THE IMPACT OF POPULATION CHARACTERISTICS AND HEALTH BEHAVIORS ON THE IMMUNOLOGIC FUNCTION OF PEOPLE LIVING WITH HIV/AIDS IN A MIDWESTERN CITY

by

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DEDICATION

Psalms 86:12

This dissertation is lovingly dedicated my mother, Raymonde Rodrigue Balthazar and father, Pierre Andre Balthazar. Without their continued love and support it would not have been possible for me to complete this process. I would also like to acknowledge my other family and friends who prayed with and for me and were a great source of strength and comfort for me throughout my pursuit of higher education.

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The Impact of Population Characteristics and Health Behaviors on the Immunologic Function of People Living with HIV/AIDS in a Midwestern City

Abstract

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There are an estimated 56,000 new human immune deficiency virus (HIV) infections diagnosed nationally each year. Research has indicated that restored immunologic function results in a reduction in HIV transmission rates by more than 96%. Treatment adherence is instrumental in reducing HIV transmission rates as well as in preventing the progression of HIV to acquired immune deficiency syndrome (AIDS) and in improving health outcomes. However, depressive symptoms and psychological stress have been linked to poor treatment adherence. Poor sleep quality has been directly and indirectly associated with elevated HIV viral load and increased mortality in this population. The purpose of this study was to explore the relationships among population characteristics (demographic data, HIV/AIDS classification, psychological stress, and depressive symptoms), health behaviors (treatment adherence, sleep, and the use of health services), and health outcomes (immunologic function) in HIV-infected individuals. Andersen's Behavioral Model for Healthcare Utilization was the theoretical framework used to guide this study. It provided further clarification about factors that may impact immune function of people living with HIV/AIDS. The study sample consisted of 104 HIV-positive adults living in Northeast Ohio. This study was a descriptive, correlational

secondary data analysis of a previously collected dataset. Descriptive statistics, Pearson's correlations and multiple linear regressions were used to identify the relationships among demographic data, HIV/AIDS classification, psychological stress, depressive symptoms, treatment adherence, sleep, missed clinic visits and immune function. Results found that population characteristics and health behaviors explained 23% of the variance in CD4+ T-lymphocyte count (R^2= .227, F= 2.795, p= .009) and 24% of the variance in HIV viral load (R^2= .244, F= 5.869, p< .001). More research is needed to identify what explains the additional variance in immune function among people living with HIV/AIDS. Understanding inter-relationship among factors such as psychological stress, depressive symptoms, and sleep and their impact the health status of people living with HIV/AIDS may allow for the development of interventions that may improve immune function and reduce HIV transmission rates.

CHAPTER I: INTRODUCTION

This chapter introduces several key elements that are associated with the research study. Embedded in this chapter is an overview of the research problem and the purpose of the proposed study. In addition, it provides the background and significance of the study along with the theoretical framework that is used to guide all aspects of the research. Descriptions of the major study variables, the research questions, and a discussion of the potential significance of this investigation follow.

Overview of the Problem

HIV/AIDS Throughout the World

HIV. HIV is a sexually transmitted infection (STI), which emerged as a global pandemic in the 1980s (Valdiserri, 2011; Vermund, 2013). It has only been in the past decade that there have been slight declines in infection rates throughout the world (Joint United Nations Programme on HIV/AIDS & United Nations, 2012; World Health Organization, 2012b).

In 2012, global estimates suggest approximately 35.3 million people are living with HIV-infection around the world (Joint United Nations Programme on HIV/AIDS & United Nations, 2012; World Health Organization, 2012b; World Health Organization, 2013b). HIV prevalence rates have been reported to range from 1 in 10 in the general adult population to as much as 1 in 2 in certain age/gender groups, such as; men who have sex with men (MSM) and female sex workers (Joint United Nations Programme on HIV/AIDS & United Nations, 2012; National Center for HIV/AIDS, Viral Hepatitis, STD, and TB Prevention (U.S.) & Division of HIV/AIDS Prevention, 2012a; National Center for HIV/AIDS, Viral Hepatitis, STD, and TB Prevention (U.S.) & Division of

HIV/AIDS Prevention, 2012b). Ninety-five to 97% of HIV-infected people are living in low- and middle-income countries (LMIC) (Joint United Nations Programme on HIV/AIDS & United Nations, 2012; Kates, Joint United Nations Programme on HIV/AIDS, & Henry J. Kaiser Family Foundation, 2012; World Health Organization, 2012b; World Health Organization, 2013b). The World Bank (2013) classifies a country as low-income when their gross national income (GNI) per capita is less than or equal to $1,035 in US dollars. A middle-income country is classified as such when their GNI is $1036 - $12,615 US dollars per capita (World Bank, 2012; World Bank, 2013).

With proper treatment, the life expectancy of an individual with HIV can be comparable to that of the general population of their given country (Joint United Nations Programme on HIV/AIDS & United Nations, 2012). However, without treatment and intervention, HIV progresses to acquired immunodeficiency syndrome (AIDS), (Hirnschall, Harries, Easterbrook, Doherty, & Ball, 2013; Vermund, 2013; World Health Organization & World Health Organization, Department of HIV/AIDS, 2012; World Health Organization, 2012b). AIDS itself can kill, but more commonly it prevents the infected individual from resisting any other infection. Such infections (which are known as opportunistic) occur only among people with impaired immune functionality.

AIDS. Advanced HIV infection gradually destroys the immune system, resulting in AIDS (Joint United Nations Programme on HIV/AIDS & United Nations, 2012; Vermund, 2013; World Health Organization, 2012b). In 1993 the Centers for Disease Control and Prevention (CDC) revised the definition of AIDS to include those who were severely immunologically suppressed, having a CD4+ T-lymphocyte count less than 200 cells/μL (Castro et al., 1993). However, since the time of this revision, combination

antiretroviral therapy (cART) has been introduced as a treatment modality for HIV/AIDS. cART has the potential for immunological reconstitution among individuals who carry the disease. People who have reached the threshold of a CD4+ T-lymphocyte threshold of less than 200 cells/μL may be able to restore their immune systems during adherence to therapy. The rebuilding of the immune system results in a rise in lymphocyte counts above 200 cells/μL, which allows for symptom-free living in those with AIDS (Vermund, 2013). Thus, HIV/AIDS are now classified as both infectious and chronic diseases (Vermund, 2013). In the United States, people whose CD4+ T-lymphocyte counts have fallen below 200 cells/μL and were subsequently diagnosed with AIDS retain that diagnosis irrespective of subsequent immunologic recovery and regardless of subsequent rise in CD4+ T-lymphocyte counts due to cART.

HIV/AIDS prevention. HIV/AIDS infection rates remain high and are even rising in certain sub-populations throughout the world, including the United States (Centers for Disease Control and Prevention, 2013; Joint United Nations Programme on HIV/AIDS & United Nations, 2012; Sidibé & Secretariat, 2013). There is no evidence to suggest that this pandemic is self-limiting or that it will resolve without intervention (Joint United Nations Programme on HIV/AIDS & United Nations, 2012; Larson, Bertozzi, & Piot, 2011; Schwartländer et al., 2011; World Health Organization, 2012b). The HIV virus mutates rapidly (Streeck, D'Souza, Littman, & Crotty, 2013). Any one individual can be co-infected with several strains, each of which may carry drug resistances. Furthermore, when different strains infect the same cell, the virus can "swap" or incorporate new resistant genes into the daughter virons. Therefore, the range of genetic variants of HIV make therapy more challenging, and also make it more

challenging to create a generalizable vaccine (World Health Organization & World Health Organization, Department of HIV/AIDS, 2012). The current state of science suggests that a vaccine against this malady will not be available in the near future (Essex & Novitsky, 2013). Therefore, other prevention modalities are recommended around the world. What follows is a brief description of some of these preventative measures.

There are numerous preventative measures encouraged by public health and infection control authorities around the world; these techniques demonstrate varying levels of efficacy. For example, the use of condoms in conjunction with lubricants has been highly effective in preventing the transmission of HIV (National Center for HIV/AIDS, Viral Hepatitis, STD, and TB Prevention (U.S.) & Division of HIV/AIDS Prevention, 2011). However, barrier protection use tends to be inconsistent (Hoffman, 2013; Lucea, Hindin, Gultiano, Kub, & Rose, 2013; Siegler, Mbwambo, McCarty, & DiClemente, 2012). A study of 732 MSM in San Francisco, California, found approximately 28% of study participants used condoms (McFarland et al., 2012). Circumcised men have a 57% to 61% decreased risk of HIV transmission from heterosexual intercourse (Auvert et al., 2013; Centers for Disease Control and Prevention, National Center for HIV/AIDS, Viral Hepatitis, STD, and TB Prevention (U.S.), & Division of HIV/AIDS Prevention, 2012; Cooper, Wodak, & Morris, 2010; Reed et al., 2012). However, some men, believing that circumcision provided adequate protection for HIV and other STIs, responded with increased sexual risk behaviors and by dispensing with condom use altogether (Lagarde, Dirk, Puren, Reathe, & Bertran, 2003). Others resist circumcision because of concerns that male circumcision impairs penile function and leads to sexual dysfunction (Forbes, 2011). The CDC does not presently have

recommendations on male circumcision for HIV prevention in the United States (Centers for Disease Control and Prevention (U.S.), 2008).

HIV is transmitted by contaminated blood as well as to through sexual intercourse. The most common exposure to blood is through shared needles through intravenous drug abuse (IVDA) (National Center for HIV/AIDS, Viral Hepatitis, STD, and TB Prevention (U.S.) & Division of HIV/AIDS Prevention, 2012b). Programs that supply clean needles to intravenous drug users have also been effective in reducing HIV transmission rates (Hyshka, Strathdee, Wood, & Kerr, 2012; Joint United Nations Programme on HIV/AIDS & United Nations, 2012; United States & Office of National AIDS Policy, 2010; World Health Organization, 2012b). Australia, for example, HIV infection rates among intravenous drug users have been maintained around one percent over the course of this pandemic. This is related to the wide use of needle exchange programs (Topp et al., 2011). There are challenges with establishing sufficient numbers of needle exchange programs to effectively control this form of HIV transmission (Mathers et al., 2010), particularly in LMIC (Joint United Nations Programme on HIV/AIDS & United Nations, 2012).

Antiretroviral drugs can be used for primary prevention as well as for treatment (M. S. Cohen, Muessig, Smith, Powers, & Kashuba, 2012). Antiretroviral agents can be used prior to exposure for pre-exposure prophylaxis (PrEP), after exposure for post-exposure prophylaxis (PEP), and as 'HIV treatment for prevention' (M. S. Cohen & Gay, 2010; Linden, 2011; Mayer & Venkatesh, 2010).

The use of antiretroviral agents as microbicides is a form of PrEP which is a promising approach to reducing the spread of HIV (National Center for HIV/AIDS, Viral

Hepatitis, STD, and TB Prevention (U.S.), 2013c); the use of intra-vaginal tenofovir gel prior to sexual intercourse demonstrated a reduction rate in HIV transmission up to 54% in sexually active adult women who were not pregnant or planning to become pregnant (Karim et al., 2010; World Health Organization & World Health Organization, Department of HIV/AIDS, 2012; World Health Organization, 2012b). However, the use of antiretroviral agents as PrEP is controversial and has recently come under criticism for being an unethical use of limited resources (Cowan & Macklin, 2013; Macklin & Cowan, 2012). There are a number of ethical principles that are in conflict with each other when it comes to treatment versus prevention of HIV/AIDS with antiretroviral agents (Macklin & Cowan, 2012). Some argue that, where antiretroviral agents are limited, the focus is on using all available resources to provide treatment to those who already have HIV/AIDS and will die without treatment. Macklin & Cowan (2012) suggest that it is unethical to allow those individuals to worsen and die so that a portion of the available antiretroviral resources can be allocated to prevent HIV infections in those who are presently uninfected even if they are at risk for becoming infected. Others argue that the focus is on preventing the most possible number of deaths from HIV/AIDS by decreasing the risk of new infections with the use of PrEP (Brock & Wikler, 2009; Singh, 2013). Not allocating resources for PrEP for those at particularly high risk for contracting HIV would be a violation of human rights (Singh, 2013). Singh (2013) argues that there is a duty to protect the interest of all people and therefore the most ethical approach is to allocate resources both HIV treatment and prevention simultaneously. With good evidence and ethical principles supporting both sides of this argument, it is unlikely that these two groups will reach a point of agreement on this topic at any point in the foreseeable future.

However, there are other promising forms of HIV/AIDS treatment and prevention that are much less controversial such as PEP and 'HIV treatment as prevention' that have thus far demonstrated higher levels of efficacy (M. S. Cohen et al., 2011; Schreiner, Stingl, Rieger, & Jalili, 2013). Nevertheless, in July 2012 the Food and Drug Administration (FDA) approved a cART regimen for use as PrEP, in conjunction with other prevention modalities, in high-risk populations in the United States (National Center for HIV/AIDS, Viral Hepatitis, STD, and TB Prevention (U.S.), 2013c). At that same time, the World Health Organization published recommendations for the use of PrEP for sero-discordant couples as well as for men and transgender women who have sex with men and are at high risk for HIV infection (World Health Organization, 2012a).

PEP is most effective when initiated within 72 hours of HIV exposure (Chan, Gough, Yoong, Dimeo, & Tan, 2013; McAllister et al., 2013; Schreiner et al., 2013). While PEP is well tolerated and has demonstrated success in preventing HIV transmission (Chan et al., 2013; Linden, 2011; McAllister et al., 2013), a major drawback is that often people are unaware that they have been exposed to the virus before the 72-hour timeframe has expired. This means that individuals who are potentially at greatest risk (i.e. MSM and IVDA) may not seek this treatment before this window has closed. Nevertheless, a study conducted in Austria found a 0% HIV seroconversion rate for 450 people who began PEP within 72 hours of HIV exposure via routes including, unprotected homosexual and heterosexual contact with an HIV-positive partner, needle-stick injuries, rape and intravenous drug use among both males and females (Schreiner et al., 2013). Study participants had follow-up visits at 1, 3, and 6 months. With comparable

findings in the United States, the CDC recommends clinicians promptly initiate cART for individuals who seek care within 72 hours of exposure to HIV (D. K. Smith et al., 2005).

'HIV treatment as Prevention' involves effectively treating those who are HIV-positive with early cART so as to decrease the likelihood that they will spread HIV to others. Early cART refers to regimens that are begun when CD4+ T-lymphocyte counts range between 350-550 cells/μL. This approach has been found to decrease HIV transmission rates by 96% among heterosexual, monogamous, sero-discordant couples (M. S. Cohen et al., 2011). However, despite the compelling evidence supporting this, there is concern about the cost effectiveness and feasibility of this approach particularly for LMIC (Walensky et al., 2013) where the resources tend to be more limited but the disease burden trend is higher (Joint United Nations Programme on HIV/AIDS & United Nations, 2012; Kates, Joint United Nations Programme on HIV/AIDS, & Henry J. Kaiser Family Foundation, 2012; World Health Organization, 2012; World Health Organization, 2013b). To help address this concern, the HPTN 052 investigators collaborated with others to project potential future outcomes in two LMIC, India and South Africa (Walensky et al., 2013). A micro-simulation model of HIV disease, treatment, and transmission was used to conduct a model-based analysis to evaluate projected costs associated with early and late cART. Late cART refers to therapy initiated after CD4+ T-lymphocyte counts have decline below 250 cells/μL. Study results demonstrated that over one's lifetime, the longer lifespan associated with early cART was associated with greater "per person" costs when compared to delayed cART. However, when taking into account the associated reduction in HIV-transmission rates (Eaton et al., 2012), early cART was actually cost saving over a 5-year period (Walensky et al., 2013).

Purpose

The purpose of this study was to explore the relationships among specific population characteristics (demographic data, HIV/AIDS classification, psychological stress, and depressive symptoms), health behaviors (treatment adherence, sleep, and the use of health services), and health outcomes (immunologic function) in HIV-infected people living in Northeast Ohio. One of the goals of nursing research is to develop knowledge for practice (Hinshaw, 1989). Psychological stress, depressive symptoms, treatment adherence, sleep, and the use of health services are variables that may impact immune function among PLWHA and are amenable to intervention at the practice level.

Background and Significance

HIV/AIDS in the United States

The economic collapse that began in 2008 has heighted public awareness of the expenses associated with healthcare. With national incidence of HIV-infection estimated at 1.1 million persons (National Center for HIV/AIDS, Viral Hepatitis, STD, and TB Prevention (U.S.) & Division of HIV/AIDS Prevention, 2012a; National Center for HIV/AIDS, Viral Hepatitis, STD, and TB Prevention (U.S.) & Division of HIV/AIDS Prevention, 2012b) the costs associated specifically with HIV-related illness, disability and death are high (Schwartländer et al., 2011; B. G. Wagner, Kahn, & Blower, 2010). In the United States, treatment of STI is estimated to cost $16 billion annually. Because HIV is a life-long illness it is among one of the costliest (National Center for HIV/AIDS, Viral Hepatitis, STD, and TB Prevention (U.S.), 2013a). It is important that research allay some of those costs through a focus on public awareness, early testing, treatment, and

management of the disease in order to improve the health outcomes for PLWHA (Vermund, 2013).

The HIV epidemic has been driven primarily by intravenous drug use (IDU) and a variety of sexual behaviors: heterosexual, homosexual and bisexual (National Center for HIV/AIDS, Viral Hepatitis, STD, and TB Prevention (U.S.) & Division of HIV/AIDS Prevention, 2012a; National Center for HIV/AIDS, Viral Hepatitis, STD, and TB Prevention (U.S.) & Division of HIV/AIDS Prevention, 2012b; Vermund & Leigh-Brown, 2012). Fortunately, effective HIV screenings and public health efforts have essentially eliminated other forms of transmission in this country, such as blood/blood product-related transmissions, which is almost zero (Joint United Nations Programme on HIV/AIDS & United Nations, 2012). This is also true of mother-to-child transmissions of HIV during pregnancy and delivery (Birkhead et al., 2010; Fowler, Gable, Lampe, Etima, & Owor, 2010; Joint United Nations Programme on HIV/AIDS & United Nations, 2012; Lampe et al., 2010; Vermund, 2013; Whitmore, Patel-Larson, Espinoza, Ruffo, & Rao, 2010; Whitmore, Zhang, Taylor, & Blair, 2011). These advances have helped to preserve the health and lives of mother, baby, and blood transfusion recipient.

At risk groups in the United States. Almost all "at risk" groups are "underprivileged" and this is true the world over. HIV-infection rates are still increasing in certain subgroups in the United States (Joint United Nations Programme on HIV/AIDS & United Nations, 2012; National Center for HIV/AIDS, Viral Hepatitis, STD, and TB Prevention (U.S.) & Division of HIV/AIDS Prevention, 2012a; National Center for HIV/AIDS, Viral Hepatitis, STD, and TB Prevention (U.S.) & Division of HIV/AIDS Prevention, 2012b).Vulnerability to HIV-infection is higher in persons who participate in

unprotected anal intercourse and, because it increases risk-taking behaviors, among those who use illicit drugs and alcohol at the time of intercourse (Joint United Nations Programme on HIV/AIDS & United Nations, 2012; National Center for HIV/AIDS, Viral Hepatitis, STD, and TB Prevention (U.S.) & Division of HIV/AIDS Prevention, 2012b; World Health Organization & World Health Organization, Department of HIV/AIDS, 2012). MSM are contracting HIV at an alarming rate (National Center for HIV/AIDS, Viral Hepatitis, STD, and TB Prevention (U.S.) & Division of HIV/AIDS Prevention, 2012a; National Center for HIV/AIDS, Viral Hepatitis, STD, and TB Prevention (U.S.) & Division of HIV/AIDS Prevention, 2012b). The highest rates of new HIV infections in the United States currently are among MSM of all races with White MSM representing the racial/ethnic group with the highest rate of new infections (22.4%), followed by Black MSM (21.2%) then Hispanic MSM (13.4%) (Centers for Disease Control and Prevention, 2013). Though representing a significantly smaller segment of the population, HIV infection rates are also disproportionately high in Asian American MSM (86%), Native Hawaiian/Pacific Islander MSM (87%) and in American Indian/Alaska Native MSM (75%) in proportion to the number of HIV-infected individuals in their respective racial/ethnic group (National Center for HIV/AIDS, Viral Hepatitis, STD, and TB Prevention (U.S.) & Division of HIV/AIDS Prevention, 2013b; Operario, Tan, & Kuo, 2013). In total, MSM account for approximately 63% of the newly HIV-infected population in the United States (Centers for Disease Control and Prevention, 2013; El-Sadr, Mayer, & Hodder, 2010; Joint United Nations Programme on HIV/AIDS & United Nations, 2012; Millett et al., 2010; National Center for HIV/AIDS, Viral Hepatitis, STD, and TB Prevention (U.S.) & Division of HIV/AIDS Prevention, 2012a; National Center

for HIV/AIDS, Viral Hepatitis, STD, and TB Prevention (U.S.) & Division of HIV/AIDS Prevention, 2012b). IVDA among MSM accounts for an additional 3% of new HIV infections in the United States (National Center for HIV/AIDS, Viral Hepatitis, STD, and TB Prevention (U.S.) & Division of HIV/AIDS Prevention, 2012b). Though rates are lower than in MSM, men who have sex with men and women are also at high risk for HIV-infection (M. R. Friedman et al., 2014). There is now a push to have bisexually behaving men added to HIV/AIDS surveillance reports so as to facilitate addressing this rising public health concern (M. R. Friedman et al., 2014).

Treatment and management. HIV/AIDS is no longer a death sentence, but rather a chronic and manageable disease (Oguntibeju, 2012; Vermund, 2013). Despite having therapeutic regimens that are effective at managing this disease, the health care delivery systems currently in place in the United States and around the world are generally inadequate to address growing rates of infection (Vermund, 2013). The Human Rights Factsheet (United Nations, Office of the High Commissioner for Human Rights, & World Health Organization, 2008; World Health Organization, 2013a) dictates that health care delivery systems have the basic responsibility of providing adequate access and quality care for people, including those with HIV/AIDS. However, health systems are driven by laws, policies and available resources. In the United States, Healthy People 2020 outlines four overarching goals for all Americans: (1) attain high quality, longer lives free of preventable disease; (2) achieve health equity; eliminate disparities; (3) create social and physical environments that promote good health; and (4) promote quality of life, healthy development, healthy behaviors across life stages (Healthy People, 2011). All of these goals are relevant to and important for PLWHA in the United States.

In congruence with Health People 2020 goals, the United States Department of Health and Human Services (DHHS), in partnership with the White House Office of National AIDS Policy and other federal partner agencies, established HIV/AIDS infection as a National Priority (United States & Office of National AIDS Policy, 2010). They released the "National HIV/AIDS Strategy for the United States" report in 2010. The major goals of this policy are to (1) reduce new HIV infections, (2) increase access to care and improve health outcomes, (3) reduce HIV-related disparities and health inequities, and (4) support global efforts to achieve the HIV/AIDS Strategy goals (United States & Office of National AIDS Policy, 2010). In 2013 (Mahle-Gray et al.), the CDC released a report on indicators of the National HIV/AIDS Strategy. In the United States, HIV is a mandatory reportable disease; all cases are reported to the CDC and monitored via the National HIV Surveillance System (Mahle-Gray et al., 2013). In analyzing data collected through this system, the CDC found that 81% of people newly diagnosed with HIV in 2009 were appropriately linked to a health care system upon diagnosis. However, there were disparities by race and age. Of note, Whites (77.4%) were most likely to have an adequately suppressed viral load (200 copies per milliliter or less); next were Hispanics at 70.3%, trailed by Blacks (60.2%). Older persons, 65 years or older, fared better, and were more likely to have an adequately suppressed viral load (84.2%) versus 44.3% for those aged 13 to 24 (Mahle-Gray et al., 2013). Because data on treatment is not available on the National HIV Surveillance System database, it was not possible for researchers to analyze the relationship between treatment and viral suppression in this study. However, these results do highlight the disparities that exist in access to appropriate suppressive cART and retention of care (Mahle-Gray et al., 2013). These are

the types of disparities that the government is actively seeking to eliminate (Healthy People, 2011; United States & Office of National AIDS Policy, 2010).

Management of HIV/AIDS is highly complex. It requires testing, linkages to care systems, cART availability, and regimen adherence (United States & Office of National AIDS Policy, 2010; Vermund, 2013). The complexities of this illness often require linkages with medical management, social support systems, and mental health care and individuals at greatest risk of HIV infection tend to be poorly educated and under-resourced (United States & Office of National AIDS Policy, 2010). The provision of these management essentials is further complicated by other health conditions that often exist in this vulnerable population. Comorbid conditions such as depressive symptoms, stress, and sleep apnea are common occurrences that can adversely affect health outcomes for persons living with HIV (Altice, Kamarulzaman, Soriano, Schechter, & Friedland, 2010; Blashill, Perry, & Safren, 2011; Gamaldo et al., 2013; Nel & Kagee, 2011; Pence, 2009; Taibi, 2013; Vermund, 2013).

Sleep health is a major concern for all Americans and has been included as one of the Healthy People 2020 objectives with one of the expectations being that more research on sleep will be conducted (Healthy People, 2011). The CDC categorizes sleep as a critical determinant of health and wellbeing (Adams, Schoenborn, National Center for Health Statistics (U.S.), & Division of Health Interview Statistics, 2010). Poor sleep health is emerging as a comorbid condition of particular concern among individuals with chronic disabilities and disorders, such as HIV/AIDS (Healthy People, 2011). The true prevalence of sleep disorders among PLWHA remains unknown (Gamaldo et al., 2013). However, research has found that up to 70% of PLWHA report experiences of sleep

disturbances (Taibi, 2013) compared to just 30% in the general population (Lee et al., 2012; Taibi, 2013). This is worrisome because sleep has both direct and indirect effects on immune function (Cardinali & Esquifino, 2012). There is a strong relationship between sleep, HIV viral load, and CD4+ T-lymphocyte count (Foster et al., 2012). Impaired sleep has also been shown to result in cART non-adherence (Saberi, Neilands, & Johnson, 2011). Because appropriate cART adherence is currently the most effective modality available for the treatment and prevention of HIV/AIDS (Vermund, 2013), further research on this specific comorbidity is warranted.

HIV/AIDS prevention. In an effort to improve the health of all Americans, Healthy People 2020 has set a goal of preventing HIV and its related illness and death for the decade 2010-2020 (Healthy People, 2011). Though there have been some promising research findings (Chan et al., 2013; M. S. Cohen & Baden, 2012; Karim et al., 2010; McAllister et al., 2013; Schreiner et al., 2013), it is unlikely that any one prevention modality will be sufficient to reverse the global progression of the HIV/AIDS pandemic (Kurth, Celum, Baeten, Vermund, & Wasserheit, 2011). A combination of biomedical and behavioral prevention strategies remains necessary to effectively reduce HIV/AIDS incidence rates (Kurth et al., 2011). It is with this understanding that the HIV Prevention Trials Network (HPTN) proceeds with HIV prevention research (Cohn & Russel, 2013; Stephenson, 2000).

HPTN is a global collaboration involving investigators, ethicists, community and other partners to evaluate new HIV prevention interventions and strategies in regions disproportionately burdened with HIV infection (Cohn & Russel, 2013; Stephenson, 2000). HPTN is funded by three institutes of the U.S. National Institutes of Health (NIH):

the National Institute of Allergies and Infectious Diseases, the National Institute of Mental Health, and the National Institute of Drug Abuse. It was established in the year 2000 and is comprised of research sites across the globe, including fourteen sights in Africa, seven sites in Asia, three sites in Latin America, one site in Europe, and nine sites in the United States. HPTN research groups focus on microbicides, mother-to-child transmission, antiretroviral therapy, behavior change, substance use, and sexually transmitted infections (Cohn & Russel, 2013; Stephenson, 2000). HPTN's central operations center is based at Family Health International (FHI) 360 in North Carolina. Central operations are responsible for facilitating and managing the scientific agenda, protocol development, study conduct, and publication of study results for HPTN. Johns Hopkins University is responsible for collecting, testing and reporting results from biological samples. HPTN's statistical and data management center is located at the Statistical Center for HIV/AIDS Research and Prevention (SCHARP) in Washington, which is responsible for data collection, reporting, and statistical analysis of HPTN trials (Cohn & Russel, 2013; Stephenson, 2000).

The HPTN 052 protocol (HPTN 052) (M. S. Cohen et al., 2011) demonstrated that cART effectively reduces infectiousness and sexual transmission of HIV. The HPTN 052 protocol studied, 1763 HIV-sero-discordant couples in nine countries (Botswana, Kenya, Malawi, South Africa, Zimbabwe, Brazil, India, Thailand, and the United States). This study found improved immunologic function as well as a reduction in HIV transmission rates by more than 96% when people received appropriate and early treatment with cART and when medication adherence was at least 95%. These findings are groundbreaking, and have already altered the standard for HIV treatment and

management around the world (World Health Organization & World Health Organization, Department of HIV/AIDS, 2012; World Health Organization, 2012b). However, the proper management of HIV/AIDS remains a highly complex endeavor (United States & Office of National AIDS Policy, 2010).

Problem Statement

HIV prevention efforts are impacted by a number of environmental and personal factors. For example, there exists a small subsample of MSM who report intentionally becoming infected with HIV for various personal reasons such as gaining social support (Loveless, 2013). Nursing interventions designed to identify these individuals, address these personal concerns, and improve social support among these MSM may reduce the incidence of such occurrences.

Though factors such as social support (Muñoz et al., 2011; Woodward & Pantalone, 2012), religious affiliation (Vyas, Limneos, Qin, & Mathews, 2014), and self efficacy (Colbert, Sereika, & Erlen, 2013) seem to buffer the negative effects of these, adherence to cART regimens can be adversely affected by issues of stigma (Okoror, Falade, Olorunlana, Walker, & Okareh, 2013; Rao et al., 2012), discrimination (G. J. Wagner, Bogart, Galvan, Banks, & Klein, 2012), homelessness (Palepu, Milloy, Kerr, Zhang, & Wood, 2011), financial stress (McAllister, Beardsworth, Lavie, MacRae, & Carr, 2013), psychological stress (Bottonari, Safren, McQuaid, Hsiao, & Roberts, 2010), and depression (J. S. Gonzalez, Batchelder, Psaros, & Safren, 2011). Additionally, the use of alcohol and illicit drugs is a not only a risk factor for HIV infection but is also related to disease progression and decreased cART adherence (A. Gonzalez, Mimiaga, Israel, Bedoya, & Safren, 2013; Mastro, Cunningham, Medrano, & van Dam, 2012;

Schneider, Chersich, Neuman, & Parry, 2012; Tran et al., 2013). Of these factors, a select few have been chosen as variables for the present study.

HIV-infected persons endure many additional barriers in their lives. In addition to the burdens of daily medication regimens, their costs, and the encumbrance of additional illnesses, they tend to suffer from stress and depression. Stress and depression further reduce their social resistance as well as their physiologic resistance to issues such as difficulty with sleep and could also lead to missed clinic visits and treatment non-adherence. This would result in disease progression and ultimately, the continued proliferation of HIV throughout the United States and the world. Andersen's Behavioral Model of Health Services Utilization (Andersen, 1995) suggests some such variables that may ultimately influence health outcomes. This model was used to identify the major variables related to health behaviors and improved health outcomes of PLWHA. This is a secondary study utilizing variables drawn from data collected in Northeast Ohio, by the study, "Exploring relationship among sTRess, Isolation, and Physical activity (TRIP) in older adults with HIV/AIDS".

Parent Study for the Current Research

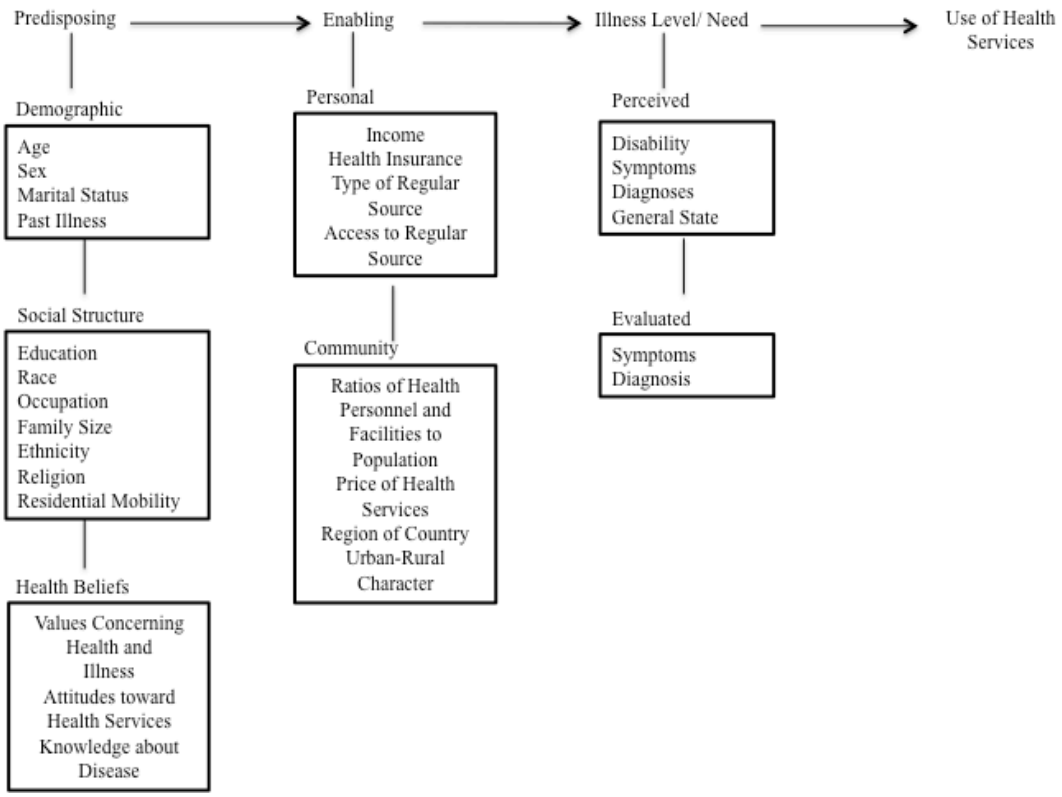
"Exploring relationship among sTRess, Isolation, and Physical activity (TRIP) in older adults with HIV/AIDS" is the parent study for this proposed research. The study goal is to (1) describe and compare levels of stress, isolation, physical activity, and sleep between younger HIV-infected adults and older HIV-infected adults; (2) describe and compare differences in levels of stress, isolation, physical activity, and sleep between men and women living with HIV/AIDS; and (3) examine the interaction between age and gender on levels of stress, isolation, physical activity, and sleep in adult PLWH. The

TRIP study is an ongoing, longitudinal study. Data collection began in 2012 and will complete in 2015 for a total of 5 data collection points. Data collected at the first time point will be analyzed by a doctoral student at a School of Nursing to answer the research questions of interest to this proposed research study.

Theoretical Framework

Andersen (1968), developed the Behavioral Model of Utilization in the 1960's for the purposes of (1) better understanding why families use health services, (2) defining and measuring equitable access to health care, and (3) assisting in the promotion of equitable access to health services (Figure 1) (Andersen, 1968). The model was initially designed to explain the individual use of health services, but did not include health outcomes measures (Andersen, 1995). Intended to both predict and explain health services utilization (Andersen, 1995), the original Behavioral Model posits that one's use of health services is a function of his or her predisposition to health services use, coupled with factors that enable or impede health services use, and driven by the individual's need for care (Andersen, 1968).

FIGURE 1. Andersen's Initial Behavioral Model (1960s)



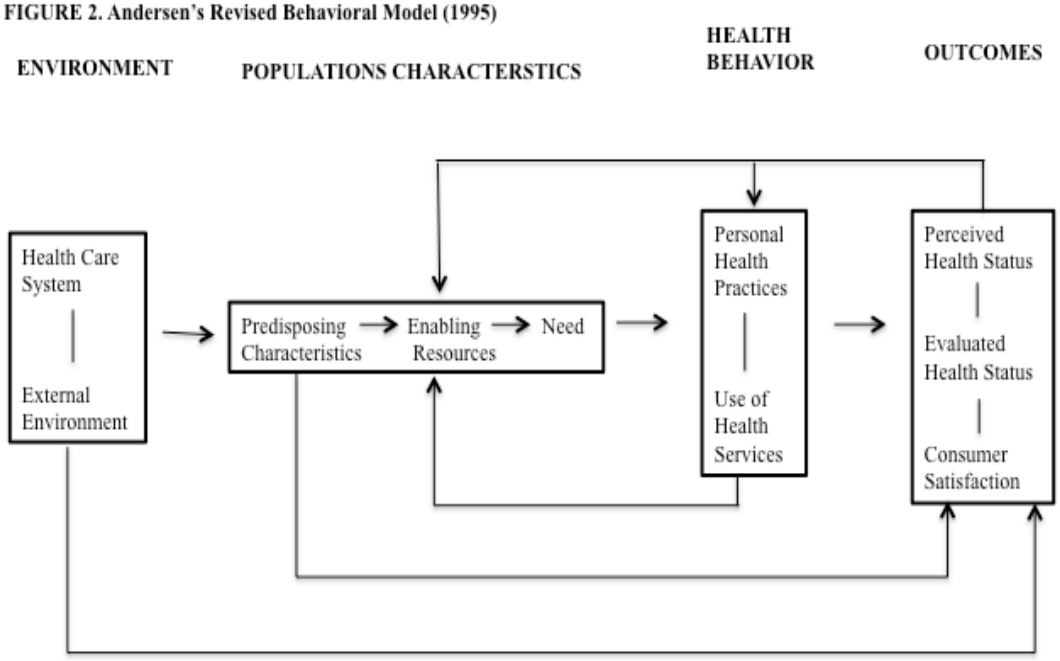
Over the years, the model has been adapted, expanded, and revised numerous times by Andersen and others (Aday & Andersen, 1974; Aday, Andersen, & Fleming, 1980; Aday, Andersen, Loevy, & Kremer, 1985; Andersen, Smedby, & Anderson, 1970; Andersen, Kravits, & Anderson, 1977; Andersen, 1995; Andersen & Newman, 2005; Fleming, 1986; Gelberg, Andersen, & Leake, 2000). The original model, along with its various adaptations, has been used nationally and internationally to frame research, develop policy, and to promote equitable access to health care in a variety of populations. Significant research findings, based on this model, have improved our understanding of health care access by women (Harcourt et al., 2013; O'Neal et al., 2013; Vijayaraghavan et al., 2012; von Heymann-Horan, Dalton et al., 2013), children (Alexander, Brijnath, & Mazza, 2013; Ganguli, Gourley, & White-Means, 2012; Magaña, Parish, Rose, Timberlake, & Swaine, 2012; Ogbuanu, Goodman et al., 2012a; Ogbuanu, Goodman et

al., 2012b), the elderly (O'Neal et al., 2013; von Heymann-Horan, Bidstrup et al., 2013), the homeless (Babitsch, Gohl, & von Lengerke, 2012; Chwastiak, Tsai, & Rosenheck, 2012; Linton & Shafer, 2014; Stein, Andersen, Robertson, & Gelberg, 2012; Vijayaraghavan et al., 2012), minorities (Doshi, Malebranche, Bowleg, & Sangaramoorthy, 2013; Harcourt et al., 2013; O'Neal et al., 2013), immigrants (Harcourt et al., 2013; Park, Cho, Park, Bernstein, & Shin, 2013; Spolsky, Marcus, Der-Martirosian, Coulter, & Maida, 2012), the disabled (Balogh, Ouellette-Kuntz, Brownell, & Colantonio, 2012; Guilcher et al., 2012; Magaña et al., 2012; Miller, Kirk, Alston, & Glos, 2013; Nath, Irene Wong, Marcus, & Solomon, 2012), the incarcerated (Graves, 2013), individuals with cancer (Harcourt et al., 2013; von Heymann-Horan et al., 2013; von Heymann-Horan et al., 2013), the HIV-infected/affected (Chartier, Carrico, Weiser, Kushel, & Riley, 2012; Doshi et al., 2013; Ganguli et al., 2012; Walter et al., 2012; Weiser, Hatcher, Guzman, Bangsberg, & Kushel, 2013), as well as by those seeking dental, mental and physical health services (Alexander et al., 2013; Azarpazhooh, Dao, Figueiredo, Krahn, & Friedman, 2013; Babitsch et al., 2012; Chartier et al., 2012; Chwastiak et al., 2012; Graves, 2013; Heaton, Mancl, Grembowski, Armfield, & Milgrom, 2013; Kovacs, 2012; Nath et al., 2012; O'Neal et al., 2013; Spolsky et al., 2012; von Heymann-Horan et al., 2013; Walter et al., 2012; Wu, Wang, Katz, & Farley, 2013). The broad use of this model in various populations demonstrates its ability to appropriately predict the use of health services and health outcomes in a variety of settings and with diverse populations.

After having observed the complex and cyclical nature of health service usage, Andersen realized the need to include health status outcomes into his model (Andersen,

1995). It is this (1995) expansion of the Behavioral Model (Figure 2) that will be used as a framework to guide this study. This model was chosen because it illustrates the factors that influence health services use and, subsequently, health status (Andersen, 1995). A detailed description of the proposed research model follows.

FIGURE 2. Andersen's Revised Behavioral Model (1995)

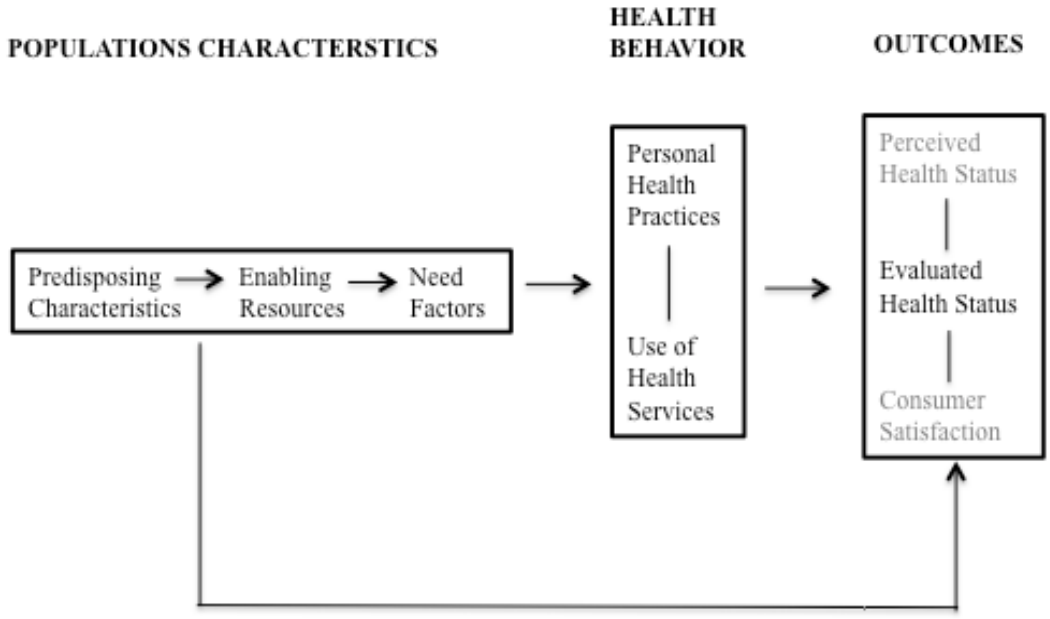


Research Model for the Proposed Study

Population characteristics, health behaviors and health outcomes are the research concepts of interest in this study (Figure 3). The Behavioral Model can be used to evaluate health services utilization at either the group level or at the individual level (Andersen, 1995). This model will be used to evaluate the variables of interest at the individual level. Not included in this study is an evaluation of the recursive relationships among the variables nor another major component of Andersen's Model (1995): the environment. This component includes the evaluation of the health care system and external environment. Though the model's primary focus is on health services, it acknowledges the physical, political, and economic components of the external

environment as important to understanding the use of health services (Andersen, 1995).

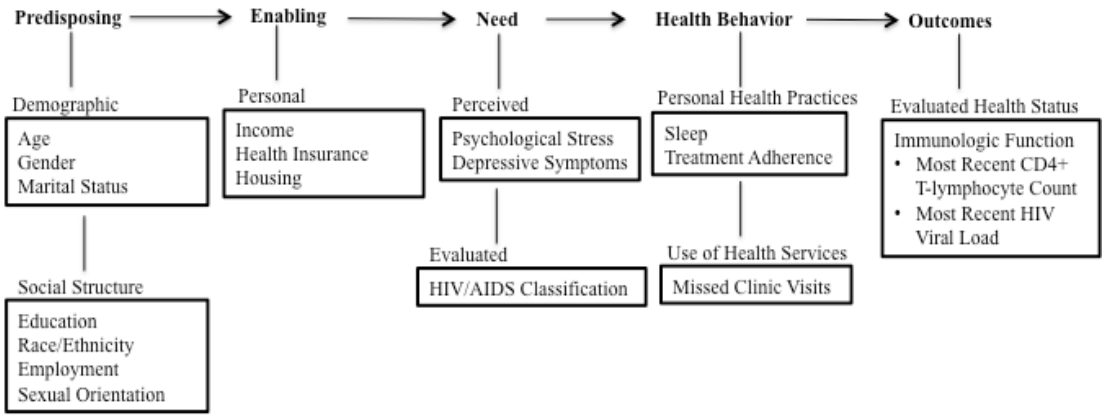
FIGURE 3. Research Model for the Study



Theoretical and Operational Definitions

The following definitions are relevant to this proposed study. Andersen (1968) theorized that there are three factors that impact health service usage: social factors, health services system factors, and individual factors. The 1995 adaptation posits that healthcare use at the individual level is a function of predisposing, enabling, and need factors. These characteristics influence health behaviors, thereby impacting, both directly and indirectly, patient health outcomes. Andersen's definitions of the major concepts of the model (1968; 1995; 2005) were used to develop the theoretical definitions for this study. See Figure 4 for a depiction of the major variables that will be explored.

FIGURE 4. Conceptual Model for the Study



Predisposing Characteristics

Some people may be more inclined than others to use health services. This inclination can be predicted by certain characteristics that exist prior to the onset of a specified illness (Andersen, 1968; Andersen, 1995; Andersen & Newman, 2005). Andersen theorized that a person's inclination, or predisposition, to seek medical attention is a function of both demographic characteristics and social structure. Predisposing factors refer to factors increasing one's likelihood of using health services (Andersen, 1968). For the purposes of this study, predisposing factors were the demographic characteristics of age, gender, and marital status. The social predisposing factors will be education, race/ethnicity, employment, and sexual orientation.

Demographic characteristics. Age and gender are demographic variables that are intimately related to health and illness (Andersen & Newman, 2005). For example, older adults tend to use more health services than their younger counterparts. This phenomenon is related to declining health related to the aging process. Consequently, studies have found age to be a statistically significant predictor of health service utilization amongst adults regardless of the setting, whether chronically ill or not, and with or without disability (Fasoli, Glickman, & Eisen, 2010; C. A. Green, Polen, Leo,

Perrin et al., 2010). However, it cannot be argued that people seek more health services just because they age. Rather, people suffer from various diseases and disorders across their lifespans. Those that lived longer have had more time to acquire diseases or disorders. Yet, they use health services based on their perceived and/or evaluated needs rather than just on their age (Andersen & Newman, 2005). Women typically have an increased need for routine primary care services because of their reproductive health needs (Maguen et al., 2012). Hence, throughout the course of life, women tend to use health services more frequently than men (Fasoli et al., 2010; Maguen et al., 2012). The use of sexual and reproductive health services among women in the United States has increased approximately 15% since 1995 and is expected to continue to rise with the implementation of the Affordable Care Act (Frost, 2013). Married persons tend to be in better physical and mental health and have lower mortality rates than their unmarried counterparts (Lindström & Rosvall, 2012; Molloy, Stamatakis, Randall, & Hamer, 2009; Pleis, Ward, & Lucas, 2010).

Social structure. The social structure variables are those which relate to an individual's social status as determined by characteristics such as level of education, employment and familial affiliations (Andersen & Newman, 2005). Studies indicate that level of education can predict health services utilization (Andersen, 1995; Andersen & Newman, 2005). Low education and impoverished living have been linked to poorer medication adherence and worsened overall health among PLWHA (Franke et al., 2011; Glass et al., 2010; Kalichman & Grebler, 2010). Better-educated people tend to get better preventative care and are less often hospitalized than their less-resourced counterparts (Miyakawa, Hanson, Theorell, & Westerlund, 2012; Reuser, Bonneux, & Willekens,

2012). Race/ethnicity has a statistically significant impact on health-seeking behaviors in the United States. Blacks and Hispanics are less likely to seek health services than Whites regardless of income and insurance status (Laiyemo et al., 2010; Sellars, Garza, Fryer, & Thomas, 2010). Occupation determines the type of workplace support. Research suggests that workplace support is a function of occupation. Studies have found healthy environments result in positive health behaviors (Bushnell, Colombi, Caruso, & Tak, 2010; Maslach & Jackson, 2013). Conversely, numerous studies have shown that stressful work environments result in negative health behaviors (Beehr, Bowling, & Bennett, 2010; Bushnell et al., 2010; Maslach & Jackson, 2013; Miyakawa et al., 2012; Owen, Healy, Matthews, & Dunstan, 2010; Payne, Jones, & Harris, 2012; Rugulies et al., 2012) such as smoking, the lack of exercise, high alcohol use, obesity and inadequate sleep (Bushnell et al., 2010).

Sexual orientation has also been found to impact health behaviors (Cochran, Bandiera, & Mays, 2013; McCabe, West, Hughes, & Boyd, 2013). While mammographic and colorectal screening rates do not differ significantly by sexual orientation (Austin et al., 2013), homosexual and bisexual women are more likely to use tobacco or to be exposed to second hand smoke than heterosexual women (Cochran et al., 2013). Homosexual and bisexual people are more likely to have a family history of substance abuse (McCabe et al., 2013). In a sample of 34,653 adults age 20 years and older, men and women who reported bisexual behaviors had at least 2 times greater odds of family histories of alcohol or other substance abuse when compared to heterosexual adults (McCabe et al., 2013). Those who are homosexual or bisexual, especially women, are also more likely to have a lifetime history of substance use disorders (Brewster &

Tillman, 2012; McCabe et al., 2013) but are less likely to seek treatment for these disorders (McCabe et al., 2013). While relevant research on the topic is quite limited, a recent study found sexual identity to be a weak covariate of service utilization among older HIV-infected adults (Brennan-Ing, Seidel, London, Cahill, & Karpiak, 2014).

Enabling Resources

The implications of the enabling factors are that a predisposition to the use of health care services is not sufficient to ensure they are actually used (Andersen, 1968; Andersen & Newman, 2005). Regardless of predispositions, health services must also be available and accessible. Andersen suggested that both personal and community enabling resources (Figure 1) must be present before an individual uses medical services (Andersen, 1968; Andersen, 1995; Andersen & Newman, 2005).

Income and health insurance can also either facilitate or impede access to health-related services. Low-income and uninsured people tend to have poorer access to quality medical services (Andersen & Davidson, 2001; Block et al., 2012; Driscoll & Bernstein, 2012; Kullgren & McLaughlin, 2010; Schoen et al., 2010; Shi & Stevens, 2010). Conversely, these same factors can facilitate health utilization. According to the Behavioral Model, factors that tend to make health services available and facilitate seeking such services are defined as ‘enabling’ (Andersen & Newman, 2005). The enabling component can include factors such as financial means, family resources, health insurance, and geographic region (Andersen, 1968; Andersen, 1995; Andersen & Newman, 2005). For the purposes of this study, enabling resources were measured as the personal characteristics of income, health insurance, and housing.

Studies have found low socio-economic status to be a barrier to receiving health care services; those with higher socio-economic status have greater access to human and material resources than those with lower socio-economic status (Artinyan et al., 2010; Blackwell, Martinez, Gentleman, Sanmartin, & Berthelot, 2009; Lejeune et al., 2010; Richardson & Norris, 2010; Stringhini et al., 2010; Williams, Mohammed, Leavell, & Collins, 2010). In addition, people with higher socio-economic status are more likely to have health insurance than those of lower socio-economic status. It has been found that having health insurance impacts the likelihood that an individual will visit a health care provider both in the general (Hwang et al., 2010; Schoen et al., 2010) and in the HIV-infected populations (Riley, Moore et al., 2011a). It has also been documented that the availability of low- and no-cost health services increases the use of health services (Allen, 2011; Gertz, Frank, & Blixen, 2011; Notaro et al., 2012). Housing status also impacts health services utilization. People who are homeless tend to use emergency and inpatient services at a significantly higher rate than those who are stably housed (Hwang et al., 2013). A research study found a decrease in overall community health care expenditures when chronically homeless individuals were transitioned to permanent supportive housing (Patterson, 2013).

Need Factors

Need factors refer to the individuals' perceived health need; they represent the most immediate cause of health service usage (Andersen, 1968; Andersen, 1995; Andersen & Newman, 2005). Even with the proper predisposition and enabling support to use health services, if there is no perceived need for healthcare it is unlikely that

services will be sought out or used by the individual (Andersen, 1968; Andersen, 1995; Andersen & Newman, 2005).

Andersen posits that those who perceive their health status as poor to fair or believe there is a need for care are more likely to seek that care (Andersen, 1968; Andersen, 1995; Andersen & Newman, 2005). The model also suggests that the need for health care has two components: perceived and evaluated. Perceived need refers to factors such as self-perception of need and satisfaction with care (Andersen, 1968; Andersen, 1995; Andersen & Newman, 2005). Evaluated need refers to health status as determined by health professionals. This may include factors such as diet, exercise, and disease status (Andersen, 1968; Andersen, 1995; Andersen & Newman, 2005). Those who feel well may not perceive the need for health services even when an evaluated need exists. One such example is with PLWHA who are non-compliant with their cART. According to the behavioral model, perceived needs are recognized as being disability, symptoms, diagnosis, or general state (Andersen, 1968; Andersen, 1995; Andersen & Newman, 2005). For the purposes of this research, psychological stress and depressive symptoms were chosen as symptoms for perceived need factors in accordance with Andersen's Behavioral Model. In this study depressive symptoms are distinctly different from a formal diagnosis of depression as outlined by the Diagnostic and Statistical Manual of Mental Disorders, 5 (American Psychiatric Association, 2013). Instead they are determined by feelings of sadness, emptiness, or irritable mood and accompanied by somatic and cognitive changes that significantly affect one's level of functionality (Ayuso-Mateos, Nuevo, Verdes, Naidoo, & Chatterji, 2010). The behavioral model recognizes evaluated need as being either symptoms or diagnosis (Andersen, 1968;

Andersen, 1995; Andersen & Newman, 2005). In this study evaluated need factors will be measured as diagnosed HIV/AIDS classification.

Perceived Need. Depression among PLWHA has been associated with poor treatment adherence and impaired immune function (Briongos-Figuero, Bachiller-Luque, Palacios-Martin, De Luis-Roman, & Eiros-Bouza, 2011). Though older, HIV-infected adults tend to be more susceptible to psychological distress, there are no statistically significant differences in symptoms of depression among older versus young HIV-infected adults (Vance, Mugavero, Willig, Raper, & Saag, 2011). Depression and stress have been shown to negatively predict health care use even after controlling for the effects of gender, age, or health status (C. A. Green et al., 2010; C. A. Green, Polen, Leo, Janoff et al., 2010). Psychological stress has also been linked to sleep disturbances, elevated HIV viral load, and increased mortality in HIV-infected adults (Fumaz et al., 2012).

Evaluated Need. HIV/AIDS classification is a function of the CD4+ T-lymphocyte count and of the HIV viral load. In the United States, HIV-infected people who ever reach CD4+ T-Lymphocyte counts below 200 cells/μL are classified as having AIDS. This diagnosis is retained irrespective of any future increase in T-cell count (Centers for Disease Control and Prevention, 1992; Gale et al., 2013). In this study, HIV versus AIDS was made on the basis of an 'ever' diagnosis of AIDS.

Health Behaviors

Health behaviors include both personal health practices and the use of health services (Andersen, 1995). Personal health practices refer to behaviors that tend to promote health such as diet, exercise, self-care, and adherence (Andersen, 1995; Gelberg

et al., 2000). For the purposes of this current research, personal health practices were measured using self-reported treatment adherence data and sleep. Use of health services will be measured as the number of missed clinic visits per year.

Personal health practices. There is a direct, reciprocal relationship between sleep and immune function (Cardinali & Esquifino, 2012). Sleep alters immune function; impaired immune function hinders sleep quality (Cardinali & Esquifino, 2012). Sleep disturbances are common among PLWHA (Taibi, 2013) and have been associated with higher incidences of depressive symptoms and stress (Marion et al., 2009).

Treatment adherence has been found to be instrumental in reducing HIV transmission rates as well as in improving health outcomes for PLWHA (M. S. Cohen et al., 2011; S. Cohen et al., 2011). Adherence to cART has an inverse relationship with HIV viral load (Oguntibeju, 2012). HIV treatment non-adherence is associated with increased HIV drug resistance and mortality (Ohl et al., 2013).

Use of health services. Proper management of HIV/AIDS hinges on the appropriate use of health care services (United States & Office of National AIDS Policy, 2010). Inadequate management of HIV/AIDS can lead to disease progression and virologic failure (Mahle-Gray et al., 2013). Unmet health service needs have been associated with lower treatment adherence among PLWHA (Kalichman et al., 2012). Missed clinic visits have been associated with increased risk of death (Ford & Spicer, 2012).

National data suggests that only 37% of individuals diagnosed with HIV in the United States are engaged in medical care (Gardner, McLees, Steiner, del Rio, & Burman, 2011). These low levels of retention in HIV medical care is associated with

increased morbidity and mortality (Ford & Spicer, 2012; Marks, Gardner, Craw, & Crepaz, 2010). The Institute of Medicine (IOM) metrics define retention of care for PLWHA as at least two clinic visits within a 12-month period at least 90 days apart (Ford & Spicer, 2012). Individuals who do not meet these minimum requirements are considered unengaged in care and at increased risk for disease transmission and progression. Use of HIV-related health services is instrumental in improving health outcomes for PLWHA (Ford & Spicer, 2012; Gardner, McLees, Steiner, del Rio, & Burman, 2011; Marks et al., 2010).

Health Outcomes

Health outcomes were also included in this study. As suggested by the model, health outcomes can be measured as self-perceived or evaluated health status (Andersen, 1995). Perceived health status refers to factors such as self-perception of health and satisfaction with care (Andersen, 1995; Andersen & Newman, 2005). Evaluated health refers to health status as determined by health professionals. The outcomes of this study will be related directly to the evaluated health status of PLWHA. These data were extracted from health records. In this study the evaluated health status of immunologic function will be measured using CD4+ T-lymphocyte counts as well as HIV viral load. Plasma HIV viral load coupled with the loss of T-cells are the most reliable indicators of disease progression in HIV/AIDS infection (Abbas & Lichtman, 2010; Mellors et al., 2009). Health outcomes will be measured using data collected on current CD4+ T-lymphocyte count and HIV viral load.

Research Questions

Using Andersen's Behavioral Model, how do population characteristics (including sexual orientation) and health behaviors (such as sleep) impact the health outcomes of HIV-infected adults? By answering the following research questions, this study aims to describe the role of population characteristics and health behaviors in the immune function of PLWHA.

1. What are the levels of population characteristics (predisposing characteristics, enabling resources, and need factors), health behaviors, and health outcomes?
2. What are the relationships among the population characteristics (predisposing characteristics, enabling resources, and need factors)?
3. How do the population characteristics (predisposing characteristics, enabling resources, and need factors) explain health behaviors?
4. How do the population characteristics (predisposing characteristics, enabling resources, and need factors) and health behaviors explain health outcomes?
5. Do health behaviors mediate the relationship between the population characteristics (predisposing characteristics, enabling resources, and need factors) and health outcomes?

Significance of the Study

The purpose of this study was to explore the relationships among specific population characteristics (demographic data, HIV/AIDS classification, psychological stress, and depressive symptoms), health behaviors (treatment adherence, sleep, and the use of health services), and health outcomes (immunologic function) in HIV-infected people living in Northeast Ohio. A recent scientific breakthrough indicates a decrease in

HIV transmission rates by more than 96% for HIV-infected individuals with adequate HIV viral suppression and functional immune systems who were on cART (M. S. Cohen et al., 2011). However, that study sample included only heterosexual individuals who were in a monogamous, sero-discordant relationship. In the United States, the majority of new HIV infections occur among MSM (Centers for Disease Control and Prevention, 2013) so it may not be appropriate to generalize the findings of the breakthrough study to the general HIV-infected population of the United States. This study sought to contribute to the current literature by using Andersen's Behavioral Model to evaluate the relationships among variables commonly found to impact immune function among PLWHA (psychological stress, depressive symptoms, and treatment adherence) while taking into account variables such as sexual orientation and sleep that are not as well evaluated in this population.

Significance to Nursing

It is one of the goals in nursing to develop knowledge for practice (Hinshaw, 1989) that can be used in the advancement of science including improved patient centered care and the development of health policy. The proposed study seeks to understand how various population characteristics influence health behaviors and immune function among PLWHA. The research findings may bring to light points of intervention that could potentially improve health outcomes. For example, if this research finds that the relationship between depression and immune function is mediated by sleep, then targeted interventions may be employed that may ultimately improve overall health outcomes. This would also benefit in the development of guidelines for best practices in nursing that will use evidence-based approaches to improve nursing care of PLWHA.

Summary

The purpose of this study was to explore the relationships among population characteristics (demographic data, HIV/AIDS classification, psychological stress, and depressive symptoms), health behaviors (treatment adherence, sleep, and the use of health services), and health outcomes (immunologic function) in HIV-infected people living in Northeast Ohio. The variables of interest will be explored using a secondary data set. An expanded version of Andersen's Behavioral Model (Andersen, 1995) will be used to guide this study. This study addresses the national HIV/AIDS strategy goals of (1) reducing new HIV infections and (2) improving the health outcomes of PLWHA (United States & Office of National AIDS Policy, 2010). This study also addresses the Healthy People 2020 goals to: (1) attain high quality, longer lives free of preventable disease; (2) achieve health equity; eliminate disparities; (3) promote good health; (4) promote healthy behaviors across life stages (Healthy People, 2011). The results of this study may be used in the advancement of science including improved patient-centered care, health policy, and for improving the health outcomes for PLWHA.

CHAPTER II: REVIEW OF LITERATURE

This chapter presents a review of the literature relevant to the proposed study. The review begins with a presentation of the relevant literature organized into sections according to the theoretical framework of Andersen's Behavioral Model of Utilization (Andersen, 1968; Andersen, 1995; Andersen & Newman, 2005), beginning first with Population Characteristics, followed by Health Behaviors and concluding with Health Outcomes.

HIV-Related Health Disparities

In 1999 the United States Congress commissioned the Institute of Medicine (IOM) to conduct research on ethnic and racial disparities in the health care system (Nelson, 2003). A health disparity is defined as differences in: (1) environment, (2) access to, utilization of, and quality of care, (3) health status, or (4) health outcomes that require in-depth evaluation (Carter-Pokras & Baquet, 2002). The Affordable Care Act expands this definition by noting that health disparities exist when there are significant differences in the overall rate of disease incidence, prevalence, morbidity, mortality, or survival rates in a given subpopulation when compared to the general population (Protection & Act, 2010). Disparities may also exist in a given group when the quality, outcomes, cost, or access to/use of/satisfaction with health services are different when compared to the general population (Protection & Act, 2010). After recognizing that racial/ethnic disparities existed not only in health but also in health care, the IOM published a number of recommendations related to patient care, education, and research geared towards improving systems and address racial/ethnic disparities (Smedby & Stith, 2003). Recommendations for improving patient care included: (1) collect and report

health care access and utilization data by patient's race/ethnicity; (2) encourage the use of evidence-based guidelines and quality improvement; and (3) support the use of language interpretation services in the clinical setting (Smedby & Stith, 2003). Recommendations for addressing disparities through training and education included: (1) increase awareness of racial/ethnic disparities in health care; (2) increase the proportion of underrepresented minorities in the health care workforce; and (3) integrate cross-cultural education into the training of all health care professionals (Smedby & Stith, 2003). The recommendation for research geared towards eliminating health disparities was to conduct further research to identify sources of disparities and promising interventions (Smedby & Stith, 2003). Health disparities remain a major concern in the United States.

Among the primary goals of the National HIV/AIDS Strategy is the reduction of HIV-related health disparities because in the United States HIV disproportionately affects those who have less access to health services and consequently tend to have poorer health outcomes (United States & Office of National AIDS Policy, 2010). The National HIV/AIDS Strategy acknowledges that every person in the United States does not have an equal chance contracting HIV. Therefore, it recommends concentrating HIV prevention efforts in groups and communities at greatest risk: (1) gay and bisexual men, (2) Black men and women, (3) Latinos and Latinas, (4) injection drug users.

The National HIV/AIDS Strategy posits that HIV-related health disparities exist for a number of reasons. For instance, in some communities individuals lack easy access to HIV prevention and care services (United States & Office of National AIDS Policy, 2010). Whereas in other communities with a high burden of HIV/AIDS, issues such as unemployment and a lack of housing tend to preside and HIV is, therefore, not often

considered a priority concern (United States & Office of National AIDS Policy, 2010). The National HIV/AIDS Strategy suggests that by expanding access to care for all, supporting treatment adherence for PLWHA, conducting research on the causes of health disparities, and using combination strategies to target high-risk communities, there can be a significant reduction in new HIV infections in the United States.

The purpose of this secondary data analysis was to explore the relationships among population characteristics (demographic data, HIV/AIDS classification, psychological stress, and depressive symptoms), health behaviors (treatment adherence, sleep, and the use of health services), and health outcomes (immunologic function) in HIV-infected individuals living in Northeast Ohio while taking into account variables of significance to the National HIV/AIDS Strategy such as sexual orientation. This study contributes to the literature by potentially identifying specific variables that may explain the source of certain health disparities. It may also provide a base to develop interventions and strategies for cost savings.

Population Characteristics Variables

Based on Andersen's Behavioral Model, the population characteristics in this study are classified as predisposing characteristics, enabling resources, and need factors. The predisposing characteristics variables are age, gender, marital status, education, race/ethnicity, employment, and sexual orientation. The enabling resources variables are income, health insurance, and housing. The need factor variables are psychological stress, depressive symptoms, and HIV/AIDS classification. The health behavior variables are sleep, treatment adherence and number of clinic visits. The outcome variable is immunologic function (HIV viral load and CD4+ T-lymphocyte count).

Predisposing Characteristics

Demographic data.

Age. Age is a statistically significant predictor of health service use amongst adults (Fasoli et al., 2010; C. A. Green et al., 2010). Advancements in the treatment of HIV/AIDS coupled with the aging of the population in general have resulted in a growing number of older adults living with HIV/AIDS. Additionally, the Centers for Disease Control and Prevention (CDC) reports that adults, aged 50 and older, account for 15% of all new HIV diagnoses (National Center for HIV/AIDS, Viral Hepatitis, STD, and TB Prevention (U.S.) & Division of HIV/AIDS Prevention, 2012a; National Center for HIV/AIDS, Viral Hepatitis, STD, and TB Prevention (U.S.) & Division of HIV/AIDS Prevention, 2012b). They also represent 19% of the HIV-infected population in the United States (National Center for HIV/AIDS, Viral Hepatitis, STD, and TB Prevention (U.S.), 2013b). Older adults are at equal risk for HIV infection as are younger Americans. Most HIV infections in older adulthood occur in MSM (44%), among MSM age 55 and older, White MSM (67%) have the highest rate of infection followed by Hispanic/Latino MSM (16%) and Black MSM (15%) (National Center for HIV/AIDS, Viral Hepatitis, STD, and TB Prevention (U.S.), 2013b). As a result of all of the factors, it has been projected that by 2015, more than 50% of HIV-infected people will be ages 50 years or older (Farrelly, 2010; Kirk & Goetz, 2009). In 2010, HIV-related illness was the 10th leading cause of death among men and women aged 50-54 (National Center for HIV/AIDS, Viral Hepatitis, STD, and TB Prevention (U.S.), 2013b).

Treatment and management of HIV tends to be more challenging in older adults when compared to younger adults in the United States. Because they are more likely to be

diagnosed with the infection later in the course of the disease, they generally begin treatment at a worsened state of immunocompromise (National Center for HIV/AIDS, Viral Hepatitis, STD, and TB Prevention (U.S.), 2013b). Older adults are, therefore, 20%-29% more likely to progress from HIV to AIDS within the first 12 months of HIV diagnosis than their younger counterparts (National Center for HIV/AIDS, Viral Hepatitis, STD, and TB Prevention (U.S.), 2013b). Their treatment and management becomes further complicated due to the development of age related co-morbidities such as coronary artery disease, hypertension, diabetes, renal disease, and hypercholesterolemia (Collazos, Asensi, Carton, Ibarra, & the Grupo Español para el Estudio Multifactorial de la Adherencia (GEEMA), 2009; Kirk & Goetz, 2009; Vance et al., 2011). Studies have also found an association between cART and increased risk of myocardial infarction (Freiberg et al., 2013; Worm et al., 2010). However, once diagnosed, older HIV-infected adults do tend to be more adherent to treatment regimens and are more likely to keep medical appointments. These findings are associated with decreased HIV viral loads in this population (Vance et al., 2011).

Gender. Women are contracting HIV at higher rates, in global communities, when compared to men (Warren, 2013). This unequal variation in epidemiological data in embedded in the social roles (subservient wife, sex workers, etc.) and anatomical characteristics of women, which place them in a particularly vulnerable position throughout the world (United States & Office of National AIDS Policy, 2010; Warren, 2013). However, though the CDC does estimate that approximately 15% of HIV-infected women in the United States are unaware of their HIV status, there has been a recent decline in HIV infection rates for women (specifically Black Women) of 21% between

2008 and 2010 (Centers for Disease Control and Prevention, 2013). While this data incites hope, it is unknown whether this trend is related to an actual decrease in new HIV infections or if this reflects a decrease in HIV testing (Centers for Disease Control and Prevention, 2013). Presently, women of all races represent approximately 25% of the HIV-infected population of the United States (Centers for Disease Control and Prevention, 2013). Eighty-four percent of HIV infections in women were contracted during heterosexual intercourse (Centers for Disease Control and Prevention, 2013).

According to the CDC a transgender individual is one whose gender identity is other than their biological sex (National Center for HIV/AIDS, Viral Hepatitis, STD, and TB Prevention (U.S.), 2013b). In the United States, transgender communities are at the highest risk for HIV infection, particularly transgender women. Approximately 28% of transgender women test positive for HIV (Centers for Disease Control and Prevention, 2013). However, HIV prevention efforts targeted towards this group have historically been minimal (United States & Office of National AIDS Policy, 2010).

For reasons not entirely understood, mortality is higher in HIV-infected men than women even after starting cART (Cornell & Myer, 2013). HIV-infected men and transgender individuals are also significantly more likely to report housing concerns than women (Kalichman et al., 2012). In a study of 317 men, women, and transgender individuals living with HIV in California, being male or male-to-female transgender and taking cART was associated with more HIV-related symptoms of pain, lack of energy, feeling drowsy, and inadequate sleep when compared to being female and taking cART (Lee et al., 2009). HIV-infected women are more likely to be depressed (Briongos-Figuero et al., 2011; Kalichman et al., 2012), and have poorer sleep quality (Woosley,

Lichstein, Taylor, Riedel, & Bush, 2012) than their male counterparts. Also, younger women are at greater risk for poor sleep quality than older women (Baker, Wolfson, & Lee, 2009).

Marital status. Being married has been associated with greater use of health services (C. A. Green et al., 2010) for both genders. People who are married tend to be in better physical and mental health and have lower mortality rates than their unmarried counterparts (Lindström & Rosvall, 2012; Molloy et al., 2009; Pleis et al., 2010). On the other hand, perhaps due to increased stress levels, being divorced or separated is a statistically significant risk factor for both sleep disturbances and substance abuse (Baker et al., 2009; Krietsch, 2012). Though it has been previously assumed that marriage is protective against HIV infection (Kimani, Ettarh, Ziraba, & Yatich, 2013), studies have documented the relationship between marital status and HIV infection in countries such as Kenya (Kimani et al., 2013) and India (Hemmige et al., 2011). In a study of 2,721 men and women living in urban slum settlements in Nairobi, Kenya, researchers found that being married or previously married was a significant risk factor for HIV infection. Study results demonstrated that participants who were married and previously married were less likely to use condoms (during extramarital affairs) than those who were never married. This lack of condom use contributed to the increased risk of HIV infection (Kimani et al., 2013). This researcher is unaware of any similar study being conducted in the United States.

Social Structure.

Education. Higher levels of education are related to increased use of health services (C. A. Green et al., 2010). Better-educated people tend to receive superior

preventative care and experience fewer hospitalizations than their less-resourced counterparts (Miyakawa et al., 2012; Reuser et al., 2012). Low levels of education and impoverished living conditions have been linked to poorer medication adherence and worsened overall health status among PLWHA (Franke et al., 2011; Glass et al., 2010; Kalichman & Grebler, 2010). Though it has been suggested that maternal HIV transmission to neonate in the United States is related to race/ethnicity, research has that the true correlation is with socioeconomics and education (Yang et al., 2012). The results of this study suggest that successful elimination of health disparities requires focused attention on modifiable risk factors such as level of education.

Race/ethnicity. There are significant racial HIV-related health disparities in the United States (United States & Office of National AIDS Policy, 2010). Although HIV/AIDS is a serious threat for all Americans, its impact is disproportionately evident among Blacks in America (Centers for Disease Control and Prevention, 2013; National Center for HIV/AIDS, Viral Hepatitis, STD, and TB Prevention (U.S.) & Division of HIV/AIDS Prevention, 2013a). In the United States, Black Americans account for about 14% of the population, but represented approximately 44% of the new HIV infections in 2010 (National Center for HIV/AIDS, Viral Hepatitis, STD, and TB Prevention (U.S.) & Division of HIV/AIDS Prevention, 2013a; Prejean et al., 2011). In 2009, HIV related illness was the 4th leading cause of death for Black American Men and Women between 25-44 years of age (Henry J. Kaiser Family Foundation, 2013a). HIV in the United States also disproportionally affects Latinos. They account for approximately 16% of the population but account for 21% of all new HIV infections. Latinos represent

approximately 19% of the HIV-infected population in the United States (Centers for Disease Control and Prevention, 2013).

Research suggests that race has a statistically significant impact on health seeking behaviors in the United States. Blacks and Hispanics are less likely to seek health services than their White counterparts, regardless of income and insurance status (Laiyemo et al., 2010; Sellars et al., 2010). Blacks/African Americans report significantly fewer HIV-related symptoms than Whites/Caucasians, Hispanics/Latinos and Mixed/Other ethnic groups (Lee et al., 2009).

Employment status. Studies have shown that some work environments help to promote positive health behaviors (such as regular exercise) in the general population (Bushnell et al., 2010; Maslach & Jackson, 2013). In a study of 260 HIV-infected women living in the United States, researchers found that being employed improved health practices (Webel, Cuca et al., 2013). PLWHA also tend to report lower levels of psychological stress when they are employed (Fumaz et al., 2012).

A retrospective study conducted in Nigeria analyzed clinical data from 1552 HIV/AIDS patients found unemployment to be a predictor for worsening clinical outcomes among PLWHA (Desilva et al., 2009). In this study, individuals reported as unemployed/unknown occupation had a significantly increased risk of death (Desilva et al., 2009). This researcher is not aware of any similar studies conducted in the United States. However, what is known is that being unemployed is a statistically significant risk factor for sleep disturbances, increased psychological stress, and depressive symptoms (Baker et al., 2009; Berchick, Gallo, Maralani, & Kasl, 2012; Wiernik et al., 2013).

However, no known study has evaluated the relationship between employment status and CD4+ T-lymphocyte count or HIV viral load.

Sexual orientation. Sexual orientation has been found to impact health behaviors (Cochran et al., 2013; McCabe et al., 2013). Despite only comprising two percent of the population at large (4% of the male population), gay and bisexual mean have represented the largest segment of the HIV-infected population in the United States since the genesis of the pandemic in the 1980s; this trend continues today (United States & Office of National AIDS Policy, 2010). Presently, MSM of all races represent the only group in the United States where new HIV-infection rates continue to rise annually (Centers for Disease Control and Prevention, 2013; National Center for HIV/AIDS, Viral Hepatitis, STD, and TB Prevention (U.S.) & Division of HIV/AIDS Prevention, 2012b). Sixty-three percent of new HIV infections occur among gay and bisexual men (Centers for Disease Control and Prevention, 2013). It will not be possible to see a substantial reduction of national HIV infection rates without concentrated efforts focused on addressing HIV in this population.

For reasons that have yet to be fully understood, those of minority sexual orientation (gays, lesbians, and bisexuals) are at approximately twice the risk of experiencing depression and anxiety, and for attempting suicide (Bolton & Sareen, 2011; Chakraborty, McManus, Brugha, Bebbington, & King, 2011; Cover, 2012; Frisell, Lichtenstein, Rahman, & Långström, 2010; Plöderl et al., 2013). However, there is some evidence to support that living in a social environment that is less supportive of sexual minorities is associated with more frequent suicide attempts within this community (Hatzenbuehler, 2011).

Depression is a statistically significant predictor of suicide attempts in the general population (Marshal et al., 2011) but significantly more so for sexual minorities (Marshal et al., 2011; Mustanski & Liu, 2013). Sexual minorities are 21%-33% more likely to have experienced an episode of depression in their lifetime than their heterosexual counterparts (Zietsch et al., 2012). Though the phenomenon is not entirely understood, researchers have found an association between sexual risk behaviors and adherence to cART among HIV-positive heterosexual men of all racial/ethnic groups (M. S. Friedman et al., 2009; Remien et al., 2013). Better adherence to cART was associated with a decrease in sexual risk behaviors in heterosexual HIV-infected men even after controlling for demographics, depression, and substance use behaviors (Remien et al., 2013). Curiously, this same association between sexual risk behaviors and adherence has not been found among homosexual men or women of any orientation (Remien et al., 2013). One hypothesized explanation for this occurrence is that heterosexual HIV-infect men may be less likely to receive HIV prevention messages within the context of their HIV care (Remien et al., 2013).

Enabling Resources

Personal.

Income. Studies have found low socio-economic status to be a barrier to receiving health care services; those with higher socio-economic status have greater access to human and material resources than those with lower socio-economic status (Artinyan et al., 2010; Blackwell et al., 2009; Lejeune et al., 2010; Richardson & Norris, 2010; Stringhini et al., 2010; Williams et al., 2010). Low-income and uninsured people are less likely to have adequate access to quality medical services (Block et al., 2012; Driscoll &

Bernstein, 2012; Kullgren & McLaughlin, 2010; Schoen et al., 2010; Shi & Stevens, 2010). Recall that higher income levels are associated with greater use of health services including prevention and maintenance (C. A. Green et al., 2010). Having low income is a statistically significant risk factor for sleep disturbances (Baker et al., 2009). This phenomenon is likely related to co-occurring psychological stress (Baker et al., 2009).

Health insurance. Having health insurance enhances the likelihood that an individual will visit a health care provider (Hwang et al., 2010; Schoen et al., 2010). In the United States, federal funding for HIV-related services is provided primarily though Medicare and Medicaid programs, and the Ryan White CARE Act (Kalichman et al., 2012). While it has also been documented that the availability of low- and no-cost health services increases the use of health resources (Allen, 2011; Gertz et al., 2011; Notaro et al., 2012), uninsured people still tend to not have adequate access to quality health services (Andersen & Davidson, 2001; Bernard, Banthin, & Encinosa, 2009; Block et al., 2012; DeNavas-Walt, Proctor, & Smith, 2009; Driscoll & Bernstein, 2012; Kullgren & McLaughlin, 2010; Schoen et al., 2010; Shi & Stevens, 2010). Even when insured, higher copayments have been related to a reduction in health services utilization among under-resourced groups (C. A. Green et al., 2010).

***Housing*.** Housing status impacts health services utilization and health outcomes. People who are homeless tend to use emergency and inpatient services at a significantly higher rate than the general population (Hwang et al., 2013). In Toronto, Canada, within a system of universal health care, a 3-year, longitudinal study of 1165 homeless participants (587 single men, 296 single women and 282 adults with families) found expenditures associated with health services usage for homeless individuals to be

approximately US $5,725 per person per year versus approximately US $1,500 for age- and gender-matched, low-income controls (Hwang et al., 2013). Stable housing is essential for appropriate treatment of HIV/AIDS; it is also integral in HIV prevention (Milloy, Marshall, Montaner, & Wood, 2012; Quinn, 2013). Homelessness is a risk factor for a number of health problems, including HIV (Wolitski et al., 2010). Unstable housing is also associated with decreased adherence to cART (Milloy et al., 2012). Homeless, or unstably housed, PLWHA demonstrate poorer health outcomes, increased mortality and morbidity, and are at greater risk for HIV transmission (Gomez, Thompson, & Barczyk, 2010; Kerker et al., 2011; McMahon, Wanke, Terrin, Skinner, & Knox, 2011; Mohtashemi & Kawamura, 2010; Riley, Moore et al., 2011b; Teruya et al., 2010; Wolitski et al., 2010). All of these maladies are less burdensome when stable housing is attained (Buchanan, Kee, Sadowski, & Garcia, 2009; Rourke et al., 2012; Wolitski et al., 2010). This suggests that a program designed to house the homeless might improve health outcomes.

Need Factors

Perceived Need.

Psychological stress. Psychological stress has been conceptualized in the literature as a function of the relationship between a stressor and one's capacity to adapt to that stressor (S. Cohen, Janicki-Deverts, & Miller, 2007). One's perception of a given stressor determines whether or not they experience stress. Stress occurs when one perceives a circumstance or event to tax or exceed their capacity to adapt (S. Cohen et al., 2007). Stress and depression have been shown to negatively predict health care utilization irrespective of gender, age, or health status (C. A. Green et al., 2010; C. A. Green et al.,

2010). Because HIV is a highly stigmatized infection, PLWHA tend to suffer from varying levels of psychological stress (Chen et al., 2011) that are related to the perceptions of others. Psychological stress is an important modulator of human immune function (Black, 2002; Fumaz et al., 2012); it has a certain immunologic impact that accelerates the progression of disease, independent of treatment adherence (Leserman, 2003). Where greater levels of stress have been associated with increased fatigue and sleep disturbances in the general population (Thomas, Bardwell, Ancoli-Israel, & Dimsdale, 2006), psychological stress has also been linked to sleep disturbances, poorer sleep quality, HIV-related fatigue, elevated HIV viral load, and increased mortality among PLWHA (Chen et al., 2012; Fumaz et al., 2012).

Depressive symptoms. Depressive symptoms are characterized by feelings of sadness, emptiness, or irritable mood and accompanied by somatic and cognitive changes that significantly affect one's level of functionality (Ayuso-Mateos et al., 2010). In this study depressive symptoms are distinctly different from a formal diagnosis of Depression as outlined by the Diagnostic and Statistical Manual of Mental Disorders 5 (American Psychiatric Association, 2013).

Depression is among the most prevalent mental health conditions in the world (Gellman & Turner, 2013) and is also one of the most commonly observed psychiatric disorders among PLWHA (Olisah, Baiyewu, & Sheikh, 2010; Sherr, Clucas, Harding, Sibley, & Catalan, 2011). The prevalence rate of depressive symptoms among PLWHA is estimated to be two to five times higher than in the general population (Olisah et al., 2010). Although older HIV-infected adults tend to be more susceptible to psychological distress in general, there are no statistically significant differences in depressive

symptomatology among age groups with a diagnosis of HIV/AIDS (Vance et al., 2011). Depression affects approximately 20-40% of PLWHA in the United States (Atkinson et al., 2008; Pence et al., 2012) as opposed to approximately 15% in the general population (Hasin, Goodwin, Stinson, & Grant, 2005). Nevertheless, because depression has an immunologic impact that accelerates the progression of disease, independent of treatment adherence (Leserman, 2008; Schuster, Bornovalova, & Hunt, 2012; Whetten, Reif, Whetten, & Murphy-McMillan, 2008), successful treatment of depressive symptoms in HIV-infected people is of critical importance (Primeau, Avellaneda, Musselman, St Jean, & Illa, 2013). It is currently estimated that only about 50% of people with depression are receiving treatment (Marcus, Yasamy, Van Ommeren, Chisholm, & Saxena, 2012; Mental Health Gap Action Programme & World Health Organization, 2010).

Depressive symptoms have been associated with unmet HIV service needs (Kalichman et al., 2012). HIV-infected people, who report experiencing depressive symptoms, require almost twice the treatment duration of cART to achieve virologic suppression when compared to those not experiencing depressive symptoms (Pence, Miller, Gaynes, & Eron Jr, 2007). These individuals also tend to reach virologic failure twice as rapidly as their non-depressed counterparts (Pence et al., 2007). Depressive symptoms can negatively influence self-care behaviors; it influences one's ability to cope with the activities of daily living, which also influences treatment adherence decision-making (Wendorf & Mosack, 2013), thereby complicating one's ability to manage complex cART regimens. Its adverse impact on cART adherence has been found to impair attention to HIV-related cues for action. Hence, the association between depressive symptoms and treatment non-adherence is strong and remains of great concern

among professionals treating PLWHA (Carrico et al., 2011; Kacanek et al., 2010; Wendorf & Mosack, 2013).

Depressive symptoms among PLWHA have been associated with poor treatment adherence, impaired immune function, and poor treatment outcomes (Briongos-Figuero et al., 2011; Carrico et al., 2011; J. S. Gonzalez et al., 2011; Kacanek et al., 2010; Schuster et al., 2012). Additional associations between severity of depressive symptoms and decline in CD4 T-lymphocyte counts, increased HIV viral load and increased mortality have also been noted (Ickovics et al., 2001; Leserman, 2008; Taniguchi, Shacham, Önen, Grubb, & Overton, 2014). Observations suggest that patients who achieved remission from depressive symptoms are more likely to have a CD4 T-lymphocyte count above 200 cells/μL (Primeau et al., 2013). In 2011, the National Institute of Mental Health (NIMH) Healthy Living Project (Carrico et al., 2011) published findings after having followed 603 participants over a span of 25 months. Study participants that reported experiencing depressive symptoms at baseline had a 50% higher mean viral load than those without depression (Carrico et al., 2011).

Beyond immunologic function, depressive symptoms have also been found to be the strongest factor associated with insomnia among HIV-infected people (Crum-Cianflone et al., 2012). The association between depressive symptoms, insomnia and sleep disturbances in HIV-infected people exists independent of immunological parameters (Jong et al., 2010; Wibbeler, Reichelt, Husstedt, & Evers, 2012).

Evaluated Need.

HIV/AIDS classification. HIV/AIDS classification is a function one's CD4+ T-lymphocyte count and HIV viral load (Castro et al., 1993; Gale et al., 2013). AIDS can,

and often does, occur after the human organism has been infected with HIV (Castro et al., 1993; Ferreira & Ceolim, 2012). Viral replication in cellular structures results in the destruction and dysfunction of CD4+ T-lymphocytes. Immunodeficiency results from the progressive depletion of CD4+ T-lymphocytes. When this depletion becomes severe it is manifested by the emergence of opportunistic infections and neoplasms. The occurrence of these opportunistic infections and neoplasms are what define AIDS: Generally, they occur once CD4+ T-lymphocytes fall below 200 cells/μL (Ferreira & Ceolim, 2012). Therefore, in the United States, HIV-infected people who experience a decline in CD4+ T-Lymphocyte counts below 200 cells/μL are diagnosed with AIDS (Centers for Disease Control and Prevention, 1992). A diagnosis of AIDS is retained regardless of any future increase in CD4+ T-lymphocyte count (Centers for Disease Control and Prevention, 1992). This policy was developed in 1992 and has not changed.

Health Behaviors Variables

Personal Health Practices

Sleep. Sleep is defined as a reversible neurobiological state characterized by closed eyes, behavioral inactivity, and disengagement from one's surroundings (Gellman & Turner, 2013). Adults need an average of 7 to 8 hours of sleep each night (Gellman & Turner, 2013; National Heart, Lung, and Blood Institute, 2011). It is estimated that thirty percent of the general population of the United States experiences some difficulty sleeping (Lee et al., 2012; Taibi, 2013). However, research has found that up to 70% of PLWHA report experiences of sleep disturbances (Taibi, 2013). The exception seems to be patients who are diagnosed and treated early for HIV; infection, they tend to exhibit similar rates of sleep disturbances as the general population (Crum-Cianflone et al.,

2012). Poor sleep for PLWHA has been associated with disease progression, medication therapy, employment status, and a lack of good sleep promotion skills in HIV-infected people (Chen et al., 2012; Kenedi & Goforth, 2011; Morin & Benca, 2012; Omonuwa, Goforth, Preud'homme, & Krystal, 2009; Schutte-Rodin, Broch, Buysse, Dorsey, & Sateia, 2008; Siebern & Manber, 2011).

Sleep has been divided into two categories (1) Rapid eye movement (REM) sleep and (2) non-REM (NREM) sleep, also known as slow wave sleep (Gellman & Turner, 2013). REM sleep is characterized by fast EEG activity, rapid horizontal eye movement, vital sign instability, and skeletal muscle hypotonia and dysautonia (Cardinali & Esquifino, 2012). NREM sleep is comprised of four stages characterized by slow EEG activity throughout the four stages (Cardinali & Esquifino, 2012). Although it remains unclear what the implications are in regards to perceived sleep quality (Taibi, Price, & Voss, 2012; Taibi, 2013), an increase in slow wave sleep among PLWHA has been found (Reid & Dwyer, 2005). Further research in this area is needed to determine whether or not this is a potential point of intervention to improve the overall sleep quality of PLWHA.

In the general population, adults living with a chronic illness are at higher risk for developing a sleep problem (Lee et al., 2012). Sleep disturbances (insomnia and daytime sleepiness) have been cited as among the most prevalent and distressing symptoms experienced by people diagnosed with HIV even when their disease is well managed (Crum-Cianflone et al., 2012; Lee et al., 2012; Taibi et al., 2012; Taibi, 2013; Webel, Dolansky, Henry, & Salata, 2012). In general, insomnia is present when a person has difficulty falling asleep, difficulty staying asleep, waking up too early, and/or non-restful

sleep, in combination with at least one daytime symptom such as sleepiness or irritability (Ohayon & Reynolds, 2009). Daytime sleepiness or fatigue has been described as the person's awareness of a decreased capacity for physical and/or mental activity. The root causes of this decreased capacity are related to imbalances in the availability, utilization, and/or restoration of the resources needed to perform a given activity (Gellman & Turner, 2013). Daytime sleepiness has been associated with difficulties concentrating, poor cognitive functioning, depressive symptoms, and reduced overall productivity (Lee et al., 2012; Roth, 2009). Lack of energy or fatigue is another prevalent complaint amongst the HIV-infected population (Lee et al., 2009). Poor sleep quality contributes to HIV-related fatigue among PLWHA (Lee et al., 2009).

Difficulty falling asleep is the least prevalent type of sleep problem reported by people infected with HIV; but is associated with the most severe symptoms related to: lack of energy, difficulty sleeping, difficulty concentrating, feeling drowsy, feeling irritable, feeling nervous, and worrying (Lee et al., 2012). Problems sleeping have also been related to higher health care utilization and the use of sleep medications. But, because PLWHA are at elevated risks for substance abuse behaviors (Volkow & Montaner, 2011) the use of sedatives as one agent in the treatment protocol could prove to be risky. Clinicians should proceed with caution in the use of sleep aids when treating sleep disturbances in this population (Zammit, 2009).

Fragmented sleep occurs most frequently among persons with chronic health conditions (Gellman & Turner, 2013). However, fragmented sleep is not always recognized by the patient (Lee et al., 2012). In a study conducted with 290 HIV-infected adults, it was found that more than half of the sample experienced severely fragmented

sleep as evaluated by sleep actigraphy. Only one-third of the sample reported these sleep disturbances (Lee et al., 2012). Greater than one-half of the participants in the study obtained less than six hours of sleep, on average, each night (Lee et al., 2012). People in this study, therefore, complained less of sleep initiation insomnia, but they frequently reported fatigue (Lee et al., 2012).

Stressful life events are strong predictors of the intensity of HIV-related fatigue and impaired function (Leserman, Barroso, Pence, Salahuddin, & Harmon, 2008). As a rule, HIV-infected people who report symptoms of insomnia are more likely to be depressed (Jean-Louis et al., 2012) and, perhaps, stressed. Sleep disturbances have long been recognized as a significant problem leading to cART non-adherence and negative health outcomes among PLWHA (McDaniel, Buboltz Jr, Chauvin, & Eddlemon, 2011; Saberi et al., 2011; Taibi et al., 2012). A strong association exists between HIV viral load, CD4+ T-lymphocyte counts, and sleep disturbances (Foster et al., 2012). There is a direct, reciprocal relationship between sleep and immune function (Cardinali & Esquifino, 2012). Sleep alters immune function and impaired immune function hinders sleep quality (Cardinali & Esquifino, 2012; Gellman & Turner, 2013). For example, symptoms of HIV such as pain, anxiety, and depressive symptoms exacerbate insomnia, which, in turn, are exacerbated by the insomnia (Crum-Cianflone et al., 2012; Jean-Louis et al., 2012; Salahuddin, Barroso, Leserman, Harmon, & Pence, 2009; Wibbeler et al., 2012). That is to say, the consequences of insomnia (fatigue, mood disturbances, etc.) are also compounded by the HIV infection (Salahuddin et al., 2009).

Sleep and the immune system share regulator molecules called cytokines (Cardinali & Esquifino, 2012). Cytokines are involved in both physiological sleep and the

disrupted sleep that occurs in response to infection or chronic inflammation (Cardinali & Esquifino, 2012). It is posited that sleep influences the immune system through the action of cytokines that are regulated during sleep (Cardinali & Esquifino, 2012). However, HIV infection directly alters sleep-regulating hormones and cytokine levels (Borges-Almeida et al., 2011; Wilk et al., 2011). This interaction, perhaps, explains the disease exacerbation, as evaluated by CD4+ T-Lymphocyte counts and HIV viral load, noted among PLWHA who suffer from disturbed sleep (Foster et al., 2012).

Treatment adherence. Early initiation of cART effectively reduces HIV transmission rates when an individual's viral load is undetectable (M. S. Cohen et al., 2011; Loutfy et al., 2013). There are more than 20 antiretroviral drugs available in the United States pharmaceutical industry (Oguntibeju, 2012). These drugs can be combined in various methods to construct a number of different regimens that are effective for initial and subsequent therapies (Oguntibeju, 2012). Effective cART treatments consist of three or more antiretroviral drugs. These regimens have helped to improve the health and survival rates of PLWHA (Oguntibeju, 2012). When taken appropriately, cART saves lives, improves immune function, reduces the risk of HIV-related complications, and diminishes the risk of HIV transmission (M. S. Cohen et al., 2011; Oguntibeju, 2012). Standard cART uses a combination of at least three antiretroviral drugs to maximally suppress HIV and stop the progression of the disease (World Health Organization & World Health Organization, Department of HIV/AIDS, 2012).

Adherence to cART has an inverse relationship with HIV viral load (Carrico et al., 2011; Oguntibeju, 2012; Primeau et al., 2013). As a high HIV viral load is associated with increased rates of HIV transmission (Wilson, Law, Grulich, Cooper, & Kaldor,

2008), treatment adherence is instrumental in reducing HIV transmission rates as well as in preventing the progression of HIV to AIDS and improving health outcomes for PLWHA (Chi et al., 2009; M. S. Cohen et al., 2011; S. Cohen et al., 2011). A high level of adherence to cART is necessary to maintain viral suppression, and to reduce the risk of antiretroviral drug resistance (Centers for Disease Control and Prevention, 2013; Glass et al., 2008; Isaakidis et al., 2010; Muyingo et al., 2008). Adherence rates less than 95% contribute to immunologic resistance and treatment failure (Centers for Disease Control and Prevention, 2002; United States, Department of Health and Human Services, National Institutes of Health (U.S.), Office of AIDS Research, & Advisory Council, 2008), compromising the treatment regimen. Therefore, those who are less than 95% adherent to their treatment regimens are classified as non-adherent. Related to poor adherence, it has been estimated that only 25% of PLWHA in the United States have adequate viral suppression (Centers for Disease Control and Prevention, 2013). This suggests that some people are not attaining the maximum benefits of the available treatments, and there are disturbing consequences. Among the costs of non-adherence to cART are decreased drug potency, increased likelihood of developing a drug-resistant viral strain, and the possibility of higher morbidity and mortality (Hong et al., 2011; Ohl et al., 2013; Wendorf & Mosack, 2013). Non-adherence is also associated with declines in CD4+ T-lymphocyte counts (Chi et al., 2009).

Level of adherence has been linked with type of regimen, daily schedule and duration of treatment (Garang, Odoi, & Kalyango, 2009; Martin et al., 2008; Raboud et al., 2011). Adherence studies have also suggested an association between young age and poor adherence to cART (Gordillo et al., 2009). Single daily dosing of cART regimens

are related to higher adherence and a decreased likelihood of missed doses when compared with multi-dose per day regimens (Raboud et al., 2011). Though delayed doses are less deleterious than missed doses, they still contribute to drug resistance (Bianco, Heckman, Sutton, Watakakosol, & Lovejoy, 2011). The use of reminder tools for taking cART, such as text messaging and cell phone alarms, is useful in this way and has been positively associated with improved levels of regimen adherence (Nozaki, Dube, Kakimoto, Yamada, & Simpungwe, 2011; Wang et al., 2008).

Sleep disturbances among PLWHA have been shown to contribute to poor medication adherence (Gay et al., 2011). However, depressive symptoms also have a direct effect on cART adherence; low levels of adherence are associated with higher levels of depressive symptoms (Rao et al., 2012). This highlights the importance of properly identifying and appropriately treating depressive symptoms in the HIV infected (Rao et al., 2012). Studies have found that PLWHA are up to three times less likely to be cART adherent if they have experienced depressive symptoms (Amberbir, Woldemichael, Getachew, Girma, & Deribe, 2008; Byakika-Tusiime et al., 2009; Kacanek et al., 2010; Peltzer, Friend-du Preez, Ramlagan, & Anderson, 2010; Rao et al., 2012). On the other hand, people that are adherent to cART not only tend to experience lower HIV viral load, but they also experience decreased depressive symptoms as well (Primeau et al., 2013).

Use of Health Services

Missed clinic visits. Unmet health service needs have been associated with higher CD4+ T-lymphocyte counts, and lower treatment adherence (Kalichman et al., 2012). The science suggests that use of health services is conversely related to depressive

symptoms and stress (Briongos-Figuero et al., 2011; C. A. Green et al., 2010; C. A. Green et al., 2010). This is to say, people who are depressed and/or experience high levels of stress are less likely to use health services.

Health Outcomes

Evaluated Health

Immunologic function. HIV infection causes impaired immune function (Cagigi et al., 2008; Pohling, Zipperlen, Hollett, Gallant, & Grant, 2010; Yadav et al., 2009). CD4+ T-lymphocyte count is a biomarker used to assess immune function among PLWHA (Centner, Bateman, & Heckmann, 2013). In most laboratories, a normal range for CD4+ T-lymphocytes is 500-1,300 cells (United States & HIV/AIDS Bureau, 2011). While CD4+ T-lymphocyte production and function decline naturally over time related to involution of the thymus as a biological function of age and time (High et al., 2008), in people with untreated HIV, CD4+ T-lymphocyte counts decline by approximately 50-80 cells/μL per year, on average (United States & HIV/AIDS Bureau, 2011). Effective cART typically results in CD4+ T-lymphocyte count increases of approximately 50-100 cells/μL per year (United States & HIV/AIDS Bureau, 2011).

HIV viral load is the biomarker used to assess level of HIV infectiousness (Mahle-Gray et al., 2013). A viral load of greater than 200 copies/mL is classified as virologic failure (United States et al., 2008). The range of detectable virus differs between viral load assay tests, the lowest levels of detection are generally between 40-75 copies/mL (United States & HIV/AIDS Bureau, 2011). A viral load below this level indicates the inability of the assay to detect HIV in the plasma, and would then be classified as undetectable. This, however, does not indicate absence or clearance of the

virus from the body (United States & HIV/AIDS Bureau, 2011). Because plasma HIV viral load coupled with the loss of T-cells are the most reliable indicators of disease progression in HIV/AIDS infection (Abbas & Lichtman, 2010; Mellors et al., 2009), the evaluated health status of immunologic function is measured using CD4+ T-lymphocyte counts as well as HIV viral load in this study.

Summary

In the United States, national infection rates are estimated at 1.1 million persons (Centers for Disease Control and Prevention, 2013). There are an estimated 56,000 new HIV infections diagnosed nationally each year (Centers for Disease Control and Prevention, 2013).

The international, HPTN 052 protocol (M. S. Cohen et al., 2011) is a landmark study. This trial recruited 1763 sexually active HIV-discordant couples from thirteen sites in nine different countries. The HPTN 052 trial is ongoing and is scheduled for completion in 2015. However, because of the compelling benefits of cART found in the first years of the study the NIH recommended making preliminary results available, they were published in 2011 (M. S. Cohen et al., 2011; M. S. Cohen et al., 2012). The HPTN 052 trial demonstrated a greater than 96% reduction in HIV transmission between HIV-discordant couples. This is to say that in a monogamous, heterosexual relationship, one person is HIV-positive while the other is HIV-negative. This stark reduction in transmission rates was evident when people were HIV-tested, linked to systems of care, received prompt and efficient interventions, and quality treatment with cART early in the disease process (M. S. Cohen et al., 2011; M. S. Cohen et al., 2012). Study participants who received early cART interventions also demonstrated a reduction in the development

of opportunistic infections (M. S. Cohen et al., 2011). Treatment adherence is instrumental in reducing HIV transmission rates as well as in preventing the progression of HIV to AIDS and improving health outcomes for PLWHA (Chi et al., 2009; M. S. Cohen et al., 2011; S. Cohen et al., 2011).

A high level of adherence to cART is necessary to maintain viral suppression, and to reduce the risk of antiretroviral drug resistance (Glass et al., 2008; Isaakidis et al., 2010; Muyingo et al., 2008). When taken appropriately, cART saves lives, improves immune function, reduces the risk of HIV-related complications, and diminishes the risk of HIV transmission (M. S. Cohen et al., 2011; Oguntibeju, 2012). However, one's mental state, especially depression, has a certain immunologic impact that accelerates the progression of HIV disease, independent of treatment adherence (Leserman, 2008; Schuster et al., 2012; Whetten et al., 2008). Also, psychological stress has been linked to sleep disturbances, poorer sleep quality, HIV-related fatigue, elevated HIV viral load, and increased mortality among PLWHA (Chen et al., 2012; Fumaz et al., 2012). Sleep disturbances (insomnia and daytime sleepiness) have been cited as among the most prevalent and distressing symptoms experienced by people diagnosed with HIV, even when their disease is well managed (Crum-Cianflone et al., 2012; Lee et al., 2012; Taibi et al., 2012; Taibi, 2013; Webel et al., 2012).

The purpose of this study was to explore the relationships among population characteristics (demographic data, HIV/AIDS classification, psychological stress, and depressive symptoms), health behaviors (treatment adherence, sleep, and the use of health services), and health outcomes (immunologic function) in HIV-infected people living in Northeast Ohio. Andersen's Behavioral Model of Health Services Utilization is used to

guide this study. It suggests that health outcomes are a function of population characteristics and health behaviors (Andersen, 1968; Andersen, 1995; Andersen & Newman, 2005).

CHAPTER III: METHODS

This chapter presents the plan for the methodology used in this study. Details are provided about the research design, the study population, the variables and their measurement, as well as the proposed analytic techniques. A discussion of the proposed plan for protecting the rights of human subjects involved in this study concludes this chapter (Edgar & Rothman, 1995; L. A. Green, Lowery, Kowalski, & Wyszewianski, 2006).

Research Design

A descriptive, correlational, secondary data analysis was selected for this study. The proposed study will use data originally collected for a different study, designed and carried out by Allison Webel, PhD (2012). The name of this parent study is "Exploring relationship among sTRess, Isolation, and Physical activity (TRIP) in older adults with HIV/AIDS" with "TRIP" as its acronym.

TRIP: The Parent Study

The TRIP study is a longitudinal, descriptive study designed to (1) describe and compare levels of stress, isolation, physical activity, and sleep between younger HIV-infected adults (18-49 years) and older HIV-infected adults ($\geq$50 years); (2) describe and compare differences in levels of stress, isolation, physical activity, and sleep between men and women living with HIV/AIDS; and (3) examine the interaction between age and gender on levels of stress, isolation, physical activity, and sleep in adult PLWH. The TRIP study has a two-factorial design with four age- and gender-stratified groups. A 3-year time frame has been projected for this study; data collection began in September 2012 and is expected to take 28 months, ending in November 2014.

Sample and Setting of the TRIP Study

Recruitment and screening for the TRIP study primarily occurred via the Cleveland HIV Research Residency database. Some clinic advertisements and referrals were also used. The Cleveland HIV Research Residency is an Institutional Review Board (IRB)-approved database that collects contact information on PLWHA in Northeast Ohio. Dr. Allison Webel of Case Western Reserve University School of Nursing developed and maintains this database. The database is made up of approximately 250 participants who have all consented to be contacted for future scientific research by the principal investigator. The Cleveland HIV Research Residency participants are 50% female. Sixty-eight percent self-identify as African American/Black, 21% White/Caucasian, and 7% Hispanic. Other ethnic minority groups were not identified in the database, which suggests a rationale for not having a sample at 100%. The mean age of participants is 45.5 years. As a number of study participants were recruited from HIV clinics, they represent a small percentage of the national HIV-infected community that are well managed and engaged in care. National data suggests that only 66% of those diagnosed with HIV are appropriately linked to care, only 37% are retained in care, and only 33% are prescribed appropriate cART (Gardner et al., 2011).

Sample size. Of the 250 people listed in the Cleveland HIV Research Residency, 100 were recruited to participate in the TRIP study. Consistent with a two-way factorial design, study participants were evenly divided into four groups. Fifty of the participants were male, 50 female. The group was further stratified by age, consisting of 50 adults 18-49 years of age and 50 adults $\geq$ 50 years of age. This ensured representativeness of the sample leaving 25 participants in each group.

Inclusion criteria. In order to participate in the TRIP study, individuals must have had a documented HIV diagnosis. These individuals also must have been currently taking HIV anti-retroviral medications and continuing to seek care with a provider. This information is document in the participant's medical chart.

Exclusion criteria. Persons unable to communicate in English were excluded from the TRIP study. People having a diagnosis of diabetes mellitus and those having an artificial cardiac pacemaker or defibrillator were also excluded from the study. Reviews of health records, by professional nurses, were used to ascertain the latter two exclusions. The TRIP study used heart rate variability as a marker for physiological stress. These exclusions were to minimize any decreases in heart rate variability related to these potentially confounding factors. Participants taking prescribed medications that impact heart rate were still enrolled in the study. These participants were asked to list their medications as well as the associated dosages. This approach helps to assure that any changes in heart rate variability that is attributed to these medications can be recognized and accounted for in the TRIP study analysis.

TRIP Study Procedures

IRB-approved telephone screening was used to determine eligibility for the TRIP study. A trained research assistant presented potential subjects with information about the study using a pre-approved script. Participants who met inclusion criteria and agreed to participate in the study were sent the informed consent document by mail. They were also given an appointment for an initial visit to meet with a trained graduate research assistant. This visit took place at a Special Immunology Unit at a university hospital associated with a research-intensive academic institution. At the time of the initial visit informed

consent was obtained from each participant. The study was fully explained using a standardized presentation designed for a 6th grade literacy level. Participants were then enrolled in the study and completed one-hour of Holter cardiac monitoring used to track heart rate variability during this first face-to-face contact. Finally, participants were instructed on the proper use of the actigraph devices that measure physical activity and sleep. They were requested to wear this device on their non-dominant wrist for the next seven consecutive days. They were also informed about how to complete the physical activity and sleep diaries. The initial visit took an average of 90 minutes to complete.

Study participants were scheduled a baseline visit for seven days after the initial visit. Participants arrived at the data collection site where they returned the actigraph and diaries. They were then escorted to a second site where additional data collection occurred. Survey data were collected thereafter using iPad-assisted delivery. This approach was designed to enhance the accuracy in self-report. To minimize fatigue, participants were provided healthy refreshments and multiple breaks were encouraged. This visit took an average of 60 minutes to complete. In the event that a procedure yielded any abnormal findings such as uncontrolled hypertension, a referral was made to an appropriate clinician during this data collection period.

In compensation for time spent and as encouragement for the return of the actigraph device as well as the diaries, participants were given a $50 cash gift card upon completion of survey materials at the conclusion of the baseline visit. This incentive is consistent with the approved IRB protocol.

As the TRIP study is ongoing, there are follow-up visits built into the protocol. Future follow-up visits will be conducted in the same manner as the initial and baseline

visits. Participants will be followed every six months for a total of five observation points over a two and a half year time span. Each follow-up visit is expected to take approximately 120 minutes to complete. Study measures, including questionnaires, will be obtained at each of these five observation points. Most of the questionnaires use Likert-type scales and consist of four to twenty items per scale.

Protection of Human Subjects in TRIP Study

A rigorous informed consent process was put in place to ensure that participants understood the risks involved in participating in the study as well as the steps that were designed to minimize those risks. Throughout the study, participants were often reminded that their involvement was voluntary and they could withdraw at any time and had the right to refuse to take part in any component of the study activity.

The appropriate Institutional Review Boards at the university hospital and the academic institution approved all study activities. All protected health information was secured as directed by the Health Insurance Portability and Accountability Act (HIPPA). Because sensitive information was obtained, confidentiality of the questionnaire data were maintained through numerous mechanisms. For example, each study participant was assigned unique identifiers for tracking purposes. All the data from the questionnaires were entered into a web-based database program, REDCap. This program is a secure software tool for electronic management of clinical research data. Hard copies of collected data were stored in a secured cabinet in a locked project office at the study site at the university. A codebook was created and maintained to track data. This codebook was also secured as directed by HIPPA standards. Participant tracking information was stored on a password-protected database. Data sets were coded with subject identification

numbers and used to match the data with participants' instruments. This approach was used to reduce data entry error and data management miscoding as well as to help assure privacy and confidentiality of study data.

All collected data were monitored and managed by the Primary Investigator (PI). All collected data were locked away in cabinets at all times. Confidentiality of the participant's identity was protected by asking only for necessary personal information and by including code numbers. No names or other identifying information were recoded on any questionnaires. This limited the risk of accessing personal information, which again, is embedded in the HIPPA standards.

Data Management in TRIP Study

At enrollment into the TRIP study participants were asked to supply demographic and social structure information including age, gender, marital status, race, education, ethnicity and employment status. Participants were also asked to respond to questionnaires regarding depressive symptoms, psychological stress, and treatment adherence. Chart abstractions were used to gather data on HIV/AIDS classification and number of missed clinic visits in the last year. Health record abstractions were also used to gather data on current CD4+ T-lymphocyte count and HIV viral load.

All data collection was monitored and managed by the PI of the TRIP study. Data on the iPads is stored in a HIPPA compliant, IRB-approved, encrypted format. Survey data collected via iPads and their accompanying trace files were then promptly uploaded to ensure immediate backup. Data were uploaded to an encrypted web-based server into a secure software toolset and workflow methodology for electronic management of clinical research data. Sleep data were collected from the portable wrist actigraph devices. A

trained research assistant blindly reviewed and edited all actigraph data and then scored them with the sleep diary data using a computer-assisted scoring analysis program.

TRIP Study Variables

A detailed description of the TRIP study variables can be found in Appendix A. This research is delineated base on selected variables from the TRIP study.

Current Research Study

The purpose of this study was to explore the relationships among population characteristics (demographic data, HIV/AIDS classification, depressive symptoms, and psychological stress), health behaviors (treatment adherence, sleep, and the use of health services), and health outcomes (immunologic function) in HIV-infected people living in Northeast Ohio. Using data extracted from the TRIP study database collected at the first time point, this proposed secondary data analysis seeks to gain a better understanding of the factors that influence health outcomes for PLWHA within the framework of the Andersen Model (Andersen, 1968; Andersen, 1995; Andersen & Newman, 2005). The following questions are proposed.

1. What are the levels of population characteristics (predisposing characteristics, enabling resources, and need factors), health behaviors, and health outcomes?
2. What are the relationships among the population characteristics (predisposing characteristics, enabling resources, and need factors)?
3. How do the population characteristics (predisposing characteristics, enabling resources, and need factors) explain health behaviors?
4. How do the population characteristics (predisposing characteristics, enabling resources, and need factors) and health behaviors explain health outcomes?

5. Do health behaviors mediate the relationship between the population characteristics (predisposing characteristics, enabling resources, and need factors) and health outcomes?

To answer the research questions the following independent and dependent variables are examined in this secondary data analysis. This approach allows for the in-depth exploration of a phenomenon of interest while producing findings that are readily translated into clinical practice (Kane, 2008). A similar methodological approach has been used with efficacy in previous research on PLWHA (Hires, 2012). Study instruments are available in Appendix B.

Independent Variables

Predisposing Characteristics

Demographic. In accordance with the Andersen model, demographic data collected includes age in years, gender and marital status (Andersen, 1968; Andersen, 1995; Andersen & Newman, 2005). These data are collected using the Demographics Form: TRIP Study.

Age. Age is a continuous variable ranging from 18-80 years of age.

Gender. Gender is categorical, measured as male or female.

Marital status. Marital status is also categorical, measured as: (1) married, (2) single, (3) separated, (4) divorced, (5) domestic partnership, or (6) other. For the purposes of this study this variable are dummy coded into two categories, Married/Domestic Partnership versus Single/Separates/Divorced/Other.

Social structure. In accordance with the Andersen model for this study social structure is measured as level of education, race/ethnicity, employment and sexual

orientation (Andersen, 1968; Andersen, 1995; Andersen & Newman, 2005; Gelberg et al., 2000). These data were collected using the Demographics Form: TRIP Study.

Education. Level of education is categorical being measured as: (1) 11th grade or less, (2) high school or General Education Development (GED), (3) some college or technical school training, (4) college degree, (5) master's degree, (6) doctoral degree.

Race/ethnicity. Race/ethnicity is also categorical, measured as: (1) African American/Black, (2) Asian/Pacific Islander, (3) Hispanic/Latino, (4) Native American/ American Indian, (5) White/Caucasian (non-Hispanic), (6) Other. For the purposes of this study, this variable is dummy coded into two categories, African American/Black versus Other Racial/ethnic groups.

Employment status. Employment status is dichotomous, measured as paid employment, yes or no.

Sexual orientation. Sexual Orientation is categorical and is measured by determining how they classify themselves (1) Gay (homosexual), (2) Bi (bisexual), (3) Straight (heterosexual), (4) Other. For the purposes of this study, Sexual orientation is dummy coded into two categories, Heterosexual versus Other.

Enabling Resources

These data were collected using the Demographics Form: TRIP Study.

Income. Monthly income is continuous, measured as: (1) no monthly income, (2) less than $200, (3) $200-$399, (4) $400-$599, (5) $600-$799, (6) $800-$999, (7) $1000 or more.

Health insurance. In the TRIP study database health insurance was determined using two questions. The first question was dichotomous, asking whether the study

participant had health insurance, (1) yes or (2) no. The second question asked what type(s) of insurance the participants had, (1) Medicaid, (2) Medicare, (3) AIDS Drug Assistance Program (ADAP), (4) Veteran's Benefits, (5) Private, provided by work, (6) Private, not provided by work, (7) Ryan White Care Act. For the purposes of this secondary data analysis, a count was done of the number of insurances each participant reported having and a new variable was created. In this study health insurance is a continuous variable, measured as number of health insurance plans ranging from 0 to 3.

Housing. Housing is dichotomous, measured as permanent housing, yes or no.

Need Factors

Perceived Need.

***Psychological stress*.** The Perceived Stress Scale (S. Cohen, Kamarck, & Mermelstein, 1983) is used to measure psychological stress in this study. It is one of the most widely used tools for measuring perceived stress (Gellman & Turner, 2013). It is a self-report measure designed to assess the degree to which an individual appraises life events as stressful. This is accomplished by identifying how unpredictable, uncontrollable, and overloaded individuals find their lives (S. Cohen et al., 1983). This scale was intended for use in adults and adolescents. Sample questions include, "In the last month, how often have you felt nervous and 'stressed'?" and "In the last month, how often have you been able to control irritations in your life?" The Perceived Stress Scale was originally designed as a 14-item scale but was later reduced to 10-items (S. Cohen et al., 1983; Reis, Hino, & Añez, 2010). The 10-item scale is used to evaluate perceived stress over the past 4 weeks. It contains six positively coded items and four reverse coded

items on a 5-point scale ranging from 0= never to 4=very often. This measure is scored between 0-40 with higher scores indicating greater perceived stress.

The Perceived Stress Scale has demonstrated strong internal consistency (α = 0.84-0.86) and good test-retest reliability (r = 0.55- 0.85) (S. Cohen et al., 1983). Cronbach's alphas have been reported at 0.87 in a study of HIV-infected adults (Barbosa-Leiker et al., 2012) and 0.86 in a study looking at HIV-infected MSM (Pantalone, Huh, Nelson, Pearson, & Simoni, 2013). These data are extracted from the study database and used as a measure of perceived psychological stress in the proposed secondary data analysis.

Depressive symptoms. Depressive symptoms were measured using the 20-item Center for Epidemiologic Studies-Depression Scale (CESD) developed by Radloff (1977). Participants rate the extent to which they experienced each depressive symptom in the past week. The items address four components of depressive symptoms: depressed affect, positive affect, psychomotor retardation, and interpersonal (Radloff, 1977). Sample items include, "During the past week, …I was bothered by things that usually don't bother me", and "…I felt fearful". The CESD is rated using a 4-point response format ranging from "rarely/none of the time" (0) to "most/all of the time" (3). Four items (items 4, 8, 12, and 16) are reverse-coded. The total summated scores ranges from 0-60. Higher scores indicate higher levels of depressive symptoms (Radloff, 1977). Scores of 16 or greater on the CESD are considered an indication of risk for clinical depression (Radloff, 1977).

The CESD is one of the most commonly used measures for depressive symptoms (Gellman & Turner, 2013); it has been used with HIV-infected adults numerous times. Of

note, it has successfully been used to assess depressive symptomatology in HIV-infected transgendered adults (Nuttbrock et al., 2013), HIV-infected MSM (Noor & Rosser, 2013; Overstreet, Earnshaw, Kalichman, & Quinn, 2013), older HIV-infected adults (Havlik, Brennan, & Karpiak, 2011), and HIV-infected women (Illangasekare, Burke, Chander, & Gielen, 2013).

Content, construct, and criterion validity for the CESD have been well documented (Radloff, 1977). It has been shown to have adequate test-retest reliability (r= 0.45-0.67) and high internal consistency reliability reported at $\alpha = 0.85$ in the general population and $\alpha = 0.90$ in the clinically depressed (Radloff, 1977). Internal consistency for the HIV-infect population has been reported at $\alpha = 0.91$ (Vosvick, Martin, Smith, & Jenkins, 2010). These data are extracted from the study database and used as a measure of perceived psychological stress in the proposed secondary data analysis.

Evaluated Need.

HIV/AIDS classification. In the United States HIV-infected people whose CD4+ T-lymphocyte counts fall below 200 cells/μL are diagnosed with AIDS (Centers for Disease Control and Prevention, 1992). A diagnosis of AIDS is retained irrespective of future recovery of T-cells related to proper treatment and management (World Health Organization, 2006). Therefore, in this study, HIV/AIDS classification is a dichotomous variable that was measured as diagnosis of AIDS, yes or no.

Health Behaviors

Personal health practices.

Sleep. Sleep is measured using wrist actigraphy data. This yields data on the three distinct variables: sleep duration, sleep fragmentation, and sleep efficiency. The primary

measure of sleep quantity is mean sleep duration. Mean sleep duration is the average amount of sleep obtained during the main sleep period over a 1-week period of time (Bagai et al., 2013). The primary measures of sleep quality are the sleep fragmentation index and sleep efficiency. The sleep fragmentation index measures periods of wakefulness during the sleep cycle (Baud, Magistretti, & Petit, 2013). Sleep efficiency is measured as the proportion of time actually spent asleep between sleep onset and final awakening (Petersen, Kecklund, D'Onofrio, Nilsson, & Åkerstedt, 2013). All three are based on findings assessed using wrist actigraphy and the corresponding sleep diary. The use of actigraphy and these approaches are widely accepted measures of sleep duration and quality (Astill, Verhoeven, Vijzelaar, & Someren, 2013; Bagai et al., 2013; Jarrin, McGrath, & Drake, 2013; Short, Gradisar, Lack, Wright, & Chatburn, 2013; Tsai, Kuo, Lee, Lee, & Landis, 2013). Wrist actigraphy has successfully been used as a measure for sleep in other studies involving HIV-infected individuals (Gamaldo et al., 2013; Kawada, 2014; Lee et al., 2012). This secondary data analysis will use the measure of sleep efficiency as an evaluation of time actually spent asleep. These data are extracted from the study database and used as a measure of sleep in the proposed secondary data analysis.

Treatment adherence. Treatment adherence is measured as the degree of compliance with prescribed HIV medications. This single item, visual analog scale, asked patients how often they had taken their medications as prescribed by their doctor. On a 10-point scale ranging from 0%-100% patients were asked to mark the spot that correlated with their level of adherence in the past three days. This is ratio level data. This information is collected from the Demographics Form: TRIP Study.

Use of Health Services. Use of health services is determined by number of missed clinic visits. This is ratio level data. Abstractions from participants' health records were used to collect this data for the TRIP study.

Dependent Variables

Health Outcomes

Immunologic function. Health record abstractions were used to collect data on most recent CD4+ T-Lymphocyte count and most recent HIV viral load. These data are used as measures of immunologic function for this proposed secondary data analysis. Both CD4+ T-Lymphocyte count and HIV Viral Load are ratio level data. CD4+ T-Lymphocyte count is measured as cells/μL of blood (Abbas & Lichtman, 2010; Mellors et al., 2009). HIV Viral Load is measured as copies/mL of blood (Abbas & Lichtman, 2010; Mellors et al., 2009).

Data Analysis

A single cohort of adults living with HIV/AIDS is used in this study. Data collected at the first time point (collected between September 2012 and January 2013) of the TRIP study is used to examine the variables of interest. Using G*Power (Buchner, 1992) for power analysis it was determined that in order to achieve a power of .80 at an alpha of .05 for regression analysis, a minimum of 92 participants were required for this analysis. However, the study has a sample size of 100 participants. Data from all 100 participants are extracted and analyzed. Fifty of these participants are male and 50 are female. Data were analyzed using the Statistical Program for the Social Sciences (SPSS) 21.0 (Cunningham & Aldrich, 2012). Descriptive statistics were conducted for all the variables, using absolute and relative frequency, measures of central tendency (mean,

median and mode) and dispersion (range, variance, and standard deviation), and normality (skewness and kurtosis).

RQ1: *What are the levels of population characteristics (predisposing characteristics, enabling resources, and need factors), health behaviors, and health outcomes?*

Descriptive statistics were used to assess the data for adequate sample size, to describe the frequencies of the data, and to determine adequate variance. This includes an evaluation of mean, range, standard deviation, skewness and kurtosis for continuous variables. Frequencies and percentages were evaluated for any categorical variables. Frequency distribution will also be used to evaluate the data for coding inaccuracies, outliers, and missing data. Normal distribution of the data was determined using skewness and kurtosis, scatterplot diagrams, histograms, and P-P plots. The most precise measures for normality are the skew index and kurtosis index. These are both measured as absolute values with the sign (-/+) indicating the direction of deviation from normality. Variables with a skew index of an absolute value > 3.0 are described as extremely skewed. Variables with a kurtosis index of an absolute value > 10.0 suggest a problem, an absolute value > 20.0 suggests a bigger problem and would be considered severely non-normal (Kline, 2011). A variable is determined to have adequate variance for analysis when no one category/response accounts for more than 90% of all variable data.

RQ2: *What are the relationships among the population characteristics (predisposing characteristics, enabling resources, and need factors)?*

Pearson's correlation coefficient was used to evaluate the relationships between population characteristic variables (age, gender, marital status, education, race/ethnicity,

employment, sexual orientation, income, health insurance, housing, psychological stress, depressive symptoms, and HIV/AIDS status). Pearson's correlation coefficient requires dichotomous, interval, or ratio level data in order to properly analyze the relationships among variables. Dummy coding is a process in which data are transformed from nominal to dichotomous. The variable is split into two relevant groups that can be analyzed in correlations and regressions. Marital status was dummy coded as single/separated/divorced versus married/other. Race/ethnicity will also be dummy coded as African American versus Other ethnic group. Sexual orientation was dummy coded as Straight versus other.

The variables were examined to insure that the assumptions for correlation are met. The assumptions for correlation are as follows: (1) Random sampling. The study sample should be randomly chosen from the population. However, as it is rare to have a truly random sample, this assumption is robust to violations. (2) Interval- or ratio-level variables. This assumption is not robust to violation. (3) Normality. The variables should be normally distributed in the population. Variables with a skew index of an absolute value > 3.0 are described as extremely skewed. Variables with a kurtosis index of an absolute value > 10.0 suggest a problem, an absolute value > 20.0 suggests a bigger problem and would be considered severely non-normal (Kline, 2011). Confidence intervals around a samples skewness and kurtosis would help make inferences about whether or not this variable is normally distributed in the population. However, this assumption is robust to violation if the sample size is greater than or equal to 50. (4) Linearity. A correlation should only be tested if the relationship between the two variables is a linear one. Scatterplots are used to assess whether or not the assumption of

linearity is violated, a best-fit line was used to ascertain whether or not the data are clearly non-linear. This assumption is not robust to violation. (5) Homoscedasticity. Scedacity refers to the spread of one variable around another. Homoscedasticity is when the spread of one variable around the other is equal at all levels of the other variable. Scatterplots are used to assess homoscedasticity. This assumption is not robust to violations (Corty, 2007). Additional assumptions include: (1) adequate variance. This involves ensuring that values for a variable do not fall primarily in one category. Frequencies were used to detect if any category has more than 90% of the data in a specific variable. (2) Absence of influential cases. An influential case is an outlier that changes the slope of the regression line. Extreme cases were identified using Cook's D (score ≥ 1.0) and standardized DfBetas (score ≥ 1.0). After ensuring no data entry error has occurred, influential cases are removed and the test will be re-run. (3) Normality of error. Error should be normally distributed. This was assessed using skewness and kurtosis of the studentized deleted residuals. (4) Constant error variance. Using scatterplots, constant error variance is assessed by plotting studentized deleted residuals (Y axis) by standardized predicted scores (X axis). Concerns arise about non-constant error when the scatter around the best-fit line has a 3:1 or greater fanning affect from highest to lowest error variance. If any of the assumptions were violated, data was removed or transformed accordingly. Transforming data involves squaring and cubing problematic variables for reassessment in the correlation.

RQ3: *How do the population characteristics (predisposing characteristics, enabling resources, and need factors) explain health behaviors?*

The independent predictor variables for research question 3 are population characteristics (age, gender, marital status, education, race/ethnicity, employment, sexual orientation, income, health insurance, housing, psychological stress, depressive symptoms, and HIV/AIDS status). The dependent outcome variables are health behaviors (sleep, treatment adherence, and number of missed clinic visits). Linear regressions were used to analyze the variance explained for each of the dependent outcome variables.

The data were assessed to insure that the assumptions for linear regressions were met. The assumptions for linear regression are as follows: (1) adequate variance. This involves ensuring that values for a variable do not fall primarily in one category. Frequencies were used to detect if any category has more than 90% of the data in a specific variable. (2) Linearity. The relationship between independent variables and outcome should be linear; scatterplots of the residuals and independent variables were assessed. Linear, quadratic, and cubic lines of best-fit were applied to the partial regression plots and assess for differences that exceed 2%. (3) Absence of influential cases. An influential case is an outlier that changes the slope of the regression line. Extreme cases were identified using Cook's D (score ≥ 1.0) and standardized DfBetas (score ≥ 1.0). After ensuring no data entry error has occurred, influential cases would be removed and repeat regression would be performed to compare the changes in the regression line. (4) Normality of error. Error should be normally distributed. This was assessed using skewness and kurtosis of the studentized deleted residuals. Variables with a skew index of an absolute value > 3.0 are described as extremely skewed. Variables

with a kurtosis index of an absolute value > 10.0 suggest a problem, an absolute value > 20.0 suggests a bigger problem and would be considered severely non-normal (Kline, 2011). (5) Constant error variance. Using scatterplots, constant error variance is assessed by plotting studentized deleted residuals (Y axis) by standardized predicted scores (X axis). Concerns arise about non-constant error when the scatter around the best-fit line has a 3:1 or greater fanning affect from highest to lowest error variance. If any of the assumptions were violated, data was removed or transformed accordingly. Transforming data involves squaring and cubing problematic variables for reassessment in the regression.

RQ4: *How do the population characteristics (predisposing characteristics, enabling resources, and need factors) and health behaviors explain health outcomes?*

The independent predictor variables for research question 4 are population characteristics (age, gender, marital status, education, race/ethnicity, employment, sexual orientation, income, health insurance, housing, psychological stress, depressive symptoms, and HIV/AIDS status) and health behaviors (sleep, treatment adherence, and number of missed clinic visits). The dependent outcome variables are evaluated health status (CD4+ T-lymphocyte count and HIV viral load).

The data were assessed to insure that the assumptions for linear regressions were met. The assumptions for linear regression are as follows: (1) adequate variance. This involves ensuring that values for a variable do not fall primarily in one category. Frequencies were used to detect if any category has more than 90% of the data in a specific variable. (2) Linearity. The relationship between independent variables and outcome should be linear; scatterplots of the residuals and independent variables were

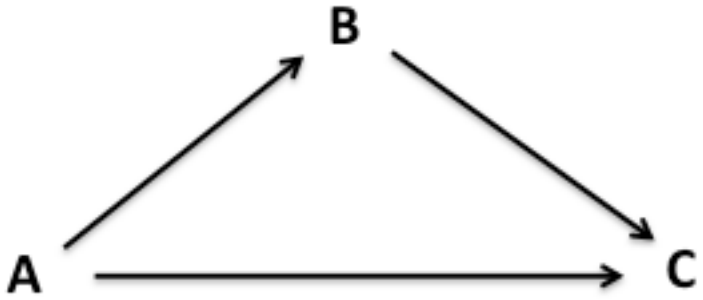
assessed. Linear, quadratic, and cubic lines of best fit were applied to the partial regression plots and assess for differences that exceed 2%. (3) Absence of influential cases. An influential case is an outlier that changes the slope of the regression line. Extreme cases were identified using Cook's D (score ≥ 1.0) and standardized DfBetas (score ≥ 1.0). After ensuring no data entry error has occurred, influential cases would be removed and repeat regression would be performed to compare the changes in the regression line. (4) Normality of error. Error should be normally distributed. This was assessed using skewness and kurtosis of the studentized deleted residuals. Variables with a skew index of an absolute value > 3.0 are described as extremely skewed. Variables with a kurtosis index of an absolute value > 10.0 suggest a problem, an absolute value > 20.0 suggests a bigger problem and would be considered severely non-normal (Kline, 2011). (5) Constant error variance. Using scatterplots, constant error variance is assessed by plotting studentized deleted residuals (Y axis) by standardized predicted scores (X axis). Concerns arise about non-constant error when the scatter around the best-fit line has a 3:1 or greater fanning affect from highest to lowest error variance. If any of the assumptions were violated, data were removed or transformed accordingly. Transforming data involves squaring and cubing problematic variables for reassessment in the regression.

RQ5: *Do health behaviors mediate the relationship between the population characteristics (predisposing characteristics, enabling resources, and need factors) and health outcomes?*

A mediator is a variable that causes a relationship between the independent variable and the dependent variable (Baron & Kenny, 1986). According to the sentinel

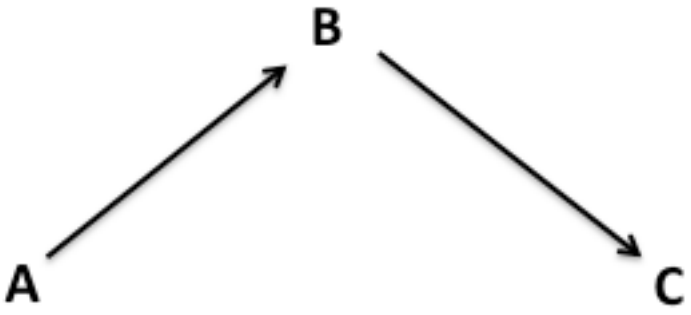
work of Baron & Kenny (1986) in order for mediation to exist, four conditions must be met. (1) There must be a statistically significant relationship between the predictor and the hypothesized mediator. (2) There must be a statistically significant relationship between the predictor and the dependent measure. (3) There must be a statistically significant relationship between the hypothesized mediator and the dependent variable. (4) The impact of the predictor variable on the dependent variable must decrease after controlling for the hypothesized mediator (Baron & Kenny, 1986). A series of three multiple regressions run simultaneously were used to test these four conditions (Figure 5) (Baron & Kenny, 1986). In the first equation (A to B) the relationship between the predictor (population characteristics) and the hypothesized mediator (health behaviors) would be examined. In the second equation (A to C) the relationship between the predictor (population characteristics) and the dependent measure (evaluated health status) would be examined. In the final equation (A and B to C), both population characteristics and health behaviors would be used as predictor variables and evaluated health status would be the dependent variable. If a mediating relationship does exist, population characteristics are less highly associated with evaluated health status in the third equation when compared to the second equation. The degree of this reduction in association is a reflection of the strength of the mediating relationship (Baron & Kenny, 1986).

Figure 5. Baron & Kenny Mediator Model (1986)



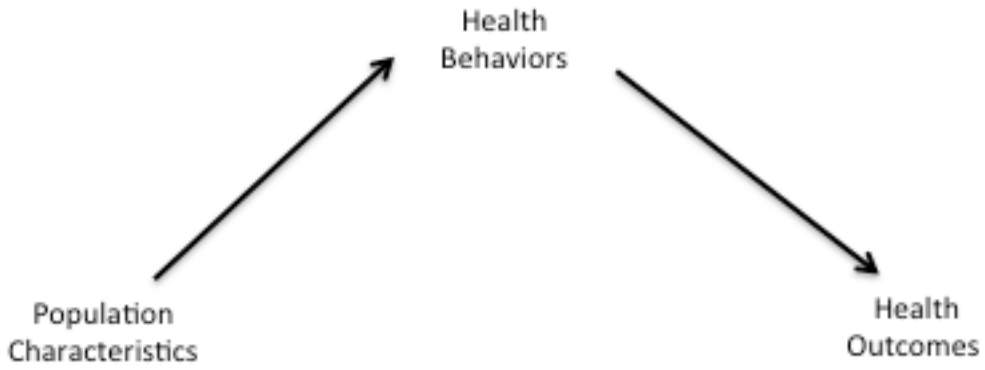
In 1998 (Kenny, Kashy, & Bolger), modified to the Baron & Kenny approach to testing mediation by suggesting that a relationship between the independent variable and the dependent variable are not necessary in order for mediation to exist. As long as (1) there is a statistically significant relationship between the predictor and the hypothesized mediator, and (2) there is a statistically significant relationship between the hypothesized mediator and the dependent variable, mediation can be tested (Kenny et al., 1998) (see Figure 6). This modified approach to testing for mediation was used to answer research question 5 in this proposed study.

Figure 6. Kenny, Kashy, & Bolger Modified Mediator Model (1998)



Regressions were used to determine whether or not health behaviors (sleep, treatment adherence, and number of missed clinic visits) mediate the relationship between population characteristics (age, gender, marital status, education, race/ethnicity, employment, sexual orientation, income, health insurance, housing, psychological stress, depressive symptoms, and HIV/AIDS status) and evaluated health status (CD4+ T-lymphocyte count and HIV viral load) (Figure 7).

Figure 7. Proposed Mediator Model



The data were assessed to insure that the assumptions for linear regressions were met. The assumptions for linear regression are as follows: (1) adequate variance. This involves ensuring that values for a variable do not fall primarily in one category. Frequencies were used to detect if any category has more than 90% of the data in a specific variable. (2) Linearity. The relationship between independent variables and outcome should be linear; scatterplots of the residuals and independent variables were assessed. Linear, quadratic, and cubic lines of best fit were applied to the partial regression plots and assess for differences that exceed 2%. (3) Absence of influential cases. An influential case is an outlier that changes the slope of the regression line. Extreme cases were identified using Cook's D (score ≥ 1.0) and standardized DfBetas

(score ≥ 1.0). After ensuring no data entry error has occurred, influential cases would be removed and repeat regression would be performed to compare the changes in the regression line. (4) Normality of error. Error should be normally distributed. This was assessed using skewness and kurtosis of the studentized deleted residuals. Variables with a skew index of an absolute value > 3.0 are described as extremely skewed. Variables with a kurtosis index of an absolute value > 10.0 suggest a problem, an absolute value > 20.0 suggests a bigger problem and would be considered severely non-normal (Kline, 2011). (5) Constant error variance. Using scatterplots, constant error variance is assessed by plotting studentized deleted residuals (Y axis) by standardized predicted scores (X axis). Concerns arise about non-constant error when the scatter around the best-fit line has a 3:1 or greater fanning affect from highest to lowest error variance. If any of the assumptions were violated, data were removed or transformed accordingly. Transforming data involves squaring and cubing problematic variables for reassessment in the regression.

Additional Analysis:

This dataset includes two transgendered individuals. While the sample size is not large enough to do a quantitative analysis of the data they supplied, their contributions are valuable to this body of literature. Therefore a discussion of their basic demographic profile was provided.

Limitations

There are a number of limitations that may have impacted the study outcomes. The most significant limitation is the population that was examined; it does not accurately represent the population as a whole, and therefore conclusions may not be

generalizable. Another limitation is methodological: a descriptive correlational study design is the potential for unmeasured confounding variables that are potentially responsible for the outcome (Kane, 2008). As a secondary data analysis this study is also limited by the tools used and the data available in the TRIP study database as these data were collected for the purposes of the TRIP study, not this current secondary data analysis (Bryman, 2012; E. Smith, 2008). The lack of control in generating the data set (E. Smith, 2008; Szabo & Strang, 1997) limits this secondary data analysis regarding the questions that can be asked and the variables that can be analyzed. As a convenience sampling of HIV patient in Northeast Ohio has been used to recruit study participants, selection bias is also a threat to this study. Study participants were recruited from HIV clinics where they were receiving treatment; however, national data suggests that only 66% of those diagnosed with HIV are appropriately linked to care and only 37% are retained in care (Gardner, McLees, Steiner, del Rio, & Burman, 2011). That makes this sample different from the general HIV-infected population in the United States. This makes it difficult to generalize these findings to the average HIV-infected person living in the United States.

Summary

The purpose of this proposed secondary data analysis was to explore the relationships among population characteristics (demographic data, HIV/AIDS classification, depressive symptoms, and psychological stress), health behaviors (treatment adherence, sleep, and the use of health services), and health outcomes (immunologic function) in HIV-infected people living in Northeast Ohio. Andersen's Behavioral Model of Health Services Utilization, which suggests that health outcomes are

a function of population characteristics and health behaviors, will guide this study (Andersen, 1968; Andersen, 1995; Andersen & Newman, 2005). A single cohort of adults living with HIV/AIDS was used. These data were collected between September 2012 and January 2013, which represents the first time point in the three-year longitudinal TRIP study. A combination of descriptive statistics, correlations, and multiple linear regressions were used to analyze the variables of interest as delineated by the five research questions.

CHAPTER IV: RESULTS

This chapter presents the findings of this secondary data analysis extracted from the "Exploring relationship among sTRess, Isolation, and Physical activity (TRIP) in older adults with HIV/AIDS" study (Webel et al., n.d.). The purpose of this secondary data analysis was to explore the relationships among population characteristics (demographic data, HIV/AIDS classification, psychological stress, and depressive symptoms), health behaviors (treatment adherence, sleep, and the use of health services), and health outcomes (immunologic function) in HIV-infected people living in Northeast Ohio. Five research questions were developed to address this purpose statement.

Research Questions and Findings

Study findings for this secondary data analysis are reported for each question. Figures and tables are included where appropriate.

Research Question One

What are the levels of population characteristics (predisposing characteristics, enabling resources, and need factors), health behaviors, and health outcomes?

Descriptive statistics were used to assess the data for adequate sample size, to describe the frequencies of the data, and determination of adequate variance. This included an evaluation of mean, range, standard deviation, skewness and kurtosis. Frequencies and percentages were evaluated for any categorical variables. No variable had more than 5% missing data. The demographic characteristics of the study participants are presented on Table 1. Major study variables are presented on Table 2.

Predisposing Characteristics

The study sample consisted of HIV-infect adults (N= 104). Adults ranged in age from 20 years to 64 years old, the mean age was 47.95 years (SD= 8.73). Fifty-four participants were male (52.9%), 48 female, two were transgender. The transgender participants were not included in the quantitative analysis; however, a discussion of their data will follow. Nine (8.7%) study participants were married, 72 (69.9%) were single, two (1.1%) were separated, 13 (6.9%) were divorced, and five (2.6%) were in a domestic partnership. Two (1.1%) people reported being in their marital status as "other". However, for the purposes of this study, marital status was dummy coded into two categories, Married/Domestic partnership (N= 14; 13.6%) and Single/Separated/Divorced (N= 89; 86.4%).

Twenty-six (25.2%) study participants reported and education level of 11^{th} grade or less, 28 (27.2%) reported an education level of High school or GED, 33 (32%) reported some college or technical school training, two (1.9%) reported two years of college/associate degree (AA)/technical school training, 12 (11.7%) reported having completed college, and two (1.9%) reported having earned a master's degree. The majority of the study sample was African American/Black (N= 85; 82.5%), two (1.1%) were Hispanic/Latino, one (1%) was Native American Indian, 11 (10.7%) were White/Angelo, one (1.0%) was Asian/Pacific Islander, and three (2.9%) reported "other" race/ethnicity. However, for the purposes of this study, Race/Ethnicity was dummy coded into two categories, African American/Black (N= 85; 82.5%) and Other Race/Ethnicity (N= 18; 17.5%). Eighty-nine (86.4%) of study participants reported not having paid

employment. Thirty (30.3%) study participants were gay, 10 (10.1%) were bisexual, 55 (55.6%) were heterosexual, and 4 (4%) reported "other" sexual orientation. However, for the purposes of this investigation sexual orientation was dummy coded into two categories, Heterosexual (N= 55; 55.6%) and Gay/Bisexual/Other (N= 44; 44.4%).

Enabling Resources

The majority of the study participants (N= 41; 39.8%) reported a monthly income ranging between $600-$799. Eighteen (17.5%) participants reported no monthly income, Seven (6.8%) reported an income of less than $200/month, Six (5.8%) reported an income of $400-$599/month, Three (2.9%) reported $400-$599/month, 11 (10.7%) reported $800-$999/month, and 17 (16.5%) reported $1000 or more/month. Five (4.9%) study participants had no health insurance, 97 (95.1%) did. Fifty-two (50%) had Medicaid, 29 (27.9%) had Medicare, eight (7.7%) had ADAP. However, in this study, insurance was dummy coded into number of insurance policies, ranging from 0-3. Five (4.9%) did not have any form of health insurance, 72 (70.6%) had one form of health insurance, 19 (18.6%) had two forms of health insurance, and six (5.9%) had three forms of health insurance. Ninety-two (89.3%) study participants reported having permanent housing, 11 (10.7%) did not.

Need Factors

Psychological stress scores on the Perceived Stress Scale (S. Cohen, 1988) ranged from 0-34 (Mean= 17.33; SD= 6.91). Depressive symptoms scores on the CESD (Radloff, 1977) ranged from 0-53 (Mean= 21.17; SD= 13.80). In this study HIV/AIDS classification was determined by whether or not there had ever been a diagnosis of AIDS. Sixty-nine (66.3%) of study participants had a diagnosis of AIDS, 35 (33.7%) did not.

Health Behaviors

Average sleep scores ranged from 121.38-878.50 minutes per night (Mean= 352.41; SD= 112.27). Treatment adherence for this study sample ranged from 0%-100% (Median= 100, IQR= 95-100) in the previous three days. Number of missed appointments ranged from 0-11 (Mean= 1.36; SD= 1.819) in the past 12 months.

Outcomes

Most recent CD4+ T-lymphocyte count ranged from 43-1766 cells/μL of blood (Mean= 609.64; SD= 375.15). Most recent HIV viral load ranged from 20-304836 copies/mL of blood (Median= 33.5, IQR= 20-45).

Table 1: Demographic Characteristics

Characteristics	**Frequency**	**Percent**
Age (Mean=47.95; SD=8.727; Range=20-64)		
20-29 years old	7	6.9%
30-39 years old	6	5.9%
40-49 years old	38	36.5%
50-59 years old	49	46.9%
60 years or older	4	3.9%
Gender		
Male	54	52.9%
Female	48	47.1%
Marital Status		
Married	9	8.7%
Single	72	69.9%
Separated	2	1.9%
Divorced	13	12.6%
Domestic Partnership	5	4.9%
Other	2	1.9%
Marital Status: Dummy Codes		
Married/Domestic Partnership	14	13.6%
Single/Separated/Divorced	89	86.4%
Education		
11th Grade or Less	26	25.2%
High School or GED	28	27.2%
Some College/Technical School	33	32%
2 Years of College/AA/Technical School Training	2	1.9%
College (BS or BA)	12	11.7%
Master's Degree	2	1.9%

Race/Ethnicity		
African American/Black	85	82.5%
Hispanic/Latino	2	1.9%
Native American Indian	1	1.0%
White/Angelo (Non-Hispanic)	11	10.7%
Asian/Pacific Islander	1	1.0%
Other	3	2.9%
Race/Ethnicity: Dummy Codes		
African American/Black	85	82.5%
Other Race/Ethnicity	18	17.5%
Employment		
No	89	86%
Yes	14	13.6%
Sexual Orientation		
Gay	30	30.3%
Bisexual	10	10.1%
Heterosexual	55	55.6%
Other	4	4.0%
Sexual Orientation: Dummy Codes		
Heterosexual	55	55.6%
Gay/Bisexual/Other	44	44.4%
Income		
No Monthly Income	18	17.5%
Less than $200/month	7	6.8%
$200-$399	6	5.8%
$400-$599	3	2.9%
$600-$799	41	39.8%
$800-$999	11	10.7%
$1000 or more	17	16.5%
Health Insurance		
No	5	4.9%
Yes	97	95.1%
Type of Health Insurance		
Medicaid	52	50%
Medicare	29	27.9%
ADAP	8	7.7%
Veterans Benefits	4	3.8%
Private, Provided by Work	4	3.8%
Private, Not Provided by Work	0	0%
Ryan White Care Act	31	29.8%
Number of Insurances: Dummy Codes		
0	5	4.9%
1	72	70.6%
2	19	18.6%
3	6	5.9%

Housing		
No	11	10.7%
Yes	92	89.3%
Diagnosed with AIDS		
No	35	33.7%
Yes	69	66.3%

Table 2: Summary of Distribution of Other Study Variables

Variable	N	Mean	Median	Mode	SD	Range	Min-Max
Psychological Stress	104	17.33	17	20	6.91	34	0-34
Depressive Symptoms	103	21.17	17	6	13.80	53	0-53
Sleep	94	352.41	358.63	121.38	112.27	757.12	121.38-878.50
Treatment Adherence	109	92.46	100	100	16.25	100	0-100
Missed Clinic Visits	94	1.36	1.00	0	1.819	25	0-11
CD4+ T-Lymphocyte Count	104	609.64	520	361	375.15	1723	43-1766
HIV Viral Load	102	10239.93	33.50	20	45318.46	304816	20-304836

Research Question Two

What are the relationships among the population characteristics (predisposing characteristics, enabling resources, and need factors)?

Pearson's correlation coefficient was used to evaluate the relationships between population characteristic variables (age, gender, marital status, education, race/ethnicity, employment, sexual orientation, income, health insurance, housing, psychological stress, depressive symptoms, and HIV/AIDS status).

The variables were examined to insure that the assumptions for correlation are met. (1) Random sampling. The study sample should be randomly chosen from the population. This study did not use randomly sampling however, this assumption is robust to violations. (2) Interval- or ratio-level variables. Ordinal-level variables were dummy coded so as to meet this assumption. (3) Normality. The variables should be normally distributed in the population. Variables with a skew index of an absolute value > 3.0 are described as extremely skewed. Variables with a kurtosis index of an absolute value > 10.0 suggest a problem, an absolute value > 20.0 suggests a bigger problem and would be considered severely non-normal (Kline, 2011). This assumption is robust to violation if the sample size is greater than or equal to 50. With a skewness of -3.170 and a kurtosis of 11.680, treatment adherence is not normally distributed. However, with a sample size of 97, this assumption is robust to violation. (4) Linearity. A correlation should only be tested if the relationship between the two variables is a linear one. Scatterplots are used to assess whether or not the assumption of linearity is violated, a best-fit line was used to ascertain whether or not the data are clearly non-linear. (5) Homoscedasticity. Scedacity refers to the spread of one variable around another. Homoscedasticity is when the spread

of one variable around the other is equal at all levels of the other variable. Scatterplots were used to assess homoscedasticity (Corty, 2007). Additional assumptions include: (1) adequate variance. As no one category had more than 90% of the data in a specific variable, there was adequate variance. (2) Absence of influential cases. An influential case is an outlier that changes the slope of the regression line. Extreme cases were identified using Cook's D (score ≥ 1.0) and standardized DfBetas (score ≥ 1.0). There were no extreme cases in this analysis. (3) Normality of error. Error should be normally distributed. This was assessed using skewness and kurtosis of the studentized deleted residuals. (4) Constant error variance. Using scatterplots, constant error variance is assessed by plotting studentized deleted residuals (Y axis) by standardized predicted scores (X axis). Concerns arise about non-constant error when the scatter around the best-fit line has a 3:1 or greater fanning affect from highest to lowest error variance. Missing data was addressed by the use of listwise case deletion. This process reduced the sample size for this correlation to 97. Among the variables included in this correlation there were a number of significant relationships.

Age was significantly correlated with paid employment. Younger adults were significantly less likely to have paid employment, $r(95)= -.23$, $p< .05$. And the older a study participant was, the greater the number of insurance policies they were likely to have, $r(95)= .23$, $p< .05$.

Gender was significantly correlated with education. The men in this study were significantly less educated than the women, $r(95)= -.25$, $p< .05$. Men were also significantly less likely to report heterosexual orientation when compared to women, $r(95)= -.67$, $p< .01$.

People who were married were significantly less likely to have ever had a diagnosis of AIDS, $r(95)= -.28$, $p< .01$. Marital status was significantly correlated with monthly income. Individuals who were married or in a domestic partnership had a lower monthly income than those who were single, separated, or divorced, $r(95)= -.23$, $p< .01$. Individuals who were married or in a domestic partnership also tended to have lower numbers of insurance policies, $r(95)= -.23$, $p< .05$. The higher the monthly income the greater the number of insurance policies, $r(95)= .40$, $p< .01$.

The higher the level of education the higher the monthly income, $r(95)= .23$, $p< .05$. Consequently, those who reported having paid employment tended to have higher levels of education, $r(95)= .22$, $p< .05$. Those who reported a sexual orientation other than heterosexual tended to have higher levels of education, $r(95)= .22$, $p< .05$. Lower levels of education were associated with lower levels of perceived stress, $r(95)= -.33$, $p< .01$ and lower levels of depressive symptoms, $r(95)= -.26$, $p< .01$.

Individuals who had never had a diagnosis of AIDS had lower levels of perceived stress, $r(95)= -.24$, $p< .05$. Higher levels of perceived stress is significantly correlated with levels of depressive symptoms, $r(95)= -.66$, $p< .01$. (See Table 3)

Table 3: Relationships Among Population Characteristics

Variables	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
1. Age	-												
2. Gender	.047	-											
3. Marital Status	.043	-.034	-										
4. Education	.069	-.247**	.041	-									
5. Ethnicity	.159	-.107	-.070	-.054	-								
6. Employed	-.232*	.063	.162	.215*	-.024	-							
7. Sexual Orientation	-.125	-.698**	.099	.220*	.060	-.004	-						
8. Income	.162	.007	-.234*	.232*	.059	.030	-.049	-					
9. Insurance	-.233*	.132	-.225*	.130	.045	-.158	-.110	.398**	-				
10. Housing	.025	.064	-.034	.103	-.032	.043	-.046	.139	.131	-			
11. Stress	-.180	.075	.093	-.330**	-.041	.042	-.079	-.190	-.153	-.165	-		
12. Depressive Symptoms	-.140	.058	.034	-.264**	.011	-.062	-.119	-.129	-.117	-.149	.661**	-	
13. HIV/AIDS Classification	.103	-.183	-.276**	.086	.076	-.149	.126	.115	-.139	.123	-.238*	-.099	-

* Correlation is significant at the 0.05 level (2-tailed). ** Correlation is significant at the 0.01 level (2-tailed).

Research Question Three

How do the population characteristics (predisposing characteristics, enabling resources, and need factors) explain health behaviors?

Preliminary analysis for research question three was conducted using bivariate correlations to test the relationships among population characteristics and health behaviors. All the assumptions for bivariate correlation were met. Greater amounts of sleep per night were related to increased levels of depressive symptoms $r(91)= .21$, $p< .05$. Higher levels of treatment adherence was associated with higher levels of education $r(95)= .24$, $p< .05$ and higher levels of monthly income $r(95)= .25$, $p< .05$. A higher number of missed appointments was associated with increased levels of psychological stress $r(92)= .25$, $p< .05$. (See table 4)

Multiple regression analysis was used to test how population characteristics explain health behaviors. Predictor variables were entered simultaneously. The data was assessed to insure that the assumptions for linear regressions were met. (1) Adequate variance. As no one category had more than 90% of the data in a specific variable, there was adequate variance. (2) Linearity. Scatterplots of the residuals and independent variables were assessed. In table 9, the relationship between the dependent variable: missed clinic visits, and the independent predictor variable psychological stress was found to be non-liner. Linear, quadratic, and cubic lines of best-fit were applied to the partial regression plots and the differences exceeded 2%. This predictor variable was transformed to correct for non-linearity; in the final model psychological stress was squared and the relationship became linear. (3) Absence of influential cases. An influential case is an outlier that changes the slope of the regression line. Extreme cases

were identified using Cook's D (score ≥ 1.0) and standardized DfBetas (score ≥ 1.0). There were no extreme cases in these analyses. (4) Normality of error. Error should be normally distributed. This was assessed using skewness and kurtosis of the studentized deleted residuals. Variables with a skew index of an absolute value > 3.0 are described as extremely skewed. Variables with a kurtosis index of an absolute value > 10.0 suggest a problem, an absolute value > 20.0 suggests a bigger problem and would be considered severely non-normal (Kline, 2011). Error for all three models was assessed and found to be normally distributed. (5) Constant error variance. Using scatterplots, constant error variance is assessed by plotting studentized deleted residuals (Y axis) by standardized predicted scores (X axis). Concerns arise about non-constant error when the scatter around the best-fit line has a 3:1 or greater fanning affect from highest to lowest error variance. There was not a greater than 3:1 fanning in constant error variance. After testing all of the assumptions, population characteristics were not significant predictors of the health behaviors. The following three tables (5, 6 and 9) are included to explicate these findings.

An additional analysis of treatment adherence was conducted using logistical regressions. An extension of linear regressions, logistical regressions provide odds ratios for a dichotomous dependent outcome. As cART adherence rates less than 95% contribute to immunologic resistance and treatment failure (Centers for Disease Control and Prevention, 2002; United States et al., 2008), treatment adherence was dichotomized as non-adherent (less than 95% adherent) vs. adherent (95% adherent or greater). The assumptions for logistical regression were met and are as follows: (1) adequate variance, (see table 7). (2) Absence of influential cases. (3) No multicollinearity (the independent

variables are not highly correlated with each other). Multicollinearity was assessed by identifying correlations >.90, tolerance values <.10 and variance inflation factor (VIF) values >10. All correlations, tolerance and VIF values fell within acceptable ranges indicating no multicollinearity between study variables. (4) No statistical interactions (the relationship between the independent and dependent variable is additive). (5) Variables are missing completely at random. There was no significant relationship between the independent variables and adherence vs. non-adherence (Nagelkerke $R^2 = .189$, $X^2 = 9.946$, $p = .26$) (see Table 8). The model correctly predicted 66.7% of the cases.

Table 4: Relationship among Population Characteristic and Health Behaviors

Variables	Sleep	Treatment Adherence	Missed Clinic Visits
Age	-.072	-.029	-.024
Gender	.152	-.017	.048
Marital Status	-.017	.022	-.050
Education	-.176	.236*	-.083
Race/Ethnicity	.041	.111	-.183
Employment	-.071	.039	-.016
Sexual Orientation	-.128	-.055	-.040
Income	-.012	.246*	-.047
Health Insurance	.052	.073	.018
Housing	-.011	.155	-.161
Psychological Stress	.147	-.154	.245*
Depressive Symptoms	.212*	-.182	.196
HIV/AIDS Classification	-.058	.027	-.018

*Correlation is significant at the 0.05 level (2-tailed).

Table 5: How Population Characteristics Explain Sleep

Variables *N=88*	**B**	**Std. Error**	**Beta**	**t**	**Sig.**	**CI(95%)**
Sleep (Constant)	300.308	61.527		4.881	.000	177.888-422.727
Gender	29.010	38.130	.129	.761	.449	-46.856-104.876
Housing	18.220	41.270	.049	.441	.660	-63.893-100.334
Sexual Orientation	5.534	37.060	.024	.149	.882	-68.204-79.272
Education	-8.332	10.330	-.092	-.807	.422	-28.884-12.221
HIV/AIDS Classification	-2.852	26.179	-.012	-.109	.914	-54.940-49.236
Depressive Symptoms	1.527	.913	.187	1.674	.098	-.288-3.343

R	**R^2**	**Adjusted R^2**	**F**	**Sig.**
.272	.074	.005	1.078	.383

Table 6: How Population Characteristics Explain Treatment Adherence

Variables *N=95*	**B**	**Std. Error**	**Beta**	**t**	**Sig.**	**CI(95%)**
Treatment Adherence (Constant)	85.819	9.240		9.288	.000	67.457-104.182
Gender	-1.254	4.609	-.039	-.272	.786	-10.413-7.905
Housing	6.792	5.783	.122	1.174	.243	-4.702-18.285
Sexual Orientation	-2.719	4.621	-.083	-.588	.588	-11.902-6.465
Education	1.948	1.396	-.157	1.395	.166	-.827-4.723
Income	1.048	.859	.129	1.220	.226	-.659-2.755
Psychological Stress	-.222	.250	-.096	-.888	.377	-.718-.275

R	**R^2**	**Adjusted R^2**	**F**	**Sig.**
.319	.102	.041	1.667	.139

Table 7: Treatment Adherence Descriptive Statistics

Treatment Adherence	Frequency	Percent
Non-Adherent	30	25.9%
Adherent	86	74.1%

Table 8: Logistic Regression Statistics Predicting Adherence vs. Non-adherence

Variables *N=97*	**B**	**S.E.**	**Wald**	**df**	**Sig.**	**Exp(B)**	**CI(95%)**
Gender	.590	.733	.647	1	.421	1.804	.429-7.585
Education	.162	.237	.469	1	.494	1.176	.740-1.869
Sexual Orientation	-.136	.711	.037	1	.848	.873	.217-3.515
Income	.106	.129	.672	1	.412	1.112	.863-1.433
Housing	1.036	.729	2.021	1	.155	2.819	.675-11.764
Psychological Stress	-.042	.040	1.094	1	.296	.959	.886-1.038
HIV/AIDS Classification	.523	.557	.879	1	.349	1.686	.566-5.028
Treatment Adherence (Constant)	-.036	1.454	.001	1	.980	.964	-

Table 9: How Population Characteristics Explain Number of Missed Clinic Visits

Variables *N=87*	**B**	**Std. Error**	**Beta**	**t**	**Sig.**	**CI(95%)**
Missed Clinic Visits (Constant)	1.160	1.012		1.146	.255	-.855-3.175
Gender	.101	.578	.027	.175	.871	-1.042-1.227
Housing	-.907	.676	-.148	-1.341	.177	-2.247-.421
Sexual Orientation	-.066	.582	-.017	-.113	.894	-1.215-1.062
Education	.026	.166	.018	.156	.882	-.303-.351
HIV/AIDS Classification	.340	.448	.086	.758	.451	-.554-1.233
Psychological Stress	.002	.001	.251	2.225	.110	.000-.004
Depressive Symptoms	.002	.020	.018	.122	.903	-.037-.042

R	**R^2**	**Adjusted R^2**	**F**	**Sig.**
.301	.091	.010	1.128	.354

Research Question Four

How do the population characteristics (predisposing characteristics, enabling resources, and need factors) and health behaviors explain health outcomes?

Preliminary analysis for research question four was conducted using bivariate correlations to test the relationships among population characteristics, health behaviors and health outcomes. All the assumptions for bivariate correlation were met. Higher CD4+ T-lymphocyte counts is associated with male gender $r(100)= .20$, $p< .05$ and increased levels of treatment adherence $r(95)= .27$, $p< .01$. Lower CD4+ T-lymphocyte counts were associated with never having been diagnosed with AIDS $r(102)= -.241$, $p< .05$. Decreased HIV viral load was associated with a lack of permanent housing $r(99)= -.22$, $p< .05$ and decreased treatment adherence $r(93)= -.43$, $p< .01$. (See table 10)

Multiple regression analysis was used to test how population characteristics and health behaviors explain health outcomes. HIV viral load less than 75 copies/mL is generally considered undetectable (United States & HIV/AIDS Bureau, 2011). Therefore, scores for HIV viral load less than 75 were recoded as 74. Predictor variables were entered simultaneously. The data were assessed to insure that the assumptions for linear regressions were met. (1) Adequate variance. As no one category had more than 90% of the data in a specific variable, there was adequate variance. (2) Linearity. Scatterplots of the residuals and independent variables were assessed. In table 12 there was a non-linear relationship between HIV viral load and treatment adherence. Linear, quadratic, and cubic lines of best-fit were applied to the partial regression plots and the differences exceeded 2%. This predictor variable was transformed to correct for non-linearity; in the final model treatment adherence was squared and the relationship became linear. (3)

Absence of influential cases. An influential case is an outlier that changes the slope of the regression line. Extreme cases were identified using Cook's D (score ≥ 1.0) and standardized DfBetas (score ≥ 1.0). There were no extreme cases in these analyses. (4) Normality of error. Error should be normally distributed. This was assessed using skewness and kurtosis of the studentized deleted residuals. Variables with a skew index of an absolute value > 3.0 are described as extremely skewed. Variables with a kurtosis index of an absolute value > 10.0 suggest a problem, an absolute value > 20.0 suggests a bigger problem and would be considered severely non-normal (Kline, 2011). In table 12, with a skewness of 4.236 and kurtosis of 24.161 of the studentized deleted residuals, the error was not normally distributed. Therefore transformation of the dependent variable: HIV viral load, was conducted using a process known as winsorization. Winsorization involves limiting extreme values to reduce the effect of outliers. The four largest scores (119139, 130000, 290000, and 304836) were recoded to be the score 83701. The regression analysis was re-run using the transformed dependent variable and the issues of non-normally distributed error were corrected (skewness= 2.719, kurtosis= 11.322). (5) Constant error variance. Using scatterplots, constant error variance is assessed by plotting studentized deleted residuals (Y axis) by standardized predicted scores (X axis). Concerns arise about non-constant error when the scatter around the best-fit line has a 3:1 or greater fanning affect from highest to lowest error variance. There was not a greater than 3:1 fanning in constant error variance. After testing all of the assumptions, population characteristics and health behavior explained 22.7% of the variance (R^2= .227, F= 2.794, p< .01) in CD4+ T-lymphocyte count (See Table 11). Approximately 24.4% of the variance in HIV viral load was explained by the independent variables (R^2= .244, F=

5.869, $p < .001$). However, treatment adherence was the only predictor of HIV viral load ($t = -4.440$, $p < .001$) (See Table 12).

An additional analysis of HIV viral load was conducted using logistical regressions. An extension of linear regressions, logistical regressions provide odds ratios for a dichotomous dependent outcome. As an HIV viral load less than 75 copies/mL is generally considered undetectable (United States & HIV/AIDS Bureau, 2011), HIV viral load was dichotomized into undetectable (HIV viral load less than 74) vs. detectable (HIV viral load of 75 or greater). The assumptions for logistical regression were met and are as: (1) adequate variance, (see Table 13) (2) absence of influential cases, (3) no multicollinearity (the independent variables are not highly correlated with each other), (4) no statistical interactions (the relationship between the independent and dependent variable is additive), (5) variables are missing completely at random. Findings were similar to the linear regression (Nagelkerke $R^2 = .243$, $X^2 = 9.527$, $p = .300$). Individuals with lower levels of treatment adherence are 97% as likely to have a detectable viral load (O.R.= .97; 95% CI= .937-.996; $p < .001$) (see Table 14). Overall the model correctly predicted 79.4% of the cases.

Table 10: Relationship among Population Characteristic, Health Behaviors and Outcomes

Variables	CD4+ T-Lymphocyte Count	HIV Viral Load
Age	-.087	-.136
Gender	.203*	.028
Marital Status	.145	-.017
Education	.128	-.109
Race/Ethnicity	-.028	-.047
Employment	-.035	-.072
Sexual Orientation	-.103	.029
Income	.051	-.016
Health Insurance	.119	.023
Housing	.148	-.218*
Psychological Stress	-.065	.168
Depressive Symptoms	-.068	.129
HIV/AIDS Classification	-.241*	.003
Sleep	.006	-.058
Treatment Adherence	.271**	-.433**
Missed Clinic Visits	-.074	.083

*Correlation is significant at the 0.05 level (2-tailed).

**Correlation is significant at the 0.01 level (2-tailed).

Table 11: How Population Characteristics and Health Behaviors Explain CD4 Count

Variables *N=85*	**B**	**Std. Error**	**Beta**	**t**	**Sig.**	**CI(95%)**
CD4 Count (Constant)	37.952	268.120		.142	.888	-.496.056- 571.959
Gender	180.359	99.673	.132	1.234	.074	-18.158-378.876
Education	47.446	28.947	.181	1.639	.105	-10.207-105.099
Housing	156.343	126.697	.132	1.234	.221	-95.996-408.683
Sexual Orientation	-35.295	100.972	-.050	-.350	.728	-236.398-165.808
HIV/AIDS Classification	-148.433	77.616	-.201	-1.912	.060	-303.019-6.153
Missed Clinic Visits	5.283	21.364	.026	.247	.805	-37.268-47.833
Treatment Adherence	3.959	2.190	.194	1.808	.075	-.402-8.321

R	**R^2**	**Adjusted R^2**	**F**	**Sig.**
.477	.227	.146	2.794	.009

Table 12: How Population Characteristics and Health Behaviors Explain HIV Viral Load

Variables *N=97*	**B**	**Std. Error**	**Beta**	**t**	**Sig.**	**CI(95%)**
HIV Viral Load (Constant)	42472.480	9340.161		4.547	.000	23919.391-61025.563
Education	103.813	1356.231	.007	.077	.939	-2590.174-2797.800
Housing	-11045.070	6088.663	-.172	-1.814	.073	-23139.452-1049.312
HIV/AIDS Classification	3138.488	3668.755	.079	.855	.395	-4149.043-10426.019
Depressive Symptoms	42.141	127.791	.032	.330	.742	-211.700-295.983
Treatment Adherence	-3.433	.773	-.426	-4.440	.000	-4.969- -1.897

R	**R^2**	**Adjusted R^2**	**F**	**Sig.**
.494	.244	.202	5.869	.000

Table 13: HIV Viral Load Descriptive Statistics

HIV Viral Load	Frequency	Percent
Undetectable	79	76%
Detectable	25	24%

Table 14: Logistic Regression Statistics Predicting Detectable vs. Undetectable HIV Viral Load

Variables *N= 97*	**B**	**S.E.**	**Wald**	**df**	**Sig.**	**Exp(B)**	**CI(95%)**
Education	-.124	.241	.265	1	.607	.883	.551-1.417
Housing	-1.242	.790	2.472	1	.116	.289	.061-1.358
Depressive Symptoms	.034	.020	3.012	1	.083	1.035	.996-1.075
HIV/AIDS Classification	.058	.575	.010	1	.920	1.059	.343-3.272
Treatment Adherence	-.034	.015	4.980	1	.026	.966	.937-.996
HIV Viral Load (Constant)	2.324	1.622	2.053	1	.152	10.221	-

Research Question Five

Do health behaviors mediate the relationship between the population characteristics (predisposing characteristics, enabling resources, and need factors) and health outcomes?

According to Baron and Kenny (1986), there must be a statistically significant relationship between the predictor and the hypothesized mediator in order for mediation to exist. In the analysis for research question 3 it was determined that there is no relationship between the population characteristics and health behaviors (See tables 5, 6, and 9). Therefore, it is impossible for health behaviors to mediate the relationship between population characteristics and health outcomes in this sample.

Additional Analysis

The sample for this study included two transgender individuals who were not included in the quantitative analysis. However, their contribution to this study and to the literature is valuable. Therefore, based on the available data a brief discussion about each person is to follow.

Individual One

The first transgender study participant was 42 years old and identified as White/Anglo. Information was not provided about whether this individual was male-to-female transgender or female-to-male transgender. This participant reported being gay and married, having an education level of 11th grade or less, having no paid employment, having a monthly income of $600-$799, having permanent housing and having three health insurance policies. From the data, in the last three days, this study participant reported 100% treatment adherence, had only missed one clinic appointment in the past

12 months and had never been diagnosed with AIDS. An average of 305.49 minutes (approximately five hours) of sleep a night was reported. A CESD score of nine and a Perceived Stress Scale score of 15 were reported; both of these scores are less than the study median.

Individual Two

The second transgender study participant was 56 years old and identified as African American/Black. Information was not provided about whether this individual was male-to-female transgender or female-to-male transgender. This participant reported being heterosexual and married, having an education level of 11^{th} grade or less, having no paid employment, having no monthly income, having permanent housing and having two health insurance policies. From the data, in the last three days, this study participant reported 40% treatment adherence, had only missed 1 clinic appointment in the past 12 months and did have a diagnosis of AIDS. This individual did not supply any sleep data. A CESD score of seven and a Perceived Stress Scale score of 12 were reported; both of these scores are less than the study median.

Analysis of Depressive Symptoms

An additional analysis of depressive symptoms was also conducted. Preliminary analysis was conducted using bivariate correlations to test the relationships among study variables and depressive symptoms. All the assumptions for bivariate correlation were met. Lower levels of education were associated with lower levels of depressive symptoms $r(101)= -.23$, $p< .05$. Higher levels of depressive symptoms were related to elevated levels of psychological stress $r(101)= .66$, $p< .01$ and greater number of minutes of sleep per night $r(91)= .21$, $p< .05$ (See table 15).

Multiple regression analysis was used to test how study variables explained depressive symptoms. Predictor variables were entered simultaneously. The data were assessed to insure that the assumptions for linear regressions were met. (1) Adequate variance. As no one category had more than 90% of the data in a specific variable, there was adequate variance. (2) Linearity. Scatterplots of the residuals and independent variables were assessed. The relationship between depressive symptoms and psychological stress was found to be non-linear. Linear, quadratic, and cubic lines of best-fit were applied to the partial regression plots and the differences exceeded 2%. This predictor variable was transformed to correct for non-linearity; in the final model psychological stress was squared and the relationship became linear (see Table 16). (3) Absence of influential cases. An influential case is an outlier that changes the slope of the regression line. Extreme cases were identified using Cook's D (score ≥ 1.0) and standardized DfBetas (score ≥ 1.0). There were no extreme cases in these analyses. (4) Normality of error. Error should be normally distributed. This was assessed using skewness and kurtosis of the studentized deleted residuals. Variables with a skew index of an absolute value > 3.0 are described as extremely skewed. Variables with a kurtosis index of an absolute value > 10.0 suggest a problem, an absolute value > 20.0 suggests a bigger problem and would be considered severely non-normal (Kline, 2011). Error for all three models was assessed and found to be normally distributed. (5) Constant error variance. Using scatterplots, constant error variance is assessed by plotting studentized deleted residuals (Y axis) by standardized predicted scores (X axis). Concerns arise about non-constant error when the scatter around the best-fit line has a 3:1 or greater fanning affect from highest to lowest error variance. There was not a greater than 3:1 fanning in

constant error variance. After testing all of the assumptions, study variables explained approximately 45% of the variance in depressive symptoms. The only significant predictor of depressive symptoms was psychological stress ($t= 7.999$, $p< .001$).

Table 15: Relationship Among Study Variables and Depressive Symptoms

Variables	**Depressive Symptoms**
Age	-.140
Gender	.068
Marital Status	.057
Education	-.232*
Race/Ethnicity	-.032
Employment	-.048
Sexual Orientation	-.138
Income	-.119
Health Insurance	-.085
Housing	-.154
Psychological Stress	.661**
HIV/AIDS Classification	-.099
Sleep	.212*
Treatment Adherence	-.182
Missed Clinic Visits	.196
CD4+ T-lymphocyte Count	-.068
HIV Viral Load	.129

*Correlation is significant at the 0.05 (2-tailed).
**Correlation is significant at the 0.01 level (2-tailed).

Table 16: How Do Population Characteristics, Health Behaviors, and Outcomes Predict Depressive Symptoms

Variables *N= 97*	**B**	**Std. Error**	**Beta**	**t**	**Sig.**	**CI(95%)**
Depressive Symptoms (Constant)	17.691	8.033		2.202	.030	1.735-33.647
Marital Status	-2.154	3.448	.654	-.625	.534	-9.003-4.695
Housing	-2.218	3.900	-.046	-.569	.571	-9.964-5.528
Psychological Stress	.036	.005	-.051	7.999	.000	.027-.045
Treatment Adherence	-.064	.065	-.078	-.974	.333	-.194-.066
HIV/AIDS Diagnosis	1.538	2.454	.052	.627	.532	-3.337-6.413

R	**R^2**	**Adjusted R^2**	**F**	**Sig.**
.669	.447	.417	14.715	.000

Summary

The purpose of this secondary data analysis was to explore the relationships among population characteristics (demographic data, HIV/AIDS classification, psychological stress, and depressive symptoms), health behaviors (treatment adherence, sleep, and the use of health services), and health outcomes (immunologic function) in HIV-infected people living in Northeast Ohio. Frequencies were used to describe the study population. Correlations were used to describe the relationships among the population characteristics. Multiple regressions were used to explore how population characteristics explained health behaviors. Multiple regressions were also used to explore how population characteristics and health behaviors explained health outcomes. And finally a brief discussion of the transgender individuals was included.

CHAPTER V: DISCUSSION

The purpose of this study was to explore the relationships among specific population characteristics (demographic data, HIV/AIDS classification, psychological stress, and depressive symptoms), health behaviors (treatment adherence, sleep, and the use of health services), and health outcomes (immunologic function) in HIV-infected people living in Northeast Ohio. This chapter presents an interpretation of the findings, limitations of the study, implications for practice, implications for policy, and recommendations for future research.

Interpretation of Results

Population Characteristics

Psychological stress scores on the Perceived Stress Scale (S. Cohen, 1988) ranged from 0-34 (Mean= 17.33; SD= 6.909). This finding was similar to other studies that have administered the Perceived Stress Scale to PLWHA (Fumaz et al., 2012; Jaggers et al., 2013; McIntosh et al., 2013) and support existing literature that suggests PLWHA tend to experience higher levels of perceived stress when compared to the general population (S. Cohen, 1988). Depressive symptoms scores on the CESD (Radloff, 1977) ranged from 0-53 (Mean= 21.17; SD= 13.80). As scores of 16 or greater on the CESD are considered an indication of risk for clinical depression (Radloff, 1977), this study did find high levels of depressive symptoms. This is in concert with other studies that have found PLWHA to be at particular risk for depression (Vyavaharkar et al., 2010).

These study results found lower levels of education to be related to lower levels of stress and depression. While these two findings are imbedded in the study, they are paradoxical and need further exploration. Large-scale national surveys have found lower

levels of education to be related to increased levels of stress (S. Cohen & Janicki-Deverts, 2012) and to be a risk factor for depression (Bosma, Lamers, Jonkers, & van Eijk, 2011; Kraus & Karaman, 2013). This study found a high association between perceived psychological stress and depressive symptoms $r(95)= .66$, $p< .01$, the parent study to this research found psychological stress, HIV-related stigma, and social isolation to be interconnected (Webel, Longenecker et al., 2013). Perhaps study participants with higher levels of education tend to experience greater levels of HIV-related stigma and social isolation resulting is increased stress and depression. Further research, over multiple time points, is needed to test this hypothesis as well as to gain a better understanding of the relationship between stress, depression, and level of education in this study sample.

Health Behaviors

Average sleep scores ranged from 121.38-878.50 minutes per night (Mean= 352.41; SD= 112.27). This is similar to findings in another study measuring sleep among PLWHA (Chen et al., 2012; Foster et al., 2012; Taibi et al., 2012). Although there was an association between sleep and depression $r(91)= .21$, $p< .05$., as is true in other such studies (Jean-Louis et al., 2012), this relationship disappeared after controlling for other population characteristics. However, depression remained the strongest predictor of sleep time in this model ($t= 1.674$; $p= .098$), which suggests that a relationship does exist between sleep and depressive symptoms. In the current study sleep was not predicted by any of the population characteristics. Sleep was also not predictive of health outcomes (most recent CD4+ T-lymphocyte count and HIV viral load). This is in conflict with current evidence that suggests sleep is associated with negative health outcomes among PLWHA (McDaniel et al., 2011; Saberi et al., 2011; Taibi et al., 2012). However, these

studies measured sleep quality versus sleep quantity, as was an analyzed in this dissertation. Research has corroborated the relationship between subjective reports of perceived sleep quality and objectively measured sleep quantity (Chen et al., 2013; Lee et al., 2012). A recent study of HIV-infected women living in China found that study participants related sleeplessness to high levels of psychological stress. Objective measures of their sleep found longer nap times when compared to the general populations suggesting that night-time sleep may not have been restful (Chen et al., 2013). There is an associated increased incidence of morbidity and mortality for sleep durations less than 6 hours or greater than 8 hours per night in the general population (Gallicchio & Kalesan, 2009). Contrary to the findings in this dissertation, a study of 350 adults living with HIV/AIDS in the San Francisco found study participants who slept less than 6 hours a night has significantly lower CD4+ T-lymphocyte counts and higher HIV viral loads (Lee et al., 2012). Study participants from the San Francisco study were recruited both from clinics and the community. In the current study, participants were recruited primarily from clinics. It is likely that this, in conjunction with the small sample size, explain the lack of relationship between sleep and health outcomes in this dissertation.

Treatment adherence for this study sample ranged from 0%-100% (Median= 100, IQR= 95-100) in the three days prior to the interview. In this study treatment adherence was significantly related to level of education $r(95)= .24$, $p< .05$ and level of income $r(95)= .25$, $p< .05$. However, although education ($t= 1.395$, $p= .166$) and income ($t= 1.220$, $p= 226$) remained the strongest predictors in the model, after controlling for other population characteristics these relationships became non-significant. An additional analysis of treatment adherence was conducted using logistical regressions. As cART

adherence rates less than 95% contribute to immunologic resistance and treatment failure (Centers for Disease Control and Prevention, 2002; United States et al., 2008), treatment adherence was dichotomized as non-adherent (less than 95% adherent) vs. adherent (95% adherent or greater). There were not significant relationships between the independent variables and adherence vs. non-adherence (Nagelkerke $R^2 = .189$, $X^2 = 9.946$, $p = .26$). This is incongruous with studies that have found that PLWHA are up to three times less likely to be cART adherent if they have experienced depressive symptoms (Amberbir et al., 2008; Byakika-Tusiime et al., 2009; Kacanek et al., 2010; Peltzer et al., 2010; Rao et al., 2012). However, this study demonstrated both high levels of adherence and high levels of depression. Therefore, it is possible that there are confounding variables that were not accounted for in this dissertation that explain treatment adherence for this population. Previous studies have found issues of stigma (Okoror et al., 2013; Rao et al., 2012), discrimination (G. J. Wagner et al., 2012), and alcohol and illicit drug use (A. Gonzalez et al., 2013; Schneider et al., 2012) to be significant predictors of cART adherence. While these variables are available in the TRIP database, they were not included in this dissertation. A replication of this dissertation might include these variables to achieve a clearer understanding of the factors that adversely affect cART adherence among PLWHA. Another study might seek to determine if, and at which levels, treatment adherence impacts certain population characteristics such as sleep, depression and stress.

Number of missed appointments ranged from 0-11 (Mean= 1.36; SD= 1.819) in the past 12 months. Preliminary analysis found an association between increased number of missed clinic visits and increased levels of psychological stress $r(92) = .25$, $p < .05$.

Although psychological stress remained the strongest predictor in the model (t= 2.225, p= .110) the relationship became non-significant after controlling for other population characteristics. None of the population characteristics predicted number of missed appointments in this sample. This is incongruous with other studies, which have found that use of health services is conversely related to depressive symptoms and stress (Briongos-Figuero et al., 2011; C. A. Green et al., 2010; C. A. Green et al., 2010). Both mean perceived stress and mean depressive symptoms were high in this sample; however, mean number of missed clinic visits was fairly low at 1.36. The lack of relationship in this study may suggest that number of missed clinic visits is not the most accurate approach to assessing the use of health services (Ford & Spicer, 2012). Without knowing the number of clinic visits attended as well as the amount of time between clinic visits, it is difficult to explicate the implication of the missed clinic visits in this study (Ford & Spicer, 2012). Study participants were recruited from HIV clinics throughout Northeast, Ohio where their HIV/AIDS was well managed (76% of study participants had an undetectable HIV viral load; mean CD4+ T-lymphocyte count was 609.64). It is also possible that the lack of relationship between population characteristics and number of missed clinic visits in this sample is related to selection bias and these findings are not representative of the community at large.

Health Outcomes

Most recent CD4+ T-lymphocyte count ranged from 43-1766 cells/μL of blood (Mean= 609.64; SD= 375.152). While this represents a wide range of immune function, the average study participant had CD4+ T-lymphocyte counts (Mean= 609.64) representing normal functioning immune systems (United States & HIV/AIDS Bureau,

2011). This is interesting to note because the majority of the study participants had a diagnosis of AIDS (66.3%) which means their CD4+ T-lymphocyte counts were at one point < 200 cells/μL (United States & HIV/AIDS Bureau, 2011). This indicates that the majority of study participants were on appropriate suppressive cART and were adherent. This is supported by the study findings suggesting that the average treatment adherence rate was 100% (Median= 100, IQR= 95-100) for study participants; anything less than 95% is considered non-adherence (Centers for Disease Control and Prevention, 2002; United States et al., 2008). In this study, CD4+ T-lymphocyte counts were associated with gender $r(100)= .20$, $p< .05$ treatment adherence $r(95)= .27$, $p< .01$ and HIV/AIDS classification $r(102)= -.241$, $p< .05$. In the final model, although none of the population characteristics or the health behaviors were statistically significant predictors of CD4+ T-lymphocyte count, gender ($t= 1.234$, $p= .074$), HIV/AIDS classification ($t= 1.912$, $p= .060$), and treatment adherence ($t= 1.808$, $p= .075$) remained the strongest predictors. The model explained 22.7% of the variance in this variable ($R^2= .227$, $F= 2.795$, $p= .009$). However, this leaves 77.3% of the changes in CD4+ T-lymphocyte count that isn't accounted for in this research. Further research into other potential predictors of CD4+ T-lymphocyte count among PLWHA is also warranted. Another potential predictor not evaluated in this dissertation is nadir (lowest ever CD4+ T-lymphocyte count). A recent study found nadir to be a significant predictor of HIV-related mortality (Bray et al., 2012). Other potential confounding variables are comorbidities and treatments for other conditions such as hypertension and diabetes. Immune function can be impacted by the presence of other acute or chronic health conditions (Armah et al., 2012).

Most recent HIV viral load ranged from undetectable-304836 cells/μL of blood (76% of study participants had an undetectable HIV viral load). HIV viral load is expected to have an inverse relationship with treatment adherence (Carrico et al., 2011; Oguntibeju, 2012; Primeau et al., 2013). There was a significant relationship between HIV viral load and permanent housing ($r(99)= -.22$, $p< .05$) and treatment adherence ($r(93)= -.43$, $p< .01$). After controlling for other population characteristics and health behaviors, treatment adherence became the only significant predictor of HIV viral load. Both linear and logistic regression analysis was used to explore HIV viral load. For the logistical analysis HIV viral load was dichotomized into undetectable (HIV viral load less than 74) vs. detectable (HIV viral load of 75 or greater). These cut points were chosen because an HIV viral load less than 75 copies/mL is generally considered undetectable (United States & HIV/AIDS Bureau, 2011). Results of the logistical regression indicate that individuals with lower levels of treatment adherence are 97% as likely to have a detectable viral load or 3% as those with higher levels of treatment adherence (O.R.= .97; 95% CI .937-.996; $p< .001$). The model was significant (Nagelkerke $R^2 = .243$, $X^2= 9.527$, $p= .300$) and correctly predicted 79.4% of the cases.

This suggests that, although treatment adherence does play a significant role in HIV viral load, there are likely other variables that explain this variable that were not included in the analysis. Regression analysis supported the findings of the logistic regression and demonstrated that treatment adherence negatively predicted HIV viral load ($t= -4.440$, $p< .001$). Approximately 24.4% of the variance in HIV Viral load was explained by the model ($R^2= .244$, $F= 5.869$, $p< .001$). It is likely that there are other variables, not included in this study, which may predict the other 75.5% of the variance in

HIV viral load. For example, it is also possible that early versus late onset of cART may be a significant predictor of HIV viral load (M. S. Cohen et al., 2011). These findings also highlight the need to substantiate level of treatment adherence using objective measures. Research has found that individuals tend to over-estimate their level of treatment adherence when using self-report measures (Thirumurthy et al., 2012). It is possible that a greater percentage of variance in HIV viral load would be explained if treatment adherence had been objectively measured using electronic monitoring of pill bottle opening (Arnsten et al., 2001; Thirumurthy et al., 2012). There should be further research in this area as reduction in HIV viral load is pivotal in reducing transmissibility of HIV infection from an infected person to a non-infected person (Mahle-Gray et al., 2013).

Additional Analysis

The profiles of the two, transgender individuals in this study were starkly different from each other. This leads to the conclusion that transgender people vary in lifestyle and world experiences as the general male/female population. In a future study, it may be helpful to intentionally seek to include a greater number of transgender people so as to allow for meaningful statistical analysis. Additionally, although sexual orientation was not significantly related to any of the outcome variables in this study, it might be helpful to gather more baseline information on transgender individuals. For example, one of the transgender study participant identified as homosexual while the other identified as heterosexual, both were married. This resulted in a number of questions, which were not possible to answer with the available information. Homosexual marriage is not yet legal in the state of Ohio and because it was not ascertained whether

they were Male-to-Female or Female-to-Male transgender individuals it is not possible to understand how they identify their sexual orientation. Is it as determined by their biological sex or by their self-identified sex? This may prove to be valuable information as it is already known that there is a subsample of the population who practice homosexual/bisexual behaviors but do not identify as homosexual or bisexual.

Analysis of Depressive Symptoms

Depression is among the most commonly observed psychiatric disorders among PLWHA (Olisah et al., 2010; Sherr et al., 2011). Therefore, an additional analysis of depressive symptoms was also conducted. The purpose of this additional analysis was to explore which study variables were predictive of depressive symptoms among study participants. Preliminary analysis found that lower levels of education were associated with lower levels of depressive symptoms $r(101)= -.23$, $p< .05$. Higher levels of depressive symptoms were related to elevated levels of psychological stress $r(101)= .66$, $p< .01$ and greater number of minutes of sleep per night $r(91)= .21$, $p< .05$. In the final model, the independent variables explained approximately 45% of the variance in depressive symptoms. The only significant predictor of depressive symptoms was psychological stress ($t= 7.999$, $p< .001$). The association between stress and depression has previously been established in the literature (C. A. Green et al., 2010; C. A. Green et al., 2010).

Study Limitations

There are a number of limitations that may have impacted the study outcomes. The most significant limitation is the population that was examined; it does not accurately represent the population as a whole, and therefore conclusions may not be

generalizable. Another limitation is methodological: a descriptive correlational study design is the potential for unmeasured confounding variables that are potentially responsible for the outcome (Kane, 2008). As a secondary data analysis this study is also limited by the tools used and the data available in the TRIP study database as these data were collected for the purposes of the TRIP study, not this current secondary data analysis (Bryman, 2012; E. Smith, 2008). The lack of control in generating the data set (E. Smith, 2008; Szabo & Strang, 1997) limits this secondary data analysis regarding the questions that can be asked and the variables that can be analyzed. As a convenience sampling of HIV patient in Northeast Ohio has been used to recruit study participants, selection bias is also a threat to this study. Study participants were recruited from HIV clinics where they were receiving treatment; however, national data suggests that only 66% of those diagnosed with HIV are appropriately linked to care and only 37% are retained in care (Gardner, McLees, Steiner, del Rio, & Burman, 2011). That makes this sample different from the general HIV-infected population in the United States. This makes it difficult to generalize these findings to the average HIV-infected person living in the United States.

There are a number of approaches to monitoring treatment adherence including self-reports, pill counts, and electronic drug monitors (Thompson et al., 2012. Of the available options, electronic drug monitoring is most closely related to health outcomes (Thompson et al., 2012). In this study, treatment adherence was self-reported using a single item visual analog scale. These reports were not substantiated with the use of objective measures such as electronic drug monitoring. The use of such tools may have eliminated some bias in measuring treatment adherence in this sample (Herzer, Ramey,

Rohan, & Cortina, 2012), as research has found that individuals tend to over-estimate their level of treatment adherence when using self-report measures (Thirumurthy et al., 2012). It is possible that a greater percentage of variance in HIV viral load would be explained if treatment adherence had been objectively measured using electronic monitoring of pill bottle opening (Arnsten et al., 2001; Thirumurthy et al., 2012). A study of 67 HIV-infected people found that 79% of subjects with objectively measured treatment adherence greater than or equal to 90% achieved an HIV viral load less than or equal to 500. Whereas, 62% of study participants with self-reported adherence greater than or equal 90% achieved an HIV viral load less than or equal to 500 (Arnsten et al., 2001). The mean difference between self-reported adherence versus electronically monitored adherence was 31% (Arnsten et al., 2001). Electronic monitoring of treatment adherence would also allow for analysis of not only dose adherence (rate of medication taken versus medication prescribed) but also for time adherence (Arnsten et al., 2001). Both are pivotal in the proper treatment and management of HIV/AIDS. It is important not only that PLWHA take their medications daily but that they also be taken within the prescribed timeframe each day.

For the purposes of this study, the use of health services was conceptualized as number of missed clinic visits in the previous 12 months. Although this information does give an idea of how study participants were using health services, it is difficult to draw any meaningful information from the data supplied. Research suggests that PLWHA should have at least one medical visit each 6 months of every 24-month period of time. These two visits should be at least 90 days apart as this results in improved health outcomes (Ford & Spicer, 2012). Without knowing how many times study participants

were seen and the timeframe between visits, it is not possible to draw any meaningful data about engagement in care. In the future, data should be collected on number of HIV clinic visits as well as amount of time between visits.

Evaluated health was conceptualized as HIV/AIDS classification. This was a dichotomous self-report of whether or not the participant had ever been diagnosed with AIDS. People whose CD4+ T-lymphocyte counts have fallen below 200 cells/μL and were subsequently diagnosed with AIDS retain that diagnosis irrespective of subsequent immunologic recovery and regardless of subsequent rise in CD4+ T-lymphocyte counts due to cART (Centers for Disease Control and Prevention, 1992; Gale et al., 2013). Given the potential of cART to slow or even reverse the progression of AIDS once diagnosed, this may not be an accurate reflection of the level of need for the use of health services. CD4 nadir may be a more appropriate measure to use in future studies.

Although people who were married or in a domestic partnership were adequately represented in this study, the vast majority were single, separated, or divorced (86.4%). Similarly, the majority of the study sample was African American/Black (82.5%) and had permanent housing (89.3%). Therefore, it may not be possible to generalize these findings to other races/ethnicities, those without permanent housing, or to those who are married/in a domestic partnership.

Implications for Practice

Study participants had high treatment adherence (Median= 100, IQR= 95-100), adequately suppressed viral load (76% of study participants had an undetectable HIV viral load) and high CD4 + T-lymphocyte count (Mean= 609.64; SD= 375.15). National data suggests that only 33% of individuals diagnosed with HIV in the United States are

provided with cART and only 25% have an adequately suppressed viral load (Gardner, McLees, Steiner, del Rio, & Burman, 2011). Study participants are doing much better than the general HIV-infected population in the United States. Study participants were recruited from various clinics in Northeast Ohio including Ryan White Care clinics. The Ryan White HIV/AIDS Program is a government supported venture designed to fill the gaps of coverage for PLWHA without sufficient coverage or financial resources to manage their HIV (Henry J. Kaiser Family Foundation, 2013b). The majority of participants had Medicare, Medicaid, and/or Ryan White Care Act insurance. The demographics of these study participants demonstrate the efficacy of HIV treatment clinics and government supported health care for PLWHA. More effort needs to be made to link HIV-infected individuals to such care (Ford & Spicer, 2012).

Implications for Health Policy

There were a number of findings in this study that were contrary to current evidence. However, it is difficult to explicate these findings without trending data. Future studies of PLWHA would benefit from having multiple time-points. In this way, meaningful conclusions can be drawn about research findings. This will allow for better understanding of this vulnerable population, allowing for improvements in clinic care and health policy.

Study participants are doing much better than the general HIV-infected population in the United States in terms of health behaviors and health outcomes (Gardner, McLees, Steiner, del Rio, & Burman, 2011). Study participants were recruited from various clinics in Northeast Ohio including Ryan White Care clinics. The majority of participants had Medicare, Medicaid, and/or Ryan White Care Act insurance. The demographics of these

study participants demonstrate the efficacy of HIV treatment clinics and government supported health care for PLWHA. More effort needs to be made to link HIV-infected individuals to such care (Ford & Spicer, 2012).

The National HIV/AIDS Strategy calls for the elimination of health disparities among PLWHA (United States & Office of National AIDS Policy, 2010) The impact of HIV/AIDS is disproportionately evident among Blacks and Latinos in America (Centers for Disease Control and Prevention, 2013; National Center for HIV/AIDS, Viral Hepatitis, STD, and TB Prevention (U.S.) & Division of HIV/AIDS Prevention, 2013a). MSM have historically been the group most impacted by the HIV/AIDS epidemic in the United States; this trend continues today (United States & Office of National AIDS Policy, 2010). The majority of the study participants in this study were African American/Black. About half were homosexual. Although knowing one's HIV status can reduce risky sexual behaviors, there is evidence to suggest that Black and Latino MSM are less likely to be aware of their HIV status (Feldman, 2010). When an individual has not been tested for HIV in more than 12 months, they are classified as unaware of HIV status (Ford & Spicer, 2012). Further research is needed to identify ways to improve HIV testing in this vulnerable population. Safe sex practices should be encouraged at all times, not just among those who are HIV-infected. Programs adapted to be community specific and designed to integrate the use of condoms into peer norms have been successful (Feldman, 2010). A community wide cultural shift is needed to improve the use of condoms among all individuals, particularly minority MSM (Belani, Centers for Disease Control and Prevention (U.S.), National Center for HIV/AIDS, Viral Hepatitis, STD, and TB Prevention (U.S.), United States, & Department of Health and Human Services, 2012;

Charania et al., 2011). An additional consideration is community viral load. Community viral load is calculated as the mean of the most recent HIV viral loads of all reported HIV-positive individuals in a given community (Das et al., 2010). A study conducted in San Francisco, California found that a in reductions in community viral load resulted in a reduction in HIV transmission at the population level. Consistent with the treatment as prevention intervention strategy, this reduction in community viral load was achieved, in part, by to a 16% increase in cART distribution among PLWHA (Das et al., 2010). Policies should involve both education of patient and clinician on the importance of routine screening for HIV infection, prompt initiation of and appropriate adherence to cART, as well as engagement in HIV medical care (Ford & Spicer, 2012; Gardner et al., 2011; Marks et al., 2010).

Recommendations for Future Research

Overall, these study findings imply that variables previously found to be related to health behaviors and health outcomes are not significant predictors of sleep, treatment adherence, missed clinic visits, or CD4+ T-lymphocyte count in this sample of HIV-infected adults living in Northeastern, Ohio. The only predictor of HIV viral load for this sample is treatment adherence. These results require confirmation with a larger study sample with greater variability in race/ethnicity, housing status, and marital status. It may also be beneficial to evaluate these relationships over multiple time points so as to evaluate changes over time. This study may have lacked the power to appropriately control for all of the variables of interest. It may also be beneficial to control for additional variables that were not evaluated within this study, such as alcohol and illicit drug abuse, comorbidities, discrimination, stigma, and early versus late onset of cART.

An additional recommendation is the use of electronic monitoring of medication bottle opening as the measure for treatment adherence as well as to use CD4 nadir in lieu of HIV/AIDS classification as a measure for evaluated health need.

Conclusion

Adequate cART adherence is, presently, the most effective modality available in the treatment and prevention of HIV/AIDS. PLWHA with an adequately suppressed viral load and a CD4+ T-lymphocyte count that is near normal when adhering to cART are significantly less likely to transmit their infection to non-HIV-infected people. While this study did not find population characteristics and health behaviors to be a statistically significant predictor, the model did explain 22.7% of the variance in CD4+ T-lymphocyte count. However, gender ($t= 1.234$, $p= .074$), HIV/AIDS classification ($t= 1.912$, $p= .060$), and treatment adherence ($t= 1.808$, $p= .075$) near significant predictors of CD4+ T-lymphocyte count in the model. It is possible that with a larger sample size the model might have more power to identify the significant predictors of this variable. On the other hand, medication adherence did explain 24% of the variance in HIV viral load and there were no other variables in the model that were close to being significant. In both of these cases, the models only explained a small percentage of the variance in outcome variables. Although it is true that this study may have lacked adequate power to capture the significant role population characteristics and health behaviors had on the immune function of PLWHA, it is also possible that other variables, not yet identified, explain these outcomes. Further research should be conducted in order to identify these variables so as to facilitate improved treatment, management, and prevention of this global pandemic.

Appendix A

TRIP STUDY VARIABLES

This section will be a discussion of the variables and tools used in the TRIP Study.

Outcome variables.

Stress level. The primary outcome of the TRIP study is stress level. It is measured using the Perceived Stress Scale (S. Cohen et al., 1983). It is a self-report measure designed to assess the degree to which an individual appraises life events as stressful. It was originally designed as a 14-item scale but was later reduced to 10-items (S. Cohen et al., 1983; Reis et al., 2010). The TRIP study utilizes the 10-item scale to evaluate perceived stress over the past 4 weeks. It contains six positively coded items and four reverse coded items on a 5-point scale ranging from 0= never to 4=very often. This measure is scored between 0-40 with higher scores indicating greater perceived stress. The Perceived Stress Scale has demonstrated adequate validity and reliability, with a Cronbach's alpha reported at 0.87, in a similar population (Barbosa-Leiker et al., 2012).

Heart rate variability. Physiological stress is measured by heart rate variability as determined by cardiac Holter monitor data. Participants were asked to wear the monitor for one hour during the initial visit. Participants were provided a quiet room to relax in and reading materials to enjoy during the hour they were being monitored. The heart rate data were then uploaded to a computer program that summarizes the data into a number of categories: (1) total beats analyzed, (2) mean of the normal-to-normal (N-N) interval, (3) standard deviation of N-N interval, and (4) the square root of the mean squared difference of successive N-N intervals. These are the standard measures of heart rate variability (Camm et al., 1996; Connes, 2010).

Isolation. The concept of isolation is measured, in the TRIP study, using the Hawthorne Friendship Scale (Hawthorne, 2006). This is a 6-item scale designed to measure the six dimensions of social isolation in the aging population. Scores range from 0 to 24 with higher scores indicating lower levels of social isolation. Cronbach's alpha for this tool has been reported at 0.76 (Hawthorne, 2006).

Physical activity. The TRIP study utilized wrist accelerometer actigraph data along with the corresponding exercise diary used to measure physical activity. These data were collected for seven days. The exercise diaries detail type, frequency, and duration of physical activity in which participants engaged. This tool has previously been used successfully as a measure for physical activity in other studies (Rothney, Schaefer, Neumann, Choi, & Chen, 2008; Troiano et al., 2008). For the purposes of the TRIP study, exercise is defined as a minimum of 10 minutes spent exercising at a minimum of 2,020 activity counts/minute. This is analogous to three metabolic equivalents (Troiano et al., 2008). Physical activity is, thereby, measured as exercise amount and frequency. Exercise frequency is measured as exercise sessions/week. Exercise amount is measured as the average number of hours exercised/week.

Sleep quality and quantity. In the TRIP study, sleep was measured as sleep duration, sleep fragmentation, and sleep efficiency. The primary measure of sleep quantity was mean sleep duration. Mean sleep duration is the average amount of sleep obtained during the main sleep period over a 1-week period of time (Bagai et al., 2013). The primary measures of sleep quality were the sleep fragmentation index and sleep efficiency. The sleep fragmentation index measures periods of wakefulness during the sleep cycle (Baud et al., 2013). Sleep efficiency is measured as the proportion of time

actually spent asleep between sleep onset and final awakening (Petersen et al., 2013). All three were based on findings assessed using wrist actigraphy and the corresponding sleep diary. The use of actigraphy and these approaches are widely accepted measures of sleep duration and quality (Astill et al., 2013; Bagai et al., 2013; Jarrin et al., 2013; Short et al., 2013; Tsai et al., 2013). In addition to mean sleep duration, both sleep efficiency and the sleep fragmentation index were also calculated for the main sleep period of each 24-hour interval, and then averaged together for a week. This instrument yields data on the three distinct variables: sleep duration, sleep fragmentation, and sleep efficiency.

Predictor variables. Predictor variables for the TRIP study include all of the following. (1) Age, as assessed by self-report on the demographic form. This is a continuous variable that ranges between 18-80 years. (2) Sex, as assessed by self-report on the demographic form. This is a dichotomous variable, male and female.

***Potential covariates*.** Validated scales are used to measure potential covariates of the outcome variables in the TRIP study. These include (1) self-reported sociodemographics including comorbid chronic health conditions, (2) social support as measured by the Lubben Social Network Scale (Lubben, 1988), (3) self-reported HIV medication adherence and history, (4) depressive symptoms as measured by the Center for Epidemiologic Studies-Depression scale (Radloff, 1977), (5) and HIV stigma as measured by the HIV Stigma Scale (Berger, Ferrans, & Lashley, 2001).

Appendix B

TRIP STUDY INSTRUMENTS

TRIP

Please mark your responses directly on this booklet.
If you need help, please see one of the research assistants.
Thank You!

FOR OFFICE USE ONLY

ID: _____
Data Collection done by: _____
Survey was:
_____ **Completed by Participant**
_____ **Read to Participant**
_____ **Both**

Date Survey Completed: _____
_____

School of Nursing
Case Western Reserve University
Allison.Webel@case.edu
June, 2012 version

Demographics Form
TRIP Study

1. Age ☐☐☐ in years

2. Race/Ethnicity (Please check one)
   - African American/Black
   - Asian/Pacific Islander
   - Hispanic/Latino
   - Native American Indian
   - White/Anglo (non-Hispanic)
   - Other, please describe: _____

3. Marital Status:
   - Married
   - Single
   - Separated
   - Divorced
   - Domestic Partnership
   - Other, Please Specify: _____

4. Highest level of education completed (Select ONE):
   - 11^{th} grade or less
   - High School or GED
   - Some college or technical school training
   - College degree (e.g., AA, BA, BS)
   - Master's degree
   - Doctoral degree (e.g., MD, PhD, JD)

5. Monthly income:
   - No monthly income
   - Less than $200
   - $200-$399
   - $400-$599
   - $600-$799
   - $800-$999
   - $1,000 or more

6. Have health insurance:
   - Yes
   - No (If no, please go to question 8)

7. Type of health insurance:
   - Medicaid
   - Medicare
   - ADAP
   - Veteran's Benefits
   - Private, provided by work
   - Private, not provided by work
   - Ryan White Care act

8. Have children:
   Yes. If yes, number that live ☐☐ with you:
   No
9. Paid employment:
   Yes
   No
10. Have permanent housing:
   Yes
   No
11. How do you see yourself…?
   Gay (homosexual)
   Bi (bisexual)
   Straight (heterosexual)
   Other:
12. What are your attractions…?
   attracted to men only
   mostly attracted to men
   equally attracted to men and women
   mostly attracted to women
   attracted to women only
   other:____
13. Sex *in the last 12 months*...
   No sex at all
   Sex with men only
   Sex with women only
   Sex with both men and women

14. For your current HIV medications, in the past 3 days, how often have you taken the medication as prescribed by your doctor?

___
0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

Chart Abstraction
TRIP Study

---

11. Year participant was first diagnosed with ☐☐☐☐ HIV:

12. AIDS Diagnosis:
   ☐ No ☐ Yes If yes, ☐☐☐☐ what year:

13. Most recent CD4 or T cell count: _____ Count

14. Most recent viral load: _____ Viral Load

15. Most recent CD4%: _____ CD4%

16. Comorbid health conditions:
☐ No ☐ Yes If yes, list conditions:

_____

_____

_____

17. Prescribed HAART:
☐ No ☐ Yes If yes, year ☐☐☐☐ initiated:

18. Seen in Emergency Department in past 12 months:
☐ No ☐ Yes

19. Admitted to hospital in past 12 months:
☐ No ☐ Yes If yes, list admissions:

First visit reason: _____ Duration: _____ days

Second visit reason: _____ Duration: _____ days

Third visit reason: _____ Duration: _____ days

Fourth visit reason: _____ Duration: _____ days

Fifth visit reason: _____ Duration: _____ days

9. Number of MD appointments scheduled past 12 ☐☐ months:

10. Number of primary care visits missed past 12 ☐☐ months:

11. Medical procedures completed in past 12 months:

_____

_____

_____

Current Medication List

Copies of other TRIP study instruments were not included in this appendix due to issues of copyright.

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