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ORIGINAL PAPER

The Relationship Between Discrimination and Missed HIV Care Appointments Among Women Living with HIV

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Abstract

Receiving regular HIV care is crucial for maintaining good health among persons with HIV. However, racial and gender disparities in HIV care receipt exist. Discrimination and its impact may vary by race/ethnicity and gender, contributing to disparities. Data from 1578 women in the Women's Interagency HIV Study ascertained from 10/1/2012 to 9/30/2016 were used to: (1) estimate the relationship between discrimination and missing any scheduled HIV care appointments and (2) assess whether this relationship is effect measure modified by race/ethnicity. Self-reported measures captured discrimination and the primary outcome of missing any HIV care appointments in the last 6 months. Log-binomial models accounting for measured sources of confounding and selection bias were fit. For the primary outcome analyses, women experiencing discrimination typically had a higher prevalence of missing an HIV care appointment. Moreover, there was no statistically significant evidence for effect measure modification by race/ethnicity. Interventions to minimize discrimination or its impact may improve HIV care engagement among women.

Keywords HIV · Social discrimination · Outpatient care · Women · Health status disparities

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Introduction

Receiving regular HIV care is crucial for maintaining good health among persons living with HIV [1]. Missing HIV clinic visits is important because it has been associated with not receiving antiretroviral therapy (ART) [2], unsuppressed HIV viral load [3], and increased mortality [4–6]. Prior work has indicated that African Americans are more likely to miss HIV clinic visits than Caucasians [3, 5, 7, 8]. Furthermore, compared to men, women have been observed to be less likely to establish HIV outpatient care [9–11] or be retained in HIV care [12, 13]. Given the importance of receiving regular HIV care and observed racial and gender disparities, identifying determinants of worse engagement in HIV care is critical to minimizing barriers to HIV care among racial minorities and women.

Discrimination may be a determinant of worse engagement in HIV care [14]. Discrimination is "the process by which a member, or members, of a socially defined group is, or are, treated differently (especially unfairly) because of his/her/their membership of that group" [15]. Research has demonstrated that discrimination in general can be a chronic psychological stressor [16, 17], which can cause deterioration of regulatory and organ systems [18, 19] and ultimately contribute to disease onset, progression, and severity [16]. A review of population-based studies [20] and a meta-analysis among African American men [21] indicated that discrimination is associated with worse mental health, which in turn has been identified as a barrier to retention in HIV care [22]. Furthermore, negative mood and somatic symptoms and percentage of days with depression have been positively associated with missing HIV care appointments [23, 24]. Prolonged stress can also affect one's self-control resources, which resultantly may impact healthy and unhealthy behaviors [25].

In 2015, women represented 23% of persons living with HIV in the United States (US) [26]. Women living with HIV may experience discrimination because of their gender, race/ethnicity, socioeconomic position, or stigma stemming from their HIV status [14, 27]. There is a dearth of quantitative evidence in the published literature that characterizes the impact of discrimination on HIV care receipt [27] or other relevant HIV outcomes [28, 29]. Furthermore, there is little evidence on whether the impact of discrimination varies by race/ethnicity, which is of interest because different racial/ethnic groups may experience different types or degrees of discrimination [27]. Characterizing the impact of discrimination may provide insights for developing interventions to promote engagement in HIV care among women, as well as identify which women defined by race/ethnicity are most likely to benefit from such interventions. We used existing data from women living with HIV enrolled in the Women's Interagency HIV Study (WIHS) to complete the following aims: (1) examine the relationship between discrimination and missing any scheduled regular HIV care appointments and (2) assess whether this relationship is effect measure modified by race/ethnicity.

Methods

Study Population

The WIHS is a multi-site prospective cohort study established to study the effects of HIV infection on women in the US. Beginning in 1994, women living with HIV or women at risk for HIV provided written informed consent in English or Spanish and were enrolled in the WIHS through four recruitment waves. Participants attend semiannual study visits at the WIHS clinical sites where they complete a scripted interview and undergo laboratory testing and physical and gynecologic exams. The locations of WIHS clinical sites include Atlanta, Georgia; Birmingham, Alabama/Jackson, Mississippi; Bronx/Manhattan, New York; Brooklyn, New York; Chapel Hill, North Carolina; Chicago, Illinois; Los Angeles, California (discontinued in 2013); Miami, Florida; San Francisco, California; and Washington, DC. The WIHS was approved by the Institutional Review Board (IRB) at each clinical site. This secondary data analysis was also approved by the Brown University IRB. The WIHS has been described previously [30–32].

Theoretical Framework

Figure 1 depicts a simplified diagram for the relationship between discrimination and missing an HIV care appointment. This diagram was in part based on prior research [3, 7, 9, 13, 14, 20, 22–24, 27, 33–36], as well as the WIHS study design. The effect of discrimination on missing an HIV care appointment is potentially mediated by socioeconomic position, alcohol/drug use, and mental health. Discrimination can directly influence socioeconomic position through discriminatory policies [33], mental health [20], and alcohol/drug use [34–36]. It is also possible, however, that socioeconomic position, gender, race/ethnicity, year of birth, alcohol/drug use, and mental health directly influence discrimination. Variables included in the diagram were captured as described below.

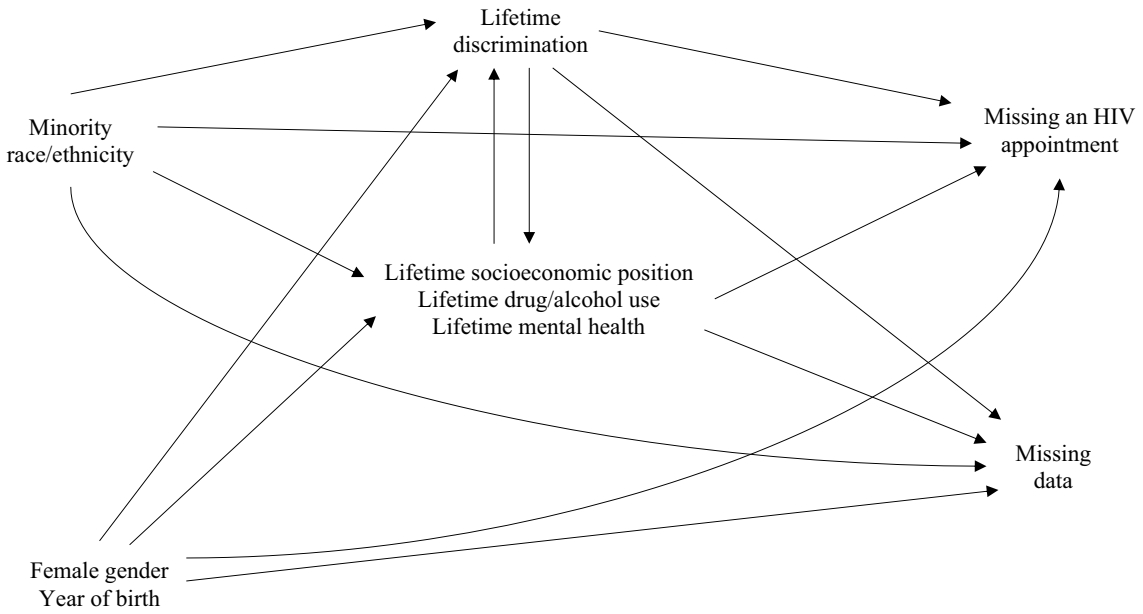

Fig. 1 Simplified diagram for the relationship between discrimination and missing an HIV appointment in the Women's Interagency HIV Study between October 1, 2012 and September 30, 2016. A missing data node is included in the diagram because the analytic sample for this secondary data analysis was restricted to women with complete data on discrimination, missing HIV appointments, and measured covariates

Analytic Sample

Figure 2 outlines the inclusion and exclusion criteria used to generate the primary analytic sample. Data were ascertained for 1751 women living with HIV who attended a study visit between October 1, 2013 and September 30, 2016 and were administered the questionnaire that assessed both discrimination and missing an HIV care appointment in the last 6 months. Of these 1751 women, 53 (3%) were excluded because their race/ethnicity was not African American, Caucasian, or Hispanic. The primary analytic sample was restricted to solely African American, Caucasian, and Hispanic women to ensure adequate sample sizes in analyses. Of the remaining 1698 women, 27 (2%), 54 (3%), and 39 (2%) were sequentially excluded due to missing data on covariates, any measure of discrimination, and missing an HIV care appointment in the last 6 months, respectively. The primary analytic sample for the primary analyses was 1578 women.

In a subset of sensitivity analyses, the outcome was missed an HIV care appointment in the last year. In these sensitivity analyses, 177 (10%) women were excluded for having missing data on the outcome (Supplementary Fig. 1), which yielded 1440 women in the corresponding analytic sample.

Measures

All relevant data were captured by self-report through questionnaires as part of the scripted interview during study visits. Discrimination was assessed using several measures [37–39]. Specifically, overall discrimination was assessed by participant response to the questions, "Overall, how much has discrimination interfered with you having a full and productive life?" (hereafter, discrimination interfered with life) and "Overall, how much harder has your life been because of discrimination?" (hereafter, discrimination made life harder). Response options included: "A lot," "Some," "A little," or "Not at all." These two overall measures were dichotomized as "Yes" ("A lot," "Some," or "A little") or "No" ("Not at all"). In a subset of sensitivity analyses, responses were categorized into the following groups: "A lot," "'Some' or 'A little,'" or "Not at all."

Another measure assessed discrimination by participant response to questions that are a part of the Major Experiences of Discrimination (Abbreviated Version) scale [37–39]. These questions included: "At any time in your life, have you ever been unfairly fired from a job or been unfairly denied a promotion in a job?"; "For unfair reasons, have you ever not been hired for a job?"; "Have you ever been unfairly stopped, searched, questioned, physically threatened or abused by the police?"; "Have you ever been unfairly discouraged by a teacher or advisor from continuing your education?"; "Have you ever been unfairly prevented

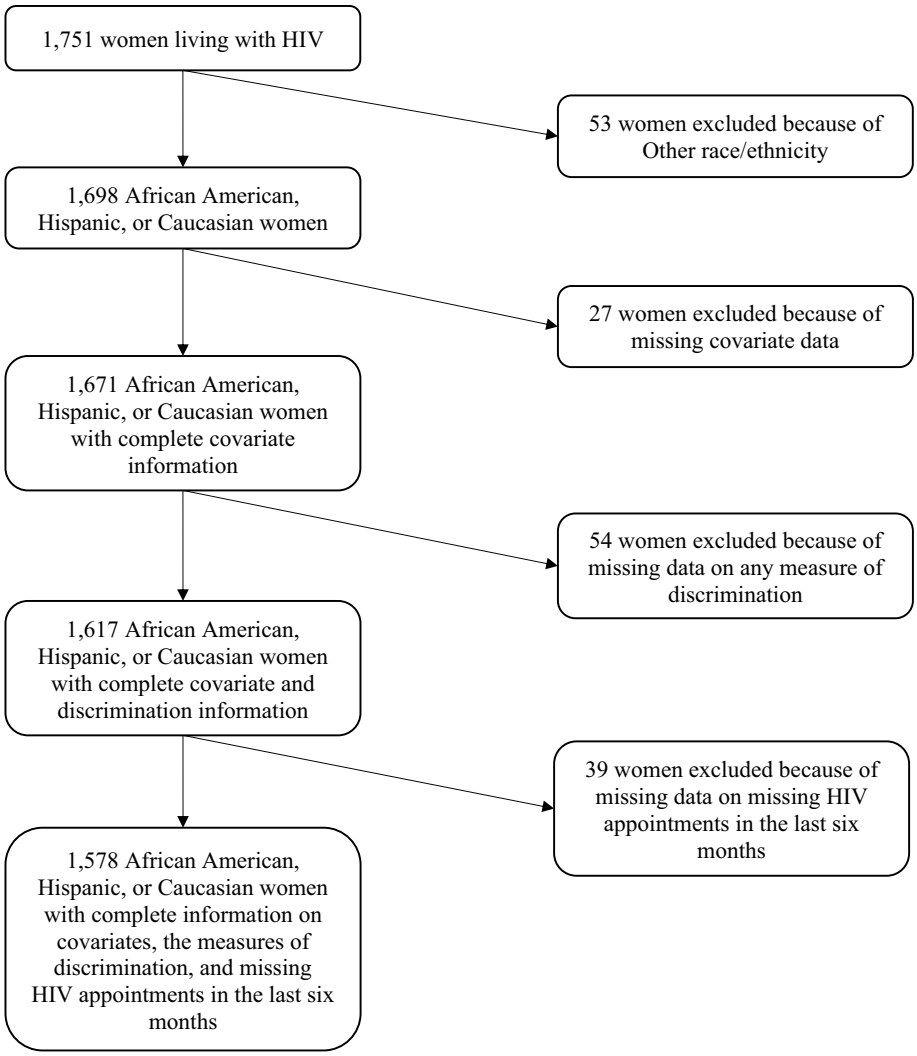

Fig. 2 Inclusion and exclusion criteria used to create the primary analytic sample of women in the Women's HIV Interagency Study whose data was ascertained between October 1, 2012 and September 30, 2016; who were African American, Hispanic, or Caucasian; and who have complete information on discrimination, missing HIV appointments in the last 6 months, and measured covariates

from moving into a neighborhood because the landlord or realtor didn't want to sell or rent you a house or apartment?"; and "Have you ever been unfairly denied a bank loan?" Response options to each question included: "Yes" or "No." The aforementioned questions were used to create a single aggregate measure (hereafter, major experience(s) of discrimination). This aggregate measure was dichotomized as "Yes" (responded "Yes" to at least one question) or "No" (responded "No" to all questions). In a subset of sensitivity analyses, the aggregate measure was categorized into the following groups: 0, 1, or 2–6 major experience(s) of discrimination.

Type of discrimination was also assessed. For each "Yes" response to the above questions that are a part of the Major Experiences of Discrimination (Abbreviated Version) scale, participants were asked the follow-up questions: "How much do you think your gender had to do with this?"; "How much do you think your race/ethnicity had to do with this?"; and "How much do you think your HIV had to do with this?" Response options to each follow-up question included: "Nothing," "A little," "Some," "A lot," and "Everything." These responses were dichotomized as "Yes" ("A little," "Some," "A lot," or "Everything") or "No" ("Nothing"). These follow-up questions and the major experience(s) of discrimination measure were used to create three aggregate measures of discrimination type (hereafter, major experience(s) of discrimination related to gender, race/ethnicity, and HIV status). Each discrimination type aggregate measure was dichotomized as "Yes" ("Yes" response to at least one follow-up question) or "No" ("No" response to all asked follow-up questions or "No" response to major experience(s) of discrimination). In a subset of sensitivity analyses, each discrimination type aggregate measure was categorized into the following groups: 0, 1, or 2–6 major experience(s) of discrimination related to a specific type of discrimination. The objective of capturing discrimination as a 3-level measure was to examine the relationship between finer categories of discrimination and missing an

HIV care appointment and to assess whether there was a dose–response relationship.

For the primary analyses and the sensitivity analyses completed in the primary analytic sample where discrimination was captured as a 3-level measure, missing an HIV care appointment was measured by the participant's response to the question, "In the last 6 months, did you miss any scheduled regular HIV care appointments? By this, I mean you did not go for a scheduled appointment and did not re-schedule" (hereafter, missed an HIV appointment in the last 6 months). This measure was assessed at a concurrent study visit to when discrimination was measured instead of at a subsequent study visit to minimize exclusions due to missing data. As part of additional sensitivity analyses, the primary analyses were repeated but missing an HIV appointment was assessed in the last year by combining the participant's responses to missed an HIV appointment in the last 6 months at both the concurrent and subsequent study visit to when discrimination was measured.

Race/ethnicity was categorized as Hispanic, non-Hispanic African American (hereafter, African American), and non-Hispanic Caucasian (hereafter, Caucasian). The remaining data (i.e., covariates) included: year of birth, mental health measured via the Center for Epidemiologic Studies Depression Scale (CES-D) score [40] and the Generalized Anxiety Disorder 7 (GAD-7) score [41], drug use, alcohol use, and socioeconomic position via average annual household income. The GAD-7 asks, "Over the last two weeks, how often have you been bothered by the following problems?" with possible responses of "Not at all," "Several Days," "More than half the days," and "Nearly every day" [41]. For the CES-D score, the GAD-7 score, alcohol use, and average annual household income, a binary indicator was created for whether the participant had a value above a pre-identified cut-point at any visit between October 1, 2012 and September 30, 2016 that was prior to or concurrent with when discrimination was measured (Table 1). Cut-points for the CES-D score (≥ 16), the GAD-7 score (≥ 10), and alcohol use (ever > 7 alcoholic drinks per week since the last visit) were informed by prior literature [41–43]. The cut-point for average annual household income was ever reporting an average annual household income $\leq$\$12,000. Drug use was assessed as a binary indicator of self-reported use of any of the following since last study visit at any study visit between October 1, 2012 and September 30, 2016 that was prior to or concurrent with when discrimination was measured: marijuana, crack cocaine, cocaine, heroin, illicit methadone, methamphetamines, hallucinogens, club drugs, injection drugs, and prescription drugs (not as prescribed). If discrimination data were missing, the covariates were assessed as previously described at visits prior to or concurrent with the last available visit.

Statistical Analysis

Included and excluded participants were compared using Pearson's χ^2 or Wilcoxon–Mann–Whitney tests based on measured covariates. Unadjusted, regression adjusted, and regression adjusted plus inverse probability weighted log-binomial regression models were used to estimate prevalence ratios (PRs) and corresponding 95% confidence limits (CL) [44] for the relationship between discrimination and missing an HIV appointment. Regression adjustment was made for year of birth using restricted quadratic splines [45] and race/ethnicity using indicator variables to control for confounding bias and selection bias due to missing data exclusions related to year of birth and race/ethnicity. Stabilized inverse probability weights were estimated as a function of all described covariates (i.e., year of birth, CES-D score, GAD-7 score, drug use, alcohol use, and socioeconomic position) and race/ethnicity using restricted quadratic splines or indicator variables [7, 46–48]. Year of birth and race/ethnicity were used to stabilize the weights to facilitate well-behaved weights [49]. The stabilized weights were used to fit the log-binomial regression models to minimize potential selection bias due to missing data exclusions and related to the described measured variables excluding year of birth and race/ethnicity (i.e., CES-D score, GAD-7 score, drug use, alcohol use, and socioeconomic position). Weights were well behaved in each model [49]. Results were not reported for models that did not converge or produce complete estimates.

Effect measure modification (EMM) by race/ethnicity was explored in the unadjusted, adjusted, and adjusted plus weighted log-binomial regression models by including product terms between race/ethnicity and discrimination in the model. The statistical significance of these product terms was assessed using likelihood ratio tests for the adjusted and adjusted plus weighted models. The statistical significance of the product terms was not assessed in the unadjusted model because a likelihood ratio test would not have been able to distinguish between any observed improvement in the model fit as a result of either controlling for race/ethnicity in the model or allowing for EMM by race/ethnicity. The statistical significance of products terms was also not assessed when a model did not converge or produce complete estimates. The statistical analysis for the primary analyses and the sensitivity analyses were the same. However, given the absence of statistically significant evidence to support EMM in the primary analyses, EMM was not examined in sensitivity analyses where discrimination was captured as a 3-level measure to maximize power. SAS version 9.4 software (SAS Institute, Inc., Cary, North Carolina) and a two-sided alpha $= 0.05$ was used for all analyses.

Table 1 Characteristics of women in the Women's HIV Interagency Study contributing data between October 1, 2012 and September 30, 2016 who were either included in the primary analytic sample or excluded from the primary analytic sample due to missing data on the measures of discrimination or missing data on missed HIV appointments in the last 6 months

Characteristic[a]	Included women (n = 1578)	Excluded due to missing data on discrimination or missed an HIV appointment in the last 6 months (n = 93)	Test statistic; *p*-value
Year of birth[b]	1965 (1959, 1972)	1967 (1962, 1973)	85,961.50; 0.07[e]
Race/ethnicity			1.35; 0.51[f]
African American	1169 (74)	69 (74)	
Hispanic	237 (15)	11 (12)	
Caucasian	172 (11)	13 (14)	
Ever average annual household income ≤$12,000			3.24; 0.07[f]
Yes	955 (61)	65 (70)	
No	623 (39)	28 (30)	
Ever CES-D[c] score ≥ 16			2.49; 0.11[f]
Yes	1231 (78)	79 (85)	
No	347 (22)	14 (15)	
Ever GAD-7[d] score ≥ 10			15.42; < 0.01[f]
Yes	284 (18)	32 (34)	
No	1294 (82)	61 (66)	
Ever drug use			1.46; 0.23[f]
Yes	499 (32)	35 (38)	
No	1079 (68)	58 (62)	
Ever > 7 alcoholic drinks per week since the last visit			6.58; 0.01[f]
Yes	303 (19)	28 (30)	
No	1275 (81)	65 (70)	
Discrimination interfered with life			
Yes	425 (27)	26 (28)	
No	1153 (73)	39 (42)	
Missing	0 (0)	28 (30)	
Discrimination made life harder			
Yes	453 (29)	23 (25)	
No	1125 (71)	40 (43)	
Missing	0 (0)	30 (32)	
Major experience(s) of discrimination			
Yes	583 (37)	26 (28)	
No	995 (63)	43 (37)	
Missing	0 (0)	33 (36)	
Major experience(s) of discrimination related to gender			
Yes	232 (15)	17 (18)	
No	1346 (85)	41 (44)	
Missing	0 (0)	35 (38)	
Major experience(s) of discrimination related to race/ethnicity			
Yes	318 (20)	21 (22)	
No	1260 (80)	38 (41)	
Missing	0 (0)	34 (37)	
Major experience(s) of discrimination related to HIV status			
Yes	98 (6)	3 (3)	
No	1480 (94)	41 (44)	
Missing	0 (0)	49 (53)	

Table 1 (continued)

Characteristic[a]	Included women (n = 1578)	Excluded due to missing data on discrimination or missed an HIV appointment in the last 6 months (n = 93)	Test statistic; *p*-value
Missed an HIV appointment in the last 6 months			
Yes	238 (15)	4 (4)	
No	1340 (85)	49 (53)	
Missing	0 (0)	40 (43)	

[a]n (%) unless otherwise noted

[b]Median (1st quartile, 3rd quartile)

[c]The Center for Epidemiologic Studies Depression Scale

[d]Generalized anxiety disorder 7

[e]Wilcoxon–Mann–Whitney test

[f]Pearson's χ^2 test

Results

Table 1 presents characteristics of the WIHS participants who were either included in or excluded from the primary analytic sample in the primary analyses. In the primary analyses, 74, 15, and 11% of the included women were African American, Hispanic, and Caucasian, respectively. The median year of birth was 1965 (1st quartile, 3rd quartile: 1959, 1972). Twenty-seven and twenty-nine percent reported that discrimination interfered with life and discrimination made life harder, respectively. Thirty-seven percent reported major experience(s) of discrimination. Fifteen, twenty, and 6% reported major experience(s) of discrimination related to gender, race/ethnicity, and HIV, respectively. Fifteen percent reported missing an HIV appointment in the last 6 months.

The unadjusted, adjusted, and adjusted plus weighted PRs for missing an HIV appointment in the last 6 months comparing women who did and did not report that discrimination interfered with life are presented in Table 2. The corresponding adjusted plus weighted PRs among all women, African Americans, Hispanics, and Caucasians were 1.412 (95% CL 1.107, 1.800; $\chi^2 = 7.72$, $p = 0.006$), 1.363 (95% CL 1.035, 1.795; $\chi^2 = 4.86$, $p = 0.028$), 1.576 (95% CL 0.842, 2.950; $\chi^2 = 2.02$, $p = 0.155$), and 1.675 (95% CL 0.665, 4.219; $\chi^2 = 1.20$, $p = 0.274$), respectively. There was no statistically significant evidence for EMM by race/ethnicity in the corresponding adjusted plus weighted model ($\chi^2 = 0.30$, $p = 0.862$).

The unadjusted, adjusted, and adjusted plus weighted PRs for missing an HIV appointment in the last 6 months comparing women who did and did not report that discrimination made life harder are presented in Table 3. The corresponding adjusted plus weighted PRs for all women, African Americans, Hispanics, and Caucasians were 1.352 (95% CL 1.061, 1.721; $\chi^2 = 5.97$, $p = 0.015$), 1.281 (95% CL 0.973, 1.686; $\chi^2 = 3.11$, $p = 0.078$), 1.494 (95% CL 0.804, 2.778; $\chi^2 = 1.61$, $p = 0.205$), and 2.002 (95% CL 0.795, 5.042; $\chi^2 = 2.17$, $p = 0.141$), respectively. There was no statistically significant evidence for EMM by race/ethnicity in the corresponding adjusted plus weighted model ($\chi^2 = 0.91$, $p = 0.636$).

The unadjusted, adjusted, and adjusted plus weighted PRs for missing an HIV appointment in the last 6 months comparing women who did and did not report major experience(s) of discrimination are presented in Table 4. The corresponding adjusted plus weighted PRs for all women, African Americans, Hispanics, and Caucasians were 1.418 (95% CL 1.123, 1.789; $\chi^2 = 8.65$, $p = 0.003$), 1.499 (95% CL 1.154, 1.947; $\chi^2 = 2.54$, $p = 0.002$), 0.792 (95% CL 0.385, 1.626; $\chi^2 = 0.40$, $p = 0.525$), and 2.279 (95% CL 0.828, 6.274; $\chi^2 = 9.19$, $p = 0.111$), respectively. There was no statistically significant evidence for EMM by race/ethnicity in the corresponding adjusted plus weighted model ($\chi^2 = 4.06$, $p = 0.131$).

The unadjusted, adjusted, and adjusted plus weighted PRs for missing an HIV appointment in the last 6 months comparing women who did and did not report major experience(s) of discrimination related to gender, race/ethnicity, or HIV status are presented in Supplementary Tables I, II, III, respectively. The corresponding adjusted plus weighted PRs for discrimination related to gender for all women, African Americans, Hispanics, and Caucasians were 1.544 (95% CL 1.167, 2.043; $\chi^2 = 9.22$, $p = 0.002$), 1.548 (95% CL 1.133, 2.114; $\chi^2 = 7.54$, $p = 0.006$), 1.633 (95% CL 0.744, 3.584; $\chi^2 = 1.50$, $p = 0.221$), and 1.387 (95% CL 0.492, 3.906; $\chi^2 = 0.38$, $p = 0.536$), respectively. The corresponding adjusted plus weighted PRs for discrimination related to race/ethnicity for all women, African Americans, Hispanics, and Caucasians were 1.449 (95% CL 1.118, 1.879; $\chi^2 = 7.86$, $p = 0.005$), 1.445 (95% CL 1.086, 1.922; $\chi^2 = 6.38$, $p = 0.012$), 1.659 (95% CL 0.805, 3.418; $\chi^2 =$, $p = 0.170$), 1.154 (95% CL 0.366, 3.643; $\chi^2 =$, $p = 0.807$), respectively. The corresponding

Table 2 Relationship between discrimination interfered with life and missed an HIV appointment in the last 6 months in the primary analytic sample of 1578 women in the Women's HIV Interagency Study contributing data between October 1, 2012 and September 30, 2016

Discrimination interfered with life	Missed an HIV appointment in the last 6 months		Unadjusted			Adjusted for year of birth and race/ethnicity[a]			Adjusted for year of birth and race/ethnicity plus weighted to minimize potential for selection bias due to missing data exclusions[b,c]		
	Yes	No	Prevalence ratio	95% CL	χ^2, p-value	Prevalence ratio	95% CL	χ^2, p-value	Prevalence ratio	95% CL	χ^2, p-value
Overall											
Yes	79	346	1.348	1.054, 1.724	5.67, 0.017	1.395	1.093, 1.780	7.14, 0.008	1.412	1.107, 1.800	7.72, 0.006
No	159	994	1.000	–	–	1.000	–	–	1.000	–	–
Total	238	1,340									
African American											
Yes	61	254	1.323	1.002, 1.746	3.91, 0.048	1.354	1.028, 1.783	4.64, 0.031	1.363	1.035, 1.795	4.86, 0.028
No	125	729	1.000	–	–	1.000	–	–	1.000	–	–
Total	186	983									
Hispanic											
Yes	11	43	1.491	0.785, 2.830	1.49, 0.222	1.560	0.825, 2.953	1.87, 0.172	1.576	0.842, 2.950	2.02, 0.155
No	25	158	1.000	–	–	1.000	–	–	1.000	–	–
Total	36	201									
Caucasian											
Yes	7	49	1.611	0.633, 4.103	1.00, 0.317	1.564	0.615, 3.976	0.88, 0.348	1.675	0.665, 4.219	1.20, 0.274
No	9	107	1.000	–	–	1.000	–	–	1.000	–	–
Total	16	156									

[a]Measure of effect measure modification by race/ethnicity in the adjusted analysis, $\chi^2 = 0.22$, $p = 0.896$

[b]Measure of effect measure modification by race/ethnicity in the adjusted plus weighted analysis, $\chi^2 = 0.30$, $p = 0.862$

[c]Mean (standard deviation) and range of inverse probability weights: 1.000 (0.021), maximum of 1.216, and minimum of 0.956

Table 3 Relationship between discrimination made life harder and missed an HIV appointment in the last 6 months in the primary analytic sample of 1578 women in the Women's HIV Interagency Study contributing data between October 1, 2012 and September 30, 2016

Discrimination made life harder	Missed an HIV appointment in the last 6 months		Unadjusted			Adjusted for year of birth and race/ethnicity[a]			Adjusted for year of birth and race/ethnicity plus weighted to minimize potential for selection bias due to missing data exclusions[b,c]		
	Yes	No	Prevalence ratio	95% CL	χ^2, p-value	Prevalence ratio	95% CL	χ^2, p-value	Prevalence ratio	95% CL	χ^2, p-value
Overall											
Yes	82	371	1.305	1.023, 1.666	4.58, 0.032	1.333	1.047, 1.699	5.42, 0.020	1.352	1.061, 1.721	5.97, 0.015
No	156	969	1.000	–	–	1.000	–	–	1.000	–	–
Total	238	1,340									
African American											
Yes	62	274	1.240	0.939, 1.636	2.30, 0.129	1.269	0.993, 1.672	2.86, 0.091	1.281	0.973, 1.686	3.11, 0.078
No	124	709	1.000	–	–	1.000	–	–	1.000	–	–
Total	186	983									
Hispanic											
Yes	12	47	1.509	0.806, 2.825	1.65, 0.199	1.482	0.796, 2.761	1.54, 0.215	1.494	0.804, 2.778	1.61, 0.205
No	24	154	1.000	–	–	1.000	–	–	1.000	–	–
Total	36	201									
Caucasian											
Yes	8	50	1.966	0.777, 4.970	2.04, 0.153	1.878	0.743, 4.747	1.77, 0.183	2.002	0.795, 5.042	2.17, 0.141
No	8	106	1.000	–	–	1.000	–	–	1.000	–	–
Total	16	156									

[a]Measure of effect measure modification by race/ethnicity in the adjusted analysis, $\chi^2 = 7.17$, $p = 0.685$

[b]Measure of effect measure modification by race/ethnicity in the adjusted plus weighted analysis, $\chi^2 = 0.91$, $p = 0.636$

[c]Mean (standard deviation) and range of inverse probability weights: 1.000 (0.024), maximum of 1.218, and minimum of 0.954

Table 4 Relationship between major experience(s) of discrimination and missed an HIV appointment in the last 6 months in the primary analytic sample of 1578 women in the Women's HIV Interagency Study contributing data between October 1, 2012 and September 30, 2016

Major experience(s) of discrimination	Missed an HIV appointment in the last 6 months		Unadjusted			Adjusted for year of birth and race/ethnicity[a]			Adjusted for year of birth and race/ethnicity plus weighted to minimize potential for selection bias due to missing data exclusions[b,c]		
	Yes	No	Prevalence ratio	95% CL	χ^2, p-value	Prevalence ratio	95% CL	χ^2, p-value	Prevalence ratio	95% CL	χ^2, p-value
Overall											
Yes	104	479	1.325	1.047, 1.675	5.50, 0.019	1.401	1.108, 1.772	7.91, 0.005	1.418	1.123, 1.789	8.65, 0.003
No	134	861	1.000	–	–	1.000	–	–	1.000	–	–
Total	238	1,340									
African American											
Yes	85	348	1.431	1.010, 1.861	7.12, 0.008	1.485	1.143, 1.930	8.75, 0.003	1.499	1.154, 1.947	2.54, 0.002
No	101	635	1.000	–	–	1.000	–	–	1.000	–	–
Total	186	983									
Hispanic											
Yes	8	58	0.740	0.356, 1.540	0.65, 0.421	0.777	0.374, 1.615	0.46, 0.499	0.792	0.385, 1.626	0.40, 0.525
No	28	143	1.000	–	–	1.000	–	–	1.000	–	–
Total	36	201									
Caucasian											
Yes	11	73	2.305	0.836, 6.353	2.60, 0.107	2.195	0.798, 6.041	2.32, 0.128	2.279	0.828, 6.274	9.19, 0.111
No	5	83	1.000	–	–	1.000	–	–	1.000	–	–
Total	16	156									

[a]Measure of effect measure modification by race/ethnicity in the adjusted analysis, $\chi^2 = 3.85$, $p = 0.146$

[b]Measure of effect measure modification by race/ethnicity in the adjusted plus weighted analysis, $\chi^2 = 4.06$, $p = 0.131$

[c]Mean (standard deviation) and range of inverse probability weights: 1.000 (0.022), maximum of 1.285, and minimum of 0.932

adjusted plus weighted PR for discrimination related to HIV status for all women was 1.178 (95% CL 0.752, 1.841; $\chi^2 = 0.51$, $p = 0.473$).

In the sensitivity analyses completed in the primary analytic sample where discrimination was captured as a 3-level measure, the PRs for the adjusted plus weighted analyses progressively increased with a greater extent to which discrimination interfered with life or made life harder as well as with a greater number of major experiences of discrimination in general or related to HIV status. However, the aforementioned PRs were not always statistically significant. The observed increase in the PR with a greater number of major experiences of discrimination did not hold up for major experience(s) of discrimination related to race/ethnicity and gender in the adjusted plus weighted analyses (Supplementary Table IV).

Supplementary Table V presents characteristics of the WIHS participants who were either included in or excluded from the analytic sample in the sensitivity analysis that repeated the primary analysis but with missing an HIV appointment assessed in the last year. In this sensitivity analysis, some findings differed from the primary analyses. Concerning discrimination interfering with life, the adjusted plus weighted PR was not statistically significant among African Americans but was statistically significant among Hispanics. Concerning discrimination making life harder, the adjusted plus weighted PR among all women was not statistically significant. Otherwise, findings for the adjusted plus weighted PRs from this sensitivity analysis for these measures were similar to those from the primary analyses (Supplementary Tables VI and VII). Concerning major experience(s) of discrimination, the adjusted plus weighted PR among all women and African Americans was not statistically significant. There was statistically significant evidence for EMM of the adjusted plus weighted PRs by race/ethnicity ($\chi^2 = 6.24$, $p = 0.044$). Otherwise, findings for the adjusted plus weighted PRs from this sensitivity analysis for this measure were similar to those from the primary analyses (Supplementary Table VIII). Concerning major experience(s) of discrimination related to gender, race/ethnicity, and HIV status, findings for the adjusted plus weighted PRs largely differed between this sensitivity analysis and the primary analyses in that none of the PRs were statistically significant in the sensitivity analysis (Supplementary Tables IX–XI, respectively).

Discussion

Based on the adjusted plus weighted results in the primary analyses, women who reported discrimination interfering with life, discrimination making life harder, and major experience(s) of discrimination had a statistically significant greater prevalence of missing an HIV appointment in the last 6 months. Women who reported discrimination related to gender and race/ethnicity also had a statistically significant greater prevalence of missing an HIV appointment in the last 6 months. Women who reported discrimination related to HIV status had a greater prevalence of missing an HIV appointment in the last 6 months, but this greater prevalence was not statistically significant.

When the primary adjusted plus weighted analyses were performed by race/ethnicity, African American women who reported discrimination interfering with life, major experience(s) of discrimination, discrimination related to gender, and discrimination related to race/ethnicity had a statistically significant greater prevalence of missing an HIV appointment in the last 6 months. African American women who reported discrimination making life harder had a greater prevalence of missing an HIV appointment in the last 6 months, but this greater prevalence was not statistically significant. There was no statistically significant evidence for EMM by race/ethnicity in the primary analyses.

Limited prior work has some similarities and differences compared to our findings from the adjusted plus weighed primary analyses. One study among African American men who have sex with men in Los Angeles was similar in that it showed a statistically significant negative association between discrimination specifically related to race/ethnicity and continuous ART medication adherence but no statistically significant association between discrimination specifically related to HIV status and continuous ART medication adherence [29]. Another study among women in Georgia and Alabama differed in that it showed a statistically significant positive association between experiencing discrimination specifically related to HIV status and avoiding seeking HIV care in the last year overall and just among African Americans upon stratification by White and African American race [27]. Lastly, a study in the WIHS differed in that it found a statistically significant negative association between discrimination in healthcare settings specifically related to HIV status and high ART adherence [28]. Differences between prior work [27, 28] and our findings may be due to differences in study populations, measures (e.g., discrimination), HIV-related outcomes, or power.

The findings from the adjusted plus weighted sensitivity analyses at times differed from the findings from the primary analyses with respect to statistical significance, but some results for these sensitivity analyses did provide evidence for a dose–response relationship between discrimination and missing HIV appointments. Differences between the sensitivity and primary analyses may have resulted from decreased sample sizes in the comparison groups in the sensitivity analyses. The observed lack of statistically significant evidence to support EMM by race/ethnicity in the primary adjusted plus weighted analyses could indicate

that the relationship between discrimination and missing an HIV appointment in the last 6 months does not vary by race/ethnicity on the PR scale. Our study may have also been underpowered to detect EMM by race/ethnicity on this scale.

There are several other limitations to this research. First, this study was cross-sectional, which limited our ability to ensure the correct temporal ordering between discrimination and the outcome as well as to perform causal mediation analyses. Second, all measures were self-reported, which could result in measurement bias. Though, a previous WIHS study found that there was high level of agreement between care receipt measured via self-report and medical records among a small subset of women who had both measures [50]. Third, the measures used to assess mental health and socioeconomic position may not have comprehensively captured participants' mental health and socioeconomic position [51]. Lastly, for the outcome that pertained to the last year, the study visit subsequent to when discrimination was measured was not restricted to be within 6 months of the study visit concurrent to when discrimination was measured to minimize exclusions. Thus, this outcome may not cover a full continuous one-year period.

Despite these limitations, our research has important strengths. The relationship between discrimination and engagement in HIV care is understudied. Thus, our study helps to address this existing gap in the literature. In addressing this gap, we minimized the potential for selection bias stemming from exclusions due to missing data using inverse probability weighting, which was necessary to avoid removal of indirect effects of interest [7, 46–48].

To further help address gaps in the literature as well as some of the identified limitations, future studies should repeat our analyses in HIV cohorts with more participants and ensure that measures of discrimination solely capture times temporally prior to the outcome. If the findings from our primary adjusted plus weighted analyses are confirmed, performing mediation analyses could help understand how discrimination operates to influence HIV care engagement. Such mediation analyses can in turn inform the development of interventions to minimize discrimination or its impact and lead to improvements in engagement in HIV care among women living with HIV.

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Compliance with Ethical Standards

Conflict of interest The authors declare 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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