the current literature by providing insight on the impact of sexual behavior on the physical health of older adults, a direction with limited examination currently. This study will also elucidate whether the availability of social support modifies the relationship between sexual behavior and health. Additionally, the study will have implications for educational tools and strategies to provide older adults. Resources can be formed to train health professionals on how to approach the topic of sexual health in late life, and information regarding the normal aging processes affecting sexual behavior and health in late. Primary care physicians could also refer older adults to sexual therapists or counselors who have more expertise in discussing sexual activity, especially with a population who might be experiencing physical or emotional issues negatively impacting their sexual behavior and health.

## **CHAPTER TWO: LITERATURE REVIEW**

### **Sexual Behavior in Late Life**

Less research has examined the role of sexual development in late life than earlier in life (i.e., adolescents or young adulthood). The physiological changes affecting older adults' sexuality (e.g., decreased hormone production for men and women leading to issues with sexual performance) combined with socially steered ageist attitudes (i.e., suggesting older adults are impotent, unattractive, and not interested in sex) has potentially contributed to the lack of information about sexual behavior in late life (Sharpe, 2004). Old age, however, encompasses another stage of sexual development spanning across midlife. Sexual expression in late life can switch from a previous focus on being able to perform more physical sexual acts to the importance of emotional outcomes such as feelings of motivation, need, and satisfaction (Sharpe, 2004). The World Health Organization (WHO) proposes sexuality includes many aspects of sexuality, and incorporates a variety of other factors considering an individual's thoughts, desires, attitudes, beliefs, and practices ("Sexual and reproductive health," 2014). WHO also addresses the interaction between biological, psychological, social, cultural, and historical factors and the influence on sexuality ("Sexual and reproductive health," 2014). On a more global perspective, sexual activity is intrinsically tied to sexual health (Spatz, Canavan, Desai, Krumholz, & Lindau, 2013). Understanding how sexual health, which holistically considers a person's well-being in relation to sexuality, and the ability to have satisfying and safe sexual



experiences provides an avenue for researchers and health professionals to focus on programs, services, and resources to aid in the promotion and protection of sexual activity in regards to relationships, safety, choice, emotional health, etc. (Spatz et al., 2013; Altarum Institute, 2014; "Sexual and reproductive health," 2014).

The growing sexuality literature tends to focus on aspects of physical ability, different types of sexual behavior, the capacity to engage in sexual activity, and attitudes towards sex (e.g., Beckman, Waem, Gustafson, & Skoog, 2008; Karraker et al., 2011; Laumann, Das, & Waite, 2008; Lindau et al., 2007). For instance, Ginsberg, Pomerantz, and Kramer-Feeley (2005) examined the prevalence of different types of sexual behavior among low-income adults over the age of 60. The findings showed over the last year between 50 to 60% of older individuals engaged in touching or holding hands, embracing or hugging, and kissing (Ginsberg et al., 2005). Also, significant differences were found between desired sexual activity and actual occurrence. For instance, over half of study participants indicated wanting more touching, hugging, and kissing than actually experienced (Ginsberg et al., 2005). The findings provide support indicative of standard views of sexual activity, such as engaging in intercourse, may not be as central to the concept of sexual behavior for older adults compared to younger adults. Similarly, Galinsky (2012) found men and women reported engaging in sexual touching (defined as engaging in kissing, hugging, caressing, and touching) nearly 80% of the time during sex with a partner in the past year. The prior studies highlight how different types of activities beyond sexual intercourse can characterize sexual behavior and remain an important aspect of sexuality in late life.

## Associations between Sexual Behavior and Physical Health

Primarily, studies examining sexual behavior in late life have focused on how health influences the ability to remain sexually active. Studies have investigated the impact of health on sexual function and frequency of sexual behavior (e.g., DeLamater & Moorman, 2007; Shifren, Monz, Russo, Segreti, & Johannes, 2008). For example, Lindau and Gavrilova (2010) analyzed the relationship between general physical health and sexual activity among middle aged and older adults. Utilizing the National Social Life, Health and Aging Project (NSHAP), findings showed self-reported good health among older men and women (57 to 85 years old) was positively associated with engaging in sexual activity (i.e., voluntary sexual activity involving sexual contact with a partner) (Lindau & Gavrilova, 2010). Similar results were found analyzing the outcome of interest in sex, revealing participants reporting *good* or *excellent* health were nearly two times more likely to indicate an interest in sex compared to adults reporting poorer health (Lindau & Gavrilova, 2010).

Using the same data set, Karraker and colleagues (2011) explored the differences between physical health and frequency of sexual activity among middle-aged and older adults. Overall, poorer physical health was associated with a 10% decline in the frequency of sexual activity for men in the older age group (57-72 years) (Karraker et al., 2011). Inconsistent findings, however, showed differences in the relationship between physical health and sexual activity between age groups. Results indicated poorer physical health was not associated with frequency of sexual activity for younger men (44-59 years old), while for older men, better physical health was significantly associated with increased sexual frequency (Karraker et al., 2011). When analyzing the relationship between health and sexual behavior between cohorts, Karraker and colleagues

(2011) suggest differences in the interpretation of self-reported physical health may explain the unexpected non-significant findings among younger versus older adults.

Studies have also looked more closely at the association between specific self-reported illnesses and sexual activity. The AARP Modern Maturity Sexuality Survey collected responses from men and women over the age of 45 (n = 1,384). The study design examined several types of sexual activity (i.e., frequency over the past six months) as outcome variables including hugging and kissing, sexual touching or caressing, oral sex, sexual intercourse, and masturbation (DeLamater & Moorman, 2007). Some of the findings showed self-reported diagnosis of high blood pressure was associated with decreased frequency in hugging and kissing among women (DeLamater & Moorman, 2007). Although minimal findings were statistically significant, the study supports previous evidence indicating poorer health is associated with decreased sexual activity among middle-aged to older adults.

Lindau and colleagues (2010) utilized NSHAP data to investigate the various types of sexual behavior among older individuals with and without diabetes. Findings revealed men with diabetes were approximately 41% more likely to report fair or poor health, while men without diabetes were 54% more likely to report excellent health (Lindau et al., 2010). Among men and women with diabetes, nearly two-thirds of men and about one-third of women were sexually active (Lindau et al., 2010). Overall, the amount of sexual activity over one month or the different types of sexual activity did not differ among older individuals with or without diabetes (Lindau et al., 2010).

The Reproductive Risk of Incontinence Study at Kaiser 2 (RRISK 2) analyzed the relationship between diabetes and various facets of sexual behavior among women between 40 and 80 years old (Copeland et al., 2012). A diabetes diagnosis was determined using a diabetes

registry to sample study participants, self-reported previous diagnosis of diabetes in combination with report of medication use or a fasting blood sugar of 126 mg/dL or greater as established by registry criteria (Copeland et al., 2012). Investigators categorized women into three groups based on diabetes diagnosis. The three groups included women who had diabetes and use insulin (insulin-treated), women who had diabetes and did not use insulin (non-insulin treated), and women who did not have diabetes. Compared to non-insulin treated diabetic women, insulin-treated diabetics reported decreased frequency of sexual activity and lower sexual desire and satisfaction (Copeland et al., 2012). Also, after adjusting for covariates such as age, race/ethnicity, marital status, BMI, and menopause status, women with diabetes were more likely to report low sexual satisfaction compared to women without diabetes (Copeland et al., 2012). The significant findings suggest the need for analysis of other chronic illnesses impacting older adults, and the potential impact on the relationship between subjective measures of health and sexual activity.

Beyond chronic illness, some research has also examined other non-pathological age-related changes influencing health and sexual behavior. Both sexual behavior and sleep can be influenced by multiple factors including age and health issues. Due to limited research, looking at the literature focused on younger populations may provide further insight into the relationship between sexual behavior and sleep. McKnight-Eily and colleagues (2011) conducted a study in 2007 investigating the role of insufficient sleep on risky health behaviors among high school students. Insufficient sleep was categorized as less than 8 hours of sleep, while multiple risky behaviors were analyzed, including sexual activity with more than one partner over a previous three months (McKnight-Eily et al., 2011). Results showed students with insufficient sleep were more likely to engage in risky sexual activity.

Further changes in sleep patterns in late life (e.g., trouble falling asleep, less amount of time in deep sleep, etc.), however, may confound evidence contradicting the findings in younger populations (Dugdale & Zieve, 2012; "National sleep foundation," 2014). Goh and Tong (2010) conducted a cross-sectional study examining the relationship sleep duration and sexual activities among Chinese men between the ages of 29 and 72. Sleep duration (e.g., ranging from less than 4 hours to over 8 hours) was not associated with the frequency of intercourse or masturbation among men of all age groups (Goh & Tong, 2010). Conflicting results and lack of studies focused on health factors specifically impacting older adults provides an area of research for further investigation. If sexual behavior is positively associated with health outcomes, it may be of interest to elucidate whether variability in the amount or quality of sleep explains a portion of the relationship in older adults.

Although cross-sectional studies provide researchers with the ability to gauge the associations between variables, cross-sectional design leaves gaps to when considering the potential directionality of the relationship between two variables. For instance, when considering chronic illness, analysis capturing one moment in an individual's life does not allow for any examination for at what point in time was the illness developed (Galinsky & Waite, 2013). The intricate relationship between sexual behavior and health is impacted by an assortment of factors (e.g., physical, psychological, and social) across the life course. In order to attempt to address the complexity of this relationship, the utilization of longitudinal data is necessary to explore the potential direction of sexual behavior influencing health in late life.

### **Physical Health Influencing/Predicting Sexual Behavior**

To date, literature exploring the directionality where physical health predicts sexual behavior has primarily focused on outcomes of sexuality related to dysfunction. For instance,

psychological health (i.e., assessed using the CES-D) and self-reported health were two factors examined influencing sexual function among women between the ages of 42 and 52 (Avis et al., 2009). Study outcomes were derived from a sexual questionnaire at baseline and a six-year follow-up. Some domains of sexual function included frequency of intercourse, frequency of masturbation, importance of sex, sexual desire, etc. (Avis et al., 2009). Results indicated participants with poorer psychological or physical health at baseline reported worse on all items of sexual function over time, excluding frequency of masturbation (Avis et al., 2009). With regards to sexual activity, this study does provide some evidence for higher anxiety and poor general health being associated with decreased frequency of sexual intercourse.

Johannes and colleagues (2000) examined the incidence of erectile dysfunction among male participants 40 to 69 years of age in the Massachusetts Male Aging Study (MMAS). Follow-up data was collected roughly 9 years after baseline. Questions related to health included self-reported diagnosis of diabetes and treatment for heart disease or hypertension (Johannes et al., 2000). Findings showed men who reported having diabetes or being treated for hypertension or heart disease had higher incidence of erectile dysfunction at follow-up, compared to men who did not report the same health issues at baseline (Johannes et al., 2000). The previous study examines more specific aspects of health associated with chronic illness in late life, but does not clearly depict how health might generally influence sexual behavior over time.

Limited literature has focused on one pathway of examining the relationship between sexual behavior and health, where health predicts sexual function. The biopsychosocial model, however, suggests the possibility for the reverse relationship to exist. Following the principles in the model, physical, psychological, and social factors can influence each other to have an influence on both health and sexuality. The impact of these relationships are not solely captured

at one time in an individual's life, but can change throughout the life course. In order to determine the extent in which sexual behavior impacts health, more research is needed testing the possible pathways of sexual behavior predicting health.

### **Sexual Behavior Influencing/Predicting Physical Health**

Still lacking in the literature is the investigation of whether sexual activity may influence health among older adults. A person's health, as interpreted using the principles of a biopsychosocial model, is directly connected to the close or intimate social relationships of that individual, such that the biological, psychological, and social health of the individual can affect and be affected by their spouse or close intimate partner (Lindau et al., 2003). Utilizing the concepts adopted from a biopsychosocial model, Lindau and colleagues (2003) hypothesized the presence of potential protective benefits of maintained sexual activity against chronic illness, mental health, and disability throughout the life course.

Due to the limited research testing the directionality of the relationship between sexual behavior and health, this study will contribute to the literature focused on sexuality in late life, by examining the frequency of sexual activity and hugging (i.e., to encompass possible sexual behaviors among older adults) as separate predictors of better physical health over time. One way to test this relationship is to utilize biomarkers associated with prevalent chronic conditions among older adults in order to determine the mechanism for which sustained sexual activity or hugging possibly prevents, delays, or minimizes chronic disease in older adults (Mayeux, 2004). The addition of evidence support the directional relationship between sexual behavior and health, as well as previous work capturing the opposite relationship will further support a bi-directional pathway between sexual behavior and health as suggested in the biopsychosocial model.

## **Chronic Illness and the Role of Biomarkers: Connecting the Relationship between Sexual Behavior and Health**

Physiological changes with aging can be accompanied by a shift in the presence of more chronic illness compared to acute diseases. As discussed above, prior work has shown general health and the presence of chronic disease influencing the relationship between health and sexual behavior among older adults. Research has also honed in on the specific impact of certain chronic conditions, such as type 2 diabetes and arthritis. Roughly 25% of older Americans over the age of 60 have diabetes ("Type 2 Diabetes," 2014), while approximately 50 million adults in the United States suffer with some form of arthritis ("Arthritis," 2013). Understanding the influence of chronic illness on health is essential as diseases such as diabetes and arthritis can impact longevity, functional mobility, risk for hospitalization, and disability for older adults ("Arthritis," 2013; "Type 2 Diabetes," 2014).

Adults with type 2 diabetes lack the ability to properly regulate insulin (e.g., resulting in excessive sugar build up in the bloodstream) causing abnormally high blood glucose levels ("Diseases and conditions: Type 2 diabetes," 2014; "Type 2 Diabetes," 2014). The presence of some risk factors can make individuals more susceptible to type 2 diabetes. For instance, Mozaffarian and colleagues (2009) found lifestyle factors including limited physical activity, poor diet, smoking, excessive drinking of alcoholic beverages, and a high body mass index (BMI) was significantly associated with incidence of diabetes among adults 65 years of age and older.

The presence of similar risk factors associated with diabetes (e.g., older age, poor diet, and smoking) also significantly influence the risk of arthritis among older adults (Abell, Hootman, Zack, Moriarty, & Helmick, 2005). Arthritis encompasses a group of rheumatic



diseases, which affect the joints by potentially causing pain, inflammation, and stiffness ("Arthritis," 2014). The two types of arthritis mainly affecting the older adult population are osteoarthritis (OA) and rheumatoid arthritis (RA). For instance, (Dominick, Ahern, Gold, & Heller, 2004) investigated the impact of arthritis on quality of life among older adults over the age of 65. Results showed older individuals who had a diagnosis of OA or RA were more likely to report poorer health-related quality of life (HRQOL) (Dominick et al., 2004).

Studies have indicated individuals with RA and associated symptoms (e.g., limited mobility, joint pain, and fatigue) were more likely to report difficulty with sexual intercourse (Tristano, 2009). Hill, Bird, and Thorpe (2003) examined the effects of RA on sexual activity in 57 patients over the age of 18. Among individuals in a partnered relationship, 56% perceived RA did not influence sexual activity in the relationship (Hill et al., 2003). On the other hand, 44% of participants who did think RA impacted the amount of sexual intercourse with a partner also reported associated symptoms contributing to pain, fatigue, and difficulty with positioning during sexual intercourse (Hill et al., 2003). Another study conducted in the Netherlands with adults over the age of 18 (i.e., average age in the mid-fifties for men and women) examined the relationship between RA and sexual motivation, activity, and satisfaction (van Berlo, van de Wiel, Rakser, Schultz, & van Rijswijk, 2007). Prior to adjusting for education, men and women with RA were more likely to report not engaging in sexual contact with a partner, masturbating, or having any sexual daydreams or fantasies compared to controls (van Berlo et al., 2007). After adjusting for education, however, the differences in sexual problems were no longer significant for male and female participants (van Berlo et al., 2007). The results of this study show that other factors, such as education, might help explain the relationship between chronic illness and sexual behavior.

The time, financial resources, and availability of data sources can dictate the amount of information available when conducting research. The assessment of self-reported diagnosis of a chronic illness, such as diabetes or arthritis, is merely the starting point for understanding how physiological processes influence the health of older adults. Subjective measures, however, can be confounded by a participant's perception of their own health compared to their peers (Baker, Stabile, & Deri, 2004), availability of health services, severity or duration of an illness, or the impact of medication on symptoms associated with a diagnosis.

Further research has attempted to gather a more in-depth understanding of physical health and underlying biological processes by analyzing biomarkers associated with disease. In research and clinical studies, biomarkers are tools used as a means of prediction, diagnosis, or to formulate treatment methods (Mayeux, 2004). Biomarkers have also been utilized to understand the causal pathway of disease, proving more accurate than solely relying on perceptions of pain or self-reported disease diagnosis (Mayeux, 2004). Biomarkers may act as a useful tool to further explore the directionality of the relationship between health and sexual behavior, by pinpointing the physiological mechanisms associated with disease progression and prevalence of sexual behavior. Currently, biomarkers do not appear to have been utilized to explore the relationship between sexual activity and physical health. The inclusion of the biomarkers in this study will add to the literature by providing evidence indicating whether the frequency of sexual activity or hugging influences physiological markers in older adults.

### **The Role of Individual Biomarkers**

One of the biomarkers commonly used to assess or diagnosis diabetes is Hemoglobin A1C (Hb-A1C). Hb-A1C develops without the presence of enzymes, when glucose reacts with amino acids on hemoglobin in the body (Ford, Li, Little, & Mokdad, 2008). Recent clinical

research has tested the use of Hb-A1C levels (e.g., Hb-A1C levels are generally acceptable below 7%) as an alternative method or accompanying diagnostic tool to fasting blood glucose level for type 2 diabetes (Bonora & Tuomilehto, 2011). Some of the positive outcomes of analyzing Hb-A1C in clinical studies and research includes lack of the need for participants to fast prior to assessment, the quality Hb-A1C assays compared to blood glucose readings, and the suitability of Hb-A1C levels for both diagnosis and monitoring of diabetes (Bonora & Tuomilehto, 2011).

Ford and colleagues (2008) utilized data from the National Health and Nutrition Examination Survey (NHANES) to analyze trends in glycemic control among adults with diabetes ( $n = 1,334$ ) in the U.S. Trends showed over 5 years, the number of participants with Hb-A1C levels less than 7% increased by roughly 20% (Ford et al., 2008). Results also showed significant differences in glycemic control between ethnic groups, with Whites having better control compared to African Americans or Mexican Americans (Ford et al., 2008). Similarly, using data from the Diabetes Prevention Program (DPP), Herman and colleagues (2007) found significant differences in Hb-A1C levels between ethnic groups, revealing Whites had the lowest Hb-A1C levels (5.78%), while Blacks and American Indians had the highest (6.18% and 6.12% respectively). These studies show Hb-A1C is a viable tool for assessing physiological changes associated with diabetes, and supports national trends highlighting differences in diabetes diagnosis and risk between ethnic groups.

Similar to diabetes, researchers have explored the potential use of a variety of biological markers best suited to monitor or diagnose arthritis. One of the markers used in studies to objectively analyze the presence of arthritis is C-reactive protein (CRP). The production of CRP is one of the processes occurring in the immune system, and has been used in studies as an

indicator of inflammation (Ridker, 2003). Some research has looked at possible causes or factors influencing varying levels of CRP among individuals with arthritis. For example, a cross-sectional study examined the relationship between physical activity and CRP levels (Colbert et al., 2004). Results showed an inverse relationship between physical activity level and CRP levels, indicating more physical activity associated with less inflammation (Colbert et al., 2004).

Another study specifically focusing on patients with RA ( $n = 118$ ) analyzed factors related to disease activity (e.g., tenderness in joints, swollen joints, joint pain and stiffness, fatigue, etc.) associated with biomarkers indicative of inflammation in the body. C-reactive protein (CRP) serum levels were one of the measures of inflammation used for analysis (Dessein, Joffe, & Stanwix, 2004). The findings showed disease activity was associated with increasing CRP levels (Dessein et al., 2004). Analysis comparing patients with low versus intermediate CRP levels (less than 2 mg/l and 2-8 mg/l, respectively), indicated participants with higher CRP levels were more likely to report more symptoms related to RA (Dessein et al., 2004).

As previously mentioned, limited research has examined sexual behavior as being beneficial for older adults' health. One reason may be a result of how health outcomes are being measured. Although informative, subjective questions of a health diagnosis are suspect to an individual's ability to recall a diagnosis, feelings regarding an illness, and perception of whether an illness is present or not based on symptoms (Baron-Epel & Kaplan, 2001; Verkuil, Brosschot, & Thayer, 2007). As a more objective indicator of health, biomarkers may help clarify the relationship between sexual behavior and health. The utilization of objective health outcomes (i.e., biomarkers), which can alert researchers and health professionals to an individual's

physiological responses, may provide the opportunity to identify and potentially validate the relationship between sexual behavior and health.

### **Social Support as it Relates to Physical Health and Sexual Behavior**

Among older adults, higher levels of social support have been significantly related to lower mortality risk, better cognitive function, and emotional health (Bertera, 2005; Choi & Ha, 2011; Seeman, Lusignolo, Albert, & Berkman, 2001; Stephens, Alpass, Towers, & Stevenson, 2011; Thoits, 2011). Much like sexuality in late life, social relationships are complex and can influence physical and emotional well-being (Thoits, 2011). Research has shown possible pathways to social support and disease, suggesting social support impacts behavioral and biological processes, which in turn influence disease morbidity and mortality (Uchino, 2006). Thus, examining social support as a potential modifiable factor influencing the relationship between sexual behavior and health may elucidate a more comprehensive understanding of how sexuality may act as a predictor of physical health among older adults.

Another issue present in studies examining sexuality in late life is the limited investigation of the influence of social support for older adults desiring to maintain a sexual identity. Lack of support (i.e., emotional or physical) from a spouse or intimate partner may negatively affect the overall health of older individuals (House, Landis, & Umberson, 1988). Previous studies have explored the benefits or potential negative effects of having an intimate partner or spouse on sexual activity (Gott & Hinchliff, 2003; Papaharitou et al., 2008). Social support, however, is not derived solely from a spouse or partner. A less explored area of research is the influence of other sources of support (e.g., family, friends, and community members) on sexuality and health in old age.

One possible explanation for limited research investigating the role of social support and sexuality in late life is the various definitions of social support across studies. Social support can encompass availability of support, perceived support, informational, instrumental, or emotional support (Berkman, Glass, Brissette, & Seeman, 2000; Kawachi & Berkman, 2001). Individuals can receive social support from a therapist, physician, social worker, friends, or family members. For instance, some health professionals may be dismissive of the idea of older adults actively pursuing a sexual life, or just apprehensive of starting a line of communication about health sexual activity in late life (Tsimtsiou et al., 2011). On the other hand, some older individuals may be more comfortable discussing questions related to sexual activity and health amongst their peers or close family members.

### **Theoretical Framework**

As discussed, previous research hypothesizes the possible existence of a bi-directional relationship between sexual behavior and health by utilizing the principles incorporated in a biopsychosocial model (Lindau et al., 2003). This study can utilize certain aspects of the biopsychosocial model to understand one direction of this relationship currently lacking in the literature, by examining whether sexual behavior predicts health in late life. A biopsychosocial model investigates the interaction between biological, psychological, and social processes influencing health and sexuality (see Figure 1 for the biopsychosocial model) (DeLamater & Moorman, 2007; Lindau et al., 2003). The focus of the biopsychosocial framework addresses health as malleable throughout the life-course, and emphasizes a more thorough understanding of internal and external factors influencing health (Lindau et al., 2003). The three dimensions of the framework (i.e., biological, psychological, and social capital) are assessed using the notion of inputs and outputs of health (Lindau et al., 2003). For example, biological capital is comprised of

factors such as genes, physiology, and sensory function, while social capital stresses the interplay of social networks on the individual (Lindau et al., 2003). On a macro level, the biopsychosocial model addresses factors outside of the individual by including the possible impact from the environment (e.g., ethnicity, gender, socioeconomic status), social expectations (e.g., social norms), and social conditions (e.g., access to resources) (Lindau et al., 2003). Utilizing the principles discussed, this study will focus on the impact of environmental factors via social norms (i.e., frequency of sexual activity or hugging) on the biological capital (i.e., subjective assessments of arthritis and diabetes and objective measures of c-reactive protein and Hb-A1C levels), and the interaction of characteristics of social networks (i.e., social support) on this relationship.

Another theoretical perspective that may be applicable when looking at the relationship between sexual behavior and health is Social Cognitive Theory (SCT). While the biopsychosocial model examines the interaction and influence of biological processes, psychological processes, social networks, and the social environment on a person's health, SCT incorporates many of the same attributes but emphasizes an individual's choices and behavior to meet health expectations. SCT analyzes socio-structural and personal determinants of health (Bandura, 1998). SCT addresses different aspects of behavior, which can be grouped to include psychological determinants of behavior, observational learning, environmental determinants, self-regulation, and moral disengagement (Glanz, Rimer, & Viswanath, 2008). Environmental determinants assess the needed support from the environment in order to accomplish what is being observed by an individual to influence change in behavior (Glanz et al., 2008). Also, self-regulation is the idea of control through the use of skills to manage one's behavior, achieved

through different avenues including self-monitoring, goal-setting, feedback, self-reward, self-instruction, and social support (Glanz et al., 2008).

In regards to health promotion, analyses of these determinants includes understanding the mechanisms in which they operate, and the best ways of incorporating this information to achieve accessible and adaptable health practices (Bandura, 2004). For example, Plotnikoff, Lippke, Courneya, Birkett, and Sigal (2008) used data from the Alberta Longitudinal Exercise and Diabetes Research Advancement (ALEXANDRA) study to test whether SCT was an efficient theoretical model to explain physical activity in adults with type 1 and type 2 diabetes. Findings revealed the SCT construct of self-efficacy was the main predictor of goals and physical behavior for adults with either type 1 or type 2 diabetes, which remained significant over the 6-month follow-up (Plotnikoff et al., 2008). Outcome expectations were significantly associated with goals for all participants, while participants with stronger goals at baseline were indicative of increased physical activity at follow-up (Plotnikoff et al., 2008). This study shows some of the constructs of SCT do impact behavior, resulting in better health among individuals with a chronic illness.

SCT can be used to indirectly assess the relationship between sexual behavior and health with the focus on health promotion. Different constructs of SCT can be used to explain the possible relationship between sexual activity and health among older adults (see Figure 2 for the potential model detailed in the following example). For example, behavior would represent engagement in sexual activity, while facilitators of behavior could be measured through spousal support or support from friends and family. Goal setting could serve as another construct addressing the goal of better physical health, albeit indirectly through sexual activity. Health could possibly be assessed through self-report in combination with biomeasures to objectively



analyze the presence of biological processes associated with chronic illness. Although outcome expectations in the SCT model reflect direct expectations from behavior, when considering sexual behavior, benefits of sexual activity would likely be an indirect expectation experienced through increased satisfaction, the perception of a good quality relationship, the capacity to function sexually, and the ability to express emotion.

### **The Present Study**

The overall goal of the proposed study is to examine sexual activity and hugging in relation to health among older adults. In addition, the potential modifying effect of social support on the relationship between sexual activity or hugging and health outcomes was also examined. Based on current literature, the following aims and hypotheses were formulated.

#### **Research Question 1**

Is sexual activity or hugging associated with better health among older adults?

#### **Hypothesis 1.**

It is expected that adults who engage in frequent sexual activity (i.e., including frequency of intercourse, masturbation, or foreplay in the last year) or hugging (i.e., including frequency of hugging in the last year) would report better physical health outcomes over a 5-year period.

#### **Research Question 2**

Does the presence of social support modify the relationship between sexual activity or hugging and health?

#### **Hypothesis 2.**

It is expected that adults who have more social support and engage in more frequent sexual activity or hugging would report better physical health outcomes over a 5-year period.

### **Research Question 3**

Does age, race, gender, or socioeconomic status or function (i.e., sleep) influence the relationship between sexual activity or hugging and health?

### **Hypothesis 3.**

It is expected that the association between sexual activity or hugging and health outcomes would be stronger for younger adults, as well as those of white race, male gender, higher income, higher education, and those reporting better sleep. It is also expected that adults who engage in more frequent sexual activity or hugging would report better health outcomes and less adverse change in health after 5 years.

## CHAPTER THREE: METHOD

### Participants

Participants included in analysis will be obtained from the National Social Life, Health, and Aging Project (NSHAP). Participants for the NSHAP study were initially obtained from survey data via the Health and Retirement Study (HRS) in 2004 (Smith et al., 2009). Various techniques were used to collect data from sample participants including face-to-face interviews, leave-behind questionnaires, and the collection of biomeasures (Smith et al., 2009). This study will use the two currently available waves of NSHAP. Data for Wave 1 was collected between 2005 and 2006 ( $n = 3,005$ ) and Wave 2 was conducted between 2010 and 2011 ( $n = 3,377$ ) (NSHAP, 2014). Wave 2 included information for respondents in the first wave, spouses and/or cohabitating partners of Wave 1 participants, and individuals who declined being interviewed for Wave 1 (NSHAP, 2014). Wave 2 contains the same information for health outcomes as Wave 1.

From the initial sample of 3,005 study participants, 175 participants were excluded due to missing data (e.g., refused to answer, don't know, or not applicable) on all of the sexual behavior measures. A remaining sample of 2,830 participants from Wave 1 of the NSHAP study had valid information for outcome variables. Refer to Figure 3 for a flow chart indicating the sub-sample sizes of each health outcome measure.

Descriptive characteristics of the overall study sample at wave 1 are summarized in Table 1. The mean age of participants was 69.07 (SD = 7.78, age range: 57-85 years), an equal

distribution of female and male participants (50%), and a majority of respondents being White (71.2%). A majority of sample participants (78.1%) had a high school degree/equivalent or higher. At wave one about half (52.2%) of participants reported 'yes' to ever being diagnosed with arthritis, while nearly a quarter (21.3%) indicated ever being diagnosed with diabetes. For participants with sufficient data for the biomarker of CRP ( $n = 1,829$ ), the average CRP level was 3.11 mg/L (SD = 5.68), while average HbA1c ( $n = 1,645$ ) was 6.09% (SD = 1.02).

Descriptive characteristics on individuals who did or did not report engaging in sexual activity or hugging at wave 1 are summarized in Table 2. Overall, participants who did not engage in sexual activity or did not engage in hugging, were older, female, and less had earned a high school degree/equivalent or higher compared to those who did report engaging in sexual activity or hugging. Compared to respondents who did report engaging in sexual activity or hugging, a higher percentage of respondents who did not engage in sexual activity or hugging reported having arthritis or diabetes. Also, participants who did not report engaging in sexual activity or hugging had higher CRP level and HbA1c level.

### **Measures**

Measures selected for analysis include factors potentially influencing the relationship between sexual behavior and health, including assessments of sexual activity, hugging, social support, function, and health conditions relevant to the aging population.

### **Dependent variables.**

**Biomeasures.** From the biomeasures collected in NSHAP, this study will utilize C-reactive protein (CRP) and hemoglobin (HbA1c) levels as objective outcome measures of health. Previous work has utilized CRP as a marker for inflammation (Aman et al., 2000), while HbA1c has been used to measure blood glucose control ("Use of glycated hemoglobin (HbA1c) in the

diagnosis of diabetes mellitus: Abbreviated report of a WHO consultation," 2011; Williams & McDade, 2009). The measures of CRP and HbA1c were gathered using dried blood spots which were collected following a prick on the finger of the respondent and the collection of a drop of blood on designated spots on a filter paper (Williams & McDade, 2009). After collection and transport of dried blood spots, enzyme immunoassay protocols were used for analysis of CRP and conducted at the Laboratory for Human Biology Research at Northwestern University (Nallanathan, McDade, Williams, & Lindau, 2008).

The findings from the CRP assays are reported in mg/L. Similar to previous research clinically assessing CRP level for chronic illness or inflammation, in the analysis for this project CRP was dichotomized to less than 10mg/L or greater than 10 mg/L (Figaro et al., 2006; Meneilly & Tessier, 2001). Analysis of the hemoglobin A1c assay was conducted at Flexsite in Palm City, FL (Gomero, McDade, Williams, & Lindau, 2008). The results from the HbA1c assays were reported as the percent of glycosylated hemoglobin from total hemoglobin. Also in the analysis for this project, HbA1c was dichotomized to  $<7\%$  or  $\geq 7\%$ , as has been used in previous clinical studies assessing fasting glucose and risk for type 2 diabetes (Ford et al., 2008).

**Self-reported health diagnosis.** The measures of self-reported arthritis and self-reported diabetes included in NSHAP will be used as health outcomes. Both arthritis and diabetes were dichotomous variables examined by asking participants to self-report, "Has a medical doctor ever told you that you have any of the following conditions..."

**Independent variables and covariates.**

**Sexual activity variable.** The measures of foreplay, intercourse, and masturbation included in NSHAP will be used to gauge sexual activity in the study analysis. For all sexual behavior questions, participants were asked to recall the frequency of sexual activity with a

partner over the last year. For the measures of foreplay and intercourse a 5-point Likert scale was used (e.g., *never, rarely, sometimes, usually, and always*). To examine the frequency of foreplay participants were asked, “When you had sex in the last 12 months, how often did your activities include kissing, hugging, caressing, or other ways of sexual touching?” The frequency of vaginal intercourse was examined by asking participants, “When you had sex in the last 12 months, how often did your activities include vaginal intercourse?” Responses to foreplay and vaginal intercourse were dichotomized to “yes” – the respondent did engage in sexual activity or “no” – the respondent did not engage in sexual activity. Frequency of masturbation was examined by asking participants, “On average, in the past 12 months how often did you masturbate?” with responses ranging from *not at all this year* to *more than once a day*. Masturbation was dichotomized to “no” if participants replied *not at all this year* to masturbating.

**Hugging variable.** Hugging was assessed by asking participants, “In the last 12 months, how often have you engaged in the following activities: hugging, kissing, caressing, or other close physical contact with [partner]?” with responses ranging from *never* to *several times a week*. Hugging was dichotomized to “yes” if participants replied hugging *several times a week* or “no” they did not frequently hug if their response indicated anything less than *several times a week*.

In the literature focusing on sexuality among older adults no standard definition specifies what is sexuality or sexual behavior. Some definitions of sexual behavior, however, include vaginal intercourse, masturbation, oral sex, and aspects of intimacy such as physical closeness and caring (Lindau et al., 2007; Rheume & Mitty, 2008; Waite, Laumann, Das, & Schumm, 2009). The inclusion of various types of sexual activity will encompass the possible alternatives of engaging in sexual behavior among older adults (i.e., outside of intercourse and with or

without a partner), which may be the only option for older adults experiencing functional decline in late life. Separately, the variable of hugging will examine responses to kissing, caressing, and close physical contact.

To explore the association between sexual behavior and health, in this analysis, the variable sexual activity will examine responses to vaginal intercourse, foreplay, and masturbation. Participants who engaged in frequent sexual activity in the last 12 months responded, “yes” to foreplay, intercourse, or masturbation, and “no” if not engaging in foreplay, intercourse, or masturbation. Hugging was dichotomized as “yes” if participants frequently engaged in hugging, and “no” if not frequently hugging.

**Sociodemographic variables.** Sociodemographic factors used in analysis will include age, gender, ethnicity, marital status, education, and household income. Age was calculated from the participant’s date of birth. Gender, ethnicity, marital status, education, and household income were self-reported. For analysis, participants identified with one of four possible ethnic groups (i.e., White, Black, Hispanic non-Black, and Other). Marital status was assessed by asking participants to indicate whether they were married, living with a partner, divorced, separated, widowed, or never married. Another possible question to gauge whether unmarried respondents had a partner asked, “Do you currently have a romantic, intimate, or sexual partner?” with possible responses being a dichotomous *yes* or *no*. For this analysis, partnership will be dichotomized to “yes” if participants reported being *married* or *living with a partner* or unmarried individuals who responded *yes* to having a partner. Participants were asked to indicate their level of education based on the following categories: *less than high school*, *high school degree or equivalent*, *vocational certificate/some college/associate’s degree*, and a *Bachelor’s degree or higher*. Household income was a continuous variable measured by asking participants

to identify their approximate household income for the current year. For analysis, household income was dichotomized based on median income responses, to participants who reported an annual income of equal to or greater than 35,000 or less than 35,000.

**Health and functioning variables.** Activities of daily living (ADLs) were used to assess a level of functioning of sample participants. In the NSHAP study participants were asked, “...tell me how much difficulty you have with each activity,” on seven activities of daily living (e.g., walking across a room, dressing oneself, bathing or showering, eating, getting in or out of bed, and using the toilet) (Williams, Pham-Kanter, & Leitsch, 2009). Difficulty was assessed using a four-point Likert scale (e.g., *no difficulty*, *some difficulty*, *much difficulty*, and *unable to do*). For this study, ADL variables were combined into a dichotomous variable indicating an overall score of any difficulty or no difficulty with any of the various ADLs reported.

Measures of physical and mental health used for analysis include self-reports of sleep, hypertension, stroke, pain with walking, and happiness. Sleep was a continuous variable, with participants asked, “How many hours do you usually sleep at night?” In further stratification analysis, sleep was used as a categorical variable. The variable sleep group was categorized as 0 to 6 hours, 7 to 8 hours, and 9 or more hours of sleep. Self-rated happiness (i.e., participants able to report being *unhappy usually*, *unhappy sometimes*, *pretty happy*, *very happy*, and *extremely happy*) was measured by asking participants, “...in general, how happy or unhappy would you say you are.” For this analysis, level of happiness was dichotomized to “no” if participants reported being *unhappy sometimes* or *unhappy usually*, otherwise participants felt happy. The occurrence of hypertension and stroke were dichotomous variables examined by asking participants to self-report, “Has a medical doctor ever told you that you have any of the following conditions...” Pain with walking was also assessed as a dichotomous variable.



Participants were asked, “During the past 12 months have you had pain, aching, or cramps in your calves, thighs, or buttocks that occurred while walking but improved with rest?”

**Social support.** The NSHAP study looked at various measures addressing the social lives of individuals. In the social network data, a range of questions were asked to participants including: identification of social network members, frequency of contact, perceived support from network members, perceived reliance on network members, engagement in social activities, and openness to talk to social network members. With the focus on health as the outcome in this study, one question specifically integrating the perceived ability to discuss one’s personal health with identified social network members was used in analysis. Participants were asked, “Suppose you had a health problem you were concerned about, or needed to make an important decision about your own medical treatment. How likely is it that you would talk with...about this?” Potential responses ranged from *not likely* to *very likely*. For analysis the question was dichotomized to “yes” if participants reported *somewhat likely* or *very likely* talk about health with a social network member or “no” not likely to talk about health with a social network member.

### **Statistical analysis**

All statistical analyses was conducted using SAS 9.4 software.

Descriptive analyses were conducted to establish baseline characteristics of sample participants for all variables of interest, including prevalence of sexual activity of hugging, levels of social support, subjective, and objective health measures. A large number of participants had missing data. An independent samples t-test was used to examine potential baseline differences of continuous measures, while a Chi-square test of independence was used to examine potential baseline differences in categorical measures. Prior to conducting regression analyses,

correlations were conducted to test for the presence of multicollinearity among independent variables.

The subjective health outcome measures (i.e., self-reported arthritis and diabetes) are dichotomous variables, and a logistic regression was used to examine the relationship between sexual activity or hugging and health. For the objective health measure of CRP and HbA1c, logistic regression was also utilized as both CRP and HbA1c were dichotomized for analysis. In both analyses, covariates (e.g., age, gender, race, education, income, marital status, ADL difficulty, sleep, happiness, stroke, hypertension, pain with walking, and social support) were included in order to control for other factors contributing to the health of older adults.

Change in health was examined using Wave 2 of NSHAP. As an indicator of change in health, I computed the difference in health between wave 1 and wave 2 for each health outcome (e.g., arthritis, diabetes, CRP, HbA1c). The health outcome variables of arthritis and diabetes were dichotomized as “yes” if participants reported the health outcome at wave 2 and not at wave 1, or “no” if participants did not report having the health outcome at wave 2. The health outcome variables of CRP and HbA1c were also dichotomized as “yes” if participants did not have high CRP or HbA1c at wave 1 but did at wave 2, or “no” if participants did not have biomarker data at wave 2.

Moderation analyses were used to examine the impact of potential moderators including social support, race, gender, socioeconomic status, and sleep on the relationship between sexual activity or hugging and health. All moderator variables will be from Wave 1. Moderation analysis provides the ability to analyze whether any association between sexual activity or hugging and health outcomes may be attenuated or strengthened by a moderator (e.g., social support) (Baron & Kenny, 1986; Edwards & Lambert, 2007). For analysis, interaction terms

between moderator and sexual activity or hugging (e.g., age x sexual activity or age x hugging) will be added to the model to determine whether sexual activity or hugging moderates health (i.e., arthritis, diabetes, CRP, or HbA1c).

## CHAPTER FOUR: RESULTS

Baseline differences in gender, education, ethnicity, and income between participants with missing data and non-missing data on c-reactive protein (CRP) or hemoglobin (HbA1c) were examined using a Chi-square test for differences in frequencies. The Chi-square test revealed no significant differences between the groups across gender,  $\chi^2 (1, N = 2830) = 0.021, p = 0.884$  and education,  $\chi^2 (3, N = 2830) = 0.583, p = 0.900$ , but Whites were more likely to have missing sexual activity or hugging data than all other minority participants,  $\chi^2 (3, N = 2818) = 29.18, p < 0.001$  and those with greater incomes were more likely to have missing sexual activity or hugging data than participants who reported annual incomes less than 35,000,  $\chi^2 (1, N = 2830) = 23.910, p < 0.001$ . An independent samples t-test was performed to examine differences in mean age between those with and without missing sexual activity or hugging data. There were no significant differences between the two groups in age,  $t (2828) = 1.57, p = 0.116$ .

Change in health variables between wave 1 and 2 was also examined. For the self-reported health outcomes of arthritis and diabetes, participant responses reflected possible positive (“yes” at wave 1, “no” at wave 2) and negative (“no” at wave 1, “yes” at wave 2) changes in these two outcomes. In this dataset, approximately 33% (n = 942) of individuals who reported *yes* to arthritis at wave 1 then reported *no* to arthritis at wave 2. While about 17% of individuals who reported *no* to arthritis at wave 1 then reported *yes* to arthritis at wave 2 (n = 473). For the health outcome of diabetes, roughly 16% of individuals who reported *yes* to diabetes at wave 1 then reported *no* to diabetes at wave 2 (n = 461). Approximately 19% of

participants who reported *no* to diabetes at wave 1 then reported *yes* to diabetes at wave 2 (n = 532).

Similarly, the biomarker outcomes of CRP and HbA1c also reflect participant response for possible positive (“high level” at wave 1, “low level” at wave 2) and negative (“low level” at wave 1, “high level” at wave 2) changes in these outcomes. About 4% (n=71) of participants who had a *high* CRP level at wave 1 then had a *low* CRP level at wave 2. Negative changes in health indicated approximately 10% (n=162) of individuals who had a *low* CRP level at wave 1 then had a *high* CRP level at wave 2. Following a biopsychosocial model and the proposed relationship between sexuality and health, engaging in sexual activity or hugging is expected to be associated with better health over time. Given other social, psychological, and environmental factors in the model, improved health may also be indicative of changes in lifestyle behavior including diet and exercise, stress, emotional health, and disease management (Ford, Bergmann, Boeing, Li, & Capewell, 2012; Lorig et al., 2001; Thoits, 2010).

### **Research Question 1: Is sexual activity or hugging associated with health among older adults?**

#### **Cross-sectional Results: Overview of regression analyses for self-reported health outcomes**

Results of the cross-sectional regression analyses for the first research question are presented in Tables 3-6. Each table shows results for sexual activity or hugging as the main independent variable from Wave 1 and arthritis, diabetes, CRP, or HbA1c as the dependent variable also from Wave 1.

### **Outcome of arthritis.**

In Table 3, the dependent variable was self-reported diagnosis of arthritis. Sexual activity was associated with about 44% ( $OR = 0.56, p < 0.001$ ) decreased likelihood of arthritis in unadjusted analyses. When demographic variables were controlled, sexual activity was associated with about 18% decreased likelihood of arthritis ( $OR = 0.82, p = 0.028$ ). Finally, when health variables were added, sexual activity was related to 15% lower likelihood of arthritis and this association was not significant ( $OR = 0.85, p = 0.126$ ).

Table 3 also shows the analyses examining hugging in relation to self-reported arthritis. In the unadjusted analyses, hugging was associated with approximately 13% decreased likelihood of arthritis, but was not significant ( $OR = 0.87, p = 0.061$ ). With the inclusion of demographic variables to the model, hugging was associated with 13% greater likelihood of reporting arthritis and this association remained insignificant ( $OR = 1.13, p = 0.149$ ). In the final model, when health factors were also controlled, hugging was related to about 23% greater likelihood of arthritis and this association was significant ( $OR = 1.23, p = 0.029$ ).

### **Outcome of diabetes.**

In Table 4, the dependent variable was self-reported diagnosis of diabetes. Sexual activity was significantly ( $OR = 0.65, p < 0.001$ ) associated with approximately 35% lower likelihood of diabetes in the unadjusted model. When controlling for demographics, sexual activity was related to 41% decreased likelihood of diabetes ( $OR = 0.59, p < 0.001$ ). Finally, additionally controlling for health factors, sexual activity was related to about 39% decreased likelihood of diabetes and this relationship remained significant ( $OR = 0.61, p < 0.001$ ).

Table 4 also shows analyses for hugging as the main independent variable. In the unadjusted model, hugging was associated with about 13% decreased likelihood of diabetes and

this association was not significant ( $OR = 0.87, p = 0.140$ ). Controlling for demographic variables, hugging was associated with approximately 5% decreased likelihood of reporting diabetes and this relationship remained insignificant ( $OR = 0.95, p = 0.613$ ). In the final model controlling for additional health factors, hugging was associated with about 7% greater likelihood of diabetes and this association was not significant ( $OR = 1.07, p = 0.553$ ).

### **Overview of regression analyses for biomarker outcomes**

Analyses performed examined whether engaging in more frequent sexual activity or hugging is related to better health outcomes. Sexual activity and hugging independent variables were used from Wave 1. Both outcomes measures of CRP and HbA1c were also from Wave 1.

#### **Outcome of CRP.**

Table 5 shows results for the association between sexual activity and CRP level. Sexual activity was not significantly associated with CRP level in the unadjusted model ( $OR = 0.67, p = 0.073$ ). When controlling for demographic variables, engaging in sexual activity was associated with 19% decreased likelihood of a high CRP level, although the association was not significant ( $OR = 0.81, p = 0.404$ ). In Model 3, controlling for additional health factors, engaging in sexual activity was associated with 29% increased likelihood of a high CRP level but the association was not significant ( $OR = 1.29, p = 0.407$ ).

Table 5 also shows analyses for CRP level as the dependent variable with hugging included as the main independent variable. In the unadjusted model, hugging was associated with 41% decreased likelihood of a high CRP level, and this association was significant ( $OR = 0.59, p = 0.018$ ). Controlling for demographic variables, hugging was associated with 29% decreased likelihood of a high CRP level, and the association was not significant ( $OR = 0.71, p = 0.156$ ). In Model 3, controlling for additional health factors, hugging was associated with 13% decreased

likelihood of a high CRP level, and the relationship remained not significant ( $OR = 0.87, p = 0.598$ ).

### **Outcome of HbA1c.**

In Table 6, the dependent variable was HbA1c level. In the unadjusted model, sexual activity was associated 32% decreased likelihood of high HbA1c level and the association was significant ( $OR = 0.68, p = 0.011$ ). When controlling for demographic variables, sexual activity was associated with 47% decreased likelihood of high HbA1c level, and the association remained significant ( $OR = 0.53, p = 0.001$ ). In Model 3, controlling for additional health factors, sexual activity was associated with 54% decreased likelihood of high HbA1c level, and the relationship was still significant ( $OR = 0.46, p < 0.001$ ).

Table 6 also shows analyses for HbA1c level with hugging as the main independent variable. In the unadjusted model, hugging was associated with 32% decreased likelihood of high HbA1c level, and the association was significant ( $OR = 0.68, p = 0.011$ ). Controlling for demographic variables, hugging was associated with 29% decreased likelihood of high HbA1c level, and this relationship remained significant ( $OR = 0.71, p = 0.040$ ). In Model 3, controlling for additional health factors, hugging was associated with 22% decreased likelihood of high HbA1c level, however, hugging was no longer significantly associated with HbA1c level ( $OR = 0.78, p = 0.199$ ).

### **Research Question 1: Longitudinal Results**

We also examined whether sexual activity or hugging was associated with better health outcomes over time. To capture this change in health, the difference in health between wave 1 and 2 (e.g., arthritis, diabetes, CRP, HbA1c) was computed. For arthritis and diabetes outcomes, change is reflected in participants who reported arthritis or diabetes at wave 2 and not at wave 1.



CRP was dichotomized to align with clinical research, which has examined CRP level related to general inflammation or indicative of chronic illness. HbA1c was also dichotomized to reflect clinical assessment, examining fasting glucose levels potentially indicating risk for diabetes. For both CRP and HbA1c outcomes, change is reflected in participants who reported CRP or HbA1c at wave 2 and not at wave 1. Demographic variables at wave 1 were included as covariates in the final model, and sexual activity or hugging were the main independent variables. Results are shown in Tables 7-9.

### **Outcome of arthritis.**

Table 7 shows analyses examining the relationship between sexual activity and self-reported arthritis at wave 2 of NSHAP, approximately 5 years following wave 1. Sexual activity was associated with a non-significant 4% increase in the likelihood of arthritis at wave 2 ( $OR = 1.04, p = 0.764$ ). When examining hugging as the main predictor, hugging was associated with 10% decreased likelihood of arthritis without reaching statistical significance ( $OR = 0.90, p = 0.362$ ) at wave 2.

### **Outcome of diabetes.**

Table 7 also shows analyses examining the relationship between sexual activity or hugging, and self-reported diabetes at wave 2. Sexual activity was associated with 36% increased likelihood of diabetes, and this relationship was significant ( $OR = 1.36, p = 0.021$ ). Hugging was associated with 1% increased likelihood of diabetes, and was not significant at wave 2 ( $OR = 1.01, p = 0.906$ ).

### **Outcome of CRP.**

Table 8 presents results examining the relationship between sexual activity or hugging, and CRP at wave 2. Sexual activity was associated with 59% increased likelihood of a high CRP

level, and this relationship was significant ( $OR = 1.59, p = 0.046$ ). Hugging did not influence the relationship with CRP level ( $OR = 0.98, p = 0.934$ ).

### **Outcome of HbA1c.**

Table 9 also shows results examining the relationship between sexual activity or hugging, and HbA1c at wave 2. Engaging in sexual activity was associated with 7% decreased likelihood of a high HbA1c level ( $OR = 0.93, p = 0.798$ ) and the relationship was not significant, while hugging was associated with 45% decreased likelihood of a high HbA1c level ( $OR = 0.55, p = 0.010$ ) and this relationship was significant at wave 2.

## **Research Question 2: Does the presence of social support modify the relationship between sexual activity or hugging and health?**

### **Cross-sectional Results: Overview of moderation analyses for self-reported health outcomes**

Results for social support as a moderator of the association between sexual activity or hugging, and self-reported arthritis or diabetes as dependent variables are presented in Table 10. The following analysis uses covariates, independent, and dependent variables from wave 1 of NSHAP. We hypothesized that social support would moderate the benefits of sexual activity or hugging on health among older adults.

### **Outcome of arthritis.**

The model used for analysis controlled for demographic variables and health factors. Sexual activity was associated with about 29% decreased likelihood of arthritis ( $OR = 0.71, p = 0.165$ ), while social support was associated with approximately 20% decreased likelihood of arthritis although the relationship was not significant ( $OR = 0.80, p = 0.302$ ). An interaction term of social support and sexual activity was added to the base model. The addition of the social

support by sexual activity interaction was associated with 24% increased likelihood of arthritis, indicating the combination of lower support and less sexual activity may combine to form a particularly strong risk of arthritis, but was not significant ( $OR = 1.24, p = 0.422$ ).

Table 10 also shows results for hugging as the independent variable, social support as the moderator, and self-reported arthritis as the dependent variable. Hugging was associated with approximately 47% increased likelihood of arthritis, although the relationship was not significant ( $OR = 1.47, p = 0.081$ ). Results indicated social support was associated with 4% increased likelihood of arthritis and the association was not significant ( $OR = 1.04, p = 0.846$ ). The interaction term of social support and hugging was associated with 19% decreased likelihood of arthritis and was also not significantly associated ( $OR = 0.81, p = 0.380$ ).

#### **Outcome of diabetes.**

Further results in Table 10 present analysis for the association between sexual activity and self-reported diabetes diagnosis with social support as the moderator. Sexual activity was associated with about 38% decreased likelihood of diabetes, although the result was not statistically significant ( $OR = 0.62, p = 0.105$ ). Social support was associated with approximately 12% increased likelihood of diabetes and this relationship was also not significant ( $OR = 1.12, p = 0.650$ ). Finally, there was a non-significant association between the interaction term of sexual activity and social support and the likelihood of arthritis ( $OR = 0.99, p = 0.961$ ).

Finally, Table 10 shows results for hugging as the independent variable, social support as the moderator, and self-reported diabetes as the dependent variable. Results indicated social support was associated with approximately 5% increased likelihood of diabetes, although the relationship was not significant ( $OR = 1.05, p = 0.833$ ). The added interaction term of social

support and hugging was associated with a 9% increased likelihood of diabetes, and this relationship remained not significant ( $OR = 1.09, p = 0.764$ ).

### **Overview of moderation analyses for biomarker outcomes**

Table 11 shows analyses for social support as a moderator of the association between sexual activity or hugging and CRP. Table 12 shows results for the analysis including the interaction of social support and sexual activity or hugging, and HbA1c.

### **Outcome of CRP.**

In the model, respondents who engaged in sexual activity were 22% more likely to have a high CRP level and the association was not significant ( $OR = 1.22, p = 0.782$ ), while social support was associated with 19% increased likelihood of a high CRP level but was not significant ( $OR = 1.19, p = 0.778$ ). Similarly, the addition of the interaction term of sexual activity and social support on CRP level was not significant ( $OR = 0.98, p = 0.977$ ).

Additionally, Table 11 shows results for hugging as the independent variable, social support as a moderator, and the interaction of hugging by social support. Hugging was associated with 8% increased likelihood of a high CRP level and the association was not significant ( $OR = 1.08, p = 0.909$ ), while social support was associated with 34% increased likelihood of a high CRP level ( $OR = 1.34, p = 0.573$ ). Analysis showed a non-significant association between the interaction term of social support and hugging on CRP level ( $OR = 0.76, p = 0.697$ ).

### **Outcome of HbA1c.**

Results in Table 12 show analysis for social support as the moderator and HbA1c as the dependent variable. Sexual activity was associated with 47% decreased likelihood of high HbA1c level and the association was not significant ( $OR = 0.53, p = 0.167$ ). Social support was associated with 20% increased likelihood of HbA1c level and the association was not significant

( $OR = 1.20, p = 0.645$ ). The interaction term of sexual activity by social support on HbA1c level was not significant ( $p = 0.754$ ), indicating social support did not moderate the relationship between sexual activity and HbA1c level.

Lastly, Table 12 shows results for hugging as the independent variable, social support as the moderator, and HbA1c as the dependent variable. Hugging was associated with 12% decreased likelihood of high HbA1c level and the relationship was not significant ( $OR = 0.88, p = 0.767$ ). Social support was associated with 19% increased likelihood of high HbA1c level, and the relationship was not significant ( $OR = 1.19, p = 0.623$ ). Analysis indicated a non-significant association between the interaction term of hugging and social support on HbA1c level ( $OR = 0.86, p = 0.754$ ).

## **Research Question 2: Longitudinal Results**

Results for social support as a moderator of the association between sexual activity or hugging, and change in health outcomes over time are presented in Tables 13-15. In all analyses, demographic and health variables at wave 1 were included as covariates. All health outcomes (e.g., arthritis, diabetes, CRP, and HbA1c) were dichotomized for analysis. Dependent variables used in analysis reflected the difference in health between wave 1 and wave 2.

### **Outcome of arthritis.**

Results presented in Table 13 show that sexual activity was associated with about 20% increased likelihood of arthritis and this association was not significant ( $OR = 1.20, p = 0.581$ ). Social support was associated with approximately 19% increased likelihood of arthritis and this relationship was also not significant ( $OR = 1.19, p = 0.563$ ). The interaction term of social support and sexual activity was associated with 15% decreased likelihood of arthritis, indicating that the combination of more social support and increased sexual activity may result in a lower

risk of arthritis, with the result again not reaching the predetermined threshold for statistical significance ( $OR = 0.85, p = 0.638$ ) by wave 2.

Table 13 also shows results for hugging as the independent variable, social support as the moderator, and change in self-reported arthritis as the dependent variable at wave 2 of the study. Hugging was not significantly associated with approximately 35% decreased likelihood of arthritis ( $OR = 0.65, p = 0.115$ ). Results indicated social support was associated with 15% decreased likelihood of arthritis and the association was not significant ( $OR = 0.85, p = 0.451$ ), while the interaction term of social support and hugging was associated with 47% increased likelihood of arthritis and the relationship was also not significant ( $OR = 1.47, p = 0.192$ ) at wave 2.

#### **Outcome of diabetes.**

Table 13 also presents analysis for the association between sexual activity and self-reported diabetes diagnosis at wave 2, with social support as the potential moderator. Sexual activity was associated with about 29% decreased likelihood of diabetes, although the result was not statistically significant ( $OR = 0.71, p = 0.228$ ). Social support was associated with approximately 34% decreased likelihood of diabetes ( $OR = 0.66, p = 0.106$ ). Finally, the association between the interaction term of sexual activity by social support and likelihood of diabetes ( $OR = 2.18, p = 0.120$ ) was also not significant.

Table 13 also shows results for hugging as the independent variable, social support as the moderator, and self-reported diabetes as the dependent variable. Hugging was associated with 25% decreased likelihood of diabetes and this relationship was not significant ( $OR = 0.75, p = 0.285$ ). Results indicated social support was associated with approximately 6% decreased

likelihood of diabetes ( $OR = 0.94, p = 0.791$ ). The association between the interaction term of hugging by social support on diabetes was also not significant ( $OR = 1.43, p = 0.217$ ).

### **Outcome of CRP.**

In Table 14, sexual activity was associated with 21% decreased likelihood of a high CRP level and the association was significant ( $OR = 0.79, p = 0.577$ ), while social support was associated with a 60% decreased likelihood in a high CRP level ( $OR = 0.40, p = 0.019$ ). The association between the interaction term of sexual activity and social support on CRP level was not significant ( $OR = 2.46, p = 0.060$ ).

Additionally, Table 14 shows results for hugging as the independent variable, social support as a moderator, and the interaction of hugging by social support at wave 2 CRP level. Hugging was associated with 2% decreased likelihood of high CRP level ( $OR = 0.98, p = 0.955$ ), while social support was associated with 25% decreased likelihood of a high CRP level, and the relationship was not significant ( $OR = 0.75, p = 0.405$ ). Analysis showed a non-significant association between the interaction of hugging by social support on CRP level by wave 2 ( $OR = 1.01, p = 0.988$ ).

### **Outcome of HbA1c.**

Results in Table 15 show analysis for social support as the moderator and HbA1c as the dependent variable at wave 2. Sexual activity was associated with 3% decreased likelihood of high HbA1c level ( $OR = 0.97, p = 0.956$ ). Social support was associated with 36% increased likelihood of high HbA1c level, and the association was not significant ( $OR = 1.36, p = 0.594$ ). The interaction of sexual activity by social support on HbA1c level was not significant ( $p = 0.954$ ).

Further analyses in Table 15 shows hugging as the independent variable, social support as the moderator, and HbA1c as the dependent variable at wave 2. Hugging was associated with 51% decreased likelihood of high HbA1c level and was not significant ( $OR = 0.49, p = 0.208$ ). Social support was associated with 22% increased likelihood of high HbA1c level, and the relationship was also not significant ( $OR = 1.22, p = 0.651$ ). Analysis indicated a non-significant association between the interaction of hugging by social support on HbA1c level at wave 2 ( $p = 0.815$ ).

**Research Question 3: Does age, race, gender, or socioeconomic status, or function (i.e., sleep) influence the relationship between sexual activity or hugging and health?**

**Cross-sectional Results: Overview of moderation analyses for self-reported health outcomes**

Results for moderation analyses for wave 1 of NSHAP are presented in Tables 16-19. The third research question examined whether there was an association between the interaction of age, race, gender, income, education, sleep, and sexual activity or hugging on health outcomes. We hypothesized younger individuals, whites, and males who engaged in frequent sexual activity or hugging would report better health outcomes. Also, persons with higher income or higher education who engaged in frequent sexual activity or hugging would have better health outcomes. Finally, we hypothesized individuals who reported more sleep (i.e., hours of sleep during the night) and frequent engagement in sexual activity or hugging would have better health outcomes.

#### **Outcome of arthritis.**

Results presented in Table 16 examined potential moderators of the association between sexual activity and arthritis (i.e., Model 1). The analyses showed non-significant interactions of



age ( $OR = 1.00, p = 0.815$ ), gender ( $OR = 1.12, p = 0.573$ ), education ( $OR = 1.16, p = 0.124$ ), race category of black ( $OR = 0.94, p = 0.631$ ), sleep ( $OR = 1.02, p = 0.783$ ), and income ( $OR = 1.10, p = 0.635$ ) by sexual activity associated with the likelihood of having arthritis. The interaction term of the race category of Hispanic, non-Black and sexual activity was associated with a 21% decreased likelihood of arthritis ( $OR = 0.79, p = 0.021$ ), suggesting being Hispanic was more closely related to the impact of sexual activity on arthritis.

Model 2 analyzed interactions of the association between hugging and arthritis. Similarly, the analyses showed non-significant interactions of age ( $OR = 1.00, p = 0.941$ ), education ( $OR = 1.03, p = 0.702$ ), gender ( $OR = 1.09, p = 0.641$ ), race category of black ( $OR = 0.92, p = 0.559$ ), race category of Hispanic, non-Black ( $OR = 0.86, p = 0.138$ ), and sleep ( $OR = 1.04, p = 0.617$ ). The interaction of hugging by income neared statistical significance ( $OR = 1.41, p = 0.086$ ), suggesting higher income may indicate a closer relationship between hugging and arthritis.

### **Outcome of diabetes.**

Further results presented in Table 17 show analysis for self-reported diabetes as the outcome variable. In Model 1, the moderators of education ( $OR = 1.01, p = 0.911$ ), gender ( $OR = 0.79, p = 0.350$ ), race category of Hispanic, non-Black ( $OR = 0.92, p = 0.479$ ), income ( $OR = 1.19, p = 0.484$ ), and sleep ( $OR = 0.96, p = 0.622$ ) by sexual activity associated with diabetes were non-significant. The interaction of age by sexual activity was associated with 4% greater likelihood of diabetes ( $OR = 1.04, p = 0.008$ ). The significant interaction suggests older age was more closely related to sexual activity and diabetes. Further analysis stratifying the study sample by age group indicated sexual activity reduces risk of diabetes among adults aged 57 to 74 years, but not older adults 75 years of age and older. Stratified analysis is represented in Figure 4. The interaction term of Black and sexual activity was associated with 48% increased likelihood of

diabetes ( $OR = 1.48, p = 0.008$ ), suggesting being Black was more closely related to the impact of sexual activity on diabetes.

Model 2 analyzed interactions of the association between hugging and diabetes. Results showed non-significant interactions of age ( $OR = 1.00, p = 0.916$ ), education ( $OR = 1.13, p = 0.257$ ), gender ( $OR = 0.86, p = 0.489$ ), race category of Hispanic, non-Black ( $OR = 1.09, p = 0.495$ ), income ( $OR = 1.29, p = 0.308$ ), and sleep ( $OR = 1.01, p = 0.910$ ) by hugging associated with the likelihood of diabetes. The significant interaction of the race category of Black and hugging was associated with 60% increased likelihood of diabetes ( $OR = 1.60, p = 0.002$ ), suggesting identifying as black was closely related to reporting a diagnosis of diabetes. Figure 5 represents moderation analysis stratified by race categories, indicating hugging was associated with greater decreased risk of diabetes among blacks ( $OR = 0.32, p = 0.320$ ) and Hispanics ( $OR = 0.25, p = 0.247$ ), compared to whites ( $OR = 0.94, p = 0.672$ ) although none of the relationships reached statistical significance.

### **Overview of moderation analyses for biomarker outcomes**

Results for moderation analyses for Wave 1 of NSHAP are also presented in Tables 18 and 19. Age, race, gender, income, education, and sleep were analyzed as potential moderators of the association between sexual activity or hugging and baseline CRP level or HbA1c level.

#### **Outcome of CRP.**

In Table 18, Model 1 results showed non-significant interactions of age ( $OR = 1.01, p = 0.862$ ), education ( $OR = 1.08, p = 0.785$ ), gender ( $OR = 0.58, p = 0.407$ ), race category of Black ( $OR = 1.19, p = 0.661$ ), race category of Hispanic, non-Black ( $OR = 1.12, p = 0.721$ ), income ( $OR = 0.60, p = 0.345$ ), and sleep ( $OR = 1.18, p = 0.364$ ) by sexual activity associated with CRP level. Further analysis in Model 2 examined the relationship between hugging and CRP level

with the addition of potential moderators. The interactions of age ( $OR = 1.02, p = 0.599$ ), education ( $OR = 1.16, p = 0.561$ ), gender ( $OR = 1.54, p = 0.405$ ), race category of Black ( $OR = 1.05, p = 0.917$ ), race category of Hispanic, non-Black ( $OR = 1.20, p = 0.546$ ), income ( $OR = 2.18, p = 0.180$ ), and sleep ( $OR = 0.94, p = 0.736$ ) were not significantly associated with CRP level.

### **Outcome of HbA1c.**

Further results in Table 19 show analysis for HbA1c as the outcome variable. In Model 1, findings showed non-significant interactions of age ( $p = 0.722$ ), education ( $p = 0.468$ ), race category of Black ( $p = 0.967$ ), race category of Hispanic, non-Black ( $p = 0.052$ ), income ( $p = 0.543$ ), and sleep ( $p = 0.792$ ). The interaction term of gender and sexual activity was significant ( $p = 0.010$ ), indicating gender was related to low HbA1c level. Stratification analysis (presented in Figure 6) by gender showed sexual activity was significantly associated with decreased the risk of high HbA1c level among females ( $OR = 0.26, p < 0.001$ ) compared to males ( $OR = 0.81, p = 0.513$ ).

Model 2 examined the association between hugging and HbA1c level with the addition of potential moderators. Results showed interactions of age ( $p = 0.482$ ), education ( $p = 0.519$ ), gender ( $p = 0.089$ ), Black ( $p = 0.145$ ), Hispanic, non-Black ( $p = 0.694$ ), income ( $p = 0.075$ ), and sleep ( $p = 0.381$ ) by hugging associated with HbA1c level, was not statistically significant.

### **Research Question 3: Longitudinal Results**

Research question 3 examined potential moderators (i.e., age, gender, ethnicity, education, income, and sleep) and the relationship between sexual activity or hugging and health outcomes by wave 2 of NSHAP. Analysis controlled for demographic and health variables at wave 1. Changes were captured by examining the difference in health between wave 1 and 2 for

all health outcomes (i.e., arthritis, diabetes, CRP, and HbA1c), and health outcomes were dichotomized for analysis. Results for analyses are presented in Tables 20-23.

### **Outcome of arthritis.**

Results presented in Table 20 examined potential moderators of the association between sexual activity and arthritis. In Model 1, results showed non-significant interactions of age ( $OR = 0.98, p = 0.268$ ), education ( $OR = 0.81, p = 0.091$ ), race category of Black ( $OR = 0.94, p = 0.782$ ), race category of Hispanic, non-Black ( $OR = 1.37, p = 0.094$ ), and sleep ( $OR = 0.95, p = 0.558$ ), and income ( $OR = 0.98, p = 0.950$ ) by sexual activity associated with the likelihood of having arthritis. The interaction of sexual activity by gender was associated with a 68% increased likelihood of arthritis and the relationship was significant ( $OR = 1.68, p = 0.045$ ). Further stratification analysis by gender indicated a higher risk for arthritis among females ( $OR = 1.22, p = 0.280$ ), and a decreased risk for arthritis among males ( $OR = 0.78, p = 0.243$ ) as a function of frequent sexual activity, although neither relationship was significant.

Model 2 analyzed interactions of the association between hugging and arthritis with the addition of potential moderators. Similarly, the analyses showed non-significant interactions of age ( $OR = 0.99, p = 0.335$ ), education ( $OR = 0.85, p = 0.130$ ), gender ( $OR = 1.21, p = 0.386$ ), race category of Black ( $OR = 0.91, p = 0.679$ ), race category of Hispanic, non-Black ( $OR = 1.10, p = 0.518$ ), and sleep ( $OR = 0.90, p = 0.217$ ). The interaction of hugging by income was associated with 43% decreased likelihood of arthritis and the relationship was significant ( $OR = 0.57, p = 0.027$ ). Further analysis stratifying by income group, indicated a higher risk for arthritis among persons who had household income less than \$35,000 ( $p = 0.255$ ), but decreases in the risk for arthritis among individuals who had a household income greater than \$35,000 ( $p = 0.053$ ) as a function of frequent hugging.

### **Outcome of diabetes.**

Table 21 shows analysis for self-reported diabetes at wave 2 as the outcome variable. In Model 1, the moderators of age ( $OR = 1.00, p = 0.805$ ), education ( $OR = 1.14, p = 0.281$ ), race category of Hispanic, non-Black ( $OR = 0.93, p = 0.651$ ), income ( $OR = 1.35, p = 0.239$ ), and sleep ( $OR = 1.08, p = 0.350$ ) by sexual activity associated with diabetes were not significant. The interaction term of gender by sexual activity was associated with 46% decreased likelihood of diabetes and was significant ( $OR = 0.54, p = 0.030$ ), and the interaction of the race category of Black by sexual activity was significant and associated with 40% decreased likelihood of diabetes ( $OR = 0.60, p = 0.028$ ). Figure 7 presents analysis stratifying by gender, showing males ( $OR = 2.06, p = 0.004$ ) were about 2 times more likely to report diabetes compared to females ( $OR = 1.18, p = 0.328$ ). Figure 8 illustrates the relationship between the interaction of race by sexual activity and diabetes. Whites ( $OR = 1.51, p = 0.005$ ) were at an increased risk of diabetes compared to both Blacks ( $OR = 0.56, p = 0.262$ ) or Hispanics ( $OR = 0.73, p = 0.556$ ).

Results in Model 2 presented interactions of the association between hugging and diabetes with the addition of potential moderators. The findings indicated non-significant interactions of age ( $OR = 1.00, p = 0.719$ ), gender ( $OR = 0.69, p = 0.092$ ), race category of Hispanic, non-Black ( $OR = 1.00, p = 0.976$ ), education ( $OR = 1.20, p = 0.078$ ), and income ( $OR = 1.23, p = 0.400$ ) by hugging associated with the likelihood of diabetes. The interaction term of race category of Black by hugging was associated with 41% decreased likelihood of diabetes and was significant ( $OR = 0.59, p = 0.033$ ), while the interaction of sleep by hugging was also significant ( $OR = 1.19, p = 0.035$ ) and associated with 19% increased likelihood of diabetes.

Figure 9 illustrates the relationship between the interaction of sleep by hugging and diabetes. Persons who reported less than 6 hours of sleep at night ( $OR = 0.69, p = 0.057$ ) or 9 or

more hours of sleep at night ( $OR = 0.93, p = 0.888$ ) were less likely to report diabetes, whereas individuals who reported 7 to 8 hours of sleep at night ( $OR = 1.25, p = 0.139$ ) were at an increased risk of diabetes although the relationships were not significant. Figure 10 shows the relationship between the interaction of race by hugging associated with likelihood of diabetes. Findings showed no statistical significance when examining likelihood by race category. Hispanics ( $OR = 1.08, p = 0.863$ ) and Whites ( $OR = 1.06, p = 0.645$ ), however, were more likely to have an increased risk of diabetes, compared to Blacks ( $OR = 0.39, p = 0.072$ ).

### **Outcome of CRP.**

Table 22 shows results for potential moderators and the relationship with sexual activity associated with CRP level at wave 2. Model 1 showed non-significant interactions for age ( $OR = 0.97, p = 0.235$ ), gender ( $OR = 1.43, p = 0.432$ ), race category of Black ( $OR = 1.07, p = 0.842$ ), race category of Hispanic, non-Black ( $OR = 0.81, p = 0.425$ ), income ( $OR = 1.76, p = 0.189$ ), and sleep ( $OR = 0.99, p = 0.943$ ) by sexual activity in relation to CRP level. The interaction term of education and sexual activity was associated with 35% decreased risk of high CRP level education ( $OR = 0.65, p = 0.037$ ). Analysis stratifying by education level (Figure 11) indicated individuals who had less than high school education were at increased risk of high CRP level ( $p = 0.005$ ) compared to those who had a high school diploma ( $p = 0.946$ ), some college education ( $p = 0.748$ ), or earned a Bachelor's degree or higher ( $p = 0.915$ ).

Further analysis in Model 2 examined the interaction between hugging and CRP level. The interactions of age ( $OR = 0.97, p = 0.231$ ), gender ( $OR = 1.56, p = 0.217$ ), education ( $OR = 1.05, p = 0.795$ ), race category of Black ( $OR = 0.97, p = 0.927$ ), race category of Hispanic, non-Black ( $OR = 0.67, p = 0.170$ ), income ( $OR = 1.21, p = 0.643$ ), and sleep ( $OR = 1.16, p = 0.272$ ) were not significant.

### **Outcome of HbA1c.**

Further results in Table 23 show analysis for change in HbA1c at wave 2 as an outcome variable. In Model 1, findings showed non-significant interactions of age ( $p = 0.188$ ), education ( $p = 0.564$ ), gender ( $p = 0.164$ ), race category of Black ( $p = 0.979$ ), race category of Hispanic, non-Black ( $p = 0.105$ ), income ( $p = 0.310$ ), and sleep ( $p = 0.163$ ) by sexual activity associated with HbA1c level.

Model 2 examined the interaction between hugging and HbA1c level. Findings showed non-significant interactions of age ( $p = 0.736$ ), education ( $p = 0.209$ ), race category of Black ( $p = 0.962$ ), income ( $p = 0.250$ ), and sleep ( $p = 0.693$ ) by hugging associated with HbA1c level. A significant interaction of gender by hugging suggested being female may be related to high HbA1c level. When stratifying by gender, males were at decreased risk of high HbA1c level ( $p < 0.001$ ) compared to females ( $p = 0.718$ ) (presented in Figure 12).

## **CHAPTER FIVE: DISCUSSION**

For many older adults, sexual activity continues to remain an important aspect in late life influenced by physical and emotional health, and the health of an intimate partner. As sexual expression in various forms may be desired in late life, older adults should be aware of the relationship between sexual activity or hugging and health. This study explored the potential influence of sexual activity or hugging on the health of older adults. The health outcomes of interest included self-reported diabetes and arthritis, as well as biomarkers of CRP and HbA1c. The role of social support as a moderator of the relationship between sexual activity or hugging and health was also examined. Additionally, I was interested in identifying whether age, gender, race, education, income, or sleep may modify the relationship between sexual activity or hugging and health.

In this study, the first research question examined the association between sexual activity or hugging and health. The hypothesis indicating sexual activity or hugging would be associated with better health outcomes was partially supported cross-sectionally for the outcomes of diabetes and HbA1c, and longitudinally for the outcome of HbA1c. The second research question, which hypothesized the interaction of social support and sexual activity/hugging would be associated with better health outcomes was not supported cross-sectionally or longitudinally. The final research question assessed the role of potential moderators (e.g, age, gender, race, education, income, and sleep) and the influence on the association between sexual activity/hugging and health. The hypothesis was partially supported as several interactions were



significant, indicating the moderator (i.e., gender, race, and education) strengthened or weakened the association between sexual activity or hugging and health.

This section will further discuss some of the significant results of each of the research questions and possible connections to theoretical perspectives in the current literature. Further discussion will more closely address significant relationships found exploring the role of sexual activity or hugging to arthritis, diabetes, CRP, and HbA1c. This section will conclude with the examination of strengths and limitations in the present study, and future research directions to enhance and expand upon the study findings.

## **Research Question 1**

### **Cross-sectional Findings**

Research question one explored the relationship between sexual activity or hugging on self-reported health outcomes of arthritis and diabetes. In the cross-sectional analysis, frequent hugging was associated with greater likelihood of arthritis. This finding conflicted with the expectation that hugging would be associated with better health. This significant finding may suggest the greater likelihood of arthritis might be attributable to the bi-directionality between health and sexual activity. Perhaps older adults with arthritis may express a greater desire to maintain close relationships with a partner or spouse by engaging in other types of behavior which are less physically taxing, such as hugging, kissing, and caressing. Older individuals already suffering from disabling symptoms associated with arthritis may not be able to engage in more physical types of sexual activity, such as intercourse.

In thinking about the relationship between hugging and increased likelihood of arthritis, the results may point to differences in disabling symptoms specifically associated with osteoarthritis (OA) and rheumatoid arthritis (RA). The variable of self-reported arthritis in the

data set did not specifically identify a diagnosis OA or RA. Some of the symptoms associated with OA and RA that may influence both hugging and health are similar such as pain, stiffness, and swollen joints (“Arthritis types,” 2014). A differentiation to note between the two types of arthritis, is OA mainly impacts degeneration of joints in the body, while the joint problems and swelling connected to RA can be related to the poor function of a person’s immune system (“Arthritis types,” 2014). While the symptoms of both OA and RA can be treated, RA may be more difficult to manage given the possible deleterious influence on other organs in the body (“Arthritis types,” 2014). If it was possible to differentiate between OA and RA in the data, it could be that participants who have RA may not be seeing benefits in health due to hugging because of the overall impact of the chronic illness compared to participants with OA.

Further, there was a negative relationship between frequent sexual activity and likelihood of diabetes. A possible explanation for this relationship could be the physical nature of sexual activity. For example, Palmeri et al. (2007) assessed blood pressure and heart rate of men and women when engaging in sexual activity compared to walking on a treadmill. The levels of blood pressure and heart rate during sexual activity were lower compared to walking on a treadmill (Palmeri et al., 2007). This association helps explain the potential positive relationship between sexual activity and diabetes, as clinical studies have shown lifestyle behavior such as exercise to decrease the risk of diabetes (Castenada et al., 2002; Tuomilehto et al., 2001). Thus, although not the exact physiological impact as moderate, intense, or prolonged periods of exercise, sexual activity may have similar effects on the body.

For research question 1, the relationship between sexual activity or hugging and the biomarkers of CRP and HbA1c was also examined. These specific biomarkers were examined to potentially help tease out the underlying biological mechanisms supporting the directionality of

the association between sexual behavior and health. Wave 1 results indicated, prior to adjustment of covariates (i.e., demographic, health and function variables), hugging was associated with low CRP level, and frequent sexual activity was associated with a lower HbA1c level. Taking into consideration the significant association between sexual activity and self-reported diabetes, the biomarker finding suggests sexual activity may reduce the risk of diabetes by possibly lowering HbA1c level.

The significant association between hugging and low CRP level may be indirectly attributable to the presence of other psychosocial factors, such as stress, which can cause inflammation in the body. The act of hugging may provide a level of reassurance, comfort, or a sense of connection for an older individual who is otherwise isolated perhaps as a result of chronic illness. For some, close physical contact has been linked to acting as a buffer against stress, which can manifest physically and psychologically (Cohen et al., 2015). Physically, stress can lead to inflammation in the body which can be measured by examining CRP level (McDade et al., 2006). Hugging may lead to lower CRP levels by addressing feelings of loneliness or life events older adults experience which may be stressful (e.g., loss of a loved one, loss of a job, negative social relationships, etc.).

### **Longitudinal Findings**

For wave 2 analysis, the association between sexual activity and diabetes remained significant; however, when assessing change in health, sexual activity was now associated with increased risk of diabetes. One possible explanation could be that over time the potential positive effects of sexual activity on diabetes no longer outweighs other social, psychological, or physical factors also influencing health. For instance, previous work has focused on the prevention and management of diabetes in relation to diet and exercise (Norris et al., 2001). Poor diet can be

associated with poor lifestyle behaviors or, for some older adults, lack of access to proper nutrition. These changes in lifestyle may have a greater effect on chronic illness, such as diabetes, to where the physical benefits of engaging in sexual activity are no longer a positive influence on health.

Also in wave 2 analysis, however, the association between hugging and change in arthritis was no longer significant. One possible explanation to the lack of significant associations at wave 2 could be the relatively short follow-up period, the small percentage of people who reported poorer health in wave 2, age of participants at baseline, whereby the change in response to sexual activity and hugging may have already occurred, or the possibility that the effect of sexual activity and hugging on change in health for arthritis may be relatively small.

## **Research Question 2**

### **Social Support and Health**

Research question two examined the role of social support in the relationship between sexual activity or hugging and health outcomes. We hypothesized the interaction of increased social support and frequent sexual activity or hugging would be associated with better health outcomes over time. The presence or lack of social support was used as a potential mechanism influencing the relationship between sexual activity or hugging and health. Social support was of particular interest as it can be viewed as an aspect of an individuals' social capital, which is modeled to be one of the potential interacting factors influencing health and sexuality in the biopsychosocial model (Lindau et al., 2003). It was speculated the presence of social support would magnify, or the lack thereof, would diminish the association between sexual activity or hugging and health.

The results did not support our hypothesis that social support moderated the associations between sexual activity or hugging and health. One possible explanation for the lack of

significant findings could be related to the type of support being measured, which may not have a great enough effect on sexual activity or hugging and the specific health outcomes included in this study. Social support can come in the form of emotional support (e.g., comforting behavior, listening, and empathizing), informational support (e.g., sharing information and offering advice), and instrumental support (e.g., help with more physical types of tasks associated with daily needs) (Ashida and Heaney, 2008). The variable used to assess social support in this study could be classified as identifying a source of informational or emotional support, as it asked participants to identify the presence of a social network member that they felt able to speak to about health concerns. Perhaps, participants who self-reported diagnosis of diabetes or arthritis, or who had high CRP or HbA1c level, needed support that was more reminiscent of instrumental tasks. The influence of informational or emotional types of support might have had a greater effect if examining psychological or emotional health outcomes.

When specifically thinking about chronic illness in late life, some clinical studies focus on ways to identify risk for chronic health conditions utilizing biomarkers. However, it might not be accurate to rely on one type of biomarker to detect all types of chronic illness. For instance, the biomarker of CRP in this study was used to indicate overall inflammation in the body. With a lack of significant findings, perhaps the influence of social support is not efficiently captured by analyzing general inflammation in the body versus other inflammatory markers of health (i.e., Interleukin-6 (IL-6) or TNF $\alpha$ ) (Kritchevsky et al., 2005).

### **Research Question 3**

#### **Cross-sectional Findings**

In research question three, the role of demographic and functional variables were analyzed as potential moderators of the relationship between sexual activity or hugging and the health outcomes of arthritis or diabetes. In the cross-sectional analysis, the relationship between

sexual activity and health was modified by age, indicating younger participants who were engaging in sexual activity were less likely to have diabetes compared to older participants. Although the question in the data did not specify between Type I or Type II diabetes, given the age range of the sample (57 to 85 years), responses were likely related to the diagnosis of Type II diabetes. While the literature is limited on the impact of sexual activity on diabetes, much more is known regarding the relationship between age and diabetes. For example, the prevalence of diabetes, more specifically Type II diabetes, has been shown to increase among individuals over the age of 60 (Gambert & Pinkstaff, 2006). In conjunction, frequency of sexual activity continues to decline in late life. Given the increased risk of diabetes as a person ages and decline in activity, perhaps the possible benefits of engaging in sexual activity diminish in advanced old age.

The significant association between sexual activity and increased likelihood of diabetes, as moderated by race, did not support the hypothesis for research question three. It was expected that the interaction of engaging in sexual activity and being white would be associated with decreased likelihood of diabetes. Limited, if any, research has shown differences in frequency of sexual activity based on an identified racial category (i.e., white, black, Hispanic, etc.). As no connection between frequency of sexual activity and race has been established, other factors associated with health disparities may be driving the relationship between sexual activity and diabetes. The findings of a significant association between sexual activity and increased likelihood of diabetes among older blacks, may actually reflect the likelihood of older blacks not being able to be seen or treated regularly by a physician, or perhaps not understanding the treatment plan prescribed as result of low health literacy levels. Health disparities among minorities, such as lack of access to resources and low health literacy, can prohibit older

minority individuals from being able to attempt the necessary tasks to improve their health or maintain quality of life.

### **Longitudinal Findings**

The interaction of hugging and sleep, indicated too little (less than 6 hours of sleep) or too much sleep (more than 9 hours of sleep) was associated with decreased likelihood of diabetes. This finding is interesting and partially conflicts with some of the literature identifying both short sleep duration (less than five hours) or long sleep duration (more than nine hours) as a risk factor for diabetes among men and women (Ayas et al., 2003; Yaggi, Araujo, & McKinlay, 2006). Research has not explored the interaction of sleep and hugging on diabetes diagnosis, nor the potential protective benefits of hugging on the relationship between short sleep duration and diabetes. Considering the complexity of both sleep issues in late life and a diabetes diagnosis, hugging may be serving as an indicator of another underlying issue related to be poor sleep. For example, hugging, the close physical contact with a spouse, family member, or friend, may be fulfilling feelings of loneliness experienced by older adults. Although not captured in this study, loneliness has been associated with overall poor physical health and poor sleep (Luanaigh, & Lawlor, 2008). A more thorough examination of factors associated with the mental health of older adults may provide further insight on the relationship between hugging and sleep on health outcomes.

On a macro level, the significant interaction between sexual activity and education on CRP level may be influenced by the relationship between social determinants (such as low socioeconomic status) and health over the life course. Individuals with low socioeconomic status, as measured by level of education, income, and wealth, can be at higher risk for chronic illness in late life. In the context of cumulative disadvantages, low education level can lead to lower level

jobs, which can then lead to poor health insurance and an inability to prevent or properly treat health concerns.

The accumulation of ongoing barriers throughout the life course can also be connected to increased stress among individuals of low socioeconomic status compared to their peers with high socioeconomic status (Lubbock, Goh, Ali, Ritchie, & Whooley, 2005). Perhaps the interaction of sexual activity and low education associated with high CRP level reflects the impact of long-term stress due to adversity spanning from adolescence to late life. The CRP variable used in analysis makes it difficult to accurately pinpoint this phenomenon, as the cut point used for analysis considers overall inflammation and inflammation likely associated with an active infection. However, studies have shown an association between socioeconomic status and prolonged inflammation by analyzing various biomarkers including CRP level and Interleukin-6 level (Hansel, Hong, Camara, & Kanel, 2010). The examination of possible psychosocial stressors may help further explain the relationship between sexual activity and CRP level among older adults.

### **Influential Factors in the Biopsychosocial Model**

As noted, the biopsychosocial models suggests the relationship between sexuality and health is influenced by the interaction of biological, psychological, and social factors (Lindau et al., 2007). Another aspect to consider that spans across all of the above mentioned factors, is the impact of life events which may affect biological and psychological health, as well changes in the structure of social relationships. Beyond physical changes in late life, older adults can be affected by retirement and the loss of a spouse, family, or friends. For older adults whose identity is intertwined with their profession, retirement may be difficult to cope with especially with the loss of a routine and social relationships. Further, the loss of spouse or a loved one, can also



affect an older adult's psychological health. Although not thoroughly examined in the analysis discussed above, loss can be accompanied by stress and grief. While the grieving is a normal process, for some, grief can negatively affect physical well-being and social relationships (Kahn, Hull, & Utzschneider, 2006). As in some of the associations discussed above, sexual activity or hugging may not alone increase the risk for poor health, but other aspects of an older adult's life may be affecting the relationship between sexual behavior and health.

Additionally, other aspects related to an individual's environment could impact the association between sexual behavior and health. For example, disease management and access to resources may influence health. Disease management can encompass access to care, quality of care an individual receives, physician and patient relationships, and barriers to communication (Andrulis, 2003). Issues with communication could include language barriers or differences in cultural values dictating how physical or mental health conditions are resolved. For an older adult who may be of a different ethnic background where food largely influences culture, a diagnosis of diabetes may be very challenging. A physician who may prescribe a change in diet or a specific medication regimen, may find the older minority individual less likely to adhere to the recommendations if not aligned with individual's cultural values. Similarly, access to resources to address health concerns can also be a problem. For some older adults the issue may not be the diagnosis of a chronic condition like diabetes, but not having the ability to address the disease. A lack of resources (e.g., transportation, low income, etc.), which may stem from a lack of health insurance due to a low paying job likely associated with level education, connects back to potential role of sociodemographic factors influencing the relationship between sexual behavior and health.

## **Strengths**

Previous research has examined the role of health on desire, level of satisfaction, or ability to engage in sexual activity in late life. To my knowledge, research has yet to test the potential bi-directionality of the relationship between sexuality and health as proposed in the biopsychosocial model. While this study does not specifically address the bi-directionality issue, it adds to the literature by examining the opposite direction (i.e., the impact of sexual activity or hugging on health). A strength of this study focuses on using the principles of the biopsychosocial model to examine the association between sexual behavior and health in a larger national sample of older adults in the United States collected in the NSHAP data set. Another strength in this study is the use of subjective and objective health outcome measures. Although subjective over health measures have previous been shown as significant predictors of mortality in late life (Jylha, Volpato, & Guralnik, 2006), subjective measures can also be subject to participant biases. As an objective health measure, biomarkers have been used to assess susceptibility to disease and potential disease progression (Bonassi & Au, 2002; Sattar, 2012). In this study, the use of biomarkers may provide further insight regarding biological processes explaining significant findings between the relationship between sexual behavior and health.

## **Limitations**

Some limitations of the current study should be mentioned. The sample only includes community dwelling older adults, and is not representative of the heterogeneity among older adults. Although analyses did include participants who identified as white, black or Hispanic (non-black), these discrete racial groups still do not encompass all possible ethnic groups in the older adult population. The data set did include a variable grouping participants who identified

with multiple races or being Hispanic (e.g., race category of Other), however, too few responses were captured to be used in analyses.

Also, the research questions for this study were exploring the potential protective benefit of sexual activity or hugging on health outcomes. It may have been difficult to capture this relationship as a majority of the study sample was in good health. It would be expected that older respondents might have a greater change in health, representative of poorer health, over time; however, a majority of older participants in this study did not have a greater change in health over study waves. For example, when assessing change in arthritis over time, of the roughly 17% of individuals who had arthritis at wave 2, about 7% were over the age of 70. Approximately 19% of individuals with a change in diabetes at wave 2, about 8% were over the age of 70. Similarly, of the 10% of participants who had a change in CRP at wave 2, less than half were 70 years of age or older. A little over half of the 7% of participants with a change in HbA1c level were 70 years of age or older.

Thus, in this healthy sample of participants five years between waves may not have been long enough to capture meaningful change in health. A longer follow-up or cross-lagged panel design (Oud, 2006), which would examine both the influence on sexual activity or hugging on health, and health on sexual activity or hugging, may help confirm or refute the absence of the activity-change in biomarkers link. Modeling of potential pathways over time may help capture the effects of other social, psychological, or environmental factors noted in the biopsychosocial model (Lindau et al., 2003).

As previously mentioned, the models in this study addressed the associations between sexual activity or hugging and health, and also examined change in health from wave 1 and wave 2. The models, however, did not address change relative to lifestyle behavior or life events,

which could impact physical health. For instance, over time some of the study participants may have retired or experienced a loss (i.e., family member, child, spouse/partner). Retirement could negatively impact an older individual's health, if they were previously working in a labor intensive atmosphere, but upon retirement were sedentary a majority of the time. If nutrition and diet are not carefully considered, the older adult could be at risk for weight gain potentially leading to obesity, which is a risk factor for Type II diabetes (Shai et al., 2006; Kahn et al., 2006).

Another example could be the influence of grief on the physical health of an older adult. The grieving process is unique to each individual and can influence psychological, emotional, or physical health (Ott, 2003; Stroebe, Schut, & Stroebe, 2007). Some studies have shown grief being associated with loss of appetite, (Shahar, Schultz, Shahar, & Wing, 2001) in which weight loss can negatively impact physical strength and mobility to conduct ADLs independently. Therefore, the research questions examined may have been better modeled to reflect both changes in health over time, and changes over time in variables relative to a person's social environment and social capital, as noted in the biopsychosocial model.

Additionally, in previous research, ADL has been dichotomized as a measure establishing dependency level (Jakobsson, 2008). ADL was also dichotomized in this study and used as a covariate controlling for health function. In the study sample with a majority of healthy older adults, capturing ADL function using only two levels may not reflect the diversity within age groups (Jakobsson, 2008).

Another limitation of the study could be the way sexual activity and hugging were defined. For instance, as one of the main variables of interest, sexual activity in this study included frequency of foreplay, intercourse, and masturbation. Limited research has investigated

the role of masturbation related to sexuality, but further research is needed to assess the potential benefits of masturbation associated with overall health (Coleman, 2003). Further masturbation, as a sexual activity outcome, has been utilized in other studies (Herbenick et al., 2010; Schick et al., 2010), but it has not been grouped with other types of sexual activity. Considering partnered and non-partnered types of sexual activity, perhaps examining masturbation alone may better capture differences in how sexual activity impacts health outcomes for individuals engaging in partnered versus non-partnered sexual behavior. In regards to hugging, the specific variable assessed hugging as it relates to the interaction with a partner. Through daily interactions the act of hugging is not necessarily restricted to only an intimate partner or spouse. Similar to that of sexual activity, the act of hugging can be with a partner (e.g., spouse or partner) or not with a partner (e.g., hugging a family member/relative, friend, a pet, etc.). Some studies have shown the act of touch and hugging, outside of the partner/spouse relationship, to have positive benefits on an individual's health (Chang, 2001). Thus, future research could consider the influence of hugging on an older adult's health based on the entirety of their social network, assessing both type and quality of the identified relationship.

The inclusion of sexual activity and hugging variables in the models presented are not mutually exclusive. Although Table 2 does break down the study sample by *yes* or *no* responses to sexual activity or hugging to examine baseline characteristics, the regression analyses for this study did not separate individuals who could have said *yes* to both sexual activity and hugging. When thinking about health outcomes, further exploration of these relationships separately may elucidate positive or negative benefits for older adults engaging in sexual activity, hugging, or both activities. Therefore, a limitation in the models is that I did not account for possible

differences between participants who were able to engage in both sexual activity and hugging over the last 12 months versus just sexual activity or just hugging.

In this study, a majority of the results exploring the interaction of social support and sexual activity or hugging on health outcomes were not significant. To our knowledge, other studies have not explored how level of social support in combination with frequency of hugging or sexual activity might be related to health. The lack of significant interaction, however, might be attributed to how social support was defined. For this study, only one variable was used to measure social support. In a prior study utilizing NSHAP data, several social support questions were combined to establish a scale assessing level of closeness or a lack thereof with identified social network members (Cornwell & Waite, 2009). Social support may differ dependent upon who is providing the support, the amount of support, perception or reliance of the support from an identified social network member (Gurung, Taylor, & Seeman, 2003). Utilizing a measure capturing the complexities of social support (i.e., frequency, perceptions, significance of social network member), perhaps would have changed the findings when exploring the interaction of social support and sexual activity or hugging and health outcomes.

### **Future Research Directions**

Future research should strive to assess health holistically, and at the least, consider the role of sexual activity on the health of the individual and their partner. This study focused on the health outcomes of arthritis and diabetes and possible associated biomarkers related to the specific outcomes. Further research could continue to explore general physical health or other physical health outcomes impacting older adults. For instance, this study was limited to a general self-report diagnosis of arthritis. Older adults, however, experience different symptoms or concerns related to care depending on whether they have been diagnosed with rheumatoid or

osteoarthritis. Research could take a closer look at disease-specific symptomology and impact on partnerships in late life. Also, this study only focused on examining the relationship between sexual behavior and physical health. The biopsychosocial model, however, also incorporates the possible interaction of psychological factors related to health. Psychological health (e.g., depression, anxiety, emotional health, well-being, etc.) can be shaped by experiences and situations throughout the life course. Further research should investigate the role of mental or emotional health of the individual on sexual behavior in late life.

More research is also needed to address the diversity within the older adult population. The older adults in this study were living in the community. Older adults, however, living in an institutional setting may experience different challenges, health issues, or ability to express their sexuality. Factors impacting the relationship between sexual behavior and health, may also differ among older adults identifying as non-gender conforming or a sexual orientation other than heterosexual.

All of the factors presented in the biopsychosocial model are influenced throughout the life course through personal behavior, the surrounding physical or social environment, or experienced trauma. Focusing on health outcomes which could be alleviated or prevented in late life might be a first step. A next step could be examining factors that have been found to directly and/or indirectly influence health, while considering change over time. Further, focusing on the role of sexual activity or hugging across the life course may also help explain the complex and dynamic relationship between sexual activity or hugging and health. A person's sexual history as well as age may influence how they express their sexuality and changes in engaging in sexual or intimate behavior in late life (Burd, Nevadunsky, & Bachmann, 2006). For instance, an individual's sexual history recorded across the life course, or even from just middle-age to older

adulthood may provide insight into factors which may contribute to the decline in sexual activity or hugging over time, such as loss of partner, sexual trauma, impotence, or distress (Nusbaum, & Hamilton, 2002). The rich detail that could be captured via sexual history, even if assessed every 6 months, may also be able to highlight factors associated with an individual's health or their partner's health, prohibiting activities such as intercourse (Nusbaum, & Hamilton, 2002). Thus, in order to fully grasp the depth of the relationship between sexual behavior and health, future research should focus on examining factors which may shape and influence sexual behavior and health throughout the life course.



## CHAPTER SIX:

### CONCLUSION

This study explored the pathway between sexual activity or hugging and health outcomes, which is currently missing from the existing literature on health and sexuality in late life. The biopsychosocial model, which was used to examine the relationship between sexual activity or hugging and health, suggests a holistic approach to assessing health. For example, beyond physical conditions or diagnoses, the biopsychosocial model proposes an individual's social relationships or living environment may also impact health. By viewing health as encompassing multiple aspects of a person's daily interactions, the quality of life should also be considered.

While quality of life is a very broad concept, generally, it is associated with good health. However, the relationship between health and quality of life may not be so concrete. For instance, an older adult who may be suffering from chronic illness, may still perceive they have a good quality of life in comparison to peers their own age who may be in poorer health. Other aspects such as faith, a positive social network, or perhaps a safe and desirable living environment may influence a person's perception of their own quality of life.

Researchers should refrain from analyzing both health and sexuality as fixed concepts. Health is multi-dimensional and should be examined in a way which addresses all potential factors that may influence the overall health of an individual. Health is often assessed utilizing objective and subjective measures. In Western medicine, objective measures may often be favored because objective results tend to coincide with more direct and treatable solutions. As

sexuality can be very subjective, perhaps a more process-based approach to health is not the most efficient method when exploring the role of health and sexuality in late life.

Moreover, health should be assessed as an aspect of people's lives that is continually being shaped and evolving over time. Similarly, sexual health should also be considered over the life course. Much of the current literature focuses on sexual education and the consequences of risky sexual behavior among adolescents and young adults. As it stands, in relation to health, sexuality and sexual activity especially for women, is often dismissed once viable reproductive years come to an end. However, just as health and responses to health change as people age, the needs and concerns of an individual's sexual well-being also changes. Re-focusing efforts to address all aspects of health across a continuum may ensure the issues or concerns regarding health and sexuality in late life are recognized as integral factors potentially impacting quality of life for older adults.

The multi-faceted aspects of health and sexuality coincide with the varied findings from this study. Overall, more of the findings in this study suggest engaging in sexual activity is good for older adults' physical health, while hugging does not benefit physical health. However, the benefits of engaging in sexual activity do not seem to reflect in less adverse change in health over time. When looking at factors which may influence the relationship between sexual activity or hugging and health, sexual activity or hugging was good for some older adults but not all. For example, when examining the influence of age, engaging in sexual activity is good for young old (e.g., less than 74 years) individuals, but does not seem to improve the physical health of persons who are older. For instance, the role of sleep indicated hugging was not useful for improving health of individuals who slept for longer periods of time during the night, compared to those who slept for a shorter time.

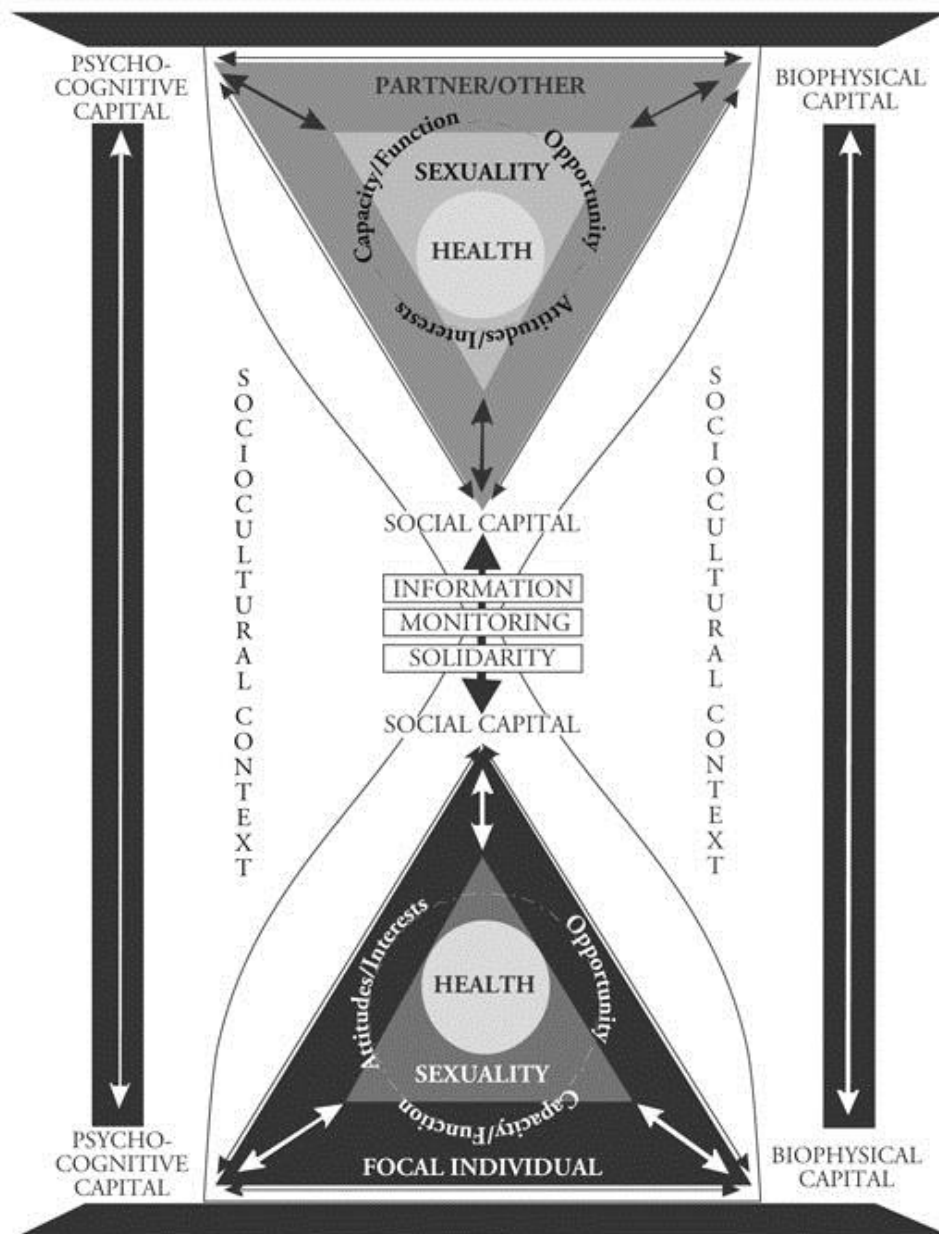
Before controlling for factors such as age or race, sexual activity was associated with decreased likelihood of diabetes. Health care providers may want to start an on-going conversation regarding sexual activity and the sexual health of their older patients who are pre-diabetic or diabetic. From these conversations, health care professionals may be able to ascertain the attitudes and concerns of older adults when it comes to engaging in sexual activity. It is with increased awareness and a sharing of information between patients and physicians, that potential concerns in being able or unable to remain sexually active can be addressed. Health care providers could then provide recommendations to address sexual health, which may indirectly influence chronic conditions, such as diabetes.

Some cross-sectional findings also suggest hugging is associated with the increased likelihood of arthritis. The mechanisms explaining this relationship need further investigation before providing older adults with the recommendation to avoid any type of close physical contact. On the contrary, perhaps older adults should be educated on symptoms associated with arthritis and how certain activities, such as hugging may indirectly, negatively impact these symptoms (e.g., aching, pain, and stiffness).

The longitudinal findings did not support an association between sexual activity or hugging and change in biomarker levels. Therefore, it is reasonable to conclude that sexual activity does not significantly relate to change in biomarkers. Alternatively, the findings may be the artifact of the design, where the follow-up period was too short or the biomarkers assessed were not sensitive enough to detect change. A longer follow-up may help confirm or refute the absence of the sexual activity-change in biomarkers link.

Understanding the possible pathways connecting sexual behavior and health may provide researchers and health professionals with another avenue to ensure quality of life for

older adults. As mentioned, generally the findings indicate there are times when sexual activity may be good for health in late life, while hugging may not be beneficial towards a person's physical health. Perhaps the way sexual behavior in health is addressed in a health care setting could be modified to help guide older adults who desire to remain sexually active. Research to date on sexuality and health has focused on addressing sexual problems or lack of communication. One approach examines issues around sexual health in relation to physiological changes in the body. What is lacking in an approach where the focus is on sexual problems, is how sexual health concerns might be addressed prior to becoming an issue. Another way sexual health is approached, is a focus on communication between health care providers and the individual. The National Coalition for Sexual Education created guidelines for how health care providers should talk about sexuality and health, as well as suggestions on when to talk about sexual health (Altarum Institute, 2016). For example, one recommendation encourages health care providers to annually ask questions about sexual activity during the overall medical history taken when seeing a patient (Altarum Institute, 2016). Establishing a line of communication between health care providers and older individuals may provide an avenue to assess specific concerns or uncover potential health problems unbeknownst to the older adult.



Source: Lindau et al. (2003).

Figure 1. A detailed depiction of the interactions in the biopsychosocial model. Lindau, Stacy Tessler. "Synthesis of Scientific Disciplines in Pursuit of Health: The Interactive Biopsychosocial Model." *Perspectives in Biology and Medicine* 46:3 (2003), S74-S86. © 2003 Johns Hopkins University Press. Reprinted with permission of Johns Hopkins University Press.

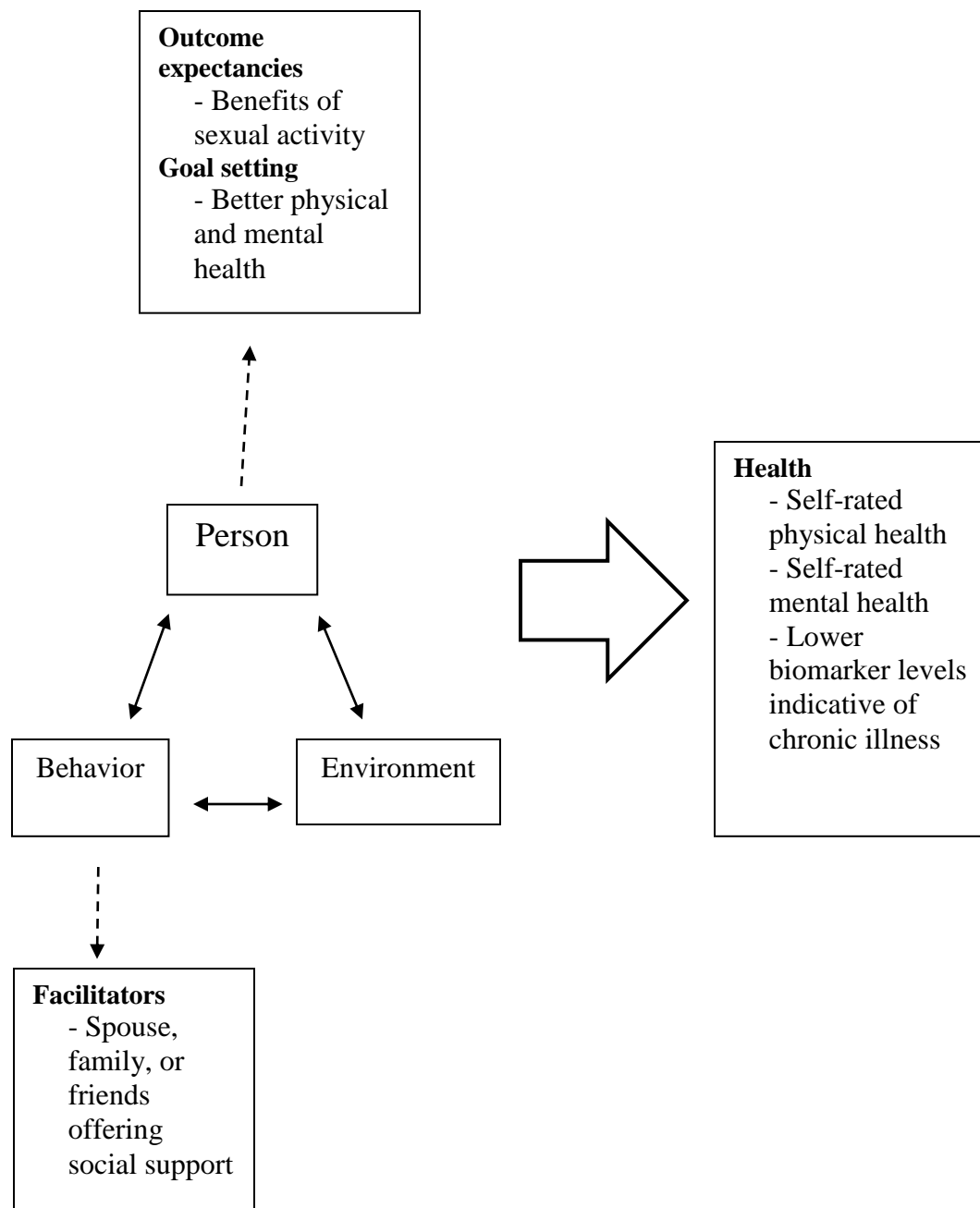


Figure 2. An adapted version of the proposed SCT model analyzing the relationship between sexual behavior and health.

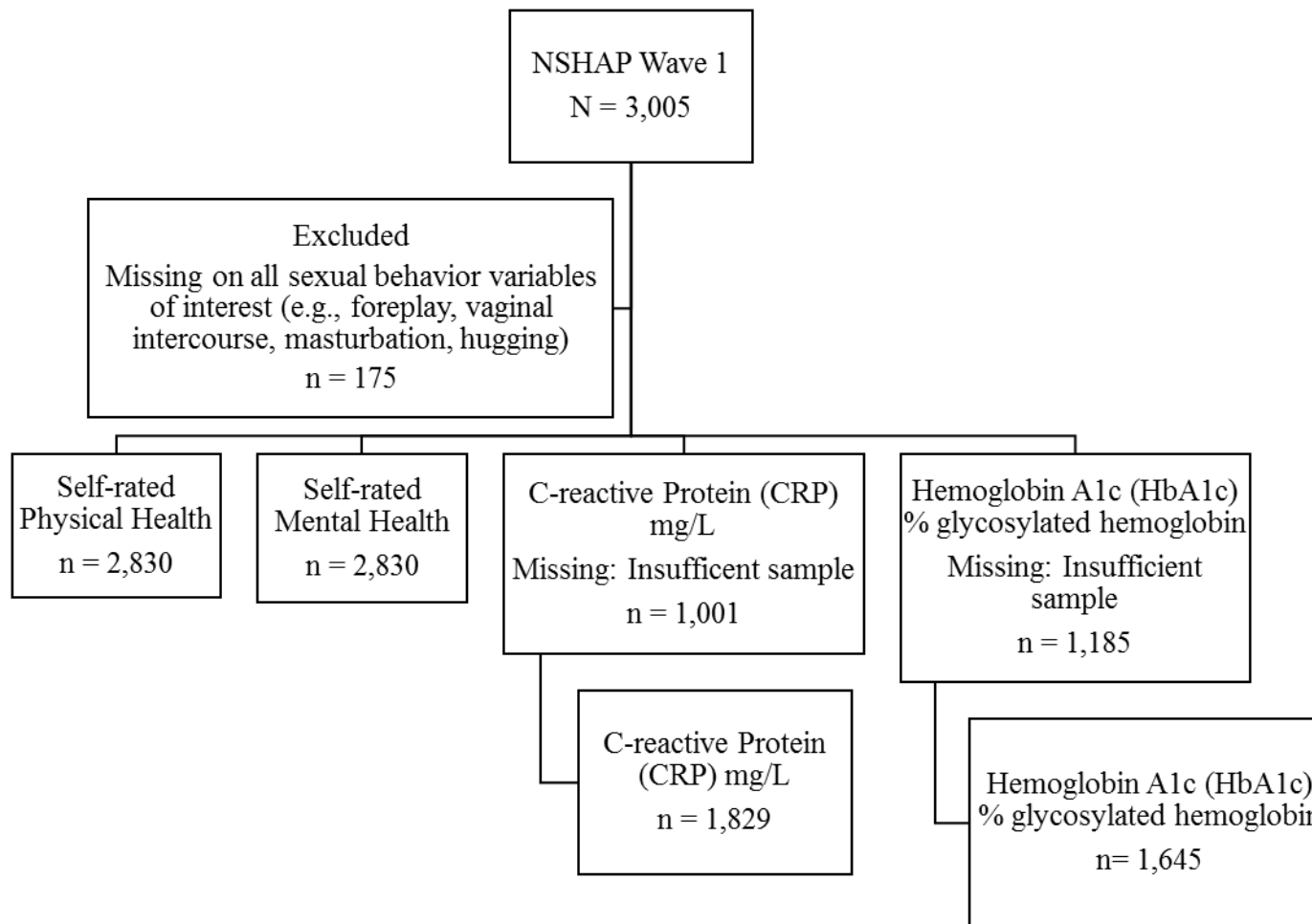


Figure 3. Flow chart of remaining participants with valid health outcome measures.

Table 1

Characteristics for NSHAP Wave 1 Sample Participants

Variable	Wave 1	
	n	M(SD)/%
Age	2,830	69.07(7.78)
Gender		
Female	2,830	50.04
Education	2,830	
< High school		21.91
High school		26.4
Some college		29.05
≥ Bachelor's degree		22.65
Ethnic Group	2,818	
White		71.15
Black		16.32
Hispanic, non-black		10.18
Other		2.34
Marital Status - Partnered	2,830	70.57
Household Income (year)		
≥35,000	2,830	65.55
Social Support		
Talk about health	2,830	83.07
ADL Difficulty	2,830	35.62
Sleep (hours)	2,814	6.89(1.37)
Happiness	2,830	90.46
Pain with walking	2,362	39.63
Stroke	2,830	8.59
Hypertension	2,830	56.86
Arthritis	2,830	52.16
Diabetes	2,830	21.34
C-reactive Protein (CRP) - mg/L	1,829	3.11(5.68)
Hemoglobin A1c - % glycosylated hemoglobin	1,645	6.09(1.02)
Sexual Activity	2,830	65.69
Hugging	2,830	50.28

*Note.* Characteristics of participants includes respondents who have reported engaging in at least one sexual behavior activity in the last 12 months. Marital status includes participants who indicated married, living with a partner, or were unmarried and had a romantic partner. Sexual activity includes participants who reported having vaginal intercourse, engaging in foreplay, or masturbating in the last 12 months. Hugging includes participants who reported hugging, kissing, caressing, or other close physical contact of a non-sexual nature.



Table 2

Baseline sexual activity or hugging characteristics for NSHAP sample: Grouped by responses to sexual behavior variables

Variable	Participants who reported sexual activity in the last 12 months (N=1859)		Participants who did not report sexual activity in the last 12 months (N=971)		Participants who reported hugging the last 12 months (N=1423)		Participants who did not report hugging in the last 12 months (N=1407)	
	n	M(SD)/%	n	M(SD)/%	n	M(SD)/%	n	M(SD)/%
Age	1,859	67.24(7.20)	971	72.57(7.66)	1,423	67.60(7.36)	1,407	70.55(7.92)
Gender	1,859		971		1,423		1,407	
Female		39.32		70.55		40.48		59.70
Education	1,859		971		1,423		1,407	
< High school		16.57		32.13		15.81		28.07
High school		24.48		30.07		25.58		27.22
Some college		31.04		25.23		31.48		26.58
≥ Bachelor's degree		27.92		12.56		27.13		18.12
Ethnic group	1,851		967		1,420		1,398	
White		73.20		67.22		78.45		63.73
Black		14.37		20.06		9.37		23.39
Hispanic, non-Black		10.05		10.44		9.86		10.52
Other		2.38		2.28		2.32		2.36
Marital Status - Partnered	1,859	85.21	971	42.53	1,423	100%	1,407	40.80
Household Income (year)	1,859		971		1,423		1,407	
>=35,000		83.43		53.86		77.09		53.87
Social Support	1,859		971		1,423		1,407	
Talk about health		83.43		82.39		83.20		82.94
ADL Difficulty	1,859	29.26	971	47.79	1,423	28.95	1,407	42.36
Sleep (hours)	1,852	6.90(1.28)	962	6.86(1.52)	1,418	6.94(1.23)	1,396	6.83(1.50)
Happiness	1,859	93.01	971	85.58	1,423	95.43	1,407	85.43
Pain with walking	1,572	35.43	790	47.97	1,273	35.35	1,089	44.63

Table 2 (Continued)

Stroke	1,859	6.89	971	11.84	1,423	6.82	1,407	10.38
Hypertension	1,859	35.43	971	61.28	1,423	52.57	1,407	61.19
Arthritis	1,859	47.01	971	62.00	1,423	49.33	1,407	55.01
Diabetes	1,859	18.83	971	26.16	1,423	19.75	1,407	22.96
C-reactive Protein (CRP) mg/L	1,197		632		897		932	
		2.85(5.87)		3.60(5.26)		2.70(5.19)		3.49(6.08)
Hemoglobin A1c % glycosylated	1,064		581		799		846	
hemoglobin		6.02(0.97)		6.23(1.09)		6.01(0.93)		6.17(1.09)

*Note.* Characteristics of participants includes respondents who have engaged in at least one sexual behavior activity in the last 12 months. Marital status includes participants who indicated married, living with a partner, or were unmarried and had a romantic partner. Sexual activity includes participants who reported having vaginal intercourse, engaging in foreplay, or masturbating in the last 12 months.

Table 3

*Cross-sectional Association of Sexual Activity or Hugging with Self-Reported Arthritis in Wave 1 of NSHAP: Odds Ratios and Confidence Intervals (CI) for Logistic Regression Models*

	Sexual Activity		Hugging	
	Odds Ratio (95% CI)	<i>p</i> value	Odds Ratio (95% CI)	<i>p</i> value
Model 1	0.56 (0.48-0.66)	< 0.001	0.87 (0.75-1.01)	0.061
Model 2	0.82 (0.68-0.98)	0.028	1.13 (0.96-1.32)	0.149
Model 3	0.85 (0.69-1.05)	0.126	1.23 (1.02-1.49)	0.029

*Note.* Model 1 = Sexual activity or hugging, Model 2 = Sexual activity or hugging + Demographic variables, and Model 3 = Sexual activity or hugging + Demographic variables + Health and Functioning.

Table 4

*Cross-sectional Association of Sexual Activity or Hugging with Self-Reported Diabetes in Wave 1 of NSHAP: Odds Ratios and Confidence Intervals (CI) for Logistic Regression Models*

	Sexual Activity		Hugging	
	Odds Ratio (95% CI)	<i>p</i> value	Odds Ratio (95% CI)	<i>p</i> value
Model 1	0.65 (0.54-0.79)	< 0.001	0.87 (0.72-1.05)	0.140
Model 2	0.59 (0.47-0.74)	< 0.001	0.95 (0.78-1.16)	0.613
Model 3	0.61 (0.47-0.79)	< 0.001	1.07 (0.85-1.36)	0.553

*Note.* Model 1 = Sexual activity or hugging, Model 2 = Sexual activity or hugging + Demographic variables, and Model 3 = Sexual activity or hugging + Demographic variables + Health and Functioning.

Table 5

*Cross-sectional Association of Sexual Activity or Hugging with C-reactive Protein (CRP) levels in Wave 1 of NSHAP: Odds Ratios and Confidence Intervals (CI) for Logistic Regression Models*

	Sexual Activity		Hugging	
	Odds Ratio (95% CI)	<i>p</i> value	Odds Ratio (95% CI)	<i>p</i> value
Model 1	0.67 (0.43-1.04)	0.073	0.59 (0.38-0.91)	0.018
Model 2	0.81 (0.48-1.34)	0.404	0.71 (0.44-1.14)	0.156
Model 3	1.29 (0.71-2.35)	0.407	0.87 (0.50-1.49)	0.598

*Note.* Model 1 = Sexual activity or hugging, Model 2 = Sexual activity or hugging + Demographic variables, and Model 3 = Sexual activity or hugging + Demographic variables + Health and Functioning.

Table 6

*Cross-sectional Association of Sexual Activity or Hugging with Glycosylated Hemoglobin (HbA1c) levels in Wave 1 of NSHAP: Odds Ratios and Confidence Intervals (CI) for Logistic Regression Models*

Variable	Sexual Activity		Hugging	
	Odds Ratio (95% CI)	<i>p</i> value	Odds Ratio (95% CI)	<i>p</i> value
Model 1	0.68 (0.50-0.91)	0.011	0.68 (0.51-0.91)	0.011
Model 2	0.53 (0.37-0.76)	0.001	0.71 (0.52-0.98)	0.040
Model 3	0.46 (0.30-0.70)	<0.001	0.78 (0.54-1.14)	0.199

*Note.* Model 1 = Sexual activity or hugging, Model 2 = Sexual activity or hugging + Demographic variables, and Model 3 = Sexual activity or hugging + Demographic variables + Health and Functioning.

Table 7

*Longitudinal Analysis of the Association of Sexual Activity or Hugging with Self-Reported Health Diagnosis: Odds Ratios and Confidence Intervals (CI) for Logistic Regression Models*

Independent variable	<u>Arthritis</u> (n = 2312)				<u>Diabetes</u> (n = 2336)			
	Sexual activity		Hugging		Sexual activity		Hugging	
	Odds Ratio (95% CI)	p value	Odds Ratio (95% CI)	p value	Odds Ratio (95% CI)	p value	Odds Ratio (95% CI)	p value
Model	1.04 (0.79-1.37)	0.764	0.90 (0.71-1.13)	0.362	1.36 (1.05-1.77)	0.021	1.01 (0.81-1.27)	0.906

*Note.* Model = Sexual activity or hugging + Demographic variables + Health and Functioning.

Table 8

*Longitudinal Analysis of the Association of Sexual Activity or Hugging with C-reactive Protein (CRP) level: Odds Ratios and Confidence Intervals (CI) for Logistic Regression Models*

Independent variable	C-reactive Protein (n = 1387)			
	Sexual activity		Hugging	
	Odds Ratio (95% CI)	p value	Odds Ratio (95% CI)	p value
Model	1.59 (1.01-2.50)	0.046	0.98 (0.68-1.43)	0.934

*Note.* Model = Sexual activity or hugging + Demographic variables + Health and Functioning.



Table 9

*Longitudinal Analysis of the Association of Sexual Activity or Hugging and Glycosylated Hemoglobin (HbA1c): Odds Ratios and Confidence Intervals (CI) for Logistic Regression Models*

<u>Glycosylated Hemoglobin (HbA1c)</u>				
<i>(n = 1249)</i>				
	Sexual activity		Hugging	
Variable	Odds Ratio (95% CI)	<i>p</i> value	Odds Ratio (95% CI)	<i>p</i> value
Sexual behavior	0.93 (0.55-1.60)	0.798	0.55 (0.35-0.87)	0.010

*Note.* Model = Sexual activity or hugging + Demographic variables + Health and Functioning.

Table 10

*Cross-sectional Results for Social Support Moderating the Relationship between Sexual Activity or Hugging and Self-Reported Health Diagnoses in Wave 1 of NSHAP: Odds Ratios and Confidence Intervals (CI) for Logistic Regression Models*

Variable	<u>Arthritis</u> (n = 2341)				<u>Diabetes</u> (n = 2341)			
	Sexual activity		Hugging		Sexual activity		Hugging	
	Model 1		Model 2		Model 1		Model 2	
	Odds Ratio (95% CI)	p value	Odds Ratio (95% CI)	p value	Odds Ratio (95% CI)	p value	Odds Ratio (95% CI)	p value
Sexual Behavior	0.71 (0.44-1.15)	0.165	1.47 (0.95-2.26)	0.081	0.62 (0.35-1.11)	0.105	1.00 (0.58-1.71)	0.989
Social Support	0.80 (0.51-1.23)	0.302	1.04 (0.73-1.48)	0.846	1.12 (0.68-1.85)	0.650	1.05 (0.68-1.63)	0.833
Sexual Behavior * Support	1.24 (0.74-2.07)	0.422	0.81 (0.51-1.30)	0.380	0.99 (0.53-1.82)	0.961	1.09 (0.61-1.97)	0.764

*Note.* Model 1 = Sexual activity + Demographic variables + Health and Functioning and Model 2 = Hugging + Demographic variables + Health and Functioning.

Table 11

*Cross-sectional Results for Social Support Moderating the Relationship between Sexual Activity or Hugging and C-reactive Protein (CRP) in Wave 1 of NSHAP: Odds Ratios and Confidence Intervals (CI) for Logistic Regression Models*

Variable	C-reactive Protein (CRP) (n = 1547)			
	Sexual activity		Hugging	
	Model 1		Model 2	
	Odds Ratio (95% CI)	p value	Odds Ratio (95% CI)	p value
Sexual Behavior	1.22 (0.31-4.81)	0.782	1.08 (0.30-3.88)	0.909
Social Support	1.19 (0.36-3.92)	0.778	1.34 (0.49-3.67)	0.573
Sexual Behavior * Support	0.98 (0.23-4.26)	0.977	0.76 (0.19-3.03)	0.697

*Note.* Model 1 = Sexual activity + Demographic variables + Health and Functioning and Model 2 = Hugging + Demographic variables + Health and Functioning.

Table 12

*Cross-sectional Results for Social Support Moderating the Relationship between Sexual Activity or Hugging and Glycosylated Hemoglobin (HbA1c) in Wave 1 of NSHAP: Odds Ratios and Confidence Intervals (CI) for Logistic Regression Models*

Variable	Glycosylated Hemoglobin (HbA1c) (n = 1396)			
	Sexual activity		Hugging	
	Model 1		Model 2	
	Odds Ratio (95% CI)	p value	Odds Ratio (95% CI)	p value
Sexual Behavior	0.53 (0.21-1.31)	0.167	0.88 (0.38-2.06)	0.767
Social Support	1.20 (0.56-2.57)	0.645	1.19 (0.60-2.36)	0.623
Sexual Behavior * Support	0.86 (0.33-2.25)	0.754	0.86 (0.34-2.18)	0.754

*Note.* Model 1 = Sexual activity + Demographic variables + Health and Functioning and Model 2 = Hugging + Demographic variables + Health and Functioning.

Table 13

*Longitudinal Analysis for Social Support Moderating the Relationship between Sexual Activity or Hugging and Self-Reported Health Diagnoses: Odds Ratios and Confidence Intervals (CI) for Logistic Regression Models*

Variable	<u>Arthritis</u> (n = 2312)				<u>Diabetes</u> (n = 2336)			
	Sexual activity		Hugging		Sexual activity		Hugging	
	Model 1		Model 2		Model 1		Model 2	
	Odds Ratio (95% CI)	p value	Odds Ratio (95% CI)	p value	Odds Ratio (95% CI)	p value	Odds Ratio (95% CI)	p value
Sexual Behavior	1.20 (0.64-2.25)	0.581	0.65 (0.39-1.11)	0.115	0.71 (0.40-1.24)	0.228	0.75 (0.45-1.27)	0.285
Social Support	1.19 (0.66-2.14)	0.563	0.85 (0.55-1.30)	0.451	0.66 (0.40-1.09)	0.106	0.94 (0.62-1.44)	0.791
Sexual Behavior * Support	0.85 (0.44-1.67)	0.638	1.47 (0.83-2.61)	0.192	2.18 (1.19-4.02)	0.120	1.43 (0.81-2.51)	0.217

*Note.* Model 1 = Sexual activity + Demographic variables + Health and Functioning and Model 2 = Hugging + Demographic variables + Health and Functioning.

Table 14

*Longitudinal Analysis for Social Support Moderating the Relationship between Sexual Activity or Hugging and C-reactive Protein (CRP): Odds Ratios and Confidence Intervals (CI) for Logistic Regression Models*

Variable	C-reactive Protein (n = 1387)			
	Sexual activity		Hugging	
	Model 1		Model 2	
	Odds Ratio (95% CI)	p value	Odds Ratio (95% CI)	p value
Sexual Behavior	0.79 (0.34-1.83)	0.577	0.98 (0.45-2.14)	0.955
Social Support	0.40 (0.18-0.86)	0.019	0.75 (0.39-1.47)	0.405
Sexual Behavior * Support	2.46 (0.96-6.29)	0.060	1.01 (0.42-2.40)	0.988

*Note.* Model 1 = Sexual activity + Demographic variables + Health and Functioning and Model 2 = Hugging + Demographic variables + Health and Functioning.

Table 15

*Longitudinal Analysis for Social Support Moderating the Relationship between Sexual Activity or Hugging and Glycosylated Hemoglobin (HbA1c): Odds Ratios and Confidence Intervals (CI) for Logistic Regression Models*

Variable	Glycosylated Hemoglobin (HbA1c) (n = 1249)			
	Sexual activity		Hugging	
	Model 1		Model 2	
	Odds Ratio (95% CI)	p value	Odds Ratio (95% CI)	p value
Sexual Behavior	0.97 (0.27-3.45)	0.956	0.49 (0.16-1.49)	0.208
Social Support	1.36 (0.44-4.25)	0.594	1.22 (0.52-2.84)	0.651
Sexual Behavior * Support	0.96 (0.25-3.67)	0.954	1.15 (0.35-3.83)	0.815

*Note.* Model 1 = Sexual activity + Demographic variables + Health and Functioning and Model 2 = Hugging + Demographic variables + Health and Functioning.

Table 16

*Cross-sectional Results for Moderators and the Relationship between Sexual Activity or Hugging and Self-reported Arthritis in Wave 1 of NSHAP: Odds Ratios and Confidence Intervals (CI) for Logistic Regression Models*

Independent variable	Arthritis (n = 2341)			
	Sexual activity		Hugging	
	Model 1		Model 2	
Moderator	Odds Ratio (95% CI)	p value	Odds Ratio (95% CI)	p value
Age	1.00 (0.98-1.03)	0.815	1.00 (0.98-1.02)	0.941
Education	1.16 (0.96-1.41)	0.124	1.03 (0.87-1.23)	0.702
Female	1.12 (0.75-1.69)	0.573	1.09 (0.76-1.55)	0.641
Ethnic Group				
Black	0.94 (0.71-1.23)	0.631	0.92 (0.69-1.22)	0.599
Hispanic, non-Black	0.79 (0.64-0.96)	0.021	0.86 (0.70-1.05)	0.138
Household Income	1.10 (0.74-1.65)	0.635	1.41 (0.95-2.10)	0.086
Sleep	1.02 (0.89-1.17)	0.783	1.04 (0.91-1.18)	0.617

*Note.* Model 1 = Sexual activity + Demographic variables + Health and Functioning and Model 2 = Hugging + Demographic variables + Health and Functioning.



Table 17

*Cross-sectional Results for Moderators and the Relationship between Sexual Activity or Hugging and Self-reported Diabetes in Wave 1 of NSHAP: Odds Ratios and Confidence Intervals (CI) for Logistic Regression Models*

Independent variable	<u>Diabetes</u> ( <i>n</i> = 2341)			
	Sexual activity		Hugging	
	Model 1		Model 2	
Moderator	Odds Ratio (95% CI)	<i>p</i> value	Odds Ratio (95% CI)	<i>p</i> value
Age	1.04 (1.01-1.08)	0.008	1.00 (0.97-1.03)	0.916
Education	1.01 (0.81-1.27)	0.911	1.13 (0.92-1.39)	0.257
Female	0.79 (0.49-1.29)	0.350	0.86 (0.55-1.33)	0.489
Ethnic Group				
Black	1.48 (1.11-1.97)	0.008	1.60 (1.19-2.16)	0.002
Hispanic, non-Black	0.92 (0.72-1.16)	0.479	1.09 (0.86-1.37)	0.495
Household Income	1.19 (0.73-1.93)	0.484	1.29 (0.79-2.09)	0.308
Sleep	0.96 (0.82-1.13)	0.622	1.01 (0.86-1.19)	0.910

*Note.* Model 1 = Sexual activity + Demographic variables + Health and Functioning and Model 2 = Hugging + Demographic variables + Health and Functioning.

Table 18

*Cross-sectional Results for Moderators and the Relationship between Sexual Activity or Hugging and C-reactive Protein (CRP) in Wave 1 of NSHAP: Odds Ratios and Confidence Intervals (CI) for Logistic Regression Models*

Independent variable	C-reactive Protein (CRP) (n = 1547)			
	Sexual activity		Hugging	
	Model 1		Model 2	
Moderator	Odds Ratio (95% CI)	p value	Odds Ratio (95% CI)	p value
Age	1.01 (0.94-1.08)	0.862	1.02 (0.95-1.09)	0.599
Education	1.08 (0.63-1.84)	0.785	1.16 (0.71-1.89)	0.561
Female	0.58 (0.16-2.12)	0.407	1.54 (0.56-4.21)	0.405
Ethnic Group				
Black	1.19 (0.55-2.55)	0.661	1.05 (0.45-2.42)	0.917
Hispanic, non-Black	1.12 (0.61-2.04)	0.721	1.20 (0.66-2.19)	0.546
Household Income	0.60 (0.21-1.73)	0.345	2.18 (0.70-6.82)	0.180
Sleep	1.18 (0.83-1.68)	0.364	0.94 (0.66-1.34)	0.736

*Note.* Model 1 = Sexual activity + Demographic variables + Health and Functioning and Model 2 = Hugging + Demographic variables + Health and Functioning.

Table 19

*Cross-sectional Results for Moderators and the Relationship between Sexual Activity or Hugging and Glycosylated Hemoglobin (HbA1c) in Wave 1 of NSHAP: Odds Ratios and Confidence Intervals (CI) for Logistic Regression Models*

Independent variable	Glycosylated Hemoglobin (HbA1c) (n = 1396)			
	Sexual activity		Hugging	
	Model 1		Model 2	
Moderator	Odds Ratio (95% CI)	p value	Odds Ratio (95% CI)	p value
Age	0.99 (0.94-1.04)	0.722	1.02 (0.97-1.07)	0.482
Education	1.14 (0.80-1.64)	0.468	1.12 (0.80-1.55)	0.519
Female	0.33 (0.15-0.77)	0.010	0.53 (0.26-1.10)	0.089
Ethnic Group				
Black	0.99 (0.59-1.65)	0.967	1.47 (0.88-2.46)	0.145
Hispanic, non-Black	0.68 (0.46-1.00)	0.052	1.08 (0.75-1.55)	0.694
Household Income	0.79 (0.38-1.67)	0.543	1.41 (0.65-3.04)	0.381
Sleep	0.97 (0.75-1.25)	0.792	1.27 (0.98-1.07)	0.075

*Note.* Model 1 = Sexual activity + Demographic variables + Health and Functioning and Model 2 = Hugging + Demographic variables + Health and Functioning.

Table 20

*Longitudinal Analysis for Moderators and the Relationship between Sexual Activity or Hugging and Self-Reported Arthritis: Odds Ratios and Confidence Intervals (CI) for Logistic Regression Models*

Independent variable	Arthritis (n = 2312)			
	Sexual activity		Hugging	
	Model 1		Model 2	
Moderator	Odds Ratio (95% CI)	p value	Odds Ratio (95% CI)	p value
Age	0.98 (0.95-1.02)	0.268	0.99 (0.96-1.02)	0.335
Education	0.81 (0.63-1.03)	0.091	0.85 (0.68-1.05)	0.130
Female	1.68 (1.01-2.80)	0.045	1.21 (0.78-1.88)	0.386
Ethnic Group				
Black	0.94 (0.59-1.50)	0.782	0.91 (0.59-1.41)	0.679
Hispanic, non-Black	1.37 (0.95-1.97)	0.094	1.10 (0.83-1.46)	0.518
Household Income	0.98 (0.58-1.66)	0.950	0.57 (0.35-0.94)	0.027
Sleep	0.95 (0.79-1.14)	0.558	0.90 (0.76-1.07)	0.217

*Note.* Model 1 = Sexual activity + Demographic variables + Health and Functioning and Model 2 = Hugging + Demographic variables + Health and Functioning.

Table 21

*Longitudinal Analysis for Moderators and the Relationship between Sexual Activity or Hugging and Self-Reported Diabetes: Odds Ratios and Confidence Intervals (CI) for Logistic Regression Models*

Independent variable	Diabetes (n = 2336)			
	Sexual activity		Hugging	
	Model 1		Model 2	
Moderator	Odds Ratio (95% CI)	p value	Odds Ratio (95% CI)	p value
Age	1.00 (0.97-1.04)	0.805	1.00 (0.97-1.02)	0.719
Education	1.14 (0.90-1.45)	0.281	1.20 (0.98-1.48)	0.078
Female	0.54 (0.31-0.94)	0.030	0.69 (0.45-1.06)	0.092
Ethnic Group				
Black	0.60 (0.39-0.95)	0.028	0.59 (0.36-0.96)	0.033
Hispanic, non-Black	0.93 (0.69-1.26)	0.651	1.00 (0.76-1.32)	0.976
Household Income	1.35 (0.82-2.23)	0.239	1.23 (0.76-1.99)	0.400
Sleep	1.08 (0.92-1.29)	0.350	1.19 (1.01-1.39)	0.035

*Note.* Model 1 = Sexual activity + Demographic variables + Health and Functioning and Model 2 = Hugging + Demographic variables + Health and Functioning.

Table 22

*Longitudinal Regression Analysis Results for Moderators and the Relationship between Sexual Activity or Hugging and C-reactive Protein (CRP): Odds Ratios and Confidence Intervals (CI) for Logistic Regression Models*

Independent variable	C-reactive Protein (CRP) (n = 1387)			
	Sexual activity		Hugging	
	Model 1		Model 2	
Moderator	Odds Ratio (95% CI)	p value	Odds Ratio (95% CI)	p value
Age	0.97 (0.92-1.02)	0.235	0.97 (0.92-1.02)	0.231
Education	0.65 (0.44-0.97)	0.037	1.05 (0.74-1.47)	0.795
Female	1.43 (0.59-3.47)	0.432	1.66 (0.77-3.18)	0.217
Ethnic Group				
Black	1.07 (0.56-2.03)	0.842	0.97 (0.53-1.80)	0.927
Hispanic, non-Black	0.81 (0.49-1.35)	0.425	0.67 (0.38-1.19)	0.170
Household Income	1.76 (0.76-4.09)	0.189	1.21 (0.55-2.65)	0.643
Sleep	0.99 (0.75-1.31)	0.943	1.16 (0.89-1.50)	0.272

*Note.* Model 1 = Sexual activity + Demographic variables + Health and Functioning and Model 2 = Hugging + Demographic variables + Health and Functioning.

Table 23

*Longitudinal Analysis for Moderators and the Relationship between Sexual Activity or Hugging and Glycosylated Hemoglobin (HbA1c): Odds Ratios and Confidence Intervals (CI) for Logistic Regression Models*

Independent variable	Glycosylated Hemoglobin (HbA1c) (n = 1249)			
	Sexual activity		Hugging	
	Model 1		Model 2	
Moderator	Odds Ratio (95% CI)	p value	Odds Ratio (95% CI)	p value
Age	1.05 (0.98-1.12)	0.188	0.99 (0.93-1.05)	0.736
Education	1.16 (0.71-1.88)	0.564	1.33 (0.85-2.07)	0.209
Female	2.05 (0.75-5.63)	0.164	3.33 (1.39-1.98)	0.007
Ethnic Group				
Black	0.98 (0.24-4.06)	0.979	0.96 (0.22-4.27)	0.962
Hispanic, non-Black	0.55 (0.26-1.13)	0.105	--	--
Household Income	1.71 (0.61-4.82)	0.310	2.05 (0.60-6.99)	0.250
Sleep	1.29 (0.90-1.85)	0.163	1.07 (0.76-1.50)	0.693

*Note.* Model 1 = Sexual activity + Demographic variables + Health and Functioning and Model 2 = Hugging + Demographic variables + Health and Functioning.

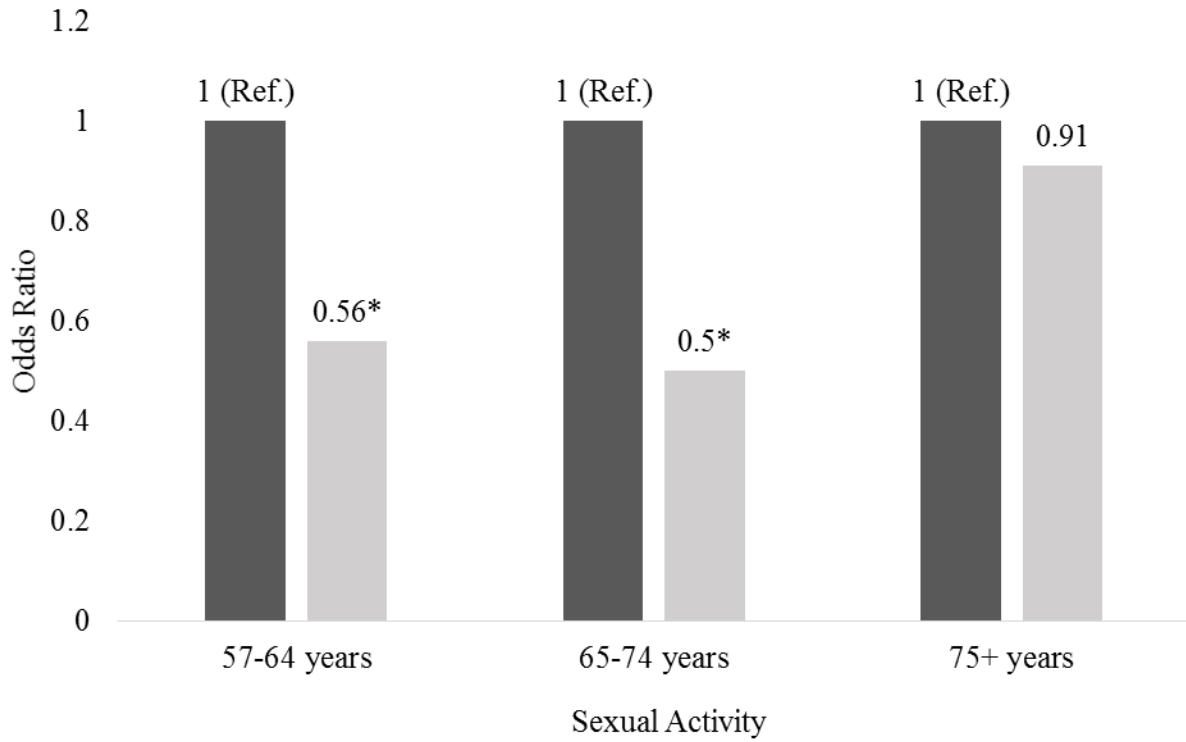


Figure 4. Association of sexual activity and diabetes by age group in NSHAP Wave 1. \*  $p < .05$



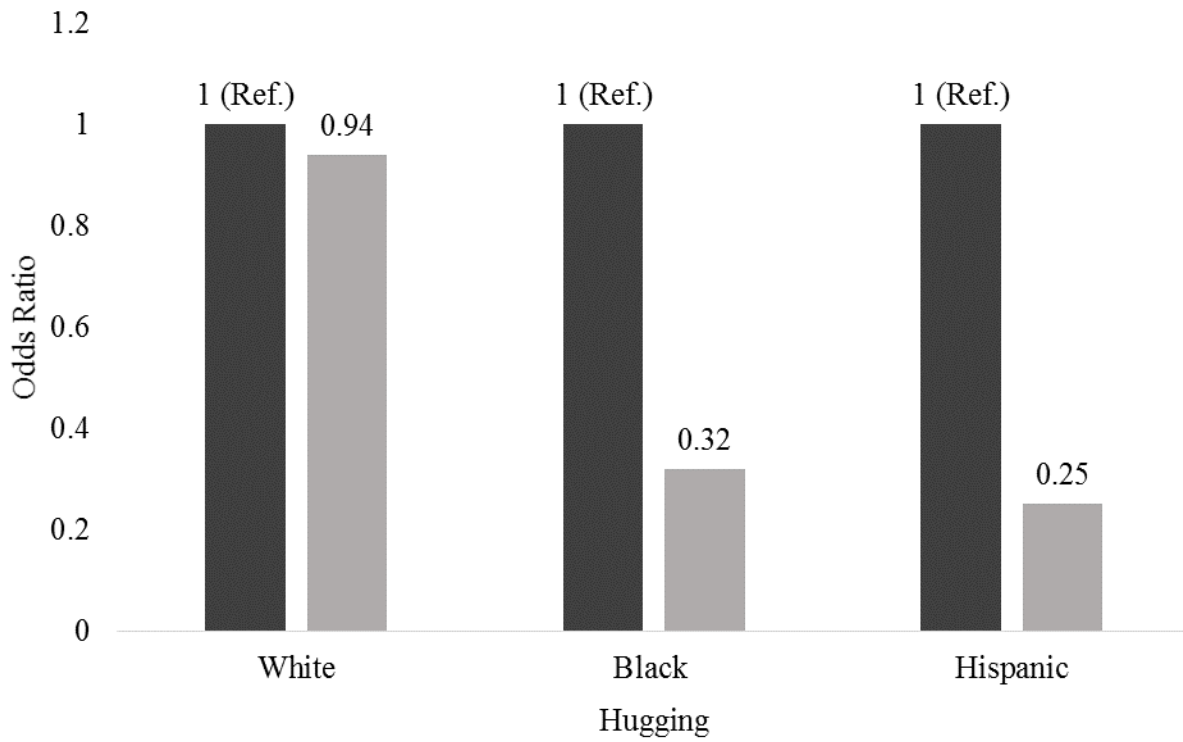


Figure 5. Association of hugging and diabetes by race category in NSHAP Wave 1. \*  $p < .05$

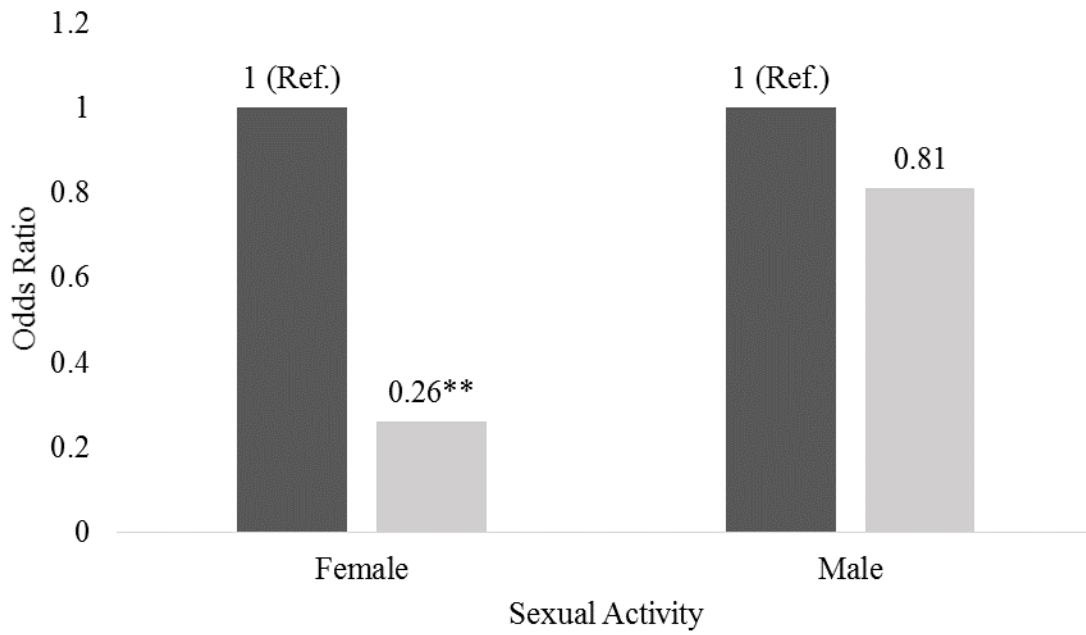


Figure 6. Association of sexual activity and HbA1c by gender in NSHAP Wave 1.  
 \* p < .05 \*\* p < .01

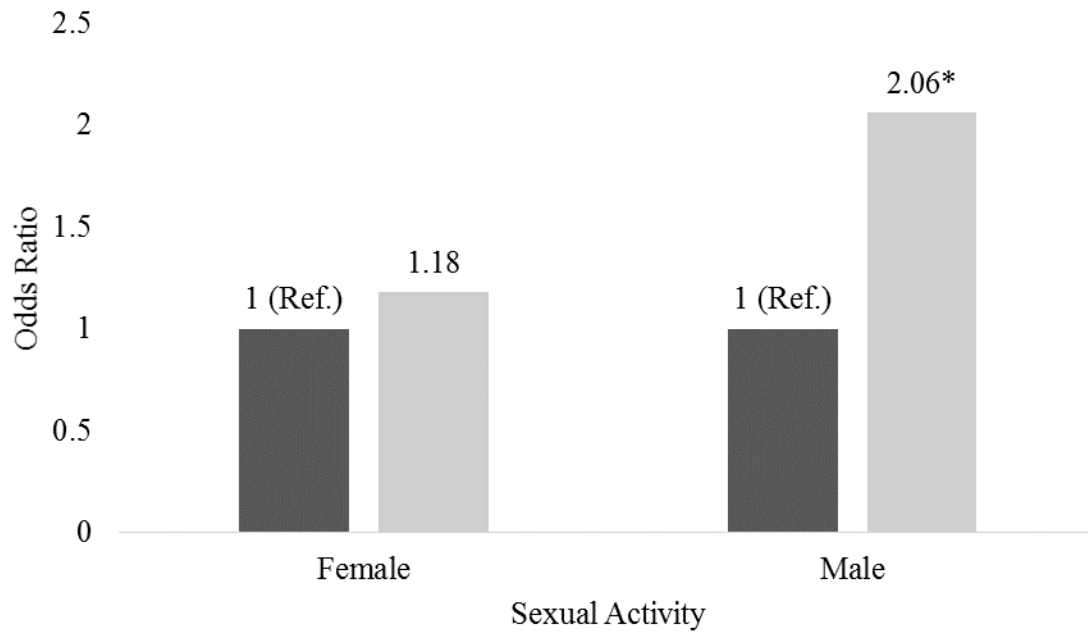


Figure 7. Association of sexual activity and diabetes by gender NSHAP Wave 2. \* p <.05

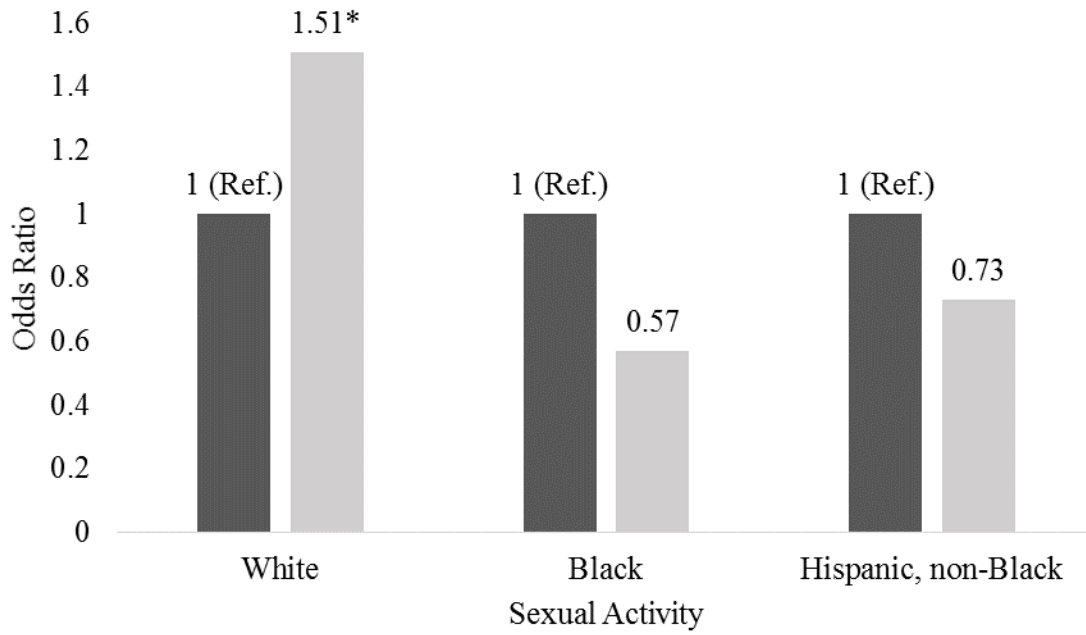


Figure 8. Association of sexual activity and diabetes by race group NSHAP Wave 2. \* p <.053

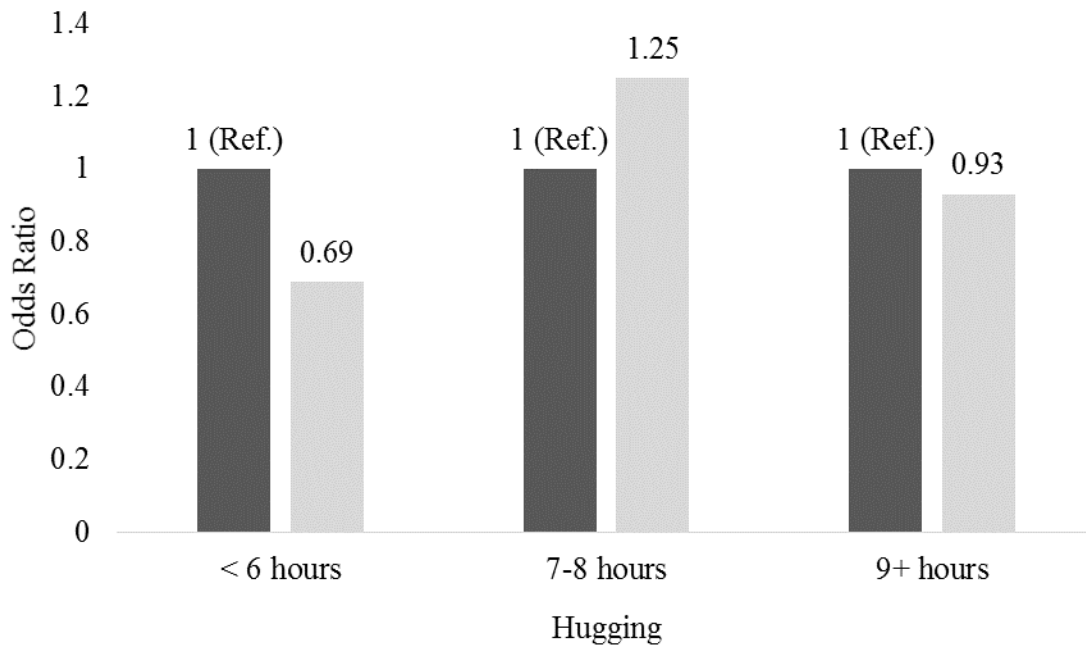


Figure 9. Association of hugging and diabetes by sleep in NSHAP Wave 2. \*  $p < .05$

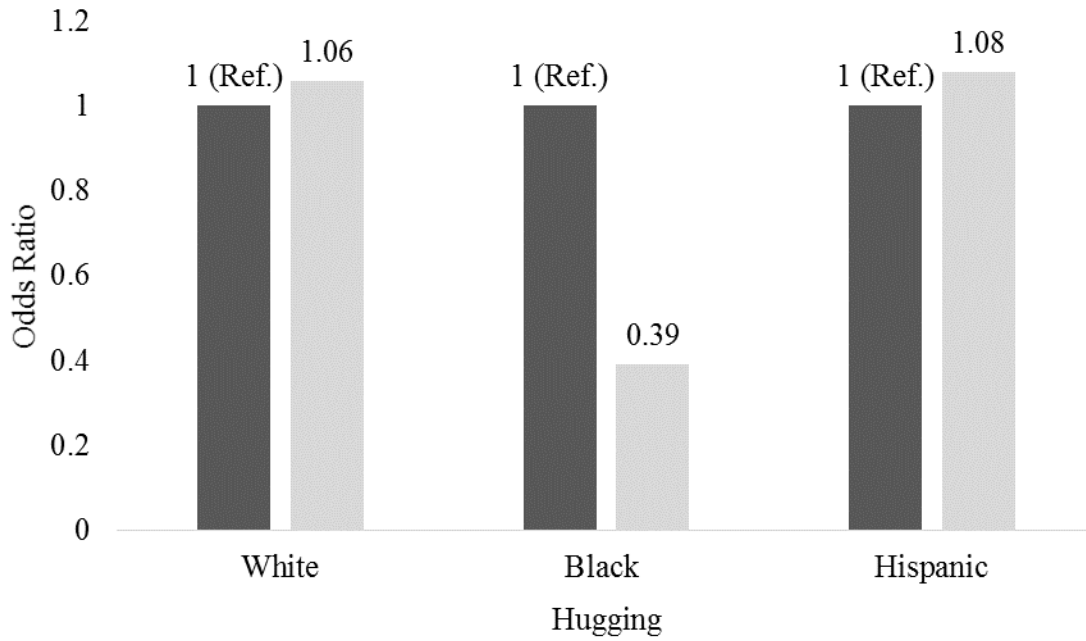


Figure 10. Association of hugging and diabetes by race category in NSHAP Wave 2. \*  $p < .05$

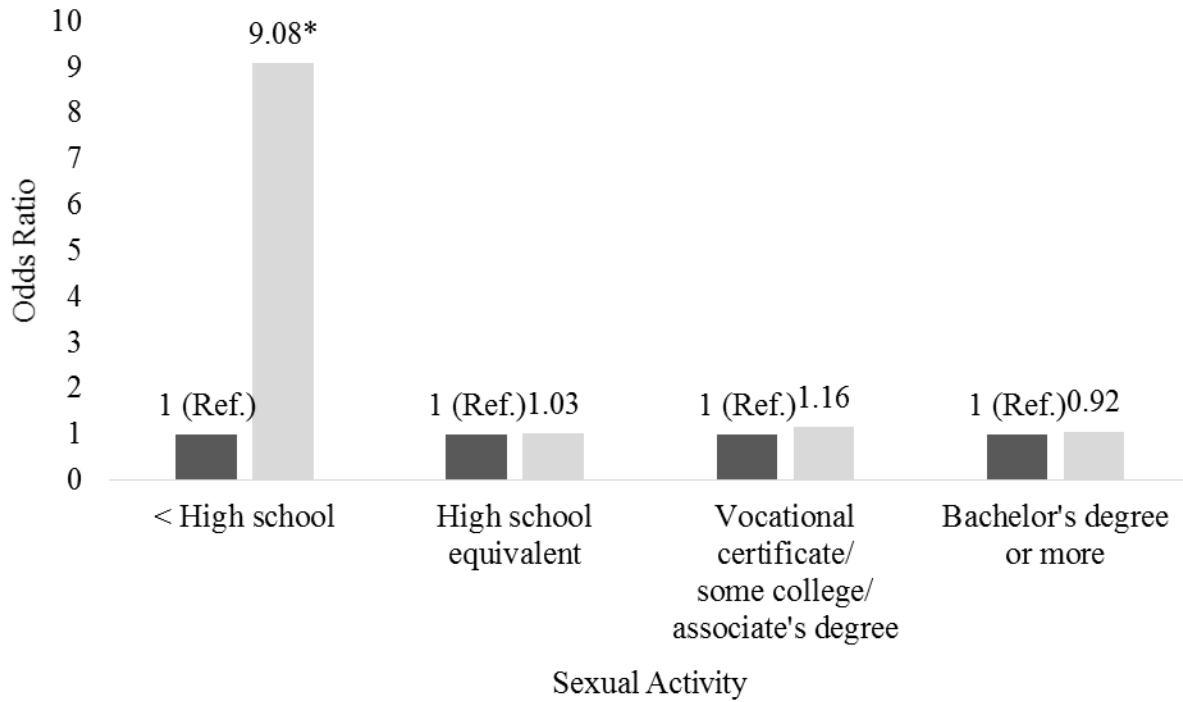


Figure 11. Association of sexual activity and CRP by education in NSHAP Wave 2. \*  $p < .05$

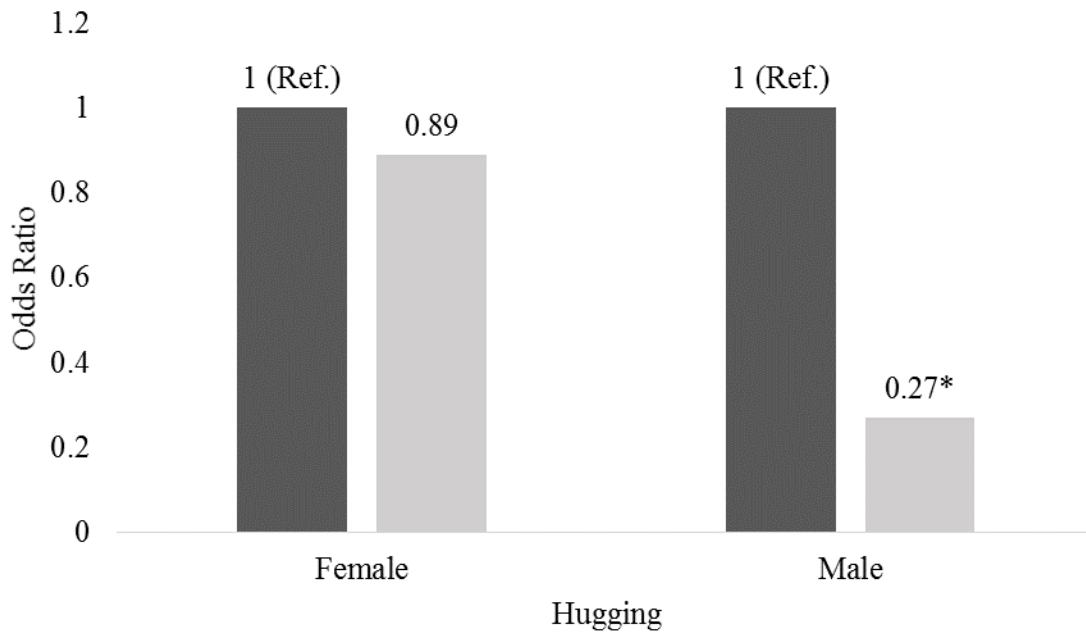


Figure 12. Association of hugging and HbA1c by gender in NSHAP Wave 2. \*  $p < .01$



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## APPENDICES



**Appendix A:** Email response for copyright material. Lindau, Stacy Tessler. "Synthesis of Scientific Disciplines in Pursuit of Health: The Interactive Biopsychosocial Model." *Perspectives in Biology and Medicine* 46:3 (2003), S74-S86. © 2003 Johns Hopkins University

**Chantelle Sharpe**

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**Sent:** Wednesday, January 18, 2017 4:32 PM  
**To:** csharpe@mail.usf.edu  
**Cc:** Rights  
**Subject:** Lindau, Stacy Tessler. Perspectives in Biology and Medicine. Synthesis of Scientific Disciplines in Pursuit of Health: The Interactive Biopsychosocial Model, pp. S74-S86

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**Appendix B:** Email response from Research Integrity and Compliance for Institutional Review Board (IRB) exemption.



RESEARCH INTEGRITY AND COMPLIANCE  
Institutional Review Boards, FWA No. 00001669  
12901 Bruce B. Downs Blvd., MDC035 • Tampa, FL 33612-4799  
(813) 974-5638 • FAX (813) 974-7091

October 16, 2014

Chantelle Sharpe  
School of Aging Studies  
Tampa, FL 33612

**RE: NOT Human Research Activities Determination**

IRB#: Pro00014195

Title: The Impact of Sexual Behavior on Health and the Role of Social Relationships among Older Adults

Dear Ms. Sharpe:

The Institutional Review Board (IRB) has reviewed the information you provided regarding the above referenced project and has determined the activities do not meet the definition of human subjects research. Therefore, IRB approval is not required. If, in the future, you change this activity such that it becomes human subjects research, IRB approval will be required. If you wish to obtain a determination about whether the activity, with the proposed changes, will be human subjects research, please contact the IRB for further guidance.

All research activities, regardless of the level of IRB oversight, must be conducted in a manner that is consistent with the ethical principles of your profession and the ethical guidelines for the protection of human subjects. As principal investigator, it is your responsibility to ensure subjects' rights and welfare are protected during the execution of this project

Also, please note that there may be requirements under the HIPAA Privacy Rule that apply to the information/data you will use in your activities. For further information about any existing HIPAA requirements for this project, please contact a HIPAA Program administrator at 813-974-5638.

We appreciate your dedication to the ethical conduct of human subject research at the University of South Florida and your continued commitment to human research protections. If you have any questions regarding this matter, please call 813-974-5638.

Sincerely,

A handwritten signature in black ink that reads "John A. Schinka, Ph.D." The signature is written in a cursive style.

John Schinka, Ph.D., Chairperson  
USF Institutional Review Board