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RESEARCH ARTICLE

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Association Between Perceived Community HIV/AIDS Stigma and HIV Testing Behaviors Among High-Risk Heterosexuals in Dallas and Houston, Texas: An Analysis of the National HIV Behavioral Surveillance System

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ABSTRACT

Background: Stigma-related behaviors place a great burden on people with HIV (PWH) or at risk of infection. For high-risk populations, perceived community HIV/AIDS stigma (PCHAS) may prevent early HIV testing, treatment, and care. The objective of this study was to assess the prevalence of PCHAS and its association with sociodemographic characteristics and HIV testing behaviors among high-risk heterosexuals in Dallas and Houston, Texas.

Methods: Data from 1,003 high-risk heterosexuals recruited using respondent-driven sampling in 2013 and obtained from the National HIV Behavioral Surveillance system in Dallas and Houston, Texas were used for this study. Data procured were subjected to descriptive and inferential statistics that included frequency run, chi-square test and univariate logistic regression models to explore the associations between perceived community HIV/AIDS stigma index (PCHASi) and HIV testing behaviors, and sociodemographic characteristics.

Results: Participants in both cities were primarily Black/African American, of low income, under poverty level, and uninsured. PCHAS was prevalent in Dallas (58.2%) and Houston (57.5%). The majority of participants in Dallas (76.7%) and Houston (86.6%) indicated ever getting tested for HIV, and about a third had tested at least once in the past 2 years. PCHAS was more common among Hispanics/Latinos (p=0.013) in Houston, and annual income (p=0.032), and homelessness (p=0.016) in the past 12 months were associated with PCHAS in Dallas. Participants in Dallas who were afraid of finding out if they had HIV (PR: 4.41, 95% CI: 1.40-13.9) and those who gave other reasons (PR: 2.64, 95%CI: 1.17-5.95) for not testing for HIV in the past year were more likely to perceive community-level support for the rights of PWH. In Houston, participants who had ever tested for HIV (PR: 2.26, 95% CI: 1.27-3.99) and those who tested 3 times (PR: 3.11, 95% CI: 1.18-8.19) in the past 2 years perceived community-level unfriendliness to PWH.

Conclusion: Our study did not establish any clear relationship between PCHAS and HIV testing behaviors. However, perceived community-level fears and unfriendliness to PWH were associated with selected HIV testing behaviors suggesting that HIV knowledge and education at individual- and community-level may be important targets for intervention. Future research should consider the role of social and cultural norms in influencing the relationship between PCHAS and HIV testing behaviors.

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Introduction

HIV/AIDS stigmatization is a recurring challenge to preventive public health efforts, and it contributes to reduced rates of HIV testing and engagement in treatment, [1-3] and consequently, to under diagnosis and underreporting of HIV cases. Some people avoid getting tested due to the fear of stigma associated with a positive test result. For the same reason, people who test positive are often discouraged from disclosing their seropositive status to sexual partners, family, and friends [4-7].

Approximately half of the HIV infected individuals worldwide are unaware of their status, [8] and stigma and discrimination have remained major issues in the acceptance of HIV testing services [9]. In the US, approximately 13% of the more than one million persons living with HIV remain undiagnosed; these individuals are responsible for nearly 30% of the new HIV transmissions in the country [10]. Delays in diagnosis result in lost opportunity for prevention and treatment, leading to poor health outcomes. Early diagnosis and treatment have been shown to improve clinical outcomes, quality of life, and economic productivity [3].

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Perceived stigma is said to be a reflection of a person's beliefs or perceptions about the magnitude of stigma in a geographically defined area [11]. Although HIV-related stigma and discrimination exist worldwide; they manifest themselves differently across countries, communities, religious groups and individuals. Among the US public, HIV/AIDS stigma has manifested as anger and other negative feelings towards PWH, including the belief that they deserve their illness, avoidance and isolation, and support for coercive public policies that threaten their human rights [2,5].

As a significant cause of stress and social disadvantage, stigma may have a substantial effect on population health, similar to other social determinants, which places it as a central driver of morbidity and mortality at a population level [12]. Addressing social factors such as discrimination and stigma that encourage HIV risk and vulnerability, often referred to as social or structural drivers, is the key to establishing effective and long-term responses through in-time testing, treatment compliance and disclosure [13,14].

National public health strategies [15] are currently directed towards reducing new HIV infections in the population as well as increasing HIV status awareness among those already infected. HIV stigmatizing behaviors in the population are also important factor to consider because they may prevent people from getting tested and diagnosed, thereby contributing to the spread of HIV. Similarly, concern about future stigmatization from others may also serve as a psychological barrier to finding out one's status. For instance, PWH's perception of others' beliefs and thoughts about them could possibly be related to the actual stigma that they encounter in the society. To this effect, stigma may be considered a health determinant for PWH and people at risk for HIV such as heterosexuals.

In the United States, 25% of new HIV diagnoses in 2013 were attributable to heterosexual contact [16]. Untangling the dynamics of heterosexual risk for HIV infection is complicated by the fact that heterosexual behavior is common and varied and does not necessarily occur in isolation of other social and behavioral risks. Data from the National HIV Behavioral Surveillance (NHBS) has been used to monitor sex and drug use risk behaviors, HIV testing experiences, and use of HIV prevention strategies among high-risk heterosexuals [17].

Over 97,844 Texans were known to be living with HIV at the end of 2019 [18]. Of this number, Dallas (20%) and Houston (28%) metropolitan areas have the highest numbers of PWH, [18] which reflects the fact that about half of the Texas population lives in these two urban areas. In addition, twenty three percent of the mode of transmission in Texas has been attributed to heterosexual contacts [18]. Due to the likelihood of sexual mixing with the general population, it becomes necessary to determine, if perceived HIV community stigma among these high-risk individuals in Houston and Dallas, Texas have any influence on their decision to engage in HIV prevention strategies such as HIV testing.

While one evidence suggests that self-stigma, or internalized stigma, has an equally damaging effect on the mental wellbeing of people living with HIV or from key affected populations [19], contrary hypothesis was opined that stigma does not actually play a significant role in the dynamics of the HIV epidemics [20]. Similarly, these contradictory findings were resounded by Logie and Gadalla [21], when they noted shifting associations between HIV-related stigma and socio-demographic factors in their meta-analysis and attributed the substantial variability to HIV-related stigma measurement techniques and the participants involved. These studies highlight the complex nature of stigma, which is rooted in concept of deviance from the values and norms of a particular community [22].

This study was further necessitated by the contentions that HIV-stigma has no effect or could even reduce the infection spread of HIV by reducing contacts between the general population and high-risk minorities [20,23]. Self-stigma and fear of a negative community reaction can hinder efforts to address the HIV epidemic by continuing the wall of silence and shame surrounding the virus, [19] which complicate decisions about testing, disclosure of status, and ability to negotiate prevention behaviors, including use of family planning services [24]. The objective of this study therefore was to assess the prevalence of perceived community HIV/AIDS stigma (PCHAS) and its associations with sociodemographic characteristics and HIV testing behaviors, among high-risk heterosexuals in Dallas and Houston, Texas.

Methods

Survey Design and Sample Population

NHBS consists of a repeated cross-sectional survey that utilizes an anonymous standardized questionnaire. The NHBS activities are implemented in rotating annual cycles with three different populations at high-risk for HIV so that data are collected from each risk group every three years. The NHBS cycles are referred to by the group of interest or high-risk group, namely: men who have sex with men (MSM), persons who inject drugs (PWID) and high-risk heterosexuals (HET). The high-risk heterosexual behavior has been defined by 2020 ICD-10-CM Diagnosis Code Z72.51 [25] and described in detail elsewhere [26,27]. The current study used NHBS-HET3 data collected from Dallas and Houston, Texas in 2013.

Sampling Method

Participants were recruited using Respondent Driven Sampling (RDS), [28,29] a peer-driven chain referral sampling used for hard-to-reach populations. The method is similar to snowball sampling and is used to recruit PWID and at-risk heterosexuals that are connected by strong social networks and ties [29]. RDS begins with the non-random selection of a small number of initial recruiters or "seeds" who, in turn, recruit other participants. It is based on the theory that if peer recruitment proceeds through a sufficiently large number of waves, the composition of the sample will stabilize, becoming independent of the "seeds" (initial recruits) thereby overcoming any bias the nonrandom choice of seeds may have introduced and obtaining a sample that resembles the underlying eligible population living in the project area. This chain of recruiters and recruits then continues for multiple "waves" of recruitment until the sample size is reached. The sampling method uses a dual incentive approach where participants are paid for completion of the survey as well as the recruitment of others for the study. Data were collected through face-to-face interviews and HIV testing was offered to participants during the study. All NHBS

activities were conducted anonymously. Further details of the sampling techniques and the sample recruitment process used for the NHBS HET are available elsewhere [30].

To be eligible for the NHBS-HET3 cycle, participants had to be 18 years or older, live in the participating project area, have had condomless vaginal or anal sex with an opposite sex partner in the past 12 months, be cismale or cisfemale, have not injected drugs without a prescription in the past 12 months, have low socioeconomic status (SES) and be able to complete the interview in English or Spanish. Participants were considered to be at low SES if they had an income at or below the poverty level or had no more than a high school degree. Eligible consenting participants were offered $25 for their participation in the study and $10 for each recruit. An additional $25 in compensation was offered to participants who agreed to HIV testing.

Data Collection

Data collection took place in fixed field sites using standard questionnaire administered by trained staff during in-person interview. Data from eligible participants of the NHBS 2013 cycle in Dallas (n=500) and Houston (n=503) totaling 1,003 records were used for the current study. NHBS data collection focuses primarily on sexual and drug-use behaviors that place individuals at high-risk for HIV infection as well as individuals' use of HIV prevention services [31]. Demographic characteristic, non-injecting drug and alcohol use, other health conditions, intimate partner violence, HIV stigma, HIV testing history, and incarceration history measures are also collected. The data comprised of high-risk heterosexual population who had mostly HIV negative status. Less than 2% of the participants had HIV positive status and were excluded in the final analytic dataset.

Measures

All measures in this study were self-reported. The socio-demographic characteristics considered in our study included gender, age, race/ethnicity, marital status, educational status, employment status, income, homeless status (past 12 months), poverty and health insurance status. HIV testing experiences were assessed through the following questions: *have you ever been tested for HIV? (yes/no); number of times tested in the past 2 years, and reasons for not testing in the past 12 months which include: think they are at low risk, afraid of finding out that they are HIV positive, don't have time, and other reasons (including no particular reason for not testing)*. These were referred to as HIV testing behaviors in our study.

Information on the participant's perception of the community's attitudes towards PWH was collected through a set of four questions related to: perceived discrimination (PD) ["Most people in [project area] would discriminate against someone with HIV"], perceived support (PS) ["Most people in [project area] would support the rights of a person with HIV to live and work wherever they want to"], perceived unfriendliness (PU) ["Most people in [project area] would not be friends with someone with HIV"], and perceived punishment (PP) ["Most people in [project area] think that people who got HIV through sex or drug use have gotten what they deserve"]. The response options for these questions were on a five-point Likert-type scale and ranged from 1 (strongly disagree) to 5 (strongly agree). PS responses were reverse-coded. The four stigma-related items were used to develop a composite stigma index, referred to as perceived community HIV/AIDS stigma index (PCHASi) that served as a composite indicator of perceived community stigmatization with higher values indicating greater perceived community HIV/AIDS stigma. Cronbach's alphas for PCHASi were 0.78 and 0.79 for Dallas and Houston, respectively. The PCHASi ranged from 4-20 with a mean of 11.93 (standard deviation=3.15). Using the mean score, participants were dichotomized as follows: less than mean value (No, perceived no community HIV/AIDS stigma) and greater or equal to mean value (Yes, perceived community HIV/AIDS stigma). Subsequently, to assess the association of each measure of perceived community stigma characteristics (PD, PS, PU and PP) with HIV testing behaviors, new variables were created by reclassifying the 5-point response scale into two, where strongly agree and agree represented 1 (Yes, perception for a given measure) and strongly disagree and disagree represented 0 (No, non-perception of a given measure). The response for neither agree nor disagree option was dropped for all measures to avoid neutrality response bias.

Data Analysis

Data obtained were initially subjected to descriptive analyses that involved frequency runs for qualitative variables and descriptive statistics for quantitative variables. Furthermore, the chi-square test was used to explore the associations between PCHASi, and sociodemographic characteristics and HIV testing behaviors. In order to assess the association of each perceived HIV-related stigma characteristics (PD, PS, PU and PP) and perceived community stigma index (PCHASi) to selected HIV testing behaviors, separate univariate logistic regression models were fitted for Dallas, Houston, and the combined data. This allowed for the understanding of each independent variable's effect without controlling for confounding variables, as the data pattern and structure did not allow for use of multivariable models due to convergence problems. For categorical variables with multiple responses, a normative category was selected as a reference category to which other categories of the variable were subsequently compared. Accordingly, "not being tested for HIV" served as reference category for "ever tested for HIV" and "number of times tested for HIV during the past 2 years, respectively, while "thought of being at low risk for HIV" was used as a reference category for reasons for not testing for HIV in the past 12 months. The analysis of each sample provided unadjusted prevalence ratios, and the associated 95% confidence intervals of the associations between the independent variables with perceived community-level stigma associated outcome variables (PD, PS, PU and PP). All statistical tests were two-tailed and used a p-value of 0.05 to determine statistical significance. The sample size for the different analyses varied slightly due to non-response or missing data. Data management and statistical analyses were carried out using SAS statistical software version 9.4 (SAS Institute, Cary, North Carolina, USA).

Human Subject Protection

Activities for NHBS were approved by local institutional review boards (IRBs) in Houston and Dallas project areas and

were in consonant with the Centers for Disease Control and Prevention (CDC) guidelines and codes of federal regulation for the protection of human subjects [32,33]. During the recruitment process, all participants were explicitly assured of the anonymous nature of the survey and the HIV testing. No personal identifiers were collected during participants' enrollment, interview, or testing. All participants provided verbal informed consent to take part in the interview and be tested for HIV. As required by local IRBs, verbal consent for all participants was documented electronically on the survey instrument and on a hard copy by interviewers.

Results

The characteristics of heterosexuals who participated in the survey in Dallas and Houston are described in Table 1. Both samples were diverse with respect to age, educational status, marital status, and employment status. There was almost an equal split between males and females in Dallas (47% vs. 53%) and Houston (48% vs. 52%). The overall mean (standard deviation) age of the study population was 37.6 (12.24) years with the mean age of participants from Houston being two years older than those in Dallas. The majority of participants were Black/African American (85% in Dallas and 93% in Houston), earned less than $20,000 per year (74% in Dallas and 82% in Houston), and were living below the federal poverty level (74% in Dallas and 84% in Houston). More than half of all participants, 53% in Dallas and 56% in Houston reported not having insurance, while 33% of participants in Dallas and 37% in Houston had public insurance. A lower proportion of participants in Dallas (13%) compared to Houston (18%) reported ever being homeless in the past 12 months.

The previous HIV testing experiences of participants are presented in Table 1 with the majority of the participants (77% in Dallas and 87% in Houston) reporting that they had tested for HIV at some point in their life. The number of times participants tested for HIV in the last 2 years varied slightly in both cities and ranged from those who tested once (32% in Dallas and 28% in Houston) to those who had tested four times or more (6% in Dallas and 9% in Houston). When participants who had not been tested were asked about the reasons for not being tested in the past 12 months, 9% in Dallas and 23% in Houston reported that they were afraid of finding out they were HIV positive, 10% in Dallas and 18% in Houston perceived that they were at low risk for HIV, 9% in Dallas and 9% in Houston said that they didn't have time, and 73% in Dallas and 50% in Houston gave other reasons for not testing for HIV.

Table 2 shows the association between PCHASi and sociodemographic characteristics of high-risk heterosexuals in Dallas and Houston. The perceived community HIV/AIDS stigma was prevalent in both metropolitan cities (58.2% in Dallas vs. 57.5% in Houston) with no significant variations (p>0.05) between majority of the sociodemographic characteristics and PCHASi. However, in Dallas, annual income was significantly (p=0.032) associated with PCHASi, with 77% of participants who earned $40,000 or higher being more likely to experience PCHASi than those in income brackets of $0-19,999 (58%) and $20,000-$39,999 (52%). Similarly, participants who reported ever being homeless in Dallas during the past 12 months significantly (p=0.016) perceived more community stigma (72%) towards PWH than those who had never been homeless (56%) during the same period. In Houston, race/ethnicity was the only characteristic that was significantly (p=0.013) associated with PCHASi. Hispanics/Latinos tended to experience more PCHASi (87%) when compared to Blacks or African Americans (56%) and other races (60%). However, in the combined data, other races (72.2%, p=0.045) were more likely to experience more PCHAS than Hispanics/Latinos and Blacks or African Americans (Table 2).

We observed no statistically significant (p>0.05) associations between PCHASi and the HIV testing behaviors among high-risk heterosexuals in both Dallas and Houston (Table 3).

The prevalence ratios of perceived community HIV/AIDS stigma characteristics of high-risk heterosexuals by HIV testing behaviors in Dallas and Houston are presented in Table 4. In general, HIV testing behaviors were not significantly associated with PD and PP in both Dallas and Houston. However, participants in Dallas who indicated that they were afraid of finding out that they had HIV," (Prevalence ratio (PR): 4.41, 95% CI: 1.40-13.9) or those who gave other reasons for not testing for HIV (PR: 2.64, 95%CI: 1.17-5.95) in the past 12 months were more likely than those who felt they were at low risk for HIV to report perceived community-level support for the rights of PWH. In contrast, perceived community-level unfriendliness with PWH was more prevalent among participants in Houston who had ever tested for HIV (PR: 2.26, 95% CI: 1.27-3.99) and those who tested for HIV 3 times in the past 2 years (PR: 3.11, 95% CI: 1.18-8.19) compared to those who had not been tested for HIV during the same period. Similar trends were reported in the combined data, where the study participants who had ever tested for HIV were 47% (PR: 1.47, 95%CI: 1.02-2.12) more likely than those who had not tested for HIV to perceived community-level unfriendliness with PWH. Furthermore, those who had tested for HIV 3 times in the past 2 years were twice (PR: 2.40, 95%CI: 1.13-5.17) more likely to espouse community-level unfriendliness to PWH.

Discussion

Stigma towards persons living with HIV and key populations at higher risk of HIV infection is a major barrier to curbing the HIV epidemic, [34-35] due to its direct impact on HIV prevention strategies and care services [36, 37]. Some community beliefs may devalue PWH and potentiate perceived community HIV stigma or the subjective awareness of HIV stigma in one's local community [38]. Findings from our study indicate that although overall perceptions of HIV/AIDS stigma in Dallas and in Houston were similar, most of the characteristics studied were not significantly associated with PCHASi despite having been related with HIV stigma in previous studies [21,36,37,39]. This finding thus seems to corroborate to some extent the hypothesis that stigma may not actually play a significant role in the dynamics of the HIV epidemics [20]. Logie and Gadalla [21] reported contradictory findings regarding the associations between HIV-related stigma and socio-demographic factors in their meta-analysis study. These variations highlight the complex nature of stigma, which is rooted in concept of deviance from the values and norms of a particular community [22].

Income and homelessness in the past 12 months were the only factors associated with PCHASi among participants in Dallas,

Table 1: Characteristics of high-risk heterosexuals in Dallas and Houston, Texas - National HIV Behavioral Surveillance System, 2013.

	Dallas		Houston		Total	
Characteristics	**n**	**(%)**	**n**	**(%)**	**n**	**(%)**
Gender						
Male	237	47.40	241	47.91	478	47.66
Female	263	52.60	262	52.09	525	52.34
Age (Years)						
≤ 24	100	20.00	70	13.92	170	16.95
25-34	152	30.40	155	30.82	307	30.61
35-44	83	16.60	97	19.28	180	17.95
45-54	119	23.80	121	24.06	240	23.93
55-64	46	9.20	60	11.93	106	10.57
Mean ± Standard Deviation	36.7 ± 12.38		38.7 ± 12.28		37.6 ± 12.24	
Race/Ethnicity						
Hispanic/Latino	47	9.40	23	4.57	70	6.98
Black/African American	427	85.40	470	93.44	897	89.43
Other[€]	26	5.20	10	1.99	36	3.59
Marital Status						
Married	63	12.60	44	8.75	107	10.67
Living together as married	64	12.80	22	4.37	86	8.57
Separated	55	11.00	61	12.13	116	11.57
Divorced	53	10.60	68	13.52	121	12.06
Widowed	5	1.00	12	2.39	17	1.69
Never Married	260	52.00	296	58.85	556	55.43
Educational Status						
≤High School or less	141	28.20	152	30.22	293	29.21
High School Diploma or GED	231	46.20	239	47.51	470	46.86
Some College/Technical Diploma,	121	24.20	107	21.27	228	22.73
Degree or Postgraduate Education	7	1.40	5	0.99	12	1.20
Employment Status						
Unemployed	176	36.74	236	47.97	412	42.43
Employed	223	46.56	184	37.40	407	41.92
Retired/Disabled to work	80	16.70	72	14.63	152	15.65
Annual Income						
$0-$19,999	370	74.00	413	82.11	783	78.07
$20,000-$39,999	95	19.00	70	13.92	165	16.45
$40,000-$74,999	35	7.00	20	3.98	55	5.48
Currently have Health Insurance						
No	264	53.01	283	56.26	547	54.65
Yes	234	46.99	220	43.74	454	45.35
Type of Insurance						
None	264	54.89	283	57.64	547	56.28
Private	56	11.64	24	4.89	80	8.23
Public	161	33.47	184	37.47	345	35.49
Ever Homeless past 12 months						
No	433	86.60	411	81.71	844	84.15
Yes	67	13.40	92	18.29	159	15.85
Poverty Status						
No	126	25.56	78	15.63	204	20.56
Yes	367	74.44	421	84.37	788	79.44
Reason not tested past 12 months						
Afraid of finding out to have HIV	32	8.56	76	23.38	108	15.45
You think you are at low risk for HIV	37	9.89	57	17.54	94	13.45
You didn't have time?	33	8.82	30	9.23	63	9.01
Other Reasons[£]	272	72.73	162	49.85	434	62.09
Ever tested for HIV						
No	116	23.34	67	13.37	183	18.34
Yes	381	76.66	434	86.63	815	81.66
Number of times tested, past 2 years						
Not tested	158	41.91	159	36.98	317	39.28
1 time	120	31.83	122	28.37	242	29.99
2 times	57	15.12	73	16.98	130	16.11
3 times	18	4.77	38	8.84	56	6.94
4 times or more	24	6.37	38	8.84	62	7.68

[€]Other race/ethnicity includes American Indian or Alaskan Native, Asian, Native Hawaiian or Pacific Islander, White and Multiracial; [£]Other reasons include: "Some other reasons" and "No particular reason"; Within characteristic and levels, the percentages may not add up to exactly 100 due to rounding.

Table 2: Association between perceived community HIV/AIDS related stigma and sociodemographic characteristics of high-risk heterosexuals in Dallas and Houston, Texas - National HIV Behavioral Surveillance System, 2013.

	Dallas						Houston						Total					
	PCHASi						PCHASi						PCHASi					
	No		Yes				No		Yes				No		Yes			
Characteristics	n	%	n	%	χ^2	*p*-value	n	%	n	%	χ^2	*p*-value	n	%	n	%	χ^2	*p*-value
Overall	209	41.8	291	58.2			214	42.5	289	57.5			423	42.2	580	57.8	0.06	0.811
Gender																		
Male	98	41.4	139	58.7			100	41.5	141	58.5			198	41.4	280	58.6		
Female	111	42.2	152	57.8	0.04	0.847	114	43.5	148	56.5	0.21	0.648	225	42.9	300	57.1	0.21	0.645
Age (Years)																		
18-24	39	39.0	61	61.0			30	42.9	40	57.1			69	40.6	101	59.4		
25-34	69	45.4	83	54.6			64	41.3	91	58.7			133	43.3	174	56.7		
35-44	34	41.0	49	59.0			43	44.3	54	55.7			77	42.8	103	57.2		
45-54	46	38.7	73	61.3			51	42.2	70	57.9			97	40.4	143	59.6		
55-64	21	45.7	25	54.4	1.92	0.751	26	43.3	34	56.7	0.25	0.992	47	44.3	59	55.7	0.88	0.928
Race/Ethnicity																		
Hispanic/Latino	20	42.6	27	57.5			3	13.0	20	87.0			23	32.9	47	67.1		
Black/African American	183	42.9	244	57.1			207	44.0	263	56.0			390	43.5	507	56.5		
Other[€]	6	23.1	20	76.9	3.95	0.139	4	40.0	6	60.0	8.64	0.013**	10	27.8	26	72.2	6.17	0.045*
Marital Status																		
Married	23	36.5	40	63.5			18	40.9	26	59.1			41	38.3	66	61.7		
Living together as married	32	50.0	32	50.0			13	59.1	9	40.9			45	52.3	41	47.7		
Separated	19	34.6	36	65.4			27	44.3	34	55.7			46	39.7	70	60.3		
Divorced	20	37.7	33	62.3			29	42.7	39	57.4			49	40.5	72	59.5		
Widowed	1	20.0	4	80.0			3	25.0	9	75.0			4	23.5	13	76.5		
Never Married	114	43.9	146	56.1	5.47	0.362	124	41.9	172	58.1	4.15	0.528	238	42.8	318	57.2	7.24	0.203
Education Status																		
Less than High School	59	41.8	82	58.2			68	44.7	84	55.3			127	43.3	166	56.7		
High School Diploma/GED	98	42.4	133	57.6			101	42.3	138	57.7			199	42.3	271	57.7		
Some College/ Technical Dip.	49	40.5	72	59.5			42	39.3	65	60.8			91	39.9	137	60.1		
Degree or Post-graduate Education	3	42.9	4	57.1	0.12	0.989	3	60.0	2	40.0	1.40	0.704	6	50.0	6	50.0	0.95	0.813
Employment Status																		
Unemployed	67	38.1	109	61.9			109	46.2	127	53.8			176	42.7	236	57.3		
Employed	101	45.3	122	54.7			67	36.4	117	63.6			168	41.3	239	58.7		
Retired/Disabled to work	31	38.8	49	61.3	2.42	0.298	32	44.4	40	55.6	4.20	0.122	63	41.5	89	58.6	0.19	0.909
Annual Income																		
$0-$19,999	155	41.9	215	58.1			181	43.8	232	56.2			336	42.9	447	57.1		
$20,000-$39,999	46	48.4	49	51.6			26	37.1	44	62.9			72	43.6	93	56.4		
$40,000-$74,999	8	22.9	27	77.1	6.88	0.032*	7	35.0	13	65.0	1.58	0.454	15	27.3	40	72.7	5.32	0.069
Currently have Insurance																		
No	107	40.5	157	59.5			126	44.5	157	55.5			233	42.6	314	57.4		
Yes	101	43.2	133	56.8	0.35	0.552	88	40.0	132	60.0	1.03	0.308	189	41.6	265	58.4	0.09	0.758
Type of Insurance																		
None	107	40.5	157	59.5			126	44.5	157	55.5			233	42.6	314	57.4		
Private Insurance	26	46.4	30	53.6			7	29.2	17	70.8			33	41.3	47	58.8		
Public Insurance	68	42.2	93	57.8	0.68	0.711	78	42.4	106	57.6	2.16	0.338	146	42.3	199	57.7	0.05	0.974
Poverty Status																		
No	50	39.7	76	60.3			27	34.6	51	65.4			77	37.8	127	62.3		
Yes	157	42.8	210	57.2	0.37	0.543	186	44.2	235	55.8	2.46	0.116	343	43.5	445	56.5	2.22	0.136
Currently Homeless																		
No	17	29.3	41	70.7			31	42.5	42	57.5			48	36.6	83	63.4		
Yes	2	22.2	7	77.8	0.19	0.661	11	57.9	8	42.1	1.44	0.229	13	46.4	15	53.6	0.93	0.335
Ever Homeless past 12 months																	1.12	0.289
No	190	43.9	243	56.1			172	41.9	239	58.2			362	42.9	482	57.1		
Yes	19	28.4	48	71.6	5.74	0.016*	42	45.7	50	54.4	0.44	0.504	61	38.4	98	61.6	1.12	0.289

PCHASi=Perceived community HIV/AIDS Stigma index; χ^2 = Chi-Square value;
[€]Other race/ethnicity includes American Indian or Alaskan Native, Asian, Native Hawaiian or Pacific Islander, White and Multiracial.
Within characteristic and level, the percentages may not add up to exactly 100 due to rounding.
*Significance level: *=p<0.05; **=p<0.01.*

Table 3: Association between perceived community HIV/AIDS stigma and HIV testing behaviors among HIV high-risk heterosexuals in Dallas and Houston, Texas - National HIV Behavioral Surveillance System, 2013.

	Dallas						Houston						Total					
	PCHASi						PCHASi						PCHASi					
	No		Yes				No		Yes				No		Yes			
Characteristics	n	%	n	%	χ^2	*p*-value	n	%	n	%	χ^2	*p*-value	n	%	n	%	χ^2	*p*-value
Ever tested for HIV																		
No	51	44.0	65	56.0			23	34.3	44	65.7			74	40.4	109	59.6		
Yes	157	41.2	224	58.8	0.28	0.598	190	43.8	244	56.2	2.12	0.145	347	42.6	468	57.1	0.28	0.596
Reasons not tested past 12 months																		
Afraid of finding to have HIV	14	43.8	18	56.3			33	43.4	43	56.6			47	43.5	61	56.5		
You think are at low HIV risk	10	27.0	27	73.0			29	50.9	28	49.1			39	41.5	55	58.5		
You didn't have time?	12	36.4	21	63.6			11	36.7	19	63.3			23	36.5	40	63.5		
Other reasons[£]	121	44.5	151	55.5	4.73	0.316	60	37.0	102	63.0	6.41	0.170	181	41.1	253	59.0	0.22	0.894
Number of times tested past 2 years																		
Not tested	66	41.8	92	58.2			71	44.7	88	55.4			137	43.2	180	56.8		
1 time	45	37.5	75	62.5			48	39.3	74	60.7			93	38.4	149	61.6		
2 times	28	49.1	29	50.9			31	42.5	42	57.5			59	45.4	71	54.6		
3 times	8	44.4	10	55.6			24	63.2	14	36.8			32	57.1	24	42.9		
4 times or more	9	37.5	15	62.5	2.55	0.768	15	39.5	23	60.5	9.08	0.106	24	38.7	38	61.3	7.39	0.116

PCHASi=Perceived community HIV/AIDS Stigma index; χ^2 = Chi-Square value
[£]Other reasons include: "Some other reasons" and "No particular reason".
Within characteristic and level, the percentages may not add up to exactly 100 due to rounding.

Table 4: Prevalence ratios of perceived community HIV/AIDS stigma characteristics of high-risk heterosexuals by HIV testing behaviors in Dallas and Houston, Texas - National HIV Behavioral Surveillance System, 2013.

	Dallas		Houston		Total	
Stigma/Testing Characteristics[£]	**PR[§]**	**95%CI**	**PR[§]**	**95%CI**	**PR[§]**	**95%CI**
Perceived Discrimination (PD)						
Ever tested for HIV						
No (*Ref*)	1.00		1.00		1.00	
Yes	0.99	0.57-1.71	1.24	0.58-2.62	1.00	0.65-1.55
Number of times tested, past 2 years						
Not tested (*Ref*)	1.00		1.00		1.00	
1 time	0.76	0.39-1.46	0.87	0.46-1.64	0.82	0.52-1.29
2 times	1.10	0.49-2.46	0.79	0.37-1.68	0.91	0.52-1.55
3 times	1.06	0.27-4.21	0.91	0.34-2.42	0.92	0.42-2.04
4 times	1.75	0.59-5.14	0.36	0.10-1.24	0.73	0.34-1.59
Reason not tested past 12 months						
You think you are at low risk for HIV (*Ref*)	1.00		1.00		1.00	
You were afraid of finding out to have HIV	2.06	0.53-8.00	0.71	0.29-1.70	0.99	0.48-2.06
You don't have time	2.06	0.53-8.00	0.64	0.20-2.02	1.01	0.44-2.32
Other Reasons[£]	2.04	0.68-6.13	0.67	0.31-1.44	1.06	0.59-1.93
Perceived Support (PS)						
Ever tested for HIV						
No (*Ref*)	1.00		1.00		1.00	
Yes	0.55	0.33-0.92	1.27	0.72-2.23	0.79	0.55-1.16
Number of times tested, past 2 years						
Not tested (*Ref*)	1.00		1.00		1.00	
1 time	1.09	0.63-1.88	1.08	0.64-1.83	1.09	0.75-1.59
2 times	1.59	0.72-3.57	1.13	0.59-2.11	1.29	0.79-2.15
3 times	1.06	0.35-3.25	2.46	0.99-6.07	1.87	0.94-3.72
4 times	0.69	0.24-2.04	1.16	0.54-2.50	1.02	0.55-1.88
Reason not tested past 12 months						
You think you are at low risk for HIV (*Ref*)	1.00		1.00		1.00	
You were afraid of finding out to have HIV	4.41*	1.40-13.90	0.51	0.24-1.10	1.03	0.56-1.89
You don't have time	1.77	0.62-5.01	0.79	0.30-2.07	1.02	0.52-2.02
Other Reasons[£]	2.64*	1.17-5.95	0.58	0.28-1.13	1.10	0.66-1.83
Perceived Unfriendliness (PU)						
Ever tested for HIV						
No (*Ref*)	1.00		1.00		1.00	
Yes	1.06	0.66-1.73	2.26**	1.27-3.99	1.47	1.02-2.12
Number of times tested, past 2 years						
Not tested (*Ref*)	1.00		1.00		1.00	
1 time	0.51	0.29-0.88	1.20	0.72-2.01	0.81	0.56-1.17
2 times	1.18	0.56-2.49	0.99	0.53-1.81	1.04	0.66-1.67
3 times	1.54	0.44-5.42	3.11*	1.18-8.19	2.40	1.13-5.17
4 times	1.03	0.34-3.15	0.84	0.39-1.79	0.87	0.47-1.63

Reason not tested past 12 months						
You think you are at low risk for HIV (*Ref*)	1.00		1.00		1.00	
You were afraid of finding out to have HIV	1.16	0.39-3.37	0.68	0.33-1.42	0.82	0.45-1.50
You don't have time	0.79	0.26-2.33	0.51	0.20-1.27	0.59	0.29-1.18
Other Reasons[£]	1.26	0.56-2.82	0.72	0.37-1.34	0.89	0.54-1.47
Perceived Punishment (PP)						
Ever tested for HIV						
No (*Ref*)	1.00		1.00		1.00	
Yes	0.90	0.48-1.69	1.29	0.72-2.33	1.00	0.66-1.55
Number of times tested, past 2 years						
Not tested (*Ref*)	1.00		1.00		1.00	
1 time	1.07	0.55-2.07	0.98	0.55-1.75	1.02	0.66-1.57
2 times	2.29	0.75-7.02	0.97	0.50-1.88	1.18	0.68-2.04
3 times	0.82	0.21-3.23	2.00	0.72-5.58	1.43	0.63-3.23
4 times	0.49	0.15-1.58	0.66	0.29-1.46	0.57	0.29-1.09
Reason not tested past 12 months						
You think you are at low risk for HIV (*Ref*)	1.00		1.00		1.00	
You were afraid of finding out to have HIV	0.46	0.14-1.48	0.58	0.25-1.37	0.55	0.28-1.09
You don't have time	1.34	0.37-4.83	0.55	0.19-1.55	0.82	0.36-1.81
Other Reasons[£]	1.72	0.68-4.34	0.67	0.31-1.44	1.11	0.61-1.98
Perceived Community HIV/AIDS Stigma Index (PCHASi)						
Ever tested for HIV						
No (*Ref*)	1.00		1.00		1.00	
Yes	1.12	0.74-1.70	0.67	0.39-1.15	0.92	0.66-1.27
Number of times tested, past 2 years						
Not tested (*Ref*)	1.00		1.00		1.00	
1 time	1.19	0.74-1.95	1.24	0.77-2.01	1.22	0.87-1.72
2 times	0.74	0.41-1.37	1.09	0.62-1.91	0.92	0.61-1.38
3 times	0.89	0.34-2.39	0.47	0.22-0.97	0.57	0.32-1.02
4 times	1.19	0.49-2.89	1.23	0.61-2.54	1.21	0.69-2.10
Reason not tested past 12 months						
You think you are at low risk for HIV (*Ref*)	1.00		1.00		1.00	
You were afraid of finding out to have HIV	0.47	0.17-1.30	1.35	0.67-2.68	0.92	0.52-1.61
You don't have time	0.64	0.23-1.78	1.78	0.72-4.42	1.23	0.63-2.37
Other Reasons[£]	0.46	0.21-0.99	1.76	0.95-3.23	0.99	0.63-1.55

*[£]Other reasons include: "Some other reasons" and "No particular reason". [§]PR: Unadjusted Prevalence ratio; Ref=Reference level; [£]The Stigma characteristics represent each independent model created for perceived discrimination (PD), perceived support (PS), perceived unfriendliness (PU), perceived punishment (PP) and perceived community HIV/AIDS stigma index (PCHASi); 95%CI= 95% Confidence Interval; Significance Level: *=p<0.05; **=p<0.01.*

in contrast to Houston, where PCHASi prevalence varied significantly by race/ethnicity. About 77% of participants in Dallas who annually earned $40,000 or above perceived their communities as having HIV stigma. This finding supports the fact that an increasing gap in income level and an individual's absolute income can create social conditions that facilitate perception of HIV community stigma [40]. Consequently, individuals with lower incomes tend to have lower PCHASi, possibly because they have fewer resources available to conceal or mitigate negative responses from the community [41]. Our study recorded significant variations in PCHASi by race/ethnicity in Houston, with majority of Hispanics/Latinos experiencing it more than other races. HIV-stigma and discrimination based on race/ethnicity, gender, and socioeconomic status have been reported in the healthcare systems [42-44]. However, there is still a limited understanding of how stigma contributes to racial/ethnic HIV disparities and how the impact of stigma can be reduced to alleviate these disparities. According to Earnshaw *et al.,* [44] strengthening economic and community empowerment, trust at the structural level, creating common in-group identities, and promoting contact with PWH among perceivers at the individual level can improve resilience to societal stigma and ultimately reduce racial/ethnic HIV disparities.

Previous studies have linked the perception of stigma to a lower HIV testing uptake [45-48]. Although we found no significant associations between HIV testing behaviors and PCHAS in our study populations, there were high prevalence of HIV testing among participants in both Dallas and Houston. This may be considered a positive development since it has been reported that high individual-level manifestations of stigma towards PWH in a particular community could prevent people from testing for HIV or disclosing their HIV-positive status to a sexual partner or family member [4-7, 9]. A possible explanation could be related to the study's focus on a high-risk heterosexual population for which HIV testing is recommended at least once a year [49]. Also, evidence supports the possibility that people seek cover for HIV testing [3,50]. For example, donating blood may provide a cover for HIV testing by allowing people to appear interested in performing the non-stigmatized service of blood donation [51]. Previous studies have shown that there are distinct processes for responding to stigmatized nature of HIV among the HIV uninfected and HIV infected persons [21,38-39]. However, awareness programs such as "Hip Hop for HIV" conducted annually in Houston and Dallas [52] have been effective in identifying undiagnosed HIV infections and getting people to identify and acknowledge their risks, and engage with services that can help them seek harm-reduction strategies.

In Houston, the health department started a broad-scale implementation of rapid HIV testing in traditional (e.g. clinic-based) and non-traditional (community-based, mobile units) settings since 2005. For instance, of the 210,565 HIV tests conducted in Houston in 2011, about 50% occurred in organizations that received no direct local public health funding [53]. This highlights the important contributions made by non-governmental organizations and CBOs in supporting prevention activities in Houston and may well explain the

ten-percentage point difference in HIV testing rates reported between Houston (87%) and Dallas (77%). Despite the CDC recommendations for HIV testing, especially for the high-risk population, [49] only about a third of the participants in both cities had tested for HIV in the past 2 years, whereas 42% in Dallas and 37% in Houston had not tested for HIV in the past 2 years. High-risk heterosexuals have been associated with low HIV testing intake in previous studies [54,55]. Gwadz *et al.* reported that high-risk heterosexuals experience serious and multifaceted barriers to annual HIV testing [56]. It is important therefore to identify barriers to HIV testing for this group in both cities as a first step in the design of culturally appropriate and targeted interventions. Such efforts could help breakdown the stigma and discrimination and enhance readiness and motivation to test for HIV.

HIV-related stigma and discrimination can undermine the ability of individuals and communities to protect themselves. We found that participants in Dallas who gave reasons other than "thought of being at low risk," such as being afraid of finding out if they have HIV, reported perceived community-level support for the rights of PWH. Many people with HIV, particularly at the time of their diagnosis, desired the emotional and practical support of people close to them at individual (families, friends, and partners), community and societal levels. These supports help PWH resist stigmatizing experiences in the community. The protection, respect, and fulfilment of human rights are important ways of combating HIV-related stigma and discrimination [57]. Earnshaw *et al.* [44] provided the first known evidence that perceived community support may enhance PWH's resilience to enacted and anticipated stigma by helping them regulate their emotions and overcome barriers associated with stigma. Similarly, individual- and community-level support may help decrease the perceived legitimacy of negative evaluations of PWH and allow individuals to develop a more positive attitude to reduce the internalization of stigma [58]. Among high-risk heterosexuals in Houston, those who had ever tested for HIV or had multiple HIV tests over a period of 2 years perceived more community-level unfriendliness to PWH than those who had not tested for HIV ever or in the last 2 years. Because routine HIV testing offers opportunity for counseling and education and should helped improve awareness, HIV knowledge and result in better relationship with PWH in the community, it is therefore, surprising to note these outcomes in our current study. Nevertheless, the decision to avoid testing for HIV has been previously reported to be a means for people to prevent the stigmatization associated with both testing and a positive test result [3].

HIV testing behaviors of participants in Dallas and Houston were not significant predictors of perceived community-level discrimination or punishment. These findings may be associated with improved knowledge of HIV and attitudes towards PWH in both cities. On the contrary, it's been reported that stigma and the resulting discriminatory attitudes towards PWH create an environment that fuels the spread of HIV [59]. Also, stigmatizing, non-acceptance and intolerance toward PWH have been implicated as obstacles in HIV prevention strategies including the education of unreached at-risk groups [60,61].

Study Limitations

Our findings are subject to several limitations. First, the study assessed the differences in perceived community stigma among high-risk heterosexual population who had mostly HIV negative status. Less than 2% of the participants had HIV positive status and were excluded in the final analysis. Second, because our data was self-reported, social desirability and recall biases may have led to under-reporting of stigma and over-reporting of willingness to test for HIV. Third, our study used the RDS technique, which tends to allow a statistically representative sample to be drawn from an unrepresentative part of the target population. The study data was not weighted to compensate for non-random recruitment patterns or network size, or the likelihood of a particular group being selected to participate in the survey. Also, the number of waves typically used in RDS studies may not be sufficient to remove seed bias. Consequently, some bias may have been introduced through differential recruitment behavior and large sampling fractions [62]. Therefore, our results might not be generalizable to other heterosexuals outside of, or within Dallas and Houston, Texas. However, using RDS and a set of eligibility and recruitment criteria, CDC concluded that these techniques resulted in a sample that represented the population of interest [63]. Finally, our study was cross-sectional in nature, and cannot be linked to any particular HIV testing initiatives, including the CDC's Expanded Testing Initiative, and thus, causality cannot be established.

Conclusion

We conclude that there are significant variations in PCHAS by race/ethnicity in Houston, and annual income, and homelessness in Dallas in the past 12 months. Although our study did not establish any clear relationship between HIV testing behaviors and PCHAS, perceived community-level fears and unfriendliness to PWH were however, significantly associated with selected HIV testing behaviors. On the other hand, the low uptake of HIV testing among high-risk heterosexuals in both cities, clearly indicate the need for targeted preventive interventions that could enhance HIV knowledge, provide behavioral counseling, and foster acceptance of HIV testing. Considering the changing racial and ethnic composition of Dallas and Houston, Texas future research should take into account stigma reduction strategies as well as focus on understanding the role played by social and cultural norms in influencing the relationship power including individual-level decisions to adopt HIV prevention strategies and care. However, the successful removal of these barriers in high-risk populations including heterosexuals may lead to PCHAS-free HIV testing, education, treatment, and care services, considered the panaceas for ending the HIV epidemic.

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Authors' Contributions

Conception, design or planning of the study: ZL, OM, SK, JP; Contributed to acquisition of data, and statistical analysis: OM, JP, ZL, MV; Prepared the initial draft of the manuscript: ZL, OM, SK. Interpretation of the study findings and participation in the critical review/revision of the article for important intellectual contents: ZL, OM, SK, JP, MV. All authors reviewed and approved the final version of the manuscript submitted for publication.

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