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Factors Associated With Condom Failure in a Longitudinal Cohort of Men Who Have Sex With Men and Transgender Women in Abuja and Lagos, Nigeria

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Background: Effective condom use is a critical intervention to limit the spread of HIV and other sexually transmitted infections, particularly among individuals in high-risk networks who practice anal sex. We characterized condom failures in cisgender men who have sex with men and transgender women in Nigeria.

Setting: The TRUST/RV368 cohort provided condoms, compatible lubricants, and safer sex education to men who have sex with men and transgender women at community-engaged health centers in Abuja and Lagos, Nigeria.

Methods: Participants completed structured interview questions about condom usage and failure every 3–6 months. Robust Poisson regression models with generalized estimating equations were used to estimate relative risks and 95% confidence intervals for prespecified factors potentially associated with condom failure in the previous month.

Results: From September 2013 to September 2019, 2221 of 2737 participants (81.1%) reported condom use for anal sex with a male partner in the last month, and 305 (13.7%) reported condom failure during this time. Multivariate analyses demonstrated an increased risk of condom failure at postenrollment visits, as well as in participants who reported frequent Internet use, 2 or more casual sexual partners, and 2–4 main sexual partners. Those who cohabited with a woman had reduced risk.

Conclusions: Condom failure was common in this population despite freely available condoms, compatible lubrication, and education. Increased risk of condom failure over time could reflect message fatigue a ceiling for effective condom use, or new uptake of condoms by inexperienced users.

Key Words: gender, key and vulnerable populations, men who have sex with men, risk factors, transgender people, condoms, Nigeria

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INTRODUCTION

Despite declining global HIV incidence over the past decade, many countries are not on target to reach World Health Organization goals of reduction in incidence and mortality by 2020 and 2030.[1] Furthermore, advances in HIV treatment and prevention efforts are not spread equally across all populations; men who have sex with men (MSM)[2,3] and transgender women (TGW)[4] have not experienced the same magnitude of declines in HIV incidence as has been observed in other groups. Many biological, behavioral, and systems-

based factors collectively determine individual risk of HIV; however, receptive anal sex with serodiscordant and viremic partners is one of the most efficient modes of transmission[5] and is more commonly practiced by MSM and TGW than other groups. For those who engage in anal sex, the latex condom is one of the cornerstones of HIV prevention. However, for physiological and mechanical reasons, condom breakage or slippage is more common during anal than vaginal sex.[6,7] Application of condom-compatible lubricant (CCL) minimizes condom failure,[8] but other types of lubricants may actually promote failure. For example, petroleum-based lubricants may degrade latex condoms and, in MSM, are associated with approximately 6 times greater likelihood of breakage as compared with water-based lubricants.[9]

In areas of the world with the highest burden of HIV and the lowest access to prevention tools like preexposure prophylaxis, MSM, TGW, and those with nonbinary or other gender identities face many barriers to accessing appropriate and sensitive health care that includes the provision of safer sex advice, condoms, and CCL. Indeed, CCL did not appear in HIV prevention efforts for MSM sponsored by the US President's Emergency Plan for AIDS Relief until 2011, so provision by clinics and nongovernmental organizations was historically limited.[10,11]

Nigeria has a substantial HIV burden, with its residents accounting for approximately 9% of the global population living with HIV in 2014,[12] despite making up only approximately 2.5% of the total global population.[13,14] In 2019, the reported HIV prevalence in Nigerian males aged 15–49 years was 0.9%,[15] a fall from 1.3% in 2018. In contrast, in 2018, the HIV prevalence in Nigerian MSM was 23%.[16] Our group has previously reported HIV prevalence as high as 44%–66% in Nigerian MSM and TGW accessing trusted community health centers.[17] Prior studies of Nigerian MSM have demonstrated that 32%–51% reported consistent condom use with noncommercial male sexual partners during the previous 6 months.[18] Other studies have demonstrated consistent condom use among less than 40% of Nigerian university students.[19] Even when condoms are widely available, this does not consistently translate into decreased infections for a range of reasons, including condom failure through breakage and slippage.[20–22]

Prior studies evaluating factors associated with condom failures in African settings were comparatively small[23] and were often conducted in the context of female sex work[24] that is associated with power imbalances, deliberate condom damage by male clients,[25] and not exclusively focused on anal sex.[23] Others are almost a decade old.[26] Studies focusing on condom failure in African MSM likewise tend to be small, cross sectional, focused on sex workers and their clients, and do not include TGW.[27–31] To understand contemporary factors associated with condom failure in Nigerian MSM, TGW, and other gender identities required a large sample engaged in longitudinal follow-up. From September 2013 to September 2019, we examined factors associated with condom failure during anal sex with men among MSM and TGW in Abuja and Lagos, Nigeria.

METHODS

Study Population

TRUST/RV368 was a prospective cohort study involving MSM, TGW, and other sexual and gender minorities who were assigned male sex at birth in Abuja and Lagos, Nigeria, as previously described.[17] The study used respondent-driven sampling (RDS) for recruitment. Briefly, several first-wave, enrolled participants representing a variety of sociodemographic backgrounds were each provided with 3 referral coupons to distribute to other potential participants in their social networks. Each successfully enrolled referral was provided with another 3 coupons to distribute. RDS is an efficient means of accessing participant populations that are marginalized by general health care and therefore may be missed by other recruitment methods.[32,33] Study eligibility required participants to be adult (≥16 years in Abuja; ≥18 years in Lagos), have been assigned male sex at birth, report anal sex with a male partner in the 12 months before enrollment, and present with a valid RDS referral coupon.

The study took place at preexisting community health centers that were run by local nongovernmental organizations, supported by President's Emergency Plan for AIDS Relief, and provided comprehensive HIV treatment and prevention services tailored to MSM, TGW, and other sexual and gender minorities. Local standards of care included the syndromic management of sexually transmitted infections (STIs) and quarterly HIV testing. TRUST/RV368 worked in parallel with these services to provide additional enhanced counseling, free condoms/lubricants, peer support, and advanced STI diagnostics. Key opinion leaders within the community and peer navigators encouraged continued study engagement and attendance at study visits every 3 months.[34] Enrollment evaluations took place over the first 2 visits, approximately 2 weeks apart. Upon enrollment, all participants underwent screening for HIV and other STIs. HIV testing used a parallel algorithm of point-of-care testing with a third tie-breaker test as required. The tests were Determine (Alere, Waltham, MA), Uni-gold (Trinity Biotech, Wicklow, Ireland), and STAT-PAK (Chembio, NY) performed per package inserts. Pre- and posttest counseling accompanied each episode of STI and HIV screening and was provided by counselors trained in MSM and TGW health-related issues. The counseling was participant specific and included education about, and provision of, condoms and water-based lubricants. Reimbursement was provided for study visits (Naira 2000–3400, equal to about US$6–11, depending on visit) and for each referral resulting in an enrollment (Naira 1500, equal to about US$5).

All participants provided written informed consent before enrollment and any study procedures. The study was conducted in accordance with the ethical standards of the responsible committee on human experimentation and with the Helsinki declaration, 1975 as revised in 2000. The study protocol was approved by Health Research Ethics Committees or Institutional Review Boards at the Nigerian Federal Capital Territory and Nigerian Ministry of Defense, Abuja, Nigeria; University of Maryland, Baltimore, MD; Johns Hopkins University, Baltimore, MD; and Walter Reed Army Institute of Research, Silver Spring, MD.

Sexual Behaviors and Condom Failures

Demographic details, sexual and social behaviors, self-reported transactional sex, defined as any exchange of sex for goods or money, and condom and lubricant use were assessed by structured interview at each visit by trained research staff. The structured interview varied by visit and included questions about condom failure at enrollment as well as 3, 9, and 15 months after enrollment. Participants were asked, "In the last month approximately how many male partners did you have anal sex with?" Those who reported one or more partners for anal sex were subsequently asked about condom failure in the past month, defined as "a time when a condom slipped off or broke."

Statistical Analysis

Comparisons between participants who did or did not experience condom failure were the focus of these analyses. If the answer to the question about condom failure was missing, the participant refused to answer, or the participant responded "don't know," that participant visit was excluded from the analyses. Because condom use is required to experience condom failure, only visits at which the participant reported condom use during anal sex were included in these analyses.

Among participants who reported condom use during anal sex, comparisons between those who did or did not experience condom failure were made using Pearson χ^2 test, the exact χ^2 test, or Wilcoxon test, as appropriate. Medians and interquartile ranges were reported for continuous variables. Prespecified factors potentially associated with condom failure, selected a priori based on review of the literature, were explored using unadjusted and adjusted Poisson regression models with generalized estimating equations and robust error variance to estimate relative risks (RRs) and 95% confidence intervals (CIs).[35] The models included time-updated values for age, HIV status, lubricant used most during anal sex with men, transactional sex with men, number of casual and main sexual partners, and anal sex position. All other variables were static based on assessment at enrollment.

To explore effect modification by gender identity, Poisson regression models with generalized estimating equations and robust variance estimators were repeated in subgroup analyses limited to (1) cisgender men, (2) TGW, and (3) nonbinary and other gender identities. Because of smaller sample sizes for the latter 2 subgroups, some categorical independent variables were collapsed or dichotomized to facilitate multivariable model convergence.

A 2-sided type-1 error of 5% was considered statistically significant for all analyses. Analyses were performed using SAS version 9.4 (SAS Institute Inc., Cary, NC).

RESULTS

Study Population

From September 2013 to September 2019, 2737 participants were enrolled in TRUST/RV368, including 2221 (81.1%) who reported condom use during anal sex with a male partner and answered the question about condom failure in the month before any study visit. This included 1771 cisgender men (79.7%), 233 TGW (10.0%), and 198 participants (8.9%) who reported nonbinary/other gender identity. Of the participants included in these analyses, 1962 reported condom use during anal sex at the enrollment visit, and an additional 259 reported condom use only at later visits. Those who contributed data only at later study visits differed from those who reported condom use at entry in most domains evaluated (see Table 1, Supplemental Digital Content, http://links.lww.com/QAI/B567) except for condom failure in the previous month (12.7% vs. 13.9%; P =0.622).

At the first visit at which condom use during anal sex was reported, 305 participants (13.7%) reported condom failure in the previous month. Participants who reported condom failure were more likely to be educated at a secondary level or above, be single, be Christian, report nearly daily internet use, and be living with HIV or have unknown HIV status (Table 1). They were less likely to be married to a woman and report lubricant use. Participants with condom failure in the previous month also reported a greater number of casual male sexual partners than those who did not experience condom failure [median 4 (interquartile range 2–10) vs. 3 (1–6); $P < 0.0001$].

Factors Associated With Condom Failure

Table 2 describes unadjusted and adjusted RRs for associations of various characteristics with condom failure within the previous month. After adjusting for other factors, increased risk of condom failure was observed after the enrollment visit, with increased Internet use, with 2 or more causal sexual partners, and with 2–4 main sexual partners. Participants who did not use lubricant had the lowest risk of condom failure. In addition, being married to or living with a woman and identifying as a Muslim were associated with decreased risk of condom failure.

Subgroup Analyses by Gender Identity

These analyses included 1771 cisgender MSM who reported condom use during anal sex in the preceding month at 3053 visits and condom failure in the preceding month at 442 visits (14.5%); 233 TGW who reported condom use during anal sex at 422 visits and condom failure at 80 visits (19.0%); and 198 participants with nonbinary or other gender identity who reported condom use during anal sex at 358 visits and condom failure at 55 visits (15.4%). Table 3 describes the subgroup analyses for factors associated with condom failure among each of these gender subgroups.

In cisgender men, factors associated with condom failure were largely consistent with the primary analysis, including religion, Internet use, number of casual sexual partners, number of main sexual partners, and lubricant use. However, associations with visit number were not significant.

When restricted to TGW, condom failure was more common at visits 3 and 9 months after enrollment, whereas at 15 months, there was only a nonsignificant trend toward increased condom failure. Reporting greater than 5 casual partners was associated with greater risk, whereas having one main sex partner was associated with less risk of condom failure.

Among participants with nonbinary or other gender identities, there was no association with visit number except a

TABLE 1. Characteristics of TRUST/RV368 Participants Who Reported Anal Sex With Male Partners in the Preceding Month, Stratified by Self-Reported Condom Failure in the Preceding Month

Characteristic	Category	Total (n = 2221)	No Condom Failure (n = 1916)	Condom Failure (n = 305)	*P*
Age	≤21 yrs	747 (33.6)	654 (34.1)	93 (30.5)	0.305
	22–30 yrs	1257 (56.6)	1072 (55.9)	185 (60.7)	
	>30 yrs	217 (9.8)	190 (9.9)	27 (8.9)	
Gender identity	Cisgender man	1771 (79.7)	1529 (79.8)	242 (79.3)	0.209
	Transgender woman	233 (10.5)	195 (10.2)	38 (12.5)	
	Nonbinary/other	198 (8.9)	173 (9.0)	25 (8.2)	
	Missing/unknown	19 (0.9)	19 (1.0)	0 (0)	
Education	Junior secondary or less	288 (13.0)	272 (14.2)	16 (5.2)	**<0.001**
	Senior secondary	1183 (53.3)	1009 (52.7)	174 (57.0)	
	Higher than senior secondary	732 (33.0)	619 (32.3)	113 (37.0)	
	Missing/unknown	18 (0.8)	16 (0.8)	2 (0.7)	
Marital status	Single/never married	2013 (90.6)	1725 (90.0)	288 (94.4)	**0.038**
	Married/living with a woman	116 (5.2)	111 (5.8)	5 (1.6)	
	Living with a man	29 (1.3)	24 (1.3)	5 (1.6)	
	Divorced/other	49 (2.2)	43 (2.2)	6 (2.0)	
	Missing/unknown	14 (0.6)	13 (0.7)	1 (0.3)	
Religion	Christian	1601 (72.1)	1354 (70.7)	247 (81.0)	**0.008***
	Muslim	596 (26.8)	540 (28.2)	56 (18.4)	
	None/other	12 (0.5)	10 (0.5)	2 (0.7)	
	Missing/unknown	12 (0.5)	12 (0.6)	0 (0)	
Internet use	Never	430 (19.4)	403 (21.0)	27 (8.9)	**<0.001**
	≤3 times per wk	454 (20.4)	397 (20.7)	57 (18.7)	
	Almost every day	1311 (59.0)	1090 (56.9)	221 (72.5)	
	Missing/unknown	26 (1.2)	26 (1.4)	0 (0)	
HIV status	At risk	1322 (59.5)	1162 (60.6)	160 (52.5)	**<0.001**
	Living with HIV	670 (30.2)	574 (30.0)	96 (31.5)	
	Unknown	229 (10.3)	180 (9.4)	49 (16.1)	
Lubricant used most	Water based	978 (44.0)	824 (43.0)	154 (50.5)	**0.002**
	Other lubricants	445 (20.0)	379 (19.8)	66 (21.6)	
	No lubricant use	396 (17.8)	364 (19.0)	32 (10.5)	
	Missing/unknown	402 (18.1)	349 (18.2)	53 (17.4)	
Transactional sex	No	944 (42.5)	820 (42.8)	124 (40.7)	0.458
	Yes	1241 (55.9)	1063 (55.5)	178 (58.4)	
	Missing/unknown	36 (1.6)	33 (1.7)	3 (1.0)	
Casual sexual partners	None	345 (15.5)	316 (16.5)	29 (9.5)	**<0.001**
	1	254 (11.4)	229 (12.0)	25 (8.2)	
	2–4	784 (35.3)	681 (35.5)	103 (33.8)	
	5 or more	757 (34.1)	617 (32.2)	140 (45.9)	
	Missing/unknown	81 (3.6)	73 (3.8)	8 (2.6)	
Main sexual partners	None	382 (17.2)	327 (17.1)	55 (18.0)	**0.021**
	1	922 (41.5)	814 (42.5)	108 (35.4)	
	2–4	734 (33.0)	611 (31.9)	123 (40.3)	
	5 or more	174 (7.8)	155 (8.1)	19 (6.2)	
	Missing/unknown	9 (0.4)	9 (0.5)	0 (0)	
Anal sex position	Only insertive	593 (26.7)	513 (26.8)	80 (26.2)	0.700
	Only receptive	495 (22.3)	431 (22.5)	64 (21.0)	
	Both insertive and receptive	1090 (49.1)	933 (48.7)	157 (51.5)	
	Missing/unknown	43 (1.9)	39 (2.0)	4 (1.3)	

Demographic and other characteristics are shown for all TRUST/RV368 participants who reported anal sex with one or more male partners. Data came from the first visit satisfying the following criteria (1) the participant reported anal sex in the preceding month and (2) the participant answered the structured interview question about condom breakage or slippage in the preceding month. All responses are reported as n (%).

Statistically significant *P*-values ($P < 0.05$) are shown in bold.

**P*-values were calculated using Pearson χ^2 test or exact χ^2 test.

TABLE 2. Factors Associated With Condom Failure During Anal Sex With a Man in the Preceding Month

Characteristic	Category	RR	*P*	aRR	*P*
Visit	Enrollment	Reference	—	—	—
	3 mo	1.11 (0.92–1.34)	0.281	**1.33 (1.08–1.64)**	**0.007**
	9 mo	1.17 (0.94–1.45)	0.156	**1.38 (1.09–1.75)**	**0.007**
	15 mo	1.11 (0.88–1.40)	0.364	**1.34 (1.04–1.73)**	**0.024**
Age	≤21 yrs	Reference	—	—	—
	22–30 yrs	1.08 (0.90–1.30)	0.418	1.01 (0.83–1.22)	0.953
	>30 yrs	0.93 (0.69–1.25)	0.614	1.02 (0.74–1.41)	0.892
Gender identity	Cisgender man	Reference	—	—	—
	Transgender woman	**1.29 (1.02–1.63)**	**0.034**	1.15 (0.90–1.47)	0.256
	Nonbinary/other	1.05 (0.78–1.40)	0.766	0.94 (0.71–1.25)	0.695
	Missing/unknown	0.43 (0.14–1.39)	0.159	0.42 (0.13–1.34)	0.142
Education	Junior secondary or less	Reference	—	—	—
	Senior secondary	**1.79 (1.21–2.66)**	**0.004**	1.19 (0.79–1.78)	0.408
	Higher than senior secondary	**1.87 (1.25–2.79)**	**0.002**	1.19 (0.78–1.82)	0.423
	Missing/unknown	1.76 (0.59–5.26)	0.314	1.63 (0.66–4.02)	0.289
Marital status	Single/never married	Reference	—	—	—
	Married/living with a woman	**0.42 (0.25–0.73)**	**0.002**	**0.53 (0.31–0.92)**	**0.023**
	Living with a man	1.27 (0.73–2.21)	0.393	0.97 (0.54–1.72)	0.906
	Divorced/other	0.83 (0.51–1.34)	0.444	0.78 (0.48–1.29)	0.334
	Missing/unknown	0.80 (0.35–1.82)	0.593	1.45 (0.69–3.05)	0.331
Religion	Christian*	Reference	—	—	—
	Muslim	**0.60 (0.47–0.75)**	**<0.001**	**0.71 (0.55–0.90)**	**0.006**
	None/other	0.60 (0.16–2.26)	0.447	0.56 (0.14–2.18)	0.403
Internet use	Never*	Reference	—	—	—
	≤3 times per week	**1.84 (1.31–2.58)**	**<0.001**	1.35 (0.96–1.91)	0.088
	Almost every day	**2.13 (1.59–2.87)**	**<0.001**	**1.54 (1.12–2.11)**	**0.007**
HIV status	At risk	Reference	—	—	—
	Living with HIV	**1.33 (1.12–1.57)**	**0.001**	1.12 (0.93–1.35)	0.224
	Missing/unknown	**1.70 (1.29–2.25)**	**<0.001**	1.27 (0.94–1.71)	0.118
Lubricant used most	Water based	Reference	—	—	—
	Other lubricants	1.04 (0.85–1.27)	0.712	1.06 (0.87–1.30)	0.566
	No lubricant use	**0.56 (0.41–0.75)**	**<0.001**	**0.71 (0.52–0.97)**	**0.033**
	Missing/unknown	0.80 (0.62–1.02)	0.069	0.95 (0.73–1.23)	0.673
Transactional sex	No	Reference	—	—	—
	Yes	**1.22 (1.05–1.43)**	**0.010**	1.14 (0.97–1.35)	0.114
	Missing/unknown	0.78 (0.31–1.92)	0.583	0.97 (0.38–2.46)	0.944
Casual sexual partners	None	Reference	—	—	—
	1	1.25 (0.93–1.68)	0.142	1.23 (0.92–1.65)	0.171
	2–4	**1.72 (1.34–2.20)**	**<0.001**	**1.74 (1.35–2.26)**	**<0.001**
	5 or more	**2.07 (1.61–2.66)**	**<0.001**	**2.15 (1.62–2.85)**	**<0.001**
	Missing/unknown	1.12 (0.59–2.11)	0.728	1.55 (0.79–3.03)	0.203
Main sexual partners	None*	Reference	—	—	—
	1	0.93 (0.75–1.15)	0.505	1.04 (0.84–1.29)	0.704
	2–4	1.17 (0.94–1.46)	0.161	**1.33 (1.06–1.66)**	**0.012**
	Five or more	0.84 (0.54–1.30)	0.435	1.02 (0.66–1.58)	0.943
Anal sex position	Only insertive	Reference	—	—	—
	Only receptive	1.07 (0.86–1.35)	0.536	0.95 (0.74–1.22)	0.675
	Both insertive and receptive	1.17 (0.96–1.41)	0.114	1.00 (0.82–1.22)	0.998
	Missing/unknown	0.81 (0.38–1.70)	0.576	1.03 (0.45–2.33)	0.945

Robust Poisson regression with generalized estimating equations was used to estimate risk ratios and 95% confidence intervals for prespecified factors potentially associated with condom failure, defined as self-reported breakage or slippage in the last month among participants who reported anal sex with male partners in that same time frame. Data from all available outcome assessments were included in statistical models, including the enrollment visit and follow-up visits at 3, 9, and 15 months. All listed variables were included in the adjusted models.

Statistically significant risk ratios ($P < 0.05$) are shown in bold.

*Participants with missing/unknown data were included in the reference category.

TABLE 3. Factors Associated With Condom Failure During Anal Sex With a Man in the Preceding Month, Subgroup Analyses by Gender Identity

		Cisgender Men		Transgender Women		Nonbinary/Other	
Characteristic	**Category**	**RR**	**aRR**	**RR**	**aRR**	**RR**	**aRR**
Visit	Enrollment	Reference	—	—	—	—	—
	3 mo	1.11 (0.92–1.34)	1.19 (0.94–1.51)	1.11 (0.92–1.34)	**2.03 (1.12–3.67)**	1.11 (0.92–1.34)	2.00 (0.92–4.33)
	9 mo	1.17 (0.94–1.45)	1.25 (0.96–1.64)	1.17 (0.94–1.45)	**2.47 (1.26–4.83)**	1.17 (0.94–1.45)	1.69 (0.78–3.69)
	15 mo	1.11 (0.88–1.40)	1.21 (0.91–1.61)	1.11 (0.88–1.40)	1.85 (0.90–3.81)	1.11 (0.88–1.40)	2.39 (0.99–5.76)
Age	≤21 yrs	Reference	—	—	—	—	—
	22–30 yrs	1.16 (0.93–1.44)	1.06 (0.84–1.34)	0.75 (0.49–1.17)	0.74 (0.49–1.11)	1.27 (0.65–2.49)	1.09 (0.51–2.29)
	>30 yrs	0.85 (0.60–1.20)	0.93 (0.63–1.37)	0.93 (0.39–2.20)	0.74 (0.35–1.53)	2.14 (0.96–4.75)	2.10 (0.79–5.58)
Education	Junior secondary or less	Reference	—	—*	—*	—*	—*
	Senior secondary	**1.99 (1.25–3.19)**	1.29 (0.79–2.12)	2.70 (0.88–8.27)	1.80 (0.57–5.70)	0.60 (0.25–1.41)	0.75 (0.29–1.91)
	Higher than senior secondary	**2.17 (1.35–3.49)**	1.34 (0.80–2.24)	2.55 (0.80–8.10)	1.75 (0.54–5.64)	0.54 (0.21–1.36)	0.52 (0.18–1.52)
	Missing/unknown	**3.48 (1.07–11.36)**	2.12 (0.89–5.02)	—	—	—	—
Marital status	Single/never married	Reference	—	—†	—†	—*	—*
	Married/living with a woman	**0.46 (0.26–0.81)**	**0.57 (0.33–0.99)**	1.10 (0.56–2.15)	0.90 (0.45–1.78)	0.55 (0.08–3.88)	0.30 (0.03–3.02)
	Living with a man	1.10 (0.57–2.12)	0.87 (0.43–1.75)	—	—	1.09 (0.20–5.92)	0.63 (0.07–6.03)
	Divorced/other	0.69 (0.35–1.36)	0.72 (0.36–1.46)	—	—	0.84 (0.20–3.46)	0.79 (0.26–2.37)
	Missing/unknown	**1.87 (1.23–2.86)**	**1.89 (1.14–3.14)**	—	—	—	—
Religion	Christian*	Reference	—	—	—	—	—
	Muslim	**0.58 (0.45–0.76)**	**0.69 (0.52–0.92)**	**0.55 (0.31–0.98)**	0.67 (0.36–1.24)	0.81 (0.38–1.72)	0.68 (0.31–1.52)
	None/other	0.60 (0.16–2.30)	0.57 (0.15–2.22)	—‡	—‡	—‡	—‡
Internet use	Never*	Reference	—	—	—	—	—
	≤ 3 times per week	**1.72 (1.18–2.52)**	1.25 (0.84–1.86)	2.20 (0.77–6.27)	1.46 (0.53–4.05)	2.06 (0.64–6.66)	2.54 (0.88–7.35)
	Almost every day	**2.07 (1.49–2.87)**	**1.45 (1.02–2.07)**	**3.03 (1.15–7.99)**	1.80 (0.68–4.82)	1.60 (0.54–4.75)	2.21 (0.68–7.21)
HIV status	At risk	Reference	—	—	—	—	—
	Living with HIV	**1.26 (1.05–1.53)**	1.08 (0.88–1.33)	1.47 (0.87–2.51)	1.04 (0.58–1.86)	1.49 (0.80–2.78)	1.14 (0.58–2.24)
	Missing/unknown	**1.53 (1.09–2.15)**	1.16 (0.81–1.65)	**2.02 (1.05–3.86)**	1.70 (0.80–3.61)	2.26 (0.91–5.59)	1.28 (0.45–3.65)
Lubricant used most	Water based	Reference	—	—	—	—	—
	Other lubricants	**1.04 (0.84–1.30)**	1.07 (0.86–1.34)	1.11 (0.62–1.98)	1.08 (0.66–1.78)	0.95 (0.46–1.96)	0.88 (0.46–1.71)
	No lubricant use	**0.51 (0.36–0.73)**	**0.62 (0.43–0.89)**	0.67 (0.32–1.41)	1.13 (0.53–2.43)	1.17 (0.53–2.57)	1.78 (0.76–4.17)
	Missing/unknown	0.75 (0.56–1.00)	0.87 (0.64–1.18)	1.30 (0.77–2.21)	**1.92 (1.08–3.39)**	0.75 (0.32–1.74)	1.03 (0.39–2.68)
Transactional sex	No	Reference	—	—*	—*	—	—
	Yes	1.13 (0.95–1.35)	1.08 (0.89–1.30)	**1.55 (1.03–2.32)**	1.42 (0.89–2.28)	1.41 (0.81–2.48)	1.23 (0.67–2.27)
	Missing/unknown	0.67 (0.23–1.97)	0.90 (0.31–2.60)	—	—	3.30 (0.85–12.75)	**7.94 (2.09–30.15)**
Casual sexual partners	None	Reference	—	—	—	—	—
	1	1.29 (0.93–1.77)	1.27 (0.92–1.76)	1.18 (0.42–3.31)	0.98 (0.38–2.56)	0.91 (0.33–2.52)	0.93 (0.29–3.03)
	2–4	**1.72 (1.30–2.28)**	**1.78 (1.33–2.38)**	1.63 (0.81–3.29)	1.39 (0.67–2.90)	1.63 (0.70–3.79)	1.88 (0.84–4.22)
	5 or more	**1.93 (1.45–2.57)**	**1.96 (1.42–2.71)**	**2.18 (1.14–4.15)**	**2.30 (1.05–5.03)**	**2.69 (1.15–6.29)**	**3.56 (1.56–8.15)**
	Missing/unknown	0.82 (0.36–1.90)	1.06 (0.41–2.73)	1.29 (0.28–5.88)	0.91 (0.35–2.32)	3.21 (0.93–11.09)	3.05 (0.74–12.63)
Main sexual partners	None	Reference	—	—	—	—	—

TABLE 3. (*Continued*) Factors Associated With Condom Failure During Anal Sex With a Man in the Preceding Month, Subgroup Analyses by Gender Identity

Characteristic	Category	Cisgender Men		Transgender Women		Nonbinary/Other	
		RR	aRR	RR	aRR	RR	aRR
	1	1.03 (0.80–1.32)	1.15 (0.90–1.48)	**0.50 (0.30–0.83)**	**0.59 (0.35–0.99)**	1.30 (0.59–2.84)	1.65 (0.77–3.51)
	2–4	1.22 (0.94–1.57)	**1.43 (1.11–1.85)**	0.77 (0.46–1.29)	0.88 (0.51–1.53)	1.58 (0.65–3.85)	2.03 (0.84–4.87)
	5 or more	1.12 (0.72–1.75)	1.46 (0.92–2.31)	0.14 (0.02–1.08)	0.14 (0.02–1.05)	—§	—§
Anal sex position	Only insertive	Reference	—	—*	—*	—	—
	Only receptive	1.03 (0.79–1.34)	1.02 (0.78–1.34)	0.86 (0.39–1.91)	0.81 (0.39–1.67)	1.35 (0.46–3.90)	1.36 (0.45–4.14)
	Both insertive and receptive	1.10 (0.89–1.34)	0.98 (0.79–1.22)	1.11 (0.52–2.41)	1.00 (0.48–2.10)	1.83 (0.69–4.82)	1.63 (0.65–4.05)
	Missing/unknown	0.66 (0.26–1.66)	1.07 (0.37–3.08)	—	—	3.77 (0.87–16.33)	3.06 (0.67–14.04)

Subgroup analyses were performed that restricted the study population to (1) cisgender men; (2) TGW; and (3) participants who reported nonbinary or other gender identity. Robust Poisson regression with generalized estimating equations was used to estimate risk ratios and 95% confidence intervals for prespecified factors potentially associated with condom failure, defined as self-reported breakage or slippage in the last month among participants who reported anal sex with male partners in that same time frame. Data from all available outcome assessments were included in statistical models, including the enrollment visit and follow-up visits at 3, 9, and 15 months. All listed variables were included in the adjusted models.

Statistically significant risk ratios ($P < 0.05$) are shown in bold. To enable convergence of statistical models, some categories were collapsed or dichotomized as noted.

*Participants with missing/unknown data were included in the reference category.

†For the TGW subgroup, marital status was dichotomized with a reference group of "single/never married" compared against all other participants.

‡No participants in the TGW or nonbinary/other subgroups reported a religion of "none/other."

§For the nonbinary/other subgroup, participants with 5 or more main sexual partners were included in the "2 to 4" category, effectively making this category "2 or more."

nonsignificant trend toward greater risk of condom failure at the final visit. Increased risk of condom failure was observed only among participants with missing data on transactional sex with men and 5 or more casual partners.

Across all gender identity subgroups, increased number of casual sexual partners was associated with increased risk of condom failure. Lubricant usage was not consistently associated with condom failure; cisgender MSM who did not use lubricant had the lowest risk of condom failure, whereas this was associated with a nonsignificant trend toward greater risk of condom failure among TGW and nonbinary/other participants. TGW with missing data on lubricant use had significantly higher risk of condom failure than TGW who used water-based lubricants.

DISCUSSION

In this study, we found that more than 1 in 7 participants who had recently used condoms during anal sex with male partners experienced condom failure. Estimation of condom use and failure rates during anal sex across studies is beset with methodological problems because studies have used a wide variety of measurement methods, and the duration of recall has been inconsistent.[36] Most prior studies were cross-sectional and the populations surveyed have differed in important characteristics, including age, gender, socioeconomic status, sexual orientation, and geographical location. A comprehensive review reported a range of condom breakage during anal sex of 0.5%–6.0% and slippage of 3.8%–5.0%.[7] There are also differences by sexual positioning; one survey estimated total failure at 2.7% for receptive anal intercourse and 3.3% for insertive anal intercourse.[37] An online survey of 9005 US MSM found a failure rate of 4.0% within the past 12 months.[6] However, in a carefully conducted randomized crossover trial that employed daily coital diaries, the rate of clinical condom failure during anal sex was less than 1%.[38] Despite the difficulties in directly comparing studies, condom failure was much more common in our study than would be expected based on prior studies. Stigma and marginalization of sexual and gender minority communities in Nigeria may lead to practices that encourage condom failure, such as sex in locations that are not conducive to proper condom use,[39] rushed sex[40] with casual partners that may complicate condom use and cause slippage through erection loss,[41] and use of improvised lubricants.[42] Further research is needed to fully explain the high rates of condom failure observed among the Nigerian MSM, TGW, and other gender minorities observed in our study.

Previous work by our group has demonstrated that engagement in care at a trusted community clinic increased the uptake of condoms and CCL.[43] Availability and uptake are necessary but not sufficient for effective condom use, which also requires that a condom is used throughout the sex act without breakage or slippage. Disappointingly, the risk of condom failure did not decrease after enrollment into a study that included ongoing education about condom use and provision of free condoms with compatible lubricants. In fact, condom failure increased among TGW. This perhaps suggests a plateauing of the effect of safer sex messages or "message fatigue" in the majority of participants. It is also possible that increased uptake of condoms at later visits by new and inexperienced users contributed to the observation of increased condom failure particularly in TGW. In contrast, cisgender MSM did not experience increased condom failure over time. This observation may be explained by greater preenrollment use of condoms, greater condom use experience, and less likelihood of failure compared with new users. In addition, it could be explained by the cumulative effect of

continuous education and condom provision by the study team at follow-up visits. However, prior studies have shown increased condom failure over time among MSM[44,45] that may partially reflect underlying temporal changes in condom use for anal sex.[44–46] In our study, however, the increase in condom failure over time was driven by the TGW participants. Future studies to address predictors of both condom use and failure in TGW are needed to better understand these phenomena.

In all groups, participants with greater numbers of casual sexual partners experienced more condom failure. For TGW, the risk of condom failure was reduced by having a single main partner. These complementary findings suggest that multiple sexual partnerships increase the risk of condom failure even if the per-act failure rate is low. However, other studies have demonstrated that greater experience with condom use is associated with less failure.[47] Therefore, in our study, the context in which sex took place may have been an unmeasured confounder, especially if sex with multiple casual partners was rushed, furtive and without ready access to CCL.

Several other relationships emerged with condom failure in the group overall and specifically among cisgender men, including protective associations with Muslim religion and being married to or living with a woman. The association of Muslim religion with lower risk of condom failure is likely because of being circumcised.[48] There were significant associations with higher Internet use. Interestingly, neither age, HIV status, nor sexual positioning were associated with condom failure in the multivariable model. Younger age has been previously associated with a number of adverse health outcomes in our cohort, including increased risk of HIV and other STIs, but this relationship does not appear to be mediated by condom failure.[49] It is possible that perceptions of condom failure were influenced by sexual position, particularly for the receptive partner who would be unable to directly observe slippage and from whom breakage might be hidden. Such perceptions may have resulted in underreporting of condom failure. An unexpected finding was that no lubricant use was associated with less condom failure than water-based lubricant use in the whole group and in cisgender men. The mechanism underlying this finding is not clear; it is possible that those using water-based lubricants had more sex acts and were therefore more likely to report failure, that CCL was used too sparingly or that its use resulted in a false sense of security and promoted prolonged anal sex activity without reapplication. The individuals enrolled in TRUST/RV368 are part of a community with a very high and sustained incidence of HIV and a large burden of other STIs[50,51] in whom proper and consistent condom use is critical.

Given these data, the acceptability and feasibility of other HIV/STI prevention measures in those with higher number of casual sexual partners should be explored. Data in Ugandan MSM suggest that there are barriers to condom use in addition to those around knowledge or access, these include societal norms,[30] partner and relationship issues, and drug and alcohol consumption[6,42] that were not addressed in this analysis. There are also factors related to self-efficacy, risk perception,[27] stigma experience,[28] pleasure,[21] and condom fit[52] that are important when taking a holistic approach to condom use, success, and failure. Suitable interventions tailored for individuals at the greatest risk of condom failure may reduce HIV/STI acquisition and onward transmission. Measures could include different-sized condoms, HIV pre- and postexposure prophylaxis, and other STI prevention strategies such as human papillomavirus and hepatitis B immunization.

The strengths of the study include large sample size, longitudinal design, partnership with trusted community organizations and the inclusion of TGW, and nonbinary and other gender identities that are historically underrepresented or conflated with MSM.[53,54] Many of the differences seen in our study population were driven by cisgender MSM who contributed the majority of participants; whereas some similar trends were observed among TGW and participants with nonbinary or other gender identity, relatively lower sample sizes in these groups limited our power to observe statistically significant effects. Questions about condom failures were restricted to the month before each study visit partially to reduce the potential for recall bias, but this limited generalizability to more distant behaviors and condom failure patterns. The study did not capture the number of sex acts, so condom failure could not be calculated per anal sex act or compared with other studies that measured condom failure in that way. Another potential limitation was the inclusion of variables in statistical models that could have independent effects while simultaneously acting as mediators of other variables. The aims of these analyses were exploratory, not hypothesis driven, and focused on proximate cause mediators because these might generate future hypotheses resulting in interventions.

CONCLUSIONS

The data presented argue that provision of condoms, CCL, and education to sexual and gender minority population in friendly settings are insufficient measures to reduce condom failure to comparable levels seen in other studies. Differences exist between MSM, TGW, and nonbinary or other gender identities that require further study to inform differentiated care delivery and the development of specific interventions to decrease condom failure. Novel ways of planning health services are required to reduce the risk of HIV and other STIs by increasing condom use and to expand the repertoire of prevention methods to those unable to successfully navigate condoms. A shift from a solely disease-focused paradigm to a more nuanced one embracing pleasure, comfort, fit,[55] partner attitudes, and motivation[56,57] may be necessary to better advocate consistent condom use and reduce transmission of HIV and other STIs.

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