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The Additive Effects of Depressive Symptoms and Polysubstance Use on HIV Risk Among Gay, Bisexual, and Other Men Who Have Sex with Men

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Abstract

Introduction—Among gay, bisexual, and other men who have sex with men (GBM), collinearity between polysubstance use and mental health concerns has obscured their combined effects on HIV risk with multivariable results often highlighting only one or the other.

Methods—We used mediation and moderation analyses to examine the effects of polysubstance use and depressive symptoms on high-risk sex (i.e., condomless anal sex with serodiscordant/unknown status partner) in a sample of sexually-active GBM, aged >16 years, recruited in Metro Vancouver using respondent driven sampling. Hospital Anxiety and Depression Scale scores assessed mental health. Alcohol Use Disorder Identification Test scores assessed alcohol disorders. Poly-use of multiple drug types (e.g., stimulants, sedatives, opiates, hallucinogens) was assessed over the previous six months.

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Data Availability

Data are available through the B.C. Centre for Excellence in HIV/AIDS. Please contact Dr. Robert S. Hogg (rhogg@sfu.ca) for additional information.

Results—Among 719 predominantly white (68.0%), gay-identified (80.7%) GBM, alcohol use was not associated with increased prevalence of high-risk sex. Controlling for demographic factors and partner number, an interaction between polysubstance use and depressive symptoms revealed that the combined effects were additively associated with increased odds for high-risk sex. Mediation models showed that polysubstance use partially mediated the relationship between depressive symptoms and high-risk sex.

Conclusion—An interaction effect between polysubstance use (defined by using 3 or more substances in the past six months) and depressive symptoms (defined by HADS scores) revealed that the combination of these factors was associated with increased risk for high-risk sex – supporting a syndemic understanding of the production of HIV risk.

Keywords

Gay and bisexual men; Polysubstance use; Alcohol use; HIV risk; Depressive Symptoms

1. Introduction

Gay, bisexual, and other men who have sex with men (GBM) represent a disproportionate percentage of new HIV infections in North America (Hogg et al., 2012). In Canada, some estimates suggest that GBM are as much as 71 times as likely as other men to contract HIV (Public Health Agency of Canada, 2014); and despite expanded prevention efforts and advancements in HIV care, the number of new diagnoses among GBM has remained stable over the past decade (Public Health Agency of Canada, 2014, 2015).

Among several salient factors contributing to HIV risk, adverse mental health conditions among GBM are regularly identified as covariates of increased sexual risk (Drabkin et al., 2013; Sander et al., 2013). For instance, depression has been associated with a nearly 10-fold increase in serodiscordant condomless anal sex (Reisner et al., 2009). Furthermore, depression is highly prevalent in the general population, among sexual minorities, and among people living with HIV (Kessler, Chiu, Demler, & Walters, 2005; Klein, 2014; Lai, Cleary, Sitharthan, & Hunt, 2015). However, the mechanisms that underlie the association between depression and HIV risk remain poorly understood.

One possible explanation for this association is the high prevalence of substance use among people living with depression. A recent meta-analysis of 22 epidemiological studies reported that individuals who used illicit drugs had 3.8 times greater odds of reporting depression (Lai et al., 2015). Similarly, recent examinations of the relationship between substance use and poor mental health among GBM found that depression was associated with 3.5 times greater odds of reporting a doctor-diagnosed substance use disorder (Lachowsky et al., 2017). Together these findings highlight significant intercorrelations between substance use and mental health – a phenomena which has come to be identified with syndemics theory (Stall et al., 2003). Summarizing the relevance of syndemics theory to the present subject, syndemics describe the additive effects of two or more health conditions that contribute to excess burden of disease among vulnerable persons. Being two regularly identified syndemic factors that impact the health of GBM (Halkitis et al., 2015; Wilson et al., 2014), the combined effect of co-occurrent substance use and mental health challenges is likely to

increase risk for HIV acquisition and transmission more than the effect of either concern individually.

Indeed, two potential mechanisms have already been identified that link substance use to condomless anal sex (Moss & Albery, 2009) – a common risk factor for HIV. The first proposed mechanism demonstrates a proximal suppressant effect on cognitive capacity whereby intoxicated persons become more easily aroused and less capable of implementing risk management strategies, such as condom use (Rehm, Shield, Joharchi, & Shuper, 2012; Scott-Sheldon, Carey, Cunningham, Johnson, & Carey, 2016). The second proposed mechanism posits that escape and pleasure motived sexual and substance use expectancies – perhaps undergirded by mental health conditions – confound the relationship between substance use and sexual risk, and that, in fact, individuals use psychoactive substances as a means to escape emotional and psychological stressors and enhance sexual pleasure – abstaining from condoms for this same reason (George, Stoner, Norris, Lopez, & Lehman, 2000; Sternberg, 2011).

However, because substance use and mental health are highly collinear, one or the other is often found to be non-significant when examining the factors that contribute to HIV risk (Deuba et al., 2013; Kelly et al., 2013; Parsons, Lelutiu-Weinberger, Botsko, & Golub, 2013). Furthermore, recent rights-based models of substance use, mental health, and sexual behavior have taken issue with the pathologizing of these phenomenon (De Block & Adriaens, 2013; Kardefelt-Winther et al., 2017; Wasserman & Wasserman, 2016); and indeed a number of studies report that only at the extremes are substance use and mental health conditions linked to sexual risk behavior (Fendrich, Avci, Johnson, & Mackesy-Amiti, 2013) – suggesting that significant socio-structural traumas, rather than particular typologies of substance use or mental health conditions, contribute to HIV risk. These considerations highlight the need to more carefully evaluate the relationships between mental health, substance use, and sexual risk – particularly among vulnerable populations such as GBM.

Consistent with a syndemic conception of the above described relationships, the present analysis used mediation and moderation analyses to examine the association between high-risk sexual behavior, depression scores, and polysubstance use among a sample of GBM recruited using respondent-driven sampling (RDS). This allowed us to achieve more reliable population-based estimates of mental health, substance use, and sexual risk – adding to the array of sampling methods which have sought to improve on traditional convenience samples, including random-digit-dialing (Stall et al., 2003), venue-based time-location sampling (Matthews et al., 2016), and national surveillance sampling (Cochran & Mays, 2000).

Using these approaches, we hypothesized that: (i) polysubstance use would partially mediate the association between depressive symptoms and high-risk sex, and (ii) an interaction term between polysubstance use and depressive symptoms would better characterize these associations in multivariate models. In doing so, the present analysis leverages previously established conventions to offer the following strengths: (i) focuses only on sexual behavior which poses a risk for HIV transmission (Jin et al., 2015); (ii) recruits GBM in a way that

allows for adjustments to account for sampling bias (Heckathorn, 2011); (iii) uses validated scales of alcohol dependence and depressive symptoms as opposed to participant reported past history of doctor diagnosed depression to reduce misclassification bias (Ferguson, 2000; McGinnis et al., 2013); and (iv) focuses on polysubstance use rather than any substance use – the latter of which has poor specificity among GBM (McCarty-Caplan, Jantz, & Swartz, 2014).

2. Methods

2.1. Study Protocol

We used respondent driven sampling (RDS) to recruit a cohort of GBM in Metro Vancouver, British Columbia. Inclusion criteria restricted participation in the study to individuals who were (i) 16 years or older, (ii) gender identified as male, (iii) lived in the Metro Vancouver area, (iv) had sex with another man in the previous 6 months, and (v) could complete a questionnaire in English. Initial seeds were recruited from community contacts and geosocial networking applications (Lachowsky, et al., 2016), following formative research which mapped the relevant in-person and online networks in Metro Vancouver (Forrest et al., 2014). Respondents completed a computer-administered self-interview (CASI) at our study site in Vancouver's downtown West End (an area traditionally thought of as Vancouver's "gay neighbourhood") and then a nurse-administered questionnaire and sexual health check-up with serology for HIV, HCV, and syphilis. Ethical approval for this study was granted by the research ethic boards of Simon Fraser University, the University of British Columbia, the Providence Healthcare Research Institute, and the University of Victoria.

2.2. Dependent Variable

High-risk sexual behavior was assessed by asking participants to report the HIV serostatus of sexual partners with whom they had had condomless anal sex (CAS) in the past six months (P6M). Individuals who reported CAS with a partner who was serodiscordant or whose HIV status they did not know were classified as having engaged in "high-risk sex," and individuals who reported not engaging in CAS or who engaged in CAS with only seroconcordant partners were classified as not having engaged in "high-risk sex." This cut-off provides a more accurate representation of HIV risk as there is reduced risk for HIV transmission between known-concordant partners (Jin et al., 2015).

2.3. Independent Variables

Substance use behaviour was measured by self-report and participants were asked to report use of drugs in the following categories over the P6M: stimulants (i.e., crack/cocaine), prescription stimulants (i.e., Ritalin, Concerta, Adderall,), methamphetamine (i.e., crystal methamphetamine, speed), inhalants (i.e., nitrous oxide), sedatives (i.e., gamma-hydroxybutyric acid), benzodiazepine, barbiturates), hallucinogens (e.g., lysergic acid diethylamide, psilocybin, ketamine, methylenedioxymethamphetamine), street opioids (i.e., heroine), prescription opioids (i.e., morphine, codeine, Oxycontin, Percocet), erectile dysfunction drugs, poppers (e.g., alkyl nitrate), cannabis, and other drugs. Polysubstance use was classified by the number of categories from which a participant reported using a drug.

Continuous counts were trichotomized as (i) no substance use, (ii) one or two categories of substance use, and (iii) three or more categories of substance use. For the purposes of the present study, alcohol use was assessed separately from polysubstance use using the Alcohol Use Disorder Identification Test (AUDIT; Saunders, Aasland, Babor, de la Fuente, & Grant, 1993). This was done because the majority of participants reported alcohol consumption over the P6M. The AUDIT is a brief screening measure that assesses harmful alcohol use and dependence and has been previously shown to have high sensitivity and specificity among both HIV-negative and HIV-positive men, even compared to other alcohol screening measures (McGinnis et al., 2013). The scale consists of three items measuring alcohol consumption, three items measuring drinking behavior, two items assessing adverse reactions, and two items assessing alcohol-related problems. Items are scored on zero-weighted five-point Likert-scales and final scores range from 0 (no harmful or dependent alcohol use) to 40 (harmful or dependent alcohol use). Clinical guidelines developed for the AUDIT suggest that scores >20 warrant treatment of alcohol dependence, scores 16–19 warrant counseling and continued monitoring, and lower scores require limited to no intervention (Miller, 2014). Balancing the sensitivity and specificity of these categorizations, the AUDIT scale was dichotomized in the present study with values between 0 and 15 indicating “low or medium risk” and scores between 16 and 40 indicating “harmful use and possible dependence” (Lachowsky et al., 2017).

To assess depressive symptoms, the depression subscale score from the Hospital Anxiety and Depression Scale (HADS; Snaith, 2003) was used. This subscale consists of seven items (e.g., “I feel as if I am slowed down”) scored on a zero-weighted four-point Likert scale. Final scores range from 0 (no depressive symptoms) to 21 (severe depressive symptoms). Based on original score cut-offs and literature showing that more severe, rather than less severe, depression is associated with abnormal sexual risk (Fendrich et al., 2013; Zigmond & Snaith, 1983), scale scores were dichotomized with scores less than or equal to 10 indicating “normal/borderline depressive symptoms” and scores greater than 10 indicating “abnormal depressive symptoms” (Whelan-Goodinson, Ponsford, & Schönberger, 2009). Further, diagnostic evaluations of the HADS depression subscale have shown that cut offs around 10 have acceptable specificity and sensitivity (Honarmand & Feinstein, 2009; Hung, Liu, Wang, Yao, & Yang, 2012; Whelan-Goodinson et al., 2009) and may better represent depression than a history of doctor diagnosed depression (Golden, Conroy, & O’Dwyer, 2007).

2.4. Other Covariates

To control for extraneous variation, baseline cross-sectional data used in this analysis included the following sociodemographic variables: age, sexual identity (gay, bisexual, other), race/ethnicity (White, Asian, Indigenous, Latin American, other), annual income (< $30,000 vs. ≥ $30,000), HIV status (negative, positive), and participant’s reported number of male anal sex partners in the P6M.

2.5. Statistical Analysis

All analyses used RDS-generated weights to adjust for network size and homophily using RDSAT (version 7.1.46, Voltz et al., 2012) and SAS (version 9.4, *SAS*, Cary, North

Carolina, USA). Bivariate statistics for demographic, mental health, and substance use factors associated with “any high-risk sex” (vs. none) were generated using simple logistic regression to identify candidate variables for multivariate models. To adjust for the confounding effects of sociodemographic variables and partner frequency, multivariable logistic regression models were constructed using a backwards selection approach wherein at each step the variable with the largest Type-III p-value was omitted until the Akaike information criterion was optimized (minimized). Only variables with a univariable p-value <0.20 were initially included. Moderation effects of polysubstance use and depressive symptoms were examined by including an interaction term between the two variables. A mediation analysis also examined the effect of polysubstance use (i.e., reporting three or more substances vs. none) on the relationship between depressive symptoms and high-risk sex. A partial posterior method (i.e., an inferential approach that assesses the weighting of the null hypothesis by assessing the distribution of the mediating effect under the null hypothesis of no mediation) was used to test the significance of indirect effects of depression on high-risk sex via polysubstance use (Biesanz, Falk, & Savalei, 2010; Falk & Biesanz, 2016). This method provides a p-value interpretable in the same way as the p-value from Sobel’s test, but offers greater power that is comparable to other commonly used alternatives (e.g., bootstrap and Monte Carlo). Finally, a ratio of the unadjusted and adjusted effects on the association between depression and high-risk sex was used to calculate the proportion of variance explained by polysubstance use.

3. Results

A total of 719 respondents were recruited, of which 119 were seeds. Of these, 703 provided valid responses for our primary outcome variable. Table 1 provides RDS-adjusted study characteristics for the study sample, stratified by the primary outcome variable of interest (i.e., high-risk sex). Univariate p-values are also provided testing the association between each factor and the outcome of interest. Overall, 23.4% of respondents were HIV-positive, 80.7% were gay identified, 68.0% were White, the median age was 33 years old (Q1-Q3: 26–47), 65.6% had at least some post-secondary education, 74.3% made less than $30,000 per year, 19.0% had moderate or severe HADS depression sub-scale scores, 57.1% had moderate or severe HADS anxiety sub-scale scores, 36.1% reported using >3 substances (excluding alcohol), 13.2% had AUDIT scale scores indicating harmful use and possible dependence, and 35.9% reported serodiscordant or unknown CAS (i.e., high-risk sex) in the P6M with an additional 26.0% reporting CAS only with a seroconcordant partner. Prevalence estimates for each substance used in the past six months are also provided in Supplemental Table 1.

Univariate interactions with HADS Depression were examined for (i) AUDIT scores (p = 0.686) and (ii) polysubstance use (p = 0.032), and an interaction term was selected for inclusion in final multivariable modeling. Neither the effects of period prevalent alcohol use (P6M, OR = 1.05, 95% CI: 0.68, 1.61), nor elevated (i.e., harmful/possible dependence) AUDIT scores (P6M, OR = 1.29, 95% CI: 0.84, 1.99) were significantly associated with high-risk sex. Setting alcohol use aside, Table 2 shows that the effects of polysubstance use on high-risk sex varied across depression levels, as did the effects of depression across polysubstance use levels. Among those with normal/borderline HADS scores, those who

used 3 or more substances were more likely to report high-risk sex (AOR = 1.65, 95%CI: 1.01, 2.68) than those without any substance use; and among those with abnormal HADS Depression Scores, the association between the highest level of polysubstance use and high-risk sex increased thirteen-fold (aOR = 20.76, 95% CI: 1.66, 260.40). Presenting an alternative way of interpreting these results: among those with the highest level of polysubstance use (>3 reported substances), depression was positively associated with high-risk sex(aOR: 5.44, 95% CI:1.56, 19.00); whereas at lower levels of polysubstance use, this relationship was not significant (1–2 substances: aOR: 1.18, 95% CI:0.35, 3.99; 0 substances: aOR: 0.43, 95% CI:0.05, 4.09).

As shown in Figure 1, univariate results showed that abnormal HADS depression scores were associated with high-risk sex (OR: 2.77, 95% CI: 1.20, 6.36) and with the highest level of polysubstance use (OR: 2.62, 95% CI: 1.06, 6.45). When adjusting for polysubstance use, the odds between depression and engaging in high-risk sex diminished to 2.41 (95% CI: 1.03, 5.62) and those with the highest level of polysubstance use had 2.11 times greater odds of engaging in high-risk sex (95% CI: 1.39, 3.21). Partial posterior p-value for indirect effect indicated that the mediation effect was significant (p = 0.026). These results suggest that, 18.2% of the effect of depression on high-risk sexwas mediated by polysubstance use.

4. Discussion

4.1. Primary Findings

In the present study we found that among 719 GBM recruited using RDS in Vancouver, Canada, neither period-prevalence alcohol use (any vs. none) nor AUDIT scores were associated with increased prevalence of high-risk sex (defined by condomless anal sex with a serodiscordant or unknown status partner). However, these findings should be interpreted within the broader literature on this topic which has produced mixed findings (Colfax et al., 2004; Sander et al., 2013; Vosburgh, Mansergh, Sullivan, & Purcell, 2012). Setting alcohol use aside and controlling for age, ethnicity, income, and number of sexual partners, an interaction effect between polysubstance use (defined by using 3 or more substances in the P6M) and depressive symptoms (defined by abnormal HADS scores) revealed that the combination of these factors was associated with greater likelihood of high-risk sex – supporting a syndemic understanding of the production of GBM's sexual behaviour and HIV risk (Halkitis, Moeller, et al., 2013; Kurtz, Buttram, Surratt, & Stall, 2012; Singer, Bulled, Ostrach, & Mendenhall, 2017).

With respect to previous research, our findings offer several important insights into the relationship between mental health, substance use, and HIV risk. First, they suggest that while alcohol use may be a driving factor for condomless sex, it is not necessarily a driving factor for HIV risk (Sandfort et al., 2017). In previous analyses we showed that alcohol use was associated with higher odds of condomless anal sex (Card et al., 2017; Lachowsky, et al., 2016), but in the present analyses, alcohol use was not associated with condomless anal sex with a serodiscordant or unknown serostatus partner. This suggests that alcohol use may have a complicated relationship with participant's patterns of seroadaptation, strategies used by GBM to facilitate sexual intimacy and sensation seeking during sexual intercourse (McKirnan, Ostrow, & Hope, 1996). This does not rule out the possibility that alcohol use

has an inhibitory cognitive effect on condom use, but does suggests that the inhibition may have a less pronounced effect on partner selection.

With that said, the interaction between polysubstance use and depression underscores the syndemic effects of comorbid health conditions on shaping patterns of HIV risk. As noted by Stall et al., there has long been irrefutable evidence of the disparities in disease concentration among marginalized groups such as MSM (Stall, Coulter, Friedman, & Plankey, 2015). The present study expands this body of literature by providing evidence for an interaction effect between syndemic factors. Specifically, we have shown that the effects of depression and polysubstance use on high-risk sex were only statistically significant at the highest cut-offs for these measures (See also, Fendrich et al., 2013), suggesting that in addition to possible dose-response relationships, there is also a synergistic relationship wherein the combined effects of comorbidities, in addition to the singular morbidities themselves, have a profound effect on shaping high-risk sexual behavior (Singer et al., 2017). In summary, our findings are consistent with empirical research showing that syndemic production of HIV through depression, polydrug use, and sexual trauma is strongly predictive of HIV seroconversion among GBM (Guadamuz et al., 2014; Mimiaga et al., 2015).

Examining a rationale for the association between depression and substance use, our mediation analysis underscores the need to better describe the mechanisms that underlie the association between depression and condomless anal sex. While we, and others (Hutton, Lyketsos, Zenilman, Thompson, & Erbelding, 2004), have hypothesized that substance use would have a large mediating effect in this relationship, in our study it explained less than 20% of the direct effect of depression on high-risk sex. This underscores the need to examine syndemics not only with respect to their behavioral endpoints, but also the antecedent biological factors that prime these behaviors (Singer et al., 2017). Regarding sexual risk, these include the endocrinological effects of glucocorticoid regulation that aggravates the stress-response, which in turn impacts the neural-cognitive processes underling risk perception and sensation seeking behavior (Arnsten, 2009; Goldey & van Anders, 2012; Harrison, Ratcliffe, Mitchell, & Smith, 2014; Mehta, Welker, Zilioli, & Carré, 2015; Shabani, Dehghani, Hedayati, & Rezaei, 2011).

4.2. Implications

The implications of our research highlight the importance of not only considering the comorbid effects of depression and substance use when screening for individuals who are at greatest risk for HIV infection, but also providing competent holistic care that can address the combination of these comorbidities as well as the underlying factors that give rise to them (Halkitis, Moeller, et al., 2013; Safren, Blashill, & O'Cleirigh, 2011; Wim, Christiana, & Marie, 2014). With an increasing number of GBM undergoing more formal evaluations of HIV risk behavior as part of the expansion of PrEP, these screenings may provide opportunities for identifying and addressing mental health concerns as well. Integrated care services may thus provide a new standard of care compared to services only addressing traditional prevention and care strategies (Halkitis, Wolitski, & Millett, 2013). As part of these interventions, identifying and enhancing patterns of resilience among GBM is believed

to be a productive approach for alleviating health disparities (Herrick et al., 2011). Serosorting, for example, has been advanced as a resiliency strategy, but it's effectiveness has been called into question by high partner frequency among those engaging in CAS (Kurtz et al., 2012) – again emphasizing the need for combined prevention focusing on traditional risk-related indicators (e.g., partner number).

4.3. Limitations

This study has several important limitations. First, while we have relied on previously established and validated cut-offs for assignment of depression and alcohol use disorders, it is possible that different schema would have produced different results. This is of particular concern given the small sample of individuals meeting the threshold for abnormal depression – which potentially reduced our power to detect significant effects. Second, our decision to not include alcohol use in our classification of polysubstance use was important for practical reasons related to the high prevalence of alcohol use in our sample. This might make it difficult to compare our polysubstance use measure to those used by others. However, with changes to the DSM-5, which has sought to disaggregate alcohol use and other substance use disorders (APA, 2013), we hope that studies will increasingly distinguish between these factors. Third, as the data used in the present analyses assessed period-prevalence at a population-level, future analyses should examine event- and network-level covariates, as these measures have previously been shown to produce divergent results (Vosburgh et al., 2012). Fourth, as polysubstance use is difficult to define (i.e., which drugs should be included, at what frequencies, and how many drugs qualify as "poly"), our results may not capture the full gradient of substance use patterns. More nuanced models of substance use behavior are needed, such as cluster or latent class analyses. Fifth, while CAS with serodiscordant or unknown status partners is a better proxy for HIV risk than CAS with serconcordant partners, the increasing availability of pre-exposure prophylaxis and antiretroviral therapies to prevent HIV transmission/acquisition, may make this measure of HIV risk an inadequate proxy for true epidemiological HIV risk in the future. Conversely, as recent seroconversion is often associated with being unaware of one's HIV status, individuals may believe they or their partner is HIV-negative, when in fact they are in a stage of acute infection or long-term non-diagnosis. It is therefore possible that strategic deployment of risk management strategies has the possibility to prevent HIV transmission for even those who experience multiple syndemic comorbidities. This may introduce some misclassification error, especially considering that substance use (alcohol use in particular) has been previously correlated with unawareness of infection among HIV-positive men (Vagenas et al., 2014). Fifth, it should be noted that due to the lack of relevant empirical comparisons of RDS and other sampling techniques (e.g., online samples, time-location samples), it is unclear exactly how these methods compare in terms of recruiting samples of MSM in which there is minimal bias. As such, readers should be attentive in comparing the results of the present study to those previously generated by alternative recruitment methods.

5. Conclusion

In conclusion, our findings underscore the need for integrated care in the management of comorbid mental health and substance use conditions, which together promote HIV risk.

Furthermore, incomplete mediation between depression and HIV risk by substance use underscores the need to further evaluate the mechanisms by which depression contributes to HIV risk. Given the present study's support for the syndemic production of HIV-risk, such models might begin by examining other previously identified syndemic factors.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Abbreviations

GBM Gay bisexual, and other men who have sex with men

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Highlights

- Increased odds for high-risk sex was seen only at the highest levels of concurrent polysubstance use and depressive symptoms.
- About one-fifth (18.2%) of the effect of depressive symptoms on condomless anal sex with serodiscordant or unknown status partners was explained by polysubstance use – highlighting a significant need for integrated healthcare services for those experiencing concurrent substance use and mental health conditions.
- Neither Alcohol Use, nor Alcohol Use Disorder Identification Test Scores were associated with condomless anal sex with serodiscordant or unknown status partners, despite being previously associated with condomless anal sex.

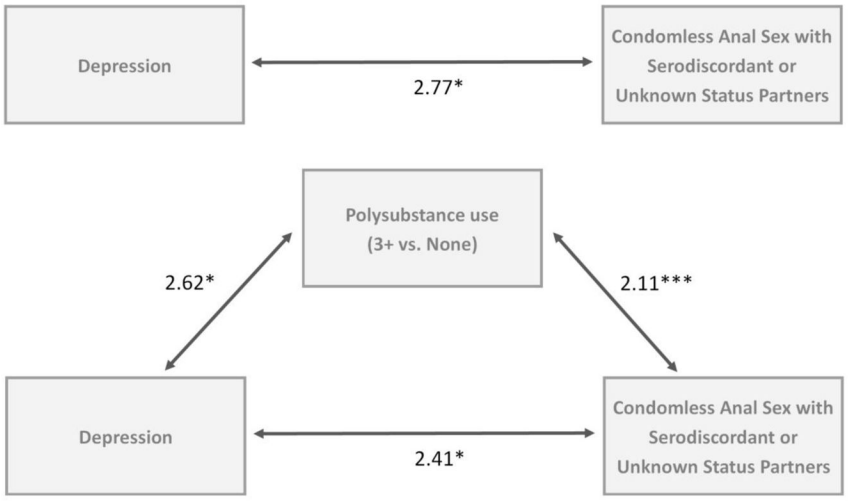

Figure 1.

Crude and Mediated Effects (Odds Ratios) Examining the Effects of Depression and Polysubstance use on Condomless Anal Sex with Serodiscordant or Unknown Status Partners.

* $p < 0.05$, ** $p < 0.01$ *** $p < 0.001$

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Table 1

Sample Characteristics, Stratified by Engagement in High-Risk Sex

	Full Sample		High-risk sex [A]				Bivariate Association
	(n = 703)		No (n = 441)		Yes (n = 262)		
Variable	**N**	**RDS%**	**N**	**RDS %**	**N**	**RDS %**	**p-value**
Age [B]	33	25, 47	31	25, 44	37	27, 49	0.0039
Sexual Identity							
Gay	597	80.1	368	62.5	229	37.5	0.0990
Bisexual	65	15.8	43	71.2	22	28.8	
Other	41	4.1	30	75.9	11	24.1	
Race/Ethnicity							
White	532	68.7	330	67.1	202	32.9	< 0.0001
Asian	67	9.1	49	71.8	18	28.2	
Indigenous	48	10.0	31	48.8	17	51.2	
Latin American	30	7.4	13	35.4	17	64.6	
Other	26	4.8	18	82.6	8	17.4	
Annual Income (CAD)							
<30,000	445	74.0	300	66.9	145	33.1	0.0236
≥30,000	258	26.0	141	57.8	117	42.2	
HIV Test Result							
Negative	508	77.8	334	68.1	174	31.9	0.0004
Positive	195	22.2	107	53.7	88	46.3	
HADS Depression [C]							
Normal/Borderline	657	93.6	418	64.5	239	35.5	0.0716
Abnormal	40	6.4	18	50.4	22	49.6	
HADS Anxiety [C]							
Normal/Borderline	519	70.9	343	65.1	176	34.9	0.2074
Abnormal	178	29.1	93	60.0	85	40.0	
Alcohol Use [A]							

	Full Sample		High-risk sex [A]				Bivariate Association
	(n = 703)		No (n = 441)		Yes (n = 262)		
Variable	**N**	**RDS%**	**N**	**RDS %**	**N**	**RDS %**	**p-value**
No	104	17.3	66	65.2	38	34.8	0.8258
Yes	599	82.7	375	64.1	224	35.9	
AUDIT Zone [D]							
Low/Medium Risk	602	86.0	387	65.1	215	34.9	0.2418
Harmful/Possible Dependence	97	14.0	51	59.0	46	41.0	
Polysubstance Use [A]							
0	184	24.5	130	70.9	54	29.1	0.0002
1–2	303	43.6	200	68.0	103	32.0	
3+	216	31.9	111	53.1	105	46.9	

[A] In the Past Six Months;

[B] (Median, Q1, Q3);

[C] Hospital Anxiety and Depression Scale

[D] Alcohol Use Disorder Identification Test

Table 2

Multivariable Adjusted Results for Associations with High-risk Sex

Variable	*AOR (95% CI)*
Age	**1.02 (1.01, 1.04)**
Sexual Identity	
Gay	Not selected
Bisexual	
Other	
Race/Ethnicity	
White	Ref
Asian	1.25 (0.67, 2.32)
Indigenous	**2.15 (1.18, 3.94)**
Latin American	**4.03 (2.02, 8.01)**
Other	0.48 (0.18, 1.28)
Annual Income (CAD)	
<$30,000	Ref
≥$30,000	**1.63 (1.10, 2.40)**
HIV Test Result	
Negative	Not selected
Positive	
Number of Male Anal Sex Partners [A]	**1.05 (1.03, 1.07)**
AUDIT	
Low/Medium Risk	Not Selected
Harmful/Possible Dependence	
Poly Substance Use	
HADS Depression: Normal/Borderline	
Polysubstance Use: 0	Ref
Polysubstance Use: 1–2	1.15 (0.74, 1.80)
Polysubstance Use: 3+	**1.65 (1.01, 2.68)**
HADS Depression: Abnormal	
Polysubstance Use: 0	Ref
Polysubstance Use: 1–2	3.16 (0.26, 39.06)
Polysubstance Use: 3+	**20.76 (1.66, 260.40)**

[A]Past Six Months; HADS = Hospital Anxiety and Depression Scale; AUDIT = Alcohol Use Disorder Identification Test.