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No evidence of bias in sexual partnership corroboration by race and ethnicity among a diverse cohort of young MSM and transgender women

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Abstract

Black MSM continue to experience disproportionately high HIV incidence rates relative to their white peers. Yet, Black MSM do not report higher levels of sexual risk behavior and contextual factors such as access to care and sexual networks only partially explain these disparities. However, risk misclassification could help explain this paradox, if measurement biases systematically underestimate sexual risk behavior among Black MSM relative to their peers. The current study examines variation in sexual partnership corroboration in the RADAR study, a large and diverse cohort of young MSM and transgender women. Network data was elicited regarding all sexual partners in the prior six months including instances where participants reported other participants as sexual partners. Using these data, anal and condomless anal sex partners were separately examined using a series of exponential random graph models (ERGMs) to estimate the rate of corroboration of sexual connections between participants and examine if this parameter varies by race/ethnicity. For both types of behavior, providing separate estimates for corroboration across race/ethnicity groups reduced model fit and did not significantly vary across groups. Accordingly, we found no evidence of measurement bias by race/ethnicity in the current data. However, overall rates of corroboration (41.2 – 50.3%) were low suggesting substantial levels of measurement error. Accordingly, it is vital that researchers continue to improve upon methods to measure risk behavior in effort to maximize their validity. We discuss the implications of these findings including potential alternative causes of risk misclassification (e.g., sampling bias) and future directions to reduce measurement error.

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Ethical approval: All procedures performed in this study were in accordance with the ethical standards and approved by our institutional review board.

Informed consent: Informed consent for participants 18 years or older and informed assent for participants ages 16–17 years old was obtained from all individuals included in the study. A waiver of parental consent was obtained from the institutional review board for participants 16 to 17 years old.

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Keywords

racial disparities; men who have sex with men; sexual networks; measurement bias

INTRODUCTION

Extensive racial and ethnic disparities in HIV transmission continue to persist in the United States both generally (Chapin-Bardales, Rosenberg, & Sullivan, 2017) and specifically among men who have sex with men (MSM; Rosenberg et al., 2018). Accordingly, understanding these disparities, identifying contributing factors, and designing interventions to reduce them remain a top priority for HIV research (Beyrer et al., 2016).

These substantial and persistent disparities do not reflect higher rates of self-reported risk behavior among Black MSM (Millett, Flores, Peterson, & Bakeman, 2007; Millett et al., 2012; Mustanski, Birkett, Kuhns, Latkin, & Muth, 2015; Mustanski et al., 2019). Furthermore, while higher HIV prevalence among African Americans and Hispanics in the US certainly contributes to the persistence (Xia, Braunstein, Wiewel, Hadler, & Torian, 2017), prevalence differences alone cannot sustain these disparities indefinitely, even with high rates of assortative (i.e., same race/ethnicity) sexual partnerships (Goodreau et al., 2017). In an attempt to account for this paradox, a large body of research has examined structural and contextual factors (Adimora & Schoenbach, 2005) that may help explain these disparities such as: access to HIV testing and care (Maulsby et al., 2014), neighborhood environments (Nunn et al., 2014; Sullivan et al., 2014), and sexual networks (Birkett, Kuhns, Latkin, Muth, & Mustanski, 2015; Krivitsky & Morris, 2017; Morris, Kurth, Hamilton, Moody, & Wakefield, 2009; Mustanski et al., 2019). These factors clearly play a role in racial disparities of HIV (Maulsby et al., 2014) but they are unlikely to fully explain the large disparities witnessed across Black MSM and their peers.

For example, one modeling study of MSM (Goodreau et al., 2017) found that the aggregate effect of multiple sources of racial disparities (i.e., biomedical determinants, HIV care, HIV status disclosure, and behavior) could only account for 55% of the difference between Black and White MSM. Furthermore, estimated HIV prevalence was roughly half of the true prevalence among Black MSM unless they were assigned behavioral values of their White peers (i.e., assuming greater levels of risk behavior than reported by Black MSM). The authors suggest that under-estimation of risk behavior (i.e., risk misclassification) among black participants could partially explain HIV disparities. Accordingly, although there is substantial evidence that Black MSM do not report higher rates of risk behavior (Millett et al., 2007), risk misclassification could mask true differences across groups if systematic measurement bias underestimates risk among Black MSM.

The veracity of this hypothesis has also been partially supported in a small number of studies among MSM finding that Black participants were more likely to underreport drug use when comparing participant self-report to drug screens (Li, Janulis, & Mustanski, 2019; White et al., 2014). Importantly, Hernandez-Romieu et al. (2016) found Black MSM had lower levels of agreement relative to White MSM in reports of condomless anal sex but found no difference across groups in concordance of reporting any anal sex. Furthermore,

another study (Clerkin, Newcomb, & Mustanski, 2011) found that Black participants report risk behavior with non-Black partners at similar rates to non-Black participants reporting risk behavior with Black partners, indicating a symmetry that does not suggest bias in reporting of risk behavior. Accordingly, the evidence remains unclear if there are differential rates of reporting sexual risk behavior across race and ethnicity groups among MSM and future work is required (Hernandez-Romieu et al., 2015).

Given the lack of a gold standard to compare against self-reported sexual risk behavior, many studies focus on reporting agreement in sexual behavior between sexual partners (Sanchez et al., 2016). Although most studies comparing reports of sexual behavior agreement are restricted to couples (Darbes, Chakravarty, Neilands, Beougher, & Hoff, 2014; J. W. Mitchell, 2014), a network approach is increasingly used to allow for additional nuance in analysis by comparing a single participant's report against many potential named partners who also participated in the study (Hernandez-Romieu et al., 2016; Phillips II, Janulis, Mustanski, & Birkett, 2017).

The current analysis uses data from a large cohort study of young men who have sex with men and transgender women (YMSM-TW) that captured detailed information regarding recent sexual partnerships and includes a large number of participants reporting sexual partnerships with other cohort members. As we would expect lower rates of corroboration among groups that systematically underreport sexual behavior, we leverage this dataset to examine the rate of corroboration across race/ethnicity groups. We are particularly interested in differences in rates of corroboration among White and Black participants as risk misclassification among Black YMSM-TW may help explain observed racial disparities in HIV. Furthermore, we examine anal sexual partnerships as well as condomless anal sexual partnerships as previous research suggests rates of corroboration may differ across these two types of behavior (Hernandez-Romieu et al., 2016). We examine these questions utilizing a modeling approach (exponential random graph models - ERGMs) that accounts for the inherent dependency within these data and provide accurate estimates of corroboration controlling for other structural factors (e.g., variation in number of named partners by race/ethnicity groups).

METHOD

All data for this analysis is from the RADAR study, a longitudinal cohort of YMSM-TW in Chicago designed to investigate multilevel drivers of substance use and HIV (Mustanski et al., 2019). Participants were recruited for the study in three ways: (1) involvement in a prior cohort of YMSM and/or lesbian, gay, bisexual, or transgender (LGBT) youth; (2) through being a serious partner of a RADAR cohort member; or (3) through peer recruitment by a RADAR cohort member. Recruitment for previous studies was accomplished through modified respondent-driven sampling, venue-based recruitment, and online recruitment. Regardless of recruitment source, all cohort members were between 16 and 29 years of age, born male, English speaking, and either reported a sexual encounter with a man in the previous year or identified as gay or bisexual. The current study used data from the beginning of data collection (March 2015) through October 2017.

Network Data

Data on sexual partners was captured during an interviewer-assisted touchscreen network protocol (netCanvas-R) designed to elicit information on social, drug use, and sex partners during the prior 6 months (Hogan et al., 2016). Participants provided full name data on all network members including sexual partners. For each sexual partner, participants were asked to identify the first and last date of sex during the past six months using a calendar widget as well as indicating type of sex (i.e., vaginal or anal), the number of sex acts, and the number of condomless sex acts.

Given that full name data were collected on all network members, it was possible to identify individuals (i.e., participants or non-participants) that appeared in more than one network interview. For all data collected from the beginning of data collection through October 2017, duplicate individuals were manually identified by two human coders using first and last name sort along with associated demographic and neighborhood data, with disagreements resolved by a third coder. Out of 29,385 potentially unique individuals, we identified 1,818 who were named in multiple networks, appearing between 2 and 10 times. The consolidated network dataset with 23,205 unique individuals was used to identify sexual partnerships between participants using first and last sex dates, as described below.

Participants

Inclusion criteria for the current analysis depended on the ability to corroborate sexual partnership reports (i.e., anal sex and/or condomless anal sex). Participants must have reported another cohort member as an anal sex partner and that partner must have completed a study visit within the timeframe to potentially corroborate the partnership. This was operationalized by examining each reported sexual partnership (and condomless sexual partnership) with another participant and examining if the corresponding sexual partner completed a study visit after the first date of reported sex and before 6 months after the date of last reported sex. If the reported sexual partner completed a study visit within this timeframe, they had the potential to corroborate this sexual partnership report and were therefore included in the study (See Figure 1).

Using this method, there were 279 instances of a participant naming another participant as a sexual partner among which 255 were able to be corroborated. Participants were roughly evenly distributed among three race/ethnicity groups with 31.1% identifying as Black non-Hispanic, 29.6% identifying as Hispanic, and 28.0% identifying as White non-Hispanic, with a sizable minority identifying with none of these groups - 11.3% (i.e., Other/Multiple). These participants had a mean age of 20.9 (SD = 3.0). Finally, of the 279 instances of a participant naming another participant, 159 involved a condomless sexual partnership.

Analysis

First, descriptive analysis was used to examine the proportion of corroborated sexual partnerships by the race/ethnicity of both partners. Chi-square test were used to see if the proportion of corroborated partnerships varies across groups. Each analysis was performed separately for the network of any sexual partnership as well as a condomless partnership.

Second, we used ERGMs to formally model the likelihood of corroborating a sexual partnership and if this likelihood varied by race. ERGMs are a class of models designed to examine selection effects (i.e., who is connected in a network) that can explicitly account both node attributes (e.g., race) and network characteristics such as tie corroboration (Robins, Pattison, Kalish, & Lusher, 2007). In contrast to traditional methods, such as logistic regression, ERGMs provide standard errors for these parameters that account for the inherent dependency between individuals within a network. Accordingly, these models allow for examining the unique parameter estimate for structural features while also controlling for the underlying structure of the network such as differences in the number of connections by node attribute. In the current analysis, for each network type, we started with a model that only provided a single parameter for corroborating a sexual tie, using the “mutual” parameter, and then expanded the model to provide a separate term for corroborating a sexual tie for each race/ethnicity group. Furthermore, we controlled for the variation by race for in-degree (i.e., likelihood to name a sexual partner), out-degree (i.e., likelihood of being named a sexual partner), and homophily (i.e., likelihood of same race/ethnicity sexual partnerships) in all models.

We tested if corroboration varied by race/ethnicity in two ways. First, we examined if the models providing a separate estimate for the corroboration term improved model fit. Improvement of model will fit was evaluated by examining the Bayesian information criterion (BIC) across the two models, with lower values indicating better fit. Second, the effect of providing separate parameter for tie corroboration by race was directly examined using specific comparisons between each group’s parameter estimate, examining the comparison between White and Black participants as our main comparison of interest. Overall goodness of fit was also evaluated by comparing simulated network in-degree and out-degree against the features of the observed network as well as examining each model for degeneracy (Hunter, Handcock, Butts, Goodreau, & Morris, 2008).

RESULTS

Descriptive analysis of the percentages of corroborated partnerships indicated little variability of corroboration by race/ethnicity (Table 1). For any sexual partnership, slightly less than half of reported partnerships were corroborated (41.2%) and there was no significant difference across racial/ethnic partnership types ($\chi^2 = 2.38$, $p = 0.987$). Similarly, 50.3% of condomless anal sex partnerships were corroborated and again we found no significant variation in corroboration by race/ethnicity pairings ($\chi^2 = 1.73$, $p = 0.997$).

For the ERGMs of any sexual partnership (Table 2), there was a significant effect for corroborating a sexual partnership (estimate = 6.64, $p < 0.001$). However, the second model providing a separate parameter by race/ethnicity did not improve model fit ($BIC_{M1} = 3817$; $BIC_{M2} = 3848$), and the separate parameter estimates for each race/ethnicity group did not significantly vary. For example, while Black individuals indicated the highest level of corroboration (estimate = 3.50, $SE = 0.21$) and White individuals indicated the lowest level of corroboration (estimate = 3.21, $SE = 0.19$), this difference was not statistically significant ($z = 1.02$, $p = 0.309$), nor was any other specific comparison.

Similar patterns for condomless anal sex partnerships were also observed. For example, there was a significant effect for corroborating a partnership (estimate = 6.60, $p < 0.001$). However, the second model did not improve fit ($BIC_{M1} = 2236$; $BIC_{M2} = 2271$) and minimal variation was observed across the race/ethnicity specific estimates. While the estimate for Latino individuals was lowest (3.23, $SE = 0.25$) and the estimate for Other individuals was highest (3.74, $SE = 0.56$), again there was no significant differences between any specific comparisons, including between the estimates for Black and White participants ($z = -0.136$, $p = 0.395$).

DISCUSSION

The current study found no evidence of bias in reporting sexual partnerships by race/ethnicity. That is, providing separate estimates by race/ethnicity for corroborating partnerships did not increase the fit of the model for either network nor did these separate estimates significantly vary across groups. Therefore, we find no evidence of underreporting of sexual partnerships among racial/ethnic minority YMSM-TW that would support the hypothesis that racial disparities among Black MSM can be explained by underreporting of risk behavior among these individuals. These results contrast with a recent study (Hernandez-Romieu et al., 2016) of racial differences in reporting sexual risk behavior that found Black partnerships had lower levels of agreement regarding condomless anal sex within the last 12 months compared to White partnerships. Some of this discrepancy may be related to differences between the two studies. For example, Hernandez-Romieu et al. (2016) examined concordance of specific sexual risk behavior among the subset of dyads that had already successfully corroborated the relationship (i.e., both participants reported a partnership) while the current analysis examined all possible corroborations among participants who named another participants as a sexual partner. Nonetheless, these contrasting results suggest future studies should continue to explore the potential for differences in risk misclassification by race/ethnicity. Exploring the measurement characteristics and populations for which such misclassification may occur is particularly important for understanding how these differences could impact our understanding of racial disparities in HIV.

Despite finding little evidence of bias in measurement by race/ethnicity, we did find substantial measurement error in the reporting of both types of behavior. Less than half (41.0%) of any anal sexual partnerships and only 50.3% of condomless anal partnerships were corroborated in the current dataset. Although these rates are similar to previously published rates of corroboration (Hernandez-Romieu et al., 2016; Phillips II et al., 2017), the results suggest major error remains in the capture of sexual partnership data, and substantial room for improvement in these methods is required. For example, follow-up prompts and the use of multiple “name generator” questions has been shown to reduce forgetting in sexual partner recall (Brewer, 2000). Furthermore, the use of smartphones and mobile applications to capture more nuanced data regarding sexual behavior provide both advantages and challenges (Dietrich et al., 2018; Swendeman, Comulada, Ramanathan, Lazar, & Estrin, 2015) that should be carefully studied to improve the accuracy of measuring sexual behavior.

Furthermore, corroboration of partnerships is only a single method for evaluating the accuracy of self-reported sexual risk behavior. For example, the use of biomarkers for evaluating self-reported risk behavior is increasingly common (DiClemente, 2016; Langhaug, Sherr, & Cowan, 2010). Unfortunately, racial and ethnic minority MSM also experience large disparities in the most common biomarkers such as chlamydia and gonorrhea (Sullivan et al., 2014). Therefore, the use of these biomarkers as objective measures of risk across groups is confounded by the same contextual influences that may impact risk for HIV (e.g., sexual networks and access to care). Future research into alternative biomarkers that may be independent of such confounding factors would be particularly useful (DiClemente, 2016).

In addition, the absence of measurement bias does not mean that risk misclassification may not contribute to unexplained racial disparities in HIV. Namely, sampling bias could lead to risk misclassification if, for example, Black YMSM-TW who decide to participate are systematically different than those that do not, but this bias is not observed among White YMSM-TW. Sampling bias has been extensively studied in different-sex sexual partners given the large disparities between the number of differentsex partners reported by men and women (K. R. Mitchell et al., 2018). This discrepancy has been partially explained by the absence of high degree female participants (e.g., sex workers) in most samples that systematically underrepresents the number of sex partners reported by females (Brewer et al., 2000). Future studies should explore the potential that similar sampling biases could confound the measurement of risk behavior across race/ethnicity groups among MSM-TW.

Beyond those discussed above, the current study had a number of important limitations. First, it is unclear how these findings can be interpreted against more traditional forms of sexual risk behavior (i.e., when not naming specific sexual partners). It is possible that individuals may report such behavior differently when not asked for in depth details regarding partners. Second, while large and diverse, the sample used for this data is neither representative nor geographically diverse (i.e., all data was collected in Chicago). Accordingly, future work is required to examine how measurement bias may differ in other regions or in more representative samples. Third, data on sexual partners was collected during an interviewer assisted process that may introduce error into the data collection process (Schroder, Carey, & Venable, 2003), particularly when providing full names. Fourth, reporting on all sexual behavior over a 6-month interval is inherently complex and may help explain the large measurement error we witnessed in this study. Future studies that examine the reporting of sexual partnerships at shorter intervals and via different methods (e.g., computer assisted self-interviewing) would be useful to better understand how method effects could impact measurement bias across race/ethnicity groups. Fifth, accurate measurement of risk is more complex than the simple measurement used in this study (i.e., anal or condomless anal sex). The probability of infection for a given act depends on numerous factors such as positioning, serostatus of each partner, and the use of antiretroviral therapy or pre-exposure prophylaxis (Patel et al., 2014). Accordingly, bias across race and ethnicity in reporting these characteristics, knowledge of their own serostatus or biomedical status, and accuracy in perceiving these characteristics among their partners could substantially impact HIV disparities and should continued to be investigated in future work.

Despite these limitations, this study provides new insight into the exploration of measurement bias, a potential source of unexplained differences in HIV risk among racial and ethnic minority YMSM-TW. We found no evidence of such bias in the current sample using data from a large and diverse cohort and modern statistical tools to account for dependency within these data. However, large measurement error was observed and future studies should continue to critically examine self-reported sexual risk behavior with a particular focus on racial/ethnicity differences and the potential for sampling bias that may confound the measurement of risk behavior across groups. Finally, these findings also support the continued investigation of contextual and structural factors that contribute to the persistence of racial disparities in the absence of observed differences in individual risk behavior.

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Figure 1. Partnership reporting inclusion requirements.

Note. Figure represents the reporting of Participant A (at 0 Months) on one 3 month long partnership with Participant B and one 1.5 month long partnerships with Participant C. Solid lines represent the reported partnership period while the dotted lines represent the period during which the corresponding partner needed to make a study visit to be included in the analysis (i.e., anytime from the reported beginning of the partnership to 6 months following the reported end).

Table 1.

Percentage of corroborated partnerships by race/ethnicity composition

Race/Ethnicity of Both Partners	n (%) Corroborated	
	Anal Sex	Condomless Anal Sex
Black – Black	23 (46.9)	18 (51.4)
Black – Latino	9 (37.5)	5 (38.5)
Black – Other	5 (41.7)	5 (55.6)
Black – White	2 (66.7)	2 (66.7)
Latino – Latino	15 (36.6)	13 (50.0)
Latino – Other	3 (33.3)	2 (40.0)
Other – Other	2 (33.3)	2 (66.7)
Latino – White	15 (40.5)	13 (50.0)
Other – White	8 (42.1)	6 (50.0)
White – White	23 (41.8)	14 (51.9)
All	105 (41.2)	80 (50.3)
χ^2 Test	$\chi^2 = 2.38, p = 0.987$	$\chi^2 = 1.73, p = 0.997$

Table 2.

ERGM parameter estimates for any anal sexual partnership

	Model 1		Model 2	
	Estimate (SE)	p-value	Estimate (SE)	p-value
Edges (Intercept)	-9.73 (0.32)	< 0.001	-9.83 (0.34)	< 0.001
Mutual	6.64 (0.19)	< 0.001		
Black			3.50 (0.21)	< 0.001
Latino			3.22 (0.20)	< 0.001
Other			3.46 (0.39)	< 0.001
White			3.21 (0.19)	< 0.001
In-Degree	1.18 (0.21)	< 0.001	1.17 (0.21)	< 0.001
Black (Reference)				
Latino	0.56 (0.28)	0.048	0.38 (0.38)	0.311
Other	0.39 (0.33)	0.244	0.8 (0.29)	0.005
White	0.74 (0.28)	0.008	1.04 (0.32)	0.001
Out-Degree	2.00 (0.22)	< 0.001	2 (0.22)	< 0.001
Black (Reference)				
Latino	0.95 (0.30)	0.002	1.04 (0.32)	0.001
Other	1.06 (0.35)	0.003	1.08 (0.37)	0.004
White	0.77 (0.32)	0.016	0.85 (0.33)	0.010
Homophily				
Black	1.77 (0.27)	< 0.001	1.73 (0.27)	< 0.001
Latino	0.38 (0.24)	0.108	0.38 (0.24)	0.107
Other	0.26 (0.36)	0.468	0.25 (0.36)	0.484
White	0.98 (0.23)	< 0.001	1.01 (0.24)	< 0.001
BIC	3817		3848	

Note. In-Degree and Out-Degree represent the parameter for geometrically weighted in and out degree, respectively.

Table 3.

ERGM parameter estimates for condomless anal sex partnerships

	Model 1		Model 2	
	Estimate (SE)	p-value	Estimate (SE)	p-value
Edges (Intercept)	-11.28 (0.49)	< 0.001	-11.24 (0.51)	< 0.001
Mutual	6.60 (0.25)	< 0.001		
Black			3.24 (0.24)	< 0.001
Latino			3.23 (0.25)	< 0.001
Other			3.74 (0.56)	< 0.001
White			3.29 (0.26)	< 0.001
In-Degree	2.28 (0.32)	< 0.001	2.29 (0.32)	< 0.001
Black (Reference)				
Latino	0.17 (0.39)	0.670	-0.17 (0.63)	0.784
Other	0.13 (0.48)	0.791	1.09 (0.38)	0.005
White	1.11 (0.37)	0.003	1.13 (0.43)	0.008
Edges (Intercept)	3.10 (0.35)	< 0.001	3.1 (0.35)	< 0.001
Black (Reference)				
Latino	1.11 (0.41)	0.006	1.13 (0.43)	0.008
Other	1.90 (0.52)	< 0.001	1.79 (0.54)	0.001
White	0.57 (0.44)	0.194	0.52 (0.47)	0.273
Homophily				
Black	1.73 (0.31)	< 0.001	1.74 (0.31)	< 0.001
Latino	0.52 (0.27)	0.056	0.49 (0.28)	0.082
Other	0.21 (0.44)	0.639	0.20 (0.42)	0.627
White	0.63 (0.28)	0.026	0.67 (0.28)	0.017
BIC	2236		2271	

Note. In-Degree and Out-Degree represent the parameter for geometrically weighted in and out degree, respectively.