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Contextual Factors and the Syndemic of Alcohol Use and Risky Sexual Behaviors Among Men Who Have Sex with Men

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Contextual Factors and the Syndemic of Alcohol Use and Risky Sexual Behaviors

Among Men Who Have Sex with Men

by

Humberto López Castillo

A dissertation submitted in partial fulfillment of the requirements for the degree of
Doctor of Philosophy
with a concentration in Public Health
Department of Community and Family Health
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DEDICATION

To the three women of my life, who love me unconditionally: Tina, Ara, and Vicky.

Your vision goes above and beyond and grows every generation. As my mother would wisely put it:

Uno nunca sabe adónde está su suerte (One never knows where one’s luck might be). She was right.
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ABSTRACT

Since the early 1990s with the AIDS pandemic, there has been an increasing interest on the importance of risky sexual behaviors, especially among men who have sex with men (MSM). An important antecedent for these behaviors is alcohol use. Studies consistently show an increased frequency of both alcohol use and risky sexual behaviors in MSM populations. However, to date, there has not been a precise estimate of the effect size in these diverse populations and a consistent way to measure it. More so, the importance of context is often cited as a source of variability, but is rarely measured in these studies.

Contextual factors are different and specific for MSM, as they have been approached by two theories, both of which will be guiding this dissertation: Singer’s Syndemic Theory and Meyer’s Minority Stress Theory. Chapter 1, then presents a comprehensive review of both theories as they apply to alcohol use, risky sexual behaviors, and contextual factors driving them.

Chapter 2 answers the first research question about effect sizes through a systematic literature review. The effect sizes or measures of association of these contextual risk and protective factors were summarized using meta-analytic techniques. Using five electronic databases, we identified 26 studies in 26 years (1990–2015), all diverse in terms of sampling techniques, assessment of sexual orientation, operationalization of alcohol use and risky sexual behaviors, contextual factors included, and measurement of effect sizes. Despite this diversity, studies reporting an effect size were pooled and summarized using both descriptive and meta-analytic techniques, as appropriate. Meta-analyses were conducted using Cochrane’s guidelines for generic inverse variance outcomes with random effects. The pooled effects of alcohol use on condomless anal intercourse (CAI; OR
1.73 [95% CI 1.43, 2.10], \( I^2 \) 0\%), heavy episodic drinking on CAI (OR 1.88 [95% CI 1.25, 2.81], \( I^2 \) 32\%), and heavy episodic drinking on condomless oral sex (OR: 8.00; 95% CI 2.48, 25.81), as well as the effects of substance use, mental health status, violence and victimization, and self-reported HIV status as contextual factors in the pathway between alcohol use and risky sexual behaviors were calculated, reported, and discussed along with study limitations and implications for public health.

Chapter 3 answers the second research question regarding a standardized measurement model for effect sizes and the multiple mediation of contextual factors. We used the male subset of Wave IV of the AddHealth dataset to test our hypotheses through structural equation modeling approaches, including measurement analysis with invariance testing, path analysis for direct effects, and multiple mediation analysis through bootstrapping for indirect effects. The AUD scale was invariant between MSM and MSW, but the risky sexual behavior scale was not. For MSM, the standardized direct effect of AUD onto risky sexual behaviors was –1.25 and the standardized total indirect effect of the multiple mediation model was 1.58, 95% CI [1.42, 1.73]. Among the mediators, the strongest indirect effect for any measured or latent mediator was the mental health construct (2.09). We conclude that even though AUD has the same measurement structure for MSM and MSW, its effect on risky sexual behaviors does not operate the same way for these two populations, supporting both causal and contextual behavioral theories.

Conclusions are individually discussed, respectively, in Chapters 2 and 3. However, Chapter 4 puts both manuscript conclusions in context and further discusses future implications for public health research, practice, and policy.
CHAPTER 1:
INTRODUCTION

Problem Statement

In 1964, the World Health Organization (WHO) defined health as “a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity” (p. 100). This definition has stood the test of time because it integrates the more-understood physical health with the less-understood mental and social aspects of health. Public health objectives are aligned with this definition of health: to prevent disease, to promote health, and to prolong the lifespan for the population at large (Martin-Moreno, Harris, Jakubowski, & Kluge, 2016). Successes in mental health promotion depart from a reductionist view of issues and use an integrative approach of behavioral health and neurosciences (Hyman, 2000), also aligned with WHO definition of health.

Public health professionals and organizations increasingly recognize the complex role of behavioral health in most public health issues (Mabry, Olster, Morgan, & Abrams, 2008). It is the complexity of causation that has brought together biomedical, behavioral, and socio-ecologic approaches to improve our understanding of disease, behavior, and context. Without a biological basis for health disparities among populations, it is important to understand mental health, context, and their interaction.

This is the case of men who have sex with men (MSM). Compared to heterosexual peers, MSM populations consistently have higher rates of alcohol use, regardless of the way alcohol use is measured. Compared to heterosexual peers, MSM populations also seem to engage in riskier sexual behaviors. Both of these issues—alcohol use and risky sexual behaviors—start early in adolescence
and escalate rapidly into adulthood and seem to co-occur at a disproportionate rate among MSM populations (Bolton, Vineke, Mak, & Dennehy, 1992; Stall, McKusick, Wiley, Coates, & Ostrow, 1986). Few preventive interventions target MSM and, to date, the CDC, the Substance Abuse and Health Services Administration (SAMHSA), and the National Institutes of Health (NIH) only have a handful of evidence-based interventions (EBIs) for the prevention of co-occurring alcohol use and/or risky sexual behaviors among MSM populations.

The last systematic review on the drivers of risky sexual behaviors among MSM who consume alcohol was conducted in the United Kingdom (Donovan & McEwan, 1995). This review acknowledged three important research limitations that are still current: inappropriate extrapolations from heterosexual populations, methodological diversity in study approaches, and lack of studies of contextual factors.

In this context, rising number of young adults ever using alcohol are of general concern as they engage in risk-taking behaviors. Particularly, MSM show higher prevalence of alcohol use and account for most of the new cases of sexually transmitted infections (STI), including the human immunodeficiency virus (HIV). Several biological theories link alcohol use to engaging in risky sexual behaviors (Stall et al., 1986) and are out of the scope of this work. However, few of these theories are comprehensive enough to understand the role of common contextual factors in the pathway between these two risk-taking behaviors.

Risky behaviors are a function of common contextual factors driving them. Several studies have identified the mediating and moderating effects of demographics, social support, victimization, mental health issues, substance use, abuse, and misuse, with regard to risk-taking behavior. To date, however, there is no comprehensive framework to understand these contextual factors within social networks and as a complete, dynamic system with interactions at multiple levels.
The purpose of this investigation is to model the role of contextual factors in the pathway of alcohol use disorder and risky sexual behaviors among MSM.

**Significance**

Although the public health impact of short- and long-term consequences of alcohol use disorders and risky sexual behaviors has been well established, even with the methodological limitations stated (Donovan & McEwan, 1995), to date there is no comprehensive model to understand the role of contextual factors in the pathway from alcohol use disorders to risky sexual behaviors among MSM. This study fills such an important gap.

The proposed dissertation is also significant because it will summarize current evidence of co-occurring morbidity within structural and personal contextual factors. This, in turn, is fundamental to prevent further spread of STI-associated morbidity and mortality, and to improve not only sexual health as an outcome, but also co-occurring conditions and structural factors that determine the five “Ds” of public health: death, disease, disability, discomfort, and dissatisfaction.

**Delimitations**

This study uses meta-analytic techniques to find strength of association between alcohol use and risky sexual behaviors in populations of MSM and the contextual factors included in these studies. Then, we used the in-home interview data from Wave IV of The Longitudinal Study of Adolescence to Adulthood Health (Add Health) to test those associations. The Add Health data were originally collected from 7th- to 9th-graders in the 1994-1995 academic year and were structured to be a representative sample of the US population. This population has been followed over time and interviewed in subsequent waves, with good response rates and little attrition (Boonstra, 2001; Chen & Chantala, 2014; Harris, 2013). The selected Wave IV was conducted when participants were between 24 to 32 years.
Research Questions

1. What are the effects of the most salient risk and protective factors in the pathway between alcohol use and risky sexual behaviors among MSM?
   1.1. What are the effect sizes of each individual risk and protective factor in the pathway between alcohol use and risky sexual behaviors among MSM?
   1.2. What is the overall effect size each individual risk and protective factor in the pathway between alcohol use and risky sexual behaviors among MSM?

2. How does the inclusion of contextual risk and protective factors change the pathway between alcohol use and risky sexual behaviors in male respondents of Wave IV of Add Health?
   2.1. Do the effect sizes for these risk and protective factors found in the meta-analysis hold true for this population?
   2.2. What model better predicts the path between alcohol use and risky sexual behaviors in this population?
   2.3. Is there measurement invariance in the model when MSM are compared to their heterosexual peers?

Theoretical Frameworks

This dissertation proposal is informed by theoretical assumptions that favor the study of context, as has been suggested by the National Institutes of Health (2001) and noted behavioral theorists (Glanz, Rimer, & Viswanath, 2008a, 2008b; Sallis, Owen, & Fisher, 2008) and theory philosophers (Hitchcock, 2012; Morrison, 2007; Nickel, 2010).

The two theories included in this dissertation are Meyer’s Minority Stress Theory (1995, 2003) and Singer’s Syndemic Theory (1994). Both theories use an ecological framework that approaches Bronfenbrenner’s (1979) and both are increasingly used for the study of mental health
and contextual health disparities, respectively, among MSM populations. The health disparities theme derives from the idea that health outcomes are socially constructed and culturally produced, resulting from cultural marginalization at the intersection of social disadvantage (Kurtz, Buttram, Surratt, & Stall, 2012). The two theories propose that factors act at two levels: the proximal, subjective, micro and the distal, objective, macro contexts. Both theories take a life-course perspective on the development of health outcomes among MSM, acknowledging that these begin earlier during adolescence the health and continue throughout the lifetime (Stall, Friedman, & Catania, 2008).

**Minority Stress Theory**

Minority Stress Theory is based on the premise that MSM “are subjected to chronic stress related to their stigmatization” (Meyer, 1995, p. 38). This minority stress is the result of juxtaposing values of the minority and the dominant groups, resulting in conflict with the social environment. Minority-related stressors include negative events (e.g., discrimination, bullying), negative attitudes towards homosexuality, internalization of discomfort with sexuality, and emotional distress related to acceptance (Goldbach, Tanner-Smith, Bagwell, & Dunlap, 2014). This theory draws concepts and relationships from other social, behavioral, and psychological frameworks, like Goffman’s Stigma and Discrimination Theory (1963), Blumer’s Symbolic Interactionism (1962), and Lemert’s Societal Reaction (Labeling) Theory (1951). According to Meyer (1995), there are three processes of minority stress among homosexual populations: internalized homophobia, perceived stigma, and prejudice events. In further exploring his own theory, Meyer (2003) added a fourth stress pathway—concealment of own sexual orientation.

*Internalized homophobia* was conceptualized as the direction of societal negative attitudes toward the self, viewing themselves from the imagined perspective of others (Meyer, 1995, p. 40), and was defined as “the internalization of societal antigay attitudes” by MSM (Meyer, 2003, p. 11).
This is the most proximal, internal, and insidious of all four stress pathways and is most acute early in the coming-out process and unlikely to abate until gay men accept their homosexuality (Meyer, 2003). This factor has been correlated with poor health outcomes among MSM (Stall et al., 2008).

Stigmatization experienced by MSM is a result of social and contextual climates leading to higher levels of internalized homophobia, perceived stigma, and prejudice, violence, and discrimination impacting their overall health (Vanden Berghe, Nöstlinger, & Laga, 2014). Negative experiences in the life course alone do not account for stigma and the stress experienced by minorities leads to a general experience of fear and mistrust in their interactions with the dominant culture, and a sense of disharmony and alienation with general society (Meyer, 1995, 2003). Four sources of stigma have been identified (Meyer, 2003): (1) categorization threat, where others categorize persons as members of a group against their will, especially when group membership is irrelevant within the particular context; (2) distinctiveness threat, which is the denial of distinct group membership when it is relevant or significant; (3) threats to the value of social identity, where the minority group’s values (e.g., their competence and morality) are undermined; and (4) threat to acceptance, which arises from negative feedback from one’s in-group and the consequent threat of rejection by the group.

Prejudice interferes with perception of the world as meaningful and orderly and includes events of discrimination, violence, and victimization, which disproportionally affect MSM populations (Meyer, 2003). These disparities are even more marked when the populations studied are young MSM, who are “even more likely than adults to be victimized by antigay prejudice events, and the psychological consequences of their victimization may be more severe” (Meyer, 2003, p. 3).

Concealment of one’s sexual identity, paradoxically, is often used as a coping strategy to avoid the negative consequences of associated stigma and harm (e.g., getting fired from a job, being attacked) or out of shame and guilt (Meyer, 2003). This coping strategy can backfire, as concealing homosexuality is an stress source for gay men that does not end after adolescence (Meyer, 2003).
Considering this theoretical focus on identity stressors, Mereish and Bradford (2014) posited that “being a member of multiple disadvantaged groups (e.g., gender, racial, and sexual minorities) might imply more negative mental health outcomes because of marginalization and stress related to [multiple] minority identities” (p. 180). This phenomenon, known as *additive stress*, has demonstrated inconsistent results in the literature (Mereish & Bradford, 2014), but must be taken into account in both the theoretical framework and methodological design of the proposed research.

**Contextual Factors**

In a recent meta-analysis, Goldbach et al. (2014) searched for studies using the Minority Stress Theory among MSM and organized the correlations between minority stressors and substance use, defined by frequency, quantity, lifetime use, past-year use, and other indices. Overall, the factors that showed the greatest correlation to substance use among MSM were not distinct from those reported by teens in the general population, regardless of sexual minority status. Limitations discussed by the authors include a small number of studies (15) with an even smaller number of unique, non-probabilistic populations included (12); the longitudinal design of most studies, where causation cannot be determined; and the lack of sensitivity of the factors included, because they were not considered a direct result of a sexual minority status (Goldbach et al., 2014).

Among the demographic factors analyzed, race (random effects mean correlation coefficient $\bar{r} = 0.04; 95\% \text{ CI } 0.01, 0.07$), gender ($\bar{r} = 0.06; 95\% \text{ CI } 0.02, 0.10$), and homelessness ($\bar{r} = 0.22; 95\% \text{ CI } 0.07, 0.36$) were significantly ($P < .05$) correlated with higher rates of substance use. Although homelessness in general has been described as a risk factor for substance abuse, among MSM it is often related to their sexual-minority status (either by running away or being evicted by parental figures) (Goldbach et al., 2014).

Statistically significant ($P < .05$) measures of internalized homophobia included time to identity acceptance ($\bar{r} = 0.10; 95\% \text{ CI } 0.02, 0.18$) and gender identity ($\bar{r} = 0.13; 95\% \text{ CI } 0.05, 0.21$).
Stigmatization was measured through sexual victimization, which was not statistically significant but only included one study with measures of this construct: gay-related victimization ($\bar{r} = 0.24; 95\% \text{ CI} 0.06, 0.41$) and general victimization ($\bar{r} = 0.60; 95\% \text{ CI} 0.32, 0.87$). The authors note lack of sensitivity in the measures of victimization as a direct result of a sexual minority status (Goldbach et al., 2014).

The two measures of prejudice and stress were statistically significantly correlated to substance abuse: general distress ($\bar{r} = 0.19; 95\% \text{ CI} 0.04, 0.34$) and gay-related distress ($\bar{r} = 0.21; 95\% \text{ CI} 0.10, 0.32$). Although stress as a factor driving substance use makes theoretical sense and was verified in this study, the authors state that stress itself cannot be determined as related to the sexual minority status due to lack of measurement specificity. Last, of six sexual identity concealment factors potentially correlated to substance abuse, only negative disclosure reactions ($\bar{r} = 0.24; 95\% \text{ CI} 0.09, 0.38$) proved to be statistically significant (Goldbach et al., 2014).

On the other hand, the authors did not find evidence that “positive disclosure reactions or self-esteem were associated with substance use” (Goldbach et al., 2014, p. 359). However, this study included other protective factors significantly correlated with substance abuse, namely, parental support ($\bar{r} = 0.21; 95\% \text{ CI} 0.15, 0.26$) and other adult support ($\bar{r} = 0.39; 95\% \text{ CI} 0.33, 0.45$). Interestingly, there was no evidence that community support or the size of MSM peer network were protective factors against substance abuse (Goldbach et al., 2014).

Syndemic Theory

The word syndemic is a portmanteau of synergistic epidemic (Singer, 2009), and it occurs when health-related problems cluster by person, place, or time (Milstein, 2001). The term was coined by Singer ca. 1992 with three objectives: (1) “to call attention to the synergistic nature of the health and social problems facing the poor and underserved” (Singer & Snipes, 1992, p. 225), (2) “to move social science analyses (...) toward the kind of holistic understanding that is needed to effectively
address critically pressing health and social issues” (Singer, 1996, p. 109), and (3) “to further refine our conceptualization, beyond conventional thinking about bounded, independent disease entities and to a realization of interlocking, mutually advancing threats to health in conducive social contexts” (Singer, 2006, p. 50).

A syndemic can be defined as (1) “a set of intertwined and mutually enhancing epidemics involving disease interactions at the biological level that develop and are sustained in a community/population because of harmful social conditions and injurious social connections” (emphasis in the original, Singer, 1994, p. 429); (2) “a set of closely intertwined and mutual enhancing health problems that significantly affect the overall health status of a population within the context of a perpetuating configuration of noxious social conditions” (Singer, 1996, p. 99); or (3) “the adverse interaction of diseases with each other and with punishing social conditions that promote both disease aggregation in a population and the reduction in immune competency and bodily capacity to resist and overcome disease (e.g., because of trauma, malnutrition, stress and infection)” (Singer, 2012, p. 1751). These conceptions have proven right over time, granting further development by (Singer, 2009) “to label a dynamic relationship involving two or more epidemic diseases or other diseases and the socio-environmental context that promotes their interaction” (p. 29) that cannot be explained by existing concepts, like co-occurrence, epidemic, or pandemic. Singer (1993) proposed that these interacting, contemporary, social realities could be more appropriately understood through community-centered research.

Framed by biosocial and political economic theories, the Syndemic Theory bridges public health, the social sciences, medicine, environmental sciences, and biology to explain how biological and social factors interact to produce increased burden of infectious, chronic non-communicable, mental, behavioral, toxic, and nutritional diseases and conditions in a population (Singer, 2009; Singer, Bulled, & Ostrach, 2012). Syndemic research simultaneously focuses “on distal and proximal
causes of disease, specific mechanisms and directionalities of interaction, broader patterns and
contexts of vulnerability and risk, and consequences of disease synergies that increase the overall
health burden of a population” (Singer, 2010, p. 15).

The traditional approach to health conditions as separate buckets or silos leads to
inefficiencies and less effective approaches to prevention and treatment (Gassman et al., 2012). The
traditional biomedical and public health strategy has been to diagnostically isolate, narrowly study,
and therapeutically treat individual cases of disease, “as if each disease were a distinct entity that
existed in nature separate from other diseases and independent of the biosocial contexts in which it
occurs” (Singer, 2010, p. 15). This reductionist strategy prevents the recognition of interconnected
processes and conditions, with a limited utility due to a distorted product (Singer, 1996). The idea of
a syndemic as a dynamic, holistic process opposes the static, atomistic, limited-value point of view of
nosology, which relies on its capacity to provide guidance for mobilizing effective responses in
prevention and treatment (Singer & Clair, 2003). As a reaction to nosology, three assumptions are
fundamental to the Syndemic Theory (Singer et al., 2006, p. 2011): (1) diseases do not necessarily
exist in isolation from other diseases and conditions, (2) disease interactions are of considerable
importance to disease course and consequences, and (3) the social conditions of disease sufferers are
critical to understanding health impacts at the individual and population levels.

Syndemic theorists seek to elucidate the tendency for multiple, co-terminus and interacting
epidemics to develop under conditions of health and social disparity (Singer et al., 2006). The first
syndemic to be labeled as such in the literature is the substance abuse, violence, and AIDS (SAVA)
(Singer, 1996) in four population groups, including MSM. However, these and other synergistic
epidemics must be explained “in terms of cultural marginalization—exclusion from dominant norms
and institutions (...)—rather than sexual orientation or same-sex sexual behavior” alone (Singer &
Syndemics reflect unequal social relationships and conditions, and their diffusion is mediated by the beliefs and behaviors of involved communities, which reflect human responses to the life experiences of injustice and social suffering (Singer et al., 2006). The problems and the reasons for their clustering define a syndemic and—although they may have nested or overlapping relationships—differentiate one syndemic from another (Milstein, 2001). All syndemics, however, share three concepts that interact in their diffusion (Singer & Clair, 2003): population-level factors, biological synergism, and social context.

Syndemics include the temporal and locational co-occurrence of two or more epidemics interacting synergistically and contributing as a result to an excess disease load at the population level (Kurtz et al., 2012; Singer, 2006), which presents health problems and health consequences of the biological interactions among the health conditions present (Singer & Clair, 2003). For example, neglected diseases occur in the interface between (1) global disparities in power, wealth, and human rights and (2) less-than-optimal living and working conditions, access to benefits of public health improvements, and health care, on the other (Singer & Bulled, 2012, pp. 329-330).

Biological synergism refers to the actual biological interaction in cases of co-affliction with two or more diseases or conditions that may facilitate the spread or impact of another agent through biochemical changes or organ system damage (Singer & Clair, 2003). This interaction may vary and does not require direct physical interaction to generate or amplify health consequences. For pathogen-pathogen interactions, the Syndemic Theory is the biosocial approach for examining their nature, pathways, contexts, and health implications (Singer, 2010).

Consequential disease interaction includes but is not limited to pathogen-pathogen interaction, as it involves interplay among infectious agents, between infectious agents and biological and other mechanisms underlying noninfectious diseases, and between noninfectious disease and other health conditions. Moreover, this perspective moves beyond
focus on the specific mechanisms of disease interaction to the interaction between disease and social conditions and the recognition that disease causation, progression, and cure cannot be viewed in solely biological terms (Singer, 2010, p. 15).

Within the syndemic framework, the construct of social context is far more complex than co-occurring epidemics that cluster by population, place, and time. Even though diseases are ultimately biological entities, they are socially produced and constructed (Singer & Bulled, 2012). The interaction of diseases and health conditions arises because of adverse social conditions—like poverty, stigmatization, and oppressive social relationships—that put socially devalued groups at heightened risk (Singer et al., 2006). The inclusion of context as a construct of this theory, then, points to the determinant importance of social conditions in the health of individuals and populations (Singer & Clair, 2003).

**Organization**

Chapter 2 answers Research Question 1 through a systematic literature review of studies of MSM framed with the Syndemic or Minority Stress Theories of alcohol use and risky sexual behaviors. The effect sizes or measures of association of these contextual risk and protective factors were summarized using meta-analytic techniques.

Chapter 3 answers Research Question 2 through a structural equation model of the factors found in Chapter 2 using data from Wave IV of male participants of Add Health. The model is tested with free parameter estimation, but also with the resulting effect sizes obtained in the meta-analysis. This final model is also tested for measurement invariance between MSM and their heterosexual peers.

Conclusions are individually discussed, respectively, in Chapters 2 and 3. However, Chapter 4 puts both manuscript conclusions in context and further discusses future implications for public health research, practice, and policy.
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CHAPTER 2:
SYNDEMIC OF ALCOHOL USE, RISKY SEXUAL BEHAVIORS, AND ASSOCIATED CONTEXTUAL FACTORS AMONG MEN WHO HAVE SEX WITH MEN—A LITERATURE REVIEW AND META-ANALYSIS.

N. B.: Per the Instructions for Authors of the target journal, the references of this manuscript will follow the Manual of Style of the American Medical Association (AMA).

Abstract

This study reviews the literature investigating syndemic factors related to alcohol use and risky sexual behaviors and associated contextual factors among men who have sex with men (MSM). Using five electronic databases, we identified 26 studies in 26 years (1990–2015), all diverse in terms of sampling techniques, assessment of sexual orientation, operationalization of alcohol use and risky sexual behaviors, contextual factors included, and measurement of effect sizes. Despite this diversity, studies reporting an effect size were pooled and summarized using both descriptive and meta-analytic techniques, as appropriate. Meta-analyses were conducted using Cochrane’s guidelines for generic inverse variance outcomes with random effects. The pooled effects of alcohol use on condomless anal intercourse (CAI; OR 1.73 [95% CI 1.43, 2.10], I² 0%), heavy episodic drinking on CAI (OR 1.88 [95% CI 1.25, 2.81], I² 32%), and heavy episodic drinking on condomless oral sex (OR: 8.00; 95% CI 2.48, 25.81), as well as the effects of substance use, mental health status, violence and victimization, and self-reported HIV status as contextual factors in the pathway between alcohol use and risky sexual behaviors were calculated, reported, and discussed along with study limitations and implications for public health.
Key words: men who have sex with men (MSM), meta-analysis, contextual factors, alcohol use, heavy episodic drinking, risky sexual behavior

Introduction

Risky sexual behaviors increase the odds of unintended pregnancy and/or sexually transmitted infections (STIs), including infection with the human immunodeficiency virus (HIV). These behaviors account for most new HIV infections among men who have sex with men (MSM). The term MSM will be preferred since it captures the diversity among men who engage in a range of sexual practices and identities, including but not limited to self-identified gay men, bisexual men, and men who self-identify as straight but have sex with other men.

By the end of 2013 in the United States (US) and its six dependent areas (DA), the prevalence of HIV among males aged 13 years or older was 547.4 per 100,000—over three times higher than the incidence for women in the same age groups. In 2014, transmission of HIV via male-to-male sexual contact (with and without injection drug use) accounted for 70% of new HIV cases among males in the US and DA. Risky sexual behaviors among MSM, thus, are paramount in the epidemiology of HIV and include condomless anal intercourse (CAI) in the absence of pre-exposure prophylaxis (PrEP) with emtricitabine/tenofovir disoproxil fumarate (Truvada®; Gilead Sciences; Foster City, CA), multiple sexual partners, and condomless oral sex. Given the frequency of CAI as a mechanism of HIV transmission among MSM, studying the risk factors facilitating this behavior is warranted.

Alcohol use and heavy episodic drinking are posited as risk factors for risky sexual behaviors, especially CAI among MSM. Several factors unique to MSM might explain the higher prevalence of alcohol use and its association with risky sexual behaviors in this population, including sexual pleasure enhancement, the venue and partner choices that allow the combination of alcohol use and sex, and alcohol’s effects on male sexual functioning.
Levels of Association Between Alcohol Use and Risky Sexual Behaviors

The association of alcohol use and risky sexual behaviors can be approached with one of three different measures. First, *global* assessments measure quantity or frequency of alcohol use within a specified time period (e.g., past month) and correlate that measure with the frequency of risky sexual behaviors in the same period. Although these two behaviors occur in the same recall period, they do not necessarily occur together, which puts global measures at the lowest level of specificity. A meta-analysis of global assessments identified an inconsistent relation between alcohol use and risky sexual behaviors among MSM, depending on the measures of alcohol use (showing greater risk of heavy episodic drinking) and the outcome measure of risky sexual behavior.

Second, *situational* approaches also measure alcohol use and sexual behavior during a specified period (e.g., past month), but specify the number of events when these two behaviors occurred together. Although the outcome measures of situational approaches could be the same as those of global approaches, specificity increases as the situational research provides a more specific analysis of the alcohol–risky sex relationship in sexual contexts. In a meta-analysis, global association studies proved a significant association between heavy episodic drinking and CAI and STIs, including HIV. When history and frequency of alcohol consumption were used as predictors, there was no significant association with CAI and STIs.

Last, *event-level* approaches have specific measures of alcohol use (e.g., type of drink, number of drinks, period of consumption) before and/or during a specific sexual encounter (e.g., the most recent encounter with another man), with specific characteristics about these encounters (e.g., substances used, partner and environment characteristics). Event-level measures can be further classified into *single-episode* (i.e., a specific sexual episode) and *multiple-episode* (i.e., sexual behavior that occurred over a specified several-day timeframe, as in a circuit party) event-level analysis. This is the most specific measure associating alcohol use and risky sexual behaviors, although it is not an
experimental test of the causal mechanisms driving the association. Event-level data suggest that heavy episodic drinking is significantly related to the incidence of HIV infection among MSM, but not to CAI. It was suggested that the presence of alcohol in heavy doses is the contributing factor to sexual risk.

**Context, Theory, and Beyond**

A recent review found that secondary data analyses were neither theory-based nor specifically designed to explain alcohol use among MSM. Co-occurrence of underage alcohol use and risky sexual behaviors share contextual factors. The first solid theoretical background acknowledging the importance of context in the trajectory from alcohol use to risky sexual behaviors was Singer’s Syndemic Theory (1994). The word syndemic is a portmanteau of synergistic epidemic and is often defined as mutually enhancing epidemics involving disease interactions that manifest in the individual’s biology but that develop and sustain in a population because of harmful social conditions and injurious social connections. Singer’s Syndemic Theory (1994) assumes that (1) diseases do not necessarily exist in isolation from other diseases and conditions; (2) disease interactions are of considerable importance to the course and consequence of diseases; and (3) the social conditions of disease sufferers are critical to understanding health impacts at the individual and population levels. According to syndemic theorists, interaction of diseases or other health problems commonly arises because of adverse social conditions that put socially devalued groups at heightened risk.

Three elements interact in a syndemic: population-level factors, biological synergism, and social context. Although population-level and biological synergistic factors influencing alcohol use and risky sexual behaviors among MSM have been described in the literature since the late 1980s and early 1990s, there is a dearth of research on the importance of social context, which, according to Singer, may be of far greater importance.
Mental health research specific to MSM has also been framed within the Minority Stress Theory, developed by psychiatric epidemiologist Ilan H. Meyer (1995, 2003). Meyer posits that MSM in a heterosexist society are subjected to chronic stress related to their stigmatization which in turn creates a unique, hostile and stressful social environment that causes mental health problems.\textsuperscript{14}

To address this gap in the literature, we aim to review, classify, and critique peer-reviewed publications analyzing measures related to alcohol use and risky sexual behaviors among MSM populations using either the Minority Stress Theory or the Syndemic Theory. The primary objective of this study is to estimate the total effect size of alcohol use and heavy episodic drinking onto four risky sexual behaviors, namely: CAI (insertive, receptive, or any), condomless oral intercourse, multiple sexual partners, and transactional sex. A secondary objective is to estimate the effect sizes of contextual factors described in association with either alcohol use or risky sexual behaviors within the same studies.

\textbf{Methods}

\textbf{Data Sources}

The authors and the librarian at the Louis de la Parte Florida Mental Health Institute Research Library at the University of South Florida (USF) created, reviewed, and performed the keyword search depicted in Figure 2.1 in the following five databases: the Cumulative Index to Nursing and Allied Health Literature (CINAHL), Excerpta Medica Database (EMBASE), Psychological Abstracts (PsychINFO), PubMed, and the Web of Science. Only original articles in peer-reviewed publications were included for analysis. We manually searched the reference lists of the selected publications for additional, relevant publications. The Institutional Review Board at USF reviewed this study (Pro00025993).
Inclusion Criteria

Abstracts from the records obtained were reviewed for relevance and included for review if (1) the publication analyzed original data (primary collected) or data sources (secondary analyses); (2) the population studied included MSM and subanalyses specific to this population were reported; (3) there was a reported measure of association, regardless of statistical significance, between (3a) alcohol use and contextual variables, (3b) risky sexual behavior and contextual variables, or (3c) both alcohol use and risky sexual behaviors (with or without contextual variables); (4) the publication specified a framework based on the Syndemic and/or the Minority Stress Theories or if the co-occurrence of these behaviors and contextual factors was acknowledged. We defined contextual variables as any variable mediating or moderating the path from alcohol use to risky sexual behaviors and we focused on studies using the Syndemic and/or the Minority Stress Theories (or an approximation to them) to increase the likelihood of finding such contextual variables.

Records were excluded if they did not fulfill the inclusion criteria, including but not limited to publications of theoretical, editorial, correspondence, or similar nature; lack of subanalyses of MSM populations; and nonuse of either theoretical framework (or an approximation to them). Records focusing on gender nonconforming and transgender subjects were also excluded.

Abstraction Process

Figure 2.1 shows the keyword search that was conducted. Besides dates (1990 to 2015) and type of publication (journal article), we did not restrict our search on the basis of language of publication, geographic area, ages of subjects, or analytic methods, as long as these reported a measure of association between alcohol use and risky sexual behaviors. We did not use truncation and, instead, we included all word variations w to ensure the same keyword search was conducted consistently in all the databases.
Publications were reviewed, extracted, and synthesized by one author (HLC) and data extraction was reviewed by a second author (CML) using the matrix method. When reported, descriptive measures of the publication (including, but not limited to, the study population size, age, racial composition, location, and sampling method) were extracted. Publications included were grouped by theoretical framework, and a thematic analysis of the contextual factors was conducted. This facilitated the ultimate goal of developing an integrated overall framework with contextual factors.

**Measures**

Publications were included if their MSM population was defined by any direct behavioral measure or by any proxy measure of sexual orientation (self-report or attraction), which could account for same-sex sexual behavior in male study participants.

According to the National Institutes for Alcohol Abuse and Alcoholism (NIAAA), measures of alcohol use should include frequency and a time frame of use. For alcohol use, we utilized the following classification: (1) any alcohol use (ie, comparing MSM who did versus those who did not consume any amount of alcohol, within a specified time frame); (2) heavy episodic drinking (ie, comparing MSM who engaged in binge, at-risk, problem, or hazardous drinking versus those who did not, within a specified time frame); and (3) alcohol use in sexual contexts (ie, comparing MSM who consumed alcohol prior to/during sex versus those who did not).

We defined risky sexual behaviors as those that increased the risk of STIs, including HIV. These behaviors included, but not were not limited to: (a) increased frequency of CAI within a time frame, (b) increased number of sexual partners within a time frame, (c) transactional sexual activities, (d) sex under the influence of alcohol or drugs, or (e) any combination of these. For the sake of precision, we will consistently refer to CAI and will save the term unprotected intercourse for any
condomless intercourse in absence of PrEP. We will also use the term CAI consistently when the publication does not specify the use of PrEP among participants of studies from 2012 onwards.

Variables that had a direct measure of association with either alcohol use or risky sexual behaviors (ie, contextual variables) were also extracted. We grouped these and analyzed their effect on the predictor (alcohol use) and/or the outcome (risky sexual behaviors).

Analysis

Study variables were grouped and approached through thematic analysis. The effect sizes of their direct associations with alcohol use or risky sexual behaviors are reported as OR with their respective 95% confidence interval (CI), and the meta-analysis was conducted using generic inverse variance with random effects and assessment of heterogeneity. For generic inverse variance meta-analysis, the reports in the studies had to be transformed: from OR to log-OR and from 95% CI or precise $P$ value to standard error (SE) of the log-OR. Weights were assigned to each effect using the reciprocal of their variance. We used the $I^2$ statistic—which describes the percentage of the variability in effect estimates due to heterogeneity rather than sampling error—to describe heterogeneity. The $I^2$ statistic is useful to quantify inconsistency across studies and can help classify the magnitude of such heterogeneity in overlapping categories along a 0%-to-100% continuum: not important (0% to 40%), moderate (30% to 60%), substantial (50% to 90%), and considerable (75% to 100%). Study quality was determined on the basis of Cochrane’s Handbook considering the objectivity of the outcome assessment and the completeness of outcome data.

When two or more studies measured the same factor, the effect sizes are presented as forest plots. We anticipated a significant amount of diversity in these studies; however, when appropriate, we performed meta-analyses on the contextual factors and their effect sizes when reported by at least two studies, following previously published methods. The meta-analytic forest plots were generated with Review Manager v. 5.3.5 (The Cochrane Collaboration; Copenhagen, Denmark) and
were reported using the best practices for forest plots. The factor themes were plotted into a finalized framework that reconciles data from effect sizes and relationships reviewed for MSM populations and the respective constructs in the Syndemic and Minority Stress Theories.

**Results**

The search strategy yielded 136 unique records to screen (Figure 2.1). From these records, 73 were excluded, mostly due to a lack of focus on MSM populations. In reviewing full-text articles (63), we found that 27 of them fulfilled the inclusion criteria for thematic analysis. Data extraction was performed on 12 records for the primary objective and on 18 records for the secondary objectives.

**Studies Included**

Table 2.1 presents a summary of the 27 publications included in the thematic analysis and meta-analysis. Two studies (7%) were published during the first ten years of the analytic timeline, while 17 (63%) studies were published during the last five years of the analysis timeline (2011-2015). Although the search and review process had no language constraints, all publications were in English. Of the 20 studies published in the USA, most included data from Illinois, California, or New York. Three studies were published in India, one online, multisite study in Latin-American countries, and one each in El Salvador, China, and Vietnam. Overall number of male participants ranged between 102 and 43,353 (median 470), and the maximum number of MSM analyzed in a single study was 24,274. All studies were observational: 22 cross-sectional, three retrospective, and two prospective studies. Studies collected global correlational (20), situational (6), and event-level (2) data. Seven studies used the Minority Stress Theory, six used the Syndemic Theory, one used a combination of both, and the rest (14) underscore a co-occurrence framework (without specifying either theory at hand) of alcohol use, risky sexual behaviors, and contextual variables. Twenty studies (74%) collected original data and three of the seven secondary
data analyses used data from *The National Longitudinal Study of Adolescence to Adulthood* (Add Health; Carolina Population Center, Chapel Hill, NC).

Twelve studies defined MSM by self-identification, nine studies by sexual behavior, one study by sexual/romantic attraction, four studies by a combination of self-identification with other parameter(s), and one study did not specify a criterion defining their MSM population.

Measures of alcohol use were present in 25 studies. These were very diverse and included alcohol use frequency; alcohol-use symptom scales such as the CAGE or AUDIT-C questionnaires; alcohol use disorders (formerly classified as alcohol abuse and alcohol dependency per *The Diagnostic and Statistical Manual of Mental Disorders*, 4th edition, text revision [DSM-IV-TR]), such as the AUDADIS-IV or the MINI; and heavy episodic drinking as defined by the NIAAA for men (ie, five or more drinks in less than 2 hours). Recall periods ranged from prior 30 days to lifetime use.

Risky sexual behaviors were measured in 17 studies and included: condomless receptive or insertive intercourse (anal or oral) with or without knowledge of partner’s HIV status, multiple sexual partners, transactional sex, and sex under the influence of alcohol or other drugs (Table 2.1). Most of the studies (8 of 17) reporting risky sexual behaviors were published after the Food and Drug Administration approved the use of PrEP in 2012. Even though the majority of these studies refer to condomless intercourse as *unprotected*, they do not specify if the respondents were using PrEP at the time of data collection. Thus, as stated in the Methods section, we will consistently refer to these behaviors as condomless intercourse for a more precise language.

**Primary Outcome**

**Alcohol Use and CAI.** Reports on the effect sizes of alcohol use and CAI among MSM were diverse in term of the reporting periods, thus the seven studies reporting this association were sub-grouped accordingly (Figure 2.2). Most studies included a measure of any form of CAI and only
one study specified receptive CAI as the outcome. When all the recall periods were pooled, the overall effect of alcohol use on CAI was significant (OR 1.73 [95% CI 1.43, 2.10]) and heterogeneity was not important ($I^2$ 0%).

Additionally, two studies reported a measure of inconsistent condom use. One study defined it as “using condoms most of the time or only sometimes during anal sex with male sex partners in the last 6 months” (p. 1229) while the other study defined it as “receptive anal intercourse with and without condoms” (pp. 15-16). One study presented correlation measures of lifetime and past 3-month alcohol use with condom use for self ($r$ were .19 and .031, respectively) and for male partners ($r$ were .16 and -.076, respectively) and lifetime anal sex ($r$ were .15 and .156, respectively).

Reports on the effect of heavy episodic drinking and CAI were less frequent (6 studies), with three recall periods: past month, past three months, or past year (Figure 2.3). Most studies did not specify the type of CAI, while only two studies specified receptive or insertive CAI and both measures were included in the analysis. These specific measures showed conflicting results: while heavy episodic drinking significantly increase the odds of receptive CAI, it also significantly decreases the odds of insertive CAI. Another study reported “consistent condom use with non-regular partners [...] on the last three partners in the past 6 months” (p. 705). Since the outcome of interest related to CAI is inconsistent condom use, we kept the magnitude of the effect found by this study, but changed its direction by switching the symbol of the log-OR. Two studies made a categorical distinction between MSM who engaged in heavy episodic drinking in the past 30 days: one study used two (1-4 vs. ≥5 episodes) and the other used three (3-4 vs. 5-9 vs. ≥10 episodes) categories. The pooled effect size was statistically significant (OR 1.27 [95% CI 1.07, 1.50]) and heterogeneity was moderate ($I^2$ 49%). When the four measures of insertive CAI are removed from the analysis, the odds of any CAI and insertive CAI is larger in all the recall periods of heavy
episodic drinking (OR 1.50 [95% CI 1.22, 1.83]) and the heterogeneity for this comparison is not important ($I^2$ 28%). When measures of receptive CAI are also removed from the analysis, the overall effect of all recall periods of heavy episodic drinking on CAI is even larger (OR 2.05 [95% CI 1.45, 2.91]) with non-important heterogeneity ($I^2$ 0%). When pooled, all receptive CAI measures show statistically significant ORs after heavy episodic drinking (4 measures in 2 studies; OR 1.31 [95% CI 1.07, 1.61]; $I^2$ 23%). However, heavy episodic drinking does not show a significant effect over all insertive CAI measures (4 measures in 2 studies; OR 1.02 [95% CI .88, 1.18]; $I^2$ 0%).

**Alcohol Use and Condomless Oral Sex.** Correlations between lifetime ($r$ .22) and past 3-month ($r$ .24, $P < .05$) alcohol use were reported for lifetime oral sex among MSM.22 Only one study$^{36}$ reported a significant effect size for condomless oral sex among MSM (OR 8.00 [95% CI 2.48, 25.81]) after heavy episodic drinking in the past 3 months.

**Alcohol Use and Multiple Sexual Partners.** One study$^{22}$ reported the correlation between lifetime alcohol use and number of lifetime male sexual partners ($r$ .18). Three studies report a measure of association between alcohol use and multiple sexual partners. One of them found that alcohol use was not a significant predictor of receptive CAI with multiple partners, but did not report the OR (95% CI) for this association.23 Two studies report four measures of association between categories of heavy episodic drinking and multiple sexual partners (Figure 2.4). The pooled effect size was statistically significant (OR 1.24 [95% CI 1.08, 1.42]) with heterogeneity that was not important ($I^2$ 0%).

**Alcohol Use and Transactional Sex.** One study$^{30}$ claimed to measure the effect of heavy episodic drinking on transactional sex, which was the same measure for lifetime or past year. This study, however, does not report the results for this association at the bivariate level and only included it in multivariate models. Another study$^{40}$ reported measures of association between three categories of heavy episodic drinking in the past month and transactional sex (3-4 vs. 5-9 vs.
≥10 episodes). The pooled analysis showed a statistically significant association (3 measures in 1 study; OR 1.55 [95% CI 1.25, 1.91]; $I^2$ 0%).

**Secondary Outcome: Contextual Factors for Both Alcohol Use and Risky Sexual Behaviors**

Four thematic categories were reported in association with both alcohol use and risky sexual behaviors: substance use, mental health conditions, HIV serostatus, and measures pertaining to internalized homophobia, violence, and victimization. Figure 2.5 summarizes the overall results presented within the Syndemic and Minority Stress theory and the results for individual measures are presented as supplementary Figures 2.S1 to 2.S10.

**Substance Use.** Five studies reported a relationship between alcohol and other substance use (supplementary Figure 2.S1). The odds of alcohol use significantly increased with the use of any substance (5 studies; OR 2.64 [95% CI 1.61, 4.34], $I^2$ 92%), marijuana (2 studies; OR 2.39 [95% CI 1.10, 5.20], $I^2$ 86%), cocaine (1 study; OR 2.01 [95% CI 1.63, 2.16]), and stimulants (1 study; OR 1.61 [95% CI 1.20, 2.16]). Although one study did not report a significant association between alcohol use and prescription drug use (OR 1.65 [95% CI 0.96, 2.83]), the overall pooled effect of alcohol use and drug use was statistically significant (OR 2.21 [95% CI 1.73, 2.83]) with substantial heterogeneity ($I^2$ 86%).

Four studies consistently reported increased odds of risky sexual behaviors with substance use (supplementary Figure 2.S2). The odds of CAI are increased with use of multiple drugs (1 study; OR 1.88, 95% CI 1.46, 2.41), stimulants (1 study with 2 measures; OR 3.54 [95% CI 1.99, 6.30], $I^2$ 0%), 3,4-methylenedioxyamphetamine (MDMA [ecstasy]; 1 study; OR 2.73 [95% CI 1.69, 4.40]), $\gamma$-hydroxybutyric acid (GHB; 1 study; OR 1.96 [95% CI 1.03, 3.73]), recreational alkyl nitrates (“poppers”; 2 studies; OR 2.86 [95% CI 1.83, 4.49], $I^2$ 0%), marijuana (1 study; OR 2.52 [95% CI 1.03, 6.16]), and methamphetamines (“Tina”; 1 study; OR 2.18 [95% CI 1.19, 3.99]). Any drug use increased the odds of CAI (OR 2.27 [95% CI 1.91, 2.69]) and heterogeneity was not important in
this comparison ($I^2 0\%$). One study$^{25}$ reported that lifetime attendance to circuit parties did not seem to significantly increase the odds of CAI (OR 1.01 [95% CI 0.65, 1.57]), but since this is not a direct measure of substance use, this was not included in the pooled analysis.

**Mental Health.** Several studies reported associations between alcohol use and mood and anxiety disorders (supplementary Figures 2.S3 and 2.S4, respectively). Overall, the odds of alcohol use significantly increase with mood (OR 1.64 [95% CI 1.38, 1.95], $I^2 76\%$) and anxiety (OR 2.12 [95% CI 1.77, 2.55], $I^2 20\%$) disorders. Likewise, the odds of CAI (Supplementary Figure 2.S5) significantly increase with depression (3 studies; OR 2.20 [95% CI 1.49, 3.26], $I^2 0\%$) and any mental condition (3 studies with 5 measures; OR 1.65 [95% CI 1.06, 2.57], $I^2 66\%$).

**HIV Serostatus.** One study$^{30}$ reported the association between the intention to test for HIV in the next 12 months and 1 to 4 (OR 1.09 [95% CI 0.60, 1.95]) or five or more (OR 1.71 [95% CI 0.96, 3.05]) heavy drinking episodes in the past 30 days. The combined effect size was not statistically significant (OR 1.37 [95% CI 0.88, 2.13]), even though the heterogeneity was not important ($I^2 13\%$). Two studies$^{26,42}$ reported a total of three measures for the relationship between HIV-positive serostatus and risky sexual behaviors (supplementary Figure 2.S6). The overall effect was statistically significant (OR 4.04 [95% CI 2.52, 6.47]) and heterogeneity was not important ($I^2 0\%$).

**Internalized Homophobia, Violence, and Victimization.** Five studies reported these constructs in association with alcohol use and three in association with risky sexual behaviors (supplementary Figures 2.S7 and 2.S8, respectively). Even though there was substantial heterogeneity ($I^2 80\%$), the overall effect of alcohol use on this construct was statistically significant (OR 1.48 [95% CI 1.22, 1.80]). Likewise, the effect of this construct on risky sexual behaviors was less heterogeneous ($I^2 15\%$) but statistically significant (OR 1.79 [95% CI 1.49, 2.16]).
Secondary Outcome: Contextual Factors Reported for Alcohol Use Only

**Suicidality.** Two studies\textsuperscript{24,29} approached the relationship between suicidality and alcohol use (supplementary Figure 2.S9). Alcohol use increased the odds of any suicidal attempt in the lifetime (1 study; OR 1.06 [95% CI 1.03, 1.10]) and of suicidal thoughts (2 studies; OR 1.46 [95% CI 0.75, 2.83], $I^2$ 99%). Overall, alcohol use increases pooled suicidal thoughts and attempts (OR 1.28 [95% CI 1.08, 1.50]) with considerable heterogeneity ($I^2$ 98%).

**Arrest History.** One study\textsuperscript{43} reported a significant association between lifetime arrest history and lifetime alcohol use (OR 11.4 [95% CI 3.82, 33.97]).

Secondary Outcome: Contextual Factors Reported for Risky Sexual Behaviors Only

**Type of Sexual Partners.** Two studies reported a total of four measures of partner type (steady, casual, transactional, and multiple) and their effect on risky sexual behaviors (supplementary Figure 2.S10). Even though overall heterogeneity was considerable ($I^2$ 93%), the pooled effect was statistically significant (OR 1.97 [95% CI 1.08, 3.61]). One study reported a greater number of transactional sex partners among MSM who smoked compared to those who did not smoke ($t(576) = 2.02; P<.05$).\textsuperscript{44}

**Other Variables.** One study\textsuperscript{45} created a count syndemic variable ranging from 0 to 3 based on the number of co-occurring psychosocial health outcomes endorsed, namely distress (a score of 16 or higher in the Centers for Epidemiological Studies Distress [CES-D] scale), illicit substance use (use of any illicit drug, except marijuana, in the past 3 months), and alcohol misuse (heavy episodic drinking in the past 30 days). This syndemic construct was significantly associated with CAI (OR 1.31 [95% CI 1.06, 1.60]). Another study\textsuperscript{28} reported nonsignificant associations of CAI with participants’ education level (OR .68 [95% CI .38, 1.21]), condom use self-efficacy (OR .52 [95% CI .38, 0.71]), and nonparticipation in HIV prevention interventions (OR 3.60 [95% CI .23, 55.71]).
Last, one study\textsuperscript{27} reported nonsignificant associations between self-esteem score on the Rosenberg Self-Esteem Scale and CAI (OR .97 [95% CI .88, 1.06]).

**Discussion**

This study reviewed and grouped measures of association between alcohol use and risky sexual behaviors among MSM using descriptive and meta-analytic methods. We included associated contextual measures reported in the same studies that can contribute to the increased prevalence of alcohol use and risky sexual behaviors among MSM, as well as promote either or both behaviors.

To the best of our knowledge, one systematic review—published in 1995—addresses the relationship between alcohol use and risky sexual behaviors in young MSM. In this review, Donovan and McEwan\textsuperscript{11} included 16 studies published between 1986 and 1993 in the US, England, Scotland, and Australia in the beginnings of the AIDS epidemic. Although the authors did not specify the search and extraction methods, nor they reported measures of association between predictor and outcome, important methodological considerations were brought to light in this review. First, establishing the association between alcohol use and risky sexual behaviors is extremely difficult due to methodological differences between studies. Second, the context in which sex takes place under the influence of alcohol must be taken into consideration, as it seems to operate distinctly between populations of MSM. Last, MSM populations are sufficiently different from populations of men who have sex with women (MSW), warranting subanalyses on their own and not through comparison with and extrapolation from MSW data. The present study, then, builds on results published more than the two decades after the Donovan and McEwan’s publication and reflects changes in scientific knowledge and practice since then. For example, alcohol use disorder is a new classification on the DSM5, different from the previous notion of alcohol abuse and alcohol dependency in the DSM-IV-TR. The approval of PrEP as a reliable method for HIV prevention in 2012 should reflect changes in preventive practices. Our review, however, did not identify any report
focusing on the use of PrEP with or without condoms, yielding ample opportunity for future research.

Although the studies included were heterogeneous in terms of MSM populations, settings, and methodological designs, most of the associations were consistently found. Most studies focused on CAI as a measure of risky sexual behaviors, but other measures were also reported, including condomless oral sex, multiple sexual partners, and transactional sex. From our results, we predict that future research using a standardized measure of alcohol use (e.g., the 11 AUD criteria in the new DSM5) and a standardized measure of heavy episodic drinking (e.g., the NIAAA criteria) with more narrow recall periods (e.g., past 3 months for alcohol use and past 30 days for heavy episodic drinking) will capture more precise associations.

We found that the overall likelihood of CAI among MSM significantly increases by 73% with alcohol use, and this likelihood differs by alcohol use recall period: 125% for past month, 92% for past 3 months, 55% for past 6 months, and 120% for lifetime. Likewise, overall odds of CAI among MSM increase 88% with heavy episodic drinking, with significant differences by recall period: 127% for past month and 77% for past year. From Donovan and McEwan’s study, we know that comparisons with heterosexual male populations are inappropriate, but to have an idea of the large order of magnitude, a secondary analysis of a nationally representative sample of the US general population found that heavy episodic drinkers are 77% more likely to engage in risky sexual behaviors, which included CAI, transactional sex, and injection drug use.

We found that although heavy episodic drinking significantly increases the odds of receptive CAI by almost 200%, it has no significant effect on the odds of insertive CAI. We propose three explanations for this difference. First, it must be noticed that both measures of alcohol use and insertive/receptive CAI arise from the same study. Hence, the same MSM population was divided in two, according to those who identify as insertive or receptive anal partners. Thus, the population is
skewed by larger numbers of MSM who identify as receptive sexual partners, decreasing the power to detect significant differences among those MSM who identify as insertive sexual partners. Although there is no evidence in the literature to support this statement, studies have demonstrated differential effects of factors associated with receptive or insertive CAI. Moreover, dichotomizing MSM as exclusively insertive or receptive partners does not take into account the possibility of more than half (57%) of MSM engaging equally in both behaviors.

Second, a differential effect of heavy episodic drinking and receptive or insertive CAI can be explained in terms of the biological and psychological effects of alcohol. On one hand, alcohol can decrease penile tumescence and increases latency to orgasm. A study demonstrated that men with AUD (by DSM-IV-TR criteria) have a statistically significantly ($P < .005$) lower International Index of Erectile Function (IIEF) score on the general satisfaction subscale when compared to males without AUD. Thus, although males could have an erection under the influence of alcohol, it is not effective enough to sustain a satisfactory intercourse. This decreases the likelihood of insertive anal intercourse, but not of receptive anal intercourse—a differential effect consistent with that observed for separate analyses of insertive and receptive CAI. On the other hand, the belief that alcohol will enhance sex increases both physiologic and subjective arousal in men. Although the psychological effect is the same regardless of insertive or receptive anal partnership, the disconnection between expected heightened psychological effect and the erectile dysfunction and delayed orgasm could also play a role in the differential effect of heavy episodic drinking on insertive and receptive CAI.

Last, both studies reporting insertive or receptive CAI were published in 2015. Even though neither study reports the use of PrEP (or lack thereof), it is possible that some of the study participants were already taking this drug and, in that case, participants were more open to insertive CAI with a likely decreased risk of HIV transmission. We anticipate observing more changes in the social norms of CAI with more widespread use of PrEP.
A secondary outcome of this study was the inclusion of contextual variables, grouped thematically using the syndemic or minority stress framework. Our review did not find any meta-analysis of Syndemic Theory, but we did find one study reviewing Minority Stress Theory, which demonstrated that victimization, lack of supportive environments, and psychological stress were among the strongest risk factors for substance use among MSM populations.\cite{51} We present an integrated framework of syndemic and minority stress factors that, according to our findings, have effects on the pathway between alcohol use and risky sexual behaviors (Figure 2.5). Further studies are warranted to test this relationship.

**Limitations.** Although this study uses a recommended review methodology, it is not free from limitations. First, publication bias is a threat to finding adequate studies: null results tend to remain unpublished and mostly studies with significant results get published.\cite{52} The biased literature, in turn, reduces the number of publications included. It has been demonstrated that the power of the $I^2$ test for heterogeneity depends on the number of studies included,\cite{53} and there is the possibility, thus, of underpowered estimates of $I^2$. The large diversity of populations, measures, and analytic methods is also an important factor to consider in conducting a meta-analysis and offer an opportunity to improve the methods for sampling, data collection, and analysis. This limitation is not very different from those made two decades ago, yet they prevail in the scientific community, opening the door for the discussion of a standardized measurement framework for sex under the influence.

**Conclusions.** Studies published in the past 26 years show great heterogeneity in their measurement of the relationship between alcohol use and risky sexual behaviors among MSM. When the studies are pooled for analysis while accounting for heterogeneity, results demonstrate that the likelihood of engaging in risky sexual behaviors—including CAI, condomless oral sex, transactional sex, and multiple sexual partners—increases with any form of alcohol use and heavy
episodic drinking. Studies also reported contextual factors that, through the lens of Syndemic and Minority Stress Theory, are playing a role in the association between alcohol use and risky sexual behaviors. Further analyses, thus, are warranted to understand their overall effect and to develop effective, comprehensive, theory-informed, evidence-based interventions to prevent the risk among MSM populations.

Future directions point to a unified study framework for alcohol use and risky sexual behaviors. Variability of the effect size estimates should not be attributed to population-level factors alone. Changes in behavioral practice also play a role in the variability of these estimates. First, over the 26-year period analyzed, different measures of alcohol use have been used, demonstrating the need of a unified instrument to encompass this construct. Second, changes in the knowledge and practices for safer sexual behaviors must be reflected in the literature. Our results point at a differential effect by type of CAI (insertive, receptive, or any) with heavy episodic drinking, underscoring the need to unify the language and tailor interventions according to these different risks. The language in the literature should also increase specificity of reports to reflect newer HIV risk-reduction practices, such as the use of PrEP even when MSM engage in CAI.
References


35. Choi K-H, Operario D, Gregorich SE, McFarland W, MacKellar D, Valeroy L. Substance use, substance choice, and unprotected anal intercourse among young asian american and


### Table 2.1. Summary of characteristics of the studies included in the thematic analysis

<table>
<thead>
<tr>
<th>Author(s), year</th>
<th>Theoretical Sample for Males</th>
<th>Analytic Sample for Males</th>
<th>Racial/ Ethnic Distribution</th>
<th>Age, mean (SD)</th>
<th>Criterion Defining MSM</th>
<th>Male Population Distribution</th>
<th>Measure of Alcohol Use</th>
<th>Measure of Risky Sex Behavior</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rotheram-Borus, et al., 1994</td>
<td>NS</td>
<td>131 youths</td>
<td>50% Hispanic, 31% black, 12% white</td>
<td>16.8 (1.40) y</td>
<td>Identity</td>
<td>69% gay; 26% bisexual; 5% other</td>
<td>Drug and Alcohol Use Survey of Adolescents</td>
<td>SERBAS-Y, lifetime and previous</td>
</tr>
<tr>
<td>Deane, et al., MST</td>
<td>174 gay youth</td>
<td>71% white, 16% black, 13% Latino</td>
<td>NR; Range 18-24 y</td>
<td>Identity</td>
<td>100% gay</td>
<td>DIS</td>
<td>(1) All receptive anal intercourse in the past (2) Receptive anal intercourse with multiple partners previous 2 y</td>
<td></td>
</tr>
<tr>
<td>Russell &amp; Joyner, 2000</td>
<td>NS</td>
<td>5686 adolescent boys with complete information on sexual orientation and suicidality</td>
<td>NR</td>
<td>NR</td>
<td>Attraction</td>
<td>8.4% same-sex romantic attraction or relationship</td>
<td>9 items that indicate problems associated with alcohol use during the past 12 mo</td>
<td>NR</td>
</tr>
<tr>
<td>Mustanski, Garofalo, Herrick, &amp; Donenberg, 2007</td>
<td>ST</td>
<td>2881 gay or bisexual MSM ≥18 y</td>
<td>“Predominately [sic] of European American ethnicity, although with substantial participation of men of color (21% of the sample)”</td>
<td>“[A] wide range of ages (16% were older than age 50 y)”</td>
<td>Behavior, Identity</td>
<td>84% gay</td>
<td>NR</td>
<td>Condomless anal intercourse with a partner of known discordant or unknown status, on the basis of respondents’ answers questions about their recent sex partners</td>
</tr>
<tr>
<td>Choi et al., 2005</td>
<td>NS</td>
<td>496 API MSM</td>
<td>28% Filipino, 27% Chinese, 17% Vietnamese</td>
<td>Median 25 y</td>
<td>Identity</td>
<td>82% gay; 13% bisexual</td>
<td>Substance use during sex</td>
<td>At least one episode of condomless insertive or receptive anal intercourse in the previous 6 mo</td>
</tr>
<tr>
<td>Mustanski, Garofalo, Herrick, &amp; Donenberg, 2007</td>
<td>ST</td>
<td>310 young MSM</td>
<td>32.9% black, 30.3% white, 25.8% Hispanic</td>
<td>20.3 (2.4) y</td>
<td>Behavior</td>
<td>82% gay; 16% bisexual</td>
<td>Binge drinking was assessed with the following question: “During the last year, how often did you have five or more drinks of alcohol in one day (including the evening)?”</td>
<td>1. Multiple anal sex partners in the last 3 mo 2. Condomless receptive anal intercourse in the last 6 mo 3. HIV status</td>
</tr>
<tr>
<td>Rotheram-Borus, et al., 1994</td>
<td>NS</td>
<td>124 gay/bisexual males</td>
<td>39.5% Hispanic, 30.6% AA, 27.4% white</td>
<td>Median 37 y, range 19-55 y</td>
<td>Behavior</td>
<td>Self-identified (?)</td>
<td>GAIN v. 5.4, which includes DSM IV-TR diagnostics for substance abuse and dependence</td>
<td>NR</td>
</tr>
</tbody>
</table>
Table 2.1 (Continued). Summary of characteristics of the studies included in the thematic analysis

<table>
<thead>
<tr>
<th>Author(s), y</th>
<th>Theoretical Sample for Males</th>
<th>Racial/ Ethnic Distribution</th>
<th>Age, mean (SD)</th>
<th>Criterion Defining MSM</th>
<th>Male Population Distribution</th>
<th>Measure of Alcohol Use</th>
<th>Measure of Risky Sex Behavior</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thomas et al., 2009</td>
<td>ST 210 MSM</td>
<td>NR</td>
<td>28.3 (8.5) y For 47 men with condomless anal sex</td>
<td>Behavior</td>
<td>For 47 men with condomless anal sex: 36.0% Panthi, 19.6% Kothi, 37.0% double-decker</td>
<td>CAGE questionnaire</td>
<td>Condomless anal sex, dichotomized as engaging any unprotected anal sex (insertive of receptive; previous 3 mo)</td>
</tr>
<tr>
<td>Mimiaga et al., 2010</td>
<td>NS 197 black MSM from urban Massachusetts</td>
<td>100% black</td>
<td>38.7 (11.3) y</td>
<td>Behavior</td>
<td>100% MSM</td>
<td></td>
<td>Two questions for condom use norms: (1) “Most of my friends think that condoms are just much of a hassle to use” (2) “Most of my friends you should always use condom when having with a new person”</td>
</tr>
<tr>
<td>Storholm, Halkitis, Siconolfi, &amp; Moeller, 2011</td>
<td>ST, MST 578 young, biologically male MSM</td>
<td>For 210 smokers: 31.9% Latino, 21.4% white, 22.4% AA For 368 nonsmokers: 29.6% Latino, 17.9% white, 29.9% AA</td>
<td>22.34 (3.50) For 210 smokers: 22.38 (3.80); Range 13-29</td>
<td>Behavior</td>
<td>For 210 smokers: 70.5% gay, 22.4% bisexual For 368 nonsmokers: 75.8% gay, 20.1% bisexual</td>
<td>&quot;[T]he use of alcohol to the point of intoxication&quot;</td>
<td>Condomless oral, receptive anal, and insertive anal intercourse with the last 2 sexual partners. Number of casual male partners with whom they engaged in transactional sex.</td>
</tr>
<tr>
<td>Lindley, Walsemann, &amp; Carter, 2012</td>
<td>MST 67 16 men</td>
<td>68.2% white, 14.7% black, 11.8% Hispanic</td>
<td>28.9 (NR)</td>
<td>Identity Behavior Attraction</td>
<td>By identity: 93.4% straight, 3.5% mostly straight, 0.6% bisexual, 1.7% gay By sexual attraction: 95.1% to opposite sex, 1.9% to both sexes, 2.1% to same sex By behavior: 90.8% only OSSP, 1.9% mostly OSSP, 1.7% male and female partners, 1.1% mostly SSSP, 1.5% only SSSP</td>
<td>Frequent binge drinking as drinking 5 drinks in a row at least 2 d a mo for the past 12 mo (i.e., 24 times in the past y)</td>
<td>NR</td>
</tr>
<tr>
<td>Author(s), y</td>
<td>Theor y Sample for Males</td>
<td>Racial/ Ethnic Dist ribution</td>
<td>Age, mean (SD)</td>
<td>Criterion Defining MSM</td>
<td>Male Population Distribution</td>
<td>Measure of Alcohol Use</td>
<td>Measure of Risky Sex Behavior</td>
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<tr>
<td>2012</td>
<td>MST</td>
<td>43,353 males with sexual orientation data</td>
<td>61.1% non-Hispanic white, 14.9% Hispanic any race, 7.9% Native American/Alaska Native, 7.7% black</td>
<td>Of the 704 MSM, 19 were &lt;18 yo, 72 were 18-24 yo, 198 were 25-34 yo, 276 were 35-44 yo, 139 were ≥45 yo</td>
<td>Identity</td>
<td>Clients were asked, “How do you identify your sexual orientation?” Possible responses included heterosexual, gay/lesbian, bisexual, transgender, questioning, and choosing not to disclose; the latter three categories were excluded</td>
<td>Age at first use, frequency of use in the past 30 d, alcohol misuse (vs. other drug), and polysubstance use</td>
</tr>
<tr>
<td>&amp; 2013</td>
<td>MST</td>
<td>6678 men</td>
<td>NR</td>
<td>NR</td>
<td>Attraction Identity</td>
<td>93.2% completely heterosexual</td>
<td>Male respondents were asked “During the past 12 mo, on how many days did you drink ≥5 drinks in a row?”</td>
</tr>
<tr>
<td>2013</td>
<td>ST</td>
<td>150 MSM</td>
<td>NR</td>
<td>25.1 (5.06)</td>
<td>Identity</td>
<td>33.1% Kothi(^b) 23% Panthi(^a) 25% other(^c) 11.5% bisexual 7.4% gay</td>
<td>MINI for alcohol dependence or abuse</td>
</tr>
<tr>
<td>2013</td>
<td>ST</td>
<td>404 MSM</td>
<td>96% Han Chinese</td>
<td>29.7 (NR)</td>
<td>Behavior</td>
<td>NR</td>
<td>Participants were asked if they had ever consumed any alcoholic drinks (e.g., beer, wine, and liquors) and, if yes, how many drinks they had consumed on average per day during the past 3 mo</td>
</tr>
<tr>
<td>2014</td>
<td>NS</td>
<td>2077 MSM</td>
<td>NR</td>
<td>30.3% 18-20 yo 41.1% 21-25 yo 15.5% 26-30 yo 7.1% 31-35 yo</td>
<td>Identity Behavior</td>
<td>78.1% homosexual 20.4% bisexual 1.2% heterosexual 0.2% transgender 66.4% Bong kin(^d) 2.6% Bong lo(^e)</td>
<td>NR</td>
</tr>
<tr>
<td>et al.</td>
<td>ST</td>
<td>470 MSM in Los Angeles</td>
<td>40.0% Mexican, 36.8% white, 23.2% AA</td>
<td>20.14 (1.57)</td>
<td>Identity</td>
<td>By attraction: 70.6% to men only, 27.4% to men and women, 1.1% to women only</td>
<td>Any binge drinking in the past 30 d, defined as consuming ≥5 drinks in a single evening.</td>
</tr>
<tr>
<td>Author(s), y, &amp;</td>
<td>Theor y</td>
<td>Sample for Males</td>
<td>Racial/ Ethnic Distribution</td>
<td>Age, mean (SD)</td>
<td>Criterion Defining MSM</td>
<td>Male Population Distribution</td>
<td>Measure of Alcohol Use</td>
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</tr>
<tr>
<td>P. Palamar, &amp; 5, 2014</td>
<td>NS</td>
<td>403 MSM</td>
<td>30.3% Hispanic, 26.5% black, 21.1% white, 11.9% API</td>
<td>23.07 (3.45)</td>
<td>Identity</td>
<td>80.1% gay 19.9% not gay</td>
<td>Men were presented with the following list of substances and asked to indicate which, if any, were used during sex: alcohol</td>
</tr>
<tr>
<td>Moeller, Palamar, Halkitis, &amp; Siconolfi, 2014</td>
<td>NS</td>
<td>119 MSM in Chicago universities</td>
<td>70.9% white 8.7% API 7.9% Hispanic 5.5 AA</td>
<td>35.3% 18-19 yo</td>
<td>35.3% 20-21 yo</td>
<td>Identity NR</td>
<td>NR</td>
</tr>
<tr>
<td>Pachankis, Hatzenbuehler, &amp; Starks, 2014</td>
<td>NS</td>
<td>300 MSM sampled by convenience in 6 sites in India</td>
<td>NR</td>
<td>30.0 (8.4)</td>
<td>Identity NR</td>
<td>NR</td>
<td>Alcohol use was the average number of drinks per week in the past 3 mo when alcoholic beverages were consumed</td>
</tr>
<tr>
<td>Chakrapani, Newman, Shunmugam, Logie, &amp; Samuel, 2015</td>
<td>ST</td>
<td>300 MSM sampled by convenience in 6 sites in India</td>
<td>NR</td>
<td>30.0 (8.4)</td>
<td>Identity NR</td>
<td>NR</td>
<td>Binge drinking: Frequency of ≥5 drinks in a single sitting in the past 30 days</td>
</tr>
<tr>
<td>Hess et al., 2015</td>
<td>NS</td>
<td>8012 MSM</td>
<td>41.6% non-Hispanic white 27.0% Hispanic 23.7% non-Hispanic black</td>
<td>27.2% 18-24 yo</td>
<td>35.4% 25-34 yo</td>
<td>Behavior NR</td>
<td>NR</td>
</tr>
<tr>
<td>Lee et al., 2015</td>
<td>NS</td>
<td>176 sexual minority and 6723 heterosexual males</td>
<td>For 176 MSM, 73.4% white and 12.5% Hispanic</td>
<td>For 176 MSM, 14.2% 18-24 yo, 44.0% 25-44 yo, 32.0% 45-64 yo</td>
<td>Identity 97.4% heterosexual</td>
<td>AUDADIS- IV, lifetime</td>
<td>NR</td>
</tr>
<tr>
<td>Marshall, 2015 et al.</td>
<td>NS</td>
<td>1065 sexually active, HIV-infected MSM</td>
<td>58.0% AA, 36.3% white</td>
<td>Median 45 (IQR 39-52)</td>
<td>Behavior NR</td>
<td>AUDIT-C questionnaire</td>
<td>NR</td>
</tr>
<tr>
<td>Mimiaga et al., 2015</td>
<td>NS</td>
<td>24,274 males in a dating app</td>
<td>NR</td>
<td>30.4 (9.1)</td>
<td>Identity 77.4% gay 19.0% bisexual 3.1% unsure, questioning, other 0.5% heterosexual</td>
<td>CAGE</td>
<td></td>
</tr>
<tr>
<td>L, 2015 et al.</td>
<td>NS</td>
<td>24,274 males in a dating app</td>
<td>NR</td>
<td>30.4 (9.1)</td>
<td>Identity 77.4% gay 19.0% bisexual 3.1% unsure, questioning, other 0.5% heterosexual</td>
<td>CAGE</td>
<td>Condomless anal sex · cisgender male or transgender partner of different or unknown status in the past 3 mo Participants reported that they had ever been diagnosed with HIV</td>
</tr>
</tbody>
</table>
Table 2.1 (Continued). Summary of characteristics of the studies included in the thematic analysis

<table>
<thead>
<tr>
<th>Author(s), y</th>
<th>Theor y</th>
<th>Analytic Sample for Males</th>
<th>Racial/ Ethnic Distribution</th>
<th>Age, mean (SD)</th>
<th>Criterion Defining MS M</th>
<th>Male Population Distribution</th>
<th>Measure of Alcohol Use</th>
<th>Measure of Risky Se Behavior</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peacock, Andrinopoulos, &amp; Hembling, 2015</td>
<td>MST</td>
<td>306 MSM and 164 TGW</td>
<td>NR</td>
<td>69.7% 18-24 yo, 22.4% 25-34 yo, 7.9% 35-65 yo</td>
<td>Behavior</td>
<td>41.3% gay/homosexual 40.2% bisexual 18.5% heterosexual</td>
<td>Participants were asked how often they drank ≥5 alcoholic drinks on the same occasion in the last 30 d.</td>
<td>Lifetime number of sex partners and lifetime transactional sex. For the last 3 partners past 6 mo, sexual relat concurrency. Age discordance (bein least 10 y younger tha a sexual partner) and co condom use with non partners were constru from the data on the 1 partners in the past 6 yr</td>
</tr>
<tr>
<td>Stults et al., 2015</td>
<td>NS</td>
<td>528 MSM</td>
<td>40.3% Hispanic 28.8% non-Hispanic white 16.3% non-Hispanic black</td>
<td>Range 18-19 yo</td>
<td>Behavior</td>
<td>NR</td>
<td>Alcohol TLFB, past 30 d</td>
<td>NR</td>
</tr>
<tr>
<td>Woodford, Kulick, &amp; Atteberry, 2015</td>
<td>MST</td>
<td>102 sexual minority students at a Midwest research university</td>
<td>Overall (males and females): 78.8% white; 12.6% API, 4.6% multiracial, 1.8% Hispanic</td>
<td>23.5 (5.31) Range 18-55 y</td>
<td>Identity</td>
<td>Overall (males and females): 11.3% completely gay 7.4% mostly gay 16.3% bisexual 65.0 mostly heterosexual</td>
<td>Expressing any level of ≥2 symptoms of alcohol abuse</td>
<td>NR</td>
</tr>
</tbody>
</table>

Abbreviations: AA, African American; API, Asian or Pacific Islander; ARBA, AIDS Risk Behavior Assessment adapted for sexual minority youth; AUDADIS-IV, Alcohol Use Disorder and Associated o Schedule - DSM-IV version; AUDIT-C, Alcohol Use Disorders Identification Test; CAGE, acronym for the four questions in the instrument (Cut down drinking, Annoyed by drinking, Guilty about drinking, and Eye-opener due to drinking); d, day; DIS, Diagnostic Interview Schedule; DSM IV-TR, Diagnostic and Statistical Manual of Mental Disorder, 4th edition, text revision; GAIN, Global Appraisal of Individual Needs; IQR, interquartile range; mo, month(s); MINI, Mini International Neuropsychiatric Interview; MS, Minority Stress Theory; NR, not reported; NS, not specified; OSSP, opposite-sex sexual partners; SD, standard deviation; SERBAS-Y, Sexual Risk Behavior Assessment Schedule-Youth for male homosexuals; SSSP, same-sex sexual partners; ST, Syndemic Theory; TGW, transgender woman; TLFB, Timeline Followback; y, year(s); yo, years old.

t: masculine appearing men who are predominantly insertive partners in anal sex.
mt: feminine acting/appearing men who are predominantly receptive partners in anal sex.
d: an MSM who has masculine appearance and wears men’s clothing and who usually keeps his sexual preferences secret to avoid both stigma and discrimination.
a: an MSM who has a feminine appearance, wears women’s clothing, and is openly gay.
Figure 2.1. Search criteria and results in the PRISMA algorithm.

Abbreviations: CINAHL: Cumulative Index to Nursing and Allied Health Literature; EMBASE: Excerpta Medica Database; MSM: men who have sex with men

*Included 2 theses/dissertations, 2 book reviews, and 1 editor’s introduction to a special issue.
**Figure 2.2.** Forest plot for different recall periods of alcohol use and condomless anal intercourse (CAI).

Abbreviations: CAI, condomless anal intercourse; CI, confidence interval; IV, inverse variance; SE, standard error.
### Figure 2.3. Forest plot for different recall periods of heavy episodic drinking and condomless anal intercourse (CAI).

Abbreviations: CAI, condomless anal intercourse; CI, confidence interval; IV, inverse variance; SE, standard error.
<table>
<thead>
<tr>
<th>Study or Subgroup</th>
<th>log(Odds Ratio)</th>
<th>SE</th>
<th>Weight</th>
<th>Odds Ratio IV, Random, 95% CI</th>
<th>Odds Ratio IV, Random, 95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hess et al., 2015 (1)</td>
<td>0.1823</td>
<td>0.1468</td>
<td>22.8%</td>
<td>1.20 [0.90, 1.60]</td>
<td></td>
</tr>
<tr>
<td>Hess et al., 2015 (2)</td>
<td>0.0953</td>
<td>0.1195</td>
<td>34.4%</td>
<td>1.10 [0.87, 1.39]</td>
<td></td>
</tr>
<tr>
<td>Hess et al., 2015 (3)</td>
<td>0.3365</td>
<td>0.1242</td>
<td>31.8%</td>
<td>1.40 [1.10, 1.79]</td>
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<tr>
<td>Peacock et al., 2015 (4)</td>
<td>0.0862</td>
<td>0.3007</td>
<td>5.4%</td>
<td>1.09 [0.60, 1.97]</td>
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<tr>
<td>Peacock et al., 2015 (5)</td>
<td>0.5365</td>
<td>0.2949</td>
<td>5.6%</td>
<td>1.71 [0.96, 3.05]</td>
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</tr>
<tr>
<td>Total (95% CI)</td>
<td></td>
<td></td>
<td>100.0%</td>
<td>1.24 [1.08, 1.42]</td>
<td></td>
</tr>
</tbody>
</table>

Heterogeneity: Tau² = 0.00; Chi² = 3.38, df = 4 (P = 0.50); I² = 0%
Test for overall effect: Z = 3.09 (P = 0.002)

**Footnotes**
1. 3 to 4 episodes of heavy drinking and number of CAI partners
2. 5 to 9 episodes of heavy drinking and number of CAI partners
3. ≥10 episodes of heavy drinking and number of CAI partners
4. 1 to 4 episodes of heavy drinking and ≥15 CAI partners
5. ≥5 episodes of heavy drinking and ≥15 CAI partners

**Figure 2.4.** Forest plot for heavy episodic drinking and multiple sexual partners.

Abbreviations: CAI, condomless anal intercourse; CI, confidence interval; IV, inverse variance; SE, standard error.
Figure 2.5. Summary of results of effect sizes (expressed as OR [95% CI]) of contextual factors in the association of alcohol use and condomless anal intercourse (CAI).

Abbreviations: CAI, condomless anal intercourse; CI, confidence interval; OR, odds ratio.
Figure 2.S1. Forest plot for different measures of substance use and alcohol use.

Abbreviations: CI, confidence interval; IV, inverse variance; SE, standard error.
### Figure 2.52. Forest plot for different measures of substance use and risky sexual behaviors.

Abbreviations: CI, confidence interval; IV, inverse variance; SE, standard error.
Figure 2.53. Forest plot for different mood disorders and alcohol use.

Abbreviations: CI, confidence interval; IV, inverse variance; SE, standard error.
**Figure 2.S4.** Forest plot for different anxiety disorders and alcohol use.

Abbreviations: CI, confidence interval; IV, inverse variance; PTSD, posttraumatic stress disorder; SE, standard error.
**Figure 2.55.** Forest plot for different mood and anxiety disorders and risky sexual behaviors.

Abbreviations: CI, confidence interval; IV, inverse variance; PTSD, posttraumatic stress disorder; SE, standard error.
**Figure 2.S6.** Forest plot for HIV-positive serostatus and risky sexual behaviors.

Abbreviations: CI, confidence interval; IV, inverse variance; SE, standard error.
**Figure 2.S7.** Forest plot for alcohol use and homophobia, violence, and victimization.

Abbreviations: CI, confidence interval; IV, inverse variance; SE, standard error.
Figure 2.8. Forest plot for homophobia, violence, and victimization and CAI.

Abbreviations: CAI, condomless anal intercourse; CI, confidence interval; IV, inverse variance; SE, standard error.
**Figure 2.89.** Forest plot for alcohol use and suicidality.

Abbreviations: CI, confidence interval; IV, inverse variance; SE, standard error.
Figure 2.S10. Forest plot for type of partner and risky sexual behaviors.

Abbreviations: CI, confidence interval; IV, inverse variance; SE, standard error.
CHAPTER 3:

MULTIPLE CONTEXTUAL FACTORS MEDIATING THE RELATION BETWEEN ALCOHOL USE DISORDER AND RISKY SEXUAL BEHAVIORS—DIFFERENCES BETWEEN MSM AND MSW

Abstract

Studies have shown that men who have sex with men (MSM) have higher odds of alcohol use disorders (AUD) than men who have sex with women (MSW). In turn, various behavioral theories deal with the causal relationship between alcohol use and risky sexual behaviors, and some other social theories deal with the importance of contextual factors driving this relation. We tested the direct effect of alcohol use disorder onto risky sexual behaviors, if there was a different pattern for MSM compared to MSW, and if there were multiple significant contextual factors mediating these effects. We used the male subset of Wave IV of the AddHealth dataset to test our hypotheses through structural equation modeling approaches, including measurement analysis with invariance testing, path analysis for direct effects, and multiple mediation analysis through bootstrapping for indirect effects. The AUD scale was invariant between MSM and MSW, but the risky sexual behavior scale was not. For MSM, the standardized direct effect of AUD onto risky sexual behaviors was −1.25 and the standardized total indirect effect of the multiple mediation model was 1.58, 95% CI [1.42, 1.73]. Among the mediators, the strongest indirect effect for any measured or latent mediator was the mental health construct (2.09). We conclude that even though AUD has the same measurement structure for MSM and MSW, its effect on risky sexual behaviors does not operate the same way for these two populations, supporting both causal and contextual behavioral theories.
Keywords: men who have sex with men (MSM), structural equation modeling (SEM), alcohol use disorder (AUD), risky sexual behaviors, contextual factors

**Introduction**

Compared to men who have sex with women (MSW) and regardless of geographic location and age, populations of men who have sex with men (MSM) show higher prevalence rates of alcohol use (Substance Abuse and Mental Health Services Administration [SAMHSA], 2013) and risky sexual behaviors (Centers for Disease Control and Prevention [CDC], 2014). In a recent meta-analysis, the relative risk (RR) for alcohol use in sexual minorities was 2.59, 95% confidence interval (CI) [1.62, 4.15] for lifetime use and 2.22, 95% CI [1.78, 2.77] for past-year use compared to heterosexual peers (King et al., 2008). Compared to heterosexual adults (26.0%), bisexual and gay/lesbian adults have significantly higher rates of heavy episodic drinking in the prior year (45.1% and 35.1%, respectively) (Ward, Dahlhamer, Galinsky, & Joestl, 2014). Populations of MSM are more likely to report lifetime (odds ratio [OR] 1.55, 95% CI [1.33, 1.82]) and past-month (40.3% vs. 56.4%; OR 1.44, 95% CI [1.41, 1.48]) alcohol use, past-month heavy episodic drinking (21.5% vs. 34.0%; OR 1.44, 95% CI [1.29, 1.60]), earlier onset of alcohol use, and more frequent past-month alcohol use when compared to heterosexual peers (Talley, Hughes, Aranda, Birkett, & Marshal, 2014).

Another risk-taking behavior among MSM that contributes to the burden of morbidity and mortality in the US is risky sexual behaviors. Risky sexual behaviors increase the odds of sexually transmitted infections and unintended pregnancies (Corte & Sommers, 2005) and comprise unwanted, unintended, and unprotected sexual activity and sex with multiple partners (US Department of Health and Human Services [DHHS], 2007). Most new HIV infections occur among MSM and almost 60% of youth living with HIV in the US do not know they are infected. Among MSM, other STIs are also of concern because of their increasing prevalence rates (per 10,000
population for ages 15-19 in 2012; CDC 2014): chlamydia (2001.7), gonorrhea (376.8), and primary and secondary syphilis (4.1, combined).

**Behavioral and Theoretical Tenets**

Alcohol has received particular attention due to its plausible association with risky sexual behaviors (Shuper, Joharchi, Irving, & Rehm, 2009). Various theories explain this link. First, the *transmission hypothesis* (Dingle & Oei, 1997) posits that an individual who has been drinking is more likely to engage in risky sexual behaviors than a sober individual (Bolton, Vincke, Mak, & Dennehy, 1992; Donovan & McEwan, 1995; Leigh & Stall, 1993; Stall, McKusick, Wiley, Coates, & Ostrow, 1986). Second, the *sexual escape theory* (McKirnan, Ostrow, & Hope, 1996; McKirnan, Vanable, Ostrow, & Hope, 2001) acknowledges that cognitively, MSM are motivated to escape the awareness of inherent risks of sexual behavior. Alcohol, then, is a facilitator of the cognitive escape of personal risk-taking (McKirnan et al., 1996). Third, one of the most cited theories is the *alcohol myopia theory* (Steele & Josephs, 1990). This theory states that risky sexual behavior as a possible outcome of alcohol use is explained in terms of psychoactive properties of alcohol, where the resulting restricted cognitive capacity makes sensation seeking more extreme (Woolf & Maisto, 2009). This response results from the preference for impelling proximal (internal) cues that promote risky sexual behaviors instead of inhibiting distal (external) cues that promote the resistance to risky sexual activities (George & Stoner, 2000). Thus, alcohol myopia results in a disinhibitory attention bias towards salient situational cues (Shuper et al., 2009). This motivates “a response that, if one were sober, would be inhibited by further access to other cues and meanings” (Steele & Josephs, 1990, p. 931). Last, *alcohol expectancy theory* (Horvath & Zuckerman, 1993) suggests that the expected effects of drinking alcohol and are considered influential determinants of sexual behavior by themselves or in relation with alcohol myopia (George & Stoner, 2000; Horvath & Zuckerman, 1993; Shuper et al., 2009; Woolf & Maisto, 2009). The belief that alcohol use can be enough to influence the likelihood
of an individual to engage in behaviors they would not normally engage in (Dingle & Oei, 1997; Woolf & Maisto, 2009).

**Methodological Rationale**

The fundamental nature of the relationship between alcohol use and risky sex behaviors among MSM remains unclear, greatly due to the lack of experimental study designs. Thus, it is necessary to use designs that take into account the nature of a direct effect, as well as those contextual factors that mediate the relation through an indirect effect between alcohol use and risky sexual behaviors among MSM (Heath, Lanoye, & Maisto, 2012). Even though studies have found that alcohol use is indeed a predictor of risky sexual behavior, the lack of consistent use of theory and research design frameworks makes comparisons between studies virtually impossible (Woolf & Maisto, 2009).

A recent meta-analysis by our group (López Castillo et al., forthcoming) found that when all recall periods for alcohol use are pooled together, the odds of risky sexual behaviors are significantly increased, namely: condomless anal intercourse (OR 1.73, 95% CI [1.43, 2.10]), condomless oral sex (OR 8.00, 95% CI [2.48, 25.81]), multiple sexual partners (OR 1.24, 95% CI [1.08, 1.42]), and transactional sex (OR 1.55, 95% CI [1.25, 1.91]). All these outcomes included contextual variables that could possibly mediate the path from alcohol use to risky sexual behaviors, namely substance use, mental health (mood and anxiety disorders), internalized homophobia/violence/victimization, suicidality, and arrest history.

In nonexperimental research, where methods for testing theories are not well developed and ethical considerations make experimental design not feasible, structural equation modeling (SEM) has become a popular methodology. There are no widely and easily applied alternative methods to SEM for modeling multivariate relations, or for estimating point and/or interval indirect effects (Byrne, 2012). In mediation analysis, SEM simplifies hypothesis testing in a single analysis and can
extend the process to multiple mediators (Gunzler, Chen, Wu, & Zhang, 2013). For inferential data purposes, then, SEM is well suited by specifying a priori the pattern of inter-variable relations. In general, a given variable may be said to function as a mediator to the extent that it accounts for the relation between the predictor and the outcome. Mediators explain, for example, how external physical events (e.g., history of childhood sexual abuse) take on internal psychological significance (e.g., depression). While moderator variables specify when certain effects will hold, mediators speak to how or why such effects occur (Baron & Kenny, 1986).

A design that has received less attention in both the methodological and applied literature involves simultaneous mediation by multiple variables, or *multiple mediation*. Several putative mediators are often considered for a predictor-outcome relation (Preacher & Hayes, 2008) and, thus, a multiple-mediator model is likely to provide a more accurate assessment of mediation effects (MacKinnon, Fairchild, & Fritz, 2007).

The first objective of this study is, then, to test the direct effects of alcohol use on a latent measure of risky sexual behaviors, indicated by five measured variables: (1) anal sex, (2) oral sex, (3) transactional sex, (4) multiple sexual partners, and (5) lifetime HIV serostatus in the male respondents of Wave IV of the National Longitudinal Study of Adolescents to Adults (AddHealth). Our second objective is to split the overall model and test for measurement invariance between the MSM and MSW subgroups to identify those measures that operate differently in these two groups. A secondary objective is to test multiple mediation of several, plausible, contextual variables in the path from alcohol use to risky sexual behaviors.

**Materials and Methods**

**Data Source**

We analyzed secondary data from Wave IV of the National Longitudinal Study of Adolescent to Adult Health (Add Health). Add Health is a school-based, longitudinal study of a US
nationwide representative sample of adolescents in 7th to 12th grade in the 1994-1995 academic year. This cohort has been followed from adolescence through adulthood with four completed in-home interviews (Waves I to IV) and a fifth interview (Wave V) currently underway. The purpose of the research program was to help explain the causes of adolescent health and health behavior, with special emphasis on the effects of multiple contexts of adolescent life (Chen & Chantala, 2014; Harris, 2013). AddHealth’s primary sampling frame was derived from the Quality Education Database, comprised of 26,666 high schools in the US. Of all students sampled in all of the groups, 20,745 (79%) participated in Wave I of the in-home survey phase (Chen & Chantala, 2014; Harris, 2013). Despite a 6- to 7-year interval since the previous data collection point, Wave IV had a response rate of 80.3%, with minimal attrition that introduced negligible bias into population estimates, a low item nonresponse, and high reliability (Harris, 2013). Secondary data analyses of Add Health have been reviewed by University of South Florida’s Institutional Review Board (Pro00017726).

**Measurements and Instruments**

All the instruments were developed from the Add Health Wave IV Codebook for the subset of biological males. Male participants of Wave IV were asked “Considering all types of sexual activity, with how many male partners have you ever had sex?” All those males who had a valid, non-zero response to this question were then asked “Considering all types of sexual activity, with how many male partners have you had sex in the past 12 months, even if only one time?” Those who had a valid, non-zero response to this last question were classified as MSM for invariance testing. The rationale behind this is that, even though a number of cases are lost, the recall period is shorter and aligned with recall periods for other items in the questionnaire, avoiding overestimation of effect sizes.
**Predictor: Alcohol Use.**

*Alcohol use disorder (AUD), modified.* Participants were asked “Have you had a drink of beer, wine, or liquor more than two or three times? (Do not include sips or tastes from someone else’s drink).” Only those who responded yes to this question were asked the follow-up questionnaire for alcohol use, which included 10 of the 11 DSM-5 criteria for the diagnosis of AUD. Craving (“In the past year, have you wanted a drink so badly you couldn’t think of anything else?”) is a new criterion added in the DSM-5 and was not asked at Wave IV when the DSM-IV-TR was in use; on the other hand, legal problems (“In the past year, have you more than once gotten arrested, been held at a police station, or had other legal problems because of your drinking?”) was a DSM-IV-TR criterion that was not included in the DSM-5. We have previously conducted CFAs of this modified, 10-item scale based on the DSM-5 for all respondents of Wave IV (i.e., both males and females), showing excellent fit indices ($\chi^2[34]=381.8, P<.001; \text{RMSEA}=.040; 95\% \text{ CI } [.037, .044]; \text{CFI}=.968; \text{TLI}=.957$) (López Castillo, 2016). We used this modified, 10-item DSM-5 AUD scale for all Wave IV male respondents.

*Heavy episodic drinking.* We included a measure of heavy episodic drinking as a direct measure of alcohol use. Male participants were asked “During the past 12 months, on how many days did you drink 5 or more drinks in a row?” Answers were coded 0 for none, and between 1 (1 or 2 days in the past 12 months) and 6 (every day or almost every day).

**Outcome: Risky Sexual Behaviors.** All of the following categories were set to load into a latent construct of risky sexual behaviors. All valid responses for each of the five indicators were dichotomized as yes or no. Below are the questions for each indicator:

*Oral sex.* “Have you ever had oral sex? That is, has a partner ever put his/her mouth on your sex organs or you put your mouth on his/her sex organs?” This question did not specify if oral sex was insertive or receptive.
Anal sex. “Have you ever had anal intercourse? (By anal intercourse, we mean when a man inserts his penis into his partner’s anus or butt hole.)” This question did not specify if anal sex was insertive or receptive.

Multiple sexual partners. “In the past 12 months, did you have sex with more than one partner at around the same time?”

Transactional sex. “In the past 12 months, how many times have you paid someone to have sex with you or has someone paid you to have sex with them?”

Lifetime HIV serostatus. Participants were asked two questions regarding lifetime HIV serostatus: (1) “Has a doctor, nurse or other health care provider ever told you that you have or had: HIV/AIDS?” and (2) “Have you ever been told by a doctor, nurse, or other health professional that you had the following sexually transmitted disease: HIV infection or AIDS?”

Latent Mediating Contextual Factors. The SEM analysis elucidated the roles of eight contextual factors identified in a recent meta-analysis (López Castillo et al., forthcoming): (1) illegal substance use (2) prescription substance use, (3) mental health, (4) violence and victimization as a victim, (5) violence and victimization as a perpetrator, (6) physical sexual abuse, (7) psychological sexual abuse, and (8) arrest history. We conducted CFAs on Wave IV male participants for each of these latent constructs using relevant items in the AddHealth codebook, and implementing modification indices as theoretically appropriate.

Substance use. Two latent constructs were created for lifetime substance use: illegal (steroids, marijuana, cocaine, methamphetamine, and others) and prescription drug use (sedatives, tranquilizers, stimulants, and pain killers).

Mental health. Lifetime history of depression, anxiety/panic disorder, PTSD, and psychological sexual abuse, as well as two additional correlated items of suicidal thoughts and attempts in the previous year. While suicidal thoughts and lifetime history of depression,
anxiety/panic disorder, and PTSD were dichotomized, suicidal attempts were quantified from 0 (none), to 1 (once) to 4 (5 or more times).

Violence and victimization. Two latent constructs were created for the participants: one for victims and one for perpetrators of partner victimization. All four items asked if the respondent received or performed actions that resulted in verbal threat, physical violence, injuries, or unwilling sex. These answers were coded by frequency as 0 for never, and between 1 (to this has not happened in the past year, but it did happen before then) and 7 (more than 20 times in the last year of the relationship).

Arrest history. Participants were asked if they have ever been arrested. For those who responded at least once, they were asked about the cause of their first arrest. A latent variable was created from the 11-item arrest causes: (1) driving under the influence; (2) other alcohol-related offenses (e.g., underage purchase or consumption, open container, public intoxication, disorderly conduct); (3) marijuana-related offenses (e.g., possession, sale, use, growing, or manufacturing of marijuana/hashish); (4) other drug offenses (e.g., unlawful possession, sale, use, or manufacturing of other narcotic drugs); (5) robbery (e.g., taking or attempting to take something using a weapon or physical force); (6) theft (e.g., taking something without using force, such as larceny, burglary, or shoplifting); (7) forcible rape (excludes statutory rape); (8) aggravated assault/intentional manslaughter/murder (i.e., unlawful attack upon another for the purpose of causing severe injury or death, excludes simple assaults); (9) simple assault (i.e., assaults and attempted assaults where no weapon is used and the victim is not seriously injured); (10) fraud, forgery, or embezzlement; and (11) other offenses.

Measured Mediating Contextual Factors. Our analysis also included six direct measures or scales: physical sexual abuse, Heatherton’s Heavy Smoking Index, CESD Depression Scale, Cohen’s Perceived Stress Scale, and Pearlin’s Mastery Scale.
Statistical Analyses

**Software.** Data management and descriptive statistics were processed in SAS v. 9.4 (The SAS Institute; Cary, NC). Statistical analyses were conducted using Mplus v. 7.4 (Muthén & Muthén; Los Angeles, CA) and structural diagrams and their estimates were generated with Mplus Diagrammer v. 1 (Muthén & Muthén; Los Angeles, CA).

**Model Measurement, Structure, and Invariance.** We conducted serial weighted CFAs with the different scales to verify the underlying measurement structure. These measurement models aim to describe the relationship between latent constructs and the observed variables. We then tested the SEMs to independently estimate the direct effect of AUD and heavy episodic drinking on the latent construct risky sexual behaviors. The establishment of measurement invariance is critical when a measure is utilized over different settings such as two or more subgroups of a population (Hox & Maas, 2001). Measurement invariance is the stability in the psychometric properties of a measure across populations (Millsap, 2010), and it can be configural when the number of factors and their relationships is the same, or structural when the different parameter estimates operate the same way. Structural invariance, in turn, can be tested for the factor loadings (weak or metric invariance), for the intercepts (strong or scalar invariance), and for the residual errors (strict or residual invariance). We sequentially tested for configural, weak, strong, and strict invariance for the subpopulations of MSM and men who have sex with women (MSW) in the AddHealth dataset.

Last, all mediators were included in the final multiple mediation model, regardless of statistical significance of their total individual effect size. Multiple mediation in the final model was tested with the bootstrapping method and codes proposed by Preacher and Hayes (2008). This method does not require statistical significance of the effect to include it, includes replacement (i.e., once an observation is drawn, it is placed back in the pool and could be re-drawn), and requires a minimum of 1000 iterations. The estimates with 95% CI are empirical and nonparametric
approximations to the sampling distribution of the indirect effects of each mediator. This
distribution is not necessarily normal and, thus, the 95% CI can be asymmetrical.

Model Estimation and Modification. Model estimation used the weighted least squares
with means and variance adjusted (WLSMV). This is a robust estimator for categorical data; it does
not assume normally distributed variables (Brown, 2015) and produces estimates comparable to
maximum likelihood estimation (Beauducel & Herzberg, 2006). We used Mplus’ modification
indices to analyze if there were effects assumed to be zero that could have a major impact in the
model fit. If these modification indices made theoretical sense, they were included in the subsequent
models and testing. For bootstrapping multiple mediation analysis we used the maximum likelihood
estimator with robust standard errors (SE) via sandwich estimation (MLR).

Model Fit. Multiple indices were examined to evaluate the model fit. The $\chi^2$ test is very
sensitive to sample sizes, and due to the relatively large sample size in this data subset and the
increasing number of degrees of freedom (df), it is anticipated that this value could always be
statistically significant ($P<$ .05). Hence, we relied on the root mean square error of approximation
(RMSEA), which is a badness-of-fit index that allows the calculation of a 90% CI and a cut-off of
.05 for a good model fit (.01 for excellent fit and .08 for mediocre fit) (Hu & Bentler, 1999;
MacCallum, Browne, & Sugawara, 1996). We also used the Comparative Fit Index (CFI), which is an
incremental goodness-of-fit index, for which values greater than roughly .90 may indicate reasonably
good fit of the researcher’s model (Hu & Bentler, 1999). Last, we used another incremental
goodness-of-fit index, the Tucker Lewis Index (TLI, also known as the non–normed fit index),
which adds no penalty for adding free parameters and, hence, always is lower than the CFI. With a
cutoff value of .90 TLI rejects up to 27.6% of all types of misspecified models and thus, we used this
cut-off value (Hu & Bentler, 1999). Although desirable, confidence intervals are not available for the
incremental (comparative) fit indices (Fabrigar & Wegener, 2002).
Results

Descriptive Statistics

A total of 7,282 males competed Wave IV interviews. Respondents without a sampling weight assigned (14) or without a valid response to the question “Have you had sex with another man in the previous 12 months” (71) were excluded from the analysis. The final analytic sample consisted of 7,197 males: 3.5% (253) were categorized as MSM and 96.5% (6,944) were MSW. Participants were asked about sexual orientation by attraction using a 5-point scale where 1 represented 100% attraction to females and 5 represented 100% attraction to males. Of all men classified as MSM by past-year behavior, 59.0% were exclusively or almost exclusively (5 and 4 in the scale, respectively) attracted to males. Of all men behaviorally classified as MSW, 99.1% are exclusively or almost exclusively (1 and 2 in the scale, respectively) attracted to females. The middle value of the scale (3) represents people who are almost as equally attracted to males as they are to females (8.4% of MSM and 0.4% of MSW; $\chi^2[1]=1835.9$, $P<.001$). The level of agreement between past-year sexual behavior (i.e., having sex with another man in the past year) and attraction (i.e., the extreme values on the scale) is substantial (Cohen’s $\kappa=.81$, 95% CI [.80, .83], $P<.001$). The survey included a sixth choice, where participants stated no attraction for either sex (4.0% of MSM and 0.4% of MSW; $\chi^2[1]=542.0$, $P<.001$).

When sampling weights were applied, the analytic sample represents 45,877.3 males from the 2008 the US population. The mean (SD) age of all male respondents included was 28.7 (5.1) years with a near-normal distribution (skewness=0.056, kurtosis=2.57). The $t$ test for the differences between the weighed mean (SD) ages of MSM (28.63 [4.96] years) and MSW (28.67 [5.10] years) was not statistically significant ($P=.33$). Overall race distribution included 56.4% white (47.9% MSM vs. 56.7% MSW, $\chi^2[1]=62.2$, $P<.001$), 12.1% African American (19.0% MSM vs. 11.9% MSW, $\chi^2[1]=93.8$, $P<.001$), 5.6% Asian (6.5% MSM vs. 5.5% MSW, $\chi^2[1]=3.34$, $P<.07$), and 4.8% Native
American/Pacific Islander (2.7% MSM vs. 4.8% MSW, $\chi^2[1]=20.40, P<.001$). The difference in Hispanic ethnicity distribution between MSM and MSW (20.7% vs. 18.9%, respectively) was not statistically significant ($\chi^2[1]=3.41, P=.06$). Overall, 18.9% of the weighted sample was of Hispanic ethnicity. In this weighted sample, 92.7% were American citizens and 99.7% spoke English as their primary language, although 18.3% also spoke Spanish.

**Measurement Models**

Table 3.1 presents the full description of the measured variables with statistical significance testing for group comparisons. Mean scores of Heatherton’s Heavy Smoking Index and heavy episodic drinking among MSM, on one hand, were statistically significantly lower, while the scores for the CESD Depression Scale and for history of physical sexual abuse for MSM, on the other hand, were statistically significantly higher compared to MSW. There were no statistically significant differences in the mean scores for Cohen’s perceived Stress Scale and Pearlin’s Mastery Scale.

The CFA results for all the latent constructs used in this study are presented in Table 3.2 and their hypothesized relationships are depicted in Figure 3.1. From the CFA results, it can be noted that the overall fit is excellent for most constructs, and minor modification indices, all of which are correlations, are required to improve the fit of data. The worst initial fit was the lifetime arrest history, which had very low means on each of the 11 categories, and the best initial fit was observed in the scale for prescription drug use.

**Invariance Testing**

Table 3.3 presents the results of invariance testing. Although most constructs did not have statistically significant metric invariance, three constructs stood out as significantly noninvariant when compared to the configural model: risky sexual behaviors, lifetime arrest history, and violence and victimization as a perpetrator. When those constructs that were metric invariant were tested for scalar invariance, illegal drug use resulted noninvariant as well.
Multiple Mediation Analysis

Before including mediators, the point estimate (SE) of the path from alcohol use to risky sexual behaviors was in 0.21 for MSW and –1.25 for MSM. For heavy episodic drinking—a direct measure of alcohol consumption—the overall standardized direct effect estimate (SD) is 0.05 (0.03). After 2,000 bootstrapping iterations with replacement for the MSM group, the total direct effect was –1.22, 95% CI [–1.39, –1.02] and the total indirect effect was 1.58, 95% CI [1.42, 1.73]. Multiple mediation analysis estimates with their respective 95% CIs are presented in Table 3.4. Refer to Figure 3.1 for the hypothesized relationships tested. The largest single indirect effect was the latent construct of mental health (2.09), over six times larger than the next largest indirect effects: victimization as a victim and illegal drug use. The large indirect effect of mental health was due to a large value on path b, the regression of risky sexual behaviors on mental health. Individually, observed scales for mental health (namely, CESD Depression Scale and Cohen’s Perceived Stress Scale) did not have such a large effect. Of note, also, the effect size of prescription drug use and the CESD Depression Scale are not statistically significant in this model and that Prescription drug use and Heatherton’s Heavy Smoking Index were marginally significant.

Discussion

Our study estimates the direct and indirect effect sizes of syndemic factors proposed as mediators between alcohol use disorder and risky sexual behaviors in the subset of males from a large, nationally representative dataset. These contextual factors include proxies for structural barriers (e.g., history of arrest, homelessness, or violence and victimization) and intrapersonal contextual variables (e.g., mental health, illegal and prescription drug use). We also hypothesized a protective factor, represented by Pearlin’s Mastery Scale.

Our analysis demonstrated that the measurement structure of the latent predictor construct (i.e., modified AUD) did not differ between MSM and MSW. This means that the way we are
measuring AUD with the DSM5 criteria reflects the same symptoms and severity for both populations. The observed measure of heavy episodic drinking, however, was significantly lower for MSM compared to MSW, aligned with previous studies showing that men of different race/ethnicities or sexual orientations have similar patterns of symptoms associated with drinking (e.g., those captured through the DSM5 AUD criteria), but clear distinct drinking patterns with more heavy episodic drinking among sexual minorities (Gilbert, Daniel-Ulloa, & Conron, 2015).

The outcome, a scale of five risky sexual behaviors, showed metric noninvariance between MSM and MSW, meaning that these five behaviors operate in a differential way in these two groups. This finding is anticipated, as sexual practices are clearly different between MSM and MSW, and thus, the factor loadings—a measure of the contribution of each individual behavior, akin to a regression coefficient—are clearly distinct for anal sex, oral sex, transactional sex, multiple sexual partners, and lifetime history of HIV (Myers, Javanbakht, Martinez, & Obediah, 2003). Thus, even though we assumed the latent structure of the predictor and the outcome were equivalent in both groups, the indicators of risky sexual behaviors did not operate in the same way for MSM and MSW.

Our path analysis shows that for every one SD increase in alcohol use disorder symptoms, there is a decrease of 1.25 SD of risky sexual behaviors for MSM and a 0.21 SD increase in risky sexual behaviors for MSW. The literature shows that higher alcohol consumption results in higher levels of risky sexual behaviors. Even though this finding seems counterintuitive for MSM, it must be bore in mind that the predictor in this model is not a direct measure of alcohol use, but a measure of the symptoms associated with problematic drinking reported by participants within the previous year. When a measure of alcohol consumption—such as heavy episodic drinking—is used as a control predictor, the direct standardized effect is positive (0.05), as it would be anticipated, but negligible in this data set. These direct path analyses also add to the fact that, even though the symptoms of problematic drinking have a similar pattern among MSM and MSW, the drinking
pattern is different and the behavioral outcomes of these drinking patterns and symptoms are also different between MSM and MSW (Gilbert et al., 2015; Myers et al., 2003).

Various theory-driven, non–mutually exclusive phenomena can partially explain the negative effect of alcohol use disorder on risky sexual behaviors for MSM. First, we will discuss causality theories. It must be acknowledged that the transmission hypothesis (Dingle & Oei, 1997) states that the risky sexual behaviors most likely occur under the influence of alcohol, but it has been demonstrated that alcohol consumption operates distinctly among MSM and MSW (Gilbert et al., 2015). The expected sexual results of intentional use of alcohol—as suggested by the alcohol expectancy (Horvath & Zuckerman, 1993) and the alcohol myopia (Steele & Josephs, 1990) theories—are different between MSM and MSW. There is a generalized belief that alcohol operates as “liquid courage” and will help people overcome internal and external barriers to engage in risky behaviors, including risky sexual behaviors. This perception is aligned with the sexual escape theory (McKirnan et al., 1996, 2001). These different expectancies can explain the differential effect of problematic symptomatic alcohol consumption on risky sexual behaviors: while the effect is positive and small for MSW, it is negative and large for MSM.

Second, this differential effect can be explained in terms of heteronormativity and sexual orientation stigmata, as posited by the Minority Stress Theory (Meyer, 1996, 2003). For MSW, alcohol consumption is not a requirement to engage in sexual behaviors in a heteronormative society. For MSM, however, alcohol can be one of the mechanisms through which an individual achieves successful sexual engagement, given the heteronormative stigmata driving individuals to bars, a de facto community center for MSM. As an illustration of these differences from the Minority Stress Theory lens, (Ramirez-Valles et al., 2010) used the same SEM approach on a sample of 643 Latin American MSM. These authors demonstrated that the intersectionality of homosexual and racial stigmata were statistically significantly associated to homosexual activity under the
influence of alcohol and drugs—especially among those MSM not involved in community organizations like HIV activism and LGBT organizations. We do not anticipate a similar finding for heterosexual activity in a heteronormative society, since no heterosexual stigmata is anticipated for the predominant, heterosexual group. Using the Minority Stress Theory in Latino MSM, (Bruce et al., 2008) found that the intersection of homosexual and racial stigmata might be not only differently associated with substance use and unprotected sex—as we found in our data set—but that the mechanisms that initially lead to alcohol and drug use and to condomless sex could also be different for the MSM Latino population. Using hierarchical linear modeling, (Hatzenbuehler et al., 2008) demonstrated that changes in internalized homophobia, discrimination experiences, and expectations of rejection were differentially associated with HIV risk behavior, substance use, and depressive symptoms, respectively. In a group of 394 ethnically diverse adolescents (280 males) in treatment for substance use problems, (Oshri et al., 2013) found that the path from sexual sensation seeking to past-year number of partners via co-occurring sex and alcohol was stronger among male adolescent.

Last, different contextual mediators can also have a differential effect between MSM and MSW and, thus, drive the two behaviors in a distinct fashion, as it is suggested by the Syndemic Theory (Singer, 1996). We tested these mediating effects of multiple risk factors and Pearlin’s Mastery Scale as a protective factor and found a significant indirect effect of mental health conditions that co-occurred, including depression, anxiety, suicidal thoughts and attempts, PTSD, and history of psychological sexual abuse. We posited that the interaction among co-occurring mental health conditions is strong given that the indirect effect is the largest measure compared to other mental health indicators, such as the CESD Depression Scale and Cohen’s Perceived Stress Scale. This probably reflects the complex interaction of co-occurring mental health conditions and their outcome in behavioral health and impaired or disadvantaged executive processes.
As another mental health condition, substance abuse also plays a role in the pathway studied, and co-occurring use of prescription drugs and cigarettes has statistically significant indirect effects in the multiple mediation model tested. Singer’s Syndemic Theory lacks a robust measurement and testing framework, but studies are increasingly using multiple mediation to test a syndemic construct. Tulloch et al. (2015) performed a multiple moderated mediation analysis of 239 MSM participants in the Sexual Health and Attitudes Research Project (SHARP) in Canada. In this study, the outcome was having unprotected, insertive or receptive anal intercourse, with a male partner of opposite or unknown HIV serostatus in the past 6 months. They found that HIV serostatus did not moderate the relation between syndemic contextual factors and risky sexual behaviors and that the relation between childhood verbal victimization, childhood physical abuse, and high-risk sexual behavior are predicted by a higher number of adult psychosocial conditions.

Limitations

Even though the AddHealth study is longitudinal in its design, using only Wave IV data imposes the limitations inherent to cross-sectional analyses: predictors, outcomes, and mediators were all collected at the same time and the causality proposed is of theoretical nature. The role of recall bias must also be noted for data collection, especially taking into account the different recall periods for our measures. This said, longitudinal analyses are only possible with a consistent measure over time, and the ever-changing nature of the questionnaires and diagnostic criteria make the ideal task of a unified recall period difficult, if not impossible. Even though we found substantial agreement between the behavioral and attraction components of sexual orientation, the dichotomization of the population into MSM and MSW does not capture the theoretical fluidity of sexual orientation and puts other minority men in a situation where they are likely misclassified: for example men who have sex with both men and women (on the behavioral continuum) or men who self-identify as asexual or bisexual (on the attraction continuum). This finding has important
implications, pushing the state-of-the-science forward to utilize non-binomial classification schemes. Third, even though we tested a large number of mediators, this number is limited compared to a real-life setting, where many more mediators operate simultaneously. Fourth, we did include a protective factor, Perlin’s Mastery Scale, which was not a significant mediator for the proposed relation; however, just like with the risk factors selected, there are many more assets in real life—explicit or implicit—that can protect an individual from engaging in risky behaviors. For example, we did not assess resilience and coping as moderators of the intensity of alcohol use disorders. Fifth, underreporting and social desirability bias is always a possibility, although AddHealth data was collected through ACASI, which has been demonstrated to reduce these types of biases, especially on sensitive topics, such as substance abuse (Adebajo et al., 2014) and risky sexual behaviors (Beauclair et al., 2013).

Last, our study did not control for demographic factors, such as age, race/ethnicity, education, or socioeconomic status. The sampling strategy for AddHealth ensured that racial and ethnic minorities were represented, yet our analytic sample showed a significantly lower proportion of white MSM compared to MSW, due to a significantly larger proportion of African American and Native American/Pacific Islander respondents. We also found a substantial agreement between sexual behavior and sexual/romantic attraction, much higher than Cohen’s \( \kappa \) reported by Savin-Williams and Ream (2007) with data from AddHealth Waves I, II, and III—all three much below the less-than-acceptable .70 value—suggesting a higher congruence of sexual attraction and behavior for males later in life.

Given these limitations, our study also has much strength to underscore. We used population-based weighted data, ensuring that minorities that were oversampled are adequately analyzed. We included invariance testing for all the measures in the models, which helped identify possible factors operating differently for MSM and MSW. For invariance testing, we used an
estimator that is robust against deviations from normality (i.e., WLSMV) and, for multiple mediation analysis, bootstrapping with MLR estimation generates accurate sampling distributions with SE and asymmetric 95% CI (Preacher & Hayes, 2008). Using SEM, all latent variables that predict or mediate an outcome are tested in a single analysis, significantly improving on ad hoc, regression methods and decreasing the possibility of finding statistically significant results due to multiple testing. Missing data was handled by pairwise deletion, another improvement over ordinary least squares regression, which requires listwise deletion.

Conclusions

This study shows that even though MSM and MSW have similar patterns of problematic drinking symptoms, their drinking patterns and motives in connection with sexual expectations are not the same. Theoretical explanations of these differences include intrinsic expectations of behavioral outcomes and extrinsic, contextual mediators, the strongest of which was co-occurring mental health conditions. Factors driving the co-occurrence of these conditions need to be further explored in association with sexual orientation stigmata in heteronormative societies.

Acknowledgements

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Analyses were partially supported by funding from the University of South Florida’s College of Public Health Graduate Student Research Award and the Department of Community and Family Health’s Doctoral Research Award.

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References


University of South Florida’s 8th Annual Graduate Student Research Symposium, Tampa, FL.


### Measurement model: Descriptive statistics of the six observed variables.

<table>
<thead>
<tr>
<th>Items</th>
<th>Recall Period</th>
<th>Theoretical Range</th>
<th>Valid N</th>
<th>Mean</th>
<th>SD</th>
<th>Skewness</th>
<th>Kurtosis</th>
<th>( t )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heavy episodic drinking</td>
<td>Past mo</td>
<td>0 - 6</td>
<td>193</td>
<td>1.42</td>
<td>4.24</td>
<td>.70</td>
<td>1.53</td>
<td></td>
</tr>
<tr>
<td>Sexual abuse, physical</td>
<td>Lifetime</td>
<td>0 - 1</td>
<td>234</td>
<td>.05</td>
<td>.66</td>
<td>5.49</td>
<td>34.43</td>
<td></td>
</tr>
<tr>
<td>Heaton's Heavy Smoking Index</td>
<td>Lifetime</td>
<td>0 - 6</td>
<td>127</td>
<td>1.73</td>
<td>4.83</td>
<td>.21</td>
<td>.21</td>
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</tr>
<tr>
<td>D Depression Scale</td>
<td>Lifetime</td>
<td>0 - 15</td>
<td>236</td>
<td>2.72</td>
<td>6.97</td>
<td>1.53</td>
<td>5.77</td>
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</tr>
<tr>
<td>Cohen's Perceived Stress Scale</td>
<td>Lifetime</td>
<td>0 - 16</td>
<td>236</td>
<td>4.55</td>
<td>7.73</td>
<td>.50</td>
<td>4.26</td>
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</tr>
<tr>
<td>lin's Mastery Scale</td>
<td>Lifetime</td>
<td>0 - 25</td>
<td>236</td>
<td>19.88</td>
<td>11.16</td>
<td>1.46</td>
<td>23.61</td>
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</tr>
</tbody>
</table>

### P values for the \( t \) test for the comparison of MSM and MSW means.

<table>
<thead>
<tr>
<th>Items</th>
<th>Recall Period</th>
<th>Theoretical Range</th>
<th>Valid N</th>
<th>Mean</th>
<th>SD</th>
<th>Skewness</th>
<th>Kurtosis</th>
<th>( t )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heavy episodic drinking</td>
<td>Past mo</td>
<td>0 - 6</td>
<td>5007</td>
<td>2.14</td>
<td>13.58</td>
<td>20.27</td>
<td>507.86</td>
<td></td>
</tr>
<tr>
<td>Sexual abuse, physical</td>
<td>Lifetime</td>
<td>0 - 1</td>
<td>6546</td>
<td>.02</td>
<td>.38</td>
<td>11.20</td>
<td>145.96</td>
<td></td>
</tr>
<tr>
<td>Heaton's Heavy Smoking Index</td>
<td>Lifetime</td>
<td>0 - 6</td>
<td>3599</td>
<td>2.19</td>
<td>5.27</td>
<td>.33</td>
<td>1.43</td>
<td></td>
</tr>
<tr>
<td>D Depression Scale</td>
<td>Lifetime</td>
<td>0 - 15</td>
<td>6559</td>
<td>2.35</td>
<td>6.86</td>
<td>2.14</td>
<td>10.53</td>
<td></td>
</tr>
<tr>
<td>Cohen's Perceived Stress Scale</td>
<td>Lifetime</td>
<td>0 - 16</td>
<td>6553</td>
<td>4.71</td>
<td>12.78</td>
<td>17.25</td>
<td>655.00</td>
<td></td>
</tr>
</tbody>
</table>

*Abbreviations: CESD, Center for Epidemiologic Studies Depression Scale; MSM, men who have sex with men; MSW, men who have sex with women; SD, standard deviation.*
### 3.2 Measurement model: Confirmatory factor analyses and modification indices of the different latent constructs.

<table>
<thead>
<tr>
<th>Construct</th>
<th>Indicators</th>
<th>Valid N</th>
<th>$\chi^2$</th>
<th>$df$</th>
<th>$P$</th>
<th>RMSEA</th>
<th>95% CI (min, max)</th>
<th>CFI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Modified alcohol use disorder</td>
<td>Model 1</td>
<td>10</td>
<td>3216</td>
<td>160.9</td>
<td>&lt;.001</td>
<td>.033</td>
<td>.028, .039</td>
<td>.946</td>
</tr>
<tr>
<td></td>
<td>Model 2</td>
<td>10</td>
<td>3216</td>
<td>111.7</td>
<td>&lt;.001</td>
<td>.027</td>
<td>.021, .032</td>
<td>.966</td>
</tr>
<tr>
<td>Sexual behaviors</td>
<td>Model 1</td>
<td>5</td>
<td>6930</td>
<td>38.1</td>
<td>&lt;.001</td>
<td>.031</td>
<td>.022, .040</td>
<td>.859</td>
</tr>
<tr>
<td></td>
<td>Model 2</td>
<td>5</td>
<td>6930</td>
<td>13.9</td>
<td>.008</td>
<td>.019</td>
<td>.009, .030</td>
<td>.958</td>
</tr>
<tr>
<td>Lifetime arrest history</td>
<td>Model 1</td>
<td>11</td>
<td>1569</td>
<td>288.1</td>
<td>&lt;.001</td>
<td>.059</td>
<td>.053, .066</td>
<td>.724</td>
</tr>
<tr>
<td></td>
<td>Model 2</td>
<td>11</td>
<td>1569</td>
<td>60.1</td>
<td>.043</td>
<td>.016</td>
<td>.003, .025</td>
<td>.981</td>
</tr>
<tr>
<td>Prescription drug use</td>
<td>Model 1</td>
<td>4</td>
<td>1324</td>
<td>1.0</td>
<td>.606</td>
<td>&lt;.001</td>
<td>&lt;.001, .044</td>
<td>1.00</td>
</tr>
<tr>
<td></td>
<td>Model 2</td>
<td>5</td>
<td>6895</td>
<td>27.8</td>
<td>.006</td>
<td>.026</td>
<td>.017, .035</td>
<td>.997</td>
</tr>
<tr>
<td>Mental health</td>
<td>Model 1</td>
<td>6</td>
<td>6930</td>
<td>77.7</td>
<td>&lt;.001</td>
<td>.033</td>
<td>.027, .040</td>
<td>.922</td>
</tr>
<tr>
<td></td>
<td>Model 2</td>
<td>6</td>
<td>6930</td>
<td>25.9</td>
<td>.001</td>
<td>.018</td>
<td>.011, .026</td>
<td>.980</td>
</tr>
<tr>
<td>Victimization as victim</td>
<td>Model 1</td>
<td>4</td>
<td>6652</td>
<td>24.2</td>
<td>&lt;.001</td>
<td>.041</td>
<td>.027, .056</td>
<td>.996</td>
</tr>
<tr>
<td></td>
<td>Model 2</td>
<td>4</td>
<td>6653</td>
<td>106.9</td>
<td>&lt;.001</td>
<td>.089</td>
<td>.075, .103</td>
<td>.971</td>
</tr>
</tbody>
</table>

Notes: The estimator used was the WLSMV; Model 1 includes loadings from each indicator assuming uncorrelated data; if modification indices were necessary to improve fit, Model 2 included the most significant correlation between indicators.

Abbreviations: CFI, comparative fit index; CI, confidence interval; df, degrees of freedom; RMSEA, root mean square error of approximation; TLI, Tucker-Lewis index; WLSMV, robust weighted least squares with mean variance adjustment.
### 3.3

**Measurement model: Invariance testing for each of the latent constructs.**

<table>
<thead>
<tr>
<th>Construct</th>
<th>FP</th>
<th>-2LL</th>
<th>FP</th>
<th>-2LL</th>
<th>( \chi^2 ) (df) vs. Configural</th>
<th>FP</th>
<th>-2LL</th>
<th>( \chi^2 ) (df) vs. Configural</th>
</tr>
</thead>
<tbody>
<tr>
<td>Modified alcohol use disorder</td>
<td>41</td>
<td>-12,031</td>
<td>32</td>
<td>-12,034</td>
<td>3.46 (9)</td>
<td>23</td>
<td>-12,043</td>
<td>13.84 (18)</td>
</tr>
<tr>
<td>Sexual behaviors</td>
<td>21</td>
<td>-10,297</td>
<td>17</td>
<td>-10,319</td>
<td>16.66 (4)**</td>
<td>13</td>
<td>-10,468</td>
<td>163.20 (8)**</td>
</tr>
<tr>
<td>Lifetime arrest history</td>
<td>45</td>
<td>-4398</td>
<td>35</td>
<td>-4401</td>
<td>95.13 (10)**</td>
<td>25</td>
<td>-4608</td>
<td>547.70 (20)**</td>
</tr>
<tr>
<td>Risky sexual behaviors</td>
<td>17</td>
<td>-3228</td>
<td>14</td>
<td>-3229</td>
<td>1.32 (3)</td>
<td>11</td>
<td>-3230</td>
<td>2.82 (6)</td>
</tr>
<tr>
<td>Lifetime arrest history</td>
<td>45</td>
<td>-4398</td>
<td>35</td>
<td>-4401</td>
<td>95.13 (10)**</td>
<td>25</td>
<td>-4608</td>
<td>547.70 (20)**</td>
</tr>
<tr>
<td>Mental health</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Victimization as victim</td>
<td>65</td>
<td>-13,605</td>
<td>62</td>
<td>-13,608</td>
<td>1.06 (3)</td>
<td>35</td>
<td>-13,650</td>
<td>34.01 (30)</td>
</tr>
<tr>
<td>Victimization as perpetrator</td>
<td>63</td>
<td>-7395</td>
<td>60</td>
<td>-74034</td>
<td>12.42 (3)**</td>
<td>34</td>
<td>-7426</td>
<td>50.71 (29)**</td>
</tr>
</tbody>
</table>

The estimator used was MLR for all Model 1 (without correlations indicated by modification indices).

---

**Abbreviations:** CFI, comparative fit index; FP, free parameters; CI, confidence interval; df, degrees of freedom; RMSEA, root mean square error of approximation; TLI, Tucker-Lewis index; WLSMV, robust weighted least squares with mean variance adjustment.
3.4

Standardized results of multiple mediation analysis through bootstrapping with replacement of the direct relationship of alcohol use and risky sexual behaviors through 11 mediators (6 latent and 5 observed; valid N = 6,930).

<table>
<thead>
<tr>
<th>Mediators</th>
<th>Path a (95% CI)</th>
<th>Path b (95% CI)</th>
<th>Total Indirect Effect (a×b) (95% CI)</th>
<th>Residual Variance (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mental health</td>
<td>0.34 (0.34, 0.36)</td>
<td>6.08 (5.49, 6.30)</td>
<td>2.09 (2.00, 2.17)</td>
<td>0.88 (0.87, 0.89)</td>
</tr>
<tr>
<td>Victimization as victim</td>
<td>0.20 (0.17, 0.21)</td>
<td>1.70 (1.51, 2.04)</td>
<td>0.34 (0.28, 0.45)</td>
<td>0.96 (0.95, 0.97)</td>
</tr>
<tr>
<td>Illegal drug use</td>
<td>0.29 (0.28, 0.30)</td>
<td>0.80 (0.58, 0.93)</td>
<td>0.23 (0.16, 0.26)</td>
<td>0.92 (0.91, 0.92)</td>
</tr>
<tr>
<td>Lifetime arrest history</td>
<td>0.23 (0.23, 0.26)</td>
<td>0.58 (0.49, 0.67)</td>
<td>0.13 (0.12, 0.16)</td>
<td>0.95 (0.93, 0.95)</td>
</tr>
<tr>
<td>Victimization as perpetrator</td>
<td>0.24 (0.22, 0.26)</td>
<td>0.08 (0.07, 0.10)</td>
<td>-0.02 (-0.03, 0.01)</td>
<td>0.94 (0.93, 0.95)</td>
</tr>
<tr>
<td>CESD Depression Scale</td>
<td>0.28 (0.26, 0.28)</td>
<td>0.06 (0.05, 0.07)</td>
<td>-0.10 (-0.11, -0.09)</td>
<td>0.92 (0.91, 0.93)</td>
</tr>
<tr>
<td>Heatherton’s Heavy Smoking Index</td>
<td>0.12 (0.09, 0.13)</td>
<td>-0.08 (-0.10, -0.06)</td>
<td>-0.01 (-0.02, -0.00)</td>
<td>0.98 (0.97, 0.99)</td>
</tr>
<tr>
<td>Perceived Stress Scale</td>
<td>0.18 (0.17, 0.22)</td>
<td>-0.13 (-0.21, -0.05)</td>
<td>-0.02 (-0.07, -0.02)</td>
<td>—</td>
</tr>
<tr>
<td>Lin’s Mastery Scale</td>
<td>0.23 (0.21, 0.25)</td>
<td>0.54 (0.46, 0.63)</td>
<td>0.12 (-0.14, -0.10)</td>
<td>0.95 (0.94, 0.96)</td>
</tr>
<tr>
<td>Sexual abuse, physical</td>
<td>-0.33 (-0.35, -0.31)</td>
<td>1.30 (1.15, 1.44)</td>
<td>-0.43 (-0.45, -0.42)</td>
<td>0.89 (0.88, 0.90)</td>
</tr>
</tbody>
</table>

Notes: The indirect effect of a mediator is the product of path a (alcohol use → mediator) and path b (mediator → risky sexual behaviors). Total effects are the sum of direct (alcohol use → risky sexual behavior) and indirect (alcohol use → mediator → risky sexual behavior) paths. Residual variances for Heatherton’s Heavy Smoking Index and physical sexual abuse could not be computed for the model.
Figure 3.1. Hypothesized multiple mediation model. The measurement model for each construct is represented within the boxes representing latent (the circle constructed by indicators [F1 … Fj]) or measured variables. The path model includes a direct effect (black arrow) and the indirect effect is the product (path $a \times b$) of the effect of the mediator regressed on the predictor (path $a$, red arrows) and the outcome regressed on the mediator (path $b$, blue arrows).
CHAPTER 4:  
CONCLUSIONS AND IMPLICATIONS

Even though specific conclusions for each study are presented in their respective chapters, our results and conclusions convey important implications for public health research, practice, and policy.

Implications for Public Health Research: Advancing Applied Theory

When theories are applied to MSM populations, the interactions among co-occurring factors provide a better understanding of the underlying syndemic-production processes and, ultimately, help finding ways to prevent and disrupt these interactions (Stall et al., 2008). Understanding the roles and interactions between the contextual factors involved in such a syndemic can yield programmatic efforts that can contribute to its prevention and control in this at-risk population (Stall et al., 2008). The growth in the recognized utility of the Syndemic Theory is evident in its diffusion across health-related disciplines and the ever-increasing pace of syndemics-related publications in the journals and edited books of various health-related disciplines (Singer et al., 2012). Even though the Syndemic Theory is not included among the “best practices” for developing evidence-based, theory-informed interventions in sexual minority youth (Hunter & Baer, 2007), authors have highlighted that other theoretical paradigms neglect the importance of context and de-emphasize variables that are relevant in the syndemic production (Stall et al., 2008).

Thus, the existence of syndemics requires a biopsychosocial reconception of disease to emphasize the interrelated factors and the influence of contexts (Singer & Clair, 2003). Reconceptualizing disease “would make us more alert to the likelihood of multiple, interacting, deleterious conditions among populations produced by the structural violence of social inequality”
(Singer & Clair, 2003, p. 434). To prevent a syndemic, one must not only prevent or control each disease, but also the forces that tie those diseases together (Singer, 2006). This must be done through effective responses implemented in system-wide interventions that respond to complex community health problems rather than compartmentalized approaches (Milstein, 2001). According to Singer and Clair (2003), the advancement of syndemics depends on multidisciplinary studies from both clinical and social perspectives, capable of determining (1) the health and social conditions likely to give rise to syndemics; (2) the mechanisms (either unidirectional, dialectical, or bidirectional) of disease interplay; (3) the processes by which syndemics emerge and how they configure in specific populations; and (4) better surveillance and response systems to syndemics, at the public-health and community level.

One limitation of the Syndemic Theory is the lack of a standardized measurement framework. The current research addresses such limitation by applying two robust analytic methods: the meta-analysis and the multiple mediation analysis through structural equation modeling. On one hand, meta-analytic techniques allow pooling studies to achieve an estimate of the association between predictor, outcome, and context across diverse populations. This, in turn, results in a closer approximation to the real population effect estimate. On the other hand, structural equation modeling allows confirmation of these estimates by simultaneously testing population data on the predictor, outcome, and context. Both applications in tandem are a measurement framework for this particular syndemic and have the potential to be extrapolated for many other syndemics.

**Implications for Public Health Practice: Reducing the Risks of Alcohol Use Among MSM**

Alcohol use plays a significant antecedent role for risky sexual behaviors among MSM. Risky sexual behaviors, in turn, increase the odds of STIs, including HIV (Corte & Sommers, 2005). Despite strategies against drinking—such as parental initiatives, campus-wide internet interventions, and comprehensive community interventions (Hingson & White, 2013)—it has been stated that
several structural factors make impossible the absolute avoidance of alcohol use (US Department of Health and Human Services [DHHS], 2007). Thus, primary prevention and reduction of alcohol use by MSM and secondary treatment of MSM with alcohol use disorders constitute paramount public health goals (DHHS, 2007).

The data reviewed show a compelling need to address alcohol use among MSM using a systematic approach that takes into account important contextual drivers. Prevention programs targeting alcohol use are a fundamental, cost-effective public health measure (DHHS, 2007). These preventive efforts, in turn, should be theory-informed in order to increase efficacy (National Institutes of Health [NIH], 2001; DHHS, 2007). Thus, our research findings have ascertained the baseline theoretical and methodological components necessary, although not sufficient, to develop efficacious preventive efforts. From our findings, an effective intervention will not only target alcohol use and risky sexual behaviors, but will assess mental health status, including but not limited to a history of violence, suicidal thoughts or attempts, depression, and anxiety. Other higher-order structural factors—such as a history of arrest or homelessness—should also be taken into account and addressed from a comprehensive, client-centered approach.

**Implications for Public Health Policy: Decreasing Health Disparities Among MSM**

Disease discriminates: some social groups get more than others (Singer et al., 2006). Research has shown that especially concentrated and chronic social disadvantage across multiple spheres of life, enduring discrimination in access to quality health care, and relative poverty, are significantly detrimental to the health not just of individuals but of whole social groups (Singer et al., 2006). Regardless of the reported higher educational attainment and social position of MSM compared to MSW, the latter consistently presents with important health disparities, including higher prevalence rates of drug use, sexually transmitted infections (STIs), including HIV, mental health conditions, and violence and victimization (Stall et al., 2008). There is sufficient data from the
past 25 years documenting the co-occurrence of these factors in many directions among MSM, but “relatively few studies have investigated the possibility that these epidemics are mutually reinforcing and function together to lower the health profile of urban American MSM” (Stall et al., 2008, p. 251).

Examining health disparities among sexual minorities is a public health priority, especially because these health disparities increase the risk of HIV/AIDS. Various goal-setting policy documents underscore the significance of these disparities and encourage scientists, technicians, policymakers, and laypersons alike to address and decrease these disparities. These documents include the *Millennium Development Goals* (United Nations, 2015), *Healthy People 2020* (DHHS, 2015), the *HIV/AIDS Research Priorities* (NIH, 2015), and the *Compendium of Evidence-based Interventions* (Centers for Disease Control and Prevention, 2015).

This dissertation provides further evidence supporting the existence of health disparities among MSM. This evidence shall inform policies aiming to reduce such disparities. From a behavioral standpoint, policies that address structural inequities vis-à-vis health risks will have the best results, not only in preventing HIV and other STIs as an ultimate goal, but also improving health conditions and social justice in this minority population.
References


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