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Depression, Drug Use, and HSV-2 Among Women Who Have Sex with Women

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Abstract

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MPH, Ponce School of Medicine, 2009

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Dissertation Submitted in Partial Fulfillment

of the Requirements for the Degree of

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Abstract

Herpes simplex virus type 2 (HSV-2), the main cause of genital herpes, is an incurable sexually transmitted infection responsible in 2018 for 18.6 million infections in the United States. HSV-2 is twice as frequent in women than in men. Women who have sex with women (WSW) have a higher prevalence of depression and drug use than women who have sex exclusively with men (WSM), which are each related to HSV-2 as they increase the likelihood of engaging in risky sexual behaviors. The purpose of this study was to assess the predictive relationship between depression status, nonprescription drug use status, and HSV-2 status in WSW while controlling for age, race, educational level, income, and total number of sex partners. The research design was a quantitative, correlational study of a cross-sectional nature using secondary data from the National Health and Nutrition Examination Survey (NHANES). The theoretical framework for this study was the escape theory, which describes why individuals engage in certain activities (e.g., drug use and risky sexual behaviors) to avoid negative thoughts about themselves. Data were analyzed using chi-square and multiple logistic regression tests to assess the relationships between variables. Results did not indicate statistically significant ($p < 0.05$) predictive relationships between depression status, nonprescription drug use status, and HSV-2 status in WSW, but age, race, educational level, income, and total number of sex partners were all predictively related to HSV-2 status at statistically significant levels. The results of this study may motivate researchers to further investigate these relationships. STI prevention planners could use this information to ensure that these risk factors are considered when designing HSV-2 interventions for sexual minority women.

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Chapter 1: Introduction to the Study

Herpes simplex virus type 2 (HSV-2) is an incurable sexually transmitted infection (STI) responsible in 2016 for over 491 million infections worldwide (James et al., 2020). This STI is more frequent among women and, in the United States, the prevalence among women is almost two times higher than for men (15.9% versus 8.2%, respectively; McQuillan et al., 2018; Spicknall et al., 2021). HSV-2 is the leading cause of genital ulcer disease, can result in serious health complications, and increases the risk of acquisition and transmission of HIV and other STIs (Johnston & Corey, 2016; Li & Wen, 2017; Looker et al., 2017, 2020; Mathew & Sapra, 2020).

Few researchers have examined HSV-2 risk or prevalence in women stratified by sexual behavior and have found that HSV-2 is more prevalent among women who have sex with women (WSW; 36%) compared with women who have sex exclusively with men (WSM; 24%; Operario et al., 2015; Xu, Sternberg, & Markowitz, 2010a). Many of these women do not seek preventive HSV-2 care because they think it is unnecessary if they are not having sex with men (Marrazzo, 2004; Muzny, Harbison, Pembleton, Hook, et al., 2013). This is due to the incorrect general assumption that the risk of woman-to-woman transmission of STIs is low (Bauer & Welles, 2001; Bernstein et al., 2013; A. Davis et al., 2016; Gorgos & Marrazzo, 2017; Naish et al., 2019; Tat et al., 2015; Van der Pol, 2014) and because of the higher prevalence of drug use and engagement in more risky sexual behaviors (e.g., infrequent or no barrier use and higher number of sex partners) than WSM, which increases their risk for HSV-2 (Rahman et al., 2020; Tat et al., 2015; Xu, Sternberg, & Markowitz, 2010a).

The Institute of Medicine (IOM) reported in 2011 that the literature on sexual minority populations, including WSW, is "sparse and that substantial research is needed" to better understand the health status of these populations (p. 8). Approximately 17.4% of women in the United States report ever having sex with another woman (Copen et al., 2016). Researchers found that only 0.1% of all research funded by the National Institutes of Health focused on sexual minority health over a 20-year period (Coulter et al., 2014). Of this, 13.5% focused on sexual minority women (Coulter et al., 2014). I aim to answer the IOM's call by examining data from a large sample of the United States adult female population and producing estimates of the burden of HSV-2 in WSW, as well as risk factors related to HSV-2 infection in this sexual minority population.

The findings from my study have the potential to contribute to positive social change for sexual minority populations in at least two ways: (a) advancing health research on WSW and (b) increasing understanding of the relationship between depression, nonprescription drug use, and HSV-2 infection in WSW. This information can be used to create HSV-2 prevention strategies specifically for sexual minority women and improve their health and quality of life. The results of my study also have the potential to increase awareness of the risk for HSV-2 infection in women who have sex exclusively with women. This chapter includes the background, problem statement, purpose of the study, research questions and hypotheses, theoretical framework, nature of the study, definitions, assumptions, scope and delimitations, limitations, significance, and summary.

Background

Herpes simplex virus (HSV) is a lifelong viral infection and one of the most prevalent diseases among humans worldwide (James et al., 2020; World Health Organization, 2020). There are two different types of HSV including HSV type 1 (HSV-1) and HSV type 2 (HSV-2). Both types can infect a human's nervous system tissue, reproduce quickly, and efficiently destroy cells (Koelle et al., 2017; Roizman & Thayer, n.d.). Clinical manifestations, mode of transmission, and epidemiology for HSV-1 and HSV-2 differ.

HSV-1 is the main cause of oral herpes and is mostly transmitted through oral-to-oral contact (e.g., kissing) with an infected individual (Gupta et al., 2007; World Health Organization, 2020). An estimated 48% of the United States population was living with HSV-1 infection during 2015–2016 (McQuillan et al., 2018). Most HSV-1 infections are asymptomatic and cases that show symptoms typically affect the lips, tongue, gums, inside lining of the cheeks, and palate (Rechenchoski et al., 2017). The infection can also cause cold sores or fever blisters on or around the mouth (Centers for Disease Control and Prevention [CDC], 2017a). Although most infections are mild, serious health complications (e.g., meningitis, blindness, and encephalitis) can occur (Corey & Wald, 2008; Ramchandani et al., 2016).

HSV-2 is nearly exclusively transmitted through sex and is the main cause of genital herpes (Groves, 2016; Looker et al., 2015; Wald & Corey, 2007). In the United States, an estimated 18.6 million individuals were living with an HSV-2 infection in 2018 and 572,000 new HSV-2 infections occurred that year (Spicknall et al., 2021). The

prevalence of HSV-2 in the United States is twice as high for women of reproductive age (15.9%) than for their male counterparts (8.2%; McQuillan et al., 2018). Women are at higher risk of acquiring HSV-2 due to their increased biologic susceptibility (Abbai et al., 2016; Brotman & Ghanem, 2015; Kouyoumjian et al., 2018). Viruses and bacteria can penetrate the lining of the vagina easier because it is thinner and more fragile than the skin on a penis, making the vagina an adequate environment for these organisms to flourish (Brotman & Ghanem, 2015; CDC, 2018). HSV-2 promotes loss of the normal vaginal flora protecting the area and increases susceptibility to other STIs (Cherpes et al., 2008; Esber et al., 2015; Schmid et al., 2000). HSV-2 increases the risk of HIV transmission and acquisition, and women infected with HSV-2 are over eight times more likely to acquire HIV after sexual exposure than healthy women (Byrne et al., 2018).

Like HSV-1, if left untreated, HSV-2 can result in meningitis (e.g., aseptic meningitis and meningoencephalitis) and blindness (Banerjee et al., 2020; Jiang et al., 2016; Ramchandani et al., 2016). But HSV-2 can potentially result in more serious health outcomes than HSV-1 (Daniels et al., 2016; World Health Organization, 2020) such as acute retinal necrosis (Bergstrom & Tripathy, 2020), acute urinary retention (especially in women; Groves, 2016), disseminated herpes (Schiffer & Corey, 2009), hepatitis (which can develop into acute liver failure and can sometimes lead to death; Down et al., 2016; Norvell et al., 2007), and pelvic inflammatory disease (Cherpes et al., 2006). In pregnant women, HSV-2 infection may result in neonatal HSV because the virus is vertically transmitted mother-to-infant during childbirth (Groves, 2016; Gupta et al., 2007; James, 2015).

HSV-2 infection may also result in negative psychological and social outcomes. An HSV-2 diagnosis could cause psychological distress, including feeling depressed (Horn et al., 2015; Hsu et al., 2016; Nowotny et al., 2018; Pratt et al., 2012), betrayed, contaminated, ashamed, and low self-esteem (Mindel, 1996; Mindel & Marks, 2005). Personal relationships could be damaged because fear of stigma from an HSV-2 diagnosis makes it hard for someone to disclose their status to potential sexual partners or medical professionals (Bickford et al., 2007; Myers et al., 2015; Royer et al., 2013).

HSV-2 among women has been widely studied and well documented (Bernstein et al., 2013; Daniels et al., 2016; A. Davis et al., 2016; Fleming et al., 1997; Korr et al., 2017; Lehavot et al., 2014; Magaret et al., 2015; Masese et al., 2014; McQuillan et al., 2018; Nowotny et al., 2018; Pratt et al., 2012; Ramchandani et al., 2017; Rollenhagen et al., 2014; Smith et al., 2002; Van der Pol, 2014; Xu et al., 2006; Xu, Sternberg, Gottlieb, et al., 2010). However, few researchers have examined HSV-2 risk or prevalence specifically among WSW and have found that HSV-2 is more prevalent among WSW than among WSM (Gorgos & Marrazzo, 2017; Operario et al., 2015; Xu, Sternberg, & Markowitz, 2010a). WSW are thought to be at higher risk of HSV-2 because of their higher prevalence of depression and drug use, as well as their engagement in more risky sexual behaviors (Gorgos & Marrazzo, 2017; Mendoza-Pérez et al., 2019; Schick et al., 2015).

Drug use has been found to be related to HSV-2 infection and HSV-2 prevalence has been reported to range between 38% and 75% among individuals who use drugs (Semaan et al., 2013). Individuals who use drugs are at higher risk for HSV-2 because of

their engagement in risky sexual behaviors (e.g., exchange of sex for drugs or money), consequences from drug use (e.g., less inhibitions, enhanced sexual pleasure), or use of drugs as self-medication to escape from their personal issues (Semaan et al., 2013). Drug use increases the likelihood of engaging in risky sexual behaviors by enhancing arousal, desire, stamina, enjoyment, and impulsivity (Feaster et al., 2016; Marshall et al., 2011; Volkow et al., 2007; Yamada et al., 2021). Sexual minority populations have higher rates of drug use than non-sexual minorities (Heinsbroek et al., 2018; Kerridge et al., 2017; Operario et al., 2015; Rice et al., 2019; Schuler et al., 2018, 2019). WSW are believed to be at higher risk for HSV-2 infection than WSM because they are over two times more likely to engage in illicit drug use (Heinsbroek et al., 2018; Operario et al., 2015; Schuler & Collins, 2020) and are two to four times more likely to have a drug use disorder in their lifetime (Kerridge et al., 2017).

Depression is also related to HSV-2 infection in women (A. Davis et al., 2016; Kelly et al., 2016; Nowotny et al., 2018). Women who experience depression are more likely to engage in risky sexual behaviors, such as sex without barrier protection and multiple sex partners, increasing their risk of acquiring HSV-2 (Burke et al., 2018; Cunningham et al., 2016; Jackson et al., 2015). This high-risk behavior may be due to impaired judgement, higher impulsivity, indifference, and alcohol consumption stemming from their depression (Burke et al., 2018). WSW are almost two times more likely to suffer from depression in the preceding year and in their lifetime compared with WSM (Dai & Meyer, 2019; Kerridge et al., 2017).

Depression and drug use commonly co-occur and almost one third of individuals who experience depression also have drug use problems (L. Davis et al., 2008; Mohamed et al., 2020). WSW are over three times more likely to experience co-occurring depression and drug use than WSM (Bränström & Pachankis, 2018). It has been suggested that depression may precede drug use among WSW, as individuals may resort to drug use to escape from psychological distress (Bränström & Pachankis, 2018; Flentje et al., 2015; Schuler et al., 2019). Depression and risky sexual behaviors co-occur in women who inject drugs, and WSW are more likely to engage in drug use than WSM (Mwangi et al., 2019; Soto-Salgado et al., 2016). WSW who experience depression and use drugs may engage in more risky sexual behaviors than WSM, which can lead to a higher risk for HSV-2 infection (A. Davis et al., 2016; Gorgos & Marrazzo, 2017; IOM, 2011; Kelly et al., 2016; Operario et al., 2015; Xu, Sternberg, & Markowitz, 2010a).

Problem Statement

HSV-2 is an incurable STI that affected an estimated 18.6 million individuals in the United States during 2018 (Spicknall et al., 2021). Those with HSV-2 infection can experience serious health complications such as meningitis, blindness (Banerjee et al., 2020), acute retinal necrosis (Bergstrom & Tripathy, 2020), acute urinary retention (especially in women; Groves, 2016), disseminated herpes (Schiffer & Corey, 2009), acute liver failure that can sometimes lead to death (Down et al., 2016), and pelvic inflammatory disease (Cherpes et al., 2006). HSV-2 also increases the risk for HIV acquisition by a two to four-fold (Byrne et al., 2018; Schiffer & Gottlieb, 2019). The prevalence of HSV-2 in the United States is twice as high for women than for men

(McQuillan et al., 2018; Spicknall et al., 2021). Among women, HSV-2 is more prevalent among WSW than WSM (Operario et al., 2015; Xu, Sternberg, & Markowitz, 2010a). However, few efforts have been made to identify risk factors that increase the risk for HSV-2 in WSW because of the general assumption that the risk of woman-to-woman transmission of STIs is low (Bauer & Welles, 2001; Gorgos & Marrazzo, 2017; Naish et al., 2019). Therefore, the problem that was addressed in this study was the insufficient understanding of the relationship between specific risk factors (i.e., depression and drug use) and HSV-2 infection in WSW.

Although the aforementioned research regarding HSV-2 illuminates important findings, I found no researchers who have assessed the relationship between depression, drug use, and HSV-2 in WSW. As such, further research is warranted that could examine this dearth of research to address this gap in the literature. Compared with WSM, WSW are more likely to experience depression (Dai & Meyer, 2019; Kerridge et al., 2017), use drugs (Heinsbroek et al., 2018; Schuler & Collins, 2020), and engage more in risky sexual behaviors (e.g., infrequent barrier use and multiple sex partners), which have all been related to a higher risk for HSV-2 infection (Gorgos & Marrazzo, 2017; Kelly et al., 2016; Operario et al., 2015). However, it is not known whether drug use is related to the probability of developing HSV-2 infection in WSW who are depressed.

Purpose of the Study

The purpose of this study was to explore the predictive relationship between demographics (age, race, educational level, income, and marital status), number of sex partners, infrequent barrier use, depression status (as measured by the Patient Health

Questionnaire-9 [PHQ-9]), and HSV-2 status in WSW (see RQ 1); the predictive relationship between demographics (age, race, educational level, income, and marital status), number of sex partners, infrequent barrier use, nonprescription drug use status, and HSV-2 status in WSW (see RQ 2); and the predictive relationship between demographics (age, race, educational level, income, and marital status), number of sex partners, infrequent barrier use, depression status (as measured by the PHQ-9), nonprescription drug use status, and HSV-2 status in WSW (see RQ 3). To examine these relationships, I conducted a quantitative, correlational study of a cross-sectional nature using secondary data previously collected by the National Health and Nutrition Examination Survey (NHANES). The NHANES is a population-based survey that includes a large sample of the United States population (National Center for Health Statistics, 2017a; U.S. Department of Health and Human Services, 2014). The independent variables included demographics (age, race, educational level, income, and marital status), number of sex partners, infrequent barrier use, depression status, and nonprescription drug use, and the dependent variable was HSV-2 status (see Chapter 3 for operationalization of variables).

Research Questions and Hypotheses

Chapter 3 contains information related to the instruments used to originally collect the data and how the data for this study was coded and processed. The following research questions were answered in this study:

Research Question 1 (RQ 1): What is the predictive relationship between demographics (age, race, educational level, income, and marital status), number of sex

partners, infrequent barrier use, depression status (as measured by the PHQ-9), and HSV-2 status in WSW?

$H_0$1: There is no statistically significant predictive relationship between demographics (age, race, educational level, income, and marital status), number of sex partners, infrequent barrier use, depression status (as measured by the PHQ-9), and HSV-2 status in WSW.

H_a1: There is a statistically significant predictive relationship between demographics (age, race, educational level, income, and marital status), number of sex partners, infrequent barrier use, depression status (as measured by the PHQ-9), and HSV-2 status in WSW.

Research Question 2 (RQ 2): What is the predictive relationship between demographics (age, race, educational level, income, and marital status), number of sex partners, infrequent barrier use, nonprescription drug use status, and HSV-2 status in WSW?

$H_0$2: There is no statistically significant predictive relationship between demographics (age, race, educational level, income, and marital status), number of sex partners, infrequent barrier use, nonprescription drug use status, and HSV-2 status in WSW.

H_a2: There is a statistically significant predictive relationship between demographics (age, race, educational level, income, and marital status), number of sex partners, infrequent barrier use, nonprescription drug use status, and HSV-2 status in WSW.

Research Question 3 (RQ 3): What is the predictive relationship between demographics (age, race, educational level, income, and marital status), number of sex partners, infrequent barrier use, depression status (as measured by the PHQ-9), nonprescription drug use status, and HSV-2 status in WSW?

$H_0$3: There is no statistically significant predictive relationship between demographics (age, race, educational level, income, and marital status), number of sex partners, infrequent barrier use, depression status (as measured by the PHQ-9), nonprescription drug use status, and HSV-2 status in WSW.

H_a3: There is a statistically significant predictive relationship between demographics (age, race, educational level, income, and marital status), number of sex partners, infrequent barrier use, depression status (as measured by the PHQ-9), nonprescription drug use status, and HSV-2 status in WSW.

Theoretical Framework

The theoretical framework utilized for this study was escape theory (Baumeister, 1988, 1990). Escape theory describes why individuals tend to engage in certain behaviors (i.e., masochism and suicide attempt) to avoid negative perceptions of the self (Baumeister, 1988, 1990). Baumeister created the theory to explain behaviors that may be seen as negative or self-destructive instead of attributing these to mental disorders or irrationality (Baumeister, 1988, 1990).

Escape refers to coping strategies adopted by some individuals to avoid stressful or negative thoughts about themselves (Baumeister, 1988; Donnelly et al., 2016; Hoyt et al., 2006; Pearlin & Schooler, 1978). Such coping strategies may temporarily protect

individuals from suffering mental distress arising from negative self-perceptions, but the behaviors that come from the desire to escape from the self are usually negative or self-destructive in some way themselves (Baumeister, 1988, 1990; Heatherton & Baumeister, 1991; Nemeroff et al., 2008; Pearlin & Schooler, 1978). The main focus of escape theory is an individual's behaviors when they realize that part of their identity does not meet their standards (Baumeister, 1988, 1990; Heatherton & Baumeister, 1991; Junhua et al., 2013). When this happens, individuals reduce their attention to the present environment to avoid serious thoughts about unfavorable features of themselves.

The escape theory has been modified by researchers to study a variety of outcomes including depression, sexual risk taking, and drug use (Alvy et al., 2011; Braje et al., 2016; Card et al., 2019; Hoyt et al., 2006; McKirnan et al., 1996, 2001, 2007; Miller, 2016; Nemeroff et al., 2008; Wells et al., 2011; M. L. Williams et al., 2000). McKirnan et al. (1996, 2001) modified the escape theory and proposed the cognitive escape model (CEM) to better understand the high rates of unprotected sex and HIV infection specifically among gay, bisexual, and other men who have sex with men (collectively referred to as MSM) despite the understanding that HIV can be prevented through safer sex practices (McKirnan et al., 1996, 2001). The main premise of the CEM is that risky behaviors are not the product of insufficient means, misinformation, or inappropriate attitudes. Instead, many individuals do not like to constantly be mindful of their risk related to STIs and restrictive sexual standards (McKirnan et al., 1996, 2001). When cognitively escaping from this mindfulness, individuals may be especially susceptible to sexual risk, and drug use may play an important role in facilitating this

cognitive escape (Card et al., 2019; McKirnan et al., 1996, 2001; Nemeroff et al., 2008; Wells et al., 2011).

Researchers have found that cognitive escape is related with drug use (Card et al., 2019; McKirnan et al., 2001), higher sexual sensation seeking (Card et al., 2019), risky sexual behaviors (Hoyt et al., 2006; Wells et al., 2011), and increased awareness of risk for HIV transmission/acquisition (Card et al., 2019; Nemeroff et al., 2008) among MSM. MSM have consistently reported using drugs during sexual encounters to remove inhibitions (Hampel et al., 2020; Heinsbroek et al., 2018; McKirnan et al., 2007), escape from strict norms regarding safer sex (McKirnan et al., 2007; M. L. Williams et al., 2000), and cope with societal rejection (Tan et al., 2018). Researchers have suggested the possibility of drugs being used as an escape mechanism by MSM wanting to escape anxiety and create favorable emotional and sexual circumstances, regardless of whether these worries are caused by concerns about HIV risk (Card et al., 2019).

During the literature review, no published studies were found where escape theory was used to explain engagement in drug use and risky sexual behaviors as escape mechanisms for WSW. Compared with their non-sexual minority counterparts, WSW and MSM have been found to have a higher prevalence of drug use, depression, and engagement in risky sexual behaviors (e.g., no barrier use during sex and multiple sex partners) that are related to the development of STIs and HIV (Gonzales et al., 2016; Seil et al., 2014). Given such similarities, it would be appropriate to apply the CEM, a modification of the escape theory, to better understand whether drug use is related to the probability of developing HSV-2 infection among WSW who are depressed. It is possible

that WSW who are depressed use drugs to escape from their negative feelings and/or thoughts and, consequently, engage in more risky sexual behaviors. This in turn may lead to HSV-2 infection. A more detailed description of the escape theory can be found in Chapter 2.

Nature of the Study

I conducted a quantitative, correlational study of a cross-sectional nature using secondary data previously collected through the NHANES to answer my research questions (National Center for Health Statistics, 2017a). The main objective of this study was to determine the predictive relationship between demographics (age, race, educational level, income, and marital status), total number of sex partners, infrequent barrier use, depression status, nonprescription drug use status, and HSV-2 status in WSW. I used SPSS software (Version 27) to analyze the data through descriptive statistics, bivariate analyses, and logistic regression.

Definitions

The following are key terms used in this study and their definitions:

Infrequent barrier use: I used *infrequent barrier use* to describe women who never or rarely used protective barriers (i.e., condom or dental dam) during sexual activity (Muzny, Harbison, Pembleton, Hook, et al., 2013; Rowen et al., 2013).

Risky sexual behaviors: I used *risky sexual behaviors* to describe any sexual activity that may put an individual at higher risk for a negative health outcome such as STIs (e.g., unprotected sex, having multiple sex partners, drug use before or during sex, and transactional sex; Chawla & Sarkar, 2019; Senn, 2013). The terms *risky sexual*

behavior (Oginni et al., 2020; Shepler et al., 2017), *high-risk sexual behavior* (Dehghani et al., 2019; Paat & Torres, 2020), and *sexual risk behavior* (Duncan et al., 2021; Swartzendruber et al., 2019) are used interchangeably in the literature to refer to such behaviors.

Sex: Sex refers to vaginal, oral, or anal sex (National Center for Health Statistics, 2017b).

Sexual behaviors: Refers to physical intimate behaviors or sexual activities such as kissing, oral sex, and vaginal or anal intercourse, among others (Patterson, 1998; K. K. Sewell et al., 2017).

Sexuality: Refers to an individual's sexual and romantic attractions and behaviors toward another individual, regardless of their gender identity or biological sex (Galupo et al., 2017; IOM, 2011; Salomaa & Matsick, 2019; World Health Organization, 2021). It is who they feel as a person (e.g., heterosexual, bisexual, lesbian, gay, etc.) and who they choose to be their sexual partner (Salomaa & Matsick, 2019).

Sexual minority populations: The term *sexual minority* refers to individuals whose sexuality, sexual identity, or sexual practices are different from the majority of individuals in society (Math & Seshadri, 2013). Individuals who are part of a sexual minority population include those who self-identify as lesbian, gay, bisexual, and transgender (collectively referred to as LGBT), as well as those who engage in same-sex sexual behavior (IOM, 2011; Math & Seshadri, 2013).

Women who have sex with women (WSW): Women who have ever had any type of sex with other women (IOM, 2011; Operario et al., 2015; Xu, Sternberg, & Markowitz,

2010a). This includes women who had sex with women only (WSW-Only) and women who had sex with both men and women (WSMW).

Assumptions

I assumed that the data collected through the NHANES were valid and accurate due to the use of both interviews and medical exams to collect health data from adults and children in the United States and that the data were coded correctly and edited for accuracy and consistency (National Center for Health Statistics, 2017a; Zipf et al., 2013). In addition, I assumed that the data file made public by the NHANES was complete and accurate (National Center for Health Statistics, 2020a). Participants' responses were assumed to be truthful and provided to the best of their knowledge because no personally identifiable information was collected from them, which lessened the chance that they would answer questions to make themselves "look better" as their identity was not connected to their data (National Center for Health Statistics, 2020a; Zipf et al., 2013). In addition, the sexual behavior questions were administered using the audio computer-assisted self-interview (ACASI) system, which guaranteed confidentiality of their responses (National Center for Health Statistics, 2017b; Simon & Goes, 2013). Finally, I assumed that the HSV-2 test results were accurate because these were performed by trained medical technologists and phlebotomists (Zipf et al., 2013).

Scope and Delimitations

My purpose was to assess the predictive relationship between depression status, nonprescription drug use status, and HSV-2 status in WSW. For this reason, the sample for this study included only women aged 18–49 years old who participated in the

NHANES cycles 2009–2010, 2011–2012, 2013–2014, and 2015–2016 combined, who reported the sex of their sex partner(s) (i.e., women or both men and women), and had a test result for HSV-2 infection. Only women 18–49 years old were included because the NHANES provides HSV-2 tests only to participants in this age group (Gottlieb & Johnston, 2017; National Center for Health Statistics, 2017c). Results from this study could not be generalized to other populations due to the data parameters used.

Limitations

I used previously collected data obtained from the NHANES (National Center for Health Statistics, 2017a). I focused only on WSW aged 18–49 years old who were tested for HSV-2 infection, which resulted in a sample size with limited statistical power. The NHANES datasets included sample weights for each case to produce nationally representative estimates (National Center for Health Statistics, 2018a, 2020b). However, because the dataset included only cases that met my inclusion criteria (convenience sample), the sample weights were not used in this study and the results were only generalizable to women in my sample (Ciol et al., 2006; Mullinix et al., 2015). The relationship between a convenience sample and the target population is unknown, so the generalizability of the convenient sample cannot be concluded with certainty (Mullinix et al., 2015). The estimated relationships between variables in a convenience sample may have been biased in one direction or another for those population groups that were oversampled (i.e., non-Whites) when sample weights were not used (Ciol et al., 2006). In addition, it was not possible to establish causal relationships between the variables in my analyses because the data used for my study were cross-sectional (Singh Setia, 2016).

Therefore, I did not attempt to infer causation but only studied predictive relationships between my variables. I did not make any causal inferences or use words that inferred causality.

Significance

The IOM (2011) called for substantial research on sexual minority populations, including WSW, as the existing literature around this population is scarce. The findings from my study have the potential to contribute to positive social change for sexual minority populations in at least two ways: (a) advancing health research on sexual minority women and (b) increasing understanding of the relationship between depression, nonprescription drug use, and HSV-2 infection in WSW. This information can be used for creating HSV-2 prevention strategies specifically for sexual minority women and improving their health and quality of life. The results of my study also have the potential to increase awareness of the risk for HSV-2 infection in women who have sex exclusively with women.

Summary

The purpose of this study was to assess the predictive relationship between depression status, nonprescription drug use status, and HSV-2 status in WSW. HSV-2 is an incurable STI that is more frequent among WSW than among WSM (Gorgos & Marrazzo, 2017; IOM, 2011; Operario et al., 2015; Xu, Sternberg, & Markowitz, 2010a). Compared to WSM, WSW are more likely to experience depression, use drugs, and engage in high-risk sexual behaviors, which are associated with increased risk for HSV-2 infection (Bränström & Pachankis, 2018; Estrich et al., 2014; Feinstein & Dyar, 2017;

Operario et al., 2015; Pérez et al., 2018). However, it is unknown whether drug use is related to the probability of acquiring HSV-2 infection in WSW who are depressed. The results from my study will fill this knowledge gap and will contribute to the evidence base on sexual minority population health. This information is essential for reducing the transmission of HSV-2, preventing serious health complications, and creating effective HSV-2 prevention strategies intended for WSW.

Chapter 2 will present a more detailed discussion of the literature related to this study. In addition, it includes the literature search strategy used and a more in-depth description of the theoretical framework used in this study.

Chapter 2: Literature Review

Herpes simplex virus type 2 (HSV-2) is an incurable and common sexually transmitted infection (STI; Rechenchoski et al., 2017; World Health Organization, 2020). In 2016, HSV-2 was responsible for an estimated 491 million prevalent infections worldwide, which is equivalent to 13.2% of the world's population (James et al., 2020). HSV-2 affects 12.1% of the United States population and is more frequent among women (15.9%) than men (8.2%; McQuillan et al., 2018; Spicknall et al., 2021). HSV-2 is almost exclusively transmitted via sexual contact, the majority of infections are asymptomatic, and many infected individuals are not aware that they have it (Bradley et al., 2014; Groves, 2016; Johnston & Corey, 2016). Infected individuals can still transmit HSV-2 to others unknowingly when no symptoms are present (James et al., 2020). HSV-2 can result in serious health complications including blindness, encephalitis, and aseptic meningitis (Mathew & Sapra, 2020; Schiffer & Corey, 2009), and can affect the liver or lungs (Schiffer & Corey, 2009). Among women, HSV-2 is also related to spontaneous abortion (Anzivino et al., 2009), preterm labor (Anzivino et al., 2009; McGee et al., 2017), and cervical cancer (Li & Wen, 2017; Smith et al., 2002). The risk of HIV acquisition is almost tripled for those with a prevalent HSV-2 infection (Looker et al., 2017, 2020).

HSV-2 infection among women overall has been widely studied and well documented (Anzivino et al., 2009; Bernstein et al., 2013; Beydoun et al., 2010; Cunningham et al., 2006; Daniels et al., 2016; A. Davis et al., 2016; Esber et al., 2015; Fleming et al., 1997; Hsu et al., 2016; Kalu et al., 2015; Kelly et al., 2016; Korr et al.,

2017; Lehavot et al., 2014; Li & Wen, 2017; Magaret et al., 2015; Masese et al., 2014; McGee et al., 2017; McQuillan et al., 2018; Nakubulwa et al., 2016; Nowotny et al., 2018; Posavad et al., 2015; Pratt et al., 2012; Ramchandani et al., 2017; Rollenhagen et al., 2014; Satterwhite et al., 2013; Smith et al., 2002; Spicknall et al., 2021; Stephens et al., 2016; Sudenga et al., 2012; Van der Pol, 2014; Xu et al., 2006; Xu, Sternberg, & Markowitz, 2010a). However, analyzing data on women without considering their sexual behavior may mask important differences in the factors related to HSV-2 infection in women who have sex with women (WSW) versus women who have sex exclusively with men (WSM; Conron et al., 2010). Few researchers have examined HSV-2 risk or prevalence specifically among WSW and have found that HSV-2 is more prevalent among WSW than among WSM (Gorgos & Marrazzo, 2017; Operario et al., 2015; Xu, Sternberg, & Markowitz, 2010a). The prevalence of HSV-2 has been estimated to be up to 36% for WSW compared with 24% for WSM (Xu, Sternberg, & Markowitz, 2010a). WSW are a diverse sexual minority population with differences in sexual identity, sexual behaviors, sexual practices, and risk behaviors from WSM (Gorgos & Marrazzo, 2017; Institute of Medicine, 2011; Schick, Rosenberger, Herbenick, & Reece, 2012).

Overall, WSW are more likely to report worse mental health outcomes and engage in high-risk behaviors than WSM, which increase their risk for HSV-2. For example, WSW are more likely than WSM to experience depression (Kerridge et al., 2017; Operario et al., 2015; Pharr et al., 2019) and engage in illicit drug use (Estrich et al., 2014; Operario et al., 2015; Schuler & Collins, 2020). Researchers have found a relationship between depression and drug use, especially among sexual minority

populations, and both depression and drug use have been independently related to HSV-2 infection among WSW (Bränström & Pachankis, 2018; Card et al., 2018; Hampel et al., 2020; Kelly et al., 2016; Mohamed et al., 2020; Moody et al., 2018; Muzny et al., 2018; Mwangi et al., 2019; Nowotny et al., 2018; Wright, 2018). However, it is unknown whether drug use is related to the probability of developing HSV-2 infection in WSW who have depression. It is possible that WSW who are depressed use drugs to escape from negative feelings and/or thoughts and may engage in high-risk sexual behaviors, which then increases their risk for HSV-2 infection. Better understanding of risk factors for HSV-2 infection among WSW is important for improving the health of these women.

The purpose of this study was to explore the predictive relationship between depression status, nonprescription drug use status, and HSV-2 status in WSW. Chapter 2 presents a summary of the findings of the literature review performed to support the purpose of this study and demonstrates a connection to the problem statement and the theoretical framework. This chapter is divided into four major topic areas: escape theory, HSV, HSV-1, and HSV-2. I close this chapter with the Summary and Conclusions section.

Literature Search Strategy

I conducted a literature review using search engines and databases through the Walden University Library. These included PubMed, CINAHL, and MEDLINE. Because current literature on HSV-2 among WSW is scarce, peer-reviewed studies published from 1975–2021 about HSV-2 among WSW (regardless of whether they had sex exclusively with women or with both men and women), depression or drug use among WSW, or the

relationship between HSV-2 and depression or drug use among WSW were reviewed. The search terms included *herpes simplex virus type 2, HSV-2, depression, mental distress, women who have sex with women* (or *WSW*), *lesbians, bisexual women, sexual minority women,* a combination of these terms, and a combination of these terms with known risk factors such as *depression, mental distress, drug use, substance use, cocaine use, heroin use, methamphetamine use, injection drug use, multiple sex partners,* and *condomless sex*.

The inclusion criteria were the following: (a) applicable to this study; (b) peer-reviewed; (c) discussed HSV-2 among WSW and related risk factors; and (d) discussed depression or drug use among WSW with HSV-2. To describe HSV-2 clinical manifestations and pathogenesis, I reviewed peer-reviewed studies and book chapters published between 1970 and 2021, as these provided a more comprehensive description of HSV-2. For this, the search terms included: *herpes simplex virus type 2, HSV-2, genital herpes* (specifically caused by HSV-2), *transmission of HSV-2, and HSV-2 and HIV*. Only the most closely related information from these studies and book chapters was included in the literature review.

Theoretical Framework

The theoretical framework utilized for this study was the escape theory proposed by Roy Baumeister (Baumeister, 1988, 1990). This theory was intended to describe how individuals tend to engage in certain behaviors (i.e., masochism and suicide attempt) to avoid negative perceptions of the self (Baumeister, 1988, 1990). Baumeister created the theory to explain behaviors that may be seen as negative or self-destructive instead of

attributing these to mental disorders or irrationality (Baumeister, 1988, 1990). Escape refers to coping strategies adopted by some individuals to avoid stressful or negative thoughts about themselves (Baumeister, 1988; Donnelly et al., 2016; Hoyt et al., 2006; Pearlin & Schooler, 1978). Such coping strategies may temporarily protect individuals from suffering mental distress arising from negative self-perceptions, but the behaviors that come from the desire to escape from the self are usually negative or self-destructive in some way themselves (Baumeister, 1988, 1990; Heatherton & Baumeister, 1991; Nemeroff et al., 2008; Pearlin & Schooler, 1978).

Researchers have studied the behaviors engaged in to escape from an individuals' perceptions of themselves (Baumeister, 1988, 1990; Donnelly et al., 2016; McKirnan et al., 1996, 2007; Miller, 2016; Neyland & Bardone-Cone, 2017; Qi & Cui, 2019). Evaluations of perceptions of self are based on how well they meet, fail to meet, or exceed their own expectations or those of society (Baumeister, 1988, 1990). The main focus of the escape theory are individuals' behaviors when they realize that part of their identity does not meet the preferred standards (Baumeister, 1988, 1990; Heatherton & Baumeister, 1991; Junhua et al., 2013). When this happens, individuals reduce their attention to the present environment to avoid significant thoughts about unfavorable features of the self.

The Self

Self-discrepancy refers to how individuals' conflicting beliefs of themselves result in discomfort or negative consequences (i.e., emotional distress) on their wellbeing (Higgins, 1987). The kind of discomfort or negative feelings experienced by individuals

is explained by the type of discrepant beliefs they have of themselves. *Self-discrepancies* are the differences between the perceived self and the socially preferred selves, and are believed to cause psychological distress in individuals (Philippot et al., 2018). There are three areas of the self, which include the *actual self* and two self-guides called the *ideal self* and the *ought self* (Higgins, 1987; Mason et al., 2019).

Actual Self

The actual self is an individual's portrayal of the characteristics they believe they really have (Bak, 2015; Higgins, 1987; Mason et al., 2019; Philippot et al., 2018). In addition to beliefs regarding the actual self, self-knowledge includes notions and expectations regarding different *possible selves* (Bak, 2015; Markus & Nurius, 1986). Possible selves refer to individuals' notions of what they may turn out to be in the future, what they would like to become, and what they fear becoming (Hoyle & Sherrill, 2006; Markus & Nurius, 1986). Possible selves are mostly based on previous experiences but are mainly based in allusions to the future, and are mental portrayals of aspirations, fears, and fantasies about the self (Bak, 2015; Markus & Nurius, 1986). Such portrayals are not always positive (Bak, 2015). Possible selves constitute the frame of reference for assessing the actual self and are important factors of the self-evaluation processes (Markus & Nurius, 1986). The individual assessment of the present state of the self must consider a specific possible state as the baseline for this assessment (Bak, 2015; Markus & Nurius, 1986). Differences between the actual self and self-standards are associated with mood and anxiety disorders (Bak, 2015; Philippot et al., 2018; Scott & O'Hara, 1993). When these differences are too large, their decline could be influenced by either

changing the present self to be more similar to the standard or by adjusting the standard towards the actual self (Bak, 2015; Duval & Wicklund, 1972; Scott & O'Hara, 1993; Strauman et al., 2001).

Ideal Self

The ideal self is an individual's portrayal of the characteristics that someone (the individual or someone else) would ideally like the individual to have (Higgins, 1987; Mason et al., 2019). When the actual self differs from the ideal self, an individual may start feeling more and more unhappy and disappointed with themselves (Duval & Wicklund, 1972; Wicklund, 1975). Such differences reflect an individual's belief that they have failed to fulfill the goals and hopes that significant others (e.g., parents, friends, etc.) have for them and they start experiencing dejected depression (e.g., feelings of failure, shame, disappointment, and devaluation) because they feel their significant others are disappointed in them (Fairbrother & Moretti, 1998; Higgins, 1987; Philippot et al., 2018; Piers & Singer, 1971).

Ought Self

The ought self is an individual's portrayal of the characteristics that someone (the individual or someone else) thinks the individual ought to have (Higgins, 1987; Mason et al., 2019). The self initially develops to assist in an individual's pursuit of happiness and avoidance of negative experiences and/or feelings (Baumeister, 1988). To accomplish this, the self tries to control the environment and to view itself as being in control. Ultimately, the self wants to be perceived positively by both itself and others, so individuals want to maintain and increase esteem, both personally and publicly

(Baumeister, 1988; Mason et al., 2019). Differences between the actual self and the ought self result in agitated depression (e.g., fear, anxiety, uneasiness, and guilt) due to worries over anticipated punishment or negative responses from others (Higgins, 1987; Scheier & Carver, 1977).

Conflict Between Types of Self

Some individuals may want to escape from the self or eliminate self-awareness because one or more of these types of self may be too burdensome (Baumeister, 1988). It is possible that a high level of self-awareness could cause anxiety and distress to individuals under certain circumstances when there are conflicts between how someone wants to be seen, how they see themselves, and how they believe others see them (Baumeister, 1990; Baumeister & Scher, 1988; Heatherton et al., 1993; McKirnan et al., 1996). It has been reported that self-awareness may magnify the severity of symptoms of depression and intense, negative self-awareness is involved in a wide range of mental disorders and maladaptive behaviors, contributing to distress in affected individuals (Baumeister, 1990; Donnelly et al., 2016; Pyszczynski & Greenberg, 1987). Having to make decisions while under pressure, taking responsibility for doing things that could disappoint or hurt others, constantly keeping a positive public and private self-image regardless of all the challenges, and maintaining control over a wayward social environment can make an individual feel oppressed and stressed, and could eventually motivate them to engage in behaviors that may be harmful to themselves (Baumeister, 1988). They may disregard or endure risks, costs, and harm to the self in order to avoid aversive emotions and discontent with their awareness of self (Bandura, 1977;

Baumeister, 1988, 1990; Baumeister & Scher, 1988). Researchers have suggested that depression is especially characterized by a higher discrepancy between the ideal self and the ought self (Mason et al., 2019; Scott & O'Hara, 1993; Weilage & Hope, 1999). This discrepancy is mainly associated with sadness, despair, and depression (Fairbrother & Moretti, 1998; Higgins, 1987; Moretti & Higgins, 1999; Scott & O'Hara, 1993). It is believed that high socially established self-discrepancies result in high ideal self-discrepancies, and that anxiety and depression are indicators for both types of discrepancies (actual versus ideal and actual versus ought), with ideal self-discrepancies acting as the closest predictor (Bryan et al., 2008; Mason et al., 2019; Watson et al., 2010). When an individual experiences self-discrepancy, they may feel discomfort and a need to evade their self-perceptions. To achieve this, individuals resort to cognitive escape.

Six Steps to Escape

Escape theory has six main steps that individuals go through in the process of escaping (Baumeister, 1990). Each of the steps in escape theory are part of a causal process and are considered as options in a decision tree. This causal process will cause an escape behavior only if each step generates a specific outcome.

1. Due to unrealistically high expectations and/or unusually bad events, the individual has an unpleasant experience where they realize that their present circumstances do not meet society's or their own standards (Baumeister, 1990; Donnelly et al., 2016). Circumstantial causes of escape behaviors are a combination of high expectations and standards with current, specific

shortcomings, stresses, or difficulties (Baumeister, 1988, 1990; Baumeister & Tice, 1990; DeWall, 2007). High expectations and standards may result in severe self-disappointment when an individual fails to meet these. The deciding element in relation to if the individual moves to the second step is the magnitude of the perceived failure (Baumeister, 1990).

2. The individual blames their shortcomings on internal qualities (i.e., areas of their personality), instead of on situational aspects of the perceived failure (Baumeister, 1990; Donnelly et al., 2016). This results in negative ideas about themselves like seeing themselves as culpable or incompetent (Baumeister, 1990). If the perceived shortcomings can be ascribed to external causes, then the individual may not move on to the third step (Baumeister, 1990; Henry & Short, 1954). However, if the individual has more severe negative self-attributions that may have enduring, unwanted qualities, especially ones that may predict more difficulties later on, then the individual may move on to the third step (Baumeister, 1990; Henry & Short, 1954).
3. The third step is where the individual reaches a highly aversive level of self-awareness that results from comparing themselves with certain standards (Baumeister, 1990; Donnelly et al., 2016). They perceive themselves as being inadequate, unattractive, incompetent, and/or guilty (Baumeister, 1990; Carver, 1979; Carver & Scheier, 1981). Two groups of standards are especially relevant to this step, including the status quo and expectations of others (Baumeister, 1990). The status quo is usually an important standard,

and shortcomings may happen if the individual believes they have not reached their own quality of standard. The expectations of others are also important. When an individual perceives themself as not being able to live up to the expectations of others, this can result in further negative perceptions of oneself and lowered self-esteem (Baumeister, 1990).

4. The individual has further negative feelings about themselves when they believe they do not meet their personal standards and/or the standards of others (Baumeister, 1990; Donnelly et al., 2016). This can continue to pull the individual into a depressed state and produces feelings of guilt and anxiety (Baumeister, 1990; Higgins, 1987; Higgins et al., 1985).
5. As these feelings develop and continue to grow, the individual tries to escape from this negative emotional state as quickly as possible through avoidance and reaches an almost numb state of *cognitive deconstruction* (Baumeister, 1990). Cognitive deconstruction is characterized by reduced emotion and focus on present circumstances, and increased focus on real sensation instead of abstract thoughts (Baumeister, 1990; Heatherton & Baumeister, 1991; Twenge et al., 2003). This focus on real sensation can be achieved through engagement in behaviors and activities that bring the individual pleasure (e.g., sex with multiple partners, unprotected sex, using drugs during sex, etc.) even if the long-term implications of these behaviors may be negative (Card et al., 2019; Forestell et al., 2012; McKirnan et al., 1996; Sheynin et al., 2019). Because the escape from negative thoughts is not permanent, the individual

may engage in increasingly strong methods of ending the negative feelings and thoughts, which can lead the individual to engage in more dangerous pleasurable behaviors (Alvy et al., 2011; Baumeister, 1990; Card et al., 2019; McKirnan et al., 1996; Miller, 2016).

6. Finally, the sixth step reveals the effects of the state of cognitive deconstruction (Donnelly et al., 2016). Here, the individual constantly struggles to avoid their negative thoughts, which can lead to a state of emotional emptiness and intense doses of pessimistic feelings (Baumeister, 1990). There is no hope that things will improve and no sense of how to continue living in a positive way (Baumeister, 1990). The individual may develop a passive or avoidant attitude regarding broad or long-term plans and important decisions. The individual avoids any responsibilities or having to make decisions and continues to engage in self-destructive behaviors (Baumeister, 1990; Silver et al., 1983). Emotions will be suppressed to the degree in which an individual successfully reaches and maintains deconstruction (Baumeister, 1990; Langer et al., 1978; Vallacher & Wegner, 1985). In general, the individual may feel bored or somewhat unhappy, but will not experience any intense negative or positive emotions (Baumeister, 1990). The effects of this state of cognitive deconstruction and avoidance of significant thought result in lack of inhibitions, moral scruples, and principles, which could increase the desire to engage in unpleasant or questionable behaviors (Baumeister, 1990; Langer et al., 1978; Vallacher & Wegner,

1985). Deconstruction eliminates awareness and decreases actions to just movements, removing all internal objections or barriers to certain actions (Twenge et al., 2003). When lacking inhibitions, individuals are willing to engage in behaviors that go against their own standards (Baumeister, 1990; Baumeister & Scher, 1988; McKirnan et al., 1996). After reflecting on their behaviors, the individual can go through the six steps again, potentially causing the individual to go through an unending cycle of self-depreciation, lowered self-esteem, and continuing to engage in self-destructive behaviors (Baumeister, 1990). Successful escape can involve adopting a new identity (at least briefly) that replaces the self from which the individual is trying to escape (Donnelly et al., 2016).

Applications of Escape Theory

The escape theory has been modified by researchers to study a variety of outcomes including depression, sexual risk taking, and drug use (Alvy et al., 2011; Braje et al., 2016; Card et al., 2019; Hoyt et al., 2006; McKirnan et al., 1996, 2001, 2007; Miller, 2016; Nemeroff et al., 2008; Wells et al., 2011; M. L. Williams et al., 2000). In the following sections, I will describe applications of the escape theory that are relevant to this study. In addition, I will discuss how escape theory applies to WSW, my study population.

Depression, Drug Use, and Risky Sexual Behaviors

Depressed individuals are believed to be more inclined to use escape as a strategy to solve their problems and are at significant risk of experiencing suicidal thoughts

(Franklin et al., 2017; Millner et al., 2019; Rogers et al., 2018; Teismann et al., 2016). According to escape theory, individuals who blame themselves for their failures have more suicidal thoughts and suicide may be the final step in their efforts to escape from the self and world (Baumeister, 1990; Chatard & Selimbegović, 2011; Junhua et al., 2013). Escape theory frames drug use as another method of escaping negative self-thoughts such as the stress and/or anxiety related to health risks and other problems (Card et al., 2019; McKirnan et al., 1996, 2001; Rabani Bavojdan et al., 2011). Drugs are also used to eliminate inhibitions and enhance pleasure during sexual encounters (*chemsex*) as a form of escape, which leads to risky sexual behaviors like having condomless sex with multiple sex partners (Ahmed et al., 2016; Card et al., 2019; N. Field et al., 2016; Maxwell et al., 2019; McKirnan et al., 1996, 2001).

Researchers have found that depression predicts low self-efficacy for consistently practicing safer sex (Maciejewski et al., 2000). Self-efficacy plays an important role in managing emotional states, as beliefs of self-efficacy allow individuals to view potentially intimidating expectations as achievable challenges and aid in reducing feelings of stress in these situations (Bandura, 1997; Rabani Bavojdan et al., 2011). Individuals can manage their emotional states by decreasing negative thoughts and worries about possible threats (Rabani Bavojdan et al., 2011). Individuals with depression are believed to have low self-efficacy for arduous health behaviors, and low self-efficacy for practicing safer sex may contribute to less condom use among these individuals (Alvy et al., 2011; John et al., 2004). Researchers have found that depression and drug use are highly comorbid because they co-occur frequently (Swendsen et al., 2010; Tolliver &

Anton, 2015; Wu et al., 2008). Depression has also been found to be a strong risk factor for drug use and is positively correlated with drug use during sex and inconsistent condom use (Bränström & Pachankis, 2018; Brickman et al., 2017; Islam & Laugen, 2015; Wright, 2018). Like drug use, depression is related with engagement in risky sexual behaviors such as condomless sex, infrequent condom use, and sex with multiple partners (Brickman et al., 2017; Foley et al., 2019; Tesfaye et al., 2019). Some individuals report engaging in such risky behaviors when feeling depressed because they are less worried about the consequences and more focused on escaping from their negative feelings (Bancroft et al., 2003; Shrier et al., 2011).

Escape Theory and Sexual Minorities

Men Who Have Sex With Men. McKirnan et al. (1996, 2001) modified the escape theory and proposed the cognitive escape model (CEM) to better understand the high rates of unprotected sex and HIV infection specifically among gay, bisexual, and other men who have sex with men (collectively referred to as MSM) despite the understanding that HIV can be prevented through safer sex practices (McKirnan et al., 1996, 2001). The main premise of the CEM is that risky behaviors are not the product of insufficient means, misinformation, or inappropriate attitudes. Instead, many individuals do not like to constantly be mindful of their risk related to STIs and restrictive sexual standards (McKirnan et al., 1996, 2001). When cognitively escaping from this mindfulness, individuals may be especially susceptible to sexual risk, and drug use may play an important role in facilitating this cognitive escape (Card et al., 2019; McKirnan et al., 1996, 2001; Nemeroff et al., 2008; Wells et al., 2011).

Researchers have found that cognitive escape is related with drug use (Card et al., 2019; McKirnan et al., 2001), higher sexual sensation seeking (Card et al., 2019), risky sexual behaviors (Hoyt et al., 2006; Wells et al., 2011) and increased awareness of risk for HIV transmission/acquisition (Card et al., 2019; Nemeroff et al., 2008) among MSM. Additionally, MSM have consistently reported using drugs during sexual encounters to remove inhibitions (Hampel et al., 2020; Heinsbroek et al., 2018; McKirnan et al., 2007), escape from strict norms regarding safer sex (McKirnan et al., 2007; M. L. Williams et al., 2000), and cope with societal rejection (Tan et al., 2018). There is a strong relationship between cognitive escape and use of sex drugs, and between cognitive escape and increased awareness of lifetime risk for HIV transmission/acquisition (Card et al., 2019). Anxiety, sexual sensation seeking, being HIV-positive, and an individual's perceived risk for HIV transmission/acquisition have also been found to be independently correlated with cognitive escape, which demonstrated that cognitive escape arises from conflict between worries regarding transmission/acquisition of HIV and the need to be sexually stimulated (Card et al., 2019). Because of these findings, researchers have suggested the possibility of drugs being used as an escape mechanism by MSM wanting to escape anxiety and create favorable emotional and sexual circumstances, regardless of whether these worries are caused by concerns about HIV risk (Card et al., 2019). Card et al. (2019) determined that the CEM does capture individual's expectations about drug use and assesses the degree to which individuals may recognize the strong effects of using drugs. Therefore, MSM could indeed use drugs to reach the levels of sexual arousal,

performance, and gratification desired, as well as to fulfill social standards and deal with other sources of stress (Card et al., 2019).

Women Who Have Sex With Women. During the literature review, no published studies were found where escape theory was used to explain engagement in drug use and risky sexual behaviors as escape mechanisms for WSW. Like MSM, WSW engage more in risky sexual behaviors that lead to STIs when compared with WSM. For example, WSW are more likely than WSM to engage in unprotected sex (Cook & Calebs, 2016; Doull et al., 2018; Islam & Laugen, 2015), have multiple sex partners (Logie et al., 2015; Rahman et al., 2020; Tat et al., 2015), and have sex with an HIV-infected partner (Tat et al., 2015). WSW are also more likely than WSM to experience depression and use drugs (Kerridge et al., 2017; Operario et al., 2015; Rahman et al., 2020; Schuler & Collins, 2020). Depression is related to risky sexual behaviors and drug use, especially among sexual minority populations (Bränström & Pachankis, 2018; Burke et al., 2018; Card et al., 2018; Wright, 2018). Both depression and drug use have been independently related with HSV-2 infection among WSW (A. Davis et al., 2016; Kelly et al., 2016; Nowotny et al., 2018).

Compared with their non-sexual minority counterparts, WSW and MSM experience a higher prevalence of drug use and depression, and engage in similar risky sexual behaviors (e.g., no barrier use during sex and multiple sex partners) that lead to STIs and HIV (Gonzales et al., 2016; Seil et al., 2014). Given such similarities, it would be appropriate to apply the CEM, a modification of the escape theory, to better understand whether drug use is related to the probability of developing HSV-2 infection

among WSW who are depressed. It is possible that WSW who are depressed use drugs to escape from their negative feelings and/or thoughts and, consequently, engage in more risky sexual behaviors. This in turn may lead to HSV-2 infection. Understanding the consequences of drug use for WSW who are depressed requires that we also consider potential contributing factors that increase their vulnerability to HSV-2 infection.

Literature Review Related to Key Variables and/or Concepts

In this section, I discuss the background of the problem addressed in this study, the variables included in the study, and also present the gap in the current literature related to the topic.

Herpes Simplex Virus

HSV is a lifelong viral infection and one of the most prevalent diseases among humans worldwide (James et al., 2020; World Health Organization, 2020). HSV infections can be caused by either HSV type 1 (HSV-1) or HSV type 2 (HSV-2). In 2016, 491.5 million individuals were living with an HSV-2 infection, 3.5 billion individuals were living with an oral HSV-1 infection, and 596–656 million individuals were living with either a genital HSV-1 or HSV-2 infection worldwide (James et al., 2020). Although estimates for the overall prevalence of HSV are not available, the prevalence estimates of HSV-1 and HSV-2 suggest that HSV overall affects over half a billion individuals worldwide (James et al., 2020). HSV is more prevalent among women than men and affects individuals of all ages, although the prevalence increases with age (Chaabane et al., 2019; James et al., 2020; McQuillan et al., 2018; Spicknall et al., 2021). HSV incidence and prevalence information is thought to be drastically underestimated since

the majority of HSV infections are asymptomatic and can be spread without either partner knowing they have the disease (Garland & Steben, 2014; Johnston et al., 2016; Schiffer & Corey, 2009).

Health Outcomes of HSV Infection

HSV infections can be severe, especially in individuals who are immunocompromised due to other diseases (e.g., HIV), transplants, or disseminated skin disease (e.g., eczema; Wald & Corey, 2007). HSV can cause systemic disease and both HSV-1 and HSV-2 can produce the same symptoms, although each virus is more likely to cause some symptoms than others (Wald & Corey, 2007). The differences in clinical signs are not completely understood, but the individual's immune system seems to be the main deciding factor of clinical manifestations for both types of HSV infection (Johnston et al., 2016; Wald & Corey, 2007).

HSV infection may cause meningitis (e.g., aseptic meningitis and meningoencephalitis; Banerjee et al., 2020; Johnston et al., 2016; Suzich & Cliffe, 2018), vision loss or blindless (Johnston et al., 2016; L. Wang et al., 2020; Zinser et al., 2018), and acute retinal necrosis if left untreated (Bergstrom & Tripathy, 2020; Horn et al., 2015). In pregnant women, HSV infection may lead to neonatal HSV if untreated because the virus is vertically transmitted mother-to-infant during childbirth (Anzivino et al., 2009; S. James, 2015; Samies & James, 2020). Neonatal HSV may result in severe morbidity in newborns, including disseminated disease and central nervous system disease (Naish et al., 2019; Samies & James, 2020; Schiffer & Corey, 2009).

Pathophysiology of HSV

Individuals may acquire HSV via close contact with an infected individual whose skin or genital secretions are shedding virus (Corey & Wald, 2008; Gupta et al., 2007). HSV is usually transmitted during childhood, from mother to child, or after the beginning of sexual activity from intimate contact (Gupta et al., 2007; Zinser et al., 2018). During primary infection, HSV enters the body through openings in the skin or mucosa (Gupta et al., 2007). The virus attaches to and enters epithelial cells of the skin or mucosal epithelial surfaces and replicates within them (Gupta et al., 2007). The virus then infects nerve endings, moving via retrograde transport to the nerve fiber (or axon), where they remain latent and are protected from the immune system and result in lifelong infection (Banerjee et al., 2020; Byrne et al., 2018; Johnston et al., 2016). Some viruses continue to multiply in the neural tissue (Gupta et al., 2007).

HSV manifestations on the skin include grouped ulcers or pustules on an erythematous base (Gupta et al., 2007). These lesions cause the main destruction of the epithelial layer, and inflammatory cells invade the surrounding wall and the dermal layer below (Gupta et al., 2007). HSV also disseminates to the local and regional lymph nodes through the lymphatic system during primary infection (Gupta et al., 2007). HSV remains latent in the sensory ganglion for the rest of the infected individual's life after recovering from primary infection and can avoid having to fight antiviral drugs used to treat the virus (Banerjee et al., 2020; Gupta et al., 2007; S. James & Prichard, 2014). HSV sometimes reactivates from latency, where it replicates and travels back to epithelial

surfaces through the nerve fiber to produce oral or genital ulcers or recurrent asymptomatic viral shedding (Gupta et al., 2007; Johnston et al., 2016).

Viral shedding occurs when the viral load is high and can happen either when lesions appear or when there are mild or no symptoms (Banerjee et al., 2020; Gupta et al., 2007). It is during viral shedding that HSV is transmitted to a healthy individual when they come into direct contact with mucous or other bodily fluids from an infected individual (Banerjee et al., 2020; Fatahzadeh & Schwartz, 2007). Reactivations of HSV can be triggered by various physiological stimuli such as stress, fever, immunosuppression, tissue damage (Dadwal & Ito, 2016; Jiang et al., 2016; Rechenchoski et al., 2017; Suzich & Cliffe, 2018), menstruation, hormonal imbalance (Roizman & Whitley, 2013), or exposure to ultraviolet light (Perna et al., 1987). Frequent reactivations of HSV in the eye can result in herpes stromal keratitis, one of the main causes of vision loss or blindness after an HSV infection (L. Wang et al., 2020).

Public Health Burden of HSV

HSV-2 contributes substantially to the economic burden of STIs in the United States (Chesson et al., 2021; Eppink et al., 2021). In 2018, the estimated direct lifetime medical cost of HSV-2 infections in the United States was $90.7 million overall, $43.9 million for women, and $46.8 million for men (Chesson et al., 2021). The lifetime medical cost for each treated case of HSV-2 was also higher for women than for men (see Table 1; Eppink et al., 2021). These costs are higher than what other researchers previously estimated to be the lifetime medical cost per HSV-2 case (Chesson et al., 2004; Owusu-Edusei et al., 2013). Medical costs may be reduced if additional HSV-2

prevention strategies are implemented, as decreases in incidence may result in considerable decreases in treatment costs (Chesson et al., 2004).

Table 1

Estimated Lifetime Medical Cost per Treated Case of HSV-2 in the United States by Year

	Estimated lifetime medical cost per treated case of HSV-2		
Sex/gender	2000 [a]	2008 [b]	2018 [c]
Women	$417.00	$621.00	$996.00
Men	$511.00	$761.00	$920.00

[a] Source = Chesson et al., 2004. [b] Source = Owusu-Edusei et al., 2013. [c] Source = Eppink et al., 2021.

States are not required by law to report HSV infections to the Centers for Disease Control and Prevention (CDC), so public health surveillance of HSV in the United States is mainly conducted via the National Health and Nutrition Examination Survey (NHANES; CDC, 2021). This is a population-based, national survey where serological testing is performed to determine the prevalence of both HSV-1 and HSV-2 in the population (CDC, 2017c; National Center for Health Statistics, 2017a). Other population-based surveys, such as the National Survey of Family Growth (NSFG), only collect data on awareness of genital herpes infection but no specific information on whether it was caused by HSV-1 or HSV-2 is collected (National Center for Health Statistics, 2020c).

Data on genital herpes from the NSFG are limited because no diagnostic tests are conducted to confirm HSV status or HSV type among participants. Instead, the data are based on self-reports and are affected by underreporting resulting from repondents not being aware of their infection or not willing to disclose their status (Anderson et al.,

1994; Rosenman et al., 2011). Self-reported HSV-2 greatly underestimates the true prevalence of this infection in the population (Marrazzo et al., 2003). According to nationally representative data, the proportion of individuals not being diagnosed with HSV-2 is 83.4% in the general population (84.5% for women and 87.9% for men; Pouget et al., 2010), so relying solely on self-reported data would provide an innacurate estimate of the burden of HSV in the population. For these reasons, I used data from the NHANES to produce estimates of the burden of HSV-2 in my study population and to answer my research questions.

Types of HSV

Clinical manifestations, mode of transmission, and epidemiologies for HSV-1 and HSV-2 differ. An overview of HSV-1 is provided in the following section, followed by a more in-depth description of HSV-2. In this study, I will focus specifically on HSV-2 infection, as it results in more serious health outcomes than HSV-1 (Daniels et al., 2016; World Health Organization, 2020).

HSV-1. HSV-1, the main cause of oral herpes, is a lifelong mucocutaneous infection of the mouth that is mostly acquired during childhood, after maternal antibodies disappear during the first year of life, or young adulthood from non-sexual contact with saliva (CDC, 2017b; Sauerbrei, 2016a; World Health Organization, 2020). An estimated 67% of the world's population is living with an HSV-1 infection (James et al., 2020; Looker et al., 2015). HSV-1 is responsible for 2.9 million new infections each year in the United States (Ayoub et al., 2019).

Nationally representative estimates indicate that the prevalence of HSV-1 in the United States has decreased over time from 59.4% in 1999 to 48.1% in 2016 (Bradley et al., 2014; Chemaitelly et al., 2019; McQuillan et al., 2018). This decrease is believed to be due to improvements in hygiene and living conditions (Chemaitelly et al., 2019). As shown in Table 2, HSV-1 prevalence in the United States is higher among women and Hispanics, and increases linearly with age, mostly affecting individuals in older age groups (McQuillan et al., 2018).

Table 2

Prevalence of HSV-1 in the United States by Demographic Characteristics

Characteristic	HSV-1 prevalence
Total	48.1%
Sex/ gender	
Women	50.9%
Men [a]	45.2%
Race/ Hispanic ethnicity	
Hispanic [b]	71.7%
Non-Hispanic Black [b, c]	58.8%
Non-Hispanic Asian [b, c]	55.7%
Non-Hispanic White[c]	36.9%
Age group	
14–19 years [d]	27.0%
20–29 years	41.3%
30–39 years	54.1%
40–49 years	59.7%

[a] Significantly lower than females. [b] Significantly higher than non-Hispanic Whites. [c] Significantly lower than Hispanics. [d] Linear increase with age group.

HSV-1 Transmission and Symptoms. HSV-1 is highly infectious and is mainly transmitted through oral-to-oral contact with an infected individual (Gupta et al., 2007). HSV-1 infections are restricted to the oropharynx and the virus is transmitted via

respiratory droplets or saliva and most commonly through kissing (Rechenchoski et al., 2017; World Health Organization, 2020). Infected individuals may experience various symptoms throughout the course of the infection, which can range from completely asymptomatic to a combination of ulcerative and vesicular lesions, fever, throat ulcers, anorexia, and pain (Rechenchoski et al., 2017). The majority of infected persons do not experience any symptoms. Cases that show symptoms typically affect the lips, tongue, gums, inside lining of the cheeks, and palate (Rechenchoski et al., 2017). The infection can also cause cold sores or fever blisters on or around the mouth (CDC, 2017a). Although most infections are mild, serious health complications (e.g., meningitis, blindness, and encephalitis) can occur (Corey & Wald, 2008; Ramchandani et al., 2016).

Most HSV-1 infections occur in or around the mouth (oral herpes), but some occur in the genital or anal area (genital herpes) due to spread from the mouth to these areas during oral sex (CDC, 2017a). Researchers have suggested that the proportion of genital herpes infections due to HSV-1 is increasing steadily over time even though the proportion of oral HSV-1 continues to decrease (Ayoub et al., 2019). It is believed that this is occurring because HSV-1 acquisition before sexual debut could be decreasing, leaving young individuals without HSV-1 antibodies susceptible to genital HSV-1 if exposed (Bradley et al., 2014; Chemaitelly et al., 2019; Korr et al., 2017). Regardless, oral-oral transmission of HSV-1 is expected to continue being the main mode of transmission (Ayoub et al., 2019).

HSV-2. HSV-2 is nearly exclusively sexually transmitted (Groves, 2016; Looker et al., 2015; Wald & Corey, 2007; World Health Organization, 2020). It is known as the

leading cause of genital ulcer disease, causes neurologic complications and neonatal herpes, and increases the risk for HIV infection (Johnston & Corey, 2016). HSV-2 is globally one of the most widespread STIs, with an estimated 491.5 million individuals infected worldwide and a prevalence of 13.2% (James et al., 2020; Looker et al., 2015; World Health Organization, 2020).

In the United States, an estimated 18.6 million individuals were living with an HSV-2 infection in 2018 and 572,000 new HSV-2 infections occurred that year (Spicknall et al., 2021). As shown in table 3, the prevalence of HSV-2 among individuals of reproductive age (14–49 years) is 12.1%, and is more prevalent among women and non-Hispanic Blacks (McQuillan et al., 2018). HSV-2 infections are more frequent among individuals of reproductive age because most HSV-2 primary infections are acquired with the beginning of sexual intercourse following puberty (McQuillan et al., 2018; Sauerbrei, 2016a). The prevalence of HSV-2 increases linearly with age, regardless of sex (McQuillan et al., 2018). Like other STIs, risk factors related to HSV-2 include high number of sexual partners, prior history of an STI, and condomless sex (Garland & Steben, 2014; Gupta et al., 2007; Magaret et al., 2015; Stanaway et al., 2012; Stephens et al., 2016). Because HSV-2 is mainly transmitted during sex, the risk of infection reflects an individual's amount of sexual activity, the number of sexual partners, as well as the prevalence of HSV-2 in the community (Wald & Corey, 2007).

Table 3

Prevalence of HSV-2 in the United States by Demographic Characteristics

Characteristic	HSV-2 prevalence
Total	12.1%
Sex/ gender	
Women	15.9%
Men [a]	8.2%
Race/ Hispanic ethnicity	
Hispanic [b, c]	9.4%
Non-Hispanic Black [c]	34.6%
Non-Hispanic Asian [b]	3.8%
Non-Hispanic White [b, c]	8.1%
Age group	
14–19 years [d]	0.8%
20–29 years	7.6%
30–39 years	13.3%
40–49 years	21.2%

[a] Significantly lower than females. [b] Significantly lower than non-Hispanic Blacks. [c] Significantly higher than non-Hispanic Asians. [d] Linear increase with age group.

HSV-2 Transmission and Symptoms. Primary HSV-2 infection occurs when a healthy individual has close contact with an infected individual who is actively shedding the virus through the skin or secretions (Groves, 2016). Early signs can last for hours or weeks and consist of pain, tingling, itching, or burning at the infection site (Groves, 2016; Mathew & Sapra, 2020). HSV-2 infections are typically asymptomatic but can produce malaise, fever, lymphadenopathy, flu-like illness, painful genital ulcers (mostly recurrent), sores, and tender lymph nodes (Groves, 2016; Johnston & Corey, 2016; Koelle et al., 2017; Looker et al., 2017; Sauerbrei, 2016b; Wald & Corey, 2007). Additional symptoms for women can include pain, swelling of the vulva, pain during urination, and cervicitis (Sauerbrei, 2016b). Sores caused by the infection can be painful enough to hinder urination and manifestations in the urethra are usually associated with

severe issues urinating (Sauerbrei, 2016b). It is common to find herpes lesions in the cervix in asymptomatic cases (Sauerbrei, 2016b).

HSV-2 infection is related to high virus shedding rates, which decrease relatively over time in most individuals but can last decades following primary infection (Ramchandani et al., 2017; Schiffer & Corey, 2009). Individuals with asymptomatic infection (subclinical shedding) experience less genital lesions and shed virus in the genital tract less often than those with symptomatic infection because genital lesions appear with recurring viral shedding (Garland & Steben, 2014; Tronstein et al., 2011). The HSV-2 virus is transmitted to sexual partners during these periods of shedding (Banerjee et al., 2020; Fatahzadeh & Schwartz, 2007; Gupta et al., 2007; Johnston & Corey, 2016). Anatomic sites of subclinical shedding include the cervix, vulva, anus, urethra, penile skin and perianal region, and associated shedding can occur at multiple anatomic sites (Johnston et al., 2014; Schiffer & Corey, 2009).

Risk of HSV-2 transmission is believed to differ by sexual practice (e.g., vaginal or anal sex via fingers, hands, or penetrating sex objects; oral-vaginal sex; vaginal-vaginal contact; and oral-anal sex; Gorgos & Marrazzo, 2017; Tat et al., 2015; X. Wang et al., 2012). WSW can transmit HSV-2 to their sexual partners through skin-to-skin or mucosal contact, cervicovaginal fluids, and menstrual blood (Knight & Jarrett, 2017). Sex through vaginal-vaginal contact can facilitate direct exchange of vaginal secretions. In a study of WSW, researchers found that over one-third of participants had vaginal-vaginal contact with their female sex partners and, of these, 40% experienced bleeding during sex (X. Wang et al., 2012). Some of these WSW reported that bleeding sometimes

occurred because they also engaged in digital-vaginal sex, which, they said, is harder and more rough than penile-vaginal sex (X. Wang et al., 2012). Sexual practices that include digital-vaginal or digital-anal contact, especially by sharing penetrative sex objects or toys, provide a potential method for transmission of infected cervicovaginal fluids (Gorgos & Marrazzo, 2017; Kwakwa & Ghobrial, 2003). For WSW, the odds of using sex toys and sharing them with their sexual partners are higher than for WSM, thus increasing their risk of HSV-2 transmission and acquisition (Soto-Salgado et al., 2016). Further, female-to-female transmission of HIV has also been reported to have occurred through sharing of sex objects (Kwakwa & Ghobrial, 2003).

Clinical manifestations of HSV-2 include macular or papular skin and mucous tissue lesions about 4 to 7 days following sexual contact, which transform into vesicles, pustules, and ulcers that persist for up to 3 weeks (Sauerbrei, 2016b). Only 10%–25% of lesions following primary infection are diagnosed; the rest of the lesions are undiagnosed, have a brief and unusual presentation, or are asymptomatic (Garland & Steben, 2014). HSV-2 is transmitted to sexual partners both through penetrative sex and genital skin-to-skin contact with an infected partner (Garland & Steben, 2014). People infected with HSV-2 are at constant risk of transmitting the virus to others through sexual contact, even when a condom is used properly, because the condom may not fully protect all the areas infected with HSV-2 (McMahon, 2019).

Health Outcomes of HSV-2. If left untreated, HSV-2 can result in meningitis (e.g., aseptic meningitis and meningoencephalitis), blindness (Banerjee et al., 2020; Jiang et al., 2016; Ramchandani et al., 2016), acute retinal necrosis (Bergstrom & Tripathy,

2020), acute urinary retention (especially in women; Groves, 2016), disseminated herpes (Schiffer & Corey, 2009), hepatitis (which can develop into acute liver failure and can sometimes lead to death; Down et al., 2016; Norvell et al., 2007), and pelvic inflammatory disease (Cherpes et al., 2006). In pregnant women, HSV-2 infection may result in neonatal HSV because the virus is vertically transmitted mother-to-infant during childbirth (Groves, 2016; Gupta et al., 2007; James, 2015). Maternal co-infection with HSV-2 and HIV are also related to increased mother-to-child transmission of HIV during the perinatal period (Sivarajah et al., 2017).

In addition to the various physical health outcomes, HSV-2 may result in negative psychological and social outcomes. An HSV-2 diagnosis could cause psychological distress, including feeling depressed (Horn et al., 2015; Hsu et al., 2016; Nowotny et al., 2018; Pratt et al., 2012), betrayed, contaminated, ashamed, and low self-esteem (Mindel, 1996; Mindel & Marks, 2005). Personal relationships could be damaged because fear of stigma from an HSV-2 diagnosis makes it hard for someone to disclose their status to potential sexual partners or medical professionals (Bickford et al., 2007; Myers et al., 2015; Royer et al., 2013).

***HSV-2 and HIV*.** HSV-2 also contributes to the HIV epidemic. For over 30 years, HSV-2 infection has been included as a clinical sign and has been part of the list of opportunistic infections related to HIV (Siegal et al., 1981; Van de Perre et al., 2008). Researchers have found that HIV and HSV-2 infections are strongly biologically related and infection with HSV-2 increases the risk for HIV acquisition by a two to four-fold because both HIV and HSV-2 increase transmissibility of each other (Byrne et al., 2018;

Corey et al., 2004; Freeman et al., 2006; Rollenhagen et al., 2014; Schiffer & Gottlieb, 2019; Van de Perre et al., 2008). Disturbances in the mucous membranes and epithelial barriers caused by genital ulcers (or herpes lesions) facilitate HIV acquisition in individuals with HSV-2 by providing a suitable entry point for HIV (Corey et al., 2004). HSV-2 increases the number of cells infected with HIV (also known as $CD4^+$ T cells), as well as HIV replication and disease progression (Byrne et al., 2018; Rollenhagen et al., 2014; Van de Perre et al., 2008).

Researchers have found that the overall prevalence of HSV-2 worldwide is five times higher than the HIV prevalence (Kouyoumjian et al., 2018). Among women, the prevalence of HSV-2 worldwide is 5.6 times higher than the HIV prevalence (Kouyoumjian et al., 2018). While among men, the prevalence of HSV-2 worldwide is 3.5 times higher than the HIV prevalence (Kouyoumjian et al., 2018). In populations where the prevalence of HSV-2 is lower than 20%, the prevalence of HIV is either low or fading. However, in populations where the HSV-2 prevalence is 20% or higher, the prevalence of HIV increases at the same time as the HSV-2 prevalence (Kouyoumjian et al., 2018). This occurs because the intensity of the risk behaviors is enough to support the spread of both infections (Kouyoumjian et al., 2018). The prevalence for both infections is greater as the intensity of the risk behaviors increases (Kouyoumjian et al., 2018). This suggests that HSV-2 prevalence can be used as an objective proxy to predict HIV prevalence or its epidemic potential in other populations (Abu-Raddad et al., 2010; Kouyoumjian et al., 2018; Omori & Abu-Raddad, 2017). HSV-2 prevalence may serve as a measure of the magnitude of sexual risk behaviors in specific sexual networks and to

identify populations or sexual networks at higher risk for HIV infection (Kouyoumjian et al., 2018; Omori & Abu-Raddad, 2017). Additional understanding of HSV-2 prevalence could assist in prioritizing, optimizing, and assigning resources for cost-effective prevention strategies (Kouyoumjian et al., 2018).

The incidence of HIV in the general population is almost tripled when exposed to prevalent HSV-2 infection and the risk of HIV is even higher following exposure to incident HSV-2 infection (Looker et al., 2017). This higher effect for incident HSV-2 infection could be because recently acquired HSV-2 infection is related to higher frequency and severity of genital ulcers, viral shedding, and inflammation of the genital tract (Looker et al., 2017). Preventing HSV-2 may also lower the prevalence of HIV infections (Schiffer & Gottlieb, 2019). Individuals who have an HSV-2 infection could be offered counselling on suppressive HSV-2 therapies that thwart the interaction between HSV-2 and HIV (e.g., Pritelivir) and can be used to prevent HIV as well (Byrne et al., 2018; Schiffer & Gottlieb, 2019).

HSV-2 Risk Factors

Sex/Gender

Women are more likely than men to have an HSV-2 infection due to their increased biologic susceptibility (Abbai et al., 2016; Brotman & Ghanem, 2015; CDC, 2018; Kouyoumjian et al., 2018). Viruses and bacteria can penetrate the lining of the vagina easier because it is thinner and more fragile than the skin on a penis, making the vagina an adequate environment for these organisms to flourish (Brotman & Ghanem, 2015; CDC, 2018). HSV-2 promotes loss of normal vaginal flora, increasing the risk of

bacterial vaginosis (BV; Cherpes, Hillier, Meyn, Busch, & Krohn, 2008; Esber et al., 2015). BV in turn reduces the levels of lactobacilli and other bacterial species protecting the area and increases susceptibility to HIV and other STIs (Esber et al., 2015; Schmid et al., 2000).

Women infected with HSV-2 are over eight times more likely to acquire HIV after sexual exposure than healthy women (Byrne et al., 2018). Women may not notice signs of HSV-2 as easy as men would. For example, women may not easily notice genital ulcers in the vagina, while men would more likely detect sores on their penis (CDC, 2018). Researchers have estimated that 85.3% of women with an HSV-2 infection are undiagnosed (Fanfair et al., 2013). Lacking awareness of their infection status, women infected with HSV-2 may continue to be asymptomatic and unknowingly transmit HSV-2 or HIV to their sexual partners (Byrne et al., 2018). Conversely, an asymptomatic woman infected with HSV-2 could unknowingly be at higher risk of acquiring HIV (Byrne et al., 2018).

An estimated 313.5 million women (17.1% prevalence) versus 178.0 million men (9.3% prevalence) are living with an HSV-2 infection worldwide (James et al., 2020). In the United States, the prevalence of HSV-2 is also higher among women than men, although the prevalence of HSV-2 has decreased for both genders through time (McQuillan et al., 2018; Xu, Sternberg, Gottlieb, et al., 2010). As shown in Table 4, the prevalence of HSV-2 decreased from 20.9% during 2005–2008 to 15.9% during 2015–2016 for women and from 11.5% during 2005–2008 to 8.2% during 2015–2016 for men (McQuillan et al., 2018; Xu, Sternberg, Gottlieb, et al., 2010).

Table 4

Prevalence of HSV-2 in the United States by Sex/Gender and Time Period

	HSV-2 prevalence	
Sex/ gender	2005–2008 [a]	2015–2016 [b]
Women	20.9%	15.9%
Men	11.5%	8.2%

[a] Source = Xu, Sternberg, Gottlieb, et al., 2010. [b] Source = McQuillan et al., 2018.

HSV-2 affects some groups of women more than others and is reportedly more prevalent among women who are pregnant (20.3%) than among those who are not pregnant (17.9%; Patton et al., 2018). Veteran status is also related to HSV-2 infection in women, as veterans are more likely than nonveterans to test positive for HSV-2 (40% versus 26%, respectively), as well as to report a history of genital warts and other STIs (Lehavot et al., 2014).

Sex of Sex Partners

The disparities in HSV-2 infection are more marked when stratifying by sex of sex partners (e.g., WSW, WSM, MSM, and men who have sex exclusively with women [MSW]). WSW include women who have sex with women only (WSW-only) and women who have sex with men and women (WSMW). WSW are a diverse minority population with differences from WSM in sexual identity, sexual activities, and risk behaviors (Gorgos & Marrazzo, 2017). Approximately 17.4% of women in the United States report ever having sex with another woman (Copen et al., 2016). Unfortunately, their health issues are frequently not addressed when seeking care in health care settings due to various factors, including not being asked about their sexuality or sexual behaviors by their doctors and fear of stigma from disclosing their sexuality or sexual behaviors to

health care staff (Silberman et al., 2016). In addition, many WSW-only do not seek preventive HSV-2 care because they think it is unnecessary since they are not having sex with men (Marrazzo, 2004; Muzny, Harbison, Pembleton, Hook, et al., 2013).

There is a general assumption that the risk of woman-to-woman transmission of STIs is low (Bauer & Welles, 2001; Bernstein et al., 2013; A. Davis et al., 2016; Gorgos & Marrazzo, 2017; Naish et al., 2019; Schick, Rosenberger, Herbenick, Calabrese, et al., 2012; Tat et al., 2015; Van der Pol, 2014). However, some researchers have demonstrated that this generalization may be incorrect and have found WSW to be at higher risk for STIs than WSM (Doull et al., 2018; Gorgos & Marrazzo, 2017; Marrazzo & Gorgos, 2012; Muzny et al., 2011; Muzny, Kapil, et al., 2014; Rahman et al., 2020; Tat et al., 2015). Researchers have also indicated that HSV-2 is more prevalent among WSW than among WSM (Gorgos & Marrazzo, 2017; Operario et al., 2015; Xu, Sternberg, & Markowitz, 2010a).

The prevalence of HSV-2 was found to be 36.2% for WSW and 23.8% for WSM during 2001–2006 (Xu, Sternberg, & Markowitz, 2010a). As shown in Table 5, when these estimates were updated to include data until 2010, HSV-2 prevalence was slightly higher for WSW (25.6%) than for WSM (24.5%; Operario et al., 2015). Although in decline, the prevalence of HSV-2 among WSW in the United States is still almost two times higher than the prevalence for women overall (15.9%; McQuillan et al., 2018).

Evaluating HSV-2 among WSW is complicated because some also have sex with men, which may lead to heterosexual acquisition of HSV-2 and possible future transmission to their female sex partners (Diamant et al., 1999; Marrazzo, 2004; Muzny

et al., 2011). WSMW (35.9%) are at higher risk for HSV-2 than WSW-only (8.2%) and WSM (23.8%; Xu, Sternberg, & Markowitz, 2010a). This is because WSMW have been found to engage more frequently in risky behaviors that lead to HSV-2 infection than women who have sex exclusively with women and WSM (Fethers et al., 2000; Nield et al., 2015; Schuler et al., 2019; Smalley et al., 2016). WSMW are more than twice more likely than WSW-only to not seek medical care because of costs (Blosnich et al., 2014).

For sexual minority men, researchers found that the prevalence of HSV-2 was higher among MSM (18.4%) than for MSW (12.5%) during 2001–2006 (see Table 5; Xu, Sternberg, & Markowitz, 2010b). When updated to include data until 2010, MSM were found to be almost two times more likely than MSW to have an HSV-2 infection, and the estimated prevalence increased among MSM to 20.3% but remained constant for MSW (12.6%; Operario et al., 2015). The prevalence of HSV-2 infection is more than two times higher for MSM (20.3%) than for men overall (8.2%; McQuillan et al., 2018; Operario et al., 2015).

Table 5

Prevalence of HSV-2 in the United States by Sex of Sex Partners and Time Period

Sex of sex partners	HSV-2 prevalence	
	2001–2006 [b]	2001–2010 [c]
WSW [a]	36.2%	25.6%
WSW-only	8.2%	NA
WSMW	35.9%	NA
WSM	23.8%	24.5%
MSM	18.4%	20.3%
MSW	12.5%	12.6%

Note. NA = Not available.

[a] Includes WSW-only and WSMW. [b] Source = Xu, Sternberg, & Markowitz, 2010a, 2010b. [c] Source = Operario et al., 2015.

Age

The risk for HSV-2 infection increases linearly with age (James et al., 2020; McQuillan et al., 2018; Spicknall et al., 2021). Overall, the prevalence of HSV-2 ranges from 0.8% among persons aged 14–19 years to 21.2% among persons aged 40–49 years (McQuillan et al., 2018). As shown in table 6, the prevalence of HSV-2 among women increases with age, ranging from 6.2% for 18–24-year-olds to 25.5% for 35–49-year-olds (Spicknall et al., 2021). Similarly, for men, HSV-2 is more prevalent among those in older age groups and ranges from 2.6% among 18–24-year-olds to 13.6% among 35–49-year-olds (Spicknall et al., 2021).

Table 6

Prevalence of HSV-2 in the United States by Age Group and Sex/Gender

Age group	HSV-2 prevalence	
	Women	Men
18–24 years	6.2%	2.6%
25–29 years	12.7%	6.6%
30–34 years	16.9%	8.7%
35–49 years	25.5%	13.6%

Note. NA = Not applicable.

Although no published studies assessing nationally representative data on HSV-2 prevalence by age and sex of sex partners were found, researchers who have studied community (Marrazzo et al., 2003) and cohort (Bohl et al., 2011) prevalence of HSV-2 in sexual minority populations (e.g., WSW, MSM) have found that the prevalence of HSV-2 also increases with age. As shown in Table 7, the prevalence of HSV-2 in WSW has been found to range from 3.9% among those aged 25 years or younger to 15.0% for those 36 years and older (Marrazzo et al., 2003). In MSM, the prevalence of HSV-2 ranges from 1.6% among 18–29-year-olds to 56.6% among those 50 years and older (Bohl et al., 2011). It is possible that the observed increases in HSV-2 prevalence with age also reflect new infections acquired in older ages (Bauer et al., 2010). In addition, slower rates of HSV-2 acquisition among older individuals compared with younger individuals are believed to be partly due to the increase in steady long-term relationships with age (Bauer et al., 2010).

Table 7

Prevalence of HSV-2 in the United States by Age Group and Sex of Sex Partner

Age group	HSV-2 prevalence	
	WSW	MSM
≤25 years	3.9%	NA
26–29 years	4.8%	NA
30–36 years	11.0%	NA
≥36 years	15.0%	NA
18–29 years	NA	1.6%
30–39 years	NA	17.4%
40–49 years	NA	29.8%
≥50 years	NA	56.6%

Note. NA = Not applicable.

Race/Hispanic Ethnicity

As shown in Table 8, non-Hispanic Black individuals are two times more likely than non-Hispanic Whites to be diagnosed with HSV-2 infection, with a prevalence of 34.6% for non-Hispanic Blacks versus 8.1% for non-Hispanic Whites (Fanfair et al., 2013; McQuillan et al., 2018). Non-Hispanic Black men are three times more likely than non-Hispanic White men to have an HSV-2 infection (McQuillan et al., 2004; Xu et al., 2006). Non-Hispanic Black women are more likely to have an HSV-2 infection than non-Hispanic White women (Fanfair et al., 2013). Further, the HSV-2 infection rate for non-Hispanic Black women has been found to be almost three times higher than for Hispanic women and almost six times higher than for non-Hispanic White women (Bernstein et al., 2013). This disparity in HSV-2 infection rates could be partly attributed to race-based variability in sexual practices and risk behaviors (Bernstein et al., 2013).

When taking into account sexual identity (e.g., heterosexual, gay, lesbian, and bisexual) in a nationally representative sample, HSV-2 appears to be more prevalent (yet not a statistically significant difference) among Hispanic sexual minorities (24.3%) than among Hispanic non-sexual minorities (16.1%; Martinez et al., 2017). No published studies where researchers utilized nationally representative data to assess the relationship between HSV-2 and race/Hispanic ethnicity by sex of sex partners (as opposed to sexual identity) were found. However, as shown in Table 8, researchers who conducted a community study of WSW found that Black WSW are two times more likely to have an HSV-2 infection than their White counterparts (Marrazzo et al., 2003). In their study of African American WSW, Muzny, Austin et al. (2014) found that WSMW were five times more likely to show serological evidence of HSV-2 than women who have sex exclusively with women. Other researchers who studied MSM found that those who are Black were two times more likely to have an HSV-2 infection than those who are White (Bohl et al., 2011; Okafor et al., 2015). The reported prevalence of HSV-2 by both researchers was similar for Black MSM (23.2% in Bohl et al., 2011 versus 23.0% in Okafor et al., 2015), yet slightly different for White MSM (19.4% in Bohl et al., 2011 versus 16.0% in Okafor et al., 2015).

Table 8

Prevalence of HSV-2 in the United States by Race/Hispanic Ethnicity, Sex/Gender, and Sex of Sex Partners

Race/ Hispanic ethnicity	HSV-2 prevalence				
	Sex/ gender			Sex of sex partners	
	Total	Women	Men	WSW [a]	MSM [a]
Non-Hispanic Black	34.6%	64.8%	42.8%	14.0%	23.0% [b]–23.2% [c]
Non-Hispanic White	8.1%	22.2%	17.5%	7.8%	16.0% [b]–19.4% [c]
Hispanic	9.4%	37.9%	26.7%	NA	20.8% [c]
Non-Hispanic Asian	3.8%	NA	NA	7.7%	2.2% [c]

Note. NA = Not available.

[a] Estimates shown represent the HSV-2 prevalence for Black, White, and Asian race without taking into account Hispanic ethnicity. Source = Marrazzo et al., 2003. [b] Source = Okafor et al., 2015. [c] Source = Bohl et al., 2011.

Marital Status

Researchers' conclusions about the relationship between marital status and HSV-2 risk are mixed. Some researchers have found that those who are married are less likely to become infected with HSV-2 than those who are not married or cohabitating (Bauer et al., 2010), while no relationship has been found by other researchers (Fanfair et al., 2013; Nowotny et al., 2018). Researchers have estimated the prevalence of HSV-2 to be between 21.7%–32.3% for women who were not married and between 13.0%–22.3% for women who were married or cohabitating (Bauer et al., 2010; Patton et al., 2018). However, no differences in HSV-2 prevalence were found for men by marital status (13.6% prevalence among unmarried versus 13.0% for married or cohabitating; Bauer et

al., 2010). Similarly, no relationship was found between HSV-2 infection and marital status among disadvantaged Mexican-American women (Nowotny et al., 2018).

I did not find any authors who assessed the relationship between marital status and HSV-2 infection in WSW or MSM. Sexual minorities represent 2.4% of the United States population, which is equivalent to 5.4 million individuals (Lunn et al., 2017). Sexual minorities are more likely to report never being married (46.9%–49.7%) than non-sexual minorities (21.3%; Lunn et al., 2017). This may be partly because same-sex marriage was not legalized in all of the United States until 2015 (Landers, 2015; Legal Information Institute, 2015). This made it difficult for researchers to assess the health effects of same-sex legal marriage versus cohabitation using nationally representative samples prior to 2015 (Kail et al., 2015; Reczek et al., 2017).

Researchers who have studied the health effects of same-sex legal marriage have found mixed results. Legal same-sex marriage has been found to be related to better quality of life and more socioeconomic resources than for those who cohabitate, as well as financial security, stability, and reduced antigay bias (Buffie, 2011; Goldsen et al., 2017; Ofosu et al., 2019). Same-sex married couples who live in states where same-sex marriage is legal report higher levels of self-rated health when compared with those living in states with antigay laws (Goldsen et al., 2017). Legal same-sex marriage has been related to improvements in family and friends' beliefs and behaviors towards individuals in same-sex relationships (Riggle et al., 2018; Shulman et al., 2011). However, this relationship was not supported when comparing same-sex couples living in

states where same-sex marriage is legal versus those living in states where it is not legal (Kennedy et al., 2018).

Same-sex marriage has been found to be related to a lower risk of acquiring STIs (Chesson, 2012; Dee, 2008; Kamerow, 2013). Researchers have suggested that the legalization of same-sex marriage supports monogamy among same-sex couples and is related to a reduction in the burden of STIs among sexual minorities (Chesson, 2012; Dee, 2008; Francis et al., 2012). MSM in same-sex civil unions have been found to engage in safer sexual behaviors and are at lower risk for STIs than those who are not in civil unions (Dee, 2008; Klausner et al., 2006). It is possible that being married is also related to a reduced risk for HSV-2 infection among WSW. More research is needed to determine whether this relationship is true.

Education Level

HSV-2 is related to lower education level (Beydoun et al., 2010; Fleming et al., 1997; Pouget et al., 2010; Stebbins et al., 2019). The estimated prevalence of HSV-2 overall in the United States was found to be higher among individuals who did not graduate high school (25.8%) than among those who had graduated high school (20.1%) and who had more than a high school education (12.2% Stebbins et al., 2019). Overall, individuals who did not graduate high school have been found to be almost three times more likely to have an undiagnosed HSV-2 infection than those who have more than a high school education (Pouget et al., 2010). Reports on the relationship between HSV-2 and education status by sex/gender are mixed. Some researchers have found that women with a high school education or less are up to three times more likely to have HSV-2 than

those with more than a high school education (Buchacz et al., 2000; Patton et al., 2018). However, no relationship was found between HSV-2 and education level for both women and men who attended sexually transmitted disease clinics (Gallo et al., 2008; Sizemore et al., 2006).

No authors were found who studied the relationship between HSV-2 and education level for WSW or MSM using national representative data. Researchers who conducted community studies have suggested that MSM with a college education or higher were almost two times more likely to be diagnosed with HSV-2 than MSM with less than a high school education, although this relationship was not statistically significant (Bohl et al., 2011; Okafor et al., 2015). More research is needed to determine the relationship between HSV-2 infection and education level among WSW.

Income/Socioeconomic Status

Low income level has been found to be related to HSV-2 infection (Buchacz et al., 2000; Cohan et al., 2005; Fanfair et al., 2013; Fleming et al., 1997; Kelly et al., 2016; Nasrallah et al., 2019; Pouget et al., 2010; Stephens et al., 2016). The prevalence of HSV-2 among individuals living below the poverty level is higher (24.2%–33.5%) than for those living at or above the poverty level (13.8%–21.3%; Fanfair et al., 2013; Fleming et al., 1997). Women who live below the poverty level are more likely to have an HSV-2 infection than those living at or above the poverty level, and women who are homeless or unstably housed are three times more likely to have an HSV-2 infection than for those who are not (Kelly et al., 2016; Patton et al., 2018). The disparity is magnified when assessing income by race and Hispanic ethnicity. The prevalence of HSV-2 among non-

Hispanic Blacks living below the poverty level is higher (48.6%) than for non-Hispanic Whites (20.7%; Fanfair et al., 2013). The prevalence of HSV-2 is also higher for non-Hispanic Blacks (39.2%) living at or above the poverty level than for their non-Hispanic White counterparts (10.1%; Fanfair et al., 2013).

No authors were found who studied the relationship between HSV-2 and income for WSW or MSM using nationally representative data. Researchers who conducted cohort studies found that income is not related with HSV-2 infection among MSM (Bohl et al., 2011; Okafor et al., 2015). No authors were found who studied the relationship between HSV-2 and poverty level for WSW. Given that HSV-2 infection has been found to be more common among women living below poverty level, it is possible that this relationship is similar for WSW (Fanfair et al., 2013; Kelly et al., 2016; Patton et al., 2018). More information is needed to determine whether this is true.

Drug Use

Drug use is related to HSV-2 infection, and HSV-2 prevalence has been reported to range between 38%–75% among individuals who use drugs (Semaan et al., 2013). Individuals who use drugs are at higher risk for HSV-2 because of their engagement in behaviors such as exchange of sex for drugs or money, consequences from drug use (e.g., less inhibitions, enhanced sexual pleasure), or use of drugs as self-medication for transactional sex or to escape from their personal issues (Semaan et al., 2013). Drug use increases the likelihood of engaging in risky sexual behaviors by enhancing arousal, desire, stamina, enjoyment, and impulsivity (Feaster et al., 2016; Marshall et al., 2011; Volkow et al., 2007; Yamada et al., 2021). The relationship between drug use and sexual

risk is worsened by the level of drug use, kind of drug used, sexual risk behavior, STIs, and their connection varies by sex and the sex of the sex partner (Adams et al., 2013; Feaster et al., 2016; Kopetz et al., 2014; Marshall et al., 2011). Drug use is concerning because it is related to both HSV-2 and HIV acquisition and contributes to disease progression in those who are infected (Buchacz et al., 2000; Valencia et al., 2012).

Sexual minority populations have higher rates of drug use than non-sexual minorities (Heinsbroek et al., 2018; Kerridge et al., 2017; Martinez et al., 2017; Newcomb et al., 2014; Operario et al., 2015; Rice et al., 2019; Schuler et al., 2018, 2019). WSW are at higher risk for HSV-2 infection than WSM because they are more likely to report high-risk behaviors that lead to HSV-2 infection such as drug use (Heinsbroek et al., 2018; Operario et al., 2015; Schuler & Collins, 2020). WSW are over two times more likely to engage in illicit drug use (Heinsbroek et al., 2018; Operario et al., 2015; Schuler & Collins, 2020), are at higher risk of drug abuse issues (Feaster et al., 2016; Kerridge et al., 2017; Schuler & Collins, 2020), and are two to four times more likely to have a drug use disorder in their lifetime than WSM (Kerridge et al., 2017). WSW are more likely than WSM to report cocaine use in their lifetime and two to three times more likely to have used drugs (e.g., cocaine, heroin, and methamphetamines) in the preceding year (Schuler et al., 2018, 2019; Xu, Sternberg, & Markowitz, 2010a). Researchers have also found that WSMW are more likely than WSW-Only to engage in illicit drug use (Kerridge et al., 2017; Newcomb et al., 2014; Schuler et al., 2019; Smalley et al., 2016).

MSM report higher prevalence of injection drugs (i.e., cocaine and amphetamine, non-injection drugs (i.e., cocaine and amphetamine), and drugs for sexual activities or

chemsex than MSW (Ahmed et al., 2016; Evers et al., 2020; Hampel et al., 2020; Heinsbroek et al., 2018; Maxwell et al., 2019; Tan et al., 2018; Weatherburn et al., 2017). In a study of 1,484 MSM in sex clinics, 23.6% reported using a combination of various types of drugs, while 21.8% reported using chemsex drugs (J. Sewell et al., 2017). Some researchers have found that injection drug use is related with HSV-2 infection among MSM (Bohl et al., 2011), while no relationship was found by others (Xu et al., 2014).

Mental Health

HSV-2 has previously been found to be related with depression among women (A. Davis et al., 2016; Kelly et al., 2016; Nowotny et al., 2018). Depression may affect brain-based skills required for memory and to perform tasks and may result in atypical social and/or physical behaviors that may hurt others, psychosocial harm, lower motivation, and unhealthy relationships (Mwangi et al., 2019). Depression and drug use commonly co-occur and almost one-third of individuals who experience depression also have drug use problems (L. Davis et al., 2008; Mohamed et al., 2020).

Women who experience depression are more likely to engage in risky sexual behaviors, such as condomless sex and multiple sex partners, increasing their risk of acquiring HSV-2 (Burke et al., 2018; Cunningham et al., 2016; Jackson et al., 2015; Magidson et al., 2014). This high-risk behavior may be due to impaired judgement, higher impulsivity, indifference, and alcohol consumption stemming from their depression (Burke et al., 2018). Researchers have found a strong comorbidity of HSV-2 with depression and injection heroin use among HSV-2 positive women, and that those

with a history of injection heroin use are four times more likely to test positive for HSV-2 than those who do not inject drugs (Nowotny et al., 2018).

WSW are almost two times more likely to suffer from depression in the preceding year and in their lifetime compared with WSM (Dai & Meyer, 2019; Kerridge et al., 2017). It has been suggested that mental health issues may precede drug use among WSW, as individuals may resort to drug use to escape from psychological distress (Bränström & Pachankis, 2018; Flentje et al., 2015; Schuler et al., 2019). WSW are over three times more likely to experience co-occurring depression and drug use than WSM (Bränström & Pachankis, 2018). Depression and risky sexual behaviors have been found to co-occur among women who inject drugs, and WSW are more likely to engage in drug use than WSM (Mwangi et al., 2019; Soto-Salgado et al., 2016). WSW who suffer from depression and use drugs may engage in more risky sexual behaviors than WSM, which can lead to a higher risk for HSV-2 infection (A. Davis et al., 2016; Gorgos & Marrazzo, 2017; IOM, 2011; Kelly et al., 2016; Muzny, Austin, et al., 2014; Operario et al., 2015; Xu, Sternberg, & Markowitz, 2010a). Researchers have suggested that the relationship between depression and STIs could be due to the confounding effects of coexisting factors such as drug use, and that drug use mediates the relationship between depression and risk of acquiring an STI (Magidson et al., 2014).

MSM are more likely to experience depression than MSW (Batchelder et al., 2017; King et al., 2008; Lee et al., 2017). MSM who experience depression were found to be more likely to engage in risky behaviors that may lead to HSV-2 such as illicit drug use and high-risk sexual behavior (e.g., unprotected anal sex and higher number of

unprotected anal sex partners) than those who were not depressed (Espinosa da Silva, 2016; Moody et al., 2018; Traube et al., 2013).

Unprotected Sex

Consistent barrier use has been found to be related to lower rates of HSV-2 and other STIs (Ganley et al., 2021; K. Holmes et al., 2004; Martin et al., 2009; Stanaway et al., 2012; Subramanian et al., 2013; Wald et al., 2001, 2005). Individuals who use condoms consistently have a 30% lower risk of HSV-2 infection than those who do not (Martin et al., 2009). The odds of acquiring HSV-2 increase by 3.6% when condoms are not used during sex (Stanaway et al., 2012).

Researchers have found that condom use decreases the per-act risk of man-to-woman transmission of HSV-2 by 96% and by 65% for woman-to-man transmission (Magaret et al., 2015). More consistent condom use could help avoid up to 315,000 new cases of HSV-2 in women (Wald et al., 2001). Inconsistent condom use has been related to depression in women and men (Brickman et al., 2017; Cooke et al., 2016). Women who experience depression are also more likely to report incorrect condom use (Shrier et al., 2011). Illicit drug use increases sexual desire and reduces the likelihood of using condoms among drug users (Johnson et al., 2017; Mhlanga et al., 2014). Condom use has been found to be highly effective in preventing HSV-2 among drug users who quit when compared with those who become drug users (Mhlanga et al., 2014).

WSMW are more likely than WSM to report infrequent barrier use, as well as unprotected sex with a nonsteady partner, which puts them at higher risk for HSV-2 infection (Nield et al., 2015; Rahman et al., 2020; X. Wang et al., 2012; Ybarra et al.,

2016). WSMW are more likely than WSM to report other risky sexual behaviors including transactional sex (MacCarthy et al., 2015; Tat et al., 2015; Walters et al., 2018), group sex (Friedman et al., 2008), sex with injection drug users (Fethers et al., 2000; Koh et al., 2005), sex under the influence (Smalley et al., 2016), sex with men who have sex with men (Fethers et al., 2000; Koh et al., 2005; Tat et al., 2015), and sex with HIV-infected partners (Tat et al., 2015). Infrequent or no use of barrier protection (e.g., condom or dental dam) during these sexual encounters increases the risk of HSV-2 infection for WSW.

WSW may not use barriers to protect them against HSV-2 or other STIs during sexual activity with other women because they believe to be at lower risk of infection (Cox & McNair, 2009; Doull et al., 2018). Some WSW consider sex with another woman to be less risky than having sex with men because they cannot get pregnant (Doull et al., 2018). WSW can acquire HSV-2 by exchanging vaginal fluids through woman-to-woman sexual contact by mouth, fingers, or sex toys (Doull et al., 2018; Schick et al., 2015). WSW may be aware of HSV-2 and other STIs but have insufficient knowledge of barriers specifically for women (e.g., dental dams) and incorrect information on the risk for STI transmission while engaging in sexual activities with other women (Cox & McNair, 2009; Doull et al., 2018; Marrazzo et al., 2005; Muzny, Harbison, Pembleton, & Austin, 2013; Muzny, Harbison, Pembleton, Hook, et al., 2013; Richters et al., 2010; Richters & Clayton, 2010).

Condomless sex among MSM has increased in recent years (Paz-Bailey et al., 2016). In a nationally representative sample of MSM, researchers found that condomless

anal sex increased during 2005–2014 from 28.7% to 40.5% among those who were HIV-negative and from 27.2% to 38.5% among those with unknown HIV status (Paz-Bailey et al., 2016). This increase in condomless sex could be because some MSM find it hard to discuss condom use with partners with whom they have already had condomless sex with, and because suggesting to wear condoms may imply that they do not trust their partner (Goedel et al., 2017). Condomless sex is related to chemsex among MSM and researchers have found that those who engage in chemsex are more likely to have condomless sex than those who do not engage in chemsex (Maxwell et al., 2019). Some MSM report unintentional condomless sex as a result from chemsex (Bourne et al., 2015). Bourne et al. (2015) found that, in some cases, this occurred because it was hard to negotiate safer sex due to the effects of the drugs. Condomless sex is also related to illicit drug use and depression (Card et al., 2018). Illicit drug use has been found to mediate the relationship between depression and condomless anal sex among MSM, which increases their risk for HSV-2 infection (Card et al., 2018).

Summary and Conclusions

HSV-2 is a lifelong, incurable infection that is more common among women than men worldwide (James et al., 2020). HSV-2 infection among women overall has been widely studied and well documented (Nowotny et al., 2018; Posavad et al., 2015; Ramchandani et al., 2017). However, few researchers have examined HSV-2 risk among women stratified by sexual behavior. These have found that HSV-2 is more prevalent among WSW than among WSM, mainly because of their engagement in more risky

sexual behaviors (Rahman et al., 2020; Tat et al., 2015; Xu, Sternberg, & Markowitz, 2010a).

WSW also report higher prevalence of depression and drug use than WSM (Borgogna et al., 2019; Bränström & Pachankis, 2018; Lawn et al., 2019; Operario et al., 2015; Schuler et al., 2018, 2019). Both depression and drug use have been independently related to HSV-2 infection among WSW (A. Davis et al., 2016; Kelly et al., 2016; Nowotny et al., 2018). However, it is unknown whether drug use is related to the probability of developing HSV-2 infection in WSW who have depression. To fill this knowledge gap, I will assess this relationship using data from the NHANES.

I used the escape theory proposed by Baumeister (1988, 1990) as the theoretical framework for this study. The escape theory was created to explain individuals' engagement in self-destructive behaviors to escape from the mental distress arising from negative self-perceptions when they realize that part of their identity does not meet the preferred standards (Baumeister, 1988, 1990; Heatherton & Baumeister, 1991; Junhua et al., 2013). Depressed individuals are believed to be more inclined to use escape as a strategy to solve their problems (Bartoskova, 2015). Drugs are used during sexual encounters as a form of escape, which leads to risky sexual behaviors like having condomless sex with multiple sex partners (Ahmed et al., 2016; Card et al., 2019; Field et al., 2016; Maxwell et al., 2019). Some individuals report engaging in such risky behaviors when feeling depressed because they are less worried about the consequences and more focused on escaping from their negative feelings (Bancroft et al., 2003; Shrier et al., 2011). It is possible that WSW who are depressed, use drugs to escape from

negative feelings and/or thoughts and, consequently, engage in high-risk sexual behaviors, increasing their risk for HSV-2 infection. In this study, I aimed to determine whether this relationship is true. The methodology used for the analysis will be described in the following chapter.

Chapter 3: Research Method

Researchers have found relationships in women between depression and herpes simplex virus type 2 (HSV-2; Nowotny et al., 2018; Pratt et al., 2012) and drug use and HSV-2 (A. Davis et al., 2016; Nowotny et al., 2018). However, examining health variables without considering their sexual behavior may mask important differences in the factors related to HSV-2 infection in women who have sex with women (WSW) versus women who have sex exclusively with men (WSM; Conron et al., 2010). Few researchers have examined HSV-2 risk or prevalence specifically among WSW, but those who have done so have found that HSV-2 is more prevalent among WSW than among WSM (Gorgos & Marrazzo, 2017; Operario et al., 2015; Xu, Sternberg, & Markowitz, 2010a). WSW have been found to be more likely to report depression and drug use than WSM, which increase their risk for HSV-2 (Estrich et al., 2014; Kerridge et al., 2017; Operario et al., 2015; Pharr et al., 2019). Both depression and drug use have been independently related to HSV-2 infection among WSW (Bränström & Pachankis, 2018; Card et al., 2018; Muzny et al., 2018; Nowotny et al., 2018). However, it is unknown whether drug use is related to the probability of developing HSV-2 infection in WSW who have depression. The purpose of this study was to assess such relationship by conducting a quantitative analysis of a convenience sample of adults in the United States.

In this chapter, I begin by discussing the research design and rationale, and provide an overall description of the proposed methodology, as well as the data source. In the Methodology section, I present a more specific description of the population, the National Health and Nutrition Examination Survey (NHANES) sampling strategy,

current study sample, analysis variables (independent and dependent), and the data analysis plan. I then discuss threats to validity and close with a discussion of the ethical procedures I will follow during the study.

Research Design and Rationale

I conducted a quantitative, correlational study of a cross-sectional nature using secondary data previously collected through a population-based survey (i.e., the NHANES) to determine the predictive relationship between demographics (age, race, educational level, income, and marital status), total number of sex partners, infrequent barrier use, depression status, nonprescription drug use, and HSV-2 status in WSW. Correlational studies are used to determine the strength of the relationship (or association) between two or more quantitative variables, as well as the direction of such relationship (Gogtay & Thatte, 2017; The BMJ, 2021a). Cross-sectional studies are one type of correlational studies and are typically used for population-based surveys and to determine the prevalence of diseases in a population in health science research (Lau, 2017; Singh Setia, 2016). In cross-sectional studies, data are collected at one point in time and relationships are analyzed but no longitudinal data collection is done (Lau, 2017; Singh Setia, 2016). Causation cannot be determined in this type of research design, and only whether the assessed variables are related can be determined (Ranganathan et al., 2017; Sperandei, 2014; The BMJ, 2021a). Cross-sectional studies can typically be conducted faster and cost less than other types of studies (e.g., longitudinal; Singh Setia, 2016). Since the NHANES data was previously collected by the National Center for Health Statistics (NCHS), there were no time constraints consistent with the design

choice or data collection process for this study as the data was readily available as soon as Institutional Review Board (IRB) approval was granted.

A correlational design was appropriate for my study because my aim was to determine whether the independent variables (depression status and nonprescription drug use) predicted the dependent variable (HSV-2 status). Other research designs that I considered were the quantitative longitudinal design and the qualitative design. Longitudinal research designs involve studying the same participants and their exposure to specific diseases over prolonged periods of time (Caruana et al., 2015; Glen, 2021a). Two groups are followed prospectively: (a) those exposed to the disease of interest and (b) the unexposed or controls (The BMJ, 2021b). Longitudinal research designs are used to determine trends in the outcome of interest over a period of time (Glen, 2021a). They are useful for assessing the relationship between risk factors for diseases and the outcomes over time, determining sequence of events, and eliminating recall bias in subjects (Caruana et al., 2015). These studies can take months or decades to complete and are costly (Caruana et al., 2015). For these reasons, a longitudinal research design was not appropriate for my dissertation study.

Qualitative research is used when researchers are interested in nonnumerical data and are focused on explaining why individuals think or behave in specific ways (Pathak et al., 2013). Qualitative data is generally collected via interviews, focus groups, analysis of written records, or observation (Pathak et al., 2013). Some advantages of qualitative research are that data collection is generally cost efficient, researchers are able to collect more detailed data to explain complicated issues, and that participants can express their

opinions about a specific topic and share information on how they have coped with various matters such as depression, disease recovery, social norms, etc. (Pathak et al., 2013). In addition, qualitative research does not require a large sample size (Lichtman, 2013; Merriam & Tisdell, 2016). On the other hand, findings from qualitative research are not generalizable to the entire population and are harder to analyze, and data collection takes longer (Lichtman, 2013; Merriam & Tisdell, 2016). A qualitative research design was not appropriate for my study because I was not interested in explaining why individuals think or behave in specific ways but was interested in the statistical relationships between variables that can be measured quantitatively.

Methodology

Population

The target population was noninstitutionalized adult women aged 18 years and older living in the United States who participated in the NHANES cycles 2009–2010, 2011–2012, 2013–2014, and 2015–2016 combined. According to the U.S. Census Bureau American Community Survey (2020), in 2019 there were an estimated 166.7 million women living in the United States. Of these, 79% (138.3 million) were 18–49 years old (U.S. Census Bureau; American Community Survey, 2020). HSV-2 is globally one of the most widespread sexually transmitted infections (STIs; James et al., 2020; World Health Organization, 2020). In the United States, approximately 18.6 million individuals aged 18–49 years old are living with HSV-2, and women in this age group account for 65% (12.2 million) of these infections (Spicknall et al., 2021).

Sampling and Sampling Procedures

Initial Data Collection: NHANES Sampling

The NHANES includes a representative sample of the United States civilian population living in all 50 states and the District of Columbia who are noninstitutionalized (T. Chen et al., 2020; NCHS, 2017a). The NHANES samples about 5,000 individuals residing in counties all over the nation, and then the data is weighted to represent the United States population (T. Chen et al., 2020). The sample is drawn using a multistage probability sampling design that includes

1. selection of primary sampling units (PSU; e.g., counties) using probability proportional to size,
2. selection of segments (or secondary sampling units) within each PSU (e.g., census blocks),
3. selection of households within segments, and
4. selection of eligible respondents within households (T. Chen et al., 2020).

The PSUs are selected from all counties in the United States and screening is conducted at the household level to identify eligible participants following an established oversampling criteria (T. Chen et al., 2020).

The sampling strategy is designed to generate stable prevalence estimates for smaller population groups by age group, gender, low-income status, and race/Hispanic ethnicity (T. Chen et al., 2020). Because public health focuses have changed through the years, these smaller population groups are oversampled in the NHANES to increase the reliability and precision of estimates of health indicators for such groups (T. Chen et al.,

2020). For NHANES cycles 2011–2012, 2013–2014, and 2015–2016, the researchers oversampled Asians for the first time and continued to oversample Hispanics, non-Hispanic Blacks, older adults, and low-income Whites and individuals of other race (T. Chen et al., 2020). The other race category included individuals who reported being of a race that was not Black, White, or Asian, as well as individuals who self-identified as being of more than one race (T. Chen et al., 2020). The Hispanic category consisted of all individuals who identified as having Hispanic ethnicity, irrespective of race (T. Chen et al., 2020).

Current Study Sampling

Sampling Method. I used a purposeful convenience sampling method for this study. A purposeful sampling method indicates that participants are selected based on whether they meet the inclusion criteria of the study (Taherdoost, 2016). Convenience sampling is a type of nonprobability sampling where participants are selected because they are easily accessible (Taherdoost, 2016). In the case of a secondary dataset, it makes sense to utilize all of the cases available in the dataset, especially if the inclusion criteria are very specific and may limit the number of cases that meet the criteria (which is the case in this study). Some advantages of convenience sampling are that it is helpful when conducting pilot studies, data can be collected in a short period of time, and it costs less to implement than other sampling methods (Dudovskiy, n.d.; Elfil & Negida, 2017). In addition, convenience sampling is effective when it is not possible to do probability sampling (Business Research Methodology, n.d.; Taherdoost, 2016). Disadvantages are that research findings are less generalizable compared to those produced through

probability sampling and it is hard to estimate sampling variability and identify potential bias (Business Research Methodology, n.d.; Taherdoost, 2016). Convenience sampling is highly susceptible to selection bias and influences that the researcher cannot control, and shows a high amount of sampling error (Dudovskiy, n.d.). Regardless, the purposeful convenience sampling method was appropriate for this study because I drew my sample from data already collected for the NHANES, which also allowed me to complete my study in a shorter time than if I were to collect the data myself.

Another type of sampling strategy I considered for this study was community venue sampling, which is used in STI and HIV research and is one of the most frequently used methods to find hard-to-reach (or hidden) populations such as sexual minority women (Meyer & Wilson, 2009; Muhib et al., 2001; Ott et al., 2018). Through this type of convenience sampling, researchers use contacts in the community to get to a population of interest that they normally would not be able to reach (Meyer & Wilson, 2009). Participants are recruited at venues where the population of interest convenes. Successful community venue sampling requires community participation to provide researchers access to community venues and events (Ott et al., 2018). The advantage of using community venue sampling is that the researcher is able to focus on a specific community of interest, which can later be converted into a community-based intervention (Ott et al., 2018). One of the biggest disadvantages of using community venue sampling is that researchers are only able to reach sexual minority individuals who visit specific venues, thus excluding those who do not visit these or are unable or unwilling to do so (Kuyper et al., 2015; Meyer & Wilson, 2009; Salway et al., 2019). Because individuals

who do not visit such venues are different from those who do, results from samples recruited from the sexual minority community are biased (Meyer & Wilson, 2009). Community venue sampling was not appropriate for my study because of the amount of time needed to recruit female participants and reach my minimum sample size since individuals visit venues at different frequencies (Meyer & Wilson, 2009).

Sampling Frame. The sample for this study was obtained from the NHANES datasets from cycles 2009–2010, 2011–2012, 2013–2014, and 2015–2016 combined. My sampling frame included cases that met the following inclusion criteria:

- self-identified as a woman
- aged 18–49 years old (HSV-2 testing was conducted only among participants in this age group)
- tested for HSV-2 (results included)
- reported sex of sex partner(s) (i.e., women or both men and women)

Cases that did not meet these inclusion criteria were excluded from the analyses. I created an analytical dataset that only included cases meeting the inclusion criteria and used this for my analyses.

Sample Size and Power Analysis. Statistical power helps researchers determine the probability that a statistical test will accurately detect a true effect (Cohen, 1988; Ellis, 2010). Power is the probability of rejecting a false null hypothesis and is inversely related to the probability of making a Type II error (i.e., accepting the null hypothesis when it is false; Ellis, 2010). It has been suggested that power levels should be fixed at 0.80 so that the probability of identifying a true effect is 80% and the probability of

making a Type II error is 20% (Cohen, 1988; Ellis, 2010). Power analysis involves four main criteria: sample size, effect size, alpha level, and the power of the significance test (Ellis, 2010; R. Williams & Zimmerman, 1989). All four criteria are interrelated and the value of one can be calculated using the desired value of the other three (Ellis, 2010).

When using multiple logistic regression it is difficult to calculate the statistical power before one has the sample and can calculate odds ratio (Allen & Le, 2008; H. Chen et al., 2010; Ialongo, 2016). Researchers have suggested that odds ratios of 1.68, 3.47, and 6.71 indicate small, medium, and large effect sizes, respectively (H. Chen et al., 2010). These effect sizes have been demonstrated to be equivalent to Cohen's *d* effect size cut-offs of 0.2 (small), 0.5 (medium), and 0.8 (large; H. Chen et al., 2010; Cohen, 1988). Researchers have recommended that a minimum sample size of 500 is required when conducting logistic regression analysis to produce estimates that represent the study population (Bujang et al., 2018; Long, 1997). Others have noted that these recommendations should not be considered rules of thumb because they are not precise and do not apply to all circumstances because of the complex interaction between sample size, effect size, and the characteristics of each predictor's distribution (Newsom, 2016; Olvera Astivia et al., 2019). Bigger sample sizes are needed when the distribution of the predictor variables is not symmetric or equal (Newsom, 2016; Olvera Astivia et al., 2019). The more skewed the predictor variable is, the bigger the sample size will need to be (Olvera Astivia et al., 2019).

Because the inclusion criteria I used for the sample would likely result in a small sample, as well as the difficulties I have outlined above regarding calculating an

appropriate sample size for logistic regression, I calculated the statistical power once I received IRB approval, cleaned the dataset, and had my final sample. Following published recommendations, I aimed to reach a medium effect size (*OR* = 3.47), alpha level of 0.05, and power of 0.80 to produce reliable estimates for the WSW in my sample (Bujang et al., 2018; Cohen, 1988, 1992; Ellis, 2010; Long, 1997).

Procedures for Recruitment, Participation, and Data Collection

Initial Data Collection (NHANES)

Recruitment and Participation. The NHANES protocols for each survey cycle were reviewed and approved annually by the NCHS Research Ethics Review Board (ERB). The ERB oversaw the ethical handling of respondents including vulnerable groups, such as pregnant women and older individuals (NCHS, 2017d; Zipf et al., 2013). Prior to data collection, potential participants went through the informed consent process (NCHS, n.d.). Adults 18 years and older signed the informed consent form, while parents or guardians provided permission for children to participate (Zipf et al., 2013). Those who decide to participate may refuse to respond to any question, refuse any medical examination, or leave the survey at any time. In exchange for their participation, participants were provided with most of their test results free of charge, as well as compensation and transportation to and from the medical examination centers (MEC; NCHS, 2017a; 2020a).

Data Collection. Data for the NHANES is collected through both interviews and medical examinations. Interviews are conducted in participants' households, while medical examinations are conducted in MECs that are transported to multiple locations

throughout the United States (NCHS, 2020a). The NHANES team includes a medical doctor, health and medical technicians, and interviewers (NCHS, 2020a). To ensure confidentiality, the NHANES team enters the information collected via interviews and medical examinations in notebook computers (Zipf et al., 2013). This information is password protected and encrypted (Zipf et al., 2013).

For sensitive subjects (e.g., related to sexual behaviors), participants answer questions in a private room at the MEC using the Audio Computer-Assisted Self-Interview (ACASI) system (NCHS, 2017b). This ACASI is administered in various languages and allows participants to both hear the sensitive questions via headphones and read these questions from the computer screen. Participants respond to questions at their own pace and use touchscreen computers to enter their answers (NCHS, 2017b). There are no proxy respondents or translators used in cases where participants cannot self-report (NCHS, 2017b).

Current Study Data Collection

The NHANES datasets were publicly available on the NHANES website (https://wwwn.cdc.gov/nchs/nhanes/Default.aspx) and there was no need to obtain written consent to use and/or analyze them (See Appendix A; NCHS, 2017a, 2020a). These data were deidentified and did not contain information that could connect the data to the participant (e.g., name, address/email, phone number, etc.). The identity of the participants was anonymous to this researcher.

The NHANES datasets were provided in SAS transport file format (.XPT), which supports the transfer of datasets between different statistical analysis software such as

SAS, SPSS, STATA, and R (NCHS, 2018a). I used SPSS software (Version 27) for my study. Once I obtained access to the NHANES data in the SAS transport file format, I exported it to SPSS, cleaned the data in the SPSS file, and then analyzed it using SPSS software.

Instrumentation and Operationalization of Constructs

Instrumentation (NHANES)

The NHANES is a nationally representative survey designed by the NCHS to evaluate the health of adults and children in the United States (NCHS, 2017a). The NHANES was established in the 1960s and prioritizes various population groups and health issues (NCHS, 2017a). The NHANES is unique because data is collected through both interviews and medical examinations (NCHS, 2017a).

Findings from the NHANES are used to estimate the prevalence and risk factors for important diseases, and are the basis for national standards for body measurements like blood pressure, weight, and height (NCHS, 2017b). Because states are not required by law to report HSV infections to the Centers for Disease Control and Prevention (CDC), public health surveillance of HSV in the United States is mainly conducted by the NHANES via serological testing to determine the prevalence of HSV in the population (CDC, 2021; NCHS, 2017c). The NHANES data were appropriate for my study because it allowed me to produce estimates of the prevalence of HSV-2 among WSW.

Operationalization of Constructs (NHANES)

Original NHANES Variables and Coding. The variables in the NHANES dataset were converted to variables that I could use for my data analyses. This required

variables from the original datasets combined to be recoded into new variables and/or items needed for this study. Appendix B contains the original NHANES variable labels and coding and explains how I recoded the variables and values to arrive at the new variables and values that I used in my study, as indicated in Table 9.

Weights. Sample weights are generated in the NHANES to account for the complex survey design, survey non-response, and post-stratification adjustments to match population totals from the United States Census Bureau (NCHS, 2018a). When the NHANES sample is weighted it is representative of the United States noninstitutionalized population (T. Chen et al., 2020; NCHS, 2018a). Each individual in the dataset is assigned a sample weight, which is an estimate of the number of individuals in the United States population that are represented by that individual in the sample (NCHS, 2018a). Weights for each individual (or case) generally should be kept in the dataset and taken into account to ensure accuracy of results and their representativeness to the entire population (NCHS, 2018a). However, due to limited computer memory, I needed to create a smaller dataset that included only cases that met my study's inclusion criteria to use for my analyses. The weighting does not work if all cases are not kept in the dataset used for analyses. Therefore, the weights were not used and the results of these analyses were only representative of those women who participated in the NHANES and met my study's inclusion criteria.

Operationalization of Constructs: Current Study

Table 9 contains the variables that were used in the data analyses (once cleaned and recoded from the original NHANES variables). This table contains the variables that

were included in the final dataset used for analyses, the research question(s) the variable were used in, and the coding that I used.

Table 9

Operationalization of Variables Used in Current Study

Variable name	RQ	Researcher variable coding [a]
Age	1, 2, 3 (IV)	Actual age in years 99 = Missing [b]
Race	1, 2, 3 (IV)	0 = White 1 = Non-White 99 = Missing [b]
Marital status	1, 2, 3 (IV)	0 = Not married 1 = Married/ living with partner 99 = Missing [b]
Educational level	1, 2, 3 (IV)	0 = No high school diploma 1 = High school or more 99 = Missing [b]
Income	1, 2, 3 (IV)	1 = $0 to $4,999 2 = $5,000 to $9,999 3 = $10,000 to $14,999 4 = $15,000 to $19,999 5 = $20,000 to $24,999 6 = $25,000 to $34,999 7 = $35,000 to $44,999 8 = $45,000 to $54,999 9 = $55,000 to $64,999 10 = $65,000 to $74,999 11 = $75,000 to $99,999 12 = $100,000 and over 99 = Missing [b]
Total number of sex partners (lifetime)	1, 2, 3 (IV)	Total number of reported female and male sex partners. 99 = Missing [b]
Infrequent barrier use	1, 2, 3 (IV)	0 = Frequent barrier use 1 = Infrequent barrier use 99 = Missing [b]
Depression status	1, 3 (IV)	0 = No depression (PHQ-9 score 0–9) 1 = Depression (PHQ-9 score 10–27) 99 = Missing [b]
Nonprescription drug use	2, 3 (IV)	0 = No nonprescription drug use 1 = Nonprescription drug use 99 = Missing [b]
HSV-2 status	1, 2, 3 (DV)	0 = No HSV-2 1 = HSV-2 99 = Missing [b]

Note. RQ = Research question(s); IV = Independent variable; DV = Dependent variable.

[a] Variables in table are recoded for the analyses in this study from original variables in NHANES dataset by simply recoding or combining data from multiple NHANES

variables. See Appendix B for the original dataset variables and coding and the transition to the variables used in this study. [b] Missing variable values were used in descriptive analyses and reported in the frequencies of categories within variables but were not included in analyses to answer research questions.

Data Analysis Plan

Data Cleaning

Once I received IRB approval, I downloaded the datasets from the NHANES cycles 2009–2010, 2011–2012, 2013–2014, and 2015–2016. I used IBM SPSS Statistics Version 27 to clean and analyze the data. The following steps were used to clean the data:

1. Combined the datasets for cycles 2009–2010, 2011–2012, 2013–2014, and 2015–2016 into one new analytical dataset.
2. Deleted cases that were not identified as Female (2) in the RIAGENDR (gender) variable in the NHANES data set.
3. Deleted cases that were not WSW in the NHANES dataset (WSW = defined as responding 1 to SXQ709 OR 1–63 to SXQ130).
4. Deleted any variables that were not listed in Appendix B because they were not used to create the recoded variables for the analysis.
5. Deleted cases that were not between ages 18–49 years in the RIDAGEYR variable (NHANES).
6. Deleted cases that did not indicate a value of positive (1) or negative (2) HSV-2 test result in LBXHE2 variable (NHANES).
7. Recoded into new variable: RIDAGEYR (NHANES) into Age.

8. Recoded into new variable: RIDRETH1 (NHANES) into Race.
9. Recoded into new variable: DMDMARTL (NHANES) into Marital status.
10. Recoded into new variable: INDFMIN (NHANES) into Income.
11. Recoded into new variable: DMDEDUC3 and DMDEDUC2 (NHANES) into one new variable Educational level variable.
12. Recoded into new variable: SXQ709, SXQ700, SXQ703, SXQ706, SXQ130, and SXD101 (NHANES) into one new variable Sex of sex partners (WSW-only, WSMW). WSW-only was defined as responding 1 to SXQ709 OR 1–63 to SXQ130 AND 2, 7, 9, or missing to SXQ700, SXQ703, and SXQ706 AND 77777, 99999, or missing to SXD101 (never had sex with men). WSMW was defined as responding 1 to SXQ709 OR 1–63 to SXQ130 AND 1 to SXQ700, SXQ703, or SXQ706 OR 1–87 or 100 to SXD101.
13. Computed variable into new variable: SXQ130+SXD101 (NHANES) into one new variable Total number of sex partners.
14. Recoded into new variable: SXQ251+SXQ645 (NHANES) into one new variable Infrequent barrier use. Infrequent barrier use was defined as responding 4, 5 to SXQ251 OR 1, 2 to SXQ645. Otherwise, frequent barrier use was defined as responding 1, 2, 3 to SXQ251 OR 3, 4 to SXQ645.
15. Computed variable into new variable: DPQ010+ DPQ020+ DPQ030+ DPQ040+ DPQ050+ DPQ060+ DPQ070+ DPQ080+ DPQ090+ DPQ100 (NHANES) into one new variable PHQ9_TotalScore.

16. Recoded into new variable: PHQ9_TotalScore into Depression status. No depression was defined as a PHQ-9 score of 0–9. Depression was defined as a PHQ-9 score of 10–27.
17. Recoded into new variable: Combined DUQ240 (NHANES) into Nonprescription drug use status.
18. Recoded into new variable: LBXHE2 (NHANES) into HSV-2 status.

Missing Data

After cleaning the data following the steps above, missing data in the analytical dataset were handled depending on the type of variable. In all variables (except the depression screener variables) responses of don't know, refused, unsure, and missing were recoded as missing (99). This ensured that the case was still included in the dataset but that the case was excluded from the analyses as there was no way to replace the missing data.

PHQ-9 Missing Data. Missing data were handled differently for the depression screener variables used to calculate the PHQ-9 total score (step 14 above). According to Kroenke et al. (2010), missing data in the PHQ-9 may be handled in two different ways. One way is to give a score of 0 to the questions that were not answered (Kroenke et al., 2010). Another way is to take individuals who are missing data in two or less questions and replace the missing value with the mean score of the questions that were completed (Kroenke et al., 2010). This is a less conservative procedure but reduces the chances of excluding individuals who have depression (Kroenke et al., 2010). For this reason, I

handled missing data in the PHQ-9 variables using the option of the question mean for that individual.

Data Analyses

Sample Characteristics and Chi-Square. I performed descriptive analyses and provided frequencies for each category within each of the variables listed in Table 9 to illustrate the characteristics of my sample. My data analysis included chi-square analysis to compare counts of HSV-2 status between groups within independent variables (sex of sex partners [WSW or WSMW], age, race, educational level, income, marital status, number of sex partners, infrequent barrier use, nonprescription drug use status, and depression status). These analyses were not done to answer the research questions but were done to provide information about the sample characteristics.

Chi-square analysis was used to determine whether there were statistically significant relationships between the dependent variable and the independent variables (Statistics Solutions, 2021). Before running the chi-square analyses, I tested the following assumptions:

- Both variables tested should be either nominal or ordinal.
- Both variables tested must have at least two mutually exclusive categories (Laerd Statistics, 2018a).

If these assumptions were not fulfilled, then a chi-square test could not be conducted and other tests may need to be considered (Laerd Statistics, 2018a).

Logistic Regression. All three research questions were analyzed using logistic regression.

Research Question 1 (RQ 1): What is the predictive relationship between demographics (age, race/Hispanic ethnicity, educational level, income, and marital status), number of sex partners, infrequent barrier use, depression status (as measured by the PHQ-9), and HSV-2 status in WSW?

$H_0$1: There is no statistically significant predictive relationship between demographics (age, race, educational level, income, and marital status), number of sex partners, infrequent barrier use, depression status (as measured by the PHQ-9), and HSV-2 status in WSW.

H_a1: There is a statistically significant predictive relationship between demographics (age, race, educational level, income, and marital status), number of sex partners, infrequent barrier use, depression status (as measured by the PHQ-9), and HSV-2 status in WSW.

Research Question 2 (RQ 2): What is the predictive relationship between demographics (age, race, educational level, income, and marital status), number of sex partners, infrequent barrier use, nonprescription drug use status, and HSV-2 status in WSW?

$H_0$2: There is no statistically significant predictive relationship between demographics (age, race, educational level, income, and marital status), number of sex partners, infrequent barrier use, nonprescription drug use status, and HSV-2 status in WSW.

H_a2: There is a statistically significant predictive relationship between demographics (age, race, educational level, income, and marital status), number

of sex partners, infrequent barrier use, nonprescription drug use status, and HSV-2 status in WSW.

Research Question 3 (RQ 3): What is the predictive relationship between demographics (age, race, educational level, income, and marital status), number of sex partners, infrequent barrier use, depression status (as measured by the PHQ-9), nonprescription drug use status, and HSV-2 status in WSW?

$H_0$3: There is no statistically significant predictive relationship between demographics (age, race, educational level, income, and marital status), number of sex partners, infrequent barrier use, depression status (as measured by the PHQ-9), nonprescription drug use status, and HSV-2 status in WSW.

H_a3: There is a statistically significant predictive relationship between demographics (age, race, educational level, income, and marital status), number of sex partners, infrequent barrier use, depression status (as measured by the PHQ-9), nonprescription drug use status, and HSV-2 status in WSW.

Logistic regression was appropriate because I used categorical and continuous variables to predict a dichotomous dependent variable (Schreiber-Gregory, 2018).

Logistic Regression Assumption Testing. The following assumptions were tested before completing the logistic regression analysis for each of the research questions:

- The dependent variable must be dichotomous.
- One or more independent variables were either continuous or categorical.
- There should not be multicollinearity between more than two independent variables. Independent variables should be highly correlated with the

dependent variable and not with each other (Midi et al., 2010; Schreiber-Gregory, 2018). I looked at the variance inflation factor (VIF) value to determine whether there was multicollinearity between two variables. The VIF provides an estimate of how much the variance of a regression coefficient increases if two predictors are correlated (Frost, 2021). Although there is no established criteria for VIF, researchers consider a VIF value of 1–10 to indicate no correlation, while a value of <1 or >10 means there is multicollinearity (Braunstein, 2007; Frost, 2021; Senaviratna & Cooray, 2019; SPSS Tests, 2018). Multicollinearity can be addressed by removing the redundant variable or increasing the sample size (Frost, 2021; Simon Fraser University, 2016). However, multicollinearity may not be an issue sometimes. In fact, it has been suggested that multicollinearity does not always need to be addressed (Analytics Vidhya, 2021; Frost, 2021; Minitab, 2013; A. F. Siegel, 2016). For example, in cases where multicollinearity is small to moderate or when there is multicollinearity between the control variables but not the experimental variables (Frost, 2021). For this study, multicollinearity between independent variables will be addressed by removing one of the independent variables that are highly correlated to each other (VIF<1 or VIF>10). To select which variable to remove, I ran two separate logistic regression models, each including one of the independent variables that were correlated. The independent variable included in the model with the highest *R*-squared value

was to be removed (Analytics Vidhya, 2021; Minitab, 2013; Simon Fraser University, 2016).

- The outcome variable must have mutually exclusive categories.
- A linear relationship should exist between the continuous independent variables and the logit transformation of the outcome variable (Laerd Statistics, 2018b).
- Sample size should be large (i.e., minimum of 10 cases for the outcome with the lowest frequency in each independent variable; Schreiber-Gregory, 2018).

Logistic Regression Data Analyses. I had three logistic regression analyses and each was performed hierarchically (A. Field, 2013). The first logistic regression (RQ 1) included depression status, demographics (age, race, educational level, income, and marital status), number of sex partners, infrequent barrier use as the independent variables, and HSV-2 status as the dependent variable. Nonprescription drug use status was not included.

The second logistic regression (RQ 2) included nonprescription drug use status, demographics (age, race, educational level, income, and marital status), number of sex partners, infrequent barrier use as the independent variables, and HSV-2 status as the dependent variable. Depression status was not included.

The third logistic regression (RQ 3) included both depression status and nonprescription drug use status, demographics (age, race, educational level, income, and marital status), number of sex partners, and infrequent barrier use as the independent variables, and HSV-2 status as the dependent variable.

All three logistic regression analyses were assessed in SPSS software using standard logistic regression analysis (Laerd Statistics, 2018a). The reference category for the dependent variable (HSV-2) was set to first (0 = No HSV-2) in the three models. The Nagelkerke R Square value was used to assess variations in the dependent variable based on the logistic regression model (Laerd Statistics, 2018a). The Hosmer-Lemeshow goodness-of-fit test was used to determine which of the models for each logistic regression is the best fit or describes the data most adequately (A. Field, 2013). The model was considered a good fit if the *p* value was >0.05 (A. Field, 2013). The Wald test was used to determine whether the contribution of each independent variable to the model was statistically significant, which is generally ascertained by a $p<0.05$ (Laerd Statistics, 2018a). Odds ratios and 95% confidence intervals were estimated to determine the probability of developing HSV-2 based on a one-unit change in each independent variable when the other independent variables are kept constant (Laerd Statistics, 2018a).

Threats to Validity

External Validity

Selection Bias

Selection bias may occur when the selection of study participants or the likelihood of them finishing the study produces a result that is not the same as the result obtained if the entire target population had been recruited (Boston University, n.d.). To address selection bias, the NHANES methodology includes a complex, multistage probability sample design to randomly select a nationally representative sample of the United States noninstitutionalized population (National Center for Health Statistics, 2018a; Paulose-

Ram et al., 2017). The NHANES also oversamples subgroups of interest (i.e., Asian Americans, Hispanics, non-Hispanic Blacks, older adults, and low income Whites and individuals of Other races) to increase the reliability and precision of estimates (T. Chen et al., 2020; NCHS, 2018a). Selection bias was also reduced by post-stratifying sample weights to population totals from the American Community Survey and based on the 2010 Census (NCHS, 2018a). Since selection bias was already addressed during the NHANES sampling and weighting process, I would not expect my study to be affected by this type of bias if I used the sample weights in my analyses. However, since I did not apply the sample weights in my analyses, my results may have been affected by selection bias (e.g., the relationship between the independent variables and HSV-2 differs between survey participants and those who did not participate; Cheung et al., 2017).

Generalizability

Another threat to external validity is generalizability, which refers to how much the results of a study can be applied to all individuals in the population from which the sample was drawn (Murad et al., 2018). Some researchers try to address generalizability issues after considering the internal validity of their study (Ferguson, 2004). Yet controlling threats to internal validity many times decreases the external validity of their findings (Ferguson, 2004). For the NHANES, the methodology used to randomly draw a representative sample of the United States non-institutionalized population and weight the data served to ensure that analyses results would be generalizable to the non-institutionalized United States population. However, because I used a convenience sample drawn from the NHANES data and did not apply the sample weights during

analyses, I the results of my study were generalizable only to the WSW who participated in the NHANES.

Construct Validity

Construct validity refers to the relationship between the operational definition of the variables and their meaning (Ferguson, 2004). Construct validity is demonstrated through multiple studies to show confidence that the procedure used to measure the construct of interest is valid (Laerd Statistics, 2012). One example of a threat to construct validity is when the construct is inadequately defined (Laerd Statistics, 2012). For my study, I measured depression status using the PHQ-9 screener created by Kroenke et al. (2002) and Spitzer et al. (1999), as per the NHANES analytical guidelines (National Center for Health Statistics, 2018a). The PHQ-9 is a short questionnaire developed to measure depression in study participants and has been validated multiple times (Kroenke et al., 2001, 2010; Kroenke & Spitzer, 2002; Spitzer et al., 1999). For this reason, I did not expect to have any issues with construct validity in my study.

Internal Validity

Sample Nonresponse

One issue related to internal validity is sample nonresponse. Not every individual in the NHANES sample was interviewed and not every individual who was interviewed was examined (NCHS, 2018a). Participant nonresponse, or failure to collect any data on a selected individual, can happen both at the interview stage and the examination stage of the survey (NCHS, 2018a).

The nonresponse bias produced by this missing information could be a major cause of survey error (NCHS, 2018a). Nonresponse bias can be considerable when two situations occur: (a) the survey response rate is relatively low and (b) the difference between the characteristics of participants and non-participants is comparatively large (NCHS, 2018b). Like other national surveys, there have been decreases in NHANES response rates through the years. The overall response rate for the interviewed sample decreased from 72.7% in the 2011–2012 cycle to 71.0% in the 2013–2014 cycle to 61.3% in the 2015–2016 cycle (NCHS, 2018a). While the overall response rate for the examined sample decreased from 69.5% in the 2011–2012 cycle to 68.5% in the 2013–2014 cycle to 58.7% in the 2015–2016 cycle (NCHS, 2018a).

Adjustments to sample weights for survey nonresponse explain only interview or medical examination non-response and do not account for item non-response, which can happen during the interview or examination stage (e.g., individual refused having their blood pressure taken during examination but completed all other exams; NCHS, 2018a). To understand how nonresponse affects NHANES data, the NCHS performed a comprehensive nonresponse bias analysis for the 2013–2014 and the 2015–2016 survey cycles and found no evidence of significant bias in the final estimates (NCHS, 2018b). Although nonresponse bias could not be entirely eliminated, sample weighting effectively decreased nonresponse bias in auxiliary variables related to most outcome estimates (NCHS, 2018b). I would not expect to have issues with sample nonresponse if I applied the sample weights to all my statistical analyses because the weights take into account both interview and medical examination non-response. However, since I did not apply the

sample weights in my analyses, my results may have been affected by nonresponse (e.g., underestimated odds/prevalence of HSV-2; Cheung et al., 2017).

Item Nonresponse

NHANES participants are offered a variety of medical examinations and tests at MECs, with each component consisting of several items (NCHS, 2018a). Some may not take part in all components of their assigned examination or may not participate completely in a specific component (NCHS, 2018a). This causes item non-response.

If the item nonresponse differs considerably by participants' demographic characteristics, the type of item, and survey cycle, then the missing values could bias analysis results (NCHS, 2018a). The amount of missing data in the datasets related to the dependent and independent variables of interest should be assessed to determine if the data can be used without the need for additional re-weighting to adjust for item nonresponse. If 10% or less of the data for the outcome of interest for a specific item is missing for eligible participants, it is acceptable to proceed with the analysis without additional assessment or adjustment (NCHS, 2018a). If over 10% of the data for a variable of interest are missing, further assessment of respondents and nonrespondents with regards to the outcome of interest may be necessary, as well as imputation of missing values or potentially using adjusted weights (NCHS, 2018a). I conducted frequency analyses on my dependent and independent variables prior to any analyses to determine the percent of missingness in each variable and followed the above-described procedure for handling missing data.

Causality

It is difficult to determine causal relationships between variables in this cross-sectional study because the data was collected at one point in time (Singh Setia, 2016). Due to the research design used in this study, I did not attempt to infer causation but only studied predictive relationships between my variables. I addressed this threat to validity by not making any causal inferences and using words that inferred causality.

Ethical Procedures

Original Data Collection

The NHANES protocol complies with the HHS Policy for Protection of Human Research Subjects (45 CFR part 46), was approved by the NCHS Research ERB, and is reviewed annually (U.S. Department of Health and Human Services, 2016; Zipf et al., 2013). This method ensured all participants, including vulnerable populations, received ethical treatment (Zipf et al., 2013). All information collected was protected by three federal laws: (a) Privacy Act of 1974 (5 U.S.C. 552a); (b) Section 308(d) of the Public Health Service Act (42 U.S.C. 242m); and (c) Confidential Information Protection and Statistical Efficiency Act (CDC, 2017b; Zipf et al., 2013).

The Public Health Service Act specifies that no information can be used for any other purpose than that for which it was provided, unless a participant consents to it, and that the information cannot be shared in a way that makes it possible to identify participants, unless they consent to it (Zipf et al., 2013). All NHANES staff abided by these strict rules, which forbade even accidental unauthorized sharing of information, and signed nondisclosure affidavits (Zipf et al., 2013). Staff were ordered not to disclose

participants' names or other identifiable information and to avoid discussing survey participants inside or outside of the MEC, as it could be overheard by others not working with NHANES. Data collected was kept in interviewer and MEC computers and was password protected, encrypted, and protected by other information technology security procedures (Zipf et al., 2013).

Current Study

I have completed human subject ethics training and my certificate will be valid until I graduate (See Appendix C). Once the proposal was approved, I applied for Walden University IRB approval. The NHANES data was not downloaded until after this approval was granted. The NHANES data are anonymous and do not include any personally identifiable information. Once the dataset was downloaded, I kept it in a password protected computer. The only individuals who were given access to my data were my committee members and designees of the IRB if requested. I will keep the data and results from my study for five years after I receive approval from the Chief Academic Officer (CAO), after which this information will be destroyed.

Summary

The purpose of this study was to determine whether nonprescription drug use is related to the probability of developing HSV-2 infection in WSW who experience depression. For this, I conducted a quantitative correlational study of a cross-sectional nature using a convenience sample drawn from secondary data previously collected for the NHANES cycles 2009–2010, 2011–2012, 2013–2014, and 2015–2016 combined. My sample population consisted of participants who: (a) self-identified as women, (b) were

aged 18–49 years old (HSV-2 testing was conducted only among participants in this age group), (c) were tested for HSV-2, and (d) reported sex of sex partner(s) (i.e., women or both men and women).

To answer my research question, I performed three separate logistic regression analyses. The first logistic regression (RQ 1) included depression status, age, race, educational level, income, marital status, number of sex partners, and infrequent barrier use as the independent variables and HSV-2 status as the dependent variable. The second logistic regression (RQ 2) included nonprescription drug use status, age, race, educational level, income, marital status, number of sex partners, and infrequent barrier use as the independent variables and HSV-2 status as the dependent variable. The third logistic regression (RQ 3) included both depression status and nonprescription drug use status, as well as age, race, educational level, income, marital status, number of sex partners, and infrequent barrier use as the independent variables and HSV-2 status as the dependent variable. Odds ratios and 95% confidence intervals were estimated to determine the probability of developing HSV-2 based on each independent variable (Laerd Statistics, 2018b). I will present the results of these analyses in Chapter 4.

Chapter 4: Results

The purpose of this study was to assess the predictive relationship between demographics (i.e., age, race, educational level, income, and marital status), number of sex partners, infrequent barrier use, depression status (as measured by the Patient Health Questionnaire-9 [PHQ-9]), nonprescription drug use status, and herpes simplex virus type 2 (HSV-2) status in women who have sex with women (WSW). I conducted a quantitative, correlational study of a cross-sectional nature using secondary data from the National Health and Nutrition Examination Survey (NHANES). The following research questions and corresponding hypotheses guided this study:

Research Question 1 (RQ 1): What is the predictive relationship between demographics (age, race, educational level, income, and marital status), number of sex partners, infrequent barrier use, depression status (as measured by the PHQ-9), and HSV-2 status in WSW?

$H_0$1: There is no statistically significant predictive relationship between demographics (age, race, educational level, income, and marital status), number of sex partners, infrequent barrier use, depression status (as measured by the PHQ-9), and HSV-2 status in WSW.

H_a1: There is a statistically significant predictive relationship between demographics (age, race, educational level, income, and marital status), number of sex partners, infrequent barrier use, depression status (as measured by the PHQ-9), and HSV-2 status in WSW.

RQ 2: What is the predictive relationship between demographics (age, race, educational level, income, and marital status), number of sex partners, infrequent barrier use, nonprescription drug use status, and HSV-2 status in WSW?

$H_0$2: There is no statistically significant predictive relationship between demographics (age, race, educational level, income, and marital status), number of sex partners, infrequent barrier use, nonprescription drug use status, and HSV-2 status in WSW.

H_a2: There is a statistically significant predictive relationship between demographics (age, race, educational level, income, and marital status), number of sex partners, infrequent barrier use, nonprescription drug use status, and HSV-2 status in WSW.

RQ 3: What is the predictive relationship between demographics (age, race, educational level, income, and marital status), number of sex partners, infrequent barrier use, depression status (as measured by the PHQ-9), nonprescription drug use status, and HSV-2 status in WSW?

$H_0$3: There is no statistically significant predictive relationship between demographics (age, race, educational level, income, and marital status), number of sex partners, infrequent barrier use, depression status (as measured by the PHQ-9), nonprescription drug use status, and HSV-2 status in WSW.

H_a3: There is a statistically significant predictive relationship between demographics (age, race, educational level, income, and marital status), number

of sex partners, infrequent barrier use, depression status (as measured by the PHQ-9), nonprescription drug use status, and HSV-2 status in WSW.

In this chapter, I discuss the data collection and data cleaning process, as well as any discrepancies in the data cleaning process from what was stated in Chapter 3. This is followed by a discussion of the analysis of the results, where I discuss the post hoc power calculation, sample demographics, chi square analyses results, assumption testing, and the logistic regression analysis results for each research question.

Data Collection

Data Collection

My study proposal was approved by Walden University on August 12, 2021, and I obtained Institutional Review Board (IRB) approval for my study on August 24, 2021 (Approval no. 08–24–21–0327014). After IRB approval, I downloaded the data from the NHANES website on August 25. I then followed the data collection plan described in Chapter 3 without any discrepancies from what was stated. The NHANES datasets included de-identified information from individuals who participated in cycles 2009–2010, 2011–2012, 2013–2014, and 2015–2016.

Data Cleaning

I created new analysis variables (independent and dependent) by recoding the original variables in Appendix B as appropriate following the coding proposed in Table 9 of Chapter 3. However, there were some discrepancies in the data cleaning process from what was stated in Chapter 3. I first changed the labeling of the response categories in the RACE variable from “White” to “Non-Hispanic White” and from “Non-White” to “Not

non-Hispanic White" to be more consistent with how data for race/Hispanic ethnicity was collected in the NHANES (see Table 10). Then, I added two continuous variables, total number of male sex partners and total number of female sex partners, to the demographics analysis since my sample of WSW comprises women who have sex with women only (WSW-only) and women who have sex with both men and women (WSMW). For all the continuous variables (i.e., age, total number of sex partners, total number of male sex partners, and total number of female sex partners), I created new categorical variables to use in the demographics and chi-square analyses, as appropriate. The new categorical age variable has four age group categories: 18–24 years, 25–29 years, 30–34 years, and 35–49 years. The new categorical variables for total number of sex partners, total number of male sex partners, and total number of female sex partners have three response categories: 0–1, 2–10, and 11 or more sex partners. I also created a new categorical variable for income status to use in the chi-square analysis. This new income variable included three categories: $0 to $34,999, $35,000 to $74,999, and $75,000 and over.

Results

Post Hoc Power Calculation

It is difficult to calculate the statistical power for multiple logistic regression before having the sample and being able to calculate the odds ratio (Allen & Le, 2008; H. Chen et al., 2010; Ialongo, 2016). For this reason, I calculated the statistical power for my analysis after data cleaning and analyses were completed. I conducted post hoc power

analysis as per the plan stated in Chapter 3 using G*Power and entered the following criteria:

1. Test family = *z* tests
2. Statistical test = logistic regression
3. Type of power analysis = Post hoc: Compute achieved power – given α, sample size, and effect size
4. Tail(s) = two
5. *OR* = 1.2
6. Pr (Y = 1| X = 1) H0 = 0.25
7. α err prob = 0.05
8. Total sample size = 597
9. X distribution = binomial
10. X parm Π = 0.5

Based on these criteria, the resulting power was 0.136 (or 13.6%), which is lower than the recommended minimum power of 0.80 or 80% (Cohen, 1988; Ellis, 2010). Therefore, the probability of making a Type II error, or accepting the null hypothesis when it is false, in my study was high at 86.4% (Cohen, 1988; Ellis, 2010). This will be addressed as a limitation as well as in the Recommendations section in Chapter 5.

Sample Demographics

My final sample consisted of 597 WSW aged 18–49 years (see Table 10). Because this was a convenience sample, analyses results were only generalizable to the WSW in my sample. WSMW accounted for most of the sample (96.6%; Table 10). WSW

more frequently reported being not Non-Hispanic White (56.3%), 35–49 years old (35.0%; *M* = 31 years), having a high school education or higher (81.7%), not being married (57.9%), and an income of $25,000–$34,999 or higher (54.0%). More WSW reported having a total of 11 or more sex partners in their lifetime (59.3%; *M* = 20), infrequent barrier use in the past 12 months (94.1%), no depression in the past two weeks (79.0%), no nonprescription drug use in their lifetime (66.2%) and tested negative for HSV-2 infection (69.7%).

Table 10

Sample Demographics

Characteristic	*N*	%
Sex of sex partners (*N* = 597)		
WSW-only	20	3.4
WSMW	577	96.6
Race (*N* = 597)		
Non-Hispanic White	261	43.7
Not Non-Hispanic White	336	56.3
Age group (*M* = 31 years; *N* = 597)		
18–24 years	179	30.0
25–29 years	122	20.4
30–34 years	87	14.6
35–49 years	209	35.0
Educational level (*N* = 597)		
No high school diploma	109	18.3
High school or more	488	81.7
Marital status [a] (*N* = 549)		
Not married	318	57.9
Married / living with partner	231	42.1
Income [b] (*N* = 571)		
$0 to $4,999	39	6.8
$5,000 to $9,999	45	7.9
$10,000 to $14,999	57	10.0
$15,000 to $19,999	52	9.1
$20,000 to $24,999	70	12.3
$25,000 to $34,999	69	12.1
$35,000 to $44,999	60	10.5
$45,000 to $54,999	38	6.7
$55,000 to $64,999	28	4.9
$65,000 to $74,999	19	3.3
$75,000 to $99,999	34	6.0
$100,000 and over	60	10.5
Total number of male sex partners (Lifetime; *M* = 17; *N* = 597)		
0–1	44	7.4
2–10	295	49.5
11 or More	257	43.1
Total number of female sex partners (Lifetime; *M* = 3; *N* = 597)		
0–1	239	40.1
2–10	332	55.7
11 or More	25	4.2
Total number of sex partners (Lifetime; *M* = 20; *N* = 597)		
0–1	7	1.2
2–10	236	39.5
11 or more	354	59.3
Infrequent barrier use (*N* = 560)		
Frequent barrier use	33	5.9
Infrequent barrier use	527	94.1
Depression status (*N* = 596)		
No depression (PHQ-9 Score 0–9)	471	79.0
Depression (PHQ-9 Score 10–27)	125	21.0
Nonprescription drug use status (*N* = 597)		
No nonprescription drug use	395	66.2
Nonprescription drug use	202	33.8
HSV-2 status (*N* = 597)		
No HSV-2	416	69.7
HSV-2	181	30.3

Note. PHQ-9 = Patient Health Questionnaire-9; WSW-only = Women who have sex with women only; WSMW = Women who have sex with both men and women.

[a] Data on marital status was publicly available only for adults aged ≥ 20 years. [b] Fourteen (2.3%) observations were excluded from the percentage calculation because they did not include specific information on income level (i.e., "$20,000 and Over" and "Under $20,000").

Chi-Square Analyses

Prior to conducting chi-square analyses, I made sure the assumptions of this test were met: (a) both variables tested should be either nominal or ordinal and (b) both variables tested must have at least two mutually exclusive categories (Laerd Statistics, 2018a). I then conducted chi-square analyses to determine differences between each independent variable and the dependent variable. A p value of < 0.05 was used to determine statistical significance.

The phi coefficient was used to determine the strength of each relationship when the independent variable was dichotomous and Cramer's V (Cramer's phi) coefficient was used for the same purpose when the independent variable had more than two response categories (SPSS Tutorials, 2021). The values for the phi coefficient range from -1 to 1 (Glen, 2021b). Specifically, 0 indicates no relationship, 1 indicates a perfect positive relationship, and -1 indicates a perfect negative relationship (Glen, 2021b). The values for Cramer's V range from 0–1, with 0 indicating no relationship and 1 indicating a perfect relationship (SPSS Tutorials, 2021). Specifically, .0 to less than .10 indicates a negligible relationship, .10 to less than .20 indicates a weak relationship, .20 to less than .40 indicates a moderate relationship, .40 to less than .60 indicates a relatively strong

relationship, .60 to less than .80 indicates a strong relationship, and .80 to less than 1.00 indicates a very strong relationship (Rea & Parker, 1992).

Sex of Sex Partners and HSV-2 Status

I conducted a chi-square analysis to determine whether HSV-2 status differed at a statistically significant level by sex of sex partners category. Results indicated that WSMW were more likely to have a positive HSV-2 status than WSW-only (see Table 11). This difference in HSV-2 status between WSW-only and WSMW was statistically significant, χ^2 (1, N = 597) = 4.04, p = 0.04. However, the phi coefficient (.082) indicated that this relationship was negligible (Glen, 2021b). This means there was almost no difference between HSV-2 status and sex of sex partner groups. It should also be noted that there were only 20 WSW-only (with 577 in WSMW) in my sample, so the results of this analysis should be interpreted with caution.

Table 11

Sex of Sex Partners and HSV-2 Status

Sex of sex partners	HSV-2 status		Total
	HSV-2	No HSV-2	
WSW-only	2	18	20
WSMW	179	398	577
Total	181	416	597

Note. χ^2 (1, N = 597) = 4.04, p = 0.04. WSW-only = Women who have sex with women only; WSMW = Women who have sex with both men and women.

Race and HSV-2 Status

I conducted a chi-square analysis to determine whether HSV-2 status differed at a statistically significant level by race category. Results indicated that not non-Hispanic Whites were more likely to have a positive HSV-2 status than non-Hispanic Whites (see Table 12). This difference in HSV-2 status between non-Hispanic White and not non-Hispanic White was statistically significant, χ^2 (1, N = 597) = 11.79, p = 0.001. However, the phi coefficient (.141) indicated that this relationship was negligible (Glen, 2021b). This means there was almost no difference between HSV-2 status by race groups.

Table 12

Race and HSV-2 Status

Race	HSV-2 status		Total
	HSV-2	No HSV-2	
Non-Hispanic White	60	201	261
Not Non-Hispanic White	121	215	336
Total	181	416	597

Note. χ^2 (1, N = 597) = 11.79, p = 0.001.

Age Group and HSV-2 Status

I conducted a chi-square analysis to determine whether HSV-2 status differed at a statistically significant level by age group. Results indicated that 35–49-year-olds were more likely to have a positive HSV-2 status than individuals in other age groups (see Table 13). This difference in HSV-2 status between 18–24-year-olds, 25–29-year-olds, 30–34-year-olds, and 35–49-year-olds was statistically significant, χ^2 (3, N = 597) = 33.40, p = 0.000. However, the phi coefficient (.237) indicated that this relationship was

weak (Glen, 2021b). This means there was almost no difference between HSV-2 status by age group.

Table 13

Age Group and HSV-2 Status

Age group	HSV-2 status		Total
	HSV-2	No HSV-2	
18–24 years	31	148	179
25–29 years	29	93	122
30–34 years	32	55	87
35–49 years	89	120	209
Total	181	416	597

Note. χ^2 (3, N = 597) = 33.40, p = 0.000.

Educational Level and HSV-2 Status

I conducted a chi-square analysis to determine whether HSV-2 status differed at a statistically significant level by educational level. Results indicated that those with high school or more were more likely to have a positive HSV-2 status than individuals with no high school diploma (see Table 14). This difference in HSV-2 status between no high school diploma and high school or more was statistically significant, χ^2 (1, N = 597) = 8.91, p = 0.003. However, the phi coefficient (-.122) indicated that this negative relationship was negligible (Glen, 2021b). This means there was almost no difference between HSV-2 status by educational level.

Table 14

Educational Level and HSV-2 Status

Educational level	HSV-2 status		Total
	HSV-2	No HSV-2	
No high school diploma	46	63	109
High school or more	135	353	488
Total	181	416	597

Note. χ^2 (1, N = 597) = 8.91, p = 0.003.

Marital Status and HSV-2 Status

I conducted a chi-square analysis to determine whether HSV-2 status differed at a statistically significant level by marital status. Results indicated that those who were not married were more likely to have a positive HSV-2 status than those who were married/living with a partner (see Table 15). This difference in HSV-2 status between not married and married/living with a partner was statistically significant, χ^2 (1, N = 549) = 5.32, p = 0.021. However, the phi coefficient (-.098) indicated that this negative relationship was negligible (Glen, 2021b). This means there was almost no difference between HSV-2 status by marital status.

Table 15

Marital Status and HSV-2 Status

Marital status [a]	HSV-2 status		Total
	HSV-2	No HSV-2	
Not married	115	203	318
Married/ living with partner	62	169	231
Total	177	372	549

Note. χ^2 (1, N = 549) = 5.32, p = 0.021.

[a] Results are for adults aged ≥20 years old.

Income and HSV-2 Status

I conducted a chi-square analysis to determine whether HSV-2 status differed at a statistically significant level by income category. Results indicated that those with an income of $0 to $34,999 were more likely to have a positive HSV-2 status than individuals with an income of $35,000 or higher (see Table 16). The difference in HSV-2 status between an income of $0 to $34,999, $35,000 to $74,999, and $75,000 and over was statistically significant, χ^2 (2, N = 571) = 14.13, p = 0.001. However, the phi coefficient (.157) indicated that this relationship was negligible (Glen, 2021b). This means there was almost no difference between HSV-2 status by income group.

Table 16

Income and HSV-2 Status

Income	HSV-2 status		Total
	HSV-2	No HSV-2	
$0 to $34,999	112	220	332
$35,000 to $74,999	46	99	145
$75,000 and over	13	81	94
Total	171	400	571

Note. χ^2 (2, N = 571) = 14.13, p = 0.001.

Total Number of Sex Partners and HSV-2 Status

I conducted a chi-square analysis to determine whether HSV-2 status differed at a statistically significant level by total number of sex partners category. Results indicated that those with 11 or more sex partners were more likely to have a positive HSV-2 status than individuals with 10 or less sex partners (see Table 17). The difference in HSV-2 status between having 0–1, 2–10, and 11 or more sex partners was statistically significant, χ^2 (2, N = 597) = 20.24, p = 0.000. However, the phi coefficient (.184) indicated that this relationship was negligible (Glen, 2021b). This means there was almost no difference between HSV-2 status by total number of sex of sex partners. It should be noted that the 0–1 sex partner category used for the total number of sex partners variable in Table 17 aligns with that used in the STI and sexual behavior literature (Buchacz et al., 2000; Diamant et al., 1999; Grabovac et al., 2020; Mercer et al., 2018; Muzny, Austin, et al., 2014; N & A, 2015; Ueda et al., 2020; Xu, Sternberg, & Markowitz, 2010b). Because they are considered to be at low risk for HSV-2 and other STIs, individuals with 0–1 sex partners are generally placed in separate categories from

those with more than 1 sex partners (considered to be at higher risk for HSV-2). Therefore, it was important to align my groups to those that are used in this discipline to ensure that the data provided through my study is comparable with the work of other researchers.

Table 17

Total Number of Sex Partners and HSV-2 Status

Total number of sex partners	HSV-2 status		Total
	HSV-2	No HSV-2	
0–1	2	5	7
2–10	47	189	236
11 or more	132	222	354
Total	181	416	597

Note. χ^2 (2, N = 597) = 20.24, p = 0.000.

Infrequent Barrier Use and HSV-2 Status

I conducted a chi-square analysis to determine whether HSV-2 status differed at a statistically significant level by infrequent barrier use group. The difference in HSV-2 status between frequent barrier use and infrequent barrier use was not statistically significant, χ^2 (1, N = 560) = 0.15, p = 0.701 (see Table 18). The phi coefficient (-.016) indicated that this negative relationship was negligible (Glen, 2021b). This confirms there was no difference between HSV-2 status by infrequent barrier use group.

Table 18

Infrequent Barrier Use and HSV-2 Status

Infrequent barrier use	HSV-2 status		Total
	HSV-2	No HSV-2	
Frequent barrier use	11	22	33
Infrequent barrier use	159	368	527
Total	170	390	560

Note. χ^2 (1, N = 560) = 0.15, p = 0.701.

Depression Status and HSV-2 Status

I conducted a chi-square analysis to determine whether HSV-2 status differed at a statistically significant level by depression status. Results indicated that those who with no depression were more likely to have a positive HSV-2 status than individuals with depression (see Table 19). The difference in HSV-2 status between no depression and depression was statistically significant, χ^2 (1, N = 596) = 3.91, p = 0.048. The phi coefficient (.081) indicated that this relationship was negligible (Glen, 2021b). This means there was almost no difference between HSV-2 status by depression status.

Table 19

Depression Status and HSV-2 Status

Depression status	HSV-2 status		Total
	HSV-2	No HSV-2	
No depression	134	337	471
Depression	47	78	125
Total	181	415	596

Note. χ^2 (1, N = 596) = 3.91, p = 0.048.

Nonprescription Drug Use Status and HSV-2 Status

I conducted a chi-square analysis to determine whether HSV-2 status differed at a statistically significant level by nonprescription drug use status. Results indicated that those who reported no nonprescription drug use were more likely to have a positive HSV-2 status than individuals who reported nonprescription drug use (see Table 20). The difference in HSV-2 status between no nonprescription drug use and nonprescription drug use was statistically significant, χ^2 (1, N = 597) = 12.46, p = 0.000. The phi coefficient (.144) indicated that this relationship was negligible (Glen, 2021b). This means there was almost no difference between HSV-2 status by nonprescription drug use status.

Table 20

Nonprescription Drug Use Status and HSV-2 Status

Nonprescription drug use	HSV-2 status		Total
	HSV-2	No HSV-2	
No nonprescription drug use	101	294	395
Nonprescription drug use	80	122	202
Total	181	416	597

Note. χ^2 (1, N = 597) = 12.46, p = 0.000.

Assumption Testing

Research Question 1 (RQ 1) Assumptions

The following assumptions were met for RQ 1: (1) the dependent variable must be dichotomous (yes/no), (2) one or more independent variables should be either continuous or categorical (all are), (3) the outcome variable must have mutually exclusive

categories (yes/no), and (4) a minimum of 10 cases for the outcome with the lowest frequency in each independent variable (met for each). I determined the existence of multicollinearity between the independent variables by calculating the Pearson's correlation coefficient (*r*) and the variance inflation factor (VIF; Frost, 2021; Laerd Statistics, 2018a).

Multicollinearity (Pearson's Correlation). A Pearson's correlation coefficient value can range from -1 to 1, where -1 indicates a perfect negative linear relationship, 0 indicates no relationship, and 1 indicates a perfect positive linear relationship (Laerd Statistics, 2018c). The general rule for determining the strength of such relationships is that an *r* value of .1–.3 (or -.1 to -.3) indicates a weak correlation, an *r* value of more than .3 to .5 (or more than -.3 to -.5) indicates a moderate correlation, and an *r* value of more than .5 to 1.0 (or more than -.5 to -1.0) indicates a strong correlation (Laerd Statistics, 2018c). If any variable has an *r* value of more than +/- .5, then these should be excluded from the binary logistic regression to ensure multicollinearity is not a problem during the analysis (A. Field, 2013). The results of the Pearson's correlation test indicated that none of the variables were highly correlated because the *r* values ranged from -.1 to .2, indicating statistically significant weak correlations. All variables were included in the logistic regression analysis for RQ 1 (see Table 21).

Table 21

Pearson's Correlation Results for RQ 1

	Age	Race	Educational level	Income	Marital status [a]	Total number of sex partners (lifetime)	Infrequent barrier use	Depression status
Age								
Pearson *r*	1.0	-.138**	.036	.157**	.107*	.193**	-.057	-.004
N	597	597	597	571	549	597	560	596
Race								
Pearson *r*		1.0	.012	-.016	-.123**	-.057	.055	-.010
N		597	597	571	549	597	560	596
Educational level								
Pearson *r*			1.0	.244**	-.001	.009	.097*	-.129**
N			597	571	549	597	560	596
Income								
Pearson *r*				1.0	.186**	-.023	.019	-.182**
N				571	525	571	537	570
Marital status [a]								
Pearson *r*					1.0	-.033	.013	-.051
N					549	549	514	549
Total number of sex partners (lifetime)								
Pearson *r*						1.0	.084*	.085*
N						597	560	596
Infrequent barrier use								
Pearson *r*							1.0	.036
N							560	559
Depression status								
Pearson *r*								1.0
N								596

[a] Results are for adults aged ≥20 years old.

** = Correlation is statistically significant at the $p < 0.01$ level. * = Correlation is statistically significant at the $p < 0.05$ level.

Multicollinearity (VIF). Researchers use a VIF value of 1–10 to indicate no correlation, while a value of <1 or >10 indicates multicollinearity (Braunstein, 2007; Frost, 2021; Senaviratna & Cooray, 2019; SPSS Tests, 2018). Table 22 shows that the VIF values for all independent variables in RQ 1 were higher than 1. This indicates that there was no multicollinearity between independent variables because all the VIF values

were between 1–10 (Braunstein, 2007; Frost, 2021; Senaviratna & Cooray, 2019; SPSS Tests, 2018). Given the results of both the Pearson's correlation test and the VIF, I included all variables in the logistic regression analysis for RQ 1.

Table 22

Variance Inflation Factor (VIF) Results for RQ 1 [a]

Model	Collinearity statistics	
	Tolerance	VIF
(Constant)		
Age	0.911	1.098
Race	0.976	1.025
Educational level	0.913	1.095
Income	0.863	1.158
Marital status [a]	0.933	1.072
Total number of sex partners (lifetime)	0.946	1.057
Infrequent barrier use	0.962	1.039
Depression status	0.941	1.063

Note. VIF = Variance Inflation Factor. Dependent Variable: HSV-2 Status.

[a] Results are for adults aged ≥20 years old.

Research Question 2 (RQ 2) Assumptions

The following assumptions were met for RQ 2: (1) the dependent variable must be dichotomous, (2) one or more independent variables should be either continuous or categorical, (3) the outcome variable must have mutually exclusive categories, and (4) a minimum of 10 cases for the outcome with the lowest frequency in each independent variable.

Multicollinearity (Pearson's Correlation). The results of the Pearson's correlation test indicated that none of the variables were highly correlated. Most of the *r* values ranged from -.1 to .2, indicating statistically significant but weak correlations

between most variables (see Table 23). However, a statistically significant moderate correlation was observed between total number of sex partners and nonprescription drug use status (r = .310, p = 0.000). I used the VIF value to determine whether to include these two variables in the logistic regression analysis for RQ 2.

Table 23

Pearson's Correlation Results for RQ 2

	Age	Race	Educational level	Income	Marital status [a]	Total number of sex partners (lifetime)	Infrequent barrier use	Nonprescription drug use status
Age								
Pearson *r*	1.0	-.138**	.036	.157**	.107*	.193**	-.057	.188**
N	597	597	597	571	549	597	560	597
Race								
Pearson *r*		1.0	.012	-.016	-.123**	-.057	.055	-.155**
N		597	597	571	549	597	560	597
Educational level								
Pearson *r*			1.0	.244**	-.001	.009	.097*	-.019
N			597	571	549	597	560	597
Income								
Pearson *r*				1.0	.186**	-.023	.019	-.017
N				571	525	571	537	571
Marital status [a]								
Pearson *r*					1.0	-.033	.013	.005
N					549	549	514	549
Total number of sex partners (lifetime)								
Pearson *r*						1.0	.084*	.310**
N						597	560	597
Infrequent barrier use								
Pearson *r*							1.0	.020
N							560	560
Nonprescription drug use status								
Pearson *r*								1.0
N								597

[a] Results are for adults aged ≥20 years old.

** = Correlation is statistically significant at the $p < 0.01$ level. * = Correlation is statistically significant at the $p < 0.05$ level.

Multicollinearity (VIF). Table 24 shows that the VIF values for all independent variables in RQ 2 were higher than 1. This indicates that there was no multicollinearity between independent variables because the VIF values were all between 1–10 (Braunstein, 2007; Frost, 2021; Senaviratna & Cooray, 2019; SPSS Tests, 2018). Given the results of both the Pearson's correlation test and the VIF, I included all variables in the logistic regression analysis for RQ 2.

Table 24

Variance Inflation Factor (VIF) Results for RQ 2 [a]

Model	Collinearity statistics	
	Tolerance	VIF
(Constant)		
Age	0.898	1.113
Race	0.961	1.041
Educational level	0.920	1.087
Income	0.882	1.134
Marital status [a]	0.934	1.070
Total number of sex partners (lifetime)	0.857	1.166
Infrequent barrier use	0.962	1.040
Nonprescription drug use	0.849	1.177

Note. VIF = Variance Inflation Factor. Dependent Variable: HSV-2 Status.

[a] Results are for adults aged ≥20 years old.

Research Question 3 (RQ 3) Assumptions

The following assumptions were met for RQ 3: (a) the dependent variable must be dichotomous, (b) one or more independent variables should be either continuous or categorical, (c) the outcome variable must have mutually exclusive categories, and (d) a

minimum of 10 cases for the outcome with the lowest frequency in each independent variable.

Multicollinearity (Pearson's Correlations). The results of the Pearson's correlation test indicated that none of the variables were highly correlated (see Table 25). Most of the *r* values ranged from -.1 to .2, indicating statistically significant weak correlations between most variables (see Table 25). However, a statistically significant moderate correlation was observed between total number of sex partners and nonprescription drug use status ($r = .310$, $p = 0.000$). I used the VIF value to determine whether to include these two variables in the logistic regression analysis for RQ 3.

Table 25

Pearson's Correlation Results for RQ 3

	Age	Race	Educational level	Income	Marital status [a]	Total number of sex partners (lifetime)	Infrequent barrier use	Nonprescription drug use status	Depression status
Age									
Pearson *r*	1.0	-.138**	.036	.157**	.107*	.193**	-.057	.188**	-.004
N	597	597	597	571	549	597	560	597	596
Race									
Pearson *r*		1.0	.012	-.016	-.123**	-.057	.055	-.155**	-.010
N		597	597	571	549	597	560	597	596
Educational level									
Pearson *r*			1.0	.244**	-.001	.009	.097*	-.019	-.129**
N			597	571	549	597	560	597	596
Income									
Pearson *r*				1.0	.186**	-.023	.019	-.017	-.182**
N				571	525	571	537	571	570
Marital status [a]									
Pearson *r*					1.0	-.033	.013	.005	-.051
N					549	549	514	549	549
Total number of sex partners (lifetime)									
Pearson *r*						1.0	.084*	.310**	.085*
N						597	560	597	596
Infrequent barrier use									
Pearson *r*							1.0	.020	.036
N							560	560	559
Nonprescription drug use status									
Pearson *r*								1.0	.066
N								597	596
Depression status									
Pearson *r*									1.0
N									596

[a] Results are for adults aged ≥20 years old.

** = Correlation is statistically significant at the $p < 0.01$ level; * = Correlation is statistically significant at the $p < 0.05$ level.

Multicollinearity (VIF). Table 26 shows that the VIF values for all independent variables in RQ 3 were higher than 1. This indicates that there was no multicollinearity between independent variables because the VIF values were between 1–10 (Braunstein, 2007; Frost, 2021; Senaviratna & Cooray, 2019; SPSS Tests, 2018). Given the results of both the Pearson's correlation test and the VIF, I included all variables in the logistic regression analysis for RQ 3.

Table 26

Variance Inflation Factor (VIF) Results for RQ 3 [a]

Model	Collinearity statistics	
	Tolerance	VIF
(Constant)		
Age	0.898	1.114
Race	0.961	1.041
Educational level	0.912	1.096
Income	0.863	1.158
Marital status [a]	0.933	1.072
Total number of sex partners (lifetime)	0.849	1.178
Infrequent barrier use	0.962	1.040
Nonprescription drug use	0.848	1.179
Depression status	0.940	1.064

Note. VIF = Variance Inflation Factor. Dependent Variable: HSV-2 Status.

[a] Results are for adults aged ≥20 years old.

Results Research Question 1 (RQ 1)

I conducted a multiple logistic regression using the enter method in SPSS to determine whether there is a statistically significant predictive relationship between demographics (i.e., age, race, educational level, income, and marital status), number of sex partners, infrequent barrier use, depression status (as measured by the PHQ-9), and

HSV-2 status in WSW. In step one, I entered all demographic variables (i.e., age, race, marital status, income level, and educational level) in the model. In step two, I entered all variables related to sexual behavior (i.e., total number of sex partners and infrequent barrier use) to the model. In the third and final step, I entered depression status to the model.

Results from the third model explained 25.0% (Nagelkerke R squared) of the variance in HSV-2 status and correctly classified 72.2% of cases. The result from the Hosmer and Lemeshow goodness-of-fit test indicated that the third model was not a good fit because the *p* value was statistically significant ($p = 0.02$). Since no multicollinearity was found between any of the independent variables, I am not sure why the Hosmer and Lemeshow goodness-of-fit test was statistically significant (Field, 2013; Laerd Statistics, 2018). My decision to select the third model as the best fit was based on previous research indicating there is a statistically significant relationship between depression and HSV-2 (Kelly et al., 2016; Muzny et al., 2018; Operario et al., 2015). It was therefore necessary to keep depression status while including the other independent variables of demographics (i.e., age, race, educational level, income, and marital status), number of sex partners, infrequent barrier use, depression status as it was important to understand how each of these variables added to one another in relation to the outcome of HSV-2 status. Removing depression status and any of the other independent variables from my model would not allow me to reach a conclusion about such a relationship.

Age (p = 0.000), race (p = 0.000), educational level (p = 0.024), income (p = 0.002), and total number of sex partners (p = 0.001) were all predictively related to HSV-2 status at statistically significant levels (see Table 27).

Table 27

Results of Multiple Logistic Regression for RQ 1

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I. for EXP(B)	
								Lower	Upper
Step 3[a]	Age	0.080	0.014	32.850	1	**0.000**	1.084	1.054	1.114
	Race(1)	1.070	0.230	21.702	1	**0.000**	2.916	1.859	4.574
	Educational level(1)	-0.656	0.291	5.069	1	**0.024**	0.519	0.293	0.919
	Income	-0.095	0.030	9.896	1	**0.002**	0.909	0.857	0.965
	Marital status [b](1)	-0.405	0.225	3.224	1	0.073	0.667	0.429	1.038
	Total number of sex partners (lifetime)	0.017	0.005	11.509	1	**0.001**	1.017	1.007	1.027
	Infrequent barrier use(1)	-0.103	0.476	0.047	1	0.828	0.902	0.355	2.293
	Depression status(1)	0.344	0.267	1.655	1	0.198	1.410	0.835	2.382
	Constant	-2.977	0.705	17.833	1	0.000	0.051		

[a] Variable(s) entered on step 3: Depression Status. [b] Results are for adults aged ≥20 years old.

The odds ratios (Exp[B]) results for each of the variables that were statistically significant are below:

- Age: For each increase of one year in age, an individual was 1.08 times more likely to have HSV-2 (*OR* = 1.08, 95% CI [1.05, 1.11], p = 0.000).
- Race: Individuals who were not non-Hispanic White were 2.92 times more likely to have HSV-2 than those who were non-Hispanic White (*OR* = 2.92, 95% CI [1.88, 4.60], p = 0.000).

- Education level: Individuals with a high school education or more were 0.52 times less likely to have HSV-2 than those with no high school diploma (*OR* = 0.52, 95% CI [0.29, 0.92], *p* = 0.024).
- Income: For each increase in income level, an individual was 0.91 times less likely to have HSV-2 (*OR* = 0.91, 95% CI [0.89, 0.97], *p* = 0.002).
- Total number of sex partners: For each increase of one sex partner, an individual was 1.02 times more likely to have HSV-2 (*OR* = 1.02, 95% CI [1.01, 1.03], *p* = 0.001).

Because all independent variables in the model were not predictively related to HSV-2 status, the null hypothesis was partially rejected for RQ 1.

Results Research Question 2 (RQ 2)

I conducted a multiple logistic regression using the enter method in SPSS to determine whether there is a statistically significant predictive relationship between demographics (i.e., age, race, educational level, income, and marital status), number of sex partners, infrequent barrier use, nonprescription drug use status and HSV-2 status in WSW. In step one, I entered all demographic variables (i.e., age, race, marital status, income level, and educational level) in the model. In step two, I entered all variables related to sexual behavior (i.e., total number of sex partners and infrequent barrier use) to the model. In the third and final step, I entered nonprescription drug status to the model.

Results from the multiple logistic regression indicated that the third model explained 25.0% (Nagelkerke R squared) of the variance in HSV-2 status and correctly classified 71.4% of cases. The result from the Hosmer and Lemeshow goodness-of-fit test

indicated that the model was a good fit since the *p* value was not statistically significant ($p = 0.78$). This was the best model because the Hosmer and Lemeshow goodness-of-fit test result was higher than that for the first ($p = 0.08$) and second ($p = 0.55$) models.

Age ($p = 0.000$), race ($p = 0.000$), educational level ($p = 0.021$), income ($p = 0.001$), and total number of sex partners ($p = 0.003$) were all predictively related to HSV-2 status at statistically significant levels (see Table 28).

Table 28

Results of Multiple Logistic Regression for RQ 2

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I. for EXP(B)	
								Lower	Upper
Step 3[a]	Age	0.079	0.014	31.101	1	**0.000**	1.082	1.052	1.112
	Race(1)	1.114	0.233	22.874	1	**0.000**	3.046	1.930	4.808
	Educational level(1)	-0.674	0.291	5.365	1	**0.021**	0.510	0.288	0.902
	Income	-0.101	0.030	11.542	1	**0.001**	0.904	0.853	0.958
	Marital status [b](1)	-0.410	0.225	3.322	1	0.068	0.663	0.427	1.031
	Total number of sex partners (lifetime)	0.015	0.005	8.695	1	**0.003**	1.015	1.005	1.026
	Infrequent barrier use(1)	-0.108	0.478	0.051	1	0.821	0.897	0.351	2.291
	Nonprescription drug use status(1)	0.322	0.240	1.809	1	0.179	1.380	0.863	2.208
	Constant	-2.900	0.705	16.918	1	0.000	0.055		

[a] Variable(s) entered on step 3: Nonprescription drug status. [b] Results are for adults aged ≥20 years old.

The odds ratios (Exp[B]) results for each of the variables that were statistically significant are below:

- Age: For each increase of one year in age, an individual was 1.08 times more likely to have HSV-2 (*OR* = 1.08, 95% CI [1.05, 1.11], $p = 0.000$).

- Race: Individuals who were not non-Hispanic White were 3.05 times more likely to have HSV-2 than those who were non-Hispanic White (*OR* = 3.05, 95% CI [1.93, 4.81], *p* = 0.000).
- Education level: Individuals with a high school education or more were 0.51 times less likely to have HSV-2 than those with no high school diploma (*OR* = 0.51, 95% CI [0.29, 0.90], *p* = 0.021).
- Income: For each increase in income level, an individual was 0.90 times less likely to have HSV-2 (*OR* = 0.90, 95% CI [0.85, 0.96], *p* = 0.001).
- Total number of sex partners: For each increase of one sex partner, an individual was 1.02 times more likely to have HSV-2 (*OR* = 1.02, 95% CI [1.01, 1.03], *p* = 0.003).

However, because all independent variables in the model were not predictively related to HSV-2 status, the null hypothesis was partially rejected for RQ 2.

Results Research Question 3 (RQ 3)

I conducted a multiple logistic regression using the enter method in SPSS to determine whether there is a statistically significant predictive relationship between demographics (i.e., age, race, educational level, income, and marital status), number of sex partners, infrequent barrier use, depression status (as measured by the PHQ-9), nonprescription drug use status, and HSV-2 status in WSW. In step one, I entered all demographic variables (i.e., age, race, marital status, income level, and educational level) in the model. In step two, I entered all variables related to sexual behavior (i.e., total

number of sex partners and infrequent barrier use) to the model. In the third and final step, I entered depression status and nonprescription drug status to the model.

Results from the multiple logistic regression indicated that the third model explained 25.4% (Nagelkerke R squared) of the variance in HSV-2 status and correctly classified 72.0% of cases. The result from the Hosmer and Lemeshow goodness-of-fit test indicated that the model was a good fit because the *p* value was not statistically significant ($p = 0.086$). However, the second model had a higher *p* value ($p = 0.55$) than the third model. Regardless, the third model was selected as the best fit because it includes my independent variables of interest (depression status and nonprescription drug use status) as well as the other independent variables. My decision to select the third model as the best fit was also based on previous research indicating statistically significant relationships between depression and HSV-2 (Kelly et al., 2016; Muzny et al., 2018; Operario et al., 2015) and drug use and HSV-2 (Bohl et al., 2011; Buchacz et al., 2000; Semaan et al., 2013; Valencia et al., 2012). Depression and drug use commonly co-occur and are related to engagement in risky sexual risk behaviors, such as infrequent barrier use and number of sex partners, which increase the risk for HSV-2 (A. Davis et al., 2016; Gorgos & Marrazzo, 2017; Kelly et al., 2016; Muzny et al., 2018; Operario et al., 2015; Xu, Sternberg, & Markowitz, 2010a).

Age ($p = 0.000$), race ($p = 0.000$), educational level ($p = 0.027$), income ($p = 0.002$), and total number of sex partners ($p = 0.005$) were all predictively related to HSV-2 status at statistically significant levels (see Table 29).

Table 29

Results of Multiple Logistic Regression for RQ 3

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I. for EXP(B)	
								Lower	Upper
	Age	0.078	0.014	30.846	1	**0.000**	1.081	1.052	1.112
	Race(1)	1.114	0.233	22.809	1	**0.000**	3.047	1.929	4.813
	Educational level(1)	-0.647	0.293	4.888	1	**0.027**	0.524	0.295	0.929
	Income	-0.095	0.030	9.980	1	**0.002**	0.909	0.857	0.965
	Marital status [b](1)	-0.409	0.226	3.294	1	0.070	0.664	0.427	1.033
Step 3[a]	Total number of sex partners (lifetime)	0.015	0.005	7.991	1	**0.005**	1.015	1.005	1.025
	Infrequent barrier use(1)	-0.130	0.478	0.074	1	0.786	0.878	0.344	2.242
	Nonprescription drug use status(1)	0.316	0.240	1.727	1	0.189	1.371	0.856	2.195
	Depression status(1)	0.336	0.268	1.573	1	0.210	1.399	0.828	2.366
	Constant	-2.985	0.707	17.832	1	0.000	0.051		

[a] Variable(s) entered on step 3: Nonprescription drug status and Depression status. [b] Results are for adults aged ≥20 years old.

The odds ratios (Exp[B]) results for each of the variables that were statistically significant are below:

- Age: For each increase of one year in age, an individual was 1.08 times more likely to have HSV-2 (*OR* = 1.08, 95% CI [1.05, 1.11], *p* = 0.000).
- Race: Individuals who were not non-Hispanic White were 3.05 times more likely to have HSV-2 than those who were non-Hispanic White (*OR* = 3.05, 95% CI [1.93, 4.81], *p* = 0.000).

- Education level: Individuals with a high school education or more were 0.52 times less likely to have HSV-2 than those with no high school diploma (*OR* = 0.52, 95% CI [0.29, 0.93], *p* = 0.027).
- Income: For each increase in income level, an individual was 0.91 times less likely to have HSV-2 (*OR* = 0.91, 95% CI [0.86, 0.97], *p* = 0.002).
- Total number of sex partners: For each increase of one sex partner, an individual was 1.02 times more likely to have HSV-2 (*OR* = 1.02, 95% CI [1.01, 1.03], *p* = 0.005).

However, because all independent variables in the model were not predictively related to HSV-2 status, the null hypothesis was partially rejected for RQ 3.

Summary

The purpose of this study was to assess the predictive relationship between demographics (i.e., age, race, educational level, income, and marital status), number of sex partners, infrequent barrier use, depression status (as measured by the PHQ-9), nonprescription drug use status, and HSV-2 status in WSW. I conducted a quantitative, correlational study of a cross-sectional nature using secondary data from the NHANES to answer my three research questions.

RQ 1 was designed to determine the predictive relationship between demographics (i.e., age, race, educational level, income, and marital status), number of sex partners, infrequent barrier use, depression status (as measured by the PHQ-9), and HSV-2 status in WSW. I partially rejected the null hypothesis because there were some statistically significant predictive relationships. Age (*p* = 0.000), race (*p* = 0.000),

educational level ($p = 0.024$), income ($p = 0.002$), and total number of sex partners ($p = 0.001$) were all predictively related to HSV-2 status at statistically significant levels. The odds ratios for these variables indicated that for each increase in one year in age, an individual was 1.08 times more likely to have HSV-2 (*OR* = 1.08). Individuals who were not non-Hispanic White were almost three times more likely to have HSV-2 than those who were non-Hispanic White (*OR* = 2.92). Individuals with a high school education or more were 0.52 times less likely to have HSV-2 than those with no high school diploma (*OR* = 0.52). For each increase in income level, an individual was 0.91 times less likely to have HSV-2 (*OR* = 0.91). For each increase of one sex of sex partner, an individual was 1.02 times more likely to have HSV-2 (*OR* = 1.02).

RQ 2 was designed to determine the predictive relationship between demographics (i.e., age, race, educational level, income, and marital status), number of sex partners, infrequent barrier use, nonprescription drug use status, and HSV-2 status in WSW. I partially rejected the null hypothesis because there were some statistically significant predictive relationships. Age ($p = 0.000$), race ($p = 0.000$), educational level ($p = 0.021$), income ($p = 0.001$), and total number of sex partners ($p = 0.003$) were all predictively related to HSV-2 status at statistically significant levels. The odds ratios for these variables indicated that for each increase in one year in age, an individual was 1.08 times more likely to have HSV-2 (*OR* = 1.08). Individuals who were not non-Hispanic White were three times more likely to have HSV-2 than those who were non-Hispanic White (*OR* = 3.05). Individuals with a high school education or more were 0.51 times less likely to have HSV-2 than those with no high school diploma (*OR* = 0.51). For each

increase in income level, an individual was 0.90 times less likely to have HSV-2 (*OR* = 0.90). For each increase of one sex of sex partner, an individual was 1.02 times more likely to have HSV-2 (*OR* = 1.02).

RQ 3 was designed to determine the predictive relationship between demographics (i.e., age, race, educational level, income, and marital status), number of sex partners, infrequent barrier use, depression status (as measured by the PHQ-9), nonprescription drug use status, and HSV-2 status in WSW. I partially rejected the null hypothesis because there were some statistically significant predictive relationships. Age ($p = 0.000$), race ($p = 0.000$), educational level ($p = 0.027$), income ($p = 0.002$), and total number of sex partners ($p = 0.005$) were all predictively related to HSV-2 status at statistically significant levels. The odds ratios for these variables indicated that for each increase in one year in age, an individual was 1.08 times more likely to have HSV-2 (*OR* = 1.08). Individuals who were not non-Hispanic White were three times more likely to have HSV-2 than those who were non-Hispanic White (*OR* = 3.05). Individuals with a high school education or more were 0.52 times less likely to have HSV-2 than those with no high school diploma (*OR* = 0.52). For each increase in income level, an individual was 0.91 times less likely to have HSV-2 (*OR* = 0.91). For each increase of one sex of sex partner, an individual was 1.02 times more likely to have HSV-2 (*OR* = 1.02).

In Chapter 5, I will provide interpretations of these results in relation to the theoretical framework utilized as well as the information provided in the literature review. I will also discuss limitations and recommendations for future research. Finally, I will discuss the social change implications of my findings.

Chapter 5: Discussion, Conclusions, and Recommendations

Herpes simplex virus type 2 (HSV-2), the main cause of genital herpes, is an incurable sexually transmitted infection responsible in 2018 for 18.6 million infections in the United States (James et al., 2020). HSV-2 is twice as frequent in women than men in the United States (McQuillan et al., 2018; Spicknall et al., 2021). A few researchers have examined HSV-2 risk or prevalence in women stratified by sexual behavior and have found that HSV-2 is more prevalent among women who have sex with women (WSW; 36%) compared with women who have sex exclusively with men (WSM; 24%; Operario et al., 2015; Xu, Sternberg, & Markowitz, 2010a). Compared with WSM, WSW are more likely to experience depression (Dai & Meyer, 2019; Kerridge et al., 2017), use drugs (Heinsbroek et al., 2018; Schuler & Collins, 2020), and engage more often in risky sexual behaviors (e.g., infrequent barrier use and multiple sex partners; Gorgos & Marrazzo, 2017; Mendoza-Pérez et al., 2019; Schick et al., 2015) , which have all been related to a higher risk for HSV-2 infection (Gorgos & Marrazzo, 2017; Kelly et al., 2016; Operario et al., 2015). However, few efforts have been made to identify risk factors that increase the risk for HSV-2 in WSW because of the general assumption that the risk of woman-to-woman transmission of STIs is low (Bauer & Welles, 2001; Gorgos & Marrazzo, 2017; Naish et al., 2019). Therefore, I statistically determined the relationship between specific risk factors (i.e., depression and nonprescription drug use) and HSV-2 infection in WSW.

The purpose of this study was to explore the predictive relationship between demographics (i.e., age, race, educational level, income, and marital status), number of sex partners, infrequent barrier use, depression status (as measured by the Patient Health

Questionnaire [PHQ-9])) and HSV-2 status in WSW (see RQ 1); determine the predictive relationship between demographics (i.e., age, race, educational level, income, and marital status), number of sex partners, infrequent barrier use, nonprescription drug use status, and HSV-2 status in WSW (see RQ 2); and determine the predictive relationship between demographics (i.e., age, race, educational level, income, and marital status), number of sex partners, infrequent barrier use, depression status (as measured by the PHQ-9), nonprescription drug use status, and HSV-2 status in WSW (see RQ3). The research design was a quantitative, correlational study of a cross-sectional nature using secondary data from multiple cycles of the National Health and Nutrition Examination Survey (NHANES). I used chi-square tests to provide further information about my sample by determining differences in the dependent variable (HSV-2 status) between independent variable groups and utilizing multiple logistic regression to answer the research questions.

Results from the chi-square analyses indicated that the difference in HSV-2 status by race, age group, educational level, marital status, income, total number of sex partners, depression status, and nonprescription drug use status were all statistically significant. However, each of these relationships were negligible. Therefore, there was almost no difference in HSV-2 status by each of these variables. The difference in HSV-2 status by infrequent barrier use group was not statistically significant, confirming there was no difference in HSV-2 status by infrequent barrier use group.

For all three of the research questions, the results were similar. While the combination of variables was different for each research question, the variables that were

found to be related to HSV-2 status at statistically significant levels were the same for each question (although *p* values and other related statistics to those variables differed across research questions). Age, race, educational level, income, and total number of sex partners were all predictively related to HSV-2 status at statistically significant levels for all three questions. However, my variables of interest (i.e., depression status and nonprescription drug use status) were not predictively related to HSV-2 status at statistically significant levels.

Interpretation of the Findings

Interpretation of Findings in Relation to the Theoretical Framework

The theoretical framework utilized for this study was the escape theory. Escape theory is used to describe why individuals tend to engage in certain behaviors to avoid (or escape) negative thoughts of themselves (Baumeister, 1988, 1990). When cognitively escaping from these negative thoughts, individuals may be especially susceptible to sexual risk, and drug use may play an important role in facilitating this cognitive escape (Card et al., 2019; McKirnan et al., 1996, 2001; Nemeroff et al., 2008; Wells et al., 2011). Cognitive escape is related with drug use (Card et al., 2019; McKirnan et al., 2001) and risky sexual behaviors (Hoyt et al., 2006; Wells et al., 2011) among sexual minority men. It is possible that drugs are used as an escape mechanism by sexual minority men wanting to escape anxiety and create favorable emotional and sexual circumstances (Card et al., 2019). No published studies were found where escape theory was used to explain engagement in drug use and risky sexual behaviors as escape mechanisms for WSW.

Compared with their non-sexual minority counterparts, WSW and MSM have a higher prevalence of drug use, depression, and engagement in risky sexual behaviors (e.g., no barrier use during sex and multiple sex partners) that are related to the development of STIs and HIV (Gonzales et al., 2016; Seil et al., 2014). Given such similarities, I used the escape theory to help interpret the results of my statistical analyses on the relationship between depression, nonprescription drug use, and HSV-2 infection among WSW. It is possible that WSW who are depressed, use drugs to escape from negative feelings and/or thoughts and, consequently, engage in high-risk sexual behaviors, increasing their risk for HSV-2 infection.

Results from the chi-square analyses indicated that the difference in HSV-2 status between depression and no depression was statistically significant. However, this relationship was negligible, so there was almost no difference between HSV-2 status by depression status. Results also indicated that the difference in HSV-2 status between no nonprescription drug use and nonprescription drug use was statistically significant. However, this relationship was negligible, so there was almost no difference between HSV-2 status by nonprescription drug use status.

The findings from the multiple logistic regression analyses further supported findings from the chi-square tests. Results indicated that there were no statistically significant predictive relationships between depression status and HSV-2 status in WSW; nonprescription drug use status and HSV-2 status in WSW; and depression status, nonprescription drug use status, and HSV-2 status in WSW. Therefore, I was unable to find enough evidence to support using escape theory to help interpret the results of my

statistical analyses on the relationship between depression, nonprescription drug use, and HSV-2 infection among WSW in my sample.

Interpretation of Findings in Relation to the Literature Reviewed

Results from RQ 1, RQ 2, and RQ 3 indicated that only age, race, educational level, income, and total number of sex partners were predictively related to HSV-2 status in WSW at statistically significant levels.

Statistically Significant Results

Age. In relation to age, Marrazzo et al. (2003) found that age predicted higher seroprevalence of HSV-2 infection among WSW in a community sample. HSV-2 seroprevalence has also been found to increase linearly with age among men, women (McQuillan et al., 2018; Spicknall et al., 2021), and sexual minority men (Bohl et al., 2011). Therefore, my results (RQ 1, RQ 2, and RQ 3: *OR* = 1.08, 95% CI [1.05, 1.11], *p* = 0.000) supported the findings of previous researchers. It is possible that the increase in HSV-2 seroprevalence with age also indicates new infections acquired in older ages (Bauer et al., 2010).

Race. I found that WSW who were not non-Hispanic White were almost three times more likely to have an HSV-2 infection than those who were non-Hispanic White (RQ 1: *OR* = 2.92, 95% CI [1.88, 4.60], *p* = 0.000; RQ 2 and RQ 3: *OR* = 3.05, 95% CI [1.93, 4.81], *p* = 0.000). Black WSW were found to be two times more likely to have an HSV-2 infection than White WSW in previous research (Marrazzo et al., 2003) and, among women overall, the HSV-2 infection rate for non-Hispanic Black women has been found to be almost six times higher than for non-Hispanic White women (Bernstein et al.,

2013). Racial minority WSW (e.g., not non-Hispanic White) experience a disproportionate burden of HSV-2 (Bernstein et al., 2013; Marrazzo et al., 2003). Some have suggested that the difference in HSV-2 infection by race in WSW could be partly attributed to race-based variability in sexual practices and risk behaviors (Bernstein et al., 2013). For example, the prevalence of HSV-2 by race may differ by number of sex partners reported (Bernstein et al., 2013). More research is needed to statistically determine related risk factors for HSV-2 and to inform the interventions necessary to address the disparities in HSV-2 prevalence among WSW (Pouget et al., 2010).

Education Level. To my knowledge, this is the first study where the relationship between education level and HSV-2 in WSW was assessed. I found that WSW with a high school education or more were significantly less likely to have an HSV-2 infection than those with no high school diploma (RQ 1: *OR* = 0.52, 95% CI [0.29, 0.92], *p* = 0.024; RQ 2: *OR* = 0.51, 95% CI [0.29, 0.90], *p* = 0.021; RQ 3: *OR* = 0.52, 95% CI [0.29, 0.93], *p* = 0.027). This is consistent with results from previous studies in women overall, which indicated that women with less than a high school education are up to three times more likely to have HSV-2 than those with more than a high school education (Buchacz et al., 2000; Patton et al., 2018). The overall prevalence of HSV-2 in the United States is also higher among individuals who did not graduate high school than among those who had graduated high school or who had more than a high school education (Stebbins et al., 2019).

The lower likelihood of having HSV-2 among those with a higher education also aligns with studies from researchers who have found that individuals with higher

education report better health outcomes than those with lower education (Fletcher, 2015; Lawrence, 2017; Zajacova & Lawrence, 2018). Although the role of education in health outcomes is not fully understood yet (Zajacova & Lawrence, 2018), some have suggested that education is a fundamental cause of disease because it determines access to factors that protect or improve health such as income, healthier lifestyles, and safer communities (Link & Phelan, 1995), whereas others have suggested that education enhances an individual's understanding, thinking, and other skills that can be used to generate health (Mirowsky & Ross, 2003). Further research is needed to statistically determine the relationship between education level and HSV-2.

Income. Results indicated that the odds of having an HSV-2 infection decreased as income level increased (RQ 1: *OR* = 0.91, 95% CI [0.89, 0.97], *p* = 0.002; RQ 2: *OR* = 0.90, 95% CI [0.85, 0.96], *p* = 0.001; RQ 3: *OR* = 0.91, 95% CI [0.86, 0.97], *p* = 0.002). During my literature review, I did not find any studies where the relationship between HSV-2 and income in WSW was assessed. However, my results are consistent with results from other studies in women overall, where HSV-2 was found to be more common among women living below poverty level (Fanfair et al., 2013; Kelly et al., 2016; Patton et al., 2018). These results also align with my findings that WSW with lower education were significantly more likely to have an HSV-2 infection. Researchers have found a relationship between poverty, education, and health outcomes and consider these to be important determinants of health (Simon, n.d.). In the United States, adults with lower educational attainment experience worse health outcomes than those with higher educational attainment (Fletcher, 2015; Marmot & Bell, 2009; Zajacova &

Lawrence, 2018). Individuals with low educational attainment are more likely to be unemployed and have economic hardship than those with higher educational attainment (Ross & Wu, 1995). Same-sex couples are more likely to be living in poverty than non-same-sex couples (Badgett et al., 2013; Gorman et al., 2015). Economic hardship may impact an individual's ability to access health care as they may delay or miss necessary medical treatment due to the high out-of-pocket costs (Bernard et al., 2014; Choi, 2017). Sexual minority women have lower education and income, and generally have more limited access to health care than non-sexual minority women (Alencar Albuquerque et al., 2016; Hsieh & Ruther, 2016, 2017). For example, sexual minority women report low insurance coverage and a higher rate of missing a doctor's appointment in the preceding year due to costs than non-sexual minority women, sexual minority men, and non-sexual minority men (Gorman et al., 2015). Low or no access to health care services, as well as not seeking services, reduces the chances that sexual minority women will learn about their risk for HSV-2 infection, associated risk behaviors, and prevention strategies (e.g., barrier use).

Total Number of Sex Partners. Finally, I found that the odds of having HSV-2 increased as the total number of sex partners increased (RQ 1: *OR* = 1.02, 95% CI [1.01, 1.03], $p = 0.001$; RQ 2: *OR* = 1.02, 95% CI [1.01, 1.03], $p = 0.003$; RQ 3: *OR* = 1.02, 95% CI [1.01, 1.03], $p = 0.005$). However, these results were marginally significant since both the odds ratio and the 95% confidence intervals were very close to 1. Similar findings were reported in cohort studies of women overall, where the incidence rate of HSV-2 was higher in those who had 10 or more sex partners than among those who had

0–1 sex partner (Dickson et al., 2007, 2014). In a cross-sectional study of WSW, those who had an STI diagnosis (including HSV-2) had significantly more sex partners than those without an STI diagnosis (Lindley et al., 2007). It is important to note that the risk for HSV-2 may also differ by sex of sex partner. In this study, most WSW (96.6%) reported having male sex partners. Almost half of these (49.5%) reported having 2–10 male sex partners in their lifetime and 43.1% reported having 11 or more male sex partners in their lifetime.

Sex with men may lead to heterosexual acquisition of HSV-2 and possible future transmission to their female sex partners (Diamant et al., 1999; Marrazzo, 2004; Muzny et al., 2011). Some WSW do not use barriers to protect them against HSV-2 when having sex with other women because they believe to be at lower risk of infection (Cox & McNair, 2009; Doull et al., 2018). Women who have sex with both men and women (WSMW) have been found to be at higher risk for HSV-2 (Xu, Sternberg, & Markowitz, 2010a) because they engage more frequently in risky behaviors that lead to HSV-2 infection than WSW-only and WSM (Fethers et al., 2000; Nield et al., 2015; Schuler et al., 2019; Smalley et al., 2016). Although WSW may be aware of HSV-2, they may have insufficient knowledge of barriers specifically for women (e.g., dental dams) and incorrect information on the risk for STI transmission while engaging in sexual activities with other women (Cox & McNair, 2009; Doull et al., 2018; Marrazzo et al., 2005; Muzny, Harbison, Pembleton, & Austin, 2013; Muzny, Harbison, Pembleton, Hook, et al., 2013; Richters et al., 2010; Richters & Clayton, 2010). To improve the sexual health of WSW, prevention strategies should address knowledge gaps in their risk for HSV-2

transmission and safer sex practices, regardless of the sex of their sex partner (Doull et al., 2018).

Non-Statistically Significant Results

Marital Status. Results from RQ 1, RQ 2, and RQ 3 indicated that there was no statistically significant predictive relationship between marital status and HSV-2 status in WSW (RQ 1: *OR* = 0.67, 95% CI [0.43, 1.04], *p* = 0.073; RQ 2: *OR* = 0.66, 95% CI [0.43, 1.03], *p* = 0.068; RQ 3: *OR* = 0.66, 95% CI [0.43, 1.03], *p* = 0.070). I did not find any studies where the relationship between marital status and HSV-2 infection in WSW was assessed. However, same-sex marriage has been found to be related to a lower risk of acquiring STIs (Chesson, 2012; Dee, 2008; Kamerow, 2013). It is possible that WSW who are married are at a lower risk for HSV-2 infection than those who are not married. More research is needed to determine whether this relationship is true.

Infrequent Barrier Use. Results from RQ 1, RQ 2, and RQ 3 indicated that there was no statistically significant predictive relationship between infrequent barrier use and HSV-2 status in WSW (RQ 1: *OR* = 0.90, 95% CI [0.35, 2.29], *p* = 0.828; RQ 2: *OR* = 0.89, 95% CI [0.35, 2.29], *p* = 0.821; RQ 3: *OR* = 0.88, 95% CI [0.34, 2.24], *p* = 0.786). Although I did not find a statistically significant predictive relationship between infrequent barrier use and HSV-2 status, use of barrier methods during sex is significantly related to lower risk for HSV-2 infection in the general population (Magaret et al., 2015; Martin et al., 2009; Stanaway et al., 2012). For example, Magaret et al. (2015) found that condom use significantly reduced the risk for HSV-2 transmission from men to women by 96%, whereas Stanaway et al. (2012) saw a 3.6% increase in the odds of HSV-2

acquisition when engaging in unprotected sex. Therefore, I expected to find a statistically significant predictive relationship between infrequent barrier use and HSV-2 status. Having a small sample size makes it difficult to determine whether the relationship found was true and increased the chances of making a Type II error (Button et al., 2013). It is possible that I could have found a statistically significant relationship if my sample size had been larger.

Depression Status. No statistically significant predictive relationship was found between depression status and HSV-2 status in WSW (RQ 1: *OR* = 1.41, 95% CI [0.83, 2.38], *p* = 0.198; RQ 3: *OR* = 1.40, 95% CI [0.83, 2.37], *p* = 0.210). This was not what I expected since depression has been related to HSV-2 infection in women overall (A. Davis et al., 2016; Kelly et al., 2016; Nowotny et al., 2018) and WSW are almost two times more likely to suffer from depression compared with WSM (Dai & Meyer, 2019; Kerridge et al., 2017). Inconsistent condom use is significantly related with depression in women, with those who experienced depression being 10 times more likely to inconsistently use condoms during sex than women without depression (Cooke et al., 2016). Therefore, I deduced that there would be a statistically significant predictive relationship between depression status and HSV-2 status since the risk for HSV-2 among WSW with depression would be higher among those who engaged in infrequent barrier use. However, these results aligned with my findings that there was no statistically significant predictive relationship between infrequent barrier use and HSV-2 status. The nonsignificant relationship between depression status and HSV-2 status may be due to the small sample of WSW in my study and because I did not include the sample weights in

my analyses. Sample weights are used in the NHANES to ensure the estimates produced are unbiased and that confidence intervals and standard errors are accurate (National Center for Health Statistics, 2018a, 2020b). This is a limitation of my study and researchers should consider using larger sample sizes and applying the sample weights in future analyses when using NHANES or other weighted data.

Nonprescription Drug Use Status. I did not find a statistically significant predictive relationship between nonprescription drug use status and HSV-2 status in WSW (RQ 2: *OR* = 1.38, 95% CI [0.86, 2.21], $p = 0.179$; RQ 3: *OR* = 1.37, 95% CI [0.86, 2.19], $p = 0.189$). This does not align with previous research where drug use was related to HSV-2 infection (Semaan et al., 2013). Individuals who use drugs are at higher risk for HSV-2 because drugs increase the likelihood of engaging in risky sexual behaviors by enhancing arousal, desire, stamina, enjoyment, and impulsivity (Feaster et al., 2016; Marshall et al., 2011; Volkow et al., 2007; Yamada et al., 2021). Sexual minority populations have higher rates of drug use than non-sexual minorities (Heinsbroek et al., 2018; Operario et al., 2015; Schuler et al., 2018, 2019). WSW are at higher risk for HSV-2 infection than WSM because they are over two times more likely to report drug use (Heinsbroek et al., 2018; Operario et al., 2015; Schuler & Collins, 2020). Therefore, I expected to see a statistically significant predictive relationship between nonprescription drug use status and HSV-2 status in WSW. The nonsignificant relationship between nonprescription drug use status and HSV-2 status may be due to the small sample of WSW in my study and because I did not include the sample weights in my analyses. This is a limitation of my study and researchers should consider using larger

sample sizes and applying the sample weights in future analyses when using NHANES or other weighted data.

Limitations of the Study

This study had several limitations including sampling method, sample size, using self-reported secondary data, and use of a correlational research design. I used a convenience sample of 597 WSW aged 18–49 years old who participated in the NHANES. Convenience sampling has some disadvantages like introduction of unknown biases to the study and poor representation of the population under study (Business Research Methodology, n.d.; Meyer & Wilson, 2009). Because my dataset included only cases that met the study's inclusion criteria, the results were only generalizable to the WSW in my sample (Ciol et al., 2006; Mullinix et al., 2015). In addition, the NHANES weights cases within their dataset to make their results generalizable to the United States population (National Center for Health Statistics, 2018a, 2020b). I did not use the sample weights in the analyses, so the results are only generalizable to the WSW in my sample. Convenience samples are useful for studying hard-to-reach or hidden populations (Meyer & Wilson, 2009; Muhib et al., 2001) and are still the main sampling method used in sexual minority research (Brennan et al., 2017). This maintains its appropriateness for my study. Convenience samples are considered a good option when the research focus is not to estimate the population prevalence, as it is the case in this study (Meyer & Wilson, 2009).

The sample size in this study was small (N = 597) even after combining data from five cycles of the NHANES (2009–2010, 2011–2012, 2013–2014, and 2015–2016).

This resulted in low statistical power (13.6%), a low chance of detecting a true effect, and a high probability of making a Type II error in this study (Button et al., 2013). The low power achieved also decreased the likelihood that any statistically significant results would represent a true effect (Button et al., 2013). In addition, most of the sample (96.6%%) consisted of WSMW, which limited the ability to measure the predictive relationship between specific risk factors and HSV-2 status in WSW-only.

All the data used in this study were self-reported, except for HSV-2 status, which was measured through laboratory tests (National Center for Health Statistics, 2017c). Therefore, this study was subject to self-report bias (Althubaiti, 2016). Information related to private topics such as nonprescription drug use and sexual behavior (e.g., sex of sex partners, number of sex partners, and barrier use) were subject to social desirability bias (Althubaiti, 2016). Even though the sexual behavior module was conducted via the audio computer-assisted self-interview (ACASI) system, which guaranteed confidentiality of their responses (National Center for Health Statistics, 2017b; Simon & Goes, 2013), some individuals may still have been hesitant to report sexual behavior due to fear of being judged.

Finally, it was not possible to establish causal relationships between the variables in this study because the research design was a correlational study of a cross-sectional nature (Singh Setia, 2016). So, I was unable to determine whether depression and nonprescription drug use occurred prior to HSV-2 infection or vice versa. However, I was able to estimate predictive relationships between my variables.

Recommendations

Results from this study could be used to provide a baseline for further research on sexual minority women, specifically, the predictive relationship between depression status, nonprescription drug use status, and HSV-2 status in WSW. I recommend using a larger sample size of WSW to study such relationship so that enough statistical power is achieved to produce more precise estimates (Cohen, 1988; Ellis, 2010). I recommend applying the sample weights if analyzing NHANES data in future studies so that results can be generalizable to the WSW population in the United States (T. Chen et al., 2020; National Center for Health Statistics, 2018a). Using sample weights can also help ensure accuracy of the results and their representativeness to the entire WSW population (National Center for Health Statistics, 2018a). This will also allow researchers to do more reliable comparisons between WSW and WSM since these are randomly surveyed data (Roberts, 2015).

I did not differentiate between total number of male and female sex partners in my logistic regression analyses, even though most of my sample consisted of WSMW. Instead, I combined the two into one variable. Researchers should consider including number of male and female sex partners separately in their analyses to investigate how this may impact the predictive relationship between infrequent barrier use, depression status, nonprescription drug use status, and HSV-2 status in WSW (which I found to not be predictively related at statistically significant levels). Other researchers have found that WSMW are more likely than WSM to report infrequent barrier use, as well as unprotected sex with a non-steady partner, putting them at higher risk for HSV-2

infection (Nield et al., 2015; Rahman et al., 2020; X. Wang et al., 2012; Ybarra et al., 2016). Further, WSW may not use barriers during sexual activity with other women because they believe to be at low risk of HSV-2 infection (Cox & McNair, 2009; Doull et al., 2018). No barrier use during sex has been related to drug use and depression (Card et al., 2018). WSW who experience depression and use drugs have a greater likelihood of engaging in more risky sexual behaviors (e.g., infrequent barrier use and multiple sex partners) than WSM, which increases their risk for HSV-2 infection (A. Davis et al., 2016; Kelly et al., 2016; Operario et al., 2015; Xu, Sternberg, & Markowitz, 2010a). Based on this information, it is possible that considering male and female sex partners separately in future analyses may yield more precise results.

Many WSW do not use barriers during sex because they think they are at low risk for HSV-2 and other STIs (Cox & McNair, 2009; Doull et al., 2018). Some WSW have sex only with women (WSW-only) while some have sex with both men and women (WSMW). Since risk factors for HSV-2 may differ between these groups, I recommend implementing education interventions tailored for WSW-only and WSMW to raise awareness of the risk for HSV-2 and other STIs, routes of transmission, and potential consequences for each of these populations.

Implications

Despite the limitations of this study, my study has several strengths. To my knowledge, this is the first time that the predictive relationship between depression status, nonprescription drug use status, and HSV-2 status in WSW is assessed. It is also the first time the predictive relationships between marital status and HSV-2 status, education level

and HSV-2 status, and income status and HSV-2 status are assessed, or at least publicly reported, for WSW specifically. Findings from this study will hopefully increase interest and encourage further research on HSV-2 infection in WSW.

Results from this study could contribute to positive social change in several ways. The Institute of Medicine (IOM) called for more research to better understand the health status of sexual minority populations in 2011 (IOM, 2011). With this study, I answered the IOM's call and added to the literature on sexual minorities by assessing risk factors related to HSV-2 infection in a sample of WSW in the United States. The results from this study may motivate researchers to further investigate the relationship between depression, nonprescription drug use, and HSV-2 in larger samples of WSW. In addition, results may guide future public health interventions aimed to increase WSW's access to information regarding prevention of HSV-2 infection. This study may also encourage integration of HSV-2 prevention messages in mental health and drug use prevention and treatment programs designed for sexual minority women.

Conclusion

The purpose of this study was to (a) explore the predictive relationship between demographics (i.e., age, race, educational level, income, and marital status), number of sex partners, infrequent barrier use, depression status (as measured by the PHQ-9) and HSV-2 status in WSW; (b) determine the predictive relationship between demographics (i.e., age, race, educational level, income, and marital status), number of sex partners, infrequent barrier use, nonprescription drug use status, and HSV-2 status in WSW (RQ 2); and (c) determine the predictive relationship between demographics (i.e., age, race,

educational level, income, and marital status), number of sex partners, infrequent barrier use, depression status (as measured by the PHQ-9), nonprescription drug use status, and HSV-2 status in WSW. For all three of the research questions, the results were similar. While the combination of variables was different for each research question, the variables that were found to be related to HSV-2 status at statistically significant levels were the same for each question (although *p* values and other related statistics to those variables differed across research questions). Age, race, educational level, income, and total number of sex partners were all predictively related to HSV-2 status at statistically significant levels for all three questions. However, marital status, infrequent barrier use, depression status, and nonprescription drug use status were not predictively related to HSV-2 status at statistically significant levels. These results should be interpreted with caution because the power for this study was low (13.6%), which reduced the likelihood that any statistically significant results would represent a true effect (Button et al., 2013).

To my knowledge, this was the first study where the predictive relationship between depression status, nonprescription drug use status, and HSV-2 status in WSW was assessed. Therefore, it was impossible to compare my results with those of other researchers. More research is needed to better understand the relationships examined in this study. As indicated throughout my study, sexual minority women are an understudied population, and more research is necessary to understand their health behaviors and improve their sexual health (IOM, 2011). Previous researchers have identified knowledge gaps in WSW regarding their risk for HSV-2 infection, behaviors that increase their risk for HSV-2 infection, and available barrier methods specifically for women to protect

them from HSV-2 and other STIs (Doull et al., 2018; Muzny, Harbison, Pembleton, & Austin, 2013; Muzny, Harbison, Pembleton, Hook, et al., 2013). There is also a general (incorrect) assumption that the risk of woman-to-woman transmission of STIs is low (Gorgos & Marrazzo, 2017; Naish et al., 2019; Schick, Rosenberger, Herbenick, Calabrese, et al., 2012; Tat et al., 2015). Many WSW-only do not seek preventive HSV-2 care because they think it is unnecessary since they are not having sex with men (Marrazzo, 2004; Muzny, Harbison, Pembleton, Hook, et al., 2013). My findings may guide future public health interventions aimed at increasing WSW's awareness and access to information regarding their risk for HSV-2 infection and prevention methods.

WSW account for approximately 17% of females in the United States (Copen et al., 2016) and are a diverse minority population with differences from WSM in sexual identity, sexual activities, and risk behaviors (Gorgos & Marrazzo, 2017). Unfortunately, their health issues are frequently not addressed when seeking care in health care settings due to various factors, including not being asked about their sexuality or sexual behaviors by their doctors and fear of stigma from disclosing their sexuality or sexual behaviors to health care staff (Silberman et al., 2016). Results from this study will hopefully encourage health care providers to ask female patients such questions so that they can provide more appropriate care and address the specific needs of WSW. Having materials available (e.g., in the waiting area) that are inclusive of WSW can help inform and make WSW feel more comfortable disclosing their identity and sexual behaviors to their health care providers (Roberts, 2015). The findings from this study may also encourage

integration of HSV-2 prevention messages in mental health and drug use prevention and treatment programs designed for sexual minority women.

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Appendix A: NHANES Data Release and Access Policy

This policy addresses when, to whom, and in what form the Division of Health Examination Surveys (DHANES) disseminates National Health and Nutrition Examination Survey (NHANES) data and outlines dissemination procedures. This DHANES policy is consistent with the CDC and NCHS policies, including the guiding principles of making high quality data available:

- As widely as practicable;
- As soon as possible after data collection;
- In as much detail as possible; and
- While maintaining survey participant confidentiality.

Various mechanisms of data release and access are used to meet the requirements of these principles including public data release as well as limited data access arrangements.

DHANES policy on public release data:

1. Since NHANES 1999-2000, public use data releases have been and continue to be made on a biannual basis. Due to the voluminous nature of NHANES and the large amount of post data-collection processing, release of all data from two years of data collection will not occur at one point in time. It is anticipated that an initial data release will occur approximately nine months after the completion of each two-year data collection cycle, and intermittent releases will follow as remaining data are processed, until all releasable data are available for public use.
2. Public use data releases from prior NHANES (through NHANES III) will consist predominantly of additional datasets derived from stored sera projects or special use agreements and will be released on an ad hoc basis. Data release occurs after data cleaning, editing, documentation and Disclosure Review Board (DRB) review, estimated to be within three months of receipt of the data, subject to work force limitations.

DHANES policy on obtaining access to data that have not been publicly released:
Several mechanisms are used for access to non-public data. Each mechanism has specific access criteria and associated procedures.

1. For quality assurance/quality control (QA/QC) purposes:

a. Recipients: current NHANES Collaborators, as outlined in inter-agency agreements (IAAs) instituted during component planning or funding process, or identified experts to assist in data collection or data processing;

b. Process: DHANES will work with NCHS Confidentiality Office to initiate a Data Sharing Agreement (DSA) or a Designated Agency Agreement (DAA) noting restrictions on QA/QC dataset sharing, analysis and publication prior to public release. The NCHS Confidentiality Office will assess the level of potential disclosure risk and stipulate the type of agreement to be used (i.e., DSA or DAA). The Director of DHANES or his/her designate, and the NCHS Confidentiality Officer or his/her designate, review agreements for approval.

2. For research purposes:
a. Recipients: Any researcher;
b. Process: Submission of a research proposal to the NCHS Research Data Center (RDC).

DHANES policy on release of new data items derived from NHANES physical samples:

Whenever new data items are developed using physical samples from a NHANES survey such as stored sera, DNA, or imaging studies, these new data items are made publicly accessible under either public use, or RDC access, depending on the nature of the derived data item and disclosure risk. If requested data are not currently collected or available in NHANES, a proposal to obtain (and fund) the new data items can be submitted via email to NHANES Biospecimen Program. The NHANES Project Officer and a technical panel evaluate all proposals for scientific merit. The NCHS Human Subject Contact and Ethics Review Board (ERB) then review the proposal for any potential human subjects concerns and the NCHS Confidentiality Officer for disclosure risk. Any data developed under this mechanism are made accessible under either public use, or RDC access to appropriate recipients as noted above. Please refer to the NHANES Biospecimen Program website for more detailed information:
https://www.cdc.gov/nchs/nhanes/biospecimens/biospecimens.htm.

National Center for Health Statistics

CDC > NCHS > National Health and Nutrition Examination Survey > Questionnaires, Datasets, and Related Documentation > NHANES 2015-2016

nhanes National Health and Nutrition Examination Survey

NHANES 2015-2016 Release Notes

NCHS releases public use data sets from the continuous NHANES in two-year groupings (cycles). This release does not contain all of the data collected on persons who participated in the survey during 2015-2016. As more data becomes available, there will be additional releases posted on the What's New page. These updates will be fully documented on this site. Data processing, methodologic and disclosure concerns are examples of the reasons why various data components from NHANES 2015-2016 are not part of this first public use data release. When (and if) these concerns are resolved, the data will be made publicly available.

The data and documentation for the interview, laboratory and examination components of the survey will be released in numerous files to facilitate ease of use and access via the Internet. This will require the user to merge files to create analytic data sets. In addition, changes in the survey design and implementation necessitate analytic guidelines that differ from previous NHANES. Many of the past general analytic principles still apply, but with adjustments for the new survey design and taking into account more recent statistical practices and procedures. This data release will allow for analyses of data collected in 2015-2016 as well as the ability to combine these data with those collected in 1999-2014. The Analytic Guidelines will provide guidance on the use of appropriate sample weights and analytic strategies and will be revised on various occasions as new issues are raised and addressed by NCHS staff. Users are encouraged to check the What's New page and this site regularly for updates on available data, documentation and guidelines for use of the data.

NHANES data in this release are in SAS transport file format.

- Use the XPORT engine to access this data in any version of SAS.
- Copy the transport files to a permanent SAS library

As an example, assume you have downloaded the Body Measures exam data to the folder "C:\NHANES". You can then use the following SAS code to copy the Body Measures Exam Data:

```
LIBNAME XP XPORT "C:\NHANES\bmx_i.xpt";
PROC COPY IN=XP OUT=SASUSER;
RUN;
```

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Appendix B: Original Variable Coding in NHANES Dataset

Original variable name	Original variable label	Original variable coding in NHANES	Researcher variable [a]
		Demographics	
RIDAGEYR	Age in years at screening	0–79 = Actual age in years 80 = ≥80 years of age . = Missing	Age (IV 1, 2, 3)
RIDRETH1	Race/ Hispanic origin	1 = Mexican American 2 = Other Hispanic 3 = Non-Hispanic White 4 = Non-Hispanic Black 5 = Other Race – Including Multi-Racial . = Missing	Race (IV 1, 2, 3)
DMDMARTL	Marital status (Adults ≥20 years) [b]	1 = Married 2 = Widowed 3 = Divorced 4 = Separated 5 = Never married 6 = Living with partner 77 = Refused 99 = Don't Know . = Missing	Marital Status (IV 1, 2, 3)
DMDEDUC3	Educational level (Children/Youth 6–19 years) ***Only data from participants aged 18–19 years collected in this variable will be included in this study. These will be recoded using the same variable coding as in the variable DMDEDUC2.*	0 = Never attended/ Kindergarten only 1 = 1st grade 2 = 2nd grade 3 = 3rd grade 4 = 4th grade 5 = 5th grade 6 = 6th grade 7 = 7th grade 8 = 8th grade 9 = 9th grade 10 = 10th grade 11 = 11th grade 12 = 12th grade 13 = High school graduate 14 = GED or equivalent 15 = More than high school 55 = Less than 5th grade 66 = Less than 9th grade 77 = Refused 99 = Don't know . = Missing	Educational Level (IV 1, 2, 3)

Original variable name	Original variable label	Original variable coding in NHANES	Researcher variable [a]
DMDEDUC2	Educational level (Adults ≥20 years) ***See note in DMDEDUC3.*	1 = Less than 9th grade 2 = 9–11th grade (Includes 12th grade with no diploma) 3 = High school graduate/GED or equivalent 4 = Some college or AA degree 5 = College graduate or above 7 = Refused 9 = Don't Know . = Missing	Educational Level (IV 1, 2, 3)
INDFMIN2	Annual family income	1 = $0 to $4,999 2 = $5,000 to $9,999 3 = $10,000 to $14,999 4 = $15,000 to $19,999 5 = $20,000 to $24,999 6 = $25,000 to $34,999 7 = $35,000 to $44,999 8 = $45,000 to $54,999 9 = $55,000 to $64,999 10 = $65,000 to $74,999 12 = $20,000 and Over 13 = Under $20,000 14 = $75,000 to $99,999 15 = $100,000 and Over 77 = Refused 99 = Don't know . = Missing	Income (IV 1, 2, 3)
	Sex of sex partners		
SXQ709	Have you ever had any kind of sex with a <u>woman</u>? By sex, we mean sexual contact with another woman's vagina or genitals. (Adults 18–69 years)	1 = Yes 2 = No 7 = Refused 9 = Don't know . = Missing	The sex of sex partner variables and number of sex partner variables will be combined to determine women's sexual behavior.
SXQ700	Have you ever had vaginal sex, also called sexual intercourse, with a <u>man</u>? This means a man's penis in your vagina. (Adults 18–69 years)	1 = Yes 2 = No 7 = Refused 9 = Don't know . = Missing	Sex of sex partner will be reported in demographic frequencies and chi-square analysis but not used in RQ analyses.

Original variable name	Original variable label	Original variable coding in NHANES	Researcher variable [a]
SXQ703	Have you ever performed oral sex on a man? This means putting your mouth on a man's penis or genitals. (Adults 18–69 years)	1 = Yes 2 = No 7 = Refused 9 = Don't know . = Missing	WSW = Responding 1 to SXQ709 OR 1–63 to SXQ130. (Categorized in the Sex Partners variable as: WSW-Only=0; WSMW=1)
SXQ706	Have you ever had anal sex? This means contact between a man's penis and your anus or butt. (Adults 18–69 years)	1 = Yes 2 = No 7 = Refused 9 = Don't know . = Missing	WSW-Only = Responding 1 to SXQ709 OR 1–63 to SXQ130 AND 2, 7, 9, or missing to SXQ700, SXQ703, and SXQ706 AND 77777, 99999, or missing to SXD101. WSMW = Responding 1 to SXQ709 OR 1–63 to SXQ130 AND 1 to SXQ700, SXQ703, or SXQ706 OR 1–87 or 100 to SXD101.
	Number of sex partners		
SXQ130	In your lifetime with how many women have you had sex? By sex, we mean sexual contact with another woman's vagina or genitals. (Females 18–59 years)	1–63 = Range of Values 77777 = Refused 99999 = Don't know . = Missing	Total number of sex partners (lifetime; IV 1, 2, 3). Combination of SXQ130 and SXD10. Number of female sex partners (lifetime) will be reported in demographic frequencies but not used in RQ analyses.
SXD101	In your lifetime, with how many men have you had any kind of sex? (Adults 18–69 years)	1–87 = Range of Values 100 = 100 or more 77777 = Refused 99999 = Don't know . = Missing	Number of male sex partners (lifetime) will be reported in demographic frequencies but not used in RQ analyses.

Original variable name	Original variable label	Original variable coding in NHANES	Researcher variable [a]
		Infrequent barrier use	
SXQ251	In the past 12 months, about how often have you had {vaginal or anal/ vaginal/anal} sex without using a condom? (Females 18–59 years)	1 = Never 2 = Less than half of the time 3 = About half of the time 4 = Not always, but more than half of the time 5 = Always 7 = Refused 9 = Don't know . = Missing	Infrequent barrier use (IV 1, 2, 3). Combination of SXQ251 and SXQ645. Infrequent barrier use = Responding 4,5 to SXQ251 OR 1,2 to SXQ645.
SXQ645	When you performed oral sex in the past 12 months, how often would you use protection, like a condom or dental dam? (Females 18–59 years)	1 = Never 2 = Rarely 3 = Usually 4 = Always 5 = Unsure 7 = Refused 9 = Don't know . = Missing	Frequent barrier use = Responding 1,2,3 to SXQ251 OR 3,4 to SXQ645.
		Depression Status (PHQ-9 Depression Screener)	
DPQ010	Over the last 2 weeks, how often have you been bothered by the following problems: little interest or pleasure in doing things? (Adults aged ≥18 years)	0 = Not at all 1 = Several days 2 = More than half the days 3 = Nearly every day 7 = Refused 9 = Don't know . = Missing	Depression status (IV 2, 3). Sum of scores in DPQ010, DPQ020, DPQ030, DPQ040, DPQ050, DPQ060, DPQ070, DPQ080, DPQ090, and DPQ100. No depression = Score of 0–9 Depression = Score of 10–27
DPQ020	Over the last 2 weeks, how often have you been bothered by the following problems: feeling down, depressed, or hopeless? (Adults aged ≥18 years)	0 = Not at all 1 = Several days 2 = More than half the days 3 = Nearly every day 7 = Refused 9 = Don't know . = Missing	
DPQ030	Over the last 2 weeks, how often have you been bothered by the following problems: trouble falling or staying asleep, or sleeping too much? (Adults aged ≥18 years)	0 = Not at all 1 = Several days 2 = More than half the days 3 = Nearly every day 7 = Refused 9 = Don't know . = Missing	

Original variable name	Original variable label	Original variable coding in NHANES	Researcher variable [a]
DPQ040	Over the last 2 weeks, how often have you been bothered by the following problems: feeling tired or having little energy? (Adults aged ≥18 years)	0 = Not at all 1 = Several days 2 = More than half the days 3 = Nearly every day 7 = Refused 9 = Don't know . = Missing	
DPQ050	Over the last 2 weeks, how often have you been bothered by the following problems: poor appetite or overeating? (Adults aged ≥18 years)	0 = Not at all 1 = Several days 2 = More than half the days 3 = Nearly every day 7 = Refused 9 = Don't know . = Missing	
DPQ060	Over the last 2 weeks, how often have you been bothered by the following problems: feeling bad about yourself - or that you are a failure or have let yourself or your family down? (Adults aged ≥18 years)	0 = Not at all 1 = Several days 2 = More than half the days 3 = Nearly every day 7 = Refused 9 = Don't know . = Missing	
DPQ070	Over the last 2 weeks, how often have you been bothered by the following problems: trouble concentrating on things, such as reading the newspaper or watching TV? (Adults aged ≥18 years)	0 = Not at all 1 = Several days 2 = More than half the days 3 = Nearly every day 7 = Refused 9 = Don't know . = Missing	
DPQ080	Over the last 2 weeks, how often have you been bothered by the following problems: moving or speaking so slowly that other people could have noticed? Or the opposite - being so fidgety or restless that you have been moving around a lot more than usual? (Adults aged ≥18 years)	0 = Not at all 1 = Several days 2 = More than half the days 3 = Nearly every day 7 = Refused 9 = Don't know . = Missing	

Original variable name	Original variable label	Original variable coding in NHANES	Researcher variable [a]
DPQ090	Over the last 2 weeks, how often have you been bothered by the following problems: Thoughts that you would be better off dead or of hurting yourself in some way? (Adults aged ≥18 years)	0 = Not at all 1 = Several days 2 = More than half the days 3 = Nearly every day 7 = Refused 9 = Don't know . = Missing	
DPQ100	How difficult have these problems made it for you to do your work, take care of things at home, or get along with people? (Adults aged ≥18 years)	0 = Not at all 1 = Several days 2 = More than half the days 3 = Nearly every day 7 = Refused 9 = Don't know . = Missing	
	Nonprescription drug use		
DUQ240	Have you ever used cocaine, crack cocaine, heroin, or methamphetamine? (Adults 18–69 years)	1 = Yes 2 = No 7 = Refused 9 = Don't know . = Missing	Nonprescription drug use (IV 2, 3)
	HSV-2 Status		
LBXHE2	Herpes Simplex Virus Type 2 (Adults 18–49 years)	1 = Positive 2 = Negative 3 = Indeterminate . = Missing	HSV-2 Status (DV 1, 2, 3)

Note. DV = Dependent variable(s); IV = Independent variable(s); RQ = Research question(s); WSW = Women who have sex with women; WSM = Women who have sex exclusively with men. The variables in this table were included in the NHANES 2009–2010, 2011–2012, 2013–2014, and 2015–2016 cycles. This table explains the original dataset variables and coding and the transition to the variables used in this study. Variables in Table 9 in Chapter 3 were recoded from original variables in NHANES

dataset. This may have involved simply recoding or combining data from multiple NHANES variables to arrive at the variable used for the analyses in this study.

[a] Indicates the matching variable name found in Table 9 in Chapter 3. [b] Data on marital status were collected from participants aged ≥14 years but were only publicly released for adults aged ≥20 years.

Appendix C: Human Subjects Protection Training Certificate

CITI PROGRAM

Completion Date 21-Jun-2021
Expiration Date N/A
Record ID 42372400

This is to certify that:

Viani Picchetti

Has completed the following CITI Program course:

Not valid for renewal of certification through CME.

Student's
(Curriculum Group)
Doctoral Student Researchers
(Course Learner Group)
1 - Basic Course
(Stage)

Under requirements set by:

Walden University

CITI
Collaborative Institutional Training Initiative

Verify at www.citiprogram.org/verify/?wa1980498-050f-43de-ba2b-e7cceba0e8d3-42372400