

The Health Status of Transgender and Gender Nonconforming Adults

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Date: March 20, 2018

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Dissertation submitted in partial fulfillment of
the requirements for the degree of Doctor
of Philosophy in the Department of
Nursing in the Graduate School
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ABSTRACT

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Abstract

Contemporary, empirically-based knowledge of transgender health is scant and lacks understanding of physical health, health problems or impairments, chronic health conditions, and the impact of individual factors known to affect health outcomes in other vulnerable populations such as socioeconomic position and sexual orientation (Bowleg, 2012; MacCarthy, Reisner, Nunn, Perez-Brumer, & Operario, 2015). Despite a growing body of health-related literature, additional research is needed to advance our understanding of health among transgender subgroups such as male-to-female (MTF, transgender women), female-to-male (FTM, transgender men), and gender nonconforming (GNC) adults. This knowledge will help prioritize health needs and identify pathways to improve the health and reduce the health inequities plaguing the transgender population in the U.S. (Feldman et al., 2016; Institute of Medicine, 2011).

The purpose of this dissertation research was to establish evidence regarding the health of transgender and GNC adults in the United States. Specifically, this dissertation 1) reviewed current literature on the experiences of transgender adults when they access and utilize healthcare, 2) identified and addressed methodological concerns related to conducting transgender health research using data from the 2015 Behavioral Risk Factor Surveillance System (BRFSS), and 3) explored the health status of three transgender subgroups (MTF, FTM, and GNC adults) and their cisgender male (CGM) and cisgender female (CGF) counterparts. Health status analyses included 1) bivariate logistic regression models and one-way analysis of variance methods to test for study group

differences in individual factors and health status, and 2) multivariable logistic regression models to determine the differential effects of individual factors on health status in the five study groups. *A posteriori* pairwise contrasts of the study groups were conducted when a significant overall study group effect was detected.

The main findings from this dissertation include the following. First, transgender adults experience numerous obstacles accessing healthcare, discrimination from healthcare professionals and clinicians, and barriers to medically necessary care, such as cross-sex hormones, as well as primary and preventative healthcare. Second, the 2015 BRFSS data collection procedures introduced measurement error and sex misclassification that contributed towards problematic BRFSS sampling weights. Third, transgender adults have poorer health than their cisgender counterparts. However, when data are disaggregated into transgender subgroups, notable differences in the health of MTF, FTM, and GNC adults are revealed. Notably, GNC adults have poorer overall health than their transgender and cisgender counterparts.

Overall, the studies from this dissertation provide empirical evidence to inform health promotion and illness prevention in transgender and GNC adults. These findings make significant contributions to the transgender health knowledge base, and advance the field by identifying priority research topics, policy areas, and methodological considerations for public health surveillance and population surveys aimed at improving the health of transgender and gender nonconforming people. Findings also provide the foundation to improve healthcare delivery and educational programs for current and

future health professionals. To further advance transgender health knowledge, a more comprehensive understanding of how gender identity and gender expression influence health status and healthcare utilization for transgender and GNC adults is needed.

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1. Introduction

The transgender population, an understudied population in U.S. health research, (Coulter, Kenst, Bowen, & Scout, 2014; Institute of Medicine, 2011), is comprised of heterogeneous communities of individuals illustrating diversity of gender identities and expressions (James et al., 2016). Furthermore, the population is one of the most marginalized groups in the U.S. (Institute of Medicine, 2011; James et al., 2016; White Hughto, Reisner, & Pachankis, 2015). Multiple social disadvantages and exposures to stigma and discrimination consequently contribute to the adverse health outcomes and inequities experienced by transgender individuals (Link & Phelan, 1995; US Department of Health Human Services, 2010). Recognizing the need to address these inequities, *Healthy People 2020* designated transgender health as a national priority (US Department of Health Human Services, 2010). This precedence was echoed by the Institute of Medicine with their landmark report that noted a substantial need for transgender-specific research addressing the inequalities the population experience (Institute of Medicine, 2011). The field of transgender health research represents an untapped and important area of focus for the nursing discipline, as the current body of health-related literature does not reflect the nursing's holistic perspective on health and healthcare (Bockting, Miner, Swinburne Romine, Hamilton, & Coleman, 2013; Brown & Jones, 2016; Deutsch, Bhakri, & Kubicek, 2015; Jaffee, Shires, & Stroumsa, 2016; Reisner, Gamarel, Dunham, Hopwood, & Hwahng, 2013). Donaldson and Crowley (1978) describe the focus of the nursing paradigm as the "health or wholeness of human beings as they interact with their environment" (p. 113), with both wellness and illness comprising health. Given this

perspective, nurse scientists can contribute high-quality research in transgender health that can identify and prioritize health-related needs and provide the foundation to develop clinical interventions aimed at promoting health and preventing illness for transgender and gender nonconforming people.

1.1 Defining transgender

In order to further understand the context of transgender health, it is important to distinguish terminology often used with the population. There is no one universal definition for the term transgender (Reisner, Deutsch, et al., 2016; Reisner, Poteat, et al., 2016). Definitions and terms associated with the transgender population have greatly evolved from being recognized by the Diagnostic Statistical Manual as a mental disorder and requiring a “sex change surgery” for individuals classified as transsexuals, to acknowledging the fluidity of gender identity and expression existing outside the boundaries of binary distinctions of sex and gender (Bockting, 2009; Bockting et al., 2016). The array of definitions is reflected in contemporary research studies (Reisner, Poteat, et al., 2016). For example, in a recent review and synthesis of 116 studies regarding the global health burden and needs of transgender populations, researchers found 95 unique definitions for the term transgender (Reisner, Poteat, et al., 2016). Similarly, identity descriptions within the transgender population fluctuate, as community members are frequently developing new language that adequately represents their own self-conceptualizations (Center of Excellence for Transgender Health, June 2016).

1.1.1 Dissertation definition for the term transgender

For this dissertation, I define transgender as an adjective and umbrella term describing individuals whose sex assigned at birth differs from their current gender expression or gender identity, or one's sense of being male, female, neither or both (Institute of Medicine, 2011). This definition suggests a comprehensive approach to inclusion, but there are communities and individuals meeting its criteria who do not self-identify with the term (e.g., nonbinary, genderqueer, man or woman, gender variant, etc.) (The National LGBT Health Education Center, 2016, n.d.). In contrast, cisgender individuals have a gender identity that aligns with their sex assigned at birth (American Psychological Association, 2015). Sex assignment, sex, or natal sex is determined at birth based on the appearance of external genitalia and sometimes by genetic testing, and one's sex is categorized as male, female, or intersex (American Psychological Association, 2012; Segal, 2017).

The term transgender will be used to represent the heterogeneity of subgroups that are diverse in gender identity and expression and include an array of self-conceptualizations and nomenclature found within the transgender population. This dissertation will focus on three distinct transgender subgroups – transgender women, transgender men, and gender nonconforming individuals. Transgender individuals assigned male at birth and currently identify as female or women are male-to-female (MTF) or trans women. Transgender men, or female-to-male (FTM) persons, are men who were assigned female at birth and currently identify as male or men (American Psychological Association, 2015). Individuals who self-identify as gender nonconforming (GNC) are members of the transgender population who have a gender identity that is at

odds with social and cultural expectations (Grant et al., 2011). Some, but not all, transgender people choose to medically transition, also referred to as gender-affirming medical interventions (Reisner, Radix, & Deutsch, 2016), with cross-sex hormones, gender-affirming surgeries and other body modifications as a way to embody and express their gender (Coleman et al., 2012).

1.1.2 Gender identity and sexual orientation

The term transgender is also part of the lesbian, gay, bisexual, transgender and queer (LGBTQ) acronym, an acronym used to represent sexual and gender minorities, as well as describe sexual orientation and gender identity, two very different concepts (Institute of Medicine, 2011). The term transgender is associated with an individual's gender identity; whereas, lesbian, gay, bisexual, and sometimes queer are used to classify sexual orientation, which describes intimate human relationships, including sexual, romantic, and emotional (American Psychological Association, 2015). Furthermore, gender identity and gender are not synonymous; gender is a socially constructed concept that is associated with social and cultural norms and expectations of gender and gender expression related to one's natal sex (American Psychological Association, 2012). Gender and gender expression, are associated with one's physical presentation, communication patterns, and behavior used to express aspects of gender identity or role (American Psychological Association, 2012).

1.2 Social significance

Contextualizing social factors is necessary to improve health outcomes because

the adverse social conditions experienced by transgender adults create disproportionate social inequities that detrimentally impact their health (Hatzenbuehler, Phelan, & Link, 2013; Link & Phelan, 1995; McLeroy, Bibeau, Steckler, & Glanz, 1988). Transgender and GNC adults endure prejudice, stigma, and discrimination, which shape the environments where they live, learn, work, and seek healthcare (Conron, Scott, Stowell, & Landers, 2012; James et al., 2016; Kenagy & Bostwick, 2005; Lombardi, Wilchins, Priesing, & Malouf, 2001; Sevelius, 2013; Sevelius, Patouhas, Keatley, & Johnson, 2014; Testa et al., 2012). The U.S. Transgender Survey (USTS), a landmark study of 27,715 transgender adults, revealed that 48% of transgender adults reported they were denied equal treatment or service, verbally harassed, and/or physically attacked because of being transgender in the past year (James et al., 2016). Furthermore, transgender people face bullying and harassment at work and school (Grant et al., 2011; James et al., 2016), which may disrupt or delay education, and career obtainment and development. In fact, transgender people endure severe economic hardship and instability (Grant et al., 2011; James et al., 2016). They experience higher rates of incarceration (Grant et al., 2011) and sexual and physical assaults (Grant et al., 2011; James et al., 2016; Lombardi et al., 2001) than the general public. Consequently, transgender adults who have encountered sexual and physical assaults are more likely to have attempted suicide than those who had not had such experiences (Testa et al., 2012). When compared to the U.S. population, transgender adults are twice as likely to be living in poverty, three times as likely to be unemployed, and three times as likely to be homeless (James et al., 2016). The social conditions experienced by transgender adults are linked to more transgender individuals

without healthcare insurance (Conron et al., 2012).

Social stigmatization associated with gender nonconformity create unsafe public spaces for transgender adults. Visibly gender nonconforming transgender adults, especially transgender women of color, are at a heightened risk of physical and sexual violence, and humiliation in public spaces, such as public transportation (Sevelius et al., 2014; Wilson, Arayasirikul, & Johnson, 2013; Xavier et al., 2012). Not only do these conditions pose life-safety concerns, they also impact health-related behaviors and decision making. For example, transgender women prioritize their safety over risking their lives traveling to daytime HIV care appointments (Wilson et al., 2013). For some transgender women living with HIV, costs associated with gender-affirming hormone therapy takes precedence over their HIV care (Sevelius et al., 2014; Wilson et al., 2013) because, over time, it affords them social acceptance while reducing the threat of harassment and violence in public spaces (Sevelius et al., 2014; Wilson et al., 2013; Xavier et al., 2012).

1.3 Healthcare discrimination

Transgender adults experience inequities, discrimination, and systematic maltreatment within healthcare environments (Grant et al., 2011; Jaffer et al., 2016; James et al., 2016). Instances of discrimination include harassment, violence, and denial of healthcare (Cicero & Black, 2016; Grant et al., 2011; Xavier, Honnold, & Bradford, 2007). Transgender adults encounter unknowledgeable healthcare professionals and frequently experience prejudice and discrimination from clinical providers and other

healthcare professionals (Bradford, Reisner, Honnold, & Xavier, 2013; James et al., 2016; Poteat, German, & Kerrigan, 2013). Transgender adults are asked invasive and unnecessary questions about being transgender, questions unrelated to their health concern, and are often faced with teaching their providers about transgender identities in order to receive needed care (James et al., 2016; Poteat et al., 2013). When transgender people are read or perceived as transgender, experiences of mistreatment and discrimination were greater than those who were not seen as transgender (James et al., 2016; Miller & Grollman, 2015; Shires & Jaffee, 2015). Transgender people anticipate and expect discriminatory experiences in healthcare settings, leading some trans adults to avoid seeking care. For example, 23% of USTS (2016) respondents reported that they avoided seeking needed care in the past year due to fear of mistreatment related to being transgender. While little is known about the experiences of GNC adults in healthcare environments, two studies performed secondary analyses of the National Transgender Discrimination Survey (NTDS) and discovered higher rates of care postponement and discrimination (Cruz, 2014; Miller & Grollman, 2015) than other transgender adults. Such stressful experiences are known to be associated with overall poorer health in other vulnerable populations (Humphreys et al., 2012; Jackson, Knight, & Rafferty, 2010).

1.4 Current knowledge of transgender health

The field of transgender health research is rapidly growing in the U.S.; however, many aspects of health remain understudied (Institute of Medicine, 2011). Likewise, the breadth of disciplines conducting transgender health research continues to broaden (World Professional Association for Transgender Health, 2016). Currently, medicine,

public health and epidemiology, as well as mental health-related fields are the predominant disciplines contributing to the literature (Bockting et al., 2013; Brown & Jones, 2016; Deutsch et al., 2015; Jaffee et al., 2016; Reisner, Bailey, & Sevelius, 2014; Reisner et al., 2013; White Hughto, Murchison, Clark, Pachankis, & Reisner, 2016). As such, we have a narrow understanding of the health status among transgender people, with much of the literature focused on mental health (Benotsch et al., 2013; Colton Meier, Fitzgerald, Pardo, & Babcock, 2011; Testa, Jimenez, & Rankin, 2014), cross-sex hormone therapy (Deutsch et al., 2015; White Hughto & Reisner, 2016b; Wilson, Chen, Arayasirikul, Wenzel, & Raymond, 2014), HIV/AIDS in transgender women (Brennan et al., 2012; Nemoto, Operario, Keatley, Han, & Soma, 2004; Santos et al., 2014; Wilson et al., 2013), and the absence of engagement in health-harming behaviors (Blosnich et al., 2013; Herman, Haas, & Rodgers, 2014; Horvath, Iantaffi, Swinburne-Romine, & Bockting, 2014; Klein & Golub, 2016). Furthermore, current empirical knowledge on the health status of transgender people is often based on non-experimental, cross-sectional (Bradford et al., 2013; Conron et al., 2012; Reisner et al., 2013), retrospective (Blosnich et al., 2013; Blosnich, Brown, Wojcio, Jones, & Bossarte, 2014; Brown & Jones, 2014) studies using a convenience (Bockting et al., 2013; Radix, Lelutiu-Weinberger, & Gamarel, 2014) or purposive (Cicero & Black, 2016; Jaffer et al., 2016; Poteat et al., 2013) sampling approaches.

1.4.1 Conceptualizations of the term transgender impacts knowledge base

One of the biggest methodological challenges impacting all comparisons of research findings is how the term transgender is conceptualized (Gender Identity in U.S.

Surveillance Group, 2014; Reisner, Deutsch, et al., 2016). Definitions for the term transgender are becoming more expansive and often dissent among researchers and community members (Bockting, 2009; Reisner, Deutsch, et al., 2016). This dissonance has limited the scope of the transgender health knowledge (Feldman et al., 2016; Reisner, Deutsch, et al., 2016). For example, some believe that one must have had a gender-affirming medical intervention such as cross-sex hormones, surgeries, and other body modifications (Dhejne et al., 2011; Wierckx et al., 2012). This myopic view of transgender identities has produced knowledge primary on MTF people, neglecting other subgroups such as FTM individuals (Feldman et al., 2016). While these gender-affirming medical interventions are critically important for some individuals as it reduces dysphoria related to the incongruence between body and gender identity, they are not desired by all members of the transgender population. Furthermore, for those wanting the interventions, significant financial and accessibility barriers exist (Center of Excellence for Transgender Health, June 2016; Coleman et al., 2012).

1.4.2 Mortality

Transgender people have an increase in overall mortality compared with the general population (Asscheman et al., 2011; Blosnich et al., 2014; Dhejne et al., 2011). According to the sole U.S. study examining 5,117 transgender veterans conducted by the Veterans Health Administration (VHA), this increase in mortality is related to suicide, AIDS, cardiovascular disease, and drug abuse (Blosnich et al., 2014). In addition, two other VHA studies found transgender veterans were significantly more likely to be diagnosed with numerous mental and physical health disparities, such as depression,

suicide ideation or attempt, HIV, cardiovascular disease, and alcohol abuse (Brown & Jones, 2016), and had a suicide rate 20 times higher than the general VHA population (Blosnich et al., 2013) when studied over 17 and 11-year spans respectively. Moreover, data on chronic disease status is limited to a single study of 5,135 transgender veterans (Brown & Jones, 2016), but findings do not reflect the heterogeneity found within the transgender and gender nonconforming communities.

1.4.3 Veterans Health Administration research contributions

Researchers from the VHA have had made significant contributions to transgender health knowledge, including information about gender identity-related suicide risks, mortality, and medical and mental health disparities of transgender veterans (Blosnich et al., 2013; Blosnich et al., 2014; Blosnich et al., 2016; Brown & Jones, 2014, 2016). However, there are considerations which further limit the generalizability of their findings. The veteran's transgender identity was determined by one of four International Classification of Diseases 9 (ICD-9) codes found within VHA electronic medical record (Blosnich et al., 2014; Brown & Jones, 2014, 2016). This method may include individuals who do not identify as transgender, exclude those who identify as transgender, as well as those transgender adults who seek care outside of VHA facilities. In fact, a group of researchers conducted a study about the healthcare utilization of MTF veterans and discovered many sought care outside of VHA facilities, including gender identity counseling (Shipherd, Mizock, Maguen, & Green, 2012). In addition, the VHA data represent a homogeneous sample of white transgender veterans, which does not reflect what is known about the racial makeup of the transgender population (Flores,

Brown, & Herman, 2016), and only includes one segment of the population, transgender women. This is particularly important given that the Williams Institute estimates that people of color are more likely than white adults to identify as transgender (Flores, Brown, et al., 2016).

1.4.4 HIV/AIDS and the transgender population

Transgender health research is shaped by the urgency to address the growing public concern of HIV/AIDS (Feldman et al., 2016; MacCarthy et al., 2015). A meta-analysis of 39 studies from 15 countries found that transgender women of color have a 49 times higher odds of HIV infection compared to cisgender adults (Baral et al., 2013). Within the U.S., two of the largest national transgender surveys, the NTDS ($N=6,450$) and the USTS ($N=27,715$), provide a glimpse into the HIV epidemic among transgender adults living in the U.S. (Grant et al., 2011; James et al., 2016). Using self-reported HIV serostatus data collected between 2008-2009, the NTDS reported an HIV infection rate over four times that of the national average (Grant et al., 2011). Similarly, the USTS data collected in 2015 reflected a five times higher rate of transgender people living with HIV as compared to the U.S. population (James et al., 2016). Researchers from the VHA discovered transgender veterans have nearly five times the odds of living with HIV than the general VHA population (Brown & Jones, 2016). The elevated HIV burden among transgender people is linked to personal and socioeconomic factors such as homelessness, drug and alcohol abuse, involvement in survival sex work, incarceration, and low socioeconomic position (Baral et al., 2013; Reisner, Bailey, et al., 2014).

1.4.5 Gender-affirming hormone therapy

Gender-affirming hormone therapy, an approach used to feminize or masculinize one's body, has been shown to improve quality of life and psychological functioning for transgender adults (Newfield, Hart, Dibble, & Kohler, 2006; White Hughto & Reisner, 2016b). This gender-affirming intervention is a medically necessary treatment in alleviating gender dysphoria, or the distress that some transgender individuals experience resulting from the discrepancy between their gender identity and sex assignment at birth (Coleman et al., 2012; Reisner, Radix, et al., 2016; Wesp & Deutsch, 2017). Hormone therapy is safe when monitored under medical supervision, as it can be associated with an elevated risk for cardiovascular and venous thromboembolic disease, polycythemia, and an increase in insulin resistance and fasting glucose (Coleman et al., 2012; Hembree et al., 2009; Weinand & Safer, 2015). Research on cross-sex hormone therapy in the U.S. is limited to a few prospective studies examining small cohorts of transgender adults for periods less than two years, unlike larger retrospective European studies exploring long-term use of hormones (Feldman et al., 2016; Institute of Medicine, 2011). One cross-sectional European study of 100 transgender adults reported MTFs and FTMs had elevated blood pressure and/or used antihypertensives (26%, 28%, respectively), had hypercholesterolemia (60%, 64%, respectively), and 6% of MTFs suffered from thromboembolic events after an average of 11.3 years on hormones (Wierckx et al., 2012). While European studies are informative, societal factors (e.g., healthcare access, social and cultural norms) influencing health differ substantially between Europe and the U.S. (Feldman et al., 2016).

1.4.6 Mental health

In addition to cross-sex hormones, much of the health-related research focuses on mental health (Benotsch et al., 2013; Colton Meier et al., 2011; Testa et al., 2014) and explores the impact of health-harming behaviors (Blosnich et al., 2013; Herman et al., 2014; Horvath et al., 2014; Klein & Golub, 2016). Researchers studying mental health found that transgender adults have higher levels of psychological distress (Benotsch et al., 2013; Bockting et al., 2013; Breslow et al., 2015; Clements-Nolle, Marx, & Katz, 2006; Lombardi, 2009), substance abuse (Benotsch et al., 2013; Reisner, Gamarel, Nemoto, & Operario, 2014; Xavier, Bobbin, Singer, & Budd, 2005), and a suicide attempt rate that is nearly nine times higher than the U.S. general public (James et al., 2016). The disproportionately high rates of depressions, anxiety, somatization and overall psychological distress experienced by transgender adults are associated with stigma and discrimination, not gender dysphoria (Bockting et al., 2013; Meyer, 2003).

1.4.7 Knowledge gaps in health-related literature

There is a very limited understanding of the health status of transgender adults that reflects the heterogeneity of personal characteristics, such as race/ethnicity and gender identity represented within the transgender population (Feldman et al., 2016; Institute of Medicine, 2011; MacCarthy et al., 2015; Reisner, Deutsch, et al., 2016). The majority of transgender health-related studies are cross-sectional and conducted within the U.S. with convenience samples that inadequately represent racial/ethnic transgender communities. (Institute of Medicine, 2011; Reisner, Deutsch, et al., 2016). One

retrospective study examined racial health disparities among non-Hispanic Black ($N=387$, 9%) and non-Hispanic white ($N=4120$, 91%) transgender veterans (Brown & Jones, 2014). This study found Black transgender veterans experienced a greater prevalence of several mental and medical conditions, such as alcohol abuse, tobacco use, congestive heart failure and were nearly seven times more likely to be infected with HIV (Brown & Jones, 2014) than their white transgender counterparts. While studies designed to examine GNC are few, a secondary analysis of 6,450 transgender adults, revealed GNC adults are more likely to attempt suicide, abuse drugs or alcohol, and smoke as compared to their gender-conforming counterparts (Miller & Grollman, 2015).

Contemporary, empirically-based knowledge of transgender health is scant and lacks understanding of physical health, health problems or impairments, chronic health conditions, and the impact of individual factors known to affect health outcomes in other vulnerable populations such as socioeconomic position and sexual orientation (Bowleg, 2012; MacCarthy et al., 2015). Despite a growing body of health-related literature, additional research is needed to advance our understanding of health among transgender subgroups such as MTF, FTM, and GNC adults. This knowledge will help prioritize health needs and identify pathways to reduce the health inequities plaguing the transgender population in the U.S. (Feldman et al., 2016; Institute of Medicine, 2011).

1.5 Conceptual framework

1.5.1 The origins of the Transgender Health Model

The conceptual framework for this dissertation is the Transgender Health Model

(THM, Figure 1). It draws upon two frameworks suggested by the Institute of Medicine (2011) when studying transgender health – the socioecological (McLeroy et al., 1988) and intersectionality (Crenshaw, 1991) frameworks. The socioecological model was built upon Bronfenbrenner’s bioecological model (Bronfenbrenner, 1979) and was developed to guide understanding for health promotion by considering both individual and environmental factors that influence health and health behavior (McLeroy et al., 1988). Whereas, intersectionality provides a critical lens to understand how multiple marginalized social identities, or being a member of multiple marginalized groups, intersect creating unique experiences reflecting the systems and structures of oppression and privilege (Crenshaw, 1991). Marginalized group membership describes belonging to a group with social disadvantage and relegation to another, and intrapersonal, interpersonal, institutional, community, and structural experience explains the first-hand accounts and impressions with individuals and systems of power, respectively (Crenshaw, 1991).

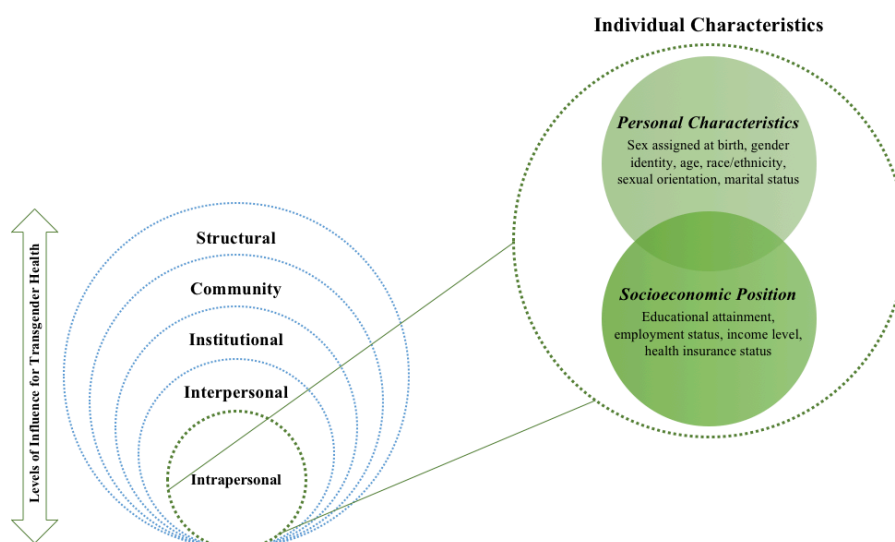


Figure 1: Transgender Health Model

1.5.2 Exploring health using the Transgender Health Model

The THM posits that the health, health behaviors, and lived experiences of an individual are affected by factors beyond an individual's personal characteristics (e.g., age, gender identity, race/ethnicity, and sexual orientation) and socioeconomic position (e.g., educational attainment and income level) (Crenshaw, 1991; McLeroy et al., 1988). Interpersonal relationships and the community and institutional settings where a person lives, works, and studies influence how they cope with stress, engage in health-related behaviors, and access resources directed at improving their quality of life (McLeroy et al., 1988). Additionally, the overarching influence of structural determinants such as local, state, and national laws and policies, affect the social and community environments, and the individual's beliefs, health-related behaviors, and lived experiences (Crenshaw, 1991; McLeroy et al., 1988).

Contextualizing the lives of transgender people is necessary when examining their health status because individual factors impact and influence their health, health-related behaviors, and lived experiences (Braveman, Egerter, & Williams, 2011; Crenshaw, 1991; Institute of Medicine, 2011; Link & Phelan, 1995; McLeroy et al., 1988). Equally important factors impacting the health of an individual are the simultaneous and interacting effects stemming from being a member of multiple minority groups such as being a woman, transgender, and Black (Crenshaw, 2016, October; Hatzenbuehler et al., 2014; Lukachko, Hatzenbuehler, & Keyes, 2014). For example, Black transgender veterans experience a greater prevalence of several mental and medical conditions when compared to their white transgender counterparts (Brown & Jones, 2014). Furthermore,

transgender adults with lower income have been found to have poorer health than their counterparts earning higher incomes (Baral et al., 2013; Bradford et al., 2013; James et al., 2016).

The transgender health model promotes a more comprehensive understanding of the transgender population's health status and the individual factors (personal characteristics and socioeconomic position) and marginalized group memberships that influence the health of transgender adults. Additionally, the THM serves as the groundwork for future studies exploring the broader context and influence of interpersonal, institutional, community, and structural factors that may impact the health of transgender individuals.

1.6 Purpose Statement

The purpose of this dissertation is to examine the health status of transgender adults in the U.S. Of particular interest is the health status among three transgender subgroups (MTF, FTM, and GNC adults) and in relation to their cisgender male (CGM) and cisgender female (CGF) counterparts. By exploring the health status of three transgender subgroups, versus as one homogeneous population, research findings will inform the design of future studies by determining the importance of defining and examining transgender subgroups as unique groups. Findings will also help prioritize future research directions for transgender people and healthcare providers, aid in the development of interventions, and guide current and future public health initiatives and policies addressing the health of the transgender population.

1.7 Research Aims

The purpose of this dissertation will be achieved through the following aims:

1.7.1 Chapter two aim

First, to describe the scope of literature pertaining to the experiences of transgender adults accessing and utilizing healthcare in the U.S. This is a critical first step in understanding the health status of transgender adults because it is influenced by the environment where transgender people seek and receive healthcare. As such, Chapter two, an integrated mixed research synthesis, explores the experiences of transgender adults accessing and utilizing healthcare in the U.S. While the THM identified the necessity of exploring healthcare environments, the gender affirmation framework is used to organize synthesis findings. The framework consists of four constructs (social, medical, psychological, and legal gender affirmation) which have been shown to influence healthcare utilization among transgender adults. (Bauer et al., 2009; Bockting, Robinson, Benner, & Scheltema, 2004; Sevelius, 2013). The gender affirmation framework is described in greater detail in Chapter two.

1.7.2 Chapter three aim

Second, to address methodological challenges that arise when using data from the Centers for Disease Control and Prevention's 2015 Behavioral Risk Factor Surveillance System (BRFSS) to study transgender population health. For this second aim, we use the 2015 BRFSS data to describe how measurement error engendered by BRFSS data collection procedures introduced misclassification bias and contributed to problematic

sampling weights. We propose that a matched-subject design can address the 2015 BRFSS methodological challenges. Further, we present a comparison of poor health using two sampling methodological approaches to illustrate their impact on parameter estimates.

1.7.3 Chapter four aims

Third, to increase the understanding of the relationships among health status and individual factors (personal characteristics and socioeconomic position) for MTF, FTM, GNC adults and their CGM and CGF counterparts. This will be accomplished by performing a secondary analysis of the 2015 BRFSS data, with health status accounting for self-rated general health, health-related quality of life, chronic health conditions, and health problems or impairments. The specific aims of this chapter are:

(1) describe and compare the personal characteristics, socioeconomic position, and health status of five study groups (MTF, FTM, GNC, CGM, and CGF), and (2) determine the differential effects of individual factors on health status in the five study groups. The second aim will allow us to: a) evaluate differences in health status between the five study groups, covarying for the effects of individual factors and their interactions with study group, and b) examine the influence of individual factors and their interactions with study group on health status.

2. Healthcare Experiences of Transgender Adults: An Integrated Mixed Research Synthesis

2.1 Introduction

Transgender, or trans, describes an incongruence between an individual's sex assigned at birth and their current gender expression or gender identity, or their sense of being male, female, both, or neither (Institute of Medicine, 2011). Individuals with an alignment between their assigned sex and gender identity are considered cisgender. The transgender population represents a spectrum of gender identities and expressions (James et al., 2016). Transgender women, or male-to-female (MTF) individuals, were assigned male at birth and currently identify as women or female; transgender men, or female-to-male (FTM) individuals, were assigned female at birth and now identify as men or male (American Psychological Association, 2015). Some, but not all, transgender people desire gender-affirming medical interventions such as cross-sex hormone therapies, gender-affirming surgeries, and other body modifications (Coleman et al., 2012). The number of adults who identify as transgender in the U.S. is approximately 1.4 million (Flores, Herman, Gates, & Brown, 2016); however, the absence of a consistent definition for the term transgender and the social stigma associated with transgender identities likely contribute to under-reporting (Reisner, Deutsch, et al., 2016). The term transgender is part of the lesbian, gay, bisexual, transgender and queer (LGBTQ) acronym that represents both sexual orientation and gender identity groups (Institute of Medicine, 2011). Lesbian, gay, bisexual, and sometimes queer are used to express sexual orientation, which includes sexual and/or romantic attractions to people of different

gender (American Psychological Association, 2015). Transgender people have a range of sexual orientations, including but not limited to gay, bisexual, asexual, queer, and heterosexual (Institute of Medicine, 2011), and can be attracted to cisgender men/women and/or other transgender people.

Transgender people in the U.S. experience social disadvantages such as living below the poverty level (Conron et al., 2012; James et al., 2016), a higher rate of homelessness (James et al., 2016), sexual and physical assaults (James et al., 2016; Lombardi et al., 2001), bullying (James et al., 2016; Kosciw, Greytak, Palmer, & Boesen, 2014), unequal treatment or service in public accommodations (Herman, 2013; Reisner et al., 2015), and they are three times as likely to be unemployed than the general public (James et al., 2016). They endure discrimination and systematic oppression by healthcare professionals and within healthcare settings (James et al., 2016; Safer et al., 2016). Discriminatory experiences include inappropriate care, care refusal, and mistreatment by health providers (Bockting et al., 2004; Lambda Legal, 2010).

Transgender-related discrimination is associated with negative psychological outcomes, such as increased rates of clinical depression and anxiety (Bockting et al., 2013; White Hughto, Pachankis, Willie, & Reisner, 2017), self-harming behaviors (Herman, 2013), drug and alcohol use and abuse (James et al., 2016; Keuroghlian, Reisner, White, & Weiss, 2015), and suicide (Blosnich et al., 2013; Testa et al., 2012). Discrimination likely contributes to the 40% lifetime suicide attempt rate in transgender-identified adults, a prevalence that far exceeds those in the general U.S. population

(4.6%) and in LGB communities (10-20%) (Bockting et al., 2013; Herman et al., 2014; James et al., 2016). With the release of *Healthy People 2020 (HP2020)*, the U.S. federal government recognized the need to address the community's health inequities and discrimination experiences by designating transgender health as a national priority (US Department of Health Human Services, 2010).

Prior to HP2020, the discrimination transgender people experienced in healthcare settings was well documented. A year after announcing the HP2020 goals, the Institute of Medicine (IOM) designated transgender health as a research priority and called for more research addressing the disparities they experience in healthcare (Institute of Medicine, 2011). The IOM (2011) recommended exploring the healthcare experiences and barriers transgender people face to equitable healthcare, as these barriers can profoundly affect their healthcare utilization and well-being. Reisner and colleagues (2015) postulate that the health inequities experienced by transgender people may be reduced by using gender-affirming approaches in the delivery of healthcare.

2.2 Background

Gender affirmation, a critical element of the health and well-being of trans individuals, is conceptualized as a social process of being affirmed and supported as one's gender identity, expression, and/or role (Reisner, Radix, et al., 2016; Sevelius, 2013). The gender affirmation framework was developed to explore the sexual and body modification behaviors of transgender women of color, where it was discovered that in the absence of gender affirmation, the women would engage in risky health behaviors

(Sevelius, 2013). The framework integrates components of intersectionality (Crenshaw, 1991), objectification theory (Fredrickson & Roberts, 1997), and the identity threat model of stigma (Major & O'Brien, 2005). It is composed of four constructs: social (name, pronouns, interpersonal and institutional acknowledgement and recognition), medical (gender-affirming medical interventions such as cross-sex hormonal therapy, surgeries, and other body modifications), psychological (self-actualization and preventing internalized negative beliefs about one's identity), and legal (gender marker and legal name changes) gender affirmation (Sevelius, 2013). Use of the framework is recommended when studying transgender individuals (Reisner, Radix, et al., 2016; Sevelius, 2013), and its constructs have been shown to influence healthcare utilization among transgender adults (Bauer et al., 2009; Bockting et al., 2004). This synthesis used a modified version of the framework (Figure 2); the conceptualizations of the original constructs were broadened to comprise aspects related to healthcare, such as the incorporation of "primary and preventative healthcare" within medical gender affirmation, "mental-health related services" under psychological gender affirmation, and legal gender affirmation includes "health insurance".

2.3 The review

2.3.1 Aim

The aim of this integrated mixed research synthesis, guided by a modified gender affirmation framework (Sevelius, 2013), was to respond to the IOM call and to contextualize the experiences of transgender adults interfacing with healthcare in the U.S.

The synthesis question was: What are the experiences of transgender adults attempting to access and utilize healthcare in the U.S.?

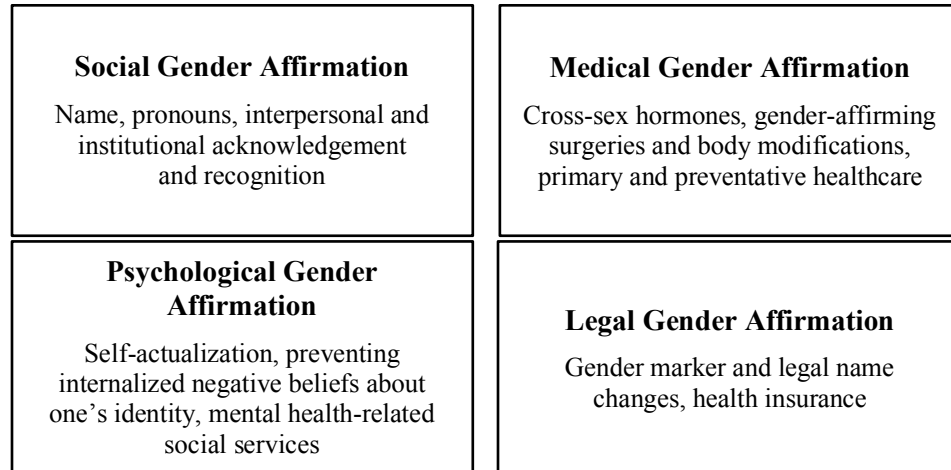


Figure 2: Modified Gender Affirmation Framework

2.3.2 Design

To better understand the healthcare experiences of transgender people, an integrated mixed research synthesis was selected. This approach allowed for inclusion of all study designs and thus, produced empirical findings representing the broadest possible understanding of the literature (Sandelowski, Voils, & Barroso, 2006). As described by Sandelowski et al. (2006), a mixed research synthesis can summarize what is known about a specific phenomenon across a homogenous sample of research participants and research questions, and they suggest using a meta-analysis and meta-synthesis to analyze data. However, this synthesis sought to identify, not address, the circumstances surrounding healthcare access and utilization of transgender adults. Due to the significant heterogeneity in both study design, transgender communities studied, and outcomes measured across the sample making a robust meta-analysis or statistical analysis impossible to conduct.

2.3.3 Search methods

This research synthesis of peer-reviewed literature covered a 6.5-year period from 2011 through June 2017 and followed the release of HP2020. A systematic approach was used to identify terms and concepts (Table 1) searched in four databases: Cumulative Index of Nursing and Allied Health Literature, PsychINFO, PubMed, and SocINDEX. Studies included were: 1) peer-reviewed journal publications; 2) any study design that provided data about the experiences of transgender adults accessing and utilizing healthcare within the U.S.; 3) about transgender adults older than 18 years-old; 4) published in 2011 through June 2017; and 5) published in English. Studies excluded were those that: 1) did not disaggregate findings about transgender individuals living in the U.S. from those in other countries; 2) did not disaggregate findings about transgender individuals from those of LGBTQ adults; 3) were focused on transgender youth; 4) did not distinguish findings of transgender individuals under 18 years-old from those over 18 years-old; 5) focused on clinical outcomes; 6) concentrated on healthcare curricula; 7) were grey literature, commentaries, editorials, or literature reviews. References from literature reviews were assessed and those references meeting the inclusion criteria were included in this synthesis.

2.3.4 Search outcome

Figure 3 provides a PRISMA diagram that illustrates the screening, eligibility, and selected manuscripts for inclusion. A total of 1,733 articles were obtained and all abstracts were imported into EndNote™ X8; 1,415 articles remained after

Table 1: Search Terms and Concatenation of Terms Utilized (n=23)

Database	Search Terms
Cumulative Index of Nursing and Allied Health Literature	transgender[MH] OR transgender[MJ] OR transgender[TI] OR transgendered[TI] OR transsexual[TI] OR transgenders[TI] OR transgendered[TI] OR trans[TI] OR “transgender healthcare”[TI] OR “transgender healthcare”[TI] OR “trans health”[TI] OR “trans healthcare”[TI] OR “trans healthcare”[TI] OR transmen[TI] OR transwomen[TI]
PsychINFO	transgender[MA] OR transgender[MJ] OR transgender[TI] OR transgendered[TI] OR transsexual[TI] OR transgenders[TI] OR transgendered[TI] OR trans[TI] OR “transgender healthcare”[TI] OR “transgender healthcare”[TI] OR “trans health”[TI] OR “trans healthcare”[TI] OR “trans healthcare”[TI] OR transmen[TI] OR transwomen[TI] (“transgender persons”[MeSH] OR “health services for transgender persons”[MeSH] OR transgender[title] OR transgendered[title] OR transsexual[title] OR transgenders[title] OR transgendered[title] OR trans[title] OR “transgender healthcare”[title] OR “transgender healthcare”[title] OR “trans health”[title] OR “trans healthcare”[title] OR “trans healthcare”[title] OR transmen[title] OR transwomen[title]) AND (healthcare[tiab] OR “healthcare”[tiab] OR “access”[tiab] OR utilization[tiab] OR “barriers”[tiab] OR “healthcare services”[tiab] OR “healthcare services”[tiab] OR “access to care”[tiab])
PubMed	transgender[DE] OR transgender[SU] OR transgender[TI] OR transgendered[TI] OR transsexual[TI] OR transgenders[TI] OR transgendered[TI] OR trans[TI] OR “transgender healthcare”[TI] OR “transgender healthcare”[TI] OR “trans health”[TI] OR “trans healthcare”[TI] OR “trans healthcare”[TI] OR transmen[TI] OR transwomen[TI]
SocINDEX	transgender[DE] OR transgender[SU] OR transgender[TI] OR transgendered[TI] OR transsexual[TI] OR transgenders[TI] OR transgendered[TI] OR trans[TI] OR “transgender healthcare”[TI] OR “transgender healthcare”[TI] OR “trans health”[TI] OR “trans healthcare”[TI] OR “trans healthcare”[TI] OR transmen[TI] OR transwomen[TI]

duplicates were removed. Of the remaining articles, EndNote™ X8 was used to scan titles and abstracts for exclusion and inclusion criteria. Fifty-three articles were retained for full-text review. Additionally, each article’s references were hand-searched to identify any articles that met our inclusion criteria, however, no additional articles were identified. The final sample included 23 articles (Table 2).

2.3.5 Quality appraisal

All articles meeting the inclusion criteria were included regardless of quality or methodological-related concerns; however, the entire sample was scrutinized, and any methodologic critiques are reported within the findings section.

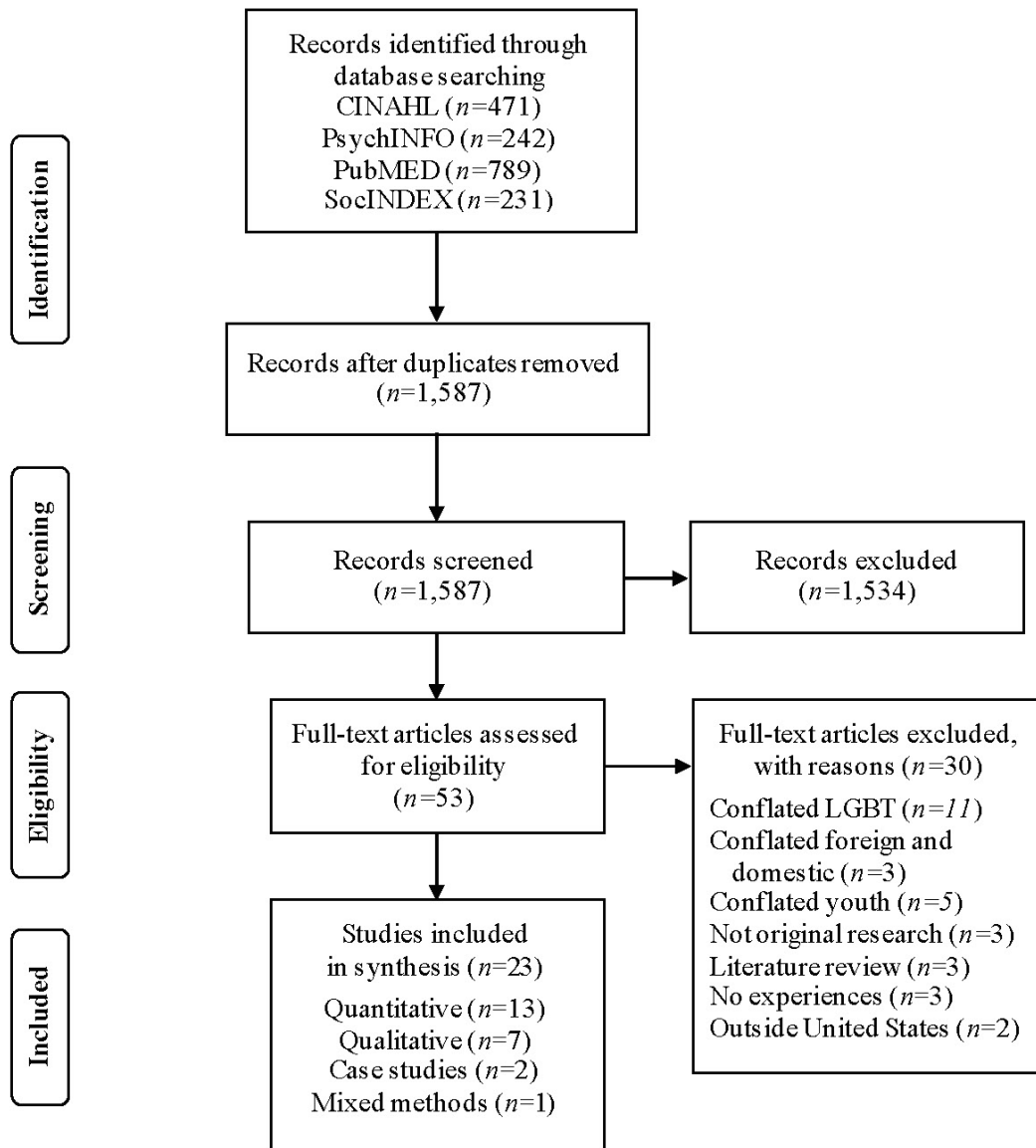


Figure 3: PRISMA Flow Diagram

Table 2: Characteristics of Articles Synthesized

Author (Year)	Focus	Data Collection	Sampling Method	Sample (N)	Geographic Location	Trans Defined
Case Studies						
Cicero and Black (2016)	An emergency room experience	2011	Purposive	FTM (1)	Southeast U.S.	Yes
Shukla et al. (2014)	Barriers to healthcare		Purposive	MTF (1)		No
Mixed Methods						
Radix et al. (2014)	Satisfaction and healthcare utilization	2013	Purposive	MTF (26) FTM (11) Trans (9)	New York City, NY	Yes
Qualitative						
Brown (2014)	The healthcare concerns of transgender inmates		Convenience	MTF (125) Trans (3)	24 states ^b	No
Hagen and Galupo (2014)	Gendered language in healthcare		Purposive, convenience	MTF (9) FTM (11)	12 states ^c	No
Poteat et al. (2013)	Stigma in transgender healthcare	2011	Purposive	MTF (30) FTM (25)	Mid-Atlantic	Yes
Roller et al. (2015)	Engagement in healthcare		Purposive	MTF (6) FTM (19)	U.S.	Yes
Sevelius et al. (2014)	Barriers and facilitators to healthcare engagement and retention for trans women living with HIV		Purposive	MTF (38)	San Francisco, CA	No
Wilson et al. (2013)	Access to HIV-related care for African American trans women living with HIV		Purposive	MTF (10)	Alameda County, CA	No
Xavier et al. (2012)	Healthcare access	2004	Purposive	MTF (32) FTM (15)	VA	Yes
Quantitative						
Bradford et al. (2013)	Social determinants of health and experiences of transgender-related discrimination	2005-2006	Purposive	MTF (229) FTM (121)	VA	Yes
Cruz (2014)	The postponement of primary curative care	2008-2009 ^a	Convenience	MTF (2427) FTM (1867)	U.S.	Yes

Author (Year)	Focus	Data Collection	Sampling Method	Sample (N)	Geographic Location	Trans Defined
de Haan et al. (2015)	Barriers to care and non-prescribed hormone use	2010	Convenience	MTF (314)	San Francisco, CA	Yes
Jaffee et al. (2016)	Delayed healthcare, perceived provider knowledge, and discrimination	2008-2009 ^a	Convenience	MTF (2068) FTM (1418)	U.S.	Yes
Jaffer et al. (2016)	Adequacy of care within jail		Purposive	MTF (25) FTM (2)	New York City, NY	No
Kattari and Hasche (2015)	Influence of age on experiences of healthcare discrimination, harassment, and victimization	2008-2009 ^a	Convenience	Trans (5885)	U.S.	Yes
Kattari et al. (2017)	Influence of (dis)ability on discriminatory experiences when accessing social services	2008-2009 ^a	Convenience	Trans (6456)	U.S.	
Kattari et al. (2015)	Race/ethnicity differences in experiences of healthcare discrimination	2008-2009 ^a	Convenience	Trans (6454)	U.S.	No
Nemoto et al. (2015)	Unmet healthcare needs	2000-2001; 2004-2006	Purposive, convenience	MTF (235)	San Francisco and Oakland, CA	Yes
Shpherd et al. (2012)	Utilization of Veterans Health Administration health services	2008	Convenience	MTF (141)	U.S.	Yes
Shires and Jaffee (2015)	Discrimination experienced in healthcare	2008-2009 ^a	Convenience	FTM (1711)	U.S.	Yes
White Hughto et al. (2016)	Geographic and individual differences in healthcare access	2008-2009 ^a	Convenience	Trans (5831)	U.S.	Yes
Whitehead et al. (2016)	Primary healthcare utilization	2014	Convenience	Trans (169)	U.S.	No

Individuals assigned male at birth but identify as something other than male are categorized as MTF; FTM represents those persons that were assigned female at birth but identify as something other than female; and the term trans is used if researchers grouped all trans people together or did not identify the trans subgroup or sex assigned at birth. Study participants may use other terminology when describing themselves. ^a National Transgender Discrimination Survey secondary analysis. ^b Located in AR, CA, CO, FL, GA, IA, ID, IN, KY, MA, MI, NV, NY, OK, OR, PA, SC, SD, TN, TX, UT, VA, WA, WI. ^c CA, MA, MD, MI, MN, NC, NJ, NV, NY, RI, TX, VA

2.3.6 Data abstraction

Following the Matrix Method (Garrard, 2013), we abstracted data from each article using a structured abstracting spreadsheet with 12 topics: author, title, year of publication, journal, study design, sampling method, data collection date, sample characteristics, findings, transgender definition, study limitations, and gender affirmation construct.

2.3.7 Synthesis

Due to the heterogeneous sample included in this synthesis, a thematic analysis was conducted to detect patterns and regularities, as well as inconsistencies (Higgins & Green, 2011). The constructs of the gender affirmation framework represented four *a priori* themes used to organize the synthesis findings.

2.4 Results

Of the 23 articles included in this synthesis, 13 (57%) were quantitative studies, seven (30%) were qualitative, two (9%) were case studies, and one was mixed method. Apart from a secondary analysis, the remaining qualitative studies used purposive sampling to recruit a range of 10 to 55 participants, mainly transgender women (77%), where only one interview was conducted per participant. Additionally, two qualitative studies collected data from 12 focus groups.

Of the quantitative studies, seven were secondary analyses of the National Transgender Discrimination Survey (NTDS), a study that explored the lifetime experiences of discrimination for 6,456 trans adults in the U.S. (Grant et al., 2011). The

study used grassroots approaches for recruitment, and data were collected in 2008-2009 (Grant et al., 2011). The remaining quantitative and mixed methods studies used convenience and purposive samples of less than 350 participants, primarily consisting of transgender women (87%). Moreover, 30% of the quantitative studies grouped all transgender participants together for their analyses without disaggregating gender identity groups. The case studies provided data on a transgender man and woman.

Data collection periods and definitions for the term transgender varied across the sample. Data were collected before and after the release of *HP2020*, and seven studies (30%) did not report their data collection periods. Additionally, eight studies (35%) did not define the word transgender. Of the remaining studies, three used the NTSD definition, 11 included gender expression and/or presentation, and one described transgender as a sexual identity.

2.4.1 Social gender affirmation

Social gender affirmation is a key component in healthcare access, utilization, and therapeutic relationships with healthcare professionals and systems, but in its absence, transgender adults experience stigma, prejudice, and discrimination (Cicero & Black, 2016; Hagen & Galupo, 2014; Kattari, Walls, & Speer, 2017; Poteat et al., 2013; Roller, Sedlak, & Draucker, 2015; Sevelius et al., 2014; Shukla, Asp, Dwyer, Georgescu, & Duggan, 2014; Wilson et al., 2013; Xavier et al., 2012). Non-affirming public spaces create life-threatening conditions and barriers to healthcare for visibly gender nonconforming transgender women, particularly those of color (Sevelius et al., 2014;

Wilson et al., 2013; Xavier et al., 2012). Three qualitative studies gave insight into how African American and Black transgender women prioritized safety over risking their lives traveling to healthcare appointments (Sevelius et al., 2014; Wilson et al., 2013; Xavier et al., 2012). The social context within healthcare settings also influence healthcare utilization. Transgender women reported avoiding HIV-related appointments because of fear that their HIV serostatus would be publically revealed if they encountered a peer or were seen entering a HIV-related care facility (Sevelius et al., 2014; Wilson et al., 2013).

Check-in and registration in healthcare settings were challenging processes where transgender adults encounter insensitive staff and structural obstacles, such as electronic medical records and patient intake forms (Cicero & Black, 2016; Hagen & Galupo, 2014; Sevelius et al., 2014; Xavier et al., 2012). For example, a transgender man checking-in to an emergency room disclosed that he was transgender, and the gender marker on both his driver's license and existing electronic medical record reflected female, his sex assigned at birth (Cicero & Black, 2016). The employee and several colleagues verbally assaulted him by referring to him as a woman, even after he voiced his objection; as a result, he left without being evaluated (Cicero & Black, 2016).

Transgender adults have a variety of reactions when patient intake forms use the terms sex and gender interchangeably, as well as when forms feature binary distinctions for sex/gender (Hagen & Galupo, 2014; Poteat et al., 2013; Roller et al., 2015). Trans participants in multiple studies reported having to interpret whether the facility sought information about their gender identity, or their sex (Hagen & Galupo, 2014; Poteat et al.,

2013; Roller et al., 2015). In these studies, trans participants described feeling invisible when forms contained binary distinctions for sex/gender; however, other participants noted feeling affirmed by the dichotomous option because they did not identify as a transgender man/woman, but as a man/woman (Hagen & Galupo, 2014). Further complications arise when trans individuals provide their legal name, current name, and pronouns on intake forms (Hagen & Galupo, 2014; Poteat et al., 2013). Staff and providers may exhibit uncertainty about which name or pronoun to use, particularly when the physical presentation and gender identity of the trans patient aligns with traditional conceptualizations of gender (Hagen & Galupo, 2014; Poteat et al., 2013). For instance, a FTM study participant shared, “If I mark trans as my gender on a form but it does not ask (FTM/MTF) because I pass extremely well as male they tend to assume I’m a transgender woman” (Hagen & Galupo, 2014, p. 24). Transgender participants also expressed fear when disclosing their gender identity because they expected or anticipated discrimination and suboptimal or inappropriate care (Cruz, 2014; Hagen & Galupo, 2014; Poteat et al., 2013; Shipherd et al., 2012; Shukla et al., 2014). Despite the abundance of non-affirming experiences in healthcare settings, more than half of the sample interviewed by Hagen and Galupo (2014) reported feeling seen and respected as a complete person by affirming language and communication approaches used by Planned Parenthood.

One study-specific limitation is related to social gender affirmation. Jaffer and colleagues (2016) sought to improve the quality of healthcare for incarcerated transgender adults in the New York jail system. Eligible participants were identified by cross-sex hormone use documented within pharmacy records. This sampling approach

excluded those who did not want or desire cross-sex hormones, thus their health needs and healthcare experiences were not evaluated. This limitation also impacts findings reported in medical gender affirmation.

2.4.2 Medical gender affirmation

Access to gender-affirming medical interventions is a priority for many transgender adults (Bradford et al., 2013; Brown, 2014; Cruz, 2014; de Haan, Santos, Arayasirikul, & Raymond, 2015; Poteat et al., 2013; Roller et al., 2015; Sevelius et al., 2014; Shipherd et al., 2012; Xavier et al., 2012). The majority of articles reviewed revealed that cross-sex hormones, an intervention requiring lifelong medical monitoring and healthcare interactions, was discussed most often. Cross-sex hormones were described as a fundamental component in a trans person's quality of life, as it affords the individual greater social acceptance and reduces the threat of harassment and violence (Brown, 2014; Jaffer et al., 2016; Radix et al., 2014; Roller et al., 2015; Sevelius et al., 2014; Wilson et al., 2013; Xavier et al., 2012). Two qualitative studies contextualized the complicated relationship transgender women living with HIV have with cross-sex hormones (Sevelius et al., 2014; Wilson et al., 2013). The women expressed a desire to be seen as cisgender women, however their motivation to access and use cross-sex hormones varied between increasing their safety in public spaces and earning higher wages for those engaged in survival sex work (Sevelius et al., 2014; Wilson et al., 2013). The women involved in transactional sex expressed prioritizing cross-sex hormones over HIV care due to cost; moreover, they agreed that the integration of cross-sex hormone therapy with their HIV care provider would facilitate compliance in maintaining

adherence to their antiretroviral therapy for viral load suppression (Sevelius et al., 2014; Wilson et al., 2013).

Trans adults attempting to access gender-affirming medical interventions and primary and preventative care experience numerous challenges and barriers, such as the scarcity of available, knowledgeable, and affirming clinicians (Bradford et al., 2013; Brown, 2014; de Haan et al., 2015; Jaffer et al., 2016; Nemoto, Cruz, Iwamoto, & Sakata, 2015; Poteat et al., 2013; Radix et al., 2014; Roller et al., 2015; Sevelius et al., 2014; Shukla et al., 2014; Whitehead, Shaver, & Stephenson, 2016; Wilson et al., 2013; Xavier et al., 2012). Trans people scour the internet and tap into social networks inquiring about supportive and competent clinicians (Poteat et al., 2013; Roller et al., 2015). They use various strategies when encountering providers who are not proficient in gender-affirming care (Brown, 2014; Poteat et al., 2013; Roller et al., 2015; Sevelius et al., 2014; Shipherd et al., 2012; Wilson et al., 2013; Xavier et al., 2012). Many arrive at appointments knowledgeable and informed about hormone therapy regimens and required medical monitoring (Poteat et al., 2013; Roller et al., 2015; Sevelius et al., 2014; Xavier et al., 2012), and some travel great distances for knowledgeable providers (Radix et al., 2014; Roller et al., 2015; Xavier et al., 2012). Researchers discovered that transgender adults living in rural areas were more than three times as likely to drive over an hour to their primary care providers than their LGB cisgender peers (Whitehead et al., 2016). However, affirming providers are not always accessible, leaving some trans adults feeling powerless (Poteat et al., 2013). To illustrate this point, a transgender woman in one study shared, “I did walk away from there a couple of times – always ended up going

back because there's nowhere else to go – so I always wind up going back” (Poteat et al., 2013, p. 28).

Transgender people are refused primary and preventative care and gender-affirming medical interventions due to their gender identity and presentation (Cicero & Black, 2016; Cruz, 2014; Jaffee et al., 2016; Kattari & Hasche, 2015; Kattari, Walls, Whitfield, & Langenderfer-Magruder, 2015; Poteat et al., 2013; Radix et al., 2014; Roller et al., 2015; Sevelius et al., 2014; Shires & Jaffee, 2015; White Hughto et al., 2016; Wilson et al., 2013; Xavier et al., 2012). Data from the Virginia Transgender Health Initiative Study revealed that more than 25% of the sample were unable to obtain gender-affirming medical interventions and nearly half of those assigned female at birth were unable to access gynecological care (Bradford et al., 2013). When trans adults are unable to access cross-sex hormones from a clinical provider, they turn to friends, the streets, and the internet (de Haan et al., 2015; Radix et al., 2014; Sevelius et al., 2014; Xavier et al., 2012). De Haan and colleagues (2015) reported that nearly half of the trans women did not receive cross-sex hormones from a provider, and 36% used non-prescribed cross-sex hormones because they were unable to access a prescribing provider. Trans individuals residing in correctional settings also face barriers to such interventions (Brown, 2014; Jaffer et al., 2016), with some women attempting or completing autocastration due to lack of access to surgical treatments while imprisoned (Brown, 2014).

Transgender adults endure discrimination in healthcare because of their gender identity or gender expression (Bradford et al., 2013; Brown, 2014; Cicero & Black, 2016;

Cruz, 2014; de Haan et al., 2015; Hagen & Galupo, 2014; Jaffee et al., 2016; Jaffer et al., 2016; Kattari & Hasche, 2015; Kattari et al., 2015; Poteat et al., 2013; Radix et al., 2014; Roller et al., 2015; Sevelius et al., 2014; Shires & Jaffee, 2015; White Hughto et al., 2016; Whitehead et al., 2016; Wilson et al., 2013; Xavier et al., 2012). Transgender adults experience higher rates of discrimination when healthcare providers are aware of their patient's gender identity (Cruz, 2014; Shires & Jaffee, 2015). White Hughto and colleagues (2016) discovered a positive association between care refusal in trans adults who were older; assigned male at birth; Native American, multi-racial or other racial/ethnic minority; had low income; and discrimination-related care avoidance. When holding these factors constant, trans residents in southern and western states had increased odds of experiencing care refusal; moreover, states with a greater percentage of Republican voters increased the odds associated with care refusal (White Hughto et al., 2016).

Healthcare access and utilization are impacted by transgender-related discrimination. Previous encounters of discrimination and knowledge of other transgender adults' discriminatory experiences precipitate transgender adults avoiding and/or delaying healthcare (Bradford et al., 2013; Cicero & Black, 2016; Cruz, 2014; Hagen & Galupo, 2014; Jaffee et al., 2016; Poteat et al., 2013; Radix et al., 2014; Roller et al., 2015; Sevelius et al., 2014; Shires & Jaffee, 2015; Wilson et al., 2013; Xavier et al., 2012). Transgender adults who reported having to teach their providers about transgender identities, were four times as likely to delay care as compared to those where provider education was not needed (Jaffee et al., 2016). Researchers studying healthcare

utilization of transgender veterans discovered that most sought care at non-Veterans Health Administration facilities because they were apprehensive about provider-based discrimination (Shipherd et al., 2012). Researchers discovered that transgender people of color reported a significantly higher prevalence of discrimination when accessing doctors and hospitals, emergency rooms, and ambulances/emergency medical technicians than their white trans counterparts (Kattari et al., 2015).

Limitations from two studies impact the findings reported within medical gender affirmation. In a secondary analysis of correspondence to a transgender prison journal, Brown (2014) did not describe the data analysis methods, therefore the trustworthiness and credibility of the findings cannot be assessed. Additionally, in a study that explored differences across age groups and discrimination, Kattari et. al. (2015) combined physical and verbal assaults, along with denial of equal treatment or services under the larger umbrella term "discrimination within healthcare settings". This approach allowed for a larger sample for analyses than would have been achievable if they had considered different types of discrimination as distinct categories. This aggregation may have influenced the chi-squared analyses because with large samples, very small associations will yield significant results, raising the likelihood of an analysis being significant but not clinically meaningful.

2.4.3 Psychological gender affirmation

Transgender adults encounter barriers when accessing mental health-related services creating unmet mental health needs; further, when they can access care, they

experience non-affirming clinicians (Bradford et al., 2013; Kattari & Hasche, 2015; Kattari et al., 2017; Radix et al., 2014; Sevelius et al., 2014; Shipherd et al., 2012; Wilson et al., 2013; Xavier et al., 2012). Nearly half of the transgender women interviewed by Sevelius and colleagues (2014) reported currently or previously utilizing mental health services and focus group participants explained that psychotropic medications were more accessible than psychotherapy, as some clinicians had a one to two year waiting period for therapy appointments. In the same study, a 49-year-old Black transgender woman described the influence of stigma when accessing care,

“We as Black trans women don’t want to address mental health because we think it’s an ugly thing. But yet, we transition and we still have anxiety and we still have PTSD; we still have domestic violence issues; we still have all that. But yet, it’s not being addressed. We’re so busy addressing the hormones and the trans thing and the HIV that we’re leaving out everything else. We’re not dealing with the total package, the total person” (Sevelius et al., 2014, p. 11).

When transgender adults access care, they encounter mental health professionals and facilities using non-affirming approaches, such as providers believing that being transgender is a form of a mental illness (Kattari & Hasche, 2015; Kattari et al., 2017; Shipherd et al., 2012; Xavier et al., 2012), resulting in some trans persons avoiding mental health services altogether (Shipherd et al., 2012; Wilson et al., 2013; Xavier et al., 2012). To mitigate these access issues, transgender study participants suggested the integration of mental health services within a multidisciplinary and comprehensive trans

health center (Radix et al., 2014).

One study found that African American transgender women living with HIV experienced clinicians providing inappropriate referrals to healthcare services, such as substance abuse programs and support for sex workers, which was based on stigma-laden assumptions about their transgender identity, race, and HIV serostatus (Wilson et al., 2013). For those seeking treatment for alcohol and substance abuse, programs often house transgender clients based on their sex, creating unwelcoming and unsafe conditions (Kattari et al., 2017; Sevelius et al., 2014). Furthermore, researchers discovered that transgender adults with a disability or impairment (socioemotional, physical, learning, or multiple disabilities) were significantly more likely to experience discrimination when accessing social services such as rape crisis centers, domestic violence shelters, and drug treatment programs than those trans people without disabilities (Kattari et al., 2017). While increases in income and age reduced the likelihood of experiencing discrimination, being a racial/ethnic and sexual minority increased the odds of discriminatory experiences (Kattari et al., 2017). For example, Latino individuals were two to four times more likely to experience discrimination accessing social services than white trans adults; bisexual and queer transgender adults were 5 and 3.5 times more likely, respectively, to experience discrimination at a drug treatment program and sexual minorities were 1.5 times more likely to experience discrimination at mental health centers than their heterosexual transgender counterparts (Kattari et al., 2017).

2.4.4 Legal gender affirmation

Health insurance companies deny benefits to transgender adults for routine preventative care and medically necessary procedures when the care is not aligned with the gender marker on their insurance policy, even though the procedures are medically appropriate for their current anatomy (Bradford et al., 2013; Hagen & Galupo, 2014; Radix et al., 2014; Roller et al., 2015; Xavier et al., 2012). Similarly, insurance companies also deny coverage for medically necessary gender-affirming medical interventions (Bradford et al., 2013; Hagen & Galupo, 2014; Radix et al., 2014; Roller et al., 2015; Xavier et al., 2012). For example, after receiving an abnormal Pap smear result, a transgender man chose to delay follow-up care, and cited that his insurance company would only pay for a hysterectomy if he was diagnosed with cervical cancer (Roller et al., 2015). To eliminate these healthcare barriers, transgender study participants suggested the incorporation of legal support for name/gender marker changes within a trans healthcare center (Radix et al., 2014).

Several analyses of NTDS data indicated that trans-related discrimination and healthcare postponement were associated with the type of health insurance coverage (Cruz, 2014; Shires & Jaffee, 2015). Trans men with public health insurance were more than twice as likely to report discrimination than those with private health insurance (Shires & Jaffee, 2015). Kattari and Hasche (2015) discovered that relative to those transgender adults without insurance, trans adults with private and those with public insurance were more likely to report higher rates of harassment, 14 and 4 times respectively. While these studies provided valuable insight, the associations reported

among health insurance, discrimination, and care postponement may be misleading because discrimination and care postponement were lifetime measures, whereas study participants provided their health insurance details at the time of the survey (Cruz, 2014; Kattari & Hasche, 2015; Shires & Jaffee, 2015).

2.5 Discussion

This integrated mixed research synthesis, framed by the gender affirmation framework, sought to contextualize the experiences of transgender adults interfacing with healthcare. Evidence from this synthesis indicates that transgender adults experience numerous obstacles when accessing healthcare such as unsafe public and healthcare spaces, lack of knowledgeable clinicians, and restricted health insurance benefits for medically necessary care. During healthcare utilization, they encounter gender non-affirming healthcare professionals and clinicians; and barriers to gender-affirming medical interventions, primary and preventative care, and mental health-related services; and they endure discrimination and healthcare refusal. Our findings are consistent with the literature published prior to HP2020; which is not surprising given that over half of the articles synthesized collected data before its release, including seven NTDS secondary analyses. These articles, representing over half of the quantitative sample, explored discrimination in healthcare and may drive the characterization of discrimination described in this synthesis. However, by using an integrated mixed research synthesis approach we discovered that discrimination was reported across all study designs.

While discriminatory experiences were frequently endorsed by transgender adults, data collection periods cannot be used as a proxy in determining when the events occurred. For example, the NTDS measured lifetime discriminatory experiences and the remaining studies synthesized did not elicit the chronology for the negative healthcare experiences. With the rise in public awareness, increase in time devoted to transgender health within healthcare curricula, and advancements to the standards of care for transgender individuals, it is important to assess their impact on improving the healthcare experiences of transgender adults. Researchers should consider framing interview and survey questions to identify the period for when such events occurred, including delineating the timeframe for exposures and outcomes. Additionally, apart from two studies, study participants perceived their experiences of discrimination were a direct result of their transgender identity and not a consequence of their race/ethnicity, class, or (dis)ability; yet, the NTDS data showed that these characteristics also influenced the prevalence of discrimination reported.

The sample synthesized did not always describe the health services sought or the type of provider encountered. When it was reported, most study participants were attempting to access gender-affirming interventions. Transgender adults, like their cisgender counterparts, interact with the healthcare system for a myriad of reasons unrelated to these interventions such as oral health, physical therapy, and sexual and reproductive health needs. Future studies are recommended to explore the variety of health services, settings, and professionals encountered.

The majority of data synthesized represented the experiences of transgender women from small purposive and convenience samples, leaving many trans communities underrepresented and unexplored such as transgender men and individuals who do not self-identify with the term transgender. The studies synthesized used an array of definitions for the term transgender; introducing selection bias that contributes to the gaps in knowledge regarding the healthcare experiences transgender subgroups. For example, the use of medical records to identify transgender adults who are using cross-sex hormones excludes those who are unable to access hormones and those who are not pursuing the gender-affirming medical intervention. These methodological concerns are also representative of the larger body of transgender health literature (Feldman et al., 2016; Reisner, Deutsch, et al., 2016); accordingly, research is needed to illuminate the healthcare experiences of transgender subgroups and reflects the diversity of gender identity and expression, and demographic characteristics found within the transgender population. Additionally, this synthesis uncovered the impact on healthcare utilization for transgender women who do not visually conform to social and cultural gender norms. This type of gender nonconformity may influence healthcare experiences for other transgender communities, thus studies are needed which integrate and examine the significance of gender (non)conformity.

2.6 Conclusion

Transgender adults experience unwelcoming healthcare environments, non-affirming healthcare professionals, and institutional practices that inhibit the delivery of

gender-affirming care. Transgender individuals utilizing healthcare face widespread adversity and barriers to safe and equitable healthcare. The integration of gender-affirming approaches in healthcare is integral in supporting the health of transgender adults. Research opportunities are rich, plentiful, and needed to help prioritize future research directions, aid in the development of interventions, and guide current and future public health initiatives and policies addressing the health of the transgender population.

3. Transgender Population Health: Behavioral Risk Factor Surveillance System Methodological Considerations

3.1 Introduction

Transgender individuals have an incongruence between the sex assigned to them at birth and their current gender identity or expression; conversely, those with an alignment between their assigned sex and their gender identity are classified as cisgender people (Institute of Medicine, 2011). Members of the transgender population who self-identify as gender nonconforming (GNC; e.g., as genderqueer or having a non-binary gender outside the traditional female-male binary) have a gender identity that is at odds with cultural and social norms (James et al., 2016). Transgender women, or male-to-female (MTF) individuals, are women who were assigned male at birth and currently identify as female or women; transgender men, or female-to-male (FTM) individuals, are men who were assigned female at birth and currently identify as male or men (Institute of Medicine, 2011). The U.S. transgender population is comprised of 1.4 million MTF, FTM, and GNC adults; these subgroups are diverse in gender identities, expressions, and roles (Meyer, Brown, Herman, Reisner, & Bockting, 2017). In 2011, the Institute of Medicine highlighted transgender health as a research priority and emphasized that there is a substantial need for rigorous studies addressing the health of transgender people (Institute of Medicine, 2011).

Today, the body of transgender health research is rapidly growing, yet knowledge on the health of transgender adults in the U.S. is largely based on non-experimental, cross-sectional studies using small nonprobability samples (Reisner, White, Bradford, &

Mimiaga, 2014; White Hughto & Reisner, 2016a) that are often recruited online (Bockting et al., 2013; James et al., 2016) or from community-health centers (Deutsch et al., 2015; Keo-Meier et al., 2015). Cross-sectional studies have been helpful in describing the status of transgender health-related phenomena, such as discrimination and mental health symptomology (Deutsch et al., 2015; James et al., 2016), but their findings do not reflect the heterogeneity of the population and have limited generalizability. Consequently, epidemiological studies characterizing the health status of the U.S. transgender population are lacking (Reisner, Deutsch, et al., 2016).

The exclusion of gender identity measures from electronic health records (EHR) and population-based surveys hinder advancements in transgender health knowledge. Gender identity measures are infrequently incorporated within the EHR, and gender identity is not routinely collected during patient interactions in healthcare settings (Deutsch et al., 2013; Haider et al., 2017). Similarly, nationally representative surveys, such as the U.S. Census, and health surveillance studies rarely include gender identity measures (Gender Identity in U.S. Surveillance Group, 2014).

Beginning in 2014, the Behavioral Risk Factor Surveillance System (BRFSS) offered all participating states and U.S. territories an optional survey module capturing data on sexual orientation and gender identity (Centers for Disease Control and Prevention, 2015a). BRFSS is an annual cross-sectional telephone survey conducted by the U.S. Centers of Disease Control and Prevention (CDC) and implemented in all states and participating U.S. territories to collect data on health and health behaviors of non-

institutionalized adults ages 18 years or older (Centers for Disease Control and Prevention, 2015a). Nineteen states and Guam implemented this module in 2014, and in 2015, 22 states included the optional module. With the inclusion of this optional module, BRFSS data represents a first look at the health status of the U.S. transgender population, albeit with limitations. The CDC has suggested that BRFSS data be analyzed with the sampling weights provided to account for the complex design of survey data and increase generalizability of sample results (Centers for Disease Control and Prevention, 2012). While this is a common approach with probability-based samples, the calculation of BRFSS sample weights relied heavily on sex-based data from the U.S. Census Bureau (Centers for Disease Control and Prevention, 2015c), which did not include gender identity measures.

In this report, we address the methodological challenges that arise when using BRFSS data to study transgender population health. By describing the 2015 BRFSS methodology including the underpinnings for the BRFSS sampling weights, we outline why BRFSS sampling weights are problematic when conducting transgender health analyses. Accordingly, we propose a methodological approach that address issues associated with the BRFSS sampling weights and improves the accuracy in parameter estimates derived from the survey data. Thereafter, we discuss methodological and conceptual factors for consideration by researchers and federal, national, and state agencies when collecting population-based data for transgender people.

3.2 2015 BRFSS: Methodological challenges

Obtaining representative data from the transgender population is fundamental to improving their health and well-being and advancing transgender health research. The addition of the BRFSS optional gender identity measure is a promising step towards better understanding transgender health; however, methodological concerns have emerged regarding the validity of data collected from transgender participants and its impact on the accuracy of population parameters derived from those data. In subsequent sections, we provide rationale substantiating concerns with the 2015 BRFSS sampling weights particularly when considering transgender health. We describe how measurement error engendered by BRFSS data collection procedures introduced misclassification bias that contributed towards problematic sampling weights for transgender participants. As a result, the application of the 2015 BRFSS sampling weights will generate biased and inaccurate estimates. Moreover, we propose that analyses using a matched-subject design may reduce bias associated with BRFSS sampling weights. By using data from the states that adopted the gender identity measure in 2015, we present a comparison of poor health status using two sampling methodological approaches (a matched-subject design without the use of BRFSS sampling weights, and the full BRFSS sample with sampling weights applied) to compare their impact of the two approaches on parameter estimates.

3.2.1 Measurement error and misclassification bias

Following BRFSS sample design and data collection standards, states obtained a probability sample of all households with landline telephones and cellular telephones (Centers for Disease Control and Prevention, 2016b). Although it is beyond the scope of

this report to examine BRFSS design weights and sampling procedures, BRFSS technical documentation are publically available online (Center for Disease Control and Prevention, 2015). BRFSS interviews were conducted at the state level by health personnel or contractors, and the BRFSS questionnaire was administered to participants using both landlines and cellular telephones (Centers for Disease Control and Prevention, 2016b).

The BRFSS interview began with a core set of standardized questions and was followed by optional modules and then any state-added questions. Data collected from the optional gender identity measure did not affect the interview schedule. For this module, participants were asked, “Do you consider yourself to be transgender?”, and if affirmed they were asked, “Do you consider yourself to be male-to-female, female-to-male, or gender nonconforming?” (Centers for Disease Control and Prevention, 2014). If participants asked how BRFSS defined transgender, the interviewer provided, “Some people describe themselves as transgender when they experience a different gender identity from their sex at birth. For example, a person born into a male body, but who feels female or lives as a woman would be transgendered. Some transgender people change their physical appearance so that it matches their internal gender identity. Some transgender people take hormones and some have surgery. A transgender person may be of any sexual orientation – straight, gay, lesbian, or bisexual”; and the definition provided for GNC, “Some people think of themselves as gender nonconforming when they do not identify only as a man or only as a woman” (Centers for Disease Control and Prevention,

2014, p.69). The gender identity module identified 369 MTF, 239 FTM, and 156 GNC adults from 22 states.

BRFSS participants were not asked their sex, instead interviewers determined it by the participant’s vocal timbre (Centers for Disease Control and Prevention, 2014). By comparing the gender identity (MTF, FTM, and GNC) of participants who self-identified as transgender and the sex assigned to them by interviewers, we discovered measurement error that produced misclassification bias. Subsequently, 74% of transgender women were misclassified as cisgender men and 66% of transgender men were misclassified as cisgender women (Table 3). It is not possible to determine the sex classification accuracy for the GNC participants because, per the BRFSS definition, these individuals do not identify as a man or woman. This measurement error and misclassification bias that ensued influenced the sex-specific algorithm used to create BRFSS sampling weights (Centers for Disease Control and Prevention, 2016b).

Table 3: 2015 BRFSS Sex Classification by Vocal Timbre

Sex assignment	Male-to-Female (<i>N</i> =369)	Female-to-Male (<i>N</i> =239)	Gender Nonconforming (<i>N</i> =156)
Male	272 (73.7%)	82 (34.3%)	79 (50.6%)
Female	97 (26.3%)	157 (65.7%)	77 (49.4%)

n (%). Data represents the transgender-identified 2015 BRFSS participants. The 22 states that included the optional gender identity and sexual orientation module were: CO, CT, DE, GA, HI, ID, IL, IN, IO, KA, MD, MA, MN, MI, NV, NY, OH, PA, TX, VA, WV, and WI. BRFSS: Behavioral Risk Factor Surveillance System.

3.2.2 Sampling weight methodology

In 2011, BRFSS began using a weighting methodology known as iterative proportional fitting, or raking, which allowed for the incorporation of additional

demographic variables into the statistical weighting process than had previously been utilized (Centers for Disease Control and Prevention, 2012). Through a series of data processing-intensive iterations, raking adjusted each participant's sampling weight based on ranking control variables, or margins, until weighted frequencies and population frequencies for each margin converged (Centers for Disease Control and Prevention, 2012). Raking required the use of auxiliary population information; BRFSS raked the sample data using intercensal population estimates from the Nielsen Company, which were derived from the U.S. Census Bureau's decennial census, and sex-specific data on education, marital status, and tenure from the U.S. Census Bureau's 2009-2013 American Community Survey (ACS) (Centers for Disease Control and Prevention, 2015c). Neither the ACS or decennial census included gender identity measures (United States Census Bureau, 2008, 2017); however, data from the Bureau were an integral part of BRFSS weighting methodology (Centers for Disease Control and Prevention, 2016b).

Throughout BRFSS technical documentation, the terms sex and gender are used interchangeably; however, the U.S. Census Bureau, ACS, and Nielsen Company data are based on sex (The Nielsen Company, 2010; United States Census Bureau, 2016, 2017). BRFSS data were raked by "categories of age by gender [sic], detailed race and ethnicity groups, education levels, marital status, regions within states, gender [sic] by race and ethnicity, telephone source, renter or owner status, and age groups by race and ethnicity" (Centers for Disease Control and Prevention, 2016b, p.3). The CDC has suggested that BRFSS data be analyzed with the sampling weights provided to increase the external validity and generalizability of the sample results (Centers for Disease Control and

Prevention, 2012). However, due to the sex-specific raking algorithm used, which was contingent on the accuracy of BRFSS participants' sex classification, BRFSS sampling weights were not able to adequately remove bias and ensure data are representative of the population.

Measurement error and sex misclassification contributed to inaccurate sampling weights for the transgender participants. Data from the 74% of transgender women who were misclassified had their data raked using population-level data for cisgender males, and population-level data for cisgender females were used to rake the 66% of transgender men who were misclassified (Table 3). Resulting parameter point and interval estimates derived from the weighted data may be affected. Hence, the sex misclassification bias has the potential to impact the validity of statistical conclusions regarding transgender people.

3.3 Addressing problematic sampling weights

Alternative methodological approaches are needed to address the problematic BRFSS sampling weights. Modifying a case-control study design, an approach used to investigate a dichotomous disease and/or exposure variable, provides one way to account for the drawbacks when using BRFSS sampling weights. In traditional case-control studies, cases are study subjects that were exposed to or have the condition under study, and controls are subjects who lack the condition and are also a representative sample of the cases selected. Controls are matched to cases by extraneous variables known *a priori* to be correlated with the condition under study (Kupper, Karon, Kleinbaum, Morgenstern, & Lewis, 1981). When exploring differences between transgender (“case”)

and cisgender (“control”) participants a matched-subject design can create a more balanced sample that mitigates the effects of confounders, increases the accuracy of parameter estimates, and addresses the systematic bias attributed to the BRFSS sampling weights (Kupper et al., 1981).

Properly matching transgender cases with cisgender controls is a key consideration for a matched-subject design; it is also a challenging task. Currently, there are no available data suggesting that the health of a transgender adult by gender identity is equivalent to that of a cisgender adult with the same sex assignment (e.g., transgender man:cisgender female). Taylor recommends not using more than four controls, as the “marginal return rapidly diminishes as the number of controls per case increases” (Taylor, 1986, p. 29). One option is to match a single transgender case with two cisgender controls, one cisgender male (CGM) and one cisgender female (CGF) (Reisner, White, et al., 2014). Furthermore, choosing the optimal variables for the matching process is critical. Conceptually, it may be important to consider the study aims and health outcome under study in terms of identifying an appropriate matching algorithm.

3.4 Illustrative example

Using data from the 22 states that adopted the 2015 BRFSS gender identity module, we present a comparison of poor health status from two sampling methodological approaches to illustrate their differential impact on population parameter estimates. The first approach utilized a 1:4 matched-subject design (each transgender participant was matched to two CGMs and two CGFs) without the use of sampling

weights, while the second approach included all transgender and cisgender participants with sampling weights applied.

The goal of this illustration was to estimate the overall prevalence of poor health status, present the adjusted odds ratios (aOR) with their 95% confidence intervals/limits (CI/L) for each of the five study groups (MTF, FTM, GNC, CGM, and CGF) using the two approaches, and then compare the pattern of results from these two methods. Poor health status was derived from a single BRFSS item that asked participants to rate their general health as *excellent, very good, good, fair, or poor*. From this, a dichotomous poor health status variable was created and coded as 0 (excellent, very good, or good) or 1 (fair or poor). This variable was operationalized to be consistent with prior research that showed its strong positive association with morbidity and mortality (Hatzenbuehler et al., 2014; Subramanian, Kawachi, & Kennedy, 2001).

3.4.1 Analysis sample

Two analysis samples were utilized in our example (Table 4). The weighted analysis sample included all transgender and cisgender participants from the 22 states. A matched-subject design was used to obtain a 1:4 matched analysis sample in which each transgender participant was matched with two CGMs and two CGFs. Matching variables were: state, metropolitan status area, age, and race/ethnicity. These variables were selected based on their known influence on health outcomes (Cagney, Browning, & Wen, 2005; Ferraro, Schafer, & Wilkinson, 2016). Participant's zip code was used to determine metropolitan status area (inside/outside of a metropolitan status area); age was partitioned

into 5-year increments (18-24 to 70-74, ≥ 80); and race/ethnicity was categorized as white, non-Hispanic; Black, non-Hispanic; Hispanic; and any other race/ethnicity.

3.4.2 Statistical plan

A logistic regression model was fit for each analysis sample to determine whether study group predicted poor health status, after covarying for age, race, educational attainment, employment status, and health insurance. Analyses that applied BRFSS sampling weights also accounted for the survey's probability sampling design. Annual household income was excluded as a covariate due to the missing rate per group exceeding 12%.

Non-directional statistical tests were performed using SAS 9.4[®] with the level of significance set at 0.05 for the overall study group and covariate effects. To further evaluate differences in poor health status among the five study groups, *a priori* pairwise comparisons of the groups were conducted. If the overall Wald chi-square value for study group from the logistic regression was statistically significant ($P \leq 0.05$), two-sided multiple comparisons were conducted using a closed test procedure with significance set at 0.05 for each test. If the overall study group result was not significant ($P > 0.05$), a more conservative sequential rejective approach (Koch & Gansky, 1996) was planned to safeguard against a Type I error.

The overall missing rate for poor health status ranged from 0.0-0.4% per group for each analysis sample. With covariates incorporated in the model, the matched analysis

Table 4: 2015 BRFSS Demographics Characteristics and Poor Health Status for the Matched and Weighted Analysis Samples^a

	Matched analysis (N=3,820) ^b				
	MTF (N=369)	FTM (N=239)	GNC (N=156)	CGM (N=1,528)	CGF (N=1,528)
Age	369	239	156	1,528	1,528
Mean (SEM)	53.9 (0.9)	54.5 (1.1)	52.8 (1.4)	53.9 (0.5)	53.9 (0.5)
Race/ethnicity	369	239	156	1,528	1,528
Racial/ethnic minority ^d	106 (28.7)	73 (30.5)	52 (33.3)	461 (30.2)	462 (30.2)
White, non-Hispanic	263 (71.3)	166 (69.5)	104 (66.7)	1,067 (69.8)	1,066 (69.8)
Educational attainment	368	238	156	1,523	1,521
High school graduate or less ^e	186 (50.6)	123 (51.7)	74 (47.4)	601 (39.4)	557 (36.6)
Post-secondary school	182 (49.5)	115 (48.4)	82 (52.6)	922 (60.6)	964 (63.4)
Employment status	366	234	154	1,514	1,516
Unemployed ^f	205 (56.0)	129 (55.1)	89 (57.8)	681 (45.0)	812 (53.6)
Employed	161 (44.0)	105 (44.9)	65 (42.2)	833 (55.0)	704 (46.4)
Annual household income	318	203	135	1,326	1,259
<\$20K	82 (25.8)	43 (21.2)	34 (25.2)	219 (16.5)	245 (19.5)
\$20K to <\$50K	114 (35.9)	91 (44.8)	50 (37.0)	452 (34.1)	448 (35.6)
≥\$50K	122 (38.4)	69 (34.0)	51 (37.8)	655 (49.4)	566 (45.0)
Health insurance status	363	237	154	1,520	1,525
Uninsured	28 (7.7)	32 (13.5)	19 (12.3)	150 (9.9)	129 (8.5)
Insured	335 (92.3)	205 (86.5)	135 (87.7)	1,370 (90.0)	1,396 (91.5)
Poor health status ^g	369	238	156	1,525	1,525
Poor health	86 (23.3)	50 (21.0)	50 (32.1)	280 (18.3)	269 (17.6)
Good health	283 (76.8)	188 (79.0)	106 (68.0)	1,245 (81.7)	1,256 (82.5)
	Weighted analysis (N=167,059) ^c				
	MTF (N=369)	FTM (N=239)	GNC (N=156)	CGM (N=70,123)	CGF (N=96,172)
Age	369	239	156	70,123	96,172
Mean (SEM)	46.0 (1.3)	43.3 (1.3)	43.2 (1.6)	47.2 (0.1)	49.0 (0.1)
Race/ethnicity	369	239	156	70,123	96,172
Racial/ethnic minority ^d	106 (40.1)	73 (50.6)	52 (48.1)	14,604 (31.6)	20,431 (31.7)
White, non-Hispanic	263 (59.9)	166 (49.4)	104 (51.9)	55,519 (68.4)	75,741 (68.3)
Educational attainment	368	238	156	69,912	95,917
High school graduate or less ^e	186 (59.5)	123 (74.7)	74 (45.8)	23,909 (43.5)	32,848 (40.6)
Post-secondary school	182 (65.1)	115 (25.3)	82 (54.3)	46,003 (56.5)	63,069 (59.3)
Employment status	366	234	154	69,692	95,601
Unemployed ^f	205 (51.4)	129 (46.5)	89 (52.3)	29,869 (34.9)	52,765 (49.3)
Employed	161 (48.6)	105 (53.5)	65 (47.7)	39,823 (65.1)	42,836 (50.7)

	Weighted analysis (N=167,059) ^c				
	MTF (N=369)	FTM (N=239)	GNC (N=156)	CGM (N=70,123)	CGF (N=96,172)
Annual household income	318	203	135	61,581	79,185
<\$20K	82 (29.5)	43 (15.8)	34 (22.4)	7,727 (14.2)	14,336 (19.4)
\$20K to <\$50K	114 (39.0)	91 (56.8)	50 (30.9)	19,554 (32.5)	27,704 (34.1)
≥\$50K	122 (31.4)	69 (27.4)	51 (46.7)	34,300 (53.3)	37,145 (46.5)
Health insurance status	363	237	154	69,825	95,901
Uninsured	28 (17.6)	32 (37.1)	19 (14.1)	5,388 (12.5)	5,350 (9.8)
Insured	335 (82.4)	205 (62.9)	135 (85.9)	64,437 (87.5)	90,551 (90.2)
Poor health status ^g	369	238	156	69,918	95,888
Poor health	86 (20.4)	50 (14.6)	50 (30.0)	11,927 (16.1)	17,431 (17.5)
Good health	283 (79.6)	188 (85.4)	106 (70.0)	57,991 (84.0)	78,457 (82.5)

^aNumber of participants in study group with data available (*N*) reported for each variable. For categorical variables, the number (*n*) and percent (%) of *N* are provided; the actual *n* and the weighted percent are reported for the weighted analysis sample. ^bEach transgender participant was matched with 2 cisgender males and 2 cisgender females. ^cAll participants from the 22 states that included the gender identity module were included in the weighted analysis sample. ^dRacial/ethnic minority = participants who did not report being white, non-Hispanic. ^eHigh school graduates or less also include those participants with a GED. ^fUnemployed = participants who were retired, a student, unable to work, a homemaker, or out of work. ^gPoor health status = original BRFSS item that asked participants to rate their general health as *excellent, very good, good, fair, or poor*. From this, a dichotomous primary outcome variable of poor health status was created and coded as good health = 0 (excellent, very good, or good) or poor health = 1 (fair or poor). BRFSS: Behavioral Risk Factor Surveillance System; CGF: cisgender female; CGM: cisgender male; FTM: female-to-male or transgender male; GNC: gender nonconforming; MTF: male-to-female or transgender female; SEM: standard error of the mean.

included 98.0% of the matched-subject sample and the weighted analysis utilized 98.6% of the weighted analysis sample. The missing rate per study group ranged from 1.4% (CGF, weighted) to 3.8% (FTM, both samples). Since the missing rate was less than 4% per group, we elected to not apply imputation methods.

3.4.3 Results

Descriptive statistics for demographic characteristics, covariates in the regression models, and self-rated poor health status unadjusted for covariates are summarized for the five study groups of each analysis sample in Table 4. The impact of sampling weights on these summary statistics can be observed in this table, particularly among the three transgender subgroups in which the sample size per group did not change based on analysis sample.

Table 5 provides the logistic regression results for both analysis samples. Study group was a significant predictor of poor health status, after adjusting for covariates in both analysis samples. The covariate results were similar for both analysis samples, with the exception of health insurance. The likelihood of poor health status was significantly associated with being older, a racial/ethnic minority, unemployed, and having a high school/GED education or less. Not having health insurance, however, was significantly associated with poor health status in the weighted analysis only.

The overall effect of study group was statistically significant for both analysis samples; thus, subsequent *a priori* pairwise comparisons were conducted with significance set at 0.05 for each contrast. Figure 2 presents the results for the study group contrasts for the poor health outcome, and the aORs (parameter point estimate) with their 95% CIs/CLs (parameter interval estimate) for each pairwise contrast for both analysis samples. Among three pairwise transgender subgroup comparisons, the matched and weighted analysis samples both indicated no significant difference between MTFs and FTMs. Relative to GNCs, the matched analysis sample revealed that both MTFs (aOR=0.65, 95% CI: 0.42, 1.01) and FTMs (aOR=0.54, 95% CI: 0.33, 0.88) had significantly lower odds of poor health status; whereas, only FTMs (aOR=0.33, 95% CL: 0.12, 0.91) had significantly lower odds of poor health status in the weighted analysis.

The contrasts between the transgender and cisgender subgroups in the matched analysis sample indicated that GNCs were significantly more likely to have poor health

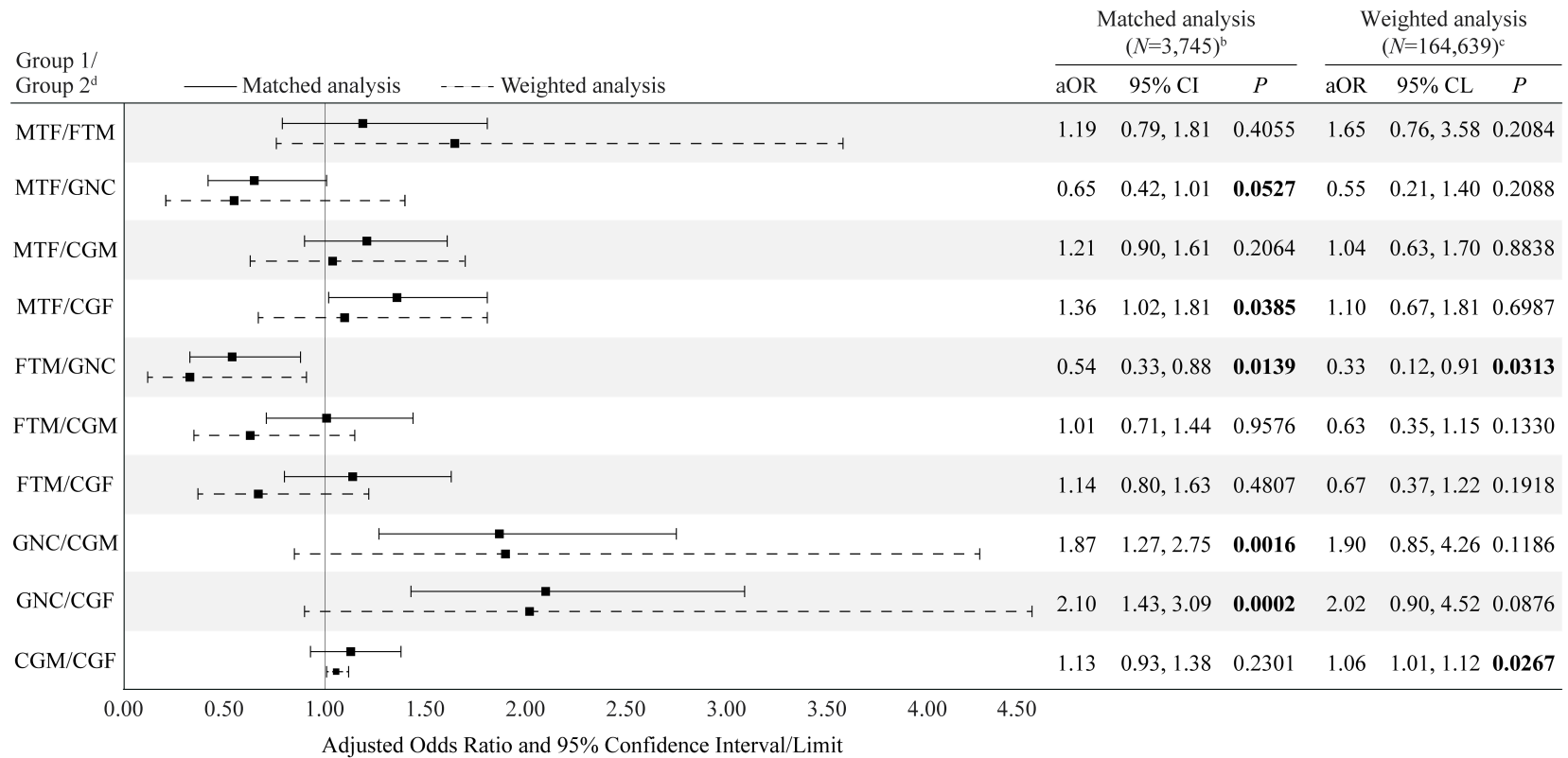
Table 5: Logistic Regression Results for the Poor Health Outcome

Analytic model	Matched analysis (N=3,745) ^a				Weighted analysis (N=164,639) ^b			
	χ^2	<i>P</i> ^c	aOR	95% CI	<i>F</i>	<i>P</i>	aOR	95% CL
Study group	16.3	0.0026			2.41	0.0471		
Age	17.3	<0.0001	1.01	1.01, 1.02	488.5	<0.0001	1.02	1.02, 1.02
Race/ethnicity								
Racial/ethnic minorities	13.0	0.0003	1.41	1.17, 1.71	266.8	<0.0001	1.66	1.57, 1.77
White, non-Hispanic (ref)								
Educational attainment								
High school/GED graduate or less	35.0	<0.0001	1.69	1.42, 2.01	673.8	<0.0001	2.00	1.90, 2.11
Post-secondary school (ref)								
Employment status								
Unemployed	123.0	<0.0001	3.07	2.52, 3.74	955.0	<0.0001	2.58	2.43, 2.74
Employed (ref)								
Health insurance status								
Uninsured	1.60	0.2086	1.21	0.90, 1.62	44.8	<0.0001	1.42	1.28, 1.57
Insured (ref)								

aOR: Adjusted odds ratio; CI: Confidence intervals; CL: Confidence limits. ^aMatched analysis: χ^2 =Wald chi-square and *P*-value from the logistic regression. ^bWeighted analysis: *F*- and *P*-values from the logistic regression that accounted for complex survey design and sampling weights. ^cBold indicates statistical significance.

status than CGMs (aOR=1.87, 95% CI: 1.27, 2.75) and CGFs (aOR=2.10, 95% CI: 1.43, 3.09); additionally, MTFs were significantly more likely to have poor health status relative to CGFs (aOR=1.36, 95% CI: 1.02, 1.81). The weighted analysis sample revealed only one significant contrast; CGMs were more likely to have poor health status (aOR=1.06, 95% CL: 1.01, 1.12) than CGFs.

The width of the confidence interval increased when BRFSS sampling weights were applied, with the exception of the CGM/CGF comparison. Given that the transgender subgroups consisted of the same transgender BRFSS



^aPoor health status outcome was derived from a single BRFSS item that asked participants to rate their general health as excellent, very good, good, fair, or poor. From this, a dichotomous primary outcome variable of poor health status was created and coded as 0 (excellent, very good, or good) or 1 (fair or poor). Bold indicates statistical significance. ^bEach transgender participant was matched with 2 cisgender males and 2 cisgender females. P-value from the logistic regression. ^cAll participants from the 22 states that included the gender identity module were included in the weighted analysis sample. P-value from logistic regression that accounted for complex survey design and sampling weights. ^dGroup 1/Group 2: pairwise study group comparisons listed on the left side of the figure. Abbreviations: OR, adjusted odds ratio; CGF, cisgender female; CGM, cisgender male; CI, confidence intervals; CL, confidence limits; FTM, female-to-male or transgender male; GNC, gender nonconforming; MTF, male-to-female or transgender female.

Figure 2: Multivariable Logistic Regression Models: Study Group Pairwise Comparisons of Poor Health Status

participants across both analysis samples, the increase in confidence intervals and variation in the aORs were particularly notable for the transgender subgroup comparisons.

3.5 Discussion

The BRFSS optional gender identity module provides researchers an unprecedented opportunity to conduct comparative studies among transgender communities and with their cisgender counterparts, including exploring the influence of individual factors, such as gender identity and socioeconomic position, on health status. However, it is important to consider the limitations of BRFSS methods, including those recommended for data analysis. The 2015 BRFSS data collection procedures introduced measurement error and sex misclassification that contributed towards problematic BRFSS sampling weights. Our findings suggest that BRFSS sampling weights can result in biased parameter estimates when evaluating factors that may influence transgender health. As expected, narrower confidence intervals were generated by using a matched-subject design versus the weighted analysis sample. However, the impact of BRFSS sampling weights is particularly evident in the pairwise comparisons of transgender subgroups, as both analysis samples included the same transgender participants and negligible differences in the sample sizes within each subgroup. In these contrasts, the application of BRFSS sampling weights contributed towards not only inaccurate poor health status estimates, but also less precision in the parameter intervals. By using a matched-subject design, the confidence intervals were narrower, thus shifting the aORs and causing the aORs to be discrepant.

Generalizations made from the weighted analysis sample may obscure the need for healthcare policy and clinical interventions aimed to promote health and prevent illness for transgender adults, particularly MTF and FTM individuals. Additional implications may surface in analyses using BRFSS data when exploring other health outcomes and associations with socioeconomic characteristics. Limitations of our findings include the exclusive focus on poor health status, included covariates, and the approach taken to establish a matched-subject analysis sample. When exploring transgender health, the use of BRFSS sampling weights may inadvertently portray a biased depiction of the health and health behaviors of transgender adults in the U.S., thus leading to erroneous clinical implications.

A matched-subject design provided a better indication between being transgender and having poor health, above and beyond the covariates that are known to influence health. It provided more accurate parameter point estimates, higher precision in parameter interval estimates, and study group differences were more apparent. The approach utilized to create our matched-subject analysis sample will help researchers match cisgender controls to transgender cases in studies using BRFSS data and in future studies that explore individuals who do not identify within binary distinctions of gender.

3.6 Future considerations

Transgender health research is hindered by the lack of gender identity measures in health-related research and studies by the U.S. Census Bureau. Methodology of current and future public health surveillance and population surveys should be reviewed to help

reduce systematic bias and to increase the validity of data collected from diverse transgender people. Data collection approaches are needed that routinely include transgender-inclusive measures by all researchers, federal, national, and state agencies. Furthermore, in cohort studies, gender identity should be assessed during each wave of data collection, as it may evolve and change over time.

The Gender Identity in U.S. Surveillance group recommends using a two-step method for identifying transgender people, asking assigned sex and current gender identity (Gender Identity in U.S. Surveillance Group, 2014). For example: 1) What sex were you assigned at birth, on your original birth certificate? (male or female) and 2) How do you describe yourself? (male, female, FTM, MTF, GNC, a different identify). By capturing both sex assignment and current gender identity, the two-step approach can minimize misclassification of transgender people, identify transgender respondents who may not use the term transgender when describing themselves, and be more effective in gathering accurate and useful information to improve the health of transgender people.

4. The Health Status of Transgender and Gender Nonconforming Adults in the United States

4.1 Introduction

The term transgender, or trans, describes an array of individuals whose sex assigned at birth differs from their current gender expression or gender identity, or one's sex of being male, female, neither, or both. In contrast, cisgender is an adjective used to describe individuals with a gender identity that aligns with their sex assigned at birth (American Psychological Association, 2015). Transgender individuals who were assigned male at birth and currently identify as women or female are male-to-female (MTF) or transgender women, and those assigned female at birth and currently identify as men or male are female-to-male (FTM) or transgender men (American Psychological Association, 2015). People who self-identify as gender nonconforming (GNC) are members of the transgender population who have a gender identity that is inconsistent with cultural and social expectations (e.g., genderqueer or having a non-binary gender outside the traditional female-male binary) are also members of the transgender population (James et al., 2016). Some, but not all, trans people pursue gender-affirming medical interventions such as cross-sex hormones and/or gender-affirming surgeries and other body modifications (Coleman et al., 2012; Reisner, Radix, et al., 2016). In the United States, the transgender population is comprised of an estimated 1.4 million MTF, FTM, and GNC adults, which is based on data from the Centers for Disease Control and Prevention's (CDC) 2014 Behavioral Risk Factor Surveillance System (BRFSS), the first time a national population-based survey provided gender identity measures to identify

transgender participants (Centers for Disease Control and Prevention, 2015a; Conron, Landers, Reisner, & Sell, 2014; Gender Identity in U.S. Surveillance Group, 2014). For this study, we use the term transgender to represent the heterogeneity of individuals illustrating the diversity of gender identities, expressions, and roles found within transgender and gender nonconforming communities.

The transgender population experience health disparities and social inequalities associated with personal characteristics (age, race/ethnicity, sexual orientation, and marital status) and socioeconomic position (educational attainment, employment status, income, and health insurance) (Conron et al., 2012; James et al., 2016; Meyer et al., 2017; Winter et al., 2016), factors known to impact the health of the general public (Hatzenbuehler et al., 2013; Link & Phelan, 1995; Marmot, 2004). To date, the majority of transgender health research has taken a narrow view of health by focusing on mental health (Bockting et al., 2013; Testa et al., 2014), cross-sex hormone therapy (Deutsch et al., 2015; White Hughto & Reisner, 2016b), and absence of engagement in health-harming behaviors (Blosnich et al., 2013; Horvath et al., 2014; Klein & Golub, 2016). Physical health has most often been examined in relation to HIV/AIDS in transgender health research (Brennan et al., 2012; Santos et al., 2014; Wilson et al., 2013), or gender-affirming medical interventions (Asscheman et al., 2011; Asscheman et al., 2014; White Hughto & Reisner, 2016b). Despite limitations, these studies contribute to our limited understanding of transgender health and offer as evidence that transgender subgroups have distinct health risks and outcomes. Findings also indicate that transgender adults have unfavorable risk factors (James et al., 2016; Winter et al., 2016), including

disproportionate levels of discrimination in healthcare settings (Cruz, 2014; Miller & Grollman, 2015) and worse health than their cisgender peers (Brown & Jones, 2014, 2016); however, health-related knowledge representing the diversity of gender identities and expressions found within the transgender population is sparse, leaving many communities underrepresented and unexplored (Bockting et al., 2016; Feldman et al., 2016; Reisner, Deutsch, et al., 2016).

Contemporary, empirically-based knowledge of transgender health is scant and lacks understanding of physical health, health problems or impairments, chronic health conditions, and the impact of individual factors known to affect health outcomes in other vulnerable populations such as socioeconomic position and sexual orientation (Bowleg, 2012; MacCarthy et al., 2015). Despite a growing body of health-related literature, additional research is needed to advance our understanding of health among transgender subgroups such as MTF, FTM, and GNC adults. This knowledge will help prioritize health needs and identify pathways to reduce the health inequities plaguing the transgender population in the U.S. (Feldman et al., 2016; Institute of Medicine, 2011).

4.2 Specific aims

The overall goal of this study is to increase understanding of the relationships among individual factors (personal characteristics and socioeconomic position) and health status with five study groups: three transgender subgroups (MTF, FTM, GNC) and their cisgender male (CGM) and cisgender female (CGF) counterparts. The specific aims were to: (1) describe and compare the personal characteristics, socioeconomic position,

and health status of five study groups (MTF, FTM, GNC, CGM, and CGF), and (2) determine the differential effects of individual factors on health status in the five study groups. The second aim allowed us to: a) evaluate differences in health status between the five study groups, covarying for the effects of individual factors and their interactions with study group, and (b) examine the influence of individual factors and their interactions with study group on health status.

4.3 Methods

This study used a descriptive, observational, and cross-sectional 1:4 matched-study design to perform a secondary analysis of data from the Centers for Disease Control and Prevention's (CDC) 2015 Behavioral Risk Factor Surveillance System (BRFSS). This secondary analysis compared the five study groups (MTF, FTM, GNC, CGM, and CGF), individual factors, and health status outcomes. Individual factors included personal characteristics (age, race/ethnicity, sexual orientation, and marital status) and socioeconomic position (educational attainment, employment status, annual household income, and health insurance status). Health status outcomes were self-rated general health, health-related quality of life, chronic health conditions, and health problems or impairments. Three additional covariates were included in the analytic models that accounted for the influence of state-level factors (discriminatory laws/policies and percent voting Republican) and the effects of seasonal variation which occurred during BRFSS data collection.

4.3.1 The 2015 Behavioral Risk Factor Surveillance System database

The BRFSS, an annual cross-sectional telephone survey conducted by the CDC and implemented in all states and participating U.S. territories, collected data on the health and health behaviors of non-institutionalized adults, aged 18 years or older, who resided in the U.S. (Centers for Disease Control and Prevention, 2016b). Interviews were conducted at the state-level where data collection was a probability sample of all households with landline and cellular telephones (Centers for Disease Control and Prevention, 2016b). All BRFSS interviews began with a core set of standardized questions and were followed by optional modules and state-added questions. Data collected from the optional modules or state-added items did not affect the interview schedule (Centers for Disease Control and Prevention, 2016b)

In 2015, an optional module assessing gender identity and sexual orientation was available for use for the second consecutive year (Centers for Disease Control and Prevention, 2015b). For the gender identity portion of this module, participants were asked, “Do you consider yourself to be transgender?”, and if affirmed they were asked, “Do you consider yourself to be male-to-female, female-to-male, or gender nonconforming?” (Centers for Disease Control and Prevention, 2014, p. 69). If participants asked how BRFSS defined transgender, the interviewer provided, “Some people describe themselves as transgender when they experience a different gender identity from their sex at birth. For example, a person born into a male body, but who feels female or lives as a woman would be transgendered. Some transgender people change their physical appearance so that it matches their internal gender identity. Some transgender people take hormones and some have surgery. A transgender person may be

of any sexual orientation – straight, gay, lesbian, or bisexual”; and the definition provided for GNC, “Some people think of themselves as gender nonconforming when they do not identify only as a man or only as a woman” (Centers for Disease Control and Prevention, 2014, p.70).

In 2015, 22 (Colorado, Connecticut, Delaware, Georgia, Hawaii, Idaho, Illinois, Indiana, Iowa, Kansas, Maryland, Massachusetts, Minnesota, Missouri, Nevada, New York, Ohio, Pennsylvania, Texas, Virginia, West Virginia, and Wisconsin) adopted this module and collected data on 764 transgender adults, which included 369 MTF, 239 FTM, and 156 GNC adults (Centers for Disease Control and Prevention, 2016a).

4.3.2 Analysis sample

A modified case-control study, or matched-subject design, was used to create the analytic sample. This approach generated more accurate parameter point estimates, higher precision in parameter interval estimates, (Kupper et al., 1981) and more apparent study group differences than using the full BRFSS sample and BRFSS sampling weights, as detailed in chapter three.

Each transgender participant (“case”) was matched with four cisgender participants (“controls”), two cisgender males and two cisgender females on four *a priori* variables (age, state, metropolitan status area [MSA], and race/ethnicity) known to influence health outcomes (Cagney et al., 2005; Ferraro et al., 2016). BRFSS collected the participant’s zip code, which BRFSS then converted into a MSA (inside/outside of a MSA). However, 21 out of 22 states sampled disproportionately for smaller geographic

regions; therefore, BRFSS suppressed MSA data to protect the confidentiality of participants within these areas (Centers for Disease Control and Prevention, 2016b). As a result, participants were first matched on state and then MSA (inside a MSA, outside a MSA, and suppressed). Age was partitioned into 5-year increments (18-24 to 70-74, \geq 80), and race/ethnicity was operationalized as white, non-Hispanic; Black non-Hispanic; Hispanic; and any other race/ethnicity. By employing a 1:4 matched-subject design, the analytic sample by design consisted of 369 MTF, 239 FTM, 156 GNC, 1528 CGM, and 1528 CGF adults.

4.3.3 Measures

Tables 6 and 7 detail the study variables, their descriptions and coded values. The bolded items in Table 6 indicate the key study variables evaluated in the analytic models, which included study group, individual and state-level factors, as well as seasonality measures. The bolded health status items in Table 7 represent the five primary health status outcomes. Non-bolded variables on each table were used to describe the sample characteristics and/or derive key study variables or primary health outcomes.

The factor of main interest was study group, which represents five different groups— MTF, FTM, GNC, CGM, and CGF. Transgender study participants were classified as MTF, FTM, or GNC based on their response to the BRFSS gender identity measure. BRFSS participants who indicated that they were not transgender were classified as cisgender. Cisgender participants were designated as CGM or CGF based on the sex assigned to them by BRFSS interviewers.

Table 6: Coding and Description for Study Variables: Study Populations, Individual and State-Level Factors, and Seasonality

Category	Variable	Coding and Description
<i>Study populations</i>	Study group	[1=male-to-female (MTF), 2=female-to-male (FTM), 3=gender nonconforming (GNC), 4=cisgender male (CGM), 5=cisgender female (CGF)] <i>Do you consider yourself to be transgender? If yes, do you consider yourself to be: male-to-female, female-to-male, or gender nonconforming? If no, BRFSS interviewer determined sex by vocal timber.</i>
<i>Individual factor</i>		
Personal characteristics	Age	Age, in years. Range: 18-79, ≥80 (reference: ¹ descending from oldest to youngest in regression models)
	Race/ethnicity	1=White, Non-Hispanic (NH); 2=Black, NH; 3=Hispanic; 4=other race/ethnicity, NH (American Indian/Alaska Native; Asian only, NH; Native Hawaiian/other Pacific Islander only, non-NH; other race only, NH; or multiracial, NH)
	Racial/ethnic minority	1=racial/ethnic minority, 0=racial/ethnic majority (reference) <i>Racial/ethnic minority=Black, NH; Hispanic; other race/ethnicity. Racial/ethnic majority=White, NH</i>
	Geographic classification	[0=suppressed, 1=not in MSA, 2=in MSA] <i>BRFSS used participant zip code to determine if in/out of a MSA, or BRFSS suppressed for participant confidentiality.</i>
	Sexual orientation	[1=straight/heterosexual, 2=lesbian or gay, 3=bisexual, 4=other, 5=don't know/not sure] <i>Do you consider yourself to be: straight, lesbian or gay, bisexual, other, or don't know/not sure?</i>
	Sexual minority	1=lesbian or gay, bisexual, other, and don't know/not sure; 0=heterosexual (reference)
	Marital status	1=married, 2=divorced, 3=widowed, 4=separated, 5=never married, 6=member of an unmarried couple
Socioeconomic position	Unmarried	1=divorced, widowed, separated, never married, 0=married and member of an unmarried couple (reference)
	Educational attainment	[1=some high school or less, 2=high school/GED graduate, 3=some college, 4=college graduate] <i>Highest grade or year of school completed.</i>
	High school graduate or less	1= high school/GED graduate or less, 0=some college or college graduate (reference)
	Employment status	1=employed for wages/self-employed, 2=out of work, 3=homemaker, 4=student, 5=retired, 6=unable to work
	Unemployed	1=out of work, unable to work, retired; 0=employed, homemaker, student (reference)
	Annual household income	[1=<\$20K, 2=\$20K to <\$50K, 3=≥\$50K] <i>Annual household income from all sources.</i>
	Low income	1=<\$20K 0=≥\$20k (reference)

Category	Variable	Coding and Description
	Health insurance status	[1=yes, 0=no] <i>Do you have any kind of health care coverage, including health insurance, prepaid plans such as HMOs, government plans such as Medicare, or Indian Health Service?</i>
	Uninsured	1=yes, 0=no (reference)
<i>State-level factor</i>	Discriminatory laws/policies²	[1=yes, 0=no (reference)] <i>Does state have any laws or policies that harm or deliberately targets transgender people?</i>
	Percent voting Republican³	[Range: 27.84%–62.30%] <i>Proportion of voters who voted for the Republican candidate in the 2012 presidential election.</i>
<i>Seasonality</i>	Winter/Fall	[1=yes, 0=no (reference)] <i>BRFSS data collection occurred during Winter/Fall (September–February).</i>

Description of variables provided in italics. Bold items represent key study measures used in analytic models. ¹Reference=reference group for the logistic regression models.

²Discriminatory laws/policies from Movement Advancement Project (2015). ³Percentage voting Republican data from the Federal Election Commission (2013).

Table 7: Coding and Description for Study Variables: Health Status Outcomes

Category	Outcome	Type	Coding and Description
<i>Self-rated general health</i>	Fair/poor health	Primary	[1=fair or poor self-rated general health, 0=excellent, very good, or good self-rated health] <i>Would you say your general health is excellent, very good, good, fair, or poor?</i>
<i>Health-related quality of life</i>	Physical unhealthy days	Descriptive ¹	Range: 0–30 days. <i>Thinking about your physical health, which includes physical illness and injury, for how many days during the past 30 days was your physical health not good?</i>
	Frequent physical unhealthy days	Primary	1= \geq 5 physical unhealthy days during the past 30 days, 0= 0–5 days
	Mental unhealthy days	Descriptive	Range: 0–30 days. <i>Thinking about your mental health, which includes stress, depression, and problems with emotions, for how many days during the past 30 days was your mental health not good?</i>
	Frequent mental unhealthy days	Primary	1= \geq 5 mental unhealthy days during the past 30 days, 0=0–5 days
<i>Chronic health conditions²</i>	\geq2 chronic health conditions	Primary	[1= \geq 2 chronic health conditions, 0= $<$ 2 chronic health conditions] <i>Based on the 9 individual chronic health conditions listed below as secondary health status outcomes.</i>
	Any chronic health condition	Secondary	1=yes (any of the 9 individual chronic health conditions), 0=no chronic health conditions
	Heart disease	Secondary	[1=yes, 0=no] <i>Heart disease (heart attack/myocardial infarction, angina, or coronary health disease)</i>
	Kidney disease	Secondary	[1=yes, 0=no] <i>Kidney disease</i>
	Diabetes	Secondary	[1=yes, 0=no] <i>Diabetes</i>
	COPD	Secondary	[1=yes, 0=no] <i>Chronic obstructive pulmonary disease, emphysema, or chronic bronchitis</i>
	Asthma	Secondary	[1=yes, 0=no] <i>Asthma</i>
	Stroke	Secondary	[1=yes, 0=no] <i>Stroke</i>
	Cancer	Secondary	[1=yes, 0=no] <i>Cancer (skin and any other type of cancer)</i>
	Arthritis	Secondary	[1=yes, 0=no] <i>A form of arthritis, rheumatoid arthritis, gout, lupus, or fibromyalgia</i>
Depressive disorder	Secondary	[1=yes, 0=no] <i>A depressive disorder including depression, major depression, dysthymia, or minor depression</i>	

Category	Outcome	Type	Coding and Description
<i>Health problems or impairments</i>	≥ 3 health problems or impairments	Primary	[1=≥3 health problems or impairments, 0=<3 health problems or impairments] <i>Based on the 7 individual health problems or impairments listed below as secondary health status outcomes.</i>
	Any health problem or impairment	Secondary	1=yes (any of the 7 individual health problems or impairments), 0=no health problems or impairments
	Limited in any way	Secondary	[1=yes, 0=no] <i>Limited in any way in any activities because of physical, mental, or emotional problems.</i>
	Use of special equipment	Secondary	[1=yes, 0=no] <i>Uses special equipment (cane, a wheelchair, special bed, or special telephone).</i>
	Blind or difficulty seeing	Secondary	[1=yes, 0=no] <i>Blind or have serious difficulty seeing, even with glasses.</i>
	Difficulty walking or climbing	Secondary	[1=yes, 0=no] <i>Serious difficulty concentrating, remembering, or making decisions because of a physical, mental, or emotional condition.</i>
	Difficulty dressing or bathing	Secondary	[1=yes, 0=no] <i>Difficulty dressing or bathing.</i>
	Difficulty concentrating, remembering, or making decisions	Secondary	[1=yes, 0=no] <i>Serious difficulty walking or climbing.</i>
77	Difficulty doing errands alone	Secondary	[1=yes, 0=no] <i>Difficulty doing errands alone because of a physical, mental, or emotional condition.</i>

Primary health status outcomes are shown in bold. ¹Measures used to describe sample characteristics and/or measures from which primary health status outcomes were derived. ²BRFSS participants are asked if a doctor, nurse, or other health professional had ever told them that they had the chronic health condition. COPD: Chronic Obstructive Pulmonary Disease

Individual factors included personal characteristics and socioeconomic position measures. These measures were evaluated because they reflect the social and economic factors that influence health-related beliefs, behaviors, and outcomes (Krieger, Williams, & Moss, 1997; Link & Phelan, 1995). Moreover, the social conditions experienced by transgender adults do not uniformly affect transgender subgroups (James et al., 2016). With the inclusion of individual factors, this study allowed us to examine study group differences in health status after taking into account the influence of individual factors, as well as evaluate the influence of individual factors and their interactions with study group on health status.

To improve the precision of parameter estimates and explain variability of health outcomes related to state-level characteristics and seasonality, variables known to impact health behaviors and health status were included as covariates (Hatzenbuehler, Keyes, & Hasin, 2009; Jia & Lubetkin, 2009; White Hughto et al., 2016). At the state level, data from the Movement Advancement Project (2015) was used to indicate if the state where the BRFSS participant resides had any laws or policies that harmed or deliberately targeted transgender people, and publically available data from Federal Election Commission (2013) was accessed to determine the percentage of voters who voted from the Republican candidate in the 2012 presidential election. Further, previous studies using BRFSS data showed seasonal variations in health-related quality of life such that Winter months adversely impacted physical health, and Fall months negatively influenced mental health (Jia & Lubetkin, 2009). As such, seasonality, in this study, reflects if BRFSS data collection occurred during Winter/Fall months.

Health status outcomes included measures of self-rated general health, health-related quality of life, chronic health conditions, and health problems or impairments related to activities of daily living and instrumental activities of daily living. These measures were then categorized as primary or secondary health outcomes (Table 7). The five primary health outcomes included fair/poor health, frequent physical unhealthy days, frequent mental unhealthy days, two or more chronic health conditions, and three or more health problems or impairments. Nine chronic health conditions and seven health problems or impairments constituted the secondary health outcomes.

4.3.4 Data analysis plan

Descriptive statistics were used to detail the study variables and health status outcomes for each of the five study groups. Non-directional statistical tests were performed using SAS 9.4.1[®] with the level of significance set at 0.05 for each test and *a posteriori* contrasts. The level of significance was not adjusted for multiple outcomes and tests due to the exploratory nature of this study.

4.3.4.1 Aim 1

Bivariate logistic regression for binary measures and one-way analysis of variance methods for continuous measures were performed to test for study group differences in key measures personal characteristics, socioeconomic position, state-level factors, seasonality, as well as each primary and secondary health outcome. The analysis of variance procedures were conducted using a General Linear Model (GLM) approach due to unequal sample sizes of the five study groups. *A posteriori* pairwise contrasts of the

study groups were conducted when a significant overall study group effect was detected. For each contrast, the effect size and its 95% confidence interval (CI) were estimated to address magnitude of effect and clinical significance.

4.3.4.2 Aim 2

Multivariable logistic regression models were utilized to determine the differential effects of individual factors on health status in the five study groups. A separate analysis was conducted for each primary health outcome. For each outcome, the initial comprehensive multivariable model included study group, individual factors and their interactions with study group, as well as state-level factors and seasonality. The specific predictor variables in the comprehensive model are listed in bold in Table 6. Each comprehensive model was then reduced to a final model using an iterative backward elimination variable selection method, whereby the least significant term was omitted from model one at a time and the model was re-evaluated until a final model was achieved. The final model included: a) study group; b) statistically significant individual factors; c) significantly study group-by individual factor interaction term; and d) statistically significant state-level and/or seasonality covariates. Study group and lower order components of a significant interaction term were retained regardless of statistical significance. Adjusted odds ratios (aOR) and their 95% CI were used to estimate effect size for significant predictor terms and the mean probabilities for subgroups of a significant interactions term were obtained. *A posteriori* pairwise contrasts of the study groups were conducted when a significant overall study group effect was detected.

4.4 Results

4.4.1 Aim 1

Descriptive statistics for the sample characteristics, key study variables, and health status outcomes for each of the five study groups are provided in Tables 8-10. The tables present the results of the bivariate logistic regression and GLMs performed to test for an overall study group effect with regard to key study measures (bolded items, Table 8), primary health outcomes (bolded items, Table 9), and secondary health outcomes (Table 5). *A posteriori* pairwise contrasts of the study groups are presented in Tables 11-13, and are detailed below.

The groups differed significantly on two personal characteristics, namely being a sexual minority and unmarried (Tables 8 and 11). GNC had the highest percent of being a sexual minority and being unmarried. However, the groups, as expected, did not differ on age or race/ethnicity, which were two variables used to create our matched-subject analytic sample. The two cisgender groups had the lowest percent of participants who reported being a sexual minority. In terms of identifying as a sexual minority, the groups significantly differed from one another with the exception of the MTF and FTM comparison. All transgender groups were more likely to be unmarried compared to CGM, but CGM had a lower probability of being unmarried than CGF. GNC also had a greater likelihood of being unmarried than CGF.

The groups differed significantly on four socioeconomic position measures, specifically being a high school graduate or less, unemployed, uninsured, and having low

income (Tables 8 and 11). The likelihood of completing 12 or less years of education was higher in the three transgender groups when compared to CGM and CGF. MTF had a higher rate of unemployment than CGM and CGF. GNC was more likely to be unemployed than CGF. MTF, GNC, and CGF had a higher likelihood of reporting an annual income less than \$20K as compared to CGM, and MTF was more likely to earn less than \$20K relative to CGF. FTM was more likely to be uninsured relative MTF and CGF.

Both cisgender groups had a significantly higher percent of BRFSS data collection that occurred during Winter and Fall months than each of the transgender groups (Tables 8 and 11); however, CGM had a lower probability of Winter/Fall data collection than CGF.

The groups differed significantly on all four primary health outcomes (Tables 9 and 12). GNC had the highest percent of having fair/poor health, frequent mental unhealthy days, two or more chronic health conditions, and three or more health problems or impairments. The likelihood of having fair/poor health, frequent mental unhealthy days, two or more chronic conditions, and three or more health problems or impairments was higher in the three transgender groups when compared to CGM and CGF. In terms of having frequent physical unhealthy days, the MTF, FTM, and CGF groups had the highest probability of experiencing five or more days in the past 30 where their physical health was not good.

There were significant group differences on several secondary health outcomes

(Table 10), including seven chronic health conditions (any chronic health condition, heart disease, diabetes, COPD, asthma, arthritis, and depressive disorder) and seven health problems or impairments (any health problem or impairment, limited in any way, blind or difficulty seeing, difficulty walking or climbing, difficulty dressing or bathing, difficulty doing errands alone, and difficulty concentrating, remembering, or making decisions). Table 8 provides the pairwise contrast results for the secondary health outcomes for which there was a significant overall study group effect.

GNC had the highest percentage of having any chronic health condition, as well as having any health problem or impairment. The likelihood of having two or more chronic conditions was higher in the three transgender groups when compared to CGM and CGF, and CGF were more likely than CGM to have two or more chronic conditions. In addition to the three transgender groups having a greater probability of having any health problem or impairment relative to the cisgender groups, within the three transgender groups, GNC were more likely to report having any health problem or impairment.

The remaining secondary outcomes were used to derive the two primary health outcomes, specifically 1) two or more chronic health conditions and 2) three or more health problems or impairments. The study group results for each secondary outcome comprising the two primary outcomes are detailed in Tables 10 and 13. Because the main focus was on the primary health outcomes, we do not discuss each significant contrast pertaining to the remaining secondary outcomes. However, these results provide

information regarding the specific chronic conditions and health problems/impairments contributing to the observed primary health outcomes.

4.4.2 Aim 2

Each comprehensive multivariable regression model evaluating the influence of study group, key individual factors, study group-by-individual factor interactions, state-level factors, and seasonality on each primary health outcome was reduced to a set of final models. Table 14 details the results of the final regression model for each primary health outcome after adjusting for influence of the other predictors in the reduced model. Table 15 provides an overview of the significant predictors for each primary health outcome.

The *a posteriori* contrasts of the groups (Table 16) indicated MTF had a lower odds of fair/poor health relative to FTM (aOR=0.21) and CGF (aOR=0.20). That is, the estimated odds of poor/fair health were approximately five times higher in FTM and CGF relative to MTF. Both MTF and CGM had lower odds (aOR=0.67, 0.66, respectively) of frequent physical unhealthy days when compared to CGM. In terms of frequent mental unhealthy days, FTM had higher odds compared to GNC (aOR=1.92) and CGM (aOR=2.54), and MTF had lower odds relative to FTM (aOR=0.62), but higher odds than CGM (aOR=1.41). Among the cisgender groups, CGM had lower odds of frequent mental unhealthy days relative to CGF (aOR=0.59). Most notably, the estimated odds of frequent mental unhealthy days for FTM were approximately 2.5 times greater than CGM, nearly two times higher than GNC, and over 1.6 times higher than MTF.

Table 8: Bivariate Model Results: Study Group, Individual and State-Level Factors, and Seasonality

Variable	MTF (N=369)	FTM (N=239)	GNC (N=156)	CGM (N=1528)	CGF (N=1528)	P
<i>Personal characteristics</i>						
Age , in years (Mean ± SD) ¹	53.89 ± 17.11	54.55 ± 17.73	52.77 ± 19.09	53.88 ± 17.74	53.92 ± 17.70	0.9159
Race/ethnicity	369	239	156	1528	1528	–
White, non-Hispanic (NH)	263 (71.27)	166 (69.46)	104 (66.67)	1067 (69.83)	1066 (69.76)	
Black, NH	29 (7.86)	20 (8.37)	11 (7.050)	120 (7.85)	121 (7.92)	
Hispanic	32 (8.67)	33 (13.81)	18 (11.54)	166 (10.86)	166 (10.86)	
Other racial/ethnic minorities, NH	45 (12.20)	20 (8.37)	23 (14.74)	175 (11.45)	175 (11.45)	
Racial/ethnic minority	106 (28.73)	73 (30.54)	52 (33.33)	461 (30.17)	462 (30.24)	0.8911
Geographic classification	369	239	156	1528	1528	0.3986
Not in a MSA	46 (12.47)	44 (18.41)	27 (17.31)	234 (15.31)	234 (15.31)	
In a MSA	145 (39.30)	101 (42.26)	69 (44.23)	630 (41.23)	630 (41.23)	
Suppressed	178 (48.24)	94 (39.33)	60 (38.46)	664 (43.46)	664 (43.46)	
Sexual orientation	366	234	153	1514	1510	–
Heterosexual	296 (80.87)	202 (86.32)	108 (70.59)	1439 (95.05)	1462 (96.82)	
Lesbian or gay	13 (3.55)	9 (3.85)	9 (5.88)	29 (1.92)	8 (0.53)	
Bisexual	39 (10.66)	13 (5.56)	29 (18.95)	18 (1.19)	25 (1.66)	
Other sexual minorities	12 (3.28)	4 (1.71)	5 (3.27)	5 (0.33)	4 (0.26)	
Don't know/not sure	6 (1.64)	6 (2.56)	2 (1.31)	23 (1.52)	11 (0.73)	
Sexual minority	70 (19.13)	32 (13.68)	45 (29.41)	75 (4.95)	48 (3.18)	<0.0001
Marital status	365	236	156	1523	1519	–
Married	178 (48.77)	114 (48.31)	64 (41.03)	835 (54.83)	739 (48.65)	
Divorced	58 (15.89)	27 (11.44)	19 (12.18)	199 (13.07)	229 (15.08)	
Widowed	26 (7.12)	38 (16.10)	23 (14.74)	92 (6.04)	223 (14.68)	
Separated	7 (1.92)	8 (3.39)	8 (5.13)	25 (1.64)	34 (2.24)	
Never married	87 (23.84)	44 (18.64)	38 (24.36)	315 (20.68)	243 (16.0)	
Member of an unmarried couple	9 (2.47)	5 (2.12)	4 (2.56)	57 (3.74)	51 (3.36)	
Unmarried	178 (48.77)	117 (49.58)	88 (56.41)	631 (41.43)	729 (47.99)	<0.0001
<i>Socioeconomic position</i>						
Educational attainment	368	238	156	1523	1521	–
Some high school or less	44 (11.96)	42 (17.65)	15 (9.62)	145 (9.52)	116 (7.63)	
High school graduate	142 (38.59)	81 (34.03)	59 (37.82)	456 (29.94)	441 (28.99)	
Some college	106 (28.80)	58 (24.37)	41 (26.28)	382 (25.08)	419 (27.55)	
College graduate	76 (20.65)	57 (23.95)	41 (26.28)	540 (35.46)	545 (35.83)	
High school graduate or less	186 (50.54)	123 (51.68)	74 (47.44)	601 (39.46)	557 (36.62)	<0.0001
Employment status	366	234	154	1514	1516	–
Employed	161 (43.99)	105 (44.87)	65 (42.21)	833 (55.02)	704 (46.44)	
Out of work	27 (7.38)	10 (4.27)	10 (6.49)	83 (5.48)	58 (3.83)	
Homemaker	13 (3.55)	14 (5.98)	8 (5.19)	5 (0.33)	156 (10.29)	
Student	20 (5.46)	11 (4.70)	8 (5.19)	70 (4.62)	64 (4.22)	
Retired	103 (28.14)	65 (27.78)	46 (29.87)	433 (28.60)	424 (27.97)	
Unable to work	42 (11.48)	29 (12.39)	17 (11.04)	90 (5.94)	110 (7.26)	
Unemployed	172 (46.99)	104 (44.44)	73 (47.40)	606 (40.03)	592 (39.05)	0.0165
Annual household income	318	203	135	1326	1259	–
<\$20K	82 (25.79)	43 (21.18)	34 (25.19)	219 (16.52)	245 (19.46)	
\$20K to <\$50K	114 (35.85)	91 (44.83)	50 (37.04)	452 (34.09)	448 (35.58)	
≥\$50K	122 (38.36)	69 (33.99)	51 (37.78)	655 (49.40)	566 (44.96)	

Variable	MTF (N=369)	FTM (N=239)	GNC (N=156)	CGM (N=1528)	CGF (N=1528)	<i>P</i>
Low income	82 (25.79)	43 (21.18)	34 (25.19)	219 (16.52)	245 (19.46)	0.0010
Health insurance status	363	237	154	1520	1525	0.0542
Uninsured	28 (7.71)	32 (13.50)	19 (12.34)	150 (9.87)	129 (8.46)	
<i>State-level</i> ¹	369	239	156	1528	1528	–
Discriminatory laws/policies	100 (27.10)	67 (28.03)	46 (29.49)	423 (27.68)	425 (27.81)	0.9880
Percent voting Republican (Mean ± SD)	47.06 ± 9.94	48.87 ± 9.03	46.80 ± 11.54	47.48 ± 10.02	47.52 ± 10.00	0.2024
<i>Seasonality</i> ¹						
Winter/Fall	182 (49.32)	108 (45.19)	68 (43.59)	1207 (78.99)	1260 (82.46)	<0.001

Number of participants in study group with data available (*N*) reported for each variable. ¹Age, state-level variables, and seasonality had no missing data. For categorical variables, number (*n*), percent (%) of *N*, and *P*-values from logistic regression provided. Least squares mean ± SD and *P*-values from General Linear Models presented for age and percent voting Republican. Variables included in the analytic models shown in bold. Bold *P*-values indicates statistical significance at the 0.05 level. CGF: cisgender female; CGM: cisgender male; FTM: female-to-male or transgender male; GNC: gender nonconforming; MSA: metropolitan status area; MTF: male-to-female or transgender female; NH: non-Hispanic; SD: standard deviation.

4.4.2.1 Age

Age was significant predictor of fair/poor health, frequent mental unhealthy days, and two or more chronic health conditions. The results with age in descending order (older to younger) indicated that as age increases by one year, the estimated odds for: a) fair/poor health were higher (aOR=1.01), b) frequent mental unhealthy days were lower (aOR=0.98), and c) two or more chronic health conditions were higher (aOR=1.04). For each 10-year increment in age, the odds increased by 10% for fair/poor health, decreased by 20% for frequent mental unhealthy days, and increased by 40% for two or more chronic health conditions.

4.4.2.2 Racial/ethnic minority

The race/ethnicity characteristic was a significant predictor of fair/poor health and two or more chronic health conditions. Racial/ethnic minority had higher odds of fair/poor health (aOR=1.35), and lower odds of two or more chronic health conditions

Table 9: Bivariate Model Results: Study Group and Primary Health Status Outcomes

Health status outcome	MTF (N=369)	FTM (N=239)	GNC (N=156)	CGM (N=1528)	CGF (N=1528)	P
<i>Self-rated general health</i>						
Self-rated general health	369	238	156	1525	1525	–
Excellent	60 (16.26)	31 (13.03)	17 (10.90)	267 (17.51)	260 (17.05)	
Very good	98 (26.56)	75 (31.51)	39 (25.00)	489 (32.07)	507 (33.25)	
Good	125 (33.88)	82 (34.45)	50 (32.05)	489 (32.07)	489 (32.07)	
Fair	59 (15.99)	27 (11.34)	33 (21.15)	197 (12.92)	197 (12.92)	
Poor	27 (7.32)	23 (9.66)	17 (10.90)	83 (5.44)	72 (4.72)	
Fair/poor health	86 (23.31)	50 (21.01)	50 (32.05)	280 (18.36)	269 (17.64)	0.0001
<i>Health-related quality of life</i>						
Physical unhealthy days	362	227	153	1496	1508	–
0 days	225 (62.15)	131 (57.71)	82 (53.59)	982 (65.64)	849 (56.30)	
1-5 days	54 (14.92)	39 (17.18)	39 (25.49)	264 (17.65)	338 (22.41)	
6-15 days	41 (11.33)	24 (10.57)	13 (8.50)	114 (7.62)	162 (10.74)	
16-29 days	11 (3.04)	9 (3.96)	2 (1.31)	28 (1.87)	48 (3.18)	
30 days	31 (8.56)	24 (10.57)	17 (11.11)	108 (7.22)	111 (7.36)	
Frequent physical unhealthy days	93 (25.69)	61 (26.87)	39 (25.49)	296 (19.79)	390 (25.86)	0.0009
Mental unhealthy days	360	232	150	1501	1496	
0 days	3.90 (7.84)	4.85 (9.11)	4.75 (9.25)	2.72 (7.13)	3.46 (7.54)	–
1-5 days	0 (0, 3.0)	0 (0, 5.0)	0 (0, 4.0)	0 (0, 0)	0 (0, 3.0)	
6-15 days	228 (63.33)	143 (61.64)	95 (63.33)	1134 (75.55)	998 (66.71)	
16-29 days	63 (17.50)	38 (16.38)	23 (15.33)	193 (12.86)	256 (17.11)	
30 days	38 (10.56)	26 (11.21)	15 (10.00)	76 (5.06)	129 (8.62)	
Frequent mental unhealthy days	81 (22.50)	63 (27.16)	37 (24.67)	216 (14.39)	312 (20.86)	<0.0001
<i>Chronic health conditions</i>						
≥ 2 chronic health conditions	354	231	149	1487	1478	0.0026
<i>Health problems or impairments</i>						
≥ 3 health problems or impairments	366	234	152	1508	1508	0.0001

Number of participants in study group with data available (N) reported for each variable. Number (n), percent (%) of N, and P-values from logistic regression provided. Variables included in analytic models shown in bold. Bold P-values indicate statistical significance at the 0.05 level. CGF: cisgender female; CGM: cisgender male; FTM: female-to-male or transgender male; GNC: gender nonconforming; MTF: male-to-female or transgender female.

Table 10: Bivariate Model Results: Study Group and Secondary Health Status Outcomes

Health status outcome	MTF (N=369)	FTM (N=239)	GNC (N=156)	CGM (N=1528)	CGF (N=1528)	<i>P</i>
<i>Chronic health conditions</i>						
Any chronic health condition	360	234	153	1508	1508	0.0003
Yes	241 (66.94)	151 (64.53)	105 (68.63)	862 (57.16)	946 (62.73)	
Heart disease	364	236	154	1518	1522	<0.0001
Yes	46 (12.64)	18 (7.63)	25 (16.23)	181 (11.92)	103 (6.77)	
Kidney disease	367	239	155	1518	1520	0.5826
Yes	15 (4.09)	5 (2.09)	6 (3.87)	46 (3.03)	56 (3.68)	
Diabetes	358	231	154	1497	1485	0.0022
Yes	72 (20.11)	32 (13.85)	24 (15.58)	214 (14.30)	177 (11.92)	
COPD	367	239	153	1523	1519	0.0545
Yes	40 (10.90)	25 (10.46)	18 (11.76)	110 (7.22)	137 (9.02)	
Asthma	368	239	153	1524	1522	<0.0001
Yes	34 (9.24)	37 (15.48)	30 (19.61)	170 (11.15)	241 (15.83)	
Stroke	368	239	155	1522	1523	0.1574
Yes	24 (6.52)	13 (5.44)	11 (7.10)	64 (4.20)	64 (4.20)	
Cancer	366	238	153	1521	1522	0.4450
Yes	49 (13.39)	28 (11.76)	20 (13.07)	230 (15.12)	239 (15.70)	
Arthritis	365	239	155	1521	1519	0.0317
Yes	117 (32.05)	82 (34.31)	48 (30.97)	428 (28.14)	504 (33.18)	
Depressive disorder	365	236	155	1522	1519	<0.0001
Yes	95 (26.03)	62 (26.27)	49 (31.61)	203 (13.34)	331 (21.79)	
<i>Health problems or impairments</i>						
Any health problem or impairment	369	238	155	1518	1519	<0.0001
Yes	150 (40.65)	95 (39.92)	79 (50.97)	502 (33.07)	493 (32.46)	
Limited in any way	367	238	155	1523	1520	0.0082
Yes	98 (26.70)	66 (27.73)	54 (34.84)	359 (23.57)	349 (22.96)	
Use of special equipment	369	239	156	1526	1527	0.0761
Yes	49 (13.28)	33 (18.81)	27 (17.31)	168 (11.01)	165 (10.81)	
Blind or difficulty seeing	369	237	154	1525	1521	0.0030
Yes	18 (4.88)	14 (5.91)	18 (11.69)	64 (4.20)	74 (4.87)	
Difficulty walking or climbing	368	239	153	1521	1522	<0.0001
Yes	72 (19.57)	55 (23.01)	43 (28.10)	217 (14.27)	258 (16.95)	
Difficulty dressing or bathing	369	239	156	1526	1527	<0.0001
Yes	31 (8.40)	14 (5.86)	19 (12.18)	71 (4.65)	60 (3.93)	
Difficulty concentrating, remembering, or making decisions	368	238	155	1519	1523	<0.0001
Yes	59 (16.03)	40 (16.81)	26 (16.77)	125 (8.23)	145 (9.52)	
Difficulty doing errands alone	368	238	156	1526	1525	<0.0001
Yes	43 (11.68)	24 (10.08)	33 (21.15)	94 (6.16)	138 (9.05)	

Number of participants in study group with data available (*N*) reported for each variable. Number (*n*), percent (%) of *N*, and *P*-values from logistic regression provided. Bold *P*-values indicate statistical significance at the 0.05 level. CGF: cisgender female; CGM: cisgender male; COPD: Chronic Obstructive Pulmonary Disease; FTM: female-to-male or transgender male; GNC: gender nonconforming; MTF: male-to-female or transgender female.

Table 11: Significant Bivariate Model Results: A posteriori Contrasts for Study Group, Individual Factors, and Seasonality

Factor	Pairwise contrasts									
	MTF/FTM	MTF/GNC	FTM/GNC	MTF/CGM	MTF/CGF	FTM/CGM	FTM/CGF	GNC/CGM	GNC/CGF	CGM/CGF
<i>Personal characteristic</i>										
Sexual minority										
<i>P</i> value	0.0843	0.0106	0.002	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.0142
OR	1.49	0.57	0.38	4.54	7.20	3.04	4.82	7.99	12.69	1.59
95% CL	0.95, 2.35	0.37, 0.88	0.23, 0.63	3.20, 6.43	4.89, 10.62	1.96, 4.72	3.01, 7.73	5.26, 12.14	8.08, 19.93	1.10, 2.30
Unmarried										
<i>P</i> value	0.8464	0.1105	0.1852	0.0111	0.7902	0.0189	0.6505	0.0004	0.0459	0.0003
OR	0.97	0.74	0.76	1.34	1.03	1.39	1.07	1.83	1.40	0.77
95% CL	0.70, 1.34	0.50, 1.07	0.51, 1.14	1.07, 1.69	0.82, 1.30	1.06, 1.83	0.81, 1.40	1.31, 2.55	1.01, 1.95	0.66, 0.88
<i>Socioeconomic position</i>										
High school grad or less										
<i>P</i> value	0.7845	0.5154	0.4100	0.0001	<0.0001	0.0004	<0.0001	0.0538	0.0083	0.1065
OR	0.96	1.13	1.19	1.57	1.77	1.64	1.85	1.38	1.56	1.13
95% CL	0.69, 1.32	0.78, 1.65	0.79, 1.7	1.25, 1.97	1.41, 2.22	1.25, 2.16	1.41, 2.44	0.99, 1.93	1.12, 2.17	0.97, 1.31
Unemployed										
<i>P</i> value	0.5411	0.9322	0.5671	0.0153	0.0056	0.2007	0.1171	0.0767	0.0444	0.5826
OR	1.11	0.98	0.89	1.33	1.38	1.20	1.25	1.35	1.41	1.04
95% CL	0.80, 1.54	0.67, 1.43	0.59, 1.34	1.06, 1.67	1.10, 1.74	0.91, 1.58	0.95, 1.65	0.97, 1.88	1.01, 1.96	0.90, 1.21
Low income										
<i>P</i> value	0.2308	0.8934	0.3906	0.0001	0.0132	0.1014	0.5671	0.0120	0.1154	0.0514
OR	1.29	1.03	0.80	1.76	1.44	1.36	1.11	1.70	1.39	0.82
95% CL	0.85, 1.97	0.65, 1.64	0.48, 1.34	1.31, 2.35	1.08, 1.92	0.94, 1.96	0.77, 1.60	1.12, 2.58	0.92, 2.11	0.67, 1.00
Uninsured										
<i>P</i> value	0.0224	0.0973	0.7384	0.2086	0.6440	0.0891	0.0130	0.3336	0.1080	0.1781
OR	0.54	0.59	1.11	0.76	0.90	1.43	1.69	1.29	1.52	1.18
95% CL	0.31, 0.92	0.32, 1.10	0.60, 2.04	0.50, 1.16	0.59, 1.38	0.95, 2.15	1.12, 2.56	0.77, 2.14	0.91, 2.54	0.93, 1.52

Factor	Pairwise contrasts									
	MTF/FTM	MTF/GNC	FTM/GNC	MTF/CGM	MTF/CGF	FTM/CGM	FTM/CGF	GNC/CGM	GNC/CGF	CGM/CGF
<i>Seasonality</i>										
Winter/Fall										
<i>P</i> value	0.3190	0.2298	0.7547	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0.0152
OR	1.18	1.26	1.07	0.26	0.21	0.22	0.18	0.21	0.16	0.80
95% CL	0.85, 1.64	0.86, 1.84	0.71, 1.60	0.20, 0.33	0.16, 0.26	0.17, 0.29	0.13, 0.23	0.15, 0.29	0.12, 0.23	0.67, 0.96

Bold indicates statistical significance at the 0.05 level. CGF: cisgender female; CGM: cisgender male; FTM: female-to-male or transgender male; CL: confidence limits; GNC: gender nonconforming; MTF: male-to-female or transgender female; OR: odds ratio (measure of effect size).

Table 12: Significant Bivariate Model Results: A Posteriori Contrasts for Study Group and Primary Health Status Outcomes

Primary health status outcome	Pairwise contrasts									
	MTF/FTM	MTF/GNC	FTM/GNC	MTF/CGM	MTF/CGF	FTM/CGM	FTM/CGF	GNC/CGM	GNC/CGF	CGM/CGF
<i>Self-rated general health</i>										
Fair/poor health										
<i>P</i> value	0.5076	0.0373	0.0143	0.0313	0.0126	0.3305	0.2099	<0.0001	<0.0001	0.6042
OR	1.14	0.64	0.56	1.35	1.42	1.18	1.24	2.10	2.20	1.05
95% CL	0.77, 1.70	0.43, 0.97	0.36, 0.89	1.03, 1.78	1.08, 1.87	0.84, 1.66	0.89, 1.74	1.46, 3.01	1.53, 3.16	0.87, 1.26
<i>Health-related quality of life</i>										
Frequent physical unhealthy days										
<i>P</i> value	0.7507	0.9620	0.7641	0.0135	0.9466	0.0146	0.7463	0.0961	0.9202	<0.0001
OR	0.94	1.01	1.07	1.40	0.99	1.49	1.05	1.39	0.98	0.71
95% CL	0.65, 1.37	0.66, 1.56	0.67, 1.71	1.07, 1.83	0.76, 1.29	1.08, 2.05	0.77, 1.44	0.94, 2.04	0.67, 1.44	0.60, 0.84
Frequent mental unhealthy days										
<i>P</i> value	0.3114	0.6146	0.7256	0.0001	0.4244	<0.0001	0.0573	0.0009	0.2548	<0.0001
OR	0.82	0.89	1.09	1.75	1.12	2.14	1.37	1.97	1.26	0.64
95% CL	0.56, 1.21	0.57, 1.40	0.68, 1.75	1.31, 2.34	0.85, 1.48	1.54, 2.98	0.99, 1.89	1.31, 2.93	0.85, 1.86	0.53, 0.77
<i>Chronic health conditions</i>										
≥ 2 chronic health conditions										
<i>P</i> value	0.4653	0.3738	0.1569	0.0124	0.6199	0.2301	0.6459	0.0056	0.1733	0.0015
OR	1.14	0.84	0.74	1.36	1.06	1.20	0.93	1.63	1.27	0.78
95% CL	0.80, 1.61	0.57, 1.24	0.48, 1.13	1.07, 1.74	0.84, 1.35	0.89, 1.61	0.70, 1.25	1.15, 2.30	0.90, 1.79	0.67, 0.91
<i>Health problems or impairments</i>										
≥3 health problems or impairments										
<i>P</i> value	0.4991	0.0963	0.3300	0.0102	0.2024	0.0024	0.0553	<0.0001	0.0036	0.0526
OR	0.86	0.66	0.77	1.54	1.24	1.80	1.44	2.33	1.86	0.80
95% CL	0.55, 1.34	0.41, 1.08	0.46, 1.30	1.11, 2.15	0.89, 1.71	1.23, 2.63	0.99, 2.09	1.52, 3.56	1.23, 2.83	0.64, 1.00

Bold indicates statistical significance at the 0.05 level. CGF: cisgender female; CGM: cisgender male; FTM: female-to-male or transgender male; CL: confidence limits; GNC: gender nonconforming; MTF: male-to-female or transgender female; OR: odds ratio (measure of effect size).

Table 13: Significant Bivariate Model Results: A Posteriori Contrasts for Study Group and Secondary Health Status Outcomes

Characteristic	Pairwise contrasts									
	MTF/FTM	MTF/GNC	FTM/GNC	MTF/CGM	MTF/CGF	FTM/CGM	FTM/CGF	GNC/CGM	GNC/CGF	CGM/CGF
<i>Chronic health conditions</i>										
Any chronic health condition	0.5440	0.7099	0.4053	0.0007	0.1360	0.0340	0.5962	0.0066	0.1504	0.0018
Heart disease	0.0545	0.2778	0.0094	0.7073	0.0002	0.0550	0.6276	0.1227	<0.0001	<0.0001
Diabetes	0.0530	0.2299	0.6370	0.0064	<0.0001	0.8578	0.4037	0.6646	0.1884	0.0549
COPD	0.8645	0.7752	0.6870	0.0202	0.2684	0.0820	0.4744	0.0461	0.2659	0.0702
Asthma	0.0206	0.0013	0.2907	0.2883	0.0015	0.0546	0.8893	0.0025	0.2281	0.0002
Arthritis	0.5643	0.8075	0.4909	0.1387	0.6814	0.0512	0.7305	0.4572	0.5770	0.0026
Depressive disorder	0.9470	0.1936	0.2524	<0.0001	0.0828	<0.0001	0.1252	<0.0001	0.0058	<0.0001
<i>Health problems or impairments</i>										
Any health problem or impairment	0.8571	0.0302	0.0315	0.0061	0.0030	0.0386	0.0237	<0.0001	<0.0001	0.7184
Limited in any way	0.7811	0.0619	0.1349	0.2089	0.1306	0.1637	0.1077	0.0021	0.0011	0.6898
Blind or difficulty seeing	0.5810	0.0065	0.0453	0.5643	0.9918	0.2360	0.4945	<0.0001	0.0006	0.3755
Difficulty walking or climbing	0.3081	0.0332	0.2567	0.0116	0.2363	0.0006	0.0233	<0.0001	0.0007	0.0416
Difficulty dressing/bathing	0.2444	0.1801	0.0296	0.0048	0.0004	0.4195	0.1694	0.0001	<0.0001	0.3246
Difficulty concentrating, remembering, or making decisions	0.8012	0.8337	0.9933	<0.0001	0.0004	<0.0001	0.0008	0.0005	0.0051	0.2108
Difficulty doing errands alone	0.5398	0.0055	0.0027	0.0003	0.1238	0.0257	0.6074	<0.0001	<0.0001	0.0028

P-values from logistic regression provided. Bold indicates statistical significance at the 0.05 level. CGF: cisgender female; CGM: cisgender male; FTM: female-to-male or transgender male; COPD: Chronic Obstructive Pulmonary Disease; GNC: gender nonconforming; MTF: male-to-female or transgender female.

(aOR=0.71) when compared to the racial/ethnic majority (White, non-Hispanic).

4.4.2.3 Sexual minority

Sexual orientation was a significant predictor for all five primary outcomes. Sexual minority had higher odds of fair/poor health (aOR=4.67), frequent physical unhealthy days (aOR=1.92), frequent mental unhealthy days (aOR=2.20), two or more chronic health conditions (aOR=1.83), and three or more health problems or impairments (aOR=2.56) when compared to heterosexual. Relative to identifying as heterosexual, the estimated odds among sexual minorities were: a) over 4.5 times greater for fair/poor health, b) nearly 2.0 times for frequent physical and mental unhealthy days, and having two or more chronic health conditions, and c) over 2.5 times for three or more health problems or impairments.

4.4.2.4 Unmarried

Marriage status was a significant predictor of frequent mental unhealthy days, two or more chronic health conditions, and three or more health problems or impairments. Being unmarried had greater odds of frequent mental unhealthy days (aOR=1.34), two or more chronic health conditions (aOR=1.47), and three or more health problems or impairments (aOR=1.47) relative to being married.

4.4.2.5 High school graduate or less

Educational attainment was a significant predictor of fair/poor health and frequent

physical unhealthy days. Having a high school education or less increased the odds of fair/poor health (aOR=1.39) and frequent physical unhealthy days (aOR=1.35) than those with postsecondary education.

4.4.2.6 Unemployed

For all five primary outcomes, employment status was a significant predictor. Unemployed had greater odds of fair/poor health (aOR=2.98), frequent physical unhealthy days (aOR=2.24), frequent mental unhealthy days (aOR=1.71), two or more chronic health conditions (aOR=1.48), and three or more health problems or impairments (aOR=5.84) when compared to employed. For those participants who reported being unemployed, the estimated odds were nearly three times higher for fair/poor health, and nearly six times higher for three or more health problems or impairments relative to participants who were employed.

4.4.2.7 Low income

Annual household income was a significant predictor of all five primary outcomes. Earning less than \$20K increased the odds of fair/poor health (aOR=3.52), frequent physical unhealthy days (aOR=1.84), frequent mental unhealthy days (aOR=1.93), two or more chronic health conditions (aOR=2.49), and three or more health problems or impairments (aOR=2.80) when compared to earning \$20K or more. That is, for participants earning less than \$20K, the estimated odds of a) fair/poor health was 3.5 times higher, b) two or more chronic health conditions was nearly 2.5 times higher, and

c) three or more health problems or impairments was nearly 3 times higher than those earning \$20K or more.

4.4.2.8 Uninsured

Health insurance status was a significant predictor of frequent physical unhealthy days, two or more chronic health conditions, and three or more health problems or impairments. Uninsured had higher odds of two or more chronic health conditions (aOR=1.65), and lower odds of frequent physical unhealthy days (aOR=0.72) and three or more health problems or impairments (aOR=0.53) compared to insured.

4.4.2.9 State-level factors

Both discriminatory laws/policies and percent voting Republican were significant predictors of several primary outcomes; however, seasonality was not a significant predictor of any of the five outcomes.

The discriminatory laws/policies measure was a significant predictor of frequent physical unhealthy days, two or more chronic health conditions, and three or more health problems or impairments. Living in a state that had a discriminatory law or policy that targets or harms transgender people increased the odds of frequent physical unhealthy days (aOR=1.26), two or more chronic health conditions (aOR=1.31), and three or more health problems or impairments (aOR=1.63) relative to states without such laws or policies.

The percent of voters who voted for the Republican candidate in the 2012

presidential election was a significant predictor of fair/poor health. The results with percent voting Republican in descending order (higher to lower percentage) indicated that as the proportion of voters increased by one percent, the estimated odds of fair/poor health were higher (aOR=1.01). For each 10% increment in proportion of voters who voted for the Republican candidate in the 2012 presidential election, the estimated odds increased by 10% for fair/poor health.

4.4.2.10 Study group interactions

Several study group interactions with an individual factor predicted one or more primary health outcomes (Table 14). For each significant interaction, Table 17 presents the estimated mean probability for the health outcome for each interaction subgroup, and Figure 3 provides a graphical representation of the interactions. Table 18 summarizes the simple effects results comparing the study groups at each level of the individual factor.

First, the interaction between study group and sexual minority was a significant predictor of fair/poor health (Figure 3a). The estimated probability of fair/poor health did not significantly differ among the study groups when the participants reported being heterosexual. Among those who reported being a sexual minority, the mean probability of poor/fair health in MTF ($M=0.28$) was significantly lower than: a) FTM ($M=0.62$, aOR=0.24), b) GNC ($M=0.50$, aOR=0.39), and c) GCF ($M=0.56$, aOR=0.30). The mean probability was higher in FTM ($M=0.62$) relative to CGM ($M=0.35$, aOR=2.93). Among the sexual minority, FTM had the highest mean probability of fair/poor health. When compared to MTF sexual minorities, the estimated odds of fair/poor health among sexual

minorities groups were nearly 4.2 times greater in FTM, over 2.5 times higher in GNC, and more than 3.3 times that of CGF.

Second, the interaction between study group and low income was a significant predictor of fair/poor health (Figure 3b). The estimated probability of fair/poor health significantly differed among study groups when participants reported an annual household income of \$20K or more (high income). Among those with a high income, the mean probability of fair/poor health in MTF ($M=0.22$) was significantly lower than GNC ($M=0.38$, $aOR=0.45$), and was significantly higher for GNC ($M=0.38$) relative to CGM ($M=0.19$, $aOR=2.61$) and CGF ($M=0.24$, $aOR=2.00$). GNC had the highest mean probability of fair/poor health among participants earning \$20K or more per year. That is, among those with a high income, the estimated odds of fair/poor health for GNC was more than 2.2 times that of MTF, greater than 2.6 times that of CGM, and 2.0 times higher than CGF. The estimated probability of fair/poor health also significantly differed among study groups for participants with low income. For those earning under \$20K, the mean probability of fair/poor health in MTF ($M=0.31$) was lower than CGF ($M=0.52$, $aOR=0.40$), such that CGF with low income were 2.5 more likely to have fair/poor health when compared to MTF with low income

Third, the interaction between study group and unemployed was a significant predictor of two or more chronic health conditions (Figure 3c). The estimated probability of two or more chronic health conditions did not significantly differ among study groups members who were unemployed; however, there were significant study group differences

for participants who were employed. Among those employed participants, the mean probability of two or more chronic health conditions in MTF ($M=0.23$) was significantly less than CGF ($M=0.38$, $aOR=0.50$), and was also lower in CGM ($M=0.26$) when compared to CGF ($M=0.39$, $aOR=0.58$). Employed CGF participants were approximately 2 times more likely to have two or more chronic health conditions compared to employed MTF and CGM participants.

Fourth, the interaction between study group and low income was a significant predictor of two or more chronic health conditions (Figure 3d). The estimated probability of two or more chronic health conditions significantly differed among study groups for participants with a high income, as well as those with low income. Among those with a high income, the mean probability of two or more chronic health conditions in GNC ($M=0.40$) was higher than CGM ($M=0.28$, $aOR=1.74$). For those with low income, the mean probability was lower in: a) MTF ($M=0.38$) when compared to CGF ($M=0.54$, $aOR=0.52$), b) GNC ($M=0.29$) relative to CGF ($M=0.54$, $aOR=0.34$), and c) CGM ($M=0.43$) than in CGF ($M=0.54$, $aOR=0.64$). Notably, when comparing those with low income, the estimated odds of two or more chronic health conditions in CGF were over 1.9 higher than in MTF, nearly 3.0 times higher compared to GNC, and over 1.5 times greater than CGM.

4.5 Sensitivity analysis

The final multivariable model for each primary health outcome did not include all 3820 BRFSS participants in the study due to missing predictor and/or outcome data. The

total sample size (N) and percent excluded per study group was determined for each final model: 1) fair/poor health – 3174 included, 648 excluded, 15%-19% excluded/group; 2) frequent physical unhealthy days – 3120 included, 700 excluded, 17%-22% excluded/group; 3) frequent mental unhealthy days – 3118 included, 702 excluded, 16%-20% excluded/group; 4) two or more chronic health conditions – 3076 included, 744 excluded, 17%-22% excluded/group; and 5) three or more health problems or impairments – 3125 included, 695 excluded, 16%-22% excluded/group.

A sensitivity analysis was conducted to determine the age and race/ethnicity of the participants within each study group that were included compared to those excluded from the final model. The demographic characteristics of those included versus excluded within each study group did not differ significantly with the exception of the following comparisons. Within the CGF group, the mean age was significantly greater in those excluded ($M=55.98$, $SD=19.88$) relative to those included ($M=53.44$, $SD=17.13$, $t=2.02$, $P=0.0445$) in the fair/poor health analysis. Similarly, the mean age within the CGF was also significantly greater in those excluded ($M=55.98$, $SD=20.03$) than those included ($M=53.42$, $SD=17.06$, $t=2.02$, $P=0.0445$) in the frequent physical unhealthy days analysis. Within the CGM group, a higher percent reported being a racial/ethnic minority among those excluded (35.46%) than those included (29.13%, $\chi^2=3.99$, $P=0.0459$) in the frequent mental unhealthy days analysis

4.6 Power calculation

The total sample was 3820, which was comprised of 369 MTF, 239 FTM, 156

GNC, 1528 CGM, and 1528 CGF adults. There was a lack of published findings comparing transgender groups and whether these groups differed from cisgender males and females with regard to individual factors and health status (Reisner, Deutsch, et al., 2016). Expected effect sizes for the planned analyses, therefore, could not be derived from the literature. Thus, power calculations were conducted based on the assumption of a medium effect size represented the smallest clinically meaningful effect (OR of 2.5 or its inverse of 0.40; Cohen *d* equivalent of 0.50). Power was then determined for the planned two-tailed analyses with significance set at 0.05 per test, with no adjustment for multiple outcomes due to the exploratory nature of the study.

The above sample size per study group provided at least 80% power for the bivariate analytic models and their *a posteriori* contrasts conducted for Aim 1. Power calculations for the comprehensive multivariable model with 19 predictors (main and interaction terms) indicated a required sample size of 580 per study group was needed to achieve 80% power to evaluate the influence of study group on the five primary outcomes. The sample sizes for the transgender groups, particularly for the GNC group, were smaller than the required sample sizes. Missing data further reduced the sample sizes for the multivariable model. Statistical power may not have been adequate for detecting all existing study group differences in the multivariable models.

4.7 Discussion

This study examined the health status and individual factors which influence the health of MTF, FTM, and GNC adults and their CGM and CGF counterparts. Further, we

sought to highlight the importance of classifying and examining the health of the transgender population as unique subpopulations versus one homogeneous population. Although previous research has identified significant differences in health-related individual factors and health outcomes between transgender and cisgender people (Crissman, Berger, Graham, & Dalton, 2017; Streed, Jr, McCarthy, & Haas, 2017; Tabaac, Sutter, Wall, & Baker, 2018), this study delineated the health differences among transgender subpopulations (groups), and in relation to their cisgender male and female counterparts, in order to identify transgender groups at greatest risk for poor health. Moreover, by acknowledging the heterogeneity of the transgender population, we fill gaps in knowledge about the health of FTM and GNC adults, two transgender groups that have been underrepresented in contemporary empirical transgender health research. In addition to this important contribution, our findings demonstrate that: a) among the transgender groups, there are notable differences in the health of MTF, FTM, and GNC adults; b) GNC adults have poorer overall health than their transgender and cisgender counterparts; and c) the health of a transgender adult by gender identity is not equivalent to that of a cisgender adult with the same sex assignment (e.g., MTF compared to CGM).

Transgender adults experience poorer health, more frequent physical and mental unhealthy days, a greater number of chronic health conditions, and more health problems or impairments than cisgender adults. GNC adults, in particular, were more likely to endorse having any chronic health condition or any health problem or impairment than any other study group. Notably, our findings indicated that GNC adults with higher income have greater odds of fair/poor health than MTF, CGM, and CGF individuals. This

finding is inconsistent with a large body of evidence linking low income with poorer health in the general population (Marmot, 2004; Subramanyam, Kawachi, Berkman, & Subramanian, 2009), but it is not surprising considering that GNC adults experience higher levels of discrimination in healthcare settings, have more unmet healthcare needs, are less likely to have an annual health exam, and engage in more health-harming behaviors (i.e., drug/alcohol abuse, smoking, and attempted suicide) than other transgender counterparts (Cruz, 2014; Gonzalez, Gallego, & Bockting, 2017; Miller & Grollman, 2015).

Further, previous research has shown that sexual minorities and transgender people are at high risk for discriminatory experiences and increased health-harming behaviors, as well as symptomology of adverse mental health outcomes, such as depression, anxiety, and psychological distress (Bockting et al., 2013; Meyer, 2003). Considering the elevated rates of discrimination experienced by GNC adults and that such experiences often decrease healthcare access and utilization (Cruz, 2014), the percentage of GNC adults reporting a lifetime diagnosis of any chronic health condition may be under-reported. Additionally, research exploring the association between discrimination and physical health outcomes in the transgender population are lacking. This represents an important area for future work, especially given that stress is associated with negative, and co-occurring, physical and mental health in other vulnerable populations (Hayward, Miles, Crimmins, & Yang, 2000; Thoits, 2010). Finally, given the disproportionate prevalence of transgender-related discrimination and poorer health experienced by GNC adults relative to MTF and FTM, health researchers

should routinely include transgender-inclusive measures that can identify transgender subgroups.

Discriminatory state-level laws and policies are significant predictors for poorer health outcomes in transgender and cisgender adults. Our findings are consistent with prior research (Blosnich et al., 2016; Hatzenbuehler, McLaughlin, Keyes, & Hasin, 2010; White Hughto et al., 2016), notwithstanding one primary health outcome, where the percentage of state residents voting Republican was a significant predictor of fair/poor health. While these two predictors were not consistently associated with our primary health outcomes, there is evidence that states with a higher percentage of conservative voters tend to lack transgender-protective laws and policies (White Hughto et al., 2016). One plausible explanation for our findings regarding state-level sociopolitical predictors may stem from the gender identity measure being an optional BRFSS module. States that have incorporated this measure have recognized the importance of collecting health-related data from transgender adults and may therefore have already enacted transgender-protective laws or policies. Without transgender health data collection conducted by all U.S. states and territories, it is difficult to further investigate this inference. Additional insight can be gained if gender identity measures are routinely included in public health surveillance and population-based surveys.

Our findings indicate that there are significant differences in the health of MTF, FTM, GNC, CGM, and CGF; although consistent patterns across outcomes were not apparent. This finding may reflect study limitations associated with BRFSS methodology

and the fact that this was a secondary analysis of cross-sectional data. Results from our final multivariable models suggest that when factors known to influence health are accounted for, GNC adults did not have significantly different health outcomes than other transgender groups and cisgender adults. In contrast, GNC adults did have the highest percentage, of any study group, of having any chronic health condition, as well as having any health problem or impairment. These conflicting findings may be explained by the small sample sizes of the transgender groups, particularly the GNC group, which was further reduced in size in the multivariable models due to missing data. Thus, one limitation of the secondary analysis was low statistical power to detect all transgender group differences that may have existed. Future research exploring the health of GNC adults is warranted and researcher might consider oversampling GNC people in surveys to achieve adequate statistical power.

Our findings bring attention to the health concerns of FTM adults. FTM adults had significantly greater odds of both fair/poor health status, especially those who also identify as a sexual minority, when compared to CGF adults, and frequent mental unhealthy days when compared MTF, GNC, and CGM. With limited FTM health-related literature, this finding not only contributes to the current knowledge base, but also highlights that FTM adult health is a research priority. We found that among transgender individuals, FTM adults have significant health concerns that require the attention of clinical interventions aimed at promoting health and preventing illness.

BRFSS methodology may have contributed to the small GNC sample size, as well

as the other transgender groups. For the BRFSS gender identity measure, participants first had to affirm being transgender before they could self-identify as GNC; not all transgender and GNC people use the term transgender when describing themselves (Gender Identity in U.S. Surveillance Group, 2014). Further, BRFSS is a telephone-based survey, which introduces a social component to gender identity disclosure with the interviewer, including perceived stigma. This may affect any transgender or GNC participant affirming their gender identity. Equally important and specific to GNC adults is BRFSS's description for gender nonconforming, as it does not align with definitions provided by three of the predominant authorities in transgender health care, the World Professional Association for Transgender Health, University of California, San Francisco Center of Excellence for Transgender Health, or The Fenway Institute's National LGBT Health Education Center (Center of Excellence for Transgender Health, June 2016; Coleman et al., 2012; The National LGBT Health Education Center, n.d.). The BRFSS gender nonconforming definition reflects a description for a non-binary identity (Center of Excellence for Transgender Health, June 2016); whereas, gender nonconforming "describes a person whose gender expression differs from a given society's norms for males and females" (The National LGBT Health Education Center, n.d., p.5). The BRFSS survey measures for gender identity coupled with social stigma associated with transgender identities may undercount the number of self-identified transgender, particularly GNC, respondents.

Second, the inconsistent pattern of results for the MTF/CGM and FTM/CGF contrasts for multivariable models may stem from the variability among transgender

individuals in pursuing and/or receiving any type of gender-affirming medical intervention (e.g., hormone therapy, surgery). Such interventions have been shown to reduce adverse mental health symptomology and improve the health and well-being of transgender people (Coleman et al., 2012; Hembree et al., 2009). However, there are significant barriers to accessing gender-affirming interventions and not all transgender people desire such interventions (James et al., 2016). Besides the gender identity module, BRFSS does not include any other survey items regarding transgender health, such as medical interventions. Future studies that examine and compare the health status of transgender and cisgender people would benefit from additional survey items pertaining to aspects of health-related behaviors known to influence the health of transgender people, such as experiences of discrimination in healthcare settings or uptake of hormone therapy.

In spite of the above limitations, our findings make major contributions to understanding the health status of MTF, FTM, and GNC adults, including components of health that have largely not been studied. Further, our study offers insights to the importance of exploring the health of transgender groups and to the vital importance of including gender identity measures by all researchers, federal, national, and state agencies conducting public health surveillance and population surveys.

4.8 Conclusion

This study, one of the first of its kind, provides a comprehensive depiction of the health status of MTF, FTM, and GNC adults while comparing each to that of their CGM

and CGF counterparts. Research opportunities remain rich, plentiful, and needed to further identify and prioritize health-related needs and provide the foundation to develop clinical interventions aimed at reducing the burden of illness in the transgender population.

Table 14: Final Multivariable Model Results: Primary Health Status Outcomes

Primary health status outcome	<i>N</i>	Predictor	Wald χ^2	df	<i>P</i>	aOR	CL
<i>Self-rated general health</i>							
Fair/poor health	3174	Study group	11.59	4	0.0207	–	–
		Age	4.21	1	0.0402	1.01	1.00, 1.01
		Racial/ethnic minority	7.14	1	0.0075	1.35	1.08, 1.67
		Sexual minority	16.65	1	<0.0001	4.67	2.23, 9.78
		High school graduate or less	10.78	1	0.0010	1.39	1.14, 1.70
		Unemployed	79.66	1	<0.0001	2.98	2.35, 3.79
		Low income	50.01	1	<0.0001	3.52	2.49, 4.99
		SG*Sexual minority	12.77	4	0.0124	–	–
		SG*Low income	13.29	4	0.0100	–	–
		Percent voting Republican	5.06	1	0.0245	1.01	1.00, 1.02
<i>Health-related quality of life</i>							
Frequent physical unhealthy days	3120	Study group	20.02	4	0.0005	–	–
		Sexual minority	15.63	1	<0.0001	1.92	1.39, 2.66
		High school graduate or less	10.64	1	0.0011	1.35	1.13, 1.62
		Unemployed	78.42	1	<0.0001	2.24	1.87, 2.68
		Low income	32.65	1	<0.0001	1.84	1.49, 2.27
		Uninsured	3.89	1	0.0486	0.72	0.52, 1.00
		Discriminatory laws/policies	5.65	1	0.0174	1.26	1.04, 1.52
		Frequent mental unhealthy days	3118	Study group	32.31	4	<0.0001
Age	50.83			1	<0.0001	0.98	0.97, 0.98
Sexual minority	22.11			1	<0.0001	2.20	3.06, 22.11
Unmarried	8.37			1	0.0038	1.34	1.64, 8.37
Unemployed	19.80			1	<0.0001	1.71	2.17, 19.80
Low income	33.20			1	<0.0001	1.93	2.42, 33.20
<i>Chronic health conditions</i>							
≥ 2 chronic health conditions	3076	Study group	3.39	4	0.4112	–	–
		Age	113.95	1	<0.0001	1.04	1.03, 1.04
		Racial/ethnic minority	11.76	1	0.0006	0.71	0.58, 0.86
		Sexual minority	12.01	1	0.0005	1.83	1.30, 2.58
		Unmarried	18.26	1	<0.0001	1.47	1.23, 1.76

		Unemployed	7.31	1	0.0068	1.48	1.11, 1.97		
		Low income	28.05	1	<0.0001	2.49	1.78, 3.49		
		Uninsured	8.00	1	0.0048	1.65	1.17, 2.32		
		SG*Unemployed	10.68	4	0.0304	–	–		
		SG*Low income	10.05	4	0.0396	–	–		
		Discriminatory laws/policies	8.39	1	0.0038	1.31	1.09, 1.58		
<hr/>									
<i>Health problems or impairments</i>									
		≥ 3 health problems or impairments	3125	Study group	6.36	4	0.1739	–	–
		Sexual minority			20.42	1	<0.0001	2.56	1.70, 3.84
		Unmarried			8.74	1	0.0031	1.47	1.14, 1.91
		Unemployed			161.58	1	<0.0001	5.84	4.45, 7.66
		Low income			58.42	1	<0.0001	2.80	2.15, 3.65
		Uninsured			6.32	1	0.0120	0.53	0.32, 0.87
		Discriminatory laws/policies			14.52	1	0.0001	1.63	1.27, 2.09

Number of participants (*N*) included in each model. Bold indicates significant, at the 0.05 level, study group main effects. aOR and their 95% CLs for significant SG main effects and interactions are reported in Tables 12 and 13, as well as Figure 1. Age and percent voting Republican in descending order (highest to lowest values). aOR: adjusted odds ratio (measure of effect size); CL: confidence limits; df: degrees of freedom; SG: study group.

Table 15: Final Multivariable Model Results: Summary of Significant Predictors for Primary Health Status Outcomes

Predictor	Primary health status outcome				
	Fair/poor health	Frequent physical unhealthy days	Frequent mental unhealthy days	≥2 chronic health conditions	≥3 health problems or impairments
Study group (SG)	x	x	x		
Age	x		x	x	
Racial/ethnic minority	x			x	
Sexual minority	x	x	x	x	x
Unmarried			x	x	x
High school graduate or less	x	x			
Unemployed	x	x	x	x	x
Low income	x	x	x	x	x
Uninsured		x		x	x
SG* Racial/ethnic minority					
SG*Sexual minority	x				
SG*Unmarried					
SG* High school graduate or less					
SG* Unemployed				x	
SG*Low income	x			x	
SG*Uninsured					
Discriminatory laws/policies		x		x	x
Percent voting Republican	x				
Winter/Fall					

Table 16: Significant Final Multivariable Model Results: A Posteriori Contrasts for Study Group and Primary Health Status Outcomes

Outcome	Pairwise contrasts									
	MTF/FTM	MTF/GNC	FTM/GNC	MTF/CGM	MTF/CGF	FTM/CGM	FTM/CGF	GNC/CGM	GNC/CGF	CGM/CGF
<i>Self-rated general health</i>										
Fair/poor health										
<i>P</i> value	0.0188	0.2993	0.1828	0.1702	0.0023	0.1736	0.9735	0.9016	0.0957	0.0712
aOR	0.21	0.55	2.64	0.51	0.20	2.46	0.98	0.93	0.37	0.40
95% CL	0.06, 0.77	0.18, 1.69	0.63, 11.05	0.20, 1.33	0.07, 0.57	0.67, 9.04	0.25, 3.77	0.31, 2.83	0.11, 1.19	0.15, 1.08
<i>Health-related quality of life</i>										
Frequent physical unhealthy days										
<i>P</i> value	0.3229	0.8768	0.5071	0.8662	0.0137	0.1876	0.3486	0.7694	0.1151	<0.0001
aOR	0.80	0.96	1.20	1.03	0.67	1.28	0.84	1.07	0.70	0.66
95% CL	0.52, 1.24	0.59, 1.58	0.70, 2.05	0.75, 1.41	0.49, 0.92	0.89, 1.85	0.58, 1.21	0.69, 1.67	0.45, 1.09	0.54, 0.80
Frequent mental unhealthy days										
<i>P</i> value	0.0336	0.4941	0.0207	0.0433	0.2601	<0.0001	0.1204	0.5154	0.1296	<0.0001
aOR	0.62	1.20	1.92	1.41	0.83	2.54	1.33	1.17	0.69	0.59
95% CL	0.40, 0.96	0.71, 2.03	1.10, 3.34	1.01, 1.96	0.60, 1.15	1.56, 3.25	0.93, 1.90	0.73, 1.90	0.43, 1.11	0.48, 0.73

Bold indicates statistical significance at the 0.05 level. aOR: adjusted odds ratio (measure of effect size); CGF: cisgender female; CGM: cisgender male; CL: confidence limits; FTM: female-to-male or transgender male; GNC: gender nonconforming; MTF: male-to-female or transgender female.

Table 17: Final Multivariable Model Results: Significant Study Group Interactions for Primary Health Status Outcomes

Primary health status outcome	SG	Sexual minority		Heterosexual		Low income		High income	
		Mean	SEM	Mean	SEM	Mean	SEM	Mean	SEM
Fair/poor health	MTF	0.28	0.06	0.24	0.03	0.31	0.05	0.22	0.04
	FTM	0.62	0.11	0.19	0.03	0.46	0.10	0.30	0.05
	GNC	0.50	0.09	0.24	0.05	0.33	0.08	0.38	0.06
	CGM	0.35	0.07	0.23	0.02	0.41	0.05	0.19	0.03
	CGF	0.56	0.09	0.21	0.02	0.52	0.06	0.24	0.04
		Unemployed		Employed		Low income		High income	
	SG	Mean	SEM	Mean	SEM	Mean	SEM	Mean	SEM
≥ 2 chronic health conditions	MTF	0.48	0.05	0.23	0.05	0.38	0.07	0.31	0.04
	FTM	0.51	0.07	0.25	0.06	0.48	0.09	0.27	0.04
	GNC	0.47	0.07	0.23	0.06	0.29	0.08	0.40	0.06
	CGM	0.45	0.04	0.26	0.03	0.43	0.05	0.28	0.03
	CGF	0.48	0.04	0.38	0.04	0.54	0.04	0.32	0.03

Least squares means and SEM for estimated probabilities, adjusted for covariates in final multivariate model. CGF: cisgender female; CGM: cisgender male; FTM: female-to-male or transgender male; GNC: gender nonconforming; MTF: male-to-female or transgender female; SEM: standard error of the mean; SG: study group.

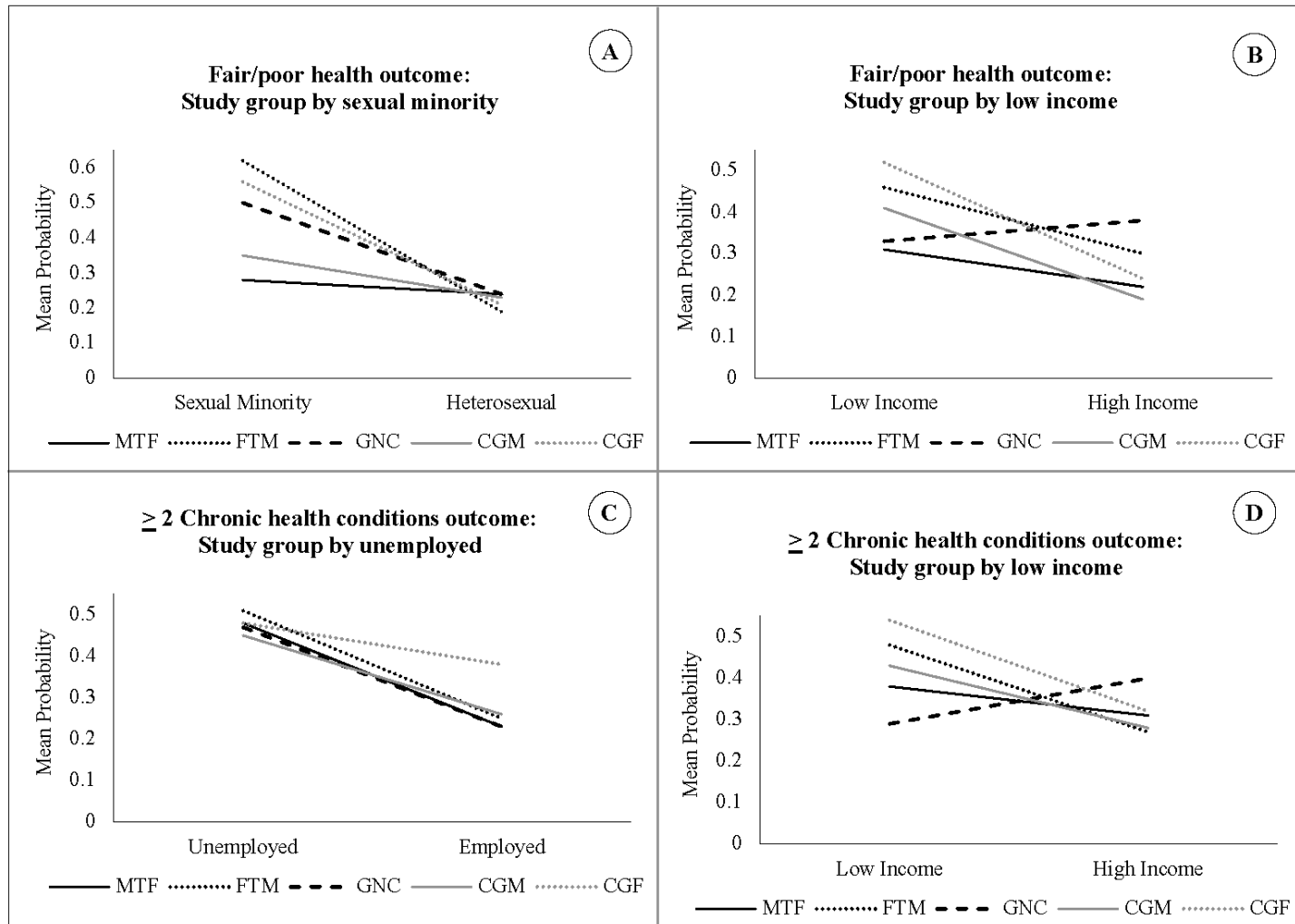


Figure 4: Final Multivariable Model Results: Significant Study Group Interactions for Primary Health Status Outcomes

Table 18: Final Multivariate Model Results: A Posteriori Contrasts for Study Group Interactions for Primary Health Status Outcomes

Primary health status outcome	SG ₁ / SG ₂	Sexual minority			Heterosexual			Low income			High income			
		aOR	95% CL	<i>P</i>	aOR	95% CL	<i>P</i>	aOR	95% CL	<i>P</i>	aOR	95% CL	<i>P</i>	
Fair/poor health	MTF/FTM	0.24	0.08, 0.70	0.0092	1.40	0.81, 2.42	0.2307	0.51	0.20, 1.29	0.1548	0.65	0.34, 1.25	0.2005	
	MTF/GNC	0.39	0.16, 0.97	0.0437	1.02	0.54, 1.92	0.9518	0.89	0.36, 2.20	0.8059	0.45	0.24, 0.84	0.0125	
	MTF/CGM	0.70	0.29, 1.65	0.4092	1.06	0.73, 1.55	0.7576	0.64	0.33, 1.21	0.1676	1.16	0.69, 1.96	0.5755	
	MTF/CGF	0.30	0.12, 0.78	0.0131	1.18	0.81, 1.72	0.4026	0.40	0.21, 0.78	0.0072	0.89	0.51, 1.56	0.6841	
	FTM/GNC	1.64	0.53, 5.13	0.3914	0.73	0.37, 1.45	0.3658	1.76	0.59, 5.24	0.3093	0.68	0.34, 1.38	0.2844	
	FTM/CGM	2.93	0.98, 8.78	0.0542	0.76	0.48, 1.21	0.2469	1.25	0.52, 3.04	0.6171	1.78	0.97, 3.26	0.0632	
	FTM/CGF	1.28	0.40, 4.08	0.6743	0.84	0.53, 1.34	0.4673	0.79	0.32, 1.95	0.6120	1.36	0.72, 2.58	0.3443	
	GNC/CGM	1.78	0.70, 4.52	0.2222	1.04	0.60, 1.82	0.8878	0.71	0.30, 1.67	0.4345	2.61	1.45, 4.70	0.0014	
	GNC/CGF	0.78	0.29, 2.12	0.6252	1.15	0.66, 2.02	0.6178	0.45	0.19, 1.07	0.0712	2.00	1.07, 3.72	0.0292	
	CGM/CGF	0.44	0.17, 1.13	0.0876	1.11	0.87, 1.42	0.4167	0.63	0.35, 1.14	0.1280	0.77	0.46, 1.27	0.3045	
≥ 2 chronic health conditions	SG ₁ / SG ₂	Unemployed			Employed			Low income			High income			
		aOR	95% CL	<i>P</i>	aOR	95% CL	<i>P</i>	aOR	95% CL	<i>P</i>	aOR	95% CL	<i>P</i>	
		MTF/FTM	0.88	0.48, 1.63	0.6897	0.90	0.43, 1.91	0.7900	0.65	0.27, 1.61	0.3544	1.22	0.73, 2.02	0.4450
		MTF/GNC	1.02	0.53, 1.98	0.9525	1.01	0.44, 2.33	0.9824	1.53	0.58, 4.04	0.3893	0.67	0.38, 1.19	0.1700
		MTF/CGM	1.11	0.72, 1.70	0.6519	0.86	0.51, 1.45	0.5754	0.81	0.43, 1.54	0.5270	1.17	0.83, 1.66	0.3773
		MTF/CGF	1.01	0.65, 1.57	0.9545	0.50	0.30, 0.83	0.0075	0.52	0.28, 0.98	0.0432	0.97	0.68, 1.37	0.8405
		FTM/GNC	1.16	0.56, 2.40	0.6966	1.12	0.45, 2.78	0.8109	2.34	0.81, 6.80	0.1182	0.55	0.30, 1.03	0.0601
		FTM/CGM	1.25	0.74, 2.12	0.4042	0.95	0.51, 1.79	0.8822	1.24	0.57, 2.69	0.5804	0.96	0.63, 1.47	0.8507
		FTM/CGF	1.15	0.68, 1.95	0.6102	0.55	0.30, 1.03	0.0606	0.80	0.37, 1.71	0.5644	0.79	0.52, 1.21	0.2844
		GNC/CGM	1.08	0.60, 1.94	0.7902	0.85	0.41, 1.79	0.6738	0.53	0.22, 1.26	0.1510	1.74	1.06, 2.86	0.0298
GNC/CGF	0.99	0.55, 1.79	0.9804	0.49	0.24, 1.03	0.0586	0.34	0.15, 0.80	0.0137	1.43	0.87, 2.36	0.1569		
CGM/CGF	0.92	0.68, 1.23	0.5641	0.58	0.42, 0.79	0.0006	0.64	0.42, 0.99	0.0431	0.83	0.67, 1.02	0.0708		

Bold indicates statistical significance at the 0.05 level. aOR: adjusted odds ratio (measure of effect size); CGF: cisgender female; CGM: cisgender male; CL: confidence limits; FTM: female-to-male or transgender male; GNC: gender nonconforming; MTF: male-to-female or transgender female; SG: study group.

5. Conclusion

5.1 Introduction

The purpose of this dissertation research was to establish evidence regarding the health of transgender and gender nonconforming (GNC) adults in the United States. Specifically, this dissertation 1) reviewed current literature on the experiences of transgender adults when they access and utilize healthcare, 2) identified and addressed methodological concerns related to conducting transgender health research using data from the 2015 Behavioral Risk Factor Surveillance System (BRFSS), and 3) explored the health status of three transgender subgroups (male-to-female [MTF or transgender female/women], female-to-male [FTM or transgender male/men], and GNC adults) and their cisgender male (CGM) and cisgender female (CGF) counterparts.

The main findings from this dissertation include the following. First, transgender adults experience numerous obstacles accessing healthcare, discrimination from healthcare professionals and clinicians, and barriers to medically necessary care, such as cross-sex hormones, as well as primary and preventative healthcare. Second, the 2015 BRFSS data collection procedures introduced measurement error and sex misclassification that contributed towards problematic BRFSS sampling weights. Third, transgender adults have poorer health than their cisgender counterparts. However, when data are disaggregated into transgender subgroups, notable differences in the health of MTF, FTM, and GNC adults are revealed. Notably, GNC adults have poorer overall health than their transgender and cisgender counterparts.

Overall, the studies from this dissertation provide empirical evidence to inform health promotion and illness prevention in transgender and GNC adults. These findings make significant contributions to the transgender health knowledge base, and advance the field by identifying priority research topics, policy areas, and methodological considerations for public health surveillance and population surveys aimed at improving the health of transgender and gender nonconforming people. Findings also provide the foundation to improve healthcare delivery and educational programs for current and future health professionals. To further advance transgender health knowledge, a more comprehensive understanding of how gender identity and gender expression influence health status and healthcare utilization for transgender and GNC adults is needed.

5.2 Chapter two. Healthcare experiences of transgender adults: An integrated mixed research synthesis

Healthy People 2020 (HP2020) designated transgender health as a national priority (US Department of Health Human Services, 2010). In response, the Institute of Medicine (2011) recommended exploring the healthcare experiences and barriers transgender people face to equitable healthcare. The purpose of this integrated mixed research synthesis was to respond to the Institute of Medicine call and to contextualize the experiences of transgender adults interfacing with healthcare in the U.S.

Evidence from the 23 articles synthesized indicated that transgender adults experience numerous obstacles when accessing healthcare such as unsafe public and healthcare spaces, lack of knowledgeable clinicians, and restricted health insurance benefits for medically necessary care. During healthcare utilization, they encounter

gender non-affirming healthcare professionals and clinicians; and barriers to gender-affirming medical interventions, primary and preventative care, and mental health-related services; and they endure discrimination and healthcare refusal. However, the majority of data synthesized represented experiences of transgender women and the context of healthcare experiences were centered on gender-affirming medical interventions. Inadvertently, these limitations may have created a biased depiction of healthcare encounters and environments experienced by all transgender people, and possibly obscured other transgender-related phenomenon associated with healthcare access and utilization. To improve healthcare access and utilization for transgender adults, more research is needed that details the health services sought and further understanding of the lived experiences representing the heterogeneity of the transgender population is urgently needed.

5.3 Chapter three. Transgender population health: Behavioral Risk Factor Surveillance System methodological considerations

Epidemiological studies characterizing the health status of the U.S. transgender population are lacking. In 2014, BRFSS, an annual cross-sectional health surveillance survey, first offered an optional survey module capturing data on gender identity. This was a promising step towards better understanding transgender health; however, methodological challenges arise when using BRFSS data to study transgender population health. This chapter 1) described such challenges, 2) proposed that a matched-subject design can address the 2015 BRFSS methodological challenges, and 3) presented a comparison of poor health using two sampling methodological approaches to illustrate

their impact on parameter estimates.

Engendered by BRFSS data collection procedures, measurement error and sex misclassification contributed to inaccurate sampling weights for the transgender participants. Data from the 74% of transgender women who were misclassified had their data raked using population-level data for CGMs, and population-level data for CGFs were used to rake the 66% of transgender men who were misclassified. The sex misclassification bias has the potential to impact the validity of statistical conclusions regarding transgender people. Modifying a case-control study design provides one way to account for the drawbacks associated with BRFSS sampling weights.

Using data from the 22 states that adopted the 2015 BRFSS gender identity module, we presented a comparison of poor health status from two sampling methodological approaches, a 1:4 matched-subject design (each transgender participant: two CGMs and two CGFs) without the use of BRFSS sampling weights, and all transgender and cisgender participants with sampling weights applied, to illustrate their differential impact on population parameter estimates. A logistic regression model was fit for each analysis sample to determine whether study group (MTF, FTM, GNC, CGM, and CGF adults) predicted poor health status, after covarying for age, race, educational attainment, employment status, and health insurance. To further evaluate differences in poor health status among the five study groups, *a priori* pairwise comparisons of the groups were conducted.

Our findings suggest that BRFSS sampling weights can result in biased

parameter estimates when evaluating factors that may influence transgender health. The impact of BRFSS sampling weights was particularly evident in the pairwise comparisons of transgender subgroups, as both analysis samples included the same transgender participants. In these contrasts, the application of BRFSS sampling weights contributed towards not only inaccurate poor health status estimates, but also less precision in the parameter intervals. Generalizations made from the weighted analysis sample may obscure the need for healthcare policy and clinical interventions aimed to promote health and prevent illness for transgender adults, particularly MTF and FTM individuals. Methodology of public health surveillance and population surveys should be reviewed to help reduce systematic bias and increase the validity of data collected from transgender people.

5.4 Chapter four. The health status of transgender and gender nonconforming adults in the United States

The overall goal of this chapter was to increase understanding of the relationships among individual factors (personal characteristics and socioeconomic position) and health status with five study groups: three transgender subgroups (MTF, FTM, GNC) and their CGM and CGF counterparts. The specific aims were to: 1) describe and compare the personal characteristics, socioeconomic position, and health status of five study groups, and 2) determine the differential effects of individual factors on health status in the five study groups. Health status outcomes included measures of self-rated general health, health-related quality of life, chronic health conditions, and health problems or impairments related to activities of daily living and instrumental activities of daily living.

This study used a descriptive, observational, and cross-sectional 1:4 matched-study design to perform a secondary analysis of data from the 2015 BRFSS. For Aim 1, bivariate logistic regression for binary measures and one-way analysis of variance methods for continuous measures were performed to test for study group differences in individual factors and health status. For Aim 2, multivariable logistic regression models were utilized to determine the differential effects of individual factors on health status in the five study groups. For both aims, *a posteriori* pairwise contrasts of the study groups were conducted when a significant overall study group effect was detected.

This study, one of the first of its kind, provided a comprehensive depiction of the health status of MTF, FTM, and GNC adults while comparing each to that of their CGM and CGF counterparts. Our findings demonstrated that transgender adults experience poorer health, more frequent physical and mental unhealthy days, a greater number of chronic health conditions, and more health problems or impairments than cisgender adults. Further, we were the first to discover that GNC adults have poorer overall health than their transgender and cisgender counterparts. Additionally, we found that FTM adults had significantly greater risk of both fair/poor health status, especially those who also identify as a sexual minority, when compared to CGF adults, and frequent mental unhealthy days when compared MTF, GNC, and CGM. Further research exploring a comprehensive depiction of the health status of GNC and FTM adults is critically needed.

5.5 Education, practice, research and policy implications of the findings from this dissertation

5.5.1 Improving practice with education initiatives

Considering that transgender and GNC adults have significantly poorer health than their cisgender counterparts, positive and affirming healthcare encounters are needed to help improve the health of transgender and GNC people. Current health professionals and health professions students need to learn about what it means to be transgender, what are the relevant concerns/issues in the competent administration of healthcare to transgender and GNC individuals, and the importance of and how to gather gender identity and sexual orientation data during patient encounters. Both didactic and clinical content on transgender health needs to be included in curricula beginning with fundamental skills such as therapeutic, gender-affirming communication through health assessment, and beyond. Healthcare facilities and healthcare systems can improve the healthcare experiences and delivery of care for transgender and GNC adults by implementing this curricula content in continuing education programs offered to current health professionals, including clinicians and administrative and/or support staff members, as well as incorporating transgender health content during new employee orientation programs.

5.5.2 Research opportunities

5.5.2.1 Healthcare access and utilization.

Barriers to equitable healthcare can profoundly affect the health and well-being of transgender and GNC adults. Although the majority of healthcare experiences contextualized in our literature synthesis were affiliated with gender-affirming hormones,

it is quite possible that barriers to care and discrimination are also experienced by transgender and GNC adults who are not pursuing such gender-affirming interventions. Future research is needed to contextualize their healthcare experiences, including the identification of facilitators and barriers to equitable gender-affirming care.

5.5.2.2 Physical health.

Previous health-related studies have largely focused on the mental health outcomes, health-risking behaviors, and mental health sequelae associated with transgender-related stigma and discrimination (Blosnich et al., 2016; Su et al., 2016; White Hughto & Reisner, 2016b). While this line of research is important, it does not fully account for an individual's state of well-being (World Health Organization, 2014); after all, there is strong evidence elucidating the intertwined relationships of physical and mental health outcomes (Juster, McEwen, & Lupien, 2010; McEwen & Stellar, 1993). As such, this dissertation research aimed to promote a greater understanding of all aspects of health for transgender and GNC. By using a broader conceptualization of health status, our findings revealed that in addition to more frequent mental unhealthy days, transgender adults experience poorer health, more frequent physical unhealthy days, a greater number of chronic health conditions, and more health problems or impairments than cisgender adults. These findings underscore the necessity of examining aspects of physical health, including chronic health conditions and health problems/impairments, which remains an important area of future research.

5.5.2.3 Gender identity measures.

The electronic health record represents a mechanism to advance transgender health knowledge (Institute of Medicine, 2011; Joint Commission, 2011). The exclusion of gender identity measures from electronic health records limits the availability of data needed to better understand the health of transgender and gender nonconforming adults. It is necessary to continue initiatives aimed at incorporating transgender-inclusive measures within the electronic health record. To identify transgender and gender nonconforming people, including those individuals who may not use the term transgender when describing themselves, a two-step method is recommended (Gender Identity in U.S. Surveillance Group, 2014). For example: 1) What sex were you assigned at birth, on your original birth certificate? (male or female) and 2) How do you describe yourself? (male, female, FTM, MTF, GNC, a different identity). Future work to implement gender identity measures within the electronic health record and to collect these measures during patient encounters may support the establishment of healthcare policy. Moreover, electronic health data can provide the ability to measure evidence-based care advancements, as well as aid researchers conducting longitudinal studies to further understand the health of the transgender and gender nonconforming population.

Similar to reasons addressed above concerning electronic health records, routine transgender-inclusive measures are needed in public health surveillance and population surveys. The addition of a transgender-inclusive survey item to BRFSS provided researchers an unprecedented opportunity to explore the health of transgender and gender

nonconforming adults. However, by examining the 2015 BRFSS methodology, we discovered methodological approaches which may impact the statistical conclusions made by research efforts. As researchers, federal, national, and state agencies work towards adopting transgender-inclusive measures, they may benefit from collaborating with researchers who specialize in methods for transgender and gender nonconforming health research. These collaborations can help to reduce systematic bias and to increase the validity of data collected from diverse transgender people.

5.5.2.4 Longitudinal and cohort studies.

Longitudinal and cohort studies can further advance transgender health knowledge. With this study design, gender identity should be assessed during each wave of data collection, so that researchers can explore time-related processes (e.g., use of cross-sex hormones), assess changes over time (e.g., changes in gender expression, fluctuation in sexual orientation and gender identity, and the influence of gender-affirming medical interventions), and determine temporal ordering of factors known to influence health and health behaviors (e.g., discriminatory laws and policies, exposure to stressful events such as discrimination, and age of cross-sex initiation or gender nonconformity).

5.5.3 Transgender-protective policy needs

Research opportunities in transgender and gender nonconforming health are rich and critically needed. Equally important is the establishment of transgender-protective laws and policies. This dissertation study discovered that unsafe public spaces and

employment-related discrimination and prejudice represent barriers to healthcare for transgender adults, and that the health of transgender and cisgender adults is adversely affected by transgender-related discriminatory laws and policies. Future work should consider accounting for the influence of discriminatory laws and policies, including discrimination in healthcare environments and by health insurance policies. Findings from these studies will support the continued efforts of organizations committed to new enactment and enforcement of transgender-protective legislation.

5.6 Limitations

This dissertation study is one of the first to provide a holistic view of the health status and of transgender and GNC adults. The insights gained are significant, but, as with any study, there are limitations. Additional research is needed to account for measurement issues and limitations of BRFSS data. Research opportunities remain regarding the health of FTM and GNC adults. While we discovered that FTM and GNC adults have significant health concerns, our study was underpowered. The sample sizes for the transgender groups, particularly for the GNC group, were smaller than the required sample sizes. Missing data further reduced the sample sizes for the multivariable model. Statistical power may not have been adequate for detecting all existing study group differences in the multivariable models. Primary data collection efforts, including those which oversample FTM and GNC groups, may be necessary to ensure that future studies are sufficiently powered.

5.7 Conclusion

The overall goal of this dissertation was to examine the health status of transgender adults in the United States. In order to promote health and well-being for transgender and gender nonconforming adults, improvements to healthcare access and to healthcare environments are paramount. By exploring the health of three transgender subgroups, the heterogeneity of the transgender population becomes more visible. This approach revealed differences in health disparities and health priorities among MTF, FTM, and GNC adults. This knowledge can help guide patient-centered care approaches and underscores the importance of examining the transgender population as unique subpopulations. The knowledge gained from this dissertation can help healthcare professionals provide the best care for the aging transgender and GNC population and identify modifiable determinants of chronic health conditions and health problems/impairments. Findings will also help prioritize future directions in transgender health research, aid in the development of interventions, and lay the foundation for current and future public health initiatives and policies addressing the health, well-being, and quality of life for all transgender and GNC people.

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Biography

Ethan Collin Cicero was born September 10, 1978 in Plantation, Florida, USA. He attended the University of North Carolina at Chapel Hill School where he earned his Bachelor of Science in Nursing with a Highest Honors designation in 2014. Ethan earned his PhD at the Duke University School of Nursing where he was named a Robert Wood Johnson Foundation Future of Nursing Scholar. His program of research focuses on health disparities in the transgender and gender nonconforming population, with a particular interest in methods used for research studying these populations.

Ethan has made significant contributions to Nursing and the body of knowledge in transgender health. His case study published in the Journal of Emergency Nursing received national and international attention with media outlets like CBS News, Huffington Post, Hospitals & Health Networks, and RadioMD. Additionally, his invited review manuscript on evidence-based practice overview for school nursing caring for transgender students was published as a featured article in the Journal of School Nursing. In 2017, Ethan successfully launched a professional nursing organization, the Association of Transgender Health Nurses. Even at this early juncture in his academic career, Ethan has influenced the incorporation of transgender health content into the curriculum of two schools of nursing; presented both internationally and nationally; lectured in undergraduate- and graduate-level courses for schools of public health, medicine, sociology, and nursing.