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Patterns of sexual behavior and sexually transmitted infections in young men who have sex with men

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Abstract

Purpose—Young men who have sex with men (YMSM) are at an increased risk for sexually transmitted infections. Recent research has documented the importance of understanding the multidimensional nature of sexual risk behavior; however, little is known about how multidimensional patterns of sexual behavior among MSM may be associated with STIs.

Method—This study applies latent class analysis to data from a large, HIV– sample of 18–25 year old MSM recruited from social and sexual networking websites ($N = 5,965$; 76% white, 11% Latino, 5% Black, 4% Asian, 4% other; 74% homosexual, 21% bisexual, 1% heterosexual, 3%, unsure/questioning 1% other) to uncover multidimensional patterns of past-year sexual behaviors, partner factors, and protective behavior and their associations with self-reported STI diagnosis.

Results—We selected a model with 8 classes, with nearly half of participants belonging to a class marked by multiple behaviors with more than one partner, and smaller numbers of individuals in classes with a smaller number of behaviors, romantic relationships, and sexual inactivity. Class membership was associated with recent STI diagnosis, with classes marked by no penetrative sex or receptive anal sex with consistent condom use having lower prevalence than those with inconsistent condom use, including those engaging in only insertive anal sex.

Conclusions—Findings suggest heterogeneity of behaviors within MSM and that prevention messages may be more effective if they are tailored to individuals' patterns of sexual behavior, as well as demographic and socio-contextual factors.

Keywords

sexual behavior; men who have sex with men (MSM); latent class analysis; sexually transmitted infections

Introduction

Young men who have sex with men (YMSM) have high prevalence of sexually transmitted infections (STIs).¹ MSM engage in a variety of sexual experiences, which vary on behaviors, partners, and protective strategies; however, research typically focuses on single behaviors, such as condomless anal intercourse, which may not fully categorize risk. Relatively little is known about the patterns of behaviors MSM engage in and how these predict STI diagnoses; this information is necessary to design effective prevention programs. We use data from a large sample of YMSM recruited from sexual networking websites to examine latent classes marked by differing patterns of sexual behaviors and how membership in these classes is associated with recent STI diagnosis.

Although MSM are often viewed as a monolithic group, there is diversity in MSM's sexual behaviors². Sexual experiences include behaviors (e.g., oral, vaginal, or anal sex), protective measures (e.g., condom use), and relationship factors (e.g., number of partners), and the intersection of these aspects may confer different STI/HIV risk^{3,4}. Research has begun to document the multidimensional nature of sexual behavior using person-centered methods like latent class analysis (LCA).⁵ In contrast to traditional variable-centered analyses which examine the impact of individual variables, person-centered analyses focus on understanding what particular patterns exist in the population. Thus, a person-centered analysis can uncover classes marked by different patterns of sexual behavior, and examine how these patterns differentially predict STIs^{3,4}.

Most person-centered research on adolescents and young adults has focused on heterosexual behavior. However, recent work has documented heterogeneity in sexual behavior among MSM^{6–12}. Most studies either solely documented patterns of risk or focused on associations with HIV, rather than STIs. However, one paper uncovered four classes of sexual risk behavior (monogamous, risk minimizer, risk potential, and risk taker), and found that all other classes had higher odds of a positive syphilis, chlamydia, or gonorrhea diagnosis compared to the monogamous class¹¹. However, this study did not include romantic relationship status or sex with female partners or examine viral STIs. In addition, most studies of profiles in MSM use relatively small samples, limiting the complexity and number of classes uncovered.

We use data from a national study of U.S. men recruited from social and sexual networking websites for MSM. Given that previous studies have suggested about 80% of YMSM have an online profile¹³, and these sites may attract men who are looking for new partners, this strategy gave us access to a large sample of men who may engage in risk behaviors. This study uses LCA to examine patterns of sexual behaviors among YMSM, with three aims:

1. To uncover latent classes of YMSM based on their past-year sexual experiences.
2. To examine how class membership differs by race/ethnicity, sexual identity, and age.
3. To examine how class membership is associated with recent STI diagnosis.

Materials and Methods

Participants and Procedure

Data was collected in 2012 through a partnership with the operators of Internet websites for men who seek social or sexual connections with men⁹. The Institutional Review Board at Indiana University approved the study. An invitation was sent to users of the company's two largest websites via the internal inbox associated with their profile. Participants completed informed consent and an online survey which took about 20 minutes. 32% of men who received emails visited the study website, and nearly 60% of these men completed the survey, resulting in a sample of 32,831 individuals. Because of our focus on young men, and because sexual behavior may differ between HIV+ and HIV- MSM, we included participants if they were between 18 and 25 years of age and self-reported HIV- status ($N=5,965$). Descriptive statistics are presented in Table 1.

Measures

Indicators of latent class membership—We included nine indicators. Six were based on questions asking whether they had engaged in a behavior in the past year. These include *mutual masturbation*, *received oral sex*, *performed oral sex*, *insertive anal intercourse*, *receptive anal intercourse*, (all with a male partner) and *vaginal sex* (with a female partner). *Multiple partners* indicated whether individuals had “engaged in sexual activities” with one partner, two or more partners, or no partners in the past year; the item was dichotomized as 0 or 1 partner v. 2+ partners in the past year. *Relationship status* indicated whether they were currently in a relationship lasting more than 3 months at the time of interview. Note that this item referred to anything the participant considered a relationship, and does not necessarily refer to a monogamous relationship, as non-monogamous relationships are relatively common among MSM.¹⁴ Thus, individuals in a relationship may have also had multiple sexual partners. *Consistency of condom use* during penetrative sex was recoded from questions asking about how often they used a condom during their last 10 occurrences of insertive and receptive anal and vaginal sex. We created a trichotomous indicator of condom use; no penetrative sex without a condom (no penetrative sex or 10/10 times with a condom), some sex without a condom (1-9/10 times with a condom), and all sex without a condom (0/10 times with a condom). Multiple partners, relationship status, and condom use question could refer to male or female partners.

Correlates—Race/ethnicity had 5 options (White, Hispanic/Latino, Black, Asian/Pacific Islander, and Other). Sexual identity was measured with 5 options (Homosexual/Gay, Bisexual, Heterosexual/Straight, Unsure/Questioning and Other). Because few individuals reported the latter three categories, we combined them into an Other category, and used a three-level measure. Age was measured in years. Recent STI diagnosis was measured by five items asking whether a participant had been diagnosed with STIs by a health care provider within the past two years. We examined any STI, followed by separate analyses for bacterial (syphilis, gonorrhea, chlamydia) and viral (HPV, genital herpes). All STI variables were dichotomized (1 = reported diagnosis).

Statistical Analyses

We modeled classes of sexual behavior using Latent Gold¹⁵. We ran models with 1–10 classes and 1000 starts, and selected the number of latent classes based on information criteria (AIC and BIC) and interpretability. For our chosen model, we examined the patterns of item response probabilities, which show how likely individuals in a given class were to report a given response on an item. We used these to create class names, which reflect characteristics of each class that are most critical in differentiating them from other classes. Next, we examined correlates of class membership using the 3-step command that implements the BCH approach. This method weights analyses by each individuals' probability of being in a given latent class, which provides less biased results than classify-analyze approaches¹⁶. We examined how class membership differed by covariates described above (race/ethnicity, sexual identity, and age) with class membership probability-weighted multinomial regression models. We then examined how class membership was associated with three STI outcomes with class membership probability-weighted logistic regression models, controlling for the demographic covariates.

Results

BIC indicated an eight-class model, and AIC indicated a ten-class model (Table 2). Because BIC selects a more parsimonious model and is recommended for large samples¹⁷ we selected the eight-class model (Table 3). We interpret item-response probabilities above .6 as a high probability of a particular response. The five most common classes involved sex with only same-sex partners, and three small classes included sex with no partners, with both men and women, or exclusively with women. Seven of the eight classes included individuals who were not currently in a relationship, whereas one class was marked by a high probability of being in a relationship.

We present the classes from most to least common. Multiple Same-Sex Behaviors (47%) was marked by high probabilities of all same sex sexual behaviors; they also had high probabilities of not being in a relationship, and using condoms some of the time. The Receptive Anal (13%) and Insertive Anal (12%), were similar to the Multiple Same-Sex Behaviors class in their patterns of behaviors and partners, with the exception of only engaging in receptive and insertive anal intercourse, respectively. These classes also differed from each other in terms of condom use, with most in the Receptive Anal class reporting no sex without a condom, and nearly all in the Insertive Anal class reporting some sex without a condom. The Relationship class (10%), was the only class marked by high probabilities of being in a relationship; however, individuals in this class had a high probability of having multiple partners and never using condoms. The Non-Penetrative class (7%), had low probabilities of anal intercourse but had high probabilities of mutual masturbation and oral sex. The Not Currently Active (6%) class was marked by low probabilities of engaging in any type of sexual behavior in the past year. Finally, two classes were marked by having a high probability of vaginal intercourse; the Same and Other Sex class (3%) had high probabilities of both vaginal intercourse (with women) and oral sex with men. The Vaginal Only class had high probability of vaginal intercourse, but no oral or anal intercourse with men.

Race/ethnicity, sexual identity, and age predicted class membership (Table 4). Black participants were overrepresented in the Insertive Anal class and underrepresented in the Relationship class. Asian participants were overrepresented in the Receptive Anal, Non-Penetrative, and Non-Active classes. Bisexual participants were more likely to be in the Insertive Anal class and less likely to be in the Receptive Anal and Relationship classes. Other sexual identity participants were greatly underrepresented in the Multiple Same-Sex Behaviors class, and less likely to be in the Relationship class, but were more likely to be in the Insertive Anal, Non-Penetrative, Same and Other Sex and Vaginal Only classes. Compared to the Multiple Sexual Behaviors class, the Receptive Anal, Non-Penetrative, and Non-Active classes had a younger mean age, and the Vaginal Only class had a higher mean age.

Finally, we examined how class membership was associated with recent STI diagnosis. Log-likelihood tests indicated that class membership was associated with STI (Figure 1). The Multiple Same Sex Behaviors class had higher prevalence than all other classes (17%). Prevalence was also high in the Insertive Anal and Relationship classes, which had higher prevalence than the Receptive Anal, Non-penetrative, and Non-Active classes. Class membership was also associated with bacterial and viral STIs (Figure 2). For bacterial STIs, prevalence was highest among the Multiple Same Sex Behaviors, Insertive Anal, and Relationship classes, which had higher prevalence than the Receptive Anal, Non-penetrative, and Non-active classes. A similar pattern was found for the Multiple Same Sex Behaviors compared to other classes; however, Receptive Anal only differed from the Multiple Same Sex Partners class (not the Insertive Anal and Relationship classes).

Discussion

We examined patterns of sexual risk behaviors among YMSM, uncovering a typical pattern of behaviors as well as considerable heterogeneity. The largest class consisted of young men who were not in a relationship, engaged in oral sex and both receptive and insertive anal intercourse with more than one partner in a year, and used condoms inconsistently. This is consistent with research showing high prevalence of both insertive and receptive anal intercourse and inconsistent condom use^{18,19}. Despite this common pattern of behavior, there was also heterogeneity, with individuals reporting patterns marked by exclusive insertive or receptive anal intercourse, non-penetrative sex, romantic relationships, sex with women, and no recent sex. These findings show that despite MSM often being considered as a single group for the purpose of HIV/STI prevention, there is variety in behaviors.

There were also differences in class membership by race/ethnicity, sexual identity, and age. Black men were more likely to be in the Insertive Anal class, whereas Asian men were more likely to be in classes without insertive anal intercourse. These findings mirror research examining racial and positioning stereotypes held by MSM, in which black men were viewed as dominant, aggressive, and more likely to take the insertive role, and Asian men are seen as more feminine and more likely to be the receptive partner²⁰. Thus, individuals in these groups may be sought by men looking for these characteristics, leading to opportunities to engage in specific behaviors. Men with a bisexual or other sexual identity were more likely to be in classes marked by vaginal sex, non-penetrative sex, or lack of a

relationship. Finally, individuals who were older were more likely to be in classes marked by multiple same-sex behaviors or relationships, suggesting a possible developmental trend towards committed romantic and sexual relationships, which may or may not be monogamous.

Class membership was also associated with STI diagnosis. In general, individuals in the Multiple Same Sex Behavior classes had highest prevalence, followed by the Insertive Anal and Relationship classes. This is somewhat surprising, as both insertive anal intercourse and being in a relationship may seem to be protective compared to receptive anal intercourse. However, the Receptive Anal class reported high probability of consistent condom use, whereas the three classes with higher STI prevalence reported inconsistent or no condom use. Thus, individuals who only engage in receptive sex may judge their risk to be higher, and use condoms, whereas individuals in other classes may feel protected by their sexual positioning and relationship status, and engage in condomless anal sex. Individuals in relationships may also be more trusting of partners or be more used to sex without a condom and view it as more pleasurable, which may be risky if they have multiple partners. However, there were fewer differences in class membership for viral STIs, which are not fully protected against by condoms²¹ and can be transmitted through non-penetrative behaviors.

There are implications of this study for prevention and clinical practice. First, results are consistent with research suggesting that YMSM are a population at high risk for STI infection¹ and most classes were marked by sex with multiple partners and inconsistent condom use. Because of these risk behaviors and the increasing ubiquity of the internet to find sexual partners, web-based interventions may play an important role in reaching YMSM²². However, the heterogeneity suggests the importance of prevention messages tailored to individuals with different behavioral patterns, as individuals may vary in how they perceive their risk. For example, individuals in the Receptive Anal group had the highest likelihood of consistent condom use, suggesting that they may be viewing themselves as being at higher risk for HIV and be taking measures to protect themselves. In contrast, individuals in the Multiple Behaviors, Insertive Anal and Relationship classes had higher STI prevalences and lower likelihood of using condoms, suggesting that they may not view themselves as being at a high risk. Despite having multiple partners in the past year, individuals in the Relationship class are likely to never use condoms. Many of these individuals may be in non-monogamous relationships, which are relatively common among MSM¹⁴. Individuals in relationships may find messages aimed at MSM in general to be irrelevant, and require different prevention strategies²³. Tailored or adaptive interventions could be used for subgroups with different patterns of behavior. Finally, our finding that the class marked by only receptive anal sex had lower prevalences of STIs than the insertive class suggests that current clinical guidelines focusing on receptive anal sex as the only behavioral marker of risk among MSM²⁴ may not be sufficient to screen individuals at high STI risk.

There are a number of limitations. First, there were several measurement issues. The measure of multiple partners assessed having more than one partner in the past-year, which might not be inherently risky. Assessing a shorter timeframe or concurrent partnerships may

better capture risk. The questions about relationships did not ask about commitment or monogamy, which limits our ability to evaluate our results in the context of a relationship. They also were assessed on a different timescale than the other behaviors, which could have resulted in misclassification. In addition, questions about condom use did not reference specific partners, so we are unable to assess whether condomless sex was occurring with long-term or more casual partners. There could be unmeasured confounders, such as network factors, which could bias our reported association. Our STI outcomes were self-report of diagnosis, which could underestimate the number of men who have an STI.²⁵ This may have biased our findings; for example, if men in the Multiple Same Sex Behaviors class were more likely to inaccurately report their STI status, the association could be attenuated.

Second, although use of internet websites and apps is common, this sample was not representative of all MSM who utilize online communities, and should be considered with the understanding that Internet samples may be biased. Men in this study were mostly white and fairly well educated, and may not be generalizable to MSM who do not interact online. Some research has also suggested men recruited from the internet may be younger, and have less same-sex sexual experiences than men recruited in other ways.²⁶ The response rate was also relatively low. Because technologies change rapidly, individuals recruited from particular websites may not represent all users of sites or apps today or in the future.

Third, we were limited in our ability to examine certain subpopulations. We did not have separate measures of race and ethnicity, so our racial description of the classes may not be complete. Our sample was too small to examine differences among some sexual identities, or to examine individuals engaging in vaginal sex only. To understand this population, and future research should examine individuals who report heterosexual and other sexual identities or engage in only other sex behaviors but are active on same sex sexual networking websites.

The timescales used for our measures of sexual behaviors and STIs were incongruent, and thus we cannot determine the temporality of associations or causality. However, we hypothesize the patterns of behavior observed in the model likely are reflective of patterns of behavior beyond the year in which they were assessed. While it is possible that the STI outcome preceded the reported sexual behaviors, we believe it is unlikely that STI diagnosis would result in riskier patterns of behavior. Regardless of the temporality, the findings suggest important subgroups for interventions. Our data was collected before pre-exposure prophylaxis (PrEP) was approved; thus, we may underestimate prevalences of risk behaviors and STIs, as some (but not all) studies suggest higher prevalences in PrEP users²⁷. We focused only on YMSM who were HIV-; future research should examine behaviors, including factors like antiretroviral adherence as well as sexual behaviors, among HIV+ men.

Despite these limitations, this study applies a new approach to understanding the heterogeneity of sexual behavior among YMSM, which has important implications for STI prevention. Profiles marked by a range of same-sex behaviors with more than one partner were common, although other patterns were observed, and these classes predicted STIs.

Findings demonstrate the importance of promoting safe sex practices in this population and of tailoring prevention messages to be more relevant to MSM with different profiles.

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Figure 1.

Proportion of sample reporting a recent STI, by latent class. Results are adjusted for race/ethnicity, sexual identity, and age. Error bars indicate 95% confidence intervals. Overall log-likelihood ratio test = 81.26, $p < .001$.

Figure 2.

Proportion of sample reporting viral and bacterial STIs, by latent class. Results are adjusted for race/ethnicity, sexual identity, and age. Error bars indicate 95% confidence intervals. Overall log-likelihood ratio tests = 132.66, $p < .001$ for bacterial and = 26.27, $p < .001$ for viral.

Table 1

Descriptive statistics for study variables

Demographics		
Race/Ethnicity	Valid Percent	N
White	76%	4,500
Latino	11%	622
Black	5%	306
Asian	4%	243
Other	4%	252
Sexual Identity		
Gay	74%	4395
Bisexual	21%	1207
Heterosexual	1%	76
Unsure/questioning	3%	192
Other	1%	85
Age (Mean/SD)	22.02 (2.09)	
Latent Class Indicators		
Mutual Masturbation	87%	4,904
Receive Oral (Male partner)	91%	5,122
Perform Oral (Male partner)	91%	5,129
Insertive Anal (Male partner)	71%	3,968
Receptive Anal	74%	4,143
Vaginal (Female partner)	12%	673
Multiple Partners	81%	4,848
In Relationship	16%	980
Condom Use		
No sex without condom	38%	1,671
Some without condom	53%	2,334
All sex without condom	10%	427
Outcomes		
Any STI	12%	671
Bacterial	8%	449
Viral	5%	307

Table 2

Fit Statistics for LCA Models of Past-Year Sexual Behavior with One through Ten Latent Classes

# of Classes	AIC	BIC
1	47523.35	47590.29
2	40660.45	40801.01
3	39565.25	39779.45
4	38905.14	39192.97
5	38419.79	38781.25
6	38201.12	38636.21
7	38038.13	38546.85
8	37907.67	38490.02
9	37851.22	38507.20
10	37824.82	38554.43

Note. AIC = Akaike information criterion; BIC = Bayesian information criterion.

Table 3

Latent Class Prevalences and Item-Response Probabilities for Eight Class Model of Sexual Behavior

Indicators	Class 1: Multiple Same Sex Behaviors	Class 2: Receptive Anal	Class 3: Insertive Anal	Class 4: Relationship	Class 5: Non-Penetrative	Class 6: Not Currently Active	Class 7: Same & Other Sex	Class 8: Vaginal Only
<i>Latent Class Prevalences</i>								
	47%	13%	12%	10%	7%	6%	3%	1%
<i>Item-Response Probabilities</i>								
Mutual Masturbation								
Yes	0.97	0.79	0.92	0.96	0.88	0.17	0.80	0.54
No	0.03	0.21	0.08	0.04	0.12	0.83	1.0	0.46
Receive Oral (Male partner)								
Yes	1.00	0.93	0.99	1.00	0.94	0.05	0.88	0.01
No	0.00	0.07	0.01	0.00	0.06	0.95	0.12	0.99
Perform Oral (Male partner)								
Yes	1.00	0.98	0.95	1.00	0.92	0.06	0.85	0.01
No	0.00	0.2	0.05	0.00	0.08	0.94	0.15	0.99
Receptive Anal (Male partner)								
Yes	1.00	1.00	0.16	0.97	0.03	0.01	0.31	0.00
No	0.00	0.00	0.84	0.03	0.97	0.99	0.69	1.00
Insertive Anal (Male partner)								
Yes	0.90	0.34	1.00	1.00	0.00	0.01	0.25	0.01
No	.10	0.76	0.00	0.00	1.00	0.99	0.75	0.99
Vaginal (Female partner)								
Yes	.13	0.03	0.17	0.03	0.00	0.00	1.00	1.00
No	.87	0.97	0.83	0.97	1.00	1.00	0.00	0.00
Multiple Partners								
0 or 1 Partner	0.02	0.36	0.10	0.36	0.31	0.94	0.08	0.65
2+ Partners	0.98	0.64	0.90	0.64	0.69	0.06	0.92	0.35
Relationship Status								
In a dating relationship	0.10	0.11	0.09	0.69	.10	0.02	0.29	0.50
Not in a relationship	0.90	0.89	0.91	0.31	0.90	0.98	0.71	0.50

	Class 1: Multiple Same Sex Behaviors	Class 2: Receptive Anal	Class 3: Insertive Anal	Class 4: Relationship	Class 5: Non-Penetrative	Class 6: Not Currently Active	Class 7: Same & Other Sex	Class 8: Vaginal Only
Condom Use								
No sex without condom	0.23	0.67	0.00	0.11	1.00	1.00	0.00	0.00
Some sex without condom	0.74	0.32	1.00	0.23	0.00	0.00	0.63	0.43
All sex without condom	0.03	0.00	0.00	0.66	0.00	0.00	0.37	0.57

Note. Bold indicates item response probabilities over .6.

Table 4

Latent Class Membership by Race/Ethnicity and Sexual Identity

	Class 1: Multiple Same Sex Behaviors	Class 2: Receptive Anal	Class 3: Insertive Anal	Class 4: Relation-ship	Class 5: Non-Penetrative	Class 6: Non-Active	Class 7: Same & Other Sex	Class 8: Vaginal Only
	% / M(SD)	% / M(SD)	% / M(SD)	% / M(SD)	% / M(SD)	% / M(SD)	% / M(SD)	% / M(SD)
Race/ethnicity								
White	47.5%	12.6%	12.0%	11.7%	6.7%	6.0%	2.7%	1.0%
Black *	46.4%	15.7%	19.4% *	2.8% *	6.7% *	6.7%	1.9%	0.0%
Latino	50.0%	10.0%	12.0%	10.1%	6.4%	7.2%	4.2%	1.0%
Asian **	39.7%	22.8% *	5.8%	9.4%	11.2% *	8.8% *	1.4%	1.0%
Other race ***	51.1%	12.5%	13.5%	4.8%	9.9%	7.5%	1.0%	0.0% *
Sexual Identity								
Gay	49.4%	14.5%	10.4%	13.0%	7.0%	5.7%	0.00%	0.00%
Bisexual ***	45.9%	8.3% *	17.4% *	4.0% *	6.1%	6.7%	9.5%	2.1%
Other sexual identity ***	28.1%	8.3%	15.6% *	4.2% *	8.9% *	13.8% *	13.6% *	7.5% *
Age *	22.1 (0.1)	21.7(.1) *	22.2 (.1)	22.3 (.1)	21.8(.1) *	21.3 (.1) *	22.3 (.20)	22.7 (.2) *

Note. For race/ethnicity and sexual identity, rows sum to 100% (e.g., percentage of people in each demographic group belonging to each latent class). For age, the mean age of participants within each latent class is presented. M = mean, SD = standard deviation.

* $p < .05$,

** $p < .01$,

*** $p < .001$.