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Condom-associated erectile function, but not other domains of sexual functioning, predicts condomless insertive anal sex among young men who have sex with men

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Abstract

Condoms effectively prevent against HIV, especially when used in conjunction with biomedical strategies such as PrEP and viral suppression. However, consistent use of condoms in the real world has been a continual health promotion challenge, even among populations at highest risk, such as young men who have sex with men (YMSM). Inconsistent condom use may be related to poor sexual functioning, but limited research exists. The analytic sample comprised 688 racially diverse YMSM aged 16–29 ($M = 22.9$) living in Chicago, IL (19.2% living with HIV). Using multivariable logistic regression, we examined longitudinal associations between condom-associated sexual functioning (erectile function, orgasm satisfaction, global satisfaction, and anal discomfort) and condomless insertive anal sex (CIAS) and condomless receptive anal sex (CRAS) 6 months later. CIAS at Time 2 was associated with condom-associated erectile function at the bivariate and multivariable levels, even after controlling for CIAS at Time 1 ($p < .05$). Condom-associated erectile function, orgasm satisfaction, and global satisfaction predicted Time 2 CRAS in bivariate models, but none remained significant in the multivariable models. Age, having had a serious partner in the past 6 months, and HIV/PrEP status at Time 2 were significant predictors of CIAS/CRAS in some but not all models. Future interventions to improve consistent condom use should specifically highlight information and skills on how to use condoms within real-world contexts rather than from a clinical perspective. Our results also support the importance of biomedical strategies for those who have continued problems with sexual functioning when using condoms.

Keywords

sexual functioning; erectile function; condom use; sexual and gender minorities; HIV

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Introduction

Condoms were the first effective and cost-effective public health response for HIV control and prevention (Grangeiro, Ferraz, Calazans, Zucchi, & Diaz-Bermudez, 2015). They continue to be a primary focus of sexual health interventions for young men who have sex with men (YMSM) (Kegeles, Hays, & Coates, 1996; Mustanski, Garofalo, Monahan, Gratzner, & Andrews, 2013; Parsons, Lelutiu-Weinberger, Botsko, & Golub, 2014), who shoulder the burden of HIV in the United States (Centers for Disease Control and Prevention [CDC], 2017; Garofalo, Hotton, Kuhns, Gratzner, & Mustanski, 2016; Halkitis, Kapadia, & Ompad, 2015; Mustanski, Newcomb, Du Bois, Garcia, & Grov, 2011). Though additional strategies such as pre-exposure prophylaxis (PrEP) and treatment as prevention (TasP) are necessary to curb incident HIV infections (Grangeiro et al., 2015; Remis, Alary, Liu, Kaul, & Palmer, 2014), condoms remain an important prevention method in the era of biomedical interventions for those who are not able to access, are not good candidates for, have not yet adopted, choose not to adopt, or improperly use these newer technologies (Paz-Bailey, Wejnert, Mendoza, & Prejean, 2016; Phillips et al., 2013). Additionally, condoms can prevent other STIs that biomedical interventions cannot, such as gonorrhea and chlamydia, some of which are becoming increasingly resistant to traditional antibiotic regimens (World Health Organization, 2016). Condoms should thus be considered as a useful strategy in combination with biomedical methods (CDC, 2018).

Despite providing high levels of protection when used properly (Smith, Herbst, Zhang, & Rose, 2015), two continual public health challenges for condoms are consistency (i.e., every sexual encounter) and completeness (i.e., throughout the entire sexual encounter) of use. Single-point estimates of 100% consistent condom use have ranged from 26% to 37% of HIV-negative adult MSM (Mao et al., 2011; McFarland et al., 2012; Snowden, Raymond, & McFarland, 2009; Snowden, Wei, McFarland, & Raymond, 2014), with uniformly lower rates (between 9% and 25%) among men living with HIV in those same studies (who instead may utilize other strategies like serosorting to reduce transmission (Grov, Rendina, Moody, Ventuneac, & Parsons, 2015)). Longitudinal estimates are low as well: In two cohorts, Smith et al. (2015) reported that 13% and 19% of MSM of any HIV status always used condoms for both insertive and receptive anal sex across the respective 4 and 3 years of observation. Regarding condom use completeness, diverse studies among sexual majority and minority men and women have found a wide range (14–60%) of incomplete condom use over varying recall periods (Sanders et al., 2012). But, there exists limited research on both consistency and completeness of condom use specific to sexual minority youth. In one study, 2,412 YMSM reported on up to four partner-by-sex-position scenarios (i.e., insertive/receptive sex X casual/regular partner) they had experienced in the past 6 months and indicated always or almost always using condoms in only 64% (3276 / 5153) of scenarios (Lachowsky, Dewey, et al., 2015). In another study, approximately one-third of YMSM reported late application and/or early removal of condoms by they themselves or their anal sex partners; percentages were higher for vaginal sex partners (Mustanski, Ryan, & Garofalo, 2014). In sum, a substantial portion of MSM and YMSM use condoms inconsistently and incompletely and many not at all. Understanding factors that drive these behaviors is of great importance to health promotion endeavors.

Some evidence suggests that problems with various domains of sexual functioning when using condoms may be antecedents of inconsistent, incomplete, and/or non-use (Ostergren, Rosser, & Horvath, 2011). First, erection loss due to condom use appears to be common. Problems that occur when applying condoms before sex have been reported by 14–28% of presumably heterosexual samples, while condom-associated erectile problems that arise during intercourse have been reported by 10–20% of respondents (Sanders et al., 2012). In contrast, 56% of YMSM in one study reported any erection loss due to condoms either before or during anal sex; of those who engaged in vaginal sex, 61% reported erectile problems (Mustanski, Ryan, et al., 2014). To maintain an erection while using condoms has been identified as one of the most frequently cited reasons by MSM who utilize erectile-enhancing medications (e.g., Viagra) recreationally (Pantalone, Bimbi, & Parsons, 2008). Condom-associated erectile problems may in turn decrease motivation to use condoms (Sanders, Hill, Crosby, & Janssen, 2014). In one study, young men who reported more such problems not only had more frequent condomless vaginal intercourse but also were less likely to use condoms consistently and more likely to remove condoms early (Graham et al., 2006).

Second, problems with the fit and feel of condoms have been reported by 7–30% of participants across several studies (Sanders et al., 2012). These issues may contribute to erection loss (Graham et al., 2006) and subsequent preferences to not use condoms (Ostergren et al., 2011). Some research indicates that young men's pleasure when using condoms may be associated with condomless sex. Specifically, young sexual majority and sexual minority males who perceive a decrease in pleasure or reduced sensitivity when using condoms have been shown to be less likely to use condoms consistently or at all (Chemnasiri, Varangrat, Chaikummao, Chitwarakorn, & Holtz, 2014; Higgins & Wang, 2015; Lachowsky, Saxton, et al., 2015; Randolph, Pinkerton, Bogart, Cecil, & Abramson, 2007). Conversely, young Black MSM who reported experiencing *enhanced* sexual pleasure from using condoms have been shown to have significantly greater odds of always engaging in condom-protected anal sex (Crosby & Mena, 2017). Still other studies have found no significant differences in men's ratings of pleasure for sex with and without condoms (Herbenick et al., 2013; Milhausen et al., 2017).

The existing literature has begun to uncover the relations between sexual functioning and condom use. However, more research is clearly needed among YMSM, who are one of the only populations in which HIV incidence continues to rise (CDC, 2017) and whose sexual attitudes, behaviors, roles, and expression differ substantially from their heterosexual peers (McDonagh, Nielsen, McDermott, Davies, & Morrison, 2018; Sandfort & de Keizer, 2001). Of growing public health interest is the potential influence of biomedical interventions (e.g., PrEP) on condom use behaviors (Kippax & Holt, 2016; Newcomb, Moran, Feinstein, Forscher, & Mustanski, 2018; Paz-Bailey, Wejnert, et al., 2016), in which sexual functioning may play a role. Additionally, as previous studies have been primarily cross-sectional in design, we need stronger evidence linking sexual functioning to condom use. In response, the current study aimed to describe condom-associated sexual functioning among a sample of racially/ethnically diverse YMSM and to identify associations between condom-associated sexual functioning and condomless insertive anal sex (CIAS) and condomless receptive anal sex (CRAS) longitudinally. We examined three domains of sexual functioning

when wearing condoms: erectile function, orgasm satisfaction, and global satisfaction with one's sex life. We also examined anal discomfort when using condoms as the receptive partner. We hypothesized that (1) poor sexual functioning when wearing condoms would predict CIAS, (2) anal discomfort when using condoms would not be associated with CIAS, (3) poor sexual functioning when wearing condoms would not be associated with CRAS, and (4) anal discomfort when using condoms would predict CRAS.

Methods

Design and setting

Data for the current analysis came from RADAR, a study of HIV and substance use among YMSM and transgender women. Detailed descriptions of RADAR's accelerated longitudinal design (Miyazaki & Raudenbush, 2000) have previously been published (Morgan, Moran, Ryan, Mustanski, & Newcomb, 2018; Mustanski et al., 2018; Swann, Bettin, Clifford, Newcomb, & Mustanski, 2017). Briefly, the RADAR supercohort comprises individuals enrolled through one of four avenues: First, we invited assigned-male-at-birth participants from two previous studies, conducted in 2007 and 2010, to participate in RADAR. At the time of recruitment to their respective cohorts, these individuals were aged 16–20, spoke English, and either reported a sexual encounter with a man in the past year or identified with a sexual minority label (e.g., gay, bisexual). Recruitment methods included venue-based (e.g., community-based organizations, bars), online (e.g., social media, sexual networking sites), and incentivized-snowball sampling. Second, we recruited a 2015 cohort of male-assigned individuals aged 16–20 using similar venue-based and online approaches. Third, RADAR participants could refer up to three peers into the study. Peer referrals had to meet the same eligibility criteria as the 2015 cohort except that they could be 16–29 years old. Finally, serious romantic partners of RADAR participants were recruited at each study visit. Partners who met the peer-referral eligibility criteria were added to the supercohort, whereas those assigned female at birth or older than 29 completed a one-time visit. In summary, participants were eligible for the supercohort if they (a) were aged 16–29; (b) spoke English; (c) lived in and around Chicago, IL; and (d) either reported a sexual encounter with a man in the past year or identified with a sexual minority label. HIV status was not a criterion for inclusion/exclusion.

Procedures

Baseline data collection (hereafter, “Time 0”) for RADAR began in February 2015 and ended in April 2017; semi-annual (i.e., every 6 months) follow-up visits are ongoing. Data for the current study were collected between August 2016 and January 2019 during the fourth (18 months after baseline) and fifth (24 months after baseline) waves of data collection. Participants provided written consent, and parental/guardian consent was waived for those < 18 years old (Mustanski, 2011). At each visit, we collected psychosocial and behavioral data via computer-assisted self-interviews (CASI) and interviews by study staff. We also collected biological data via blood, urine, and anal swab samples. Rapid HIV testing using the blood sample was provided at each visit and confirmed by an offsite laboratory.

Because of limited space and competition with other constructs of interest in RADAR, sexual functioning measures were included in the CASI survey starting with the fourth study visit, hereafter referred to as “Time 1.” Data from the fifth study visit will hereafter be referred to as “Time 2.” The current analytic sample comprised only those participants who had completed both Time 1 and Time 2 interviews by January 2019. Because of conceptual differences in how transgender women and gender non-conforming/non-binary individuals might interpret questions related to condom use, particularly for insertive sex, as well as limited sample sizes for these groups, we included only cisgender YMSM in this study. All study activities were conducted with oversight from the Northwestern University Institutional Review Board.

Measures

General sexual functioning at Time 1.—We assessed four domains of sexual functioning at 18 months after baseline using the Patient-Reported Outcomes Measurement Information System, Sexual Function and Satisfaction Measures (PROMIS-SexFS), Brief Profile for Males, Version 1.0 (Flynn, Lin, et al., 2013; Flynn, Reeve, et al., 2013). This instrument comprised two items measuring interest in sexual activity ($\alpha = .826$), three items measuring erectile function ($\alpha = .725$), one item measuring orgasm satisfaction, and two items measuring global satisfaction with sexual activity ($\alpha = .968$), all within the past 30 days. For those participants who reported having receptive anal sex in the past month, we assessed anal discomfort during sex in the past 30 days using the four-item PROMIS-SexFS Anal Discomfort scale, Version 1.0 ($\alpha = .768$). Items in both PROMIS-SexFS instruments were scored on 5-point scales, with higher scores representing greater functioning or discomfort, respectively. Additional details on how the PROMIS-SexFS measures have been used and scored with this cohort have been previously published (Li, Remble, Macapagal, & Mustanski, 2019). For the current study, mean scores were calculated to equalize score ranges across domains.

Sexual functioning with condoms at Time 1.—To assess sexual functioning and anal discomfort related to condom use, we adapted the PROMIS-SexFS instruments to ask about participants’ experiences when using condoms. Three items measured erectile function when wearing a condom ($\alpha = .855$), one item measured orgasm satisfaction when wearing a condom, two items measured global satisfaction with sexual activity when wearing a condom ($\alpha = .936$), and two items measured anal discomfort when using condoms during sex as the receptive partner ($\alpha = .738$) (see Appendix A for the specific items). The sexual interest items were not adapted because they were considered a primarily psychological construct, whereas function, satisfaction, and discomfort have physiological bases in addition to psychological ones. Similar to the original PROMIS-SexFS measures, the condom-associated SexFS (CA-SexFS) items were scored on 5-point scales and averaged to create mean scores in four domains.

HIV/PrEP status at Time 2.—We assess HIV and PrEP-use status at each wave in RADAR. For the present study, we used measures from 24 months after baseline. At the beginning of their Time 2 visit, we derived participants’ currently known HIV status based on self-report data and confirmatory HIV test results from their previous visit as well as

interim communications with study staff. We asked participants at Time 2 if they had taken any PrEP medication to reduce HIV transmission risk in the past 6 months. Combining these two pieces of information, we created one variable with three categories: not living with HIV (NLWH), not on PrEP; NLWH, on PrEP; and living with HIV (LWH).

Sexual partners and condomless anal sex.—At each visit, participants were asked to name up to four of their most recent sexual partners using the HIV Risk Assessment of Sexual Partnerships (Swann, Newcomb, & Mustanski, 2018). For each partner assigned male at birth with whom they indicated having had anal sex, participants reported separately the number of condomless insertive and condomless receptive anal sex acts they had with that partner. We dichotomized the counts to either having had or not had CIAS or CRAS in the past 6 months. CIAS and CRAS at Time 2 were used as dependent variables in subsequent analyses while CIAS and CRAS at Time 1 were used as respective covariates. We also asked if any of the partners at Time 2 were serious partners, self-defined by the participants. We dichotomized this variable to having had or not had at least one serious partner in the past 6 months.

Demographic covariates.—Participants self-reported their race/ethnicity at baseline (Time 0), which we categorized into Non-Hispanic White, Non-Hispanic Black, Hispanic/Latino, or other. We assessed current age and self-reported sexual orientation at every visit. Sexual orientation was categorized into gay, bisexual, or other. The current analysis used age and sexual orientation data from Time 1.

Analytic approach

At the time of analysis, 688 individuals had completed both Time 1 and Time 2 visits (i.e., 18 and 24 months after baseline). We conducted Wilcoxon signed-rank tests to compare the PROMIS-SexFS measures to their corresponding CA-SexFS measures, accounting for the dependent samples and the non-normal distributions of the variables. Using simple logistic regression, we examined the associations between reporting any CIAS or any CRAS at Time 2 and the other variables. Variables that were significant at $p < .1$ at the bivariate level and all demographic covariates were carried forward into multiple logistic regression main effects models for CIAS and CRAS. We first excluded Time 1 CIAS and CRAS from the multivariable models because prior behavior could potentially mask other effects of interest, and any effect of sexual functioning on future CIAS/CRAS would have likely predated Time 1. We then included Time 1 CIAS and CRAS to control for potential confounding and examine if the effects of the preceding models would remain independent and robust. Finally, we tested for interaction effects between significant sexual functioning variables and other covariates. All analyses were conducted using IBM SPSS Statistics, Version 25.

Results

Sample characteristics

Table 1 presents descriptive statistics for our sample of YMSM. RADAR participants who had data for both Times 1 and 2 were on average 22.6 years old and racially/ethnically diverse. The majority identified as gay (69.6%). At Time 1, over half the sample reported

engaging in recent CIAS and CRAS. Participants reported being more than “somewhat” interested in sex ($M = 3.3$ out of 5), experienced little to no erectile difficulties ($M = 4.7$), rated their ability to have a satisfying orgasm as “very good” ($M = 4.1$), reported being “quite a bit” satisfied with sexual activity ($M = 4.1$), and very “rarely” experienced anal discomfort during receptive anal sex ($M = 1.8$).

Mean scores for CA-SexFS were all lower than for their respective PROMIS-SexFS counterparts. Per the Wilcoxon signed-rank tests, participants reported significantly lower erectile function ($Z = -11.93$, $p < .001$), orgasm satisfaction ($Z = -9.20$, $p < .001$), and global satisfaction with their sex lives ($Z = -7.76$, $p < .001$) but also significantly less anal discomfort ($Z = -8.18$, $p < .001$) when using condoms versus in general.

At Time 2, approximately 64% of participants were NLWH and not on PrEP, 16.5% were NLWH and on PrEP, and 19.2% were LWH. As before, over half of the sample had engaged in recent CIAS and CRAS. A similar percentage also reported having had a serious partner in the prior 6 months, and about 42% reported multiple sexual partners. Though not shown in the table, 39.4% ($n = 128$) of participants who reported having had a serious partner also reported having had multiple sexual partners, and this percentage was significantly less than participants without recent serious partners (49.7%, $n = 158$), $\chi^2(1) = 6.91$, $p < .01$.

Sexual functioning on condomless anal sex

At the bivariate level (Table 2), sexual interest was significantly associated with both behaviors, such that greater interest in sex predicted higher odds of engaging in CIAS ($p = .02$) and CRAS ($p < .001$). Greater orgasm satisfaction was associated with CIAS ($p < .10$), and more anal discomfort was associated with CRAS ($p = .06$). In contrast, condom-associated erectile function was significantly associated with both behaviors: Greater erectile ability when wearing a condom predicted lower odds of CIAS and CRAS ($ps < .01$). For CRAS only, condom-associated orgasm satisfaction and global satisfaction were also associated with lower odds of the behavior ($p = .04$ and $p < .01$, respectively), while anal discomfort when using a condom was not significantly associated with either outcome. To examine if the aforementioned findings could be explained by sexual positioning in general, we conducted sensitivity analyses with insertive and receptive anal sex (i.e., not specifying condomless) as dependent variables. We found no significant associations between any of the PROMIS- and CA-SexFS scores and engaging in either behavior ($ps = .21-.98$).

Demographic and other characteristics associated with CIAS at the bivariate level included age, LWH, and having had a recent serious partner. Characteristics associated with CRAS at the bivariate level included being Non-Hispanic Black, identifying as bisexual, NLWH on PrEP, and having had a serious partner. CIAS/CRAS at Time 1 (18 months after baseline) strongly predicted CIAS/CRAS at Time 2 (24 months after baseline).

Table 3 presents the multivariable models for Time 2 CIAS on selected sexual functioning variables. Tests of multicollinearity indicated no strong correlations among the covariates (VIFs < 1.8). In the model excluding CIAS at Time 1 (M1), sexual interest and general orgasm satisfaction attenuated to non-significance, whereas condom-associated erectile function remained significantly associated with lower odds of CIAS ($p < .01$). The effect

size for condom-associated erectile function increased relative to the bivariate model, as did those for other significant covariates: age ($p = .01$), living with HIV ($p < .01$), and having had a serious partner ($p < .001$). When Time 1 CIAS was added to the model (M2), only LWH attenuated to marginal significance ($p = .06$). Condom-associated erectile function remained significantly predictive of lower CIAS 6 months later ($p < .05$). We conducted a sensitivity analysis by including all CA-SexFS variables in a multivariable model (not shown), but the results did not differ; condom-associated erectile function, age, having had a serious partner, and Time 1 behavior were still associated with Time 2 CIAS. We found no significant interactions between condom-associated erectile function and other variables in the model.

Table 4 presents the multivariable models for CRAS ($VIFs < 2.8$). In the model excluding prior behavior (M1), most variables that were significant at the bivariate level (i.e., general sexual interest and anal discomfort; condom-associated erectile function, orgasm satisfaction, and global satisfaction; Black race; and bisexual orientation) attenuated to non-significance. Being on PrEP at Time 2 and having had a serious partner in the past 6 months remained associated with increased odds of Time 2 CRAS ($p = .04$ and $p = .03$, respectively), both at greater magnitudes than in their respective bivariate models. However, both became marginally significant ($p = .05$ and $p = .09$, respectively) with the addition of Time 1 CRAS to the model (M2). A sensitivity analysis including all CA-SexFS variables found the same pattern of results. Because no sexual functioning variables were significant in either M1 or M2, we did not pursue additional interaction models.

Discussion

Among a sample of YMSM, decreased erectile function associated with wearing condoms contributed to increased odds of engaging in CIAS. This finding partially supports our first hypothesis, that poor sexual functioning when wearing condoms would predict CIAS. RADAR participants reported significantly lower erectile function, orgasm satisfaction, and global sexual activity satisfaction when having sex with condoms compared to when having sex in general (both with and without condoms), suggesting the difference may be attributed to condomless sex. However, the lack of effect from condom-associated orgasm satisfaction and global satisfaction signifies that the decision to not use condoms when engaging in insertive anal sex may not be strongly based on the perceived or actual decreases in pleasure from using condoms. Instead, the effect of condoms on the physical mechanics of having insertive anal sex seems to be a more proximate cause, further supported by the fact that general erectile function was not associated with CIAS in our analyses. This finding aligns with a previous report of increased condomless vaginal intercourse among young heterosexual men who experienced more condom-associated erectile problems (Graham et al., 2006) and corroborates other studies that suggest such an association (Sanders et al., 2014; Sanders et al., 2012). Conversely, the finding that condom-associated orgasm and global satisfaction did not have effects on CIAS stands in contrast to a report that Black YMSM who rated condoms as enhancing sexual pleasure had 66% lower odds of engaging in CIAS (Crosby & Mena, 2017). It is possible that our measures of one's ability to have satisfying orgasms when using condoms and one's satisfaction with recent sexual activity using condoms may tap into different constructs than one's beliefs about condoms as a

sexual enhancement tool (at primarily a psychological or emotional level), but more research is needed to tease out such nuances.

Our third hypothesis, that poor sexual functioning when wearing condoms would not be associated with CRAS, was also partially supported. Although condom-associated erectile function, orgasm satisfaction, and global satisfaction significantly predicted lower odds of CRAS at the bivariate level, those effects attenuated in the multivariable models. Crosby and Mena (2017) found that Black YMSM who reported enhanced pleasure when using condoms had 57% lower odds of engaging in CRAS. But, they controlled only for age, so it is unknown how additional covariates would alter their results. YMSM may engage in multiple sexual roles (i.e., both insertive and receptive) with their partners (Tieu et al., 2013), possibly within the same sex event. Those who experience erectile problems or lower satisfaction when using condoms may have engaged in CIAS and switched to receptive anal sex without stopping to put on a condom. Further investigation into other potential reasons for these findings is warranted.

In concordance with our second hypothesis, anal discomfort when using condoms was not associated with engaging in CIAS. However, our results did not support our fourth hypothesis, that anal discomfort when using condoms would predict CRAS. The condom-associated anal discomfort items were administered only to participants who reported engaging in receptive anal sex with a condom in the past 30 days, so individuals who may have experienced discomfort and eschewed condoms prior to the study would have been excluded. Individuals who may have previously stopped having receptive anal sex due to general discomfort would also not have been captured. Of those participants who answered the items, the vast majority reported never experiencing anal discomfort when having sex with condoms, with only five individuals out of 106 reporting experiencing discomfort more than rarely (mean score > 2). Thus, the lack of variability may have impeded the detection of a relation between the two constructs. Alternatively, participants reported significantly less anal discomfort when engaging in receptive anal sex with condoms than when doing so in general, suggesting that condoms may actually reduce anal discomfort. This may be because individuals who consistently use condoms with sexual partners may be more likely to prepare sufficiently for anal sex (e.g., digital stimulation for relaxation, use of lubrication) (Thienkrua et al., 2016), which can enhance comfort and pleasure for the receptive partner. It may also be that individuals who consistently use condoms during anal sex have more experience in the receptive role, which may lead to greater relaxation and comfort.

Several covariate effects are important to note. First, age was a consistent predictor of engaging in CIAS. Some previous research from India and Cambodia has shown that YMSM who are in their mid-twenties and older (26 and 25, respectively) are more likely to report inconsistent condom use compared to YMSM who are not yet that age (Ramanathan et al., 2013; Yi et al., 2015). In contrast, studies from Thailand, Ghana, and the U.S. have reported the opposite, that younger YMSM are more likely to report unprotected anal sex (Mansergh et al., 2006; Margolis et al., 2014; Nelson et al., 2015). For YMSM in RADAR, our finding may reflect several possible explanations, including increased feelings of invulnerability, increased reinforcement of risk taking, decreased reinforcement of safer sex practices, and increased prevention fatigue and treatment optimism associated with age

and repeated negative HIV test results (Feinstein, Johnson, Parsons, & Mustanski, 2017; Kippax & Holt, 2016; Macapagal, Birkett, Janulis, Garofalo, & Mustanski, 2017; Mustanski, Rendina, Greene, Sullivan, & Parsons, 2014). Compared to younger participants, older YMSM in RADAR may also engage in different risk reduction strategies in lieu of condoms. More research is needed to understand these discrepancies in age effects across studies.

Second, YMSM who identified as bisexual had 61% lower odds of engaging in CRAS at the bivariate level. Although the effect dissipated in the multivariable models, this finding corroborates behavioral differences observed in previous work: Compared to men who have sex with only men, men who have sex with both men and women were equally likely to report CIAS and overall condomless anal intercourse but less likely to report CRAS (Friedman et al., 2014; Maulsby, Sifakis, German, Flynn, & Holtgrave, 2013). This phenomenon may be attributed to bisexual YMSM's engaging in less receptive anal sex in general (Williams, Mackesy-Amiti, McKirnan, & Ouellet, 2009).

Third, having had a serious partner tripled the odds of engaging in CIAS and doubled the odds of engaging in CRAS, in agreement with previous studies that reported similar relations (Lachowsky, Dewey, et al., 2015; Mustanski, Newcomb, & Clerkin, 2011; Newcomb, Ryan, Garofalo, & Mustanski, 2014). YMSM may be more likely to forgo using condoms in serious relationships as a way to achieve emotional intimacy and trust with partners (Chemnasiri et al., 2014; Ostergren et al., 2011), and they may perceive their relationships to be monogamous and thus less risky (Greene, Andrews, Kuper, & Mustanski, 2014). However, these practices may actually place YMSM at potentially greater risk. Main sexual partners have been estimated to account for the majority of HIV transmissions, especially among YMSM, because of factors such as shorter relationship durations and a greater proportion of unrecognized infections (Sullivan, Salazar, Buchbinder, & Sanchez, 2009). The latter fact makes serostatus and monogamy assumptions within serious relationships particularly concerning. In a qualitative study of 20 YMSM dyads, Greene et al. (2014) found that some couples did not use condoms during their first anal sex act together. That finding was juxtaposed against some couples reporting uncertainty around their partner's HIV status and having discordant understandings of their sexual agreements, primarily around monogamy. In our RADAR sample, nearly 40% of YMSM who reported having a serious partner also reported multiple sexual partners in the same time span, which increases HIV transmission risk.

Individuals NLWH on PrEP were not more likely to engage in CIAS than individuals NLWH who were not on PrEP, even at the bivariate level. Conversely, individuals on PrEP were nearly three times more likely to have CRAS after adjusting for covariates. Using data from the first three waves of RADAR, Newcomb et al. (2018) found strong evidence of increased CRAS among YMSM on PrEP. Holt et al. (2018) also reported that a rapid increase in PrEP use in Australia was accompanied by a rapid decrease in consistent condom use. Earlier work reported that over a third of a sample of high-risk adult MSM indicated they would be likely to decrease condom use while on PrEP (Golub, Kowalczyk, Weinberger, & Parsons, 2010), driven by psychosocial factors such as substituting PrEP for condoms (behavioral disinhibition) and feeling like the risk of HIV has been reduced enough to warrant not using condoms (risk compensation). Gamarel and Golub (2015) added that,

based on a survey of MSM about condom use motivations and PrEP adoption intentions, a desire to increase intimacy within couples may be another motivator to eschew condoms for PrEP. Relatedly, researchers have noted a parallel pattern of increased CIAS and CRAS among YMSM living with HIV who agreed that undetectable viral load reduces infectiousness (Bruce, Harper, Suleta, & Adolescent Medicine Trials Network for HIV AIDS Interventions, 2013). Larger behavioral studies have not substantiated such a link between antiretroviral therapy (ART) and declining condom use (Lachowsky et al., 2016; Paz-Bailey, Mendoza, et al., 2016). The current study found reduced odds of CIAS among participants LWH, but we were not able to differentiate between those on treatment/virally suppressed and those who were not.

Our results have implications on targets for future interventions to improve consistent condom use. Most HIV prevention interventions address information such as the steps to properly use a condom, condom use motivations, and sometimes strategies to facilitate condom use (e.g., take one with you when you go out), but this information is often presented clinically and out of context. Sexual functioning has long been missing from discussions of sexual health (Fortenberry, 2016; Wolitski & Fenton, 2011). Given our findings, sexual health education programs should specifically highlight information and skills on how to use condoms within sexualized situations and in ways that do not adversely affect erectile function. Example activities could include modeling (e.g., with scripted videos) ways in which condoms are brought out and used during foreplay leading up to penetrative sex. EHealth and mHealth interventions could use multimedia role playing and gamification to better simulate real-life encounters and practice one's cognitive response to use condoms in a heightened emotional state. There could be frank discussions that normalize condom-associated erectile problems among young men to reduce stigma and provide strategies to mitigate issues (e.g., using lubrication inside the condom, mindfulness techniques). Following the recommendations of Wolitski and Fenton (2011), interventions should take a positive and expanded approach to sexuality (cf. one focused on disease prevention and control) that recognizes the complex physical, emotional, and social aspects of sex; acknowledges pleasure and satisfaction as important outcomes; and reframes sexual health as one facet of achieving pleasure and satisfaction (Crosby & Mena, 2017). A complementary future direction would be for manufacturers to continue to improve on condom design (e.g., fit and feel) to reduce any sexual functioning problems when using their products.

Our findings also highlight the importance of biomedical approaches for YMSM who continue to have erectile function problems when using condoms, as well as for those individuals who have serious partners. When taken properly, interventions like PrEP and ART offer passive protection against HIV (but not other STIs) that are subject to neither erectile dysfunction nor other condom errors and failures frequently reported among the general population and YMSM (Mustanski, Ryan, et al., 2014; Smith et al., 2015). Also, because YMSM are much less likely to use condoms with serious partners, HIV prevention programs should raise their awareness of their actual increased risk of HIV transmission and facilitate PrEP as a key prevention strategy and contingency plan for young couples, who may have outside sexual partners either within the bounds of their sexual agreements or otherwise.

Our findings should be interpreted with some caveats. First, because of when the PROMIS-SexFS and CA-SexFS measures were administered, our analytic sample comprised only individuals who had completed their Time 2 visit (24 months after baseline), reported engaging in anal sex, completed the sexual functioning items, and identified as a man—a portion of the full RADAR supercohort. Some underlying relations among the variables may therefore not have been detected at our significance threshold. Second, while the PROMIS-SexFS instruments have been validated among adult populations (Flynn, Reeve, et al., 2013) and did engage sexual minority individuals in those validation efforts (HealthMeasures, 2018), the measures have not been validated specifically among YMSM. Additionally, its validity among non-cisgender (e.g., transgender, non-binary) populations is still unclear, so we were unable to include those RADAR participants in the current study. Though we believe the items have adequate face validity for our sample, additional psychometric analyses of both the PROMIS-SexFS and CA-SexFS are areas of potential future research. Third, our outcome measures were any CIAS and any CRAS in the past 6 months, which do not capture more nuanced behaviors such as condom use consistency and completeness of use. Fourth, the multivariable models included only those participants who had data for all measures, resulting in a reduction in sample size. There appears to be a difference between the number of participants completing the PROMIS-SexFS and CA-SexFS instruments. Reasons for why participants did not complete the latter should be explored. Fifth, we did not assess lubrication use, which may be an additional layer of nuance that can affect sexual function, comfort, pleasure, and thus potentially condom use. Finally, the RADAR supercohort is a community sample of primarily urban participants, so findings may not be generalizable to individuals in other types of areas.

Despite these limitations, our study contributes to a small body of literature on sexual functioning and condom use that has thus far had limited focus on YMSM, key target populations for HIV prevention. Our work also highlights essential components of sexual health and wellbeing beyond the absence of disease, which are critically understudied in public health research, especially among youth (Fortenberry, 2016; Wolitski & Fenton, 2011). In conclusion, even as biomedical interventions continue to improve and expand their reach, consistent and complete condom use must continue to be a mainstay of HIV prevention initiatives. Condoms can bridge the gaps inherent in the slow pace of PrEP and ART implementation and ensure the benefits of biomedical interventions are not undermined (Paz-Bailey, Mendoza, et al., 2016; Paz-Bailey, Wejnert, et al., 2016; Phillips et al., 2013). To do so, HIV prevention and health promotion initiatives must be willing to broaden their scopes to include conversations about sexual function, pleasure, and satisfaction as well as intimacy and relationships. Only through a more holistic, person-centered approach, combined with a battery of biomedical and behavioral strategies tailored to individuals' and/or couples' needs, can we hope to end the HIV epidemic.

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Appendix A.: Adaptation of Patient-Reported Outcomes Measurement Information System, Sexual Function and Satisfaction (PROMIS-SexFS) measures for condom use.

For each item, please select the response option that best represents your experiences using condoms.

1. In general, how much does wearing a condom affect your ability to get an erection?

0, I've never used a condom

5, Not at all

4, A little bit

3, Somewhat

2, Quite a bit

1, Very

Items 2–6 were administered only if the response to Item 1 > 0.

2. In general, how much does wearing a condom affect your ability to keep an erection (stay hard)?

0, I've never used a condom

5, Not at all

4, A little bit

3, Somewhat

2, Quite a bit

1, Very

3. In general, your ability to have an erection when wearing a condom is...

0, I've never used a condom

1, Very poor

2, Poor

3, Fair

4, Good

5, Very good

4. In general, how would you rate your ability to have a satisfying orgasm/climax when wearing a condom?
- 0, I've never used a condom
 - 5, Excellent
 - 4, Very good
 - 3, Good
 - 2, Fair
 - 1, Poor
5. In general, when you have had sexual activity when wearing a condom, how much have you enjoyed it?
- 0, I've never used a condom
 - 5, Not at all
 - 4, A little bit
 - 3, Somewhat
 - 2, Quite a bit
 - 1, Very much
6. In general, when you have had sexual activity when wearing a condom, how satisfying has it been?
- 0, I've never used a condom
 - 5, Not at all
 - 4, A little bit
 - 3, Somewhat
 - 2, Quite a bit
 - 1, Very
7. In the past 30 days, how often have you decided to have anal without a condom because you've experienced pain, bleeding or irritation when you were the bottom?
- 0, Have not used a condom in the past 30 days
 - 1, Never
 - 2, Rarely
 - 3, Sometimes
 - 4, Often
 - 5, Always

Item 8 was administered only if the response to Item 7 > 0.

8. In the past 30 days, how often have you stopped using a condom in the middle of anal sex (but continued having sex without a condom) because you were experiencing pain, bleeding or irritation when you were the bottom?

1, Never

2, Rarely

3, Sometimes

4, Often

5, Always

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Table 1.Descriptive statistics of YMSM in RADAR who completed both Time 1 and Time 2 interviews ($N = 688$)

Independent variable	% or M (SD)	n or (median; range)	N
Demographics at Time 1			
Age	22.6 (2.88)	22.13; 17.46–31.19	688
Race/ethnicity			688
Non-Hispanic White	23.8%	164	
Non-Hispanic Black	32.7%	225	
Hispanic/Latino	32.3%	222	
Other	11.2%	77	
Sexual orientation			688
Gay	74.1%	510	
Bisexual	17.4%	120	
Other	8.4%	58	
Sexual functioning and behavior at Time 1			
General sexual functioning (mean score)			
Sexual interest	3.27 (1.05)	3.50; 1.00–5.00	655
Erectile function	4.72 (0.53)	5.00; 2.33–5.00	609
Orgasm satisfaction	4.14 (1.00)	4.00; 1.00–5.00	623
Global satisfaction with sex life	4.11 (0.91)	4.00; 1.00–5.00	586
Anal discomfort	1.81 (0.73)	1.75; 1.00–5.00	341
Condom-associated sexual functioning (mean score)			
Erectile function	4.02 (1.04)	4.33; 1.00–5.00	382
Orgasm satisfaction	3.40 (1.28)	3.00; 1.00–5.00	382
Global satisfaction with sex life	3.66 (1.10)	4.00; 1.00–5.00	382
Anal discomfort	1.25 (0.64)	1.00; 1.00–5.00	166
Had condomless insertive anal sex	50.7%	273	538
Had condomless receptive anal sex	53.9%	290	538
Sexual functioning and behavior at Time 2			
HIV/PrEP status			678
Not living with HIV, not on PrEP	64.3%	436	
Not living with HIV, on PrEP	16.5%	112	
Living with HIV	19.2%	130	
Had a serious partner(s) in past 6 months	50.5%	325	643
Had multiple sex partners in past 6 months	44.3%	305	688
Had condomless insertive anal sex	51.0%	281	551
Had condomless receptive anal sex	53.7%	296	551

Note. YMSM = young men who have sex with men. PrEP = pre-exposure prophylaxis. Ns vary because of question nesting and missing data.

Table 2.

Bivariate logistic regressions of condomless anal sex by position on sexual functioning and covariates among YMSM in RADAR ($N=688$)

Independent variable	Any CIAS				Any CRAS			
	OR	90% CI		P	OR	90% CI		P
General sexual functioning								
Sexual interest	1.22	1.06	1.41	0.019	1.38	1.20	1.60	<0.001
Erectile function	0.88	0.67	1.16	0.448	0.80	0.60	1.05	0.174
Orgasm satisfaction	1.16	1.00	1.34	0.098	1.09	0.94	1.26	0.334
Global satisfaction with sex life	1.06	0.90	1.25	0.583	1.03	0.88	1.22	0.744
Anal discomfort	0.91	0.70	1.19	0.570	1.42	1.05	1.91	0.055
Condom-associated sexual functioning								
Erectile function	0.70	0.58	0.84	0.002	0.74	0.61	0.88	0.006
Orgasm satisfaction	0.94	0.81	1.09	0.477	0.83	0.72	0.96	0.038
Global satisfaction with sex life	0.89	0.75	1.06	0.286	0.76	0.63	0.90	0.009
Anal discomfort	0.97	0.64	1.49	0.912	1.24	0.77	1.97	0.457
Age	1.07	1.02	1.13	0.018	0.97	0.93	1.02	0.362
Race/ethnicity (Ref=Non-Hispanic White)								
Non-Hispanic Black	0.71	0.48	1.03	0.134	0.43	0.29	0.64	<0.001
Hispanic/Latino	1.30	0.89	1.89	0.252	0.87	0.60	1.28	0.560
Other	0.78	0.47	1.29	0.412	0.77	0.46	1.30	0.413
Sexual orientation (Ref=Gay)								
Bisexual	1.32	0.89	1.96	0.254	0.39	0.26	0.59	<0.001
Other	1.11	0.66	1.86	0.751	0.66	0.39	1.11	0.192
HIV/PrEP status (Ref=NLWH, not on PrEP)								
NLWH, on PrEP	1.29	0.88	1.89	0.270	1.68	1.14	2.47	0.029
LWH	0.42	0.29	0.63	<0.001	0.78	0.53	1.14	0.275
Had multiple sex partners in past 6 months	1.11	0.84	1.47	0.546	1.32	1.00	1.75	0.106
Had a serious partner(s) in past 6 months	2.36	1.75	3.18	<0.001	1.76	1.31	2.36	0.002
Any CIAS/CRAS at Time 4	5.73	4.10	7.96	<0.001	7.37	5.23	10.37	<0.001

Note. CIAS = condomless insertive anal sex. CRAS = condomless receptive anal sex. OR = odds ratio. CI = confidence interval. NLWH = not living with HIV. PrEP = pre-exposure prophylaxis. LWH = living with HIV. Bold indicates significance at $p < .10$.

Table 3.

Multiple logistic regressions of CIAS on sexual functioning and covariates among YMSM in RADAR ($N = 688$)

Independent variable	M1: Time 1 CIAS excluded ($n = 284$)			M2: Time 1 CIAS included ($n = 245$)		
	AOR	95% CI	P	AOR	95% CI	P
Sexual functioning						
Sexual interest ^a	1.00	0.76	1.30	0.977	0.69	1.29
Orgasm satisfaction	1.23	0.92	1.63	0.164	0.78	1.49
Condom-associated erectile function ^a	0.67	0.51	0.88	0.003	0.73	1.00
Age	1.15	1.03	1.27	0.011	1.02	0.027
Race/ethnicity (Ref=Non-Hispanic White)						
Non-Hispanic Black	0.73	0.35	1.51	0.396	0.79	1.82
Hispanic/Latino	1.86	0.92	3.77	0.084	2.06	0.085
Other	0.77	0.28	2.11	0.607	0.61	2.03
Sexual orientation (Ref=Gay)						
Bisexual	1.49	0.73	3.03	0.274	1.59	0.71
Other	1.19	0.45	3.13	0.728	1.14	0.34
HIV/PrEP status (Ref=NLWH, not on PrEP)						
NLWH, on PrEP	1.33	0.67	2.65	0.415	1.26	0.58
LWH	0.33	0.15	0.75	0.008	0.41	1.04
Had a serious partner(s) in past 6 months	3.55	2.05	6.14	< .001	2.87	1.52
Any CIAS at Time 1	--	--	--	--	5.57	3.02
					10.27	< .001

Note. CIAS = condomless insertive anal sex. AOR = adjusted odds ratio. CI = confidence interval. NLWH = not living with HIV. PrEP = pre-exposure prophylaxis. LWH = living with HIV. Bold indicates significance at $p < .05$.

^aCentered at 1 so that the lowest value = 0.

Table 4. Multiple logistic regressions of CRAS on sexual functioning and covariates among YMSM in RADAR ($N = 688$)

Independent variable	M1: Time 1 CRAS excluded ($n = 158$)			M2: Time 1 CRAS included ($n = 152$)		
	AOR	95% CI	p	AOR	95% CI	p
Sexual functioning						
Sexual interest ^a	1.18	0.79	1.77	0.419	0.80	1.88
Anal discomfort ^a	1.12	0.65	1.94	0.676	0.62	1.98
Condom-associated erectile function ^a	0.80	0.49	1.31	0.368	0.45	1.26
Condom-associated orgasm satisfaction ^a	0.91	0.59	1.42	0.688	0.59	1.53
Condom-associated global satisfaction with sex life ^a	0.86	0.52	1.43	0.555	0.56	1.68
Age	1.09	0.94	1.26	0.277	0.93	1.29
Race/ethnicity (Ref=Non-Hispanic White)						
Non-Hispanic Black	0.79	0.28	2.22	0.658	0.84	0.29
Hispanic/Latino	1.02	0.39	2.66	0.965	1.03	0.38
Other	0.91	0.23	3.58	0.888	0.99	0.24
Sexual orientation (Ref=Gay)						
Bisexual	0.50	0.17	1.48	0.208	0.54	0.17
Other	2.09	0.35	12.46	0.418	2.19	0.34
HIV/PrEP status (Ref=NLWH, not on PrEP)						
NLWH, on PrEP	2.99	1.07	8.39	0.037	2.94	0.99
LWH	0.81	0.30	2.17	0.677	1.04	0.37
Had a serious partner(s) in past 6 months	2.27	1.06	4.83	0.034	2.00	0.90
Any CRAS at Time 4	--	--	--	--	2.98	1.31
					6.76	0.009

Note. CRAS = condomless receptive anal sex. NLWH = not living with HIV. PrEP = pre-exposure prophylaxis. LWH = living with HIV. Bold indicates significance at $p < .05$.

^aCentered at 1 so that the lowest value = 0.