



A Person-Centered Approach to HIV-Related Protective and Risk Factors for Young Black Men Who Have Sex with Men: Implications for Pre-exposure Prophylaxis and HIV Treatment as Prevention

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Abstract

Although young Black men who have sex with men (YBMSM) are disproportionately affected by HIV, they may be more heterogeneous as a group than is typically appreciated. Thus, the present study used a person-centered data-analytic approach to determine profiles of HIV-related risk among YBMSM and whether these profiles could be distinguished by age, HIV status, and socioeconomic risk (i.e., socioeconomic distress). YBMSM ($N=1808$) aged 18 to 29 years completed a survey of sociodemographic characteristics, HIV status, and HIV-related behavioral and attitudinal factors (i.e., safer-sex self-efficacy, negative condom attitudes, being in difficult sexual situations, being in difficult sexual relationships, HIV treatment optimism, perceived HIV stigma). Latent profile analysis was used to identify HIV risk profiles and whether age, HIV status, and socioeconomic distress were associated with these profiles. Four profiles emerged: low-, medium-, and high-risk profiles, respectively, and a mixed profile characterized by a tendency to be in difficult sexual situations and relationships while also reporting high safer-sex self-efficacy and low negative attitudes toward condom use. Difficult sexual situations emerged as the key defining indicator of whether a profile reflected higher or lower risk. Younger age, being HIV-positive, and socioeconomic distress were associated with having a higher-risk profile. Given that unique risk profiles emerged that were differentially predicted by sociodemographic characteristics and HIV status, these findings have implications for tailoring interventions to the needs of different subgroups of YBMSM. Also, disempowering or risky sexual situations and relationships among YBMSM must be addressed.

Keywords Young Black men who have sex with men · HIV · Protective factors · Risk factors · Latent profile analysis

Introduction

In the United States (US), young Black men who have sex with men (YBMSM, under age 30) continue to be disproportionately affected by HIV. Although Black men who have sex with men (BMSM) comprise only 14% of all men who have sex with men (MSM) in the US, they represent approximately 37% of new infections among MSM [1, 2].

Racial disparities are particularly pronounced in the South compared to other regions of the US [3]. Among YBMSM, being under the age of 25 has been linked to greater HIV incidence and prevalence than being an older YBMSM [4, 5]. Additionally, YBMSM are disproportionately affected by socioeconomic stressors (e.g., lower income and education, unemployment) [6], which in turn are associated with late HIV testing [7], condomless anal intercourse [8, 9], non-adherence to pre-exposure prophylaxis (PrEP) and antiretroviral treatment (ART) [10], and HIV disease burden [11]. HIV-negative YBMSM are less likely than other groups to be prescribed, be informed about, or perceive having access to PrEP [12, 13]. HIV-positive YBMSM are less likely than others to be engaged in any step of the HIV continuum of care (i.e., HIV diagnosis, linkage to HIV care, ART adherence, achieving HIV viral suppression) [14–16]. A clearer understanding of potential protective and risk profiles based

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on key, HIV-related factors for both HIV-negative and -positive YBMSM may be helpful for informing prevention and intervention efforts with this health-disparity population.

YBMSM are not a monolithic group; an examination of their within-group heterogeneity has the potential to inform HIV prevention and treatment for YBMSM [17]. Specifically, a person-centered approach, as opposed to a variable-centered approach, may be needed to explore the different ways in which HIV-related protective and risk factors manifest based on different profiles or subgroups of YBMSM. Variable-centered approaches such as regression and path analysis focus on associations between variables [18, 19]. In contrast, person-centered approaches such as latent profile analysis seek to identify how different individuals or subgroups within a larger group (e.g., higher- versus lower-risk YBMSM) can be characterized by different combinations of variables (e.g., high scores on certain variables but low on others); they describe how group members differ in terms of indicators such as protective or risk factors [18, 19]. A person-centered approach can be combined with a variable-centered approach [19, 20] to examine what predictor variables are associated with having a higher- or lower-risk profile.

There are a number of potential HIV-related protective and risk factors that could be used to define person-centered profiles in order to identify subgroups of YBMSM who may benefit from uniquely tailored approaches. For example, the tendency to be in difficult sexual and relationship situations (e.g., being in a sexual situation with someone that one is afraid of losing, being in a sexual situation with someone who does not want to use a condom, being in sexual situations in which one or one's partner is high on alcohol or drugs) increases the risk of HIV transmission [8, 9]. Specifically, power dynamics driven by social hierarchies and stereotypes around masculinity, age, race or ethnicity, HIV status, and other factors affect the extent to which BMSM negotiate safer sex and HIV prevention practices such as condom use or seropositioning [21, 22] (i.e., having condomless anal intercourse with a partner of serodiscordant or unknown HIV status in a sexual position that reduces the biological risk of HIV transmission, such as the HIV-negative man performing the anal-insertive role and the HIV-positive man enacting the anal-receptive role) [23, 24]. A more masculine-presenting partner with untreated HIV may be expected to play the anal-insertive role, which would place the anal-receptive partner at greater biological risk of infection if no form of prophylaxis is used [25, 26].

Furthermore, YBMSM have reported a desire to establish trust and intimacy by allowing condomless anal intercourse as part of their goal of finding a long-term partner [22, 27]. Further, in the context a sexual situation or relationship, YBMSM may use alcohol or drugs in order to play sexual roles they do not prefer, such as the riskier anal-receptive

role, for a partner who prefers the anal-insertive role [21, 22]. In fact, difficult sexual or relationship dynamics may be the most important determining characteristic of HIV risk for BMSM, including YBMSM, as these dynamics determine whether some YBMSM feel a sense of agency or control [28, 29], whether they take the anal-receptive or anal-insertive role, or whether they give control or trust to their partner with respect to use of condoms or other forms of prophylaxis [8, 9, 21, 22].

Other psychosocial factors may be protective and, thus, related to a lower-HIV risk profile. For example, in a counseling intervention designed to enhance safer-sex self-efficacy (i.e., one's belief that one is able to engage in and negotiate safer-sex practices, such as condom use) and promote positive attitudes toward condom use, HIV-negative YBMSM increased their condom use [30]. However, given that BMSM are no more likely to engage in serodiscordant condomless sex than MSM of other racial or ethnic groups [6], the relevance of YBMSM's individual safer-sex self-efficacy or attitudes likely depends on their unique sexual risk profiles [31]. Another factor, perceived HIV stigma (i.e., one's concern that others hold negative attitudes toward people living with HIV) [32], may be associated with increased HIV risk and is a barrier to PrEP use, ART adherence, and disclosure of HIV status to potential partners [33–35].

Finally, HIV treatment optimism (i.e., belief that HIV treatment works well in terms of viral suppression and reduced HIV transmissibility) [36] has been found to be independently associated with increased condomless anal intercourse, and this association holds for BMSM [37, 38]. Although increased HIV treatment optimism is an important goal of HIV-prevention interventions for treatment as prevention (TasP; i.e., the suppression of HIV viral load via ART to prevent HIV transmission to others) for YBMSM [39], it may be informative to consider this factor when examining HIV risk [40]. More specifically, it is currently known that “Undetectable = Untransmittable,” (U = U; i.e., treated HIV-positive persons who are virally suppressed are effectively not at risk of transmitting HIV) [41, 42]. However, increased condomless anal intercourse may be problematic if (1) incorrect assumptions are made about one's own or one's partner's current status as undetectable and (2) there is a co-occurring sexually transmitted infection (STI), which increases the transmissibility of HIV and reduces the biological effectiveness of PrEP and TasP [43–45]. BMSM are disproportionately affected by both HIV and STIs [15, 46].

The Present Study

Although the incidence and prevalence of HIV among YBMSM as a group are relatively high, it is important to recognize their within-group heterogeneity [17]. Given the

potentially disparate impact of HIV on different subgroups within the larger population of YBMSM and the continued need to focus on HIV-related attitudinal and behavioral factors (hereafter referred to as behavioral factors) to address these issues, the present study used a person-centered approach, latent-profile analysis, to determine the extent to which these behavioral factors cluster around profiles of risk and relative protection using a sizeable sample of YBMSM in the US South. The present study also incorporated a variable-centered approach to determine whether age, HIV status, or socioeconomic distress distinguished which profile YBMSM were likely to fit. (See Fig. 1.)

Method

Participants

YBMSM (N = 1933) in Dallas and Houston, Texas metropolitan areas were recruited and completed a survey as part of a community-level intervention trial, as disparities in HIV prevalence for Black MSM relative to other MSM are particularly pronounced in the US South compared to other regions of the US. In addition, Dallas and Houston were selected because they rank among the top US metropolitan areas with significant HIV infection rates, particularly for

BMSM [47, 48], and have been under-researched. The original intervention study involved independent, annual, cross-sectional samples which were surveyed 1 year apart in each city from 2013 to 2015. Participants were recruited independently of the intervention. Eligibility criteria were: being aged 18–29 years, identifying as Black or African American, living in either Dallas or Houston metropolitan areas, being able to complete the survey in English, and being a man who had sex with another man in the prior 12 months.

Recruitment

The data were collected using an established venue-based, time-location sampling approach adapted from the National HIV Behavioral Surveillance Survey [49] for recruiting YBMSM. Specifically, locations and sampling time periods were selected to optimize the representation of YBMSM and efficiency in sampling these men during 4-h sampling time periods [7, 9]. At least two research staff members were present in the venue during data collection so that they could recruit enough participants, and at least eight YBMSM needed to be present at the venue at the beginning of the sampling period in order for data collection to proceed. No more than 20 surveys were collected at any venue in a given sampling period so as not to oversample venues. Given the numbers of YBMSM at each type of venue (e.g., bars, clubs,

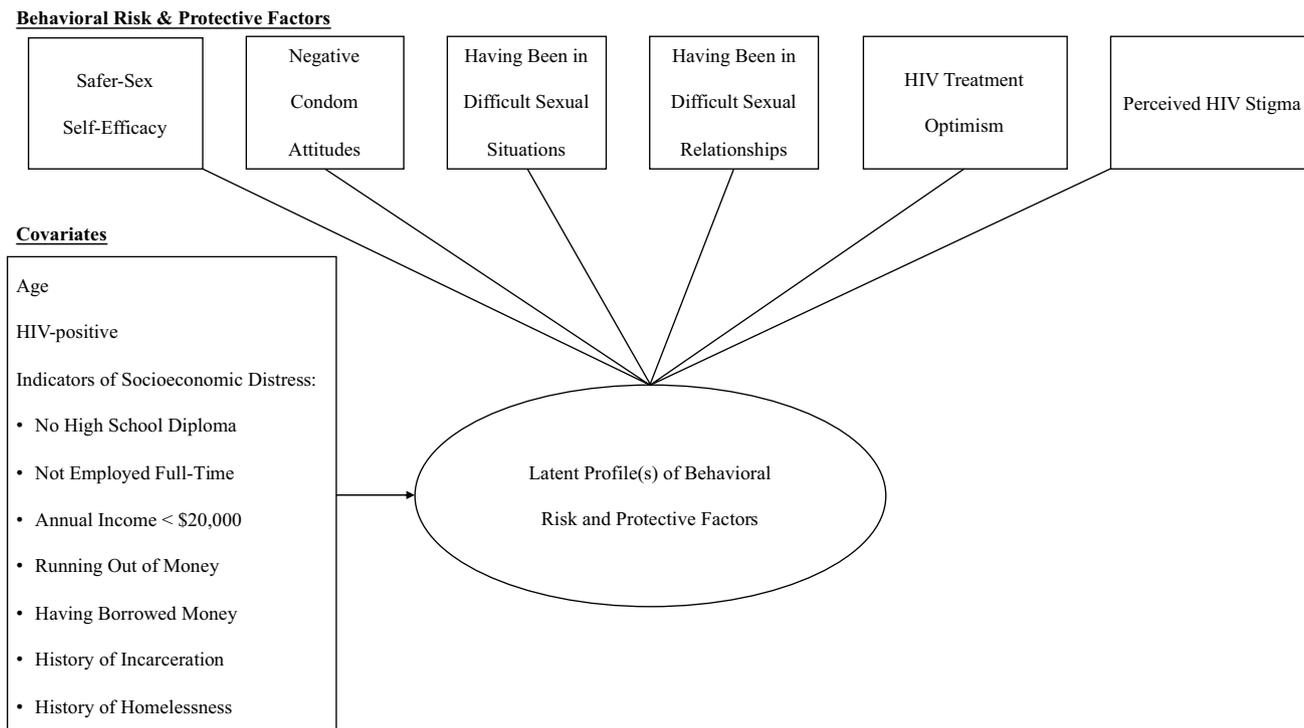


Fig. 1 Conceptual, latent profile model of HIV-related, behavioral risk and protective factors. Profile membership may be distinguished, or predicted, by potential covariates such as age, HIV status, and socioeconomic distress

retail establishments, restaurants and cafes, adult bookstores, bathhouses, high-traffic street locations, religious organizations, parks), the majority of recruitment (93%) occurred at bars and clubs. The remaining recruitment occurred at the project offices at a major university (7%) and a community agency that provides youth services (0.4%).

Procedures

Prospective participants were approached and screened at each recruitment venue, consecutively and individually, by trained study interviewers. Of the men who were approached in 2013, 87% agreed to be screened. Of these, 71% were eligible, and 90% of the eligible men agreed to participate in the study. In 2014, 76% agreed to be screened. Of these, 68% were eligible, and 91% of them agreed to participate. In 2015, 79% agreed to be screened. Of these, 71% were eligible, and 88% of them agreed to participate. After interviewers explained the study, participants provided verbal informed consent and then completed the study survey anonymously. On average, the survey took 24 min to complete. Participants completed the survey using hand-held personal digital assistants (PDAs). The PDAs presented written questions sequentially and allowed participants to respond directly on the devices. When more than one participant was completing the survey at any given time, they were instructed not to talk to each other about the survey. PDA-based data collection has been shown to improve participants' reporting of behaviors that may be perceived as socially undesirable (e.g., risky sexual behaviors, substance use) [50]. Participants provided several pieces of information that allowed the researchers to create a unique identifier to track repeat responders within and across waves so that the duplicate surveys could be deleted. Participants were paid \$30 for their time. All study procedures were approved by the institutional review boards at the home institution of the principal investigator and the institution of the data collection subcontractor in each city.

Measures

City

The metropolitan statistical area in which participants were recruited, Dallas or Houston, was recorded. Dallas was coded as zero and Houston as one.

Age

Each participant provided his date of birth, from which age was computed.

HIV Status

Participants reported whether they had been previously diagnosed with HIV. They were coded as one if diagnosed positive and zero if not.

Socioeconomic Distress

A combination of seven independent indicators were used to measure socioeconomic distress: [7, 9, 51] (1) not having a high school degree or GED, (2) not currently being employed full time, (3) having a personal annual income of less than \$20,000, (4) running out of money in at least 1 month out of the past 12 months, (5) having to borrow money to meet basic needs during the past year, (6) having a history of incarceration, and (7) having a history of homelessness. Each indicator was coded zero when the item did not apply and one for participants for whom the item did apply. Item codes were summed to create an index score of socioeconomic distress such that higher scores reflected more socioeconomic distress. On average, participants scored 2.80 (SD = 1.79, range = 0–7).

Safer-Sex Self-efficacy

Safer-sex self-efficacy was measured using four items from a measure developed with a focus on MSM and HIV risk reduction [28, 52]. Sample items include, "If a man you are having sex with starts to do something unsafe, how difficult is it for you to stop him?" and "How difficult is it for you to let a male sex partner know that you want to have safe sex?" Response options range from 1 ("not at all difficult") to 5 ("extremely difficult"). Item responses were reverse-coded such that higher scores indicated greater self-efficacy. Cronbach's alpha for the present sample was 0.87.

Negative Condom Attitudes

Participants' negative attitudes toward condom use were assessed using three items from a condom-attitudes scale [53] to measure the extent of adherence to beliefs that condoms adversely affect the sexual experience. Sample items include, "How much does pausing to put on a condom ruin the sexual mood?" and "How difficult is it for a man to cum (have an orgasm) while using condoms?" Response options range from 1 ("not at all") to 5 ("a great deal"). Cronbach's alpha was 0.84.

Difficult Sexual Situations and Relationships

Engagement in difficult sexual *situations* in the past year was assessed using nine items from the Difficult Sexual Situations Scale [8, 54]. Sample items include, "In

the last 12 months, how often have you been lonely and depressed and had sex in order to feel good?” and “In the last 12 months, how often have you been in a sexual situation where you or your sex partner was high on drugs?” Response options range from 1 (“never”) to 5 (“very often”). Cronbach’s alpha was 0.91.

Participation in difficult sexual *relationships* situations in the past year was assessed using four separate items from the Difficult Sexual Situations Scale [8, 54]. Sample items include, “In the last 12 months, how often have you been in a sexual situation with someone you were afraid of losing?” and “In the last 12 months, how often have you been in a sexual situation with a person who asks you to trust him?” Response options range from 1 (“never”) to 5 (“very often”). Cronbach’s alpha was 0.82.

HIV Treatment Optimism

Four items from the HIV Treatment Optimism Scale were used to measure participants’ beliefs about how well HIV treatment works in terms of viral suppression and reduced HIV transmissibility without condoms [36]. Sample items include, “HIV-positive persons who take HIV medications are less likely to infect their sex partners during unsafe sex,” and “It is safe to have anal sex without a condom with an HIV positive man who has an undetectable viral load.” Response options range from 1 (“strongly disagree”) to 4 (“strongly agree”). Cronbach’s alpha was 0.74.

Perceived HIV Stigma

Eight items from the subscale of the HIV Stigma Scale that assesses an individual’s concern with others’ attitudes toward people living with HIV [32] were used to assess perceived HIV stigma. Sample items include, “Most people are uncomfortable around someone with HIV,” and “Most people are rejected when others learn they have HIV.” Response options range from 1 (“disagree strongly”) to 6 (“agree strongly”). Cronbach’s alpha was 0.92.

Data Analysis

Descriptive statistics were calculated using Stata 15 [55] and consisted of counts and percentages for categorical variables and means and standard deviations for continuous variables. The primary data analyses were conducted in Mplus 7 [56]. Latent profile analysis (LPA) was used to identify profiles of HIV-related behavioral protective and risk factors in the present sample. Broadly, LPA is a form of latent-variable analysis that aims to identify subsets, or “classes,” of observations using observed data (i.e., identifying which of the emergent classes participants are in). The latent variable (i.e., the classes) is categorical, with each

level of the variable corresponding to a class; the indicators of the latent variable in LPA are continuous [57]. LPA is preferable to other person-centered approaches (e.g., cluster analysis) due to increased reliability and the ability to examine model fit indices when identifying the number of classes [57]. Unlike cluster analysis, class membership is probabilistic and accounts for sample sizes in each class when assigning probabilistic class membership [58]. Full-information maximum likelihood estimation was used to handle missing data.

Model selection (i.e., the number of classes, or profiles) was guided by established statistical recommendations for model fit indices, model class sizes, parsimony, and existing literature and theory [59, 60]. Several fit indices were compared: Akaike information criterion (AIC) [61], the Bayesian information criterion (BIC) [62], sample-size adjusted BIC [63], and entropy [64]. Lower BIC and AIC values indicate better model fit [65], and entropy scores closer to 1 (range 0–1) indicate greater classification accuracy [64]. Also, the Lo–Mendell–Rubin two-times-the-likelihood difference test (LMRV *2LL*) [66] and the Vuong–Lo–Mendell–Rubin two-times-the-log likelihood difference test (VLMR *2LL*) [67] were estimated to compare the improvement in model fit with each successive class added to the LPA solution and to determine whether improvement in model fit was statistically significant. Means (*M*) and standard errors (*SE*) for profile indicators were reported.

Upon identifying the number of classes in the final solution, the covariates (i.e., age, HIV status, socioeconomic distress) served as auxiliary variables [68]. Specifically, they were tested to determine if they were associated with class membership (i.e., the latent profile fit) of YBMSM in the sample when adjusting for city. Their unstandardized coefficients (*b*), standard errors (*SE*), adjusted odds ratios (*aOR*), and *p*-values were reported.

Results

Preliminary Analyses

Of the 1933 surveys collected, 116 surveys came from men who participated in more than one assessment; only their first assessment was used. After excluding these duplicate surveys and an additional nine participants (0.5%) due to missing survey data, the final sample consisted of 1808 YBMSM.

As shown in Table 1, the average participant was approximately 25 years of age. The majority, about 85%, reported earning a high school diploma or GED, and roughly one-fifth reported having a college degree. Nearly a quarter of the sample reported earning less than \$10,000 per year, whereas over one in ten participants reported earning at

Table 1 Participant characteristics (*N* = 1808)

Variable	Descriptive statistics
City (%)	
Dallas/Houston	50.25/49.75
Mean age in years (SD)	(24.86, 2.85)
Education (%)	
Less than high school diploma or GED	14.47
High School Diploma or GED	23.56
Some college	41.05
College degree or more	20.92
Annual income (%)	
Less than \$10,000	23.60
\$10,000–\$19,999	18.54
\$20,000–\$39,999	31.27
\$40,000–\$59,999	14.99
\$60,000 or more	11.60
Not currently employed full time (%)	21.06
Ran out of money at least once in the past year (%)	13.35
Borrowed money to meet basic needs during the past year (%)	6.96
History of incarceration (%)	2.59
History of homelessness (%)	0.23
Tested positive for HIV (%)	14.37

least \$60,000 per year. The modal income range, \$20,000 to \$39,999 per year, represented over 30% of the sample. Most participants, nearly 80%, reported being employed full-time, although nearly 15% reported having run out of money at least once in the past year. Relatively few participants reported having been incarcerated in the past year (< 5%) or having been homeless in the past year (< 1%). Approximately 15% of participants reported an HIV-positive status at the time of assessment. (See Table 1 for additional sample characteristics.)

Participants reported low to moderate levels of having been in difficult sexual situations (*M* = 18.00, *SD* = 8.25, range 9–45) and having been in difficult sexual relationships (*M* = 9.56, *SD* = 4.44, range 4–20). They generally showed low HIV treatment optimism (*M* = 7.85, *SD* = 3.30, range 4–16) and moderate levels of perceived HIV stigma (*M* = 29.81, *SD* = 12.44, range 8–48). Participants also reported a relatively high degree of safer-sex self-efficacy

(*M* = 16.53, *SD* = 4.20, range 4–20) and low levels of negative condom attitudes (*M* = 5.88, *SD* = 3.22, range 3–15). As shown in Table 2, which displays the Pearson correlations among the HIV-related behavioral factors, safer-sex self-efficacy was inversely associated with all other HIV-related behavioral factors, all of which were positively associated with one another.

Primary Analyses

As shown in Table 3, the latent profile analysis yielded four distinct profiles of HIV-related behavioral protective and risk factors for YBMSM in the sample. Model fit significantly improved up to a four-profile solution (*AIC* = 62,583.14; *BIC* = 62,764.64; *BIC_{adjusted}* = 62,659.80, entropy = 0.821; LMR 2LL difference = 382.08, *p* = 0.003; VLMR 2LL difference = 390.08, *p* = 0.003) whereas the five- and six-profile solutions did not significantly improve

Table 2 Correlations Among HIV-related behavioral protective and risk factors (*N* = 1808)

Variable	1	2	3	4	5	6
Safer-sex self-efficacy	1.00					
Negative condom attitudes	−0.63***	1.00				
Being in difficult sexual situations	−0.56***	0.56***	1.00			
Being in difficult sexual relationships	−0.33***	0.32***	0.64***	1.00		
HIV treatment optimism	−0.34***	0.34***	0.38***	0.24***	1.00	
Perceived HIV stigma	−0.15***	0.15***	0.21***	0.24***	0.07**	1.00

p* < .05, *p* < .01, ****p* < .001

Table 3 Comparison of one- to six-profile solutions of latent profiles of HIV-related behavioral protective and risk factors for young black men who have sex with men ($N=1808$)

Index	1 Profile	2 Profiles	3 Profiles	4 Profiles	5 Profiles	6 Profiles
AIC	66,010.84	63,572.34 ($\Delta=2438.50$)	62,959.22 ($\Delta=613.12$)	62,583.14 ($\Delta=376.08$)	62,270.80 ($\Delta=312.34$)	62,053.37 ($\Delta=217.43$)
BIC	66,076.84	63,676.84 ($\Delta=2400.00$)	63,102.22 ($\Delta=574.62$)	62,764.64 ($\Delta=337.58$)	62,490.80 ($\Delta=273.84$)	62,311.87 ($\Delta=178.93$)
Adjusted BIC	66,038.71	63,616.48 ($\Delta=2422.23$)	63,019.62 ($\Delta=596.86$)	62,659.80 ($\Delta=359.82$)	62,363.72 ($\Delta=296.08$)	62,162.55 ($\Delta=201.17$)
Entropy	N/A	0.863	0.882	0.821	0.836	0.845
Lo, Mendell, Rubin test (p)	N/A	2406.65, $p < 0.001$	615.40, $p = 0.004$	382.08, $p = 0.003$	320.24, $p = 0.116$	227.105, $p = 0.122$
Vuong, Lo, Mendell, Rubin test (p)	N/A	2452.50, $p < 0.001$	627.12, $p = 0.003$	390.08, $p = 0.003$	326.34, $p = 0.111$	231.43, $p = 0.118$
n for each profile (P_i) in each solution model	$P = 1808$	$P_1 = 1264$ $P_2 = 544$	$P_1 = 574$ $P_2 = 1150$ $P_3 = 84$	$P_1 = 332$ $P_2 = 488$ $P_3 = 88$ $P_4 = 900$	$P_1 = 95$ $P_2 = 851$ $P_3 = 71$ $P_4 = 439$ $P_5 = 352$	$P_1 = 87$ $P_2 = 766$ $P_3 = 421$ $P_4 = 420$ $P_5 = 78$ $P_6 = 36$

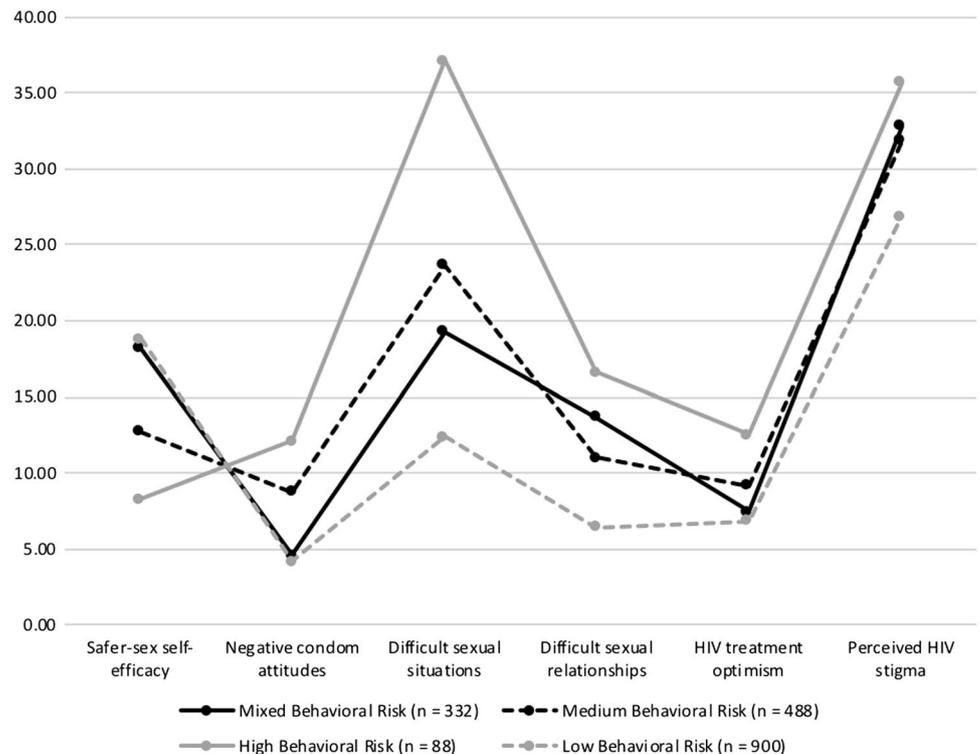
A four-profile solution was selected as the best fitting, most parsimonious solution

model fit. Model fit statistics for all solutions are presented in Table 3. Profile 1 was labeled as *Low behavioral risk* ($n = 900, 49.7%$). Profile 2 was labeled as *Medium behavioral risk* ($n = 488, 27.0%$). Profile 3 was labeled as *High behavioral risk* ($n = 88, 4.9%$). Profile 4 was labeled as *Mixed behavioral risk*, with some indicators of low

risk despite having also been difficult sexual situations ($n = 332, 18.4%$). (See Fig. 2.)

YBMSM characterized by Profile 1 (low risk) had high scores on safer-sex self-efficacy ($M = 18.80, SE = 0.14$); low scores on negative condom attitudes ($M = 4.16, SE = 0.09$), difficult sexual situations ($M = 12.39, SE = 0.19$), difficult

Fig. 2 Plot of estimated means for a four-profile solution of a latent profile analysis of HIV-related, behavioral risk among young Black men who have sex with men. Y-axis: Scores on each measure in their original scale. X-axis: 1 = Safer-sex self-efficacy, 2 = Negative condom attitudes, 3 = Having been in difficult sexual situations, 4 = Having been in a difficult sexual relationship, 5 = HIV treatment optimism, 6 = Perceived HIV stigma. Each line represents a different profile, or class—i.e., mixed behavioral risk, high safer-sex self-efficacy and other indicators of low risk despite difficult sexual situations; medium behavioral risk; high behavioral risk; and low behavioral risk



sexual relationships ($M = 6.40, SE = 0.18$), and HIV treatment optimism ($M = 6.81, SE = 0.11$); and moderate scores on perceived HIV stigma ($M = 26.86, SE = 0.51$). YBMSM characterized by Profile 2 (medium risk) had relatively moderate scores on safer-sex self-efficacy ($M = 12.72, SE = 0.33$), negative condom attitudes ($M = 8.74, SE = 0.17$), difficult sexual situations ($M = 23.65, SE = 0.55$), difficult sexual relationships ($M = 10.99, SE = 0.27$), HIV treatment optimism ($M = 9.13, SE = 0.16$), and perceived HIV stigma ($M = 31.85, SE = 0.58$). YBMSM characterized by Profile 3 (high risk) had the lowest scores on safer-sex self-efficacy ($M = 8.24, SE = 0.80$) and the highest scores on difficult sexual situations ($M = 37.17, SE = 0.94$) as well as difficult sexual relationships ($M = 16.62, SE = 0.42$), negative condom attitudes ($M = 12.12, SE = 0.456$), HIV treatment optimism ($M = 12.48, SE = 0.57$), and perceived HIV stigma ($M = 35.72, SE = 1.47$). As indicated by its label, YBMSM characterized by Profile 4 (mixed risk) scored high on safer-sex self-efficacy ($M = 18.18, SE = 0.18$) and moderately on difficult sexual situations ($M = 19.30, SE = 0.79$). They also had low scores on negative condom attitudes ($M = 4.60, SE = 0.23$) and HIV treatment optimism ($M = 7.47,$

$SE = 0.20$), but high scores on difficult sexual relationships ($M = 13.7, SE = 0.40$) and perceived HIV stigma ($M = 32.85, SE = 0.66$).

The extent to which the auxiliary variables (i.e., age, being HIV-positive, socioeconomic distress) predicted which profile better characterized participants is shown in Fig. 3. The low-risk group served as the reference group for the higher-risk profiles. YBMSM who scored high on socioeconomic distress ($b = 0.30, SE = 0.05, aOR = 1.35, p < 0.001$) and who were HIV-positive ($b = 1.07, SE = 0.22, aOR = 2.92, p < 0.001$) were better characterized by the medium-risk profile than YBMSM who reported less socioeconomic distress or being HIV-negative, respectively. Age did not predict having a medium-risk profile. YBMSM who reported higher socioeconomic distress were better characterized by the high-risk profile, including a very high tendency to be in difficult sexual situations, than YBMSM who reported lower socioeconomic distress ($b = 0.20, SE = 0.08, aOR = 1.23, p = 0.011$). HIV-positive YBMSM exhibited over twice the odds, albeit not reaching statistical significance, of fitting the high-risk profile than HIV-negative YBMSM ($b = 0.75, SE = 0.40, aOR = 2.11, p = 0.061$). Age did not predict

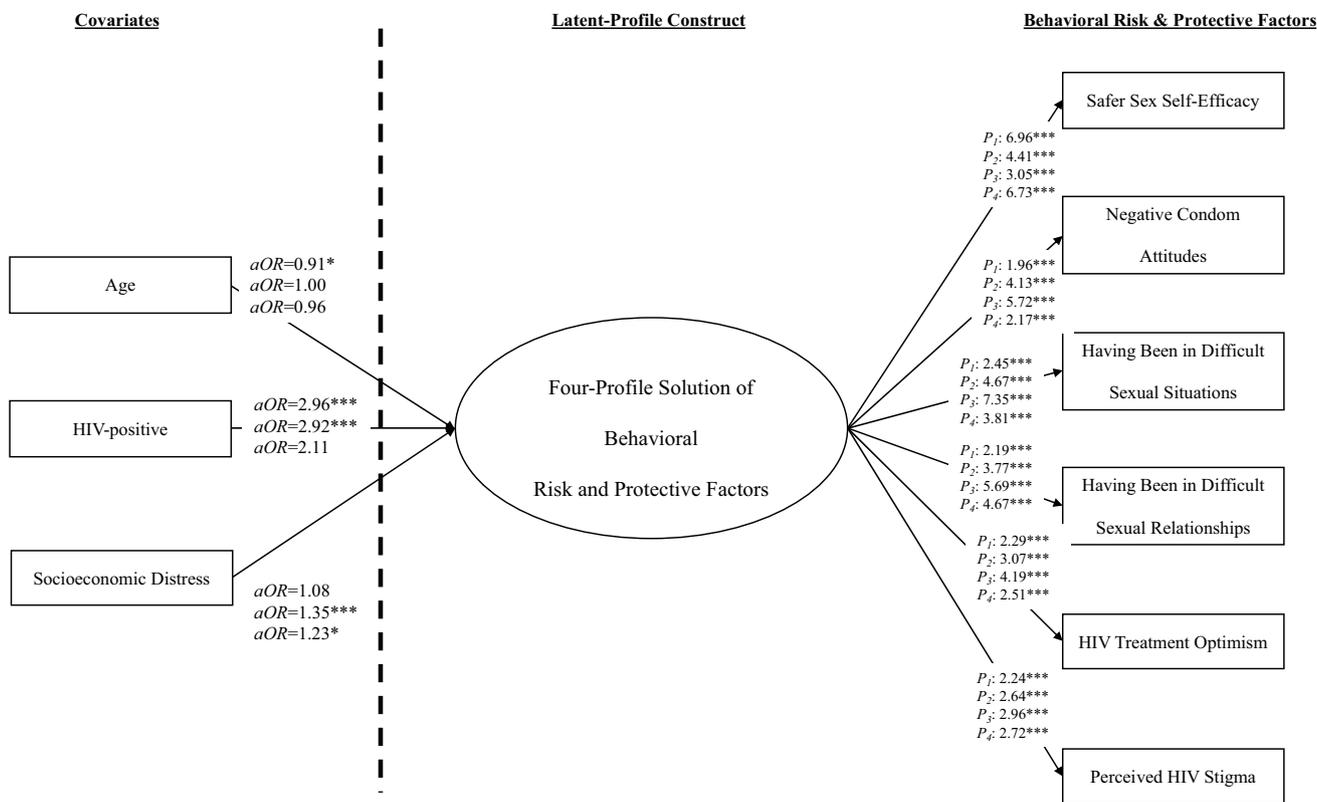


Fig. 3 Primary analyses: latent profile model (four-profile solution) of HIV-related, behavioral risk and protective factors with age, HIV status, and an index of socioeconomic distress as covariates. P1 = profile 1 (Low behavioral risk). P2 = profile 2 (Medium behavioral risk). P3 = profile 3 (High behavioral risk). P4 = profile 4 (Mixed behavioral

risk). Adjusted odds ratios ($aORs$) are given for the regression coefficients of latent profiles on covariates. Profile 1 was the reference group for each aOR . Standardized means are given for the indicators of the latent variable (i.e., the four-profile solution). $^{***}p < 0.001$, $^{**}p < 0.01$, $^*p < 0.05$

whether YBMSM would fit the high-risk profile. Although high scores on socioeconomic distress did not predict having a mixed-risk profile, YBMSM who were younger in age ($b = -0.09$, $SE = 0.04$, $aOR = 0.91$, $p = 0.007$) and HIV-positive ($b = 1.08$, $SE = 0.26$, $aOR = 2.96$, $p < 0.001$) were better characterized by the mixed-risk profile than were older or HIV-negative YBMSM, respectively.

Discussion

The present findings show that YBMSM in the sample could be distinguished by four profiles of HIV-related behavioral protective and risk factors: (1) a protective, low-risk profile that characterized nearly half the sample and reflected high scores on safer-sex self-efficacy and relatively low scores on HIV-related behavioral risk factors, including difficult sexual situations; (2) a medium-risk profile that comprised over one quarter of the sample and that represented higher scores than the low-risk profile on HIV-related behavioral risk factors, including the second highest scores on difficult sexual situations among the four profiles; (3) a high-risk profile that described the smallest proportion of the sample, about one in 20 men, and that exhibited the highest scores of all four profiles in HIV-related behavioral risk factors, including very high scores on difficult sexual situations; and (4) a mixed-risk profile that consisted of nearly one-fifth of the sample and that was characterized by relatively high scores on safer-sex self-efficacy and low scores on negative condom attitudes—comparable to the lowest-risk profile—but elevated scores on other HIV-related behavioral risk factors, including difficult sexual situations. Of all of the HIV-related risk factors, having been in difficult sexual situations in the past year appeared to be the key feature that defined the degree to which a profile reflected risk; its mean scores varied widely between profiles, with its highest point in the high-risk profile and its lowest point in the low-risk profile. Men who were younger, HIV-positive, or more socioeconomically distressed were more likely to fit a higher-risk profile than men who were older, HIV-negative, or less socioeconomically distressed, respectively.

Men who fit the high-risk profile were uniquely characterized by experiencing the highest levels of difficult sexual situations. According to prior research, being in difficult sexual situations is a main driver of HIV and have historically been a focus of HIV- and STI-prevention interventions [8, 69, 70], including for BMSM [71]. The present findings indicate that this emphasis on sexual contexts remains critical, and these sexual contexts may be the key to identifying the highest HIV risk among YBMSM. Moreover, given that men characterized by the high-risk profile also endorsed negative condom attitudes three times more strongly than men in the low-risk profile, prior research suggests PrEP

may be an ideal approach for those who do not use condoms or another form of safer sex, or who have insufficient sense of agency to negotiate safer sex, while in sexual situations [72]. In order to further minimize risk, STI screening and treatment are also needed [43–45]. Additionally, efforts at increasing condom use may still benefit men at high risk of HIV [30, 71, 73].

The medium-risk group outnumbered the high-risk group by a factor of approximately five and a half. Given the large proportion of men fitting the mixed-risk profile, this profile may be more reflective of YBMSM who seroconvert than the high-risk profile. Specifically, consistent with previous studies, sexual-risk behavior is less a driver of HIV incidence among BMSM than are high background prevalence and closed sexual networks due, in part, to a preference for Black partners [74], discrimination by other MSM [75], and socioeconomic marginalization [6, 15]. As such, even moderate levels of HIV-related behavioral risk might place YBMSM at equivalent or greater risk of HIV infection than comparable or higher levels of HIV-related behavioral risk among young MSM of other racial or ethnic groups. However, more research is needed to examine this possibility.

The men who fit the mixed-risk profile were at elevated behavioral risk due to difficult sexual situations and relationships despite feeling that they would be able to negotiate safer sex in a hypothetical sense and having positive attitudes toward safer sex. This pattern of results indicates that, for some YBMSM, disempowering sexual situations and relationships in which YBMSM feel that they lack agency—or in which their decision-making is affected by substances such as alcohol and marijuana—may be more appropriate targets of intervention than their individual condom use or attitudes. These findings may help to explain results from prior literature indicating that sexual networks, rather than individual safer-sex practices, contribute to HIV risk among YBMSM [74, 76, 77]. Specifically, limited sexual networks may contribute to difficult sexual situations. Also, given the large proportion of YBMSM who might fit this profile, it may be helpful to heed the call by some investigators to engage MSM in a prevention-oriented PrEP continuum of care [78].

In the present sample, the older that YBMSM were, the lower were their odds of being in the mixed-risk group than the low-risk group; thus, when younger YBMSM's risk was elevated based on their profiles, they still tended to report relatively high safer-sex self-efficacy and less negative attitudes toward condom use. The youngest YBMSM were more likely to find themselves in difficult sexual situations and relationships that were disempowering. Against a backdrop of high HIV prevalence along with closed social networks that are partly due to social and economic marginalization [6, 15, 76, 77], these difficult sexual situations and relationships may fuel HIV risk. These sexual and relationship

contexts may require further inquiry for the youngest and possibly most vulnerable YBMSM.

Men living with HIV, on average, fit the mixed- and medium-risk profiles better than HIV-negative men in the sample. Increased HIV-related behavioral risk among men with untreated HIV infection adversely affects HIV incidence and prevalence. These results highlight the continued need to develop and assess interventions designed to engage HIV-positive BMSM in TasP with the goal of achieving viral suppression—to maximize their own health and the health of their communities. Also, although HIV treatment optimism has been found to be associated with sexual-risk behavior in the past [37, 38], the general lack of high HIV treatment optimism in the sample suggests that it may be an important factor to target if the goal is to engage men living with HIV in care to achieve viral suppression. This is especially true given current knowledge of Undetectable = Untransmittable [41, 42]. Additionally, given the risk posed by STIs to the use of TasP [43–45], the roles of STI screening and treatment merit further study.

The more socioeconomic distress that YBMSM reported, the greater were their odds of fitting the medium- or high-risk profiles. This is consistent with prior literature that did not involve the person-centered approach of latent-profile analysis. For example, socioeconomic distress and other adverse social contexts (e.g., social oppression) have been linked to being in difficult sexual situations and other HIV risk factors [9, 51, 54]. Socioeconomic conditions may be inextricably linked to HIV-related and other health disparities for BMSM [79–83].

To synthesize, a key issue that may explain why these profiles and associations emerged is that social and economic marginalization may place some YBMSM at greater risk for being in disempowering sexual situations and relationships [8, 9]. These sexual situations and relationships may be critical distinguishing factors of risk profiles in this sample of YBMSM regardless of these men's own attitudes toward or their confidence in their ability to engage in individual safer-sex practices (e.g., condom use). YBMSM who struggle to meet basic financial needs or achieve a sense of socioeconomic stability may be particularly vulnerable to being in disempowering sexual situations and relationships that undermine their sense of agency due to potential power imbalances. Compared to older YBMSM in the present sample, younger YBMSM may be more vulnerable to power dynamics in their relationships or to experimentation with substances that affect sexual decision-making. Additionally, the most robust determinant of fitting a higher-risk profile was being HIV-positive, indicating that HIV-positive YBMSM are particularly vulnerable to, or perhaps feel that they must accept, being in disempowering sexual situations and relationships. They may not feel that they deserve or can secure a more empowering relationship, and they may

be particularly sensitive to perceptions or experiences of HIV-related stigma from potential partners or sources of social support [27]. Furthermore, social hierarchies (e.g., hierarchies around the degree of masculinity in one's gender expression), a desire to establish trust and intimacy in the hopes of a relationship, and other factors are also important in determining sexual and relationship dynamics and, thus, HIV risk [21, 22].

Although this study has many strengths, several limitations must be noted. The original study used a cross-sectional design; thus, the present findings constitute correlations and distinguishing characteristics in the sample, not causal effects. In addition, although the time-location sampling method used to recruit the current sample yielded a sizable number of YBMSM and is among the largest samples of YBMSM in the available literature, this sampling strategy did not produce a representative, probability sample.

The present findings have several implications for intervention development and future research. Given that many men either may not use condoms or may find themselves in high-risk situations (e.g., difficult sexual situations), PrEP programs must increase their efforts at reaching HIV-negative YBMSM. For HIV-positive YBMSM, early diagnosis and achieving viral suppression is key. Interventions could aim to increase the generally low HIV treatment optimism observed in the sample and help to overcome other factors about their health-care experiences that adversely affect their engagement or trust in HIV care [13, 84]. In tandem, STI screening and treatment—as well as support to prevent faulty assumptions about one's own or one's partner's HIV status—may also be needed for both HIV-positive and -negative YBMSM. Additionally, clinical interventions and programming must focus more explicitly on YBMSM's sexual situations and relationships by providing psychosocial support for preempting or managing difficult sexual situations and relationships for higher-risk and HIV-positive YBMSM. Structural interventions designed to address socioeconomic barriers (e.g., running out of money, housing instability), such as intensive case-management services to help meet immediate or imminent financial needs or advocacy for policies that address socioeconomic disparities, are important given that high socioeconomic distress was linked to having a medium- or high-risk profile. With respect to research implications, the present study highlights the importance of examining individual and subgroup differences and nuances within groups that are at increased risk of HIV, including YBMSM, given the availability of person-centered analytic methods such as latent profile analysis [17].

In conclusion, in this large sample of YBMSM, men fit into four profiles based on behavioral protective and risk factors for HIV, including a mixed-risk profile that consisted of nearly a fifth of the participants. Men who were younger, HIV-positive, or more socioeconomically distressed were

distinguished by higher-risk profiles compared to men who were older, HIV-negative, or less socioeconomically distressed. Overall, the present findings support a continued focus on addressing not only safer-sex self-efficacy, PrEP and Undetectable = Untransmittable awareness, and condom attitudes, but, more pertinently, helping YBMSM to feel more empowered and able to navigate difficult sexual situations and relationships that pose challenges to HIV prevention.

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Compliance with Ethical Standards

Conflict of interest All the authors declared that they have no conflict of interest.

Ethical Approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed Consent Informed consent was obtained from all individual participants included in the study.

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