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Racial and Ethnic Composition of Students, Graduates, and Faculty in Environmental Health Sciences, 2011 to 2021

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ABSTRACT: The lack of diversity among the environmental health sciences (EHS) workforce has been an ongoing concern. However, limited research exists on the racial and ethnic composition of EHS students and faculty over time. We analyzed 2011 and 2021 data on EHS students, graduates, and faculty to compare changes in the racial and ethnic composition among Association of Schools and Programs of Public Health-member institutions. Among the institutions that reported data in both years, we observed significant proportion increases among Hispanic enrolled students (overall and master's: both $P = .01$), Multiracial enrolled students and graduates (overall: both $P < .05$, master's level: both $P < .05$), and Asian tenured professors ($P = .01$). Significant decreases were observed among Unknown enrolled students (overall: $P = .01$, master's level: $P < .001$), Unknown master's level graduates ($P = .01$), AI/AN enrolled students (overall and master's: both $P < .05$), and White full professors ($P < .001$) and tenured faculty ($P < .001$). Despite these findings, no substantial change existed among the other racial and ethnic groups. More efforts are needed to recruit, train, and promote racial and ethnic minorities who can leverage their lived experiences to provide novel solutions to environmental challenges.

KEYWORDS: Environmental health sciences, racial composition, racial and ethnic diversity, student diversity, faculty diversity

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Introduction

The lack of diversity in the Environmental Health Sciences (EHS) workforce has been an ongoing concern of several leading EHS organizations, including the National Institute of Environmental Health Science, the National Environmental Health Association, the Association of Environmental Health Academic Programs, the National Environmental Health Science and Protection Accreditation Council (EHAC), and the Centers for Disease Control and Prevention.[1-8] Increasing diversity in the EHS workforce is important because it plays a critical role in improving the health outcomes of individuals and communities exposed to environmental toxins and chemicals.[8]

In many cases, high concentrations of these environmental exposures have contributed to health inequities among underrepresented, underserved, and socioeconomically disadvantaged populations.[9-14] For example, mounting evidence suggests a link between higher concentrations of endocrine-disrupting chemicals and higher risk of diabetes among Hispanic, Black, and low-income individuals.[15] Unequal exposure to environmental chemicals overall may be driven by the poor built environment conditions that are partly a result of discriminatory practices such as redlining and residential segregation.[11] More recently, these poor built environment conditions may have contributed to the increased spread of the coronavirus among marginalized populations.[16] A detailed examination of electronic health records from 399 hospitals across 21 states showed that non-White patients experienced higher coronavirus infection, hospitalization, and death rates than White patients.[17] The infection rates among Hispanic (143.0/10 000) and Black (107.0/10 000) patients were more than twice that of White (46.0/10 000) patients. The death rates were more than twice as high: Hispanic (5.6/10 000), Black (5.6/10 000), and White (2.3/10 000) patients. These findings are consistent with national data that show high coronavirus cases and deaths among Hispanic and Black populations.[18]

One approach to help reduce environmental health (EH) inequities is to increase the racial and ethnic representation of the EHS workforce.[1,2,8,13] Limited evidence exists regarding the impacts of increased minority representation in the EHS workforce on EH inequities. However, increased minority representation within clinical medicine has been shown to reduce health inequities.[19-21] Studies show improvements in adherence to cardiovascular disease medications,[19] cholesterol screening,[20] and lung cancer risk perception[21] when patients are seen by doctors of the same race or ethnicity. These improvements could also address EH inequities since racial and ethnic minority EHS professionals have a better understanding of community and cultural dynamics.[1,3]

Increasing minority representation in the EHS workforce requires examining the racial and ethnic composition of students and faculty in EHS training programs. To date, there has been one such study, which examined annual survey data from

EHAC-accredited EHS programs from academic years 2009-2010 to 2020-2021.[22] That study included student and faculty data that was reported from up to 9 EHS graduate programs each year. Balanay et al[22] reported that the total number of EHS graduate students decreased by 6 students (from n = 255 in 2009 to n = 249 in 2020) and the total number of EHS graduate faculty increased by 16 professors (from n = 191 in 2009 to n = 207 in 2020). Although the authors found a substantial increase in the proportion of Black graduate students (from 17.6% in 2009 to 32.1% in 2020, percentage-point difference (PPD) = 14.5), substantial decreases were observed among Asian (from 16.1% in 2009 to 6.0% in 2020, PPD = −10.1) and Hispanic (from 13.3% in 2009 to 6.8% in 2020, PPD = −6.5) graduate students.[22] Over the same period, the authors reported <1.5 PPDs across all racial and ethnic minority graduate faculty.[22]

Other studies exist on the racial and ethnic composition of academic programs, however, these studies focused on schools of public health[23] and departments of biostatistics and epidemiology specifically.[24] The study of schools of public health included student and graduate data from 26 Association of Schools and Programs of Public Health (ASPPH)-member institutions in 1996 and 2016, and faculty data from 27 ASPPH-member institutions in 1997 and 2017.[23] The study of departments of biostatistics (student and graduate data: n = 41 institutions, faculty data: n = 38 institutions) and epidemiology (student, graduate, and faculty data: n = 45 institutions) included data from ASPPH-member institutions in 2010 and 2020.[24] Both studies show increases in the number of students, graduates, and faculty, but also show that there has been little-to-no change in the proportions of underrepresented racial and ethnic groups.[23,24] The study of schools of public health showed a ⩽5.0 PPD in the proportions of non-White graduate student enrollment between 1996 and 2016.[23] The study of departments of biostatistics and epidemiology reported statistically significant changes in Hispanic student enrollment in biostatistics (from 5.8% in 2010 to 10.2% in 2020, PPD = 4.4, $P = .01$) and in Hispanic epidemiology graduates (from 8.8% in 2010 to 13.8% in 2020, PPD = 5.0, $P = .01$), but found no significant changes among enrolled students and graduates who belong to other racial and ethnic groups.[24]

We aimed to extend the work of the EHAC study by examining the racial and ethnic composition of EHS students, graduates, and faculty among ASPPH-member institutions in 2011 and 2021. We hypothesized that the increases seen among previous ASPPH studies,[23-25] would not be reflected in a study of EHS programs and that there would be no substantial changes among most racial and ethnic minority groups.

Methods

Race and ethnicity

We used data from the ASPPH Data Center to compare changes in the racial and ethnic composition among ASPPH-member institutions reporting data on EHS students, graduates, and faculty in 2011 and 2021.[26] Racial and ethnic groups included American Indian/Alaska Native (AI/AN), Asian, Hispanic/Latinx (Hispanic), Native Hawaiian/Pacific Islander (NH/PI), Non-Hispanic Black or African American (Black), Non-Hispanic White (White), Unknown, and Multiracial (2 or more races). For student and graduate data reported in both 2011 and 2021, the Unknown group consisted of those whose race and ethnicity were unknown (not reported), and who were not US citizens (at US institutions). For faculty data reported in both 2011 and 2021, the Unknown group consisted of those whose race and ethnicity were unknown. Annual reporting data for faculty in both 2011 and 2021 did not include citizenship information, therefore faculty from non-US ASPPH-member institutions, were categorized as their race and ethnicity irrespective of US citizen status.

Analytic sample

The development of the analytic samples are as follows. Seventy institutions reported student and graduate data in 2011 and/or 2021. Of these, 3 institutions reported data only in 2011, and 22 institutions reported data only in 2021, resulting in 45 institutions (including 1 non-US institution) being included in the 2011 to 2021 comparison cohort sample of EHS students and graduates. We categorized students who enrolled during the fall semester (2011-2012 and 2021-2022) as "enrolled" and students who graduated in the previous academic year (2010-2011 and 2020-2021) as "graduated." For enrolled students and students who had graduated, racial and ethnic proportions were analyzed overall (master's and doctoral combined) and by degree level (master's or doctoral). For the faculty analysis, 72 institutions reported faculty data in 2011 and/or 2021. Of these, 4 institutions reported data only in 2011, and 24 institutions reported data only in 2021, resulting in 44 (1 non-US institution) institutions being included in the 2011 to 2021 comparison cohort sample of EHS faculty. Racial and ethnic categories were analyzed by proportion in terms of professor rank (full, associate, and assistant) and by tenure status (tenured and tenure-track) among institutions that grant tenure. The faculty comparison cohort included 1 institution that is not in the student cohort and the student cohort contained 2 institutions that were not in the faculty cohort.

Statistical analysis

For the primary analysis comparing the 2011 and 2021 data, we tabulated counts and percentages of each racial and ethnic group. We calculated the PPD of each racial and ethnic group between 2011 and 2021 and tested whether this difference was statistically significant by using a 2-sample test for proportions. For a secondary analysis, we calculated counts and percentages for all ASPPH-member institutions that reported data in 2021. This included 67 institutions that reported data on EHS students/graduates and 68 institutions that reported EHS faculty data in 2021 (including 4 non-US institutions). All

analyses were performed using Stata 17 (StataCorp LLC).[27] Statistical tests were 2-sided with a .05 significance level.

Results

Enrolled students

In a comparison of the 2011 and 2021 data (Table 1), the number of enrolled students increased overall (from n = 699 in 2011 to n = 766 in 2021, increase = 67 students) and by degree status (master's: from n = 480 in 2011 to n = 506 in 2021, increase = 26 students; doctoral: from n = 219 in 2011 to n = 260 in 2021, increase = 41 students). Among all racial and ethnic groups considered, the largest percentage-point increases were exhibited by Hispanic enrolled students overall (11.4% in 2011; 16.2% in 2021, PPD = 4.8, $P = .01$) and at the master's level (11.5% in 2011; 17.6% in 2021, PPD = 6.1, $P = .01$). The second largest percentage-point increases were exhibited by Multiracial enrolled students overall (3.4% in 2011; 7.2% in 2021, PPD = 3.8, $P = .01$), and at the master's level (3.8% in 2011; 7.7% in 2021, PPD = 3.9, $P = .01$). We observed small percentage-point increases (no statistically significant differences) among Asian enrolled students overall (from 14.3% in 2011 to 15.5% in 2021, PPD = 1.2, $P = .51$) and by degree status (master's: from 14.4% in 2011 to 15.6% in 2021, PPD = 1.2, $P = .59$; doctoral: from 14.2% in 2011 to 15.4% in 2021, PPD = 1.2, $P = .71$). We found no statistically significant differences among Black enrolled students overall (10.9% in 2011; 12.0% in 2021, PPD = 1.1, $P = .49$), at the master's level (10.8% in 2011; 12.8% in 2021, PPD = 2.0, $P = .33$), or at the doctoral level (11.0% in 2011; 10.4% in 2021, PPD = −0.6, $P = .84$).

We observed the largest percentage-point decreases among Unknown enrolled students overall (27.3% in 2011; 21.1% in 2021, PPD = −6.2, $P = 0.01$), and at the master's level (27.5% in 2011; 18.0% in 2021, PPD = −9.5, $P < .001$). Statistically significant percentage-point decreases were observed among AI/AN and NH/PI enrolled students overall and at the master's level, but not at the doctoral level. The proportion of AI/AN enrolled students decreased from 2.0% in 2011 to 0.4% in 2021 (PPD = −1.6, $P = .01$) overall, from 2.1% in 2011 to 0.4% in 2021 (PPD = −1.7, $P = .02$) at the master's level, and from 1.8% in 2011 to 0.4% in 2021 (PPD = −1.4, $P = .12$) at the doctoral level. The proportion of NH/PI enrolled students decreased from 1.7% in 2011 to 0.0% in 2021 (PPD = −1.7, $P < .001$) overall, from 1.9% in 2011 to 0.0% in 2021 (PPD = −1.9, $P = .01$) at the master's level, and from 1.4% in 2011 to 0.0% in 2021 (PPD = −1.4, $P = .06$) at the doctoral level. No statistically significant percentage-point changes (all $P > .05$) were observed among White enrolled students overall and by degree level (master's or doctoral).

Graduates

Between 2011 and 2021, the total number of graduates increased from 366 to 384 overall (increase = 18 students): from 293 to 297 (increase = 4 students) at the master's level and from 73 to 87 (increase = 14 students) at the doctoral level (Table 1). The largest percentage-point increases were seen among Multiracial (overall and master's only), Asian, Hispanic, and Unknown (doctoral only) graduates; however, only the Multiracial increases were statistically significant. Multiracial graduates overall increased from 2.5% in 2011 to 5.5% in 2021 (PPD = 3.0, $P = .04$), and at the master's level increased from 3.1% in 2011 to 6.7% in 2021 (PPD = 3.6, $P = .04$). The proportion of Asian graduates increased from 12.3% to 15.9% overall (PPD = 3.6, $P = .16$), from 12.3% to 16.2% at the master's level (PPD = 3.9, $P = .18$), and from 12.3% to 14.9% at the doctoral level (PPD = 2.6, $P = .63$). The proportion of Hispanic graduates increased from 9.0% to 12.8% overall (PPD = 3.8, $P = .10$), from 9.9% to 13.1% at the master's level (PPD = 3.2, $P = .22$), and from 5.5% to 11.5% at the doctoral level (PPD = 6.0, $P = .18$). Doctoral degree graduates with race classified as Unknown increased from 30.1% to 34.5% (PPD = 4.4, $P = .56$). Despite this increase at the doctoral level for students with Unknown race and ethnicity, we observed a nonsignificant percentage-point decrease overall (from 27.6% in 2011 to 21.6% in 2021, PPD = −6.0, $P = .06$) and a statistically significant decrease at the master's level (from 27.0% in 2011 to 17.8% in 2021, PPD = −9.2, $P = .01$). The percentage-point decreases found among White graduates were not statistically significant. The proportion of White graduates decreased from 38.0% to 33.9% overall (PPD = −4.1, $P = .24$), from 36.5% to 35.0% at the master's level (PPD = −1.5, $P = .70$), and from 43.8% to 29.9% at the doctoral level (PPD = −13.9, $P = .07$). Small changes were identified in the proportions (<1.5 PPD; all $P > .05$) from 2011 to 2021 for the remaining racial and ethnic groups (AI/AN, NH/PI, and Black).

Faculty by rank

As shown in Table 2, the total number of EHS faculty at each rank increased by at least 45 people across the study period (2011-2021): full professors (from n = 247 in 2011 to n = 294 in 2021; increase = 47 professors), associate professors (from n = 146 in 2011 to n = 208 in 2021; increase = 62 professors), and assistant professors (from n = 136 in 2011 to n = 209 in 2021; increase = 73 professors). The largest percentage-point increases were found among Asian faculty (full and associate rank only; not statistically significant) or Unknown (all ranks). The proportion of Asian full professors increased 4.5 percentage points from 5.7% in 2011 to 10.2% in 2021 ($P = .06$). Asian associate professors increased 4.3 percentage points from 11.6% in 2011 to 15.9% in 2021 ($P = .26$). The proportion of Asian assistant professors decreased by 0.2 percentage points (from 21.3% in 2011 to 21.1% in 2021, $P = .95$). The proportion of Unknown full professors increased 6.4 percentage points from 0.4% in 2011 to 6.8% in 2021 ($P < .001$), associate professors increased 3.6 percentage points from 0.7% in 2011 to 4.3% in 2021 ($P = .04$), and assistant professors increased 7.8 percentage points from 2.2% in 2011 to 10.0% in 2021 ($P = .01$).

Table 1. Change in the number and percentage of environmental health science enrolled students and graduates at schools and programs of public health, by degree level, race and ethnicity, and student status, 2011 to 2021[a].

N = 45 REPORTING INSTITUTIONS	STUDENTS ENROLLED				GRADUATED			
RACE AND ETHNICITY	2011 NO. (%)	2021 NO. (%)	PERCENTAGE-POINT DIFFERENCE	*P* VALUE[b]	2011 NO. (%)	2021 NO. (%)	PERCENTAGE-POINT DIFFERENCE	*P* VALUE[b]
Overall								
Total	699 (100.0)	766 (100.0)	—[c]	—[c]	366 (100.0)	384 (100.0)	—[c]	—[c]
American Indian/ Alaska Native	14 (2.0)	3 (0.4)	−1.6	**.004**	3 (0.8)	4 (1.0)	0.2	.75
Asian	100 (14.3)	119 (15.5)	1.2	.51	45 (12.3)	61 (15.9)	3.6	.16
Hispanic/Latinx[d]	80 (11.4)	124 (16.2)	4.8	**.009**	33 (9.0)	49 (12.8)	3.8	.10
Native Hawaiian/ Pacific Islander	12 (1.7)	0 (0.0)	−1.7	**<.001**[e]	3 (0.8)	1 (0.3)	−0.5	.29
Non-Hispanic Black or African American	76 (10.9)	92 (12.0)	1.1	.49	33 (9.0)	35 (9.1)	0.1	.96
Non-Hispanic White	202 (28.9)	211 (27.5)	−1.4	.57	139 (38.0)	130 (33.9)	−4.1	.24
Unknown	191 (27.3)	162 (21.1)	−6.2	**.006**	101 (27.6)	83 (21.6)	−6.0	.06
Multiracial	24 (3.4)	55 (7.2)	3.8	**.002**	9 (2.5)	21 (5.5)	3.0	**.036**
Master's								
Total	480 (100.0)	506 (100.0)	—[c]	—[c]	293 (100.0)	297 (100.0)	—[c]	—[c]
American Indian/ Alaska Native	10 (2.1)	2 (0.4)	−1.7	**.016**	3 (1.0)	3 (1.0)	0.0	.99
Asian	69 (14.4)	79 (15.6)	1.2	.59	36 (12.3)	48 (16.2)	3.9	.18
Hispanic/Latinx[d]	55 (11.5)	89 (17.6)	6.1	**.006**	29 (9.9)	39 (13.1)	3.2	.22
Native Hawaiian/ Pacific Islander	9 (1.9)	0 (0.0)	−1.9	**.002**[e]	3 (1.0)	1 (0.3)	−0.7	.31
Non-Hispanic Black or African American	52 (10.8)	65 (12.8)	2.0	.33	27 (9.2)	29 (9.8)	0.6	.82
Non-Hispanic White	135 (28.1)	141 (27.9)	−0.2	.93	107 (36.5)	104 (35.0)	−1.5	.70
Unknown	132 (27.5)	91 (18.0)	−9.5	**<.001**	79 (27.0)	53 (17.8)	−9.2	**.008**
Multiracial	18 (3.8)	39 (7.7)	3.9	**.008**	9 (3.1)	20 (6.7)	3.6	**.040**
Doctoral								
Total	219 (100.0)	260 (100.0)	—[c]	—[c]	73 (100.0)	87 (100.0)	—[c]	—[c]
American Indian/ Alaska Native	4 (1.8)	1 (0.4)	−1.4	0.12	0 (0.0)	1 (1.1)	1.1	.36[e]
Asian	31 (14.2)	40 (15.4)	1.2	0.71	9 (12.3)	13 (14.9)	2.6	.63
Hispanic/Latinx[d]	25 (11.4)	35 (13.5)	2.1	0.50	4 (5.5)	10 (11.5)	6.0	.18
Native Hawaiian/ Pacific Islander	3 (1.4)	0 (0.0)	−1.4	0.06[e]	0 (0.0)	0 (0.0)	0.0	—[f]

(Continued)

Table 1. (Continued)

N = 45 REPORTING INSTITUTIONS	STUDENTS ENROLLED				GRADUATED			
RACE AND ETHNICITY	2011 NO. (%)	2021 NO. (%)	PERCENTAGE-POINT DIFFERENCE	*P* VALUE[b]	2011 NO. (%)	2021 NO. (%)	PERCENTAGE-POINT DIFFERENCE	*P* VALUE[b]
Non-Hispanic Black or African American	24 (11.0)	27 (10.4)	−0.6	0.84	6 (8.2)	6 (6.9)	−1.3	.75
Non-Hispanic White	67 (30.6)	70 (26.9)	−3.7	0.38	32 (43.8)	26 (29.9)	−13.9	.07
Unknown	59 (26.9)	71 (27.3)	0.4	0.93	22 (30.1)	30 (34.5)	4.4	.56
Multiracial	6 (2.7)	16 (6.2)	3.5	0.08	0 (0.0)	1 (1.1)	1.1	.36[e]

[a]Data source: Association of Schools and Programs of Public Health.[26] Percentages may not total to 100 because of rounding.
[b]*P* values determined by test for difference in 2 proportions; $P < .05$ considered significant.
[c]The em dash "—" represents "does not apply."
[d]Includes Hispanic Black or African American and Hispanic White.
[e]*P* value should be interpreted with caution because of the value of zero in 2011 or 2021.
[f]No data reported for 2011 or 2021.
Statistically significant *P*-values are bolded.

The largest percentage-point decreases were found among White professors: 11.5 percentage-point decrease at the full professor rank (from 87.0% in 2011 to 75.5% in 2021, $P < .001$), 9.2 percentage-point decrease (not statistically significant) at the associate professor rank (from 76.0% in 2011 to 66.8% in 2021, $P = .06$), and 10.2 percentage-point decrease (not statistically significant) among assistant professors (from 64.7% in 2011 to 54.5% in 2021, $P = .06$).

Among the Hispanic faculty, the proportions across ranks were relatively similar (no statistically significant differences) between 2011 and 2021: 0.8 percentage-point increase among full professors (from 5.7% in 2011 to 6.5% in 2021, $P = .70$), 0.5 percentage-point decrease among associate professors (from 8.2% in 2011 to 7.7% in 2021, $P = .86$), and 1.3 percentage-point increase among assistant professors (from 5.9% in 2011 to 7.2% in 2021, $P = .64$). We also observed this trend among AI/AN, NH/PI, Black, and Multiracial professors across all ranks (PPDs for all were ⩽1.0; all $P > .05$).

Tenured/tenure-track faculty

Table 3 presents the racial and ethnic composition of EHS faculty by tenure status in 2011 and 2021 among the comparable cohort. The total number of tenured (n = 270 in 2011; n = 289 in 2021; increase = 19 faculty) and tenure-track (n = 127 in 2011; n = 134 in 2021; increase = 7 faculty) faculty increased. Asian or Unknown faculty were the only groups to have significant increases in tenured professorships. In 2011, 6.3% of the tenured faculty were Asian, which increased to 12.5% in 2021 (PPD = 6.2, $P = .01$). For faculty who were classified as Unknown race and ethnicity, the proportions of tenured faculty increased from 0.4% in 2011 to 6.2% in 2021 (PPD = 5.8, $P < .001$). By contrast, the largest percentage-point decreases were among White tenured professors (from 82.6% in 2011 to 68.9% in 2021, PPD = −13.7, $P < .001$).

No statistically significant differences (all $P > .05$) in tenured professors were found among the remaining racial and ethnic groups: AI/AN (0.4% in 2011; 0.0% in 2021; PPD = −0.4), Hispanic (8.5% in 2011; 10.0% in 2021; PPD = 1.5), NH/PI (0.0% in 2011; 0.4% in 2021; PPD = 0.4), Black (1.9% in 2011; 1.7% in 2021; PPD = −0.2), and Multiracial (0.0% in 2011; 0.4% in 2021; PPD = 0.4). We also found no statistically significant differences (all $P > .05$) in tenure-track faculty across all racial and ethnic groups: AI/AN (0.0% in 2011; 0.0% in 2021; PPD = 0.0), Asian (21.3% in 2011; 26.9% in 2021; PPD = 5.6), Hispanic (6.3% in 2011; 6.0% in 2021; PPD = −0.3), NH/PI (0.0% in 2011; 0.0% in 2021; PPD = 0.0), Black (3.9% in 2011; 5.2% in 2021; PPD = 1.3), White (67.7% in 2011; 57.5% in 2021; PPD = −10.2), Unknown (0.8% in 2011; 3.7% in 2021; PPD = 2.9), and Multiracial (0.0% in 2011; 0.8% in 2021; PPD = 0.8).

Enrolled students and graduates in 2021

Table 4 provides a snapshot of the racial and ethnic composition of enrolled students and graduates in 2021. A total of 878 students were enrolled in the 67 ASPPH-member institutions that reported EHS student data in 2021. Of the 878 students, 50.6% identified as White (28.6%, n = 251) or Unknown (22.0%, n = 193). The proportions of Asian (14.9%, n = 131) or Hispanic (15.4%, n = 135) students were similar, followed by Black students (n = 102), who comprised 11.6% of the student population. The lowest proportions were of students who were Multiracial (7.1%, n = 62), AI/AN (0.5%, n = 4), or NH/PI (0.0%, n = 0). The 67 institutions reported a total of 452 graduates in 2021. Of the 452 graduates, the majority (57.3%)

Table 2. Change in the number and percentage of environmental health science professors at schools and programs of public health, by race and ethnicity and by rank, 2011 to 2021[a].

N = 44 REPORTING INSTITUTIONS	FULL PROFESSOR				ASSOCIATE PROFESSOR				ASSISTANT PROFESSOR			
RACE AND ETHNICITY	2011 NO. (%)	2021 NO. (%)	PERCENTAGE-POINT DIFFERENCE	*P* VALUE[b]	2011 NO. (%)	2021 NO. (%)	PERCENTAGE-POINT DIFFERENCE	*P* VALUE[b]	2011 NO. (%)	2021 NO. (%)	PERCENTAGE-POINT DIFFERENCE	*P* VALUE[b]
Total	247 (100.0)	294 (100.0)	—[c]	—[c]	146 (100.0)	208 (100.0)	—[c]	—[c]	136 (100.0)	209 (100.0)	—[c]	—[c]
American Indian/ Alaska Native	1 (0.4)	1 (0.3)	−0.1	.90	0 (0.0)	2 (1.0)	1.0	.24[d]	0 (0.0)	0 (0.0)	0.0	—[e]
Asian	14 (5.7)	30 (10.2)	4.5	.06	17 (11.6)	33 (15.9)	4.3	.26	29 (21.3)	44 (21.1)	−0.2	.95
Hispanic/Latinx[f]	14 (5.7)	19 (6.5)	0.8	.70	12 (8.2)	16 (7.7)	−0.5	.86	8 (5.9)	15 (7.2)	1.3	.64
Native Hawaiian/ Pacific Islander	0 (0.0)	1 (0.3)	0.3	.36[d]	0 (0.0)	1 (0.5)	0.5	.40[d]	0 (0.0)	0 (0.0)	0.0	—[e]
Non-Hispanic Black or African American	2 (0.8)	1 (0.3)	−0.5	.46	5 (3.4)	7 (3.4)	0.0	.98	8 (5.9)	13 (6.2)	0.3	.90
Non-Hispanic White	215 (87.0)	222 (75.5)	−11.5	**<.001**	111 (76.0)	139 (66.8)	−9.2	.06	88 (64.7)	114 (54.5)	−10.2	.06
Unknown	1 (0.4)	20 (6.8)	6.4	**<.001**	1 (0.7)	9 (4.3)	3.6	**.042**	3 (2.2)	21 (10.0)	7.8	**.005**
Multiracial	0 (0.0)	0 (0.0)	0.0	—[e]	0 (0.0)	1 (0.5)	0.5	.40[d]	0 (0.0)	2 (1.0)	1.0	.25[d]

[a]Data source: Association of Schools and Programs of Public Health.[26] Percentages may not total to 100 because of rounding.
[b]*P* values determined by test for difference in 2 proportions; $P < .05$ considered significant.
[c]The em dash "—" represents "does not apply."
[d]*P* value should be interpreted with caution because of the value of zero enrolled students in 2011.
[e]No data reported for 2011 or 2021.
[f]Includes Hispanic Black or African American and Hispanic White.
Bold indicates *P*-value < 0.05.

Table 3. Change in the number and percentage of environmental health science faculty at schools and programs of public health, by race and ethnicity and by tenure status, 2011 to 2021[a].

N = 44 REPORTING INSTITUTIONS	TENURED[b]				TENURE-TRACK[b]			
RACE AND ETHNICITY	2011 NO. (%)	2021 NO. (%)	PERCENTAGE-POINT DIFFERENCE	*P* VALUE[c]	2011 NO. (%)	2021 NO. (%)	PERCENTAGE-POINT DIFFERENCE	*P* VALUE[c]
Total	270 (100.0)	289 (100.0)	—[d]	—[d]	127 (100.0)	134 (100.0)	—[d]	—[d]
American Indian/ Alaska Native	1 (0.4)	0 (0.0)	−0.4	.30[e]	0 (0.0)	0 (0.0)	0.0	—[f]
Asian	17 (6.3)	36 (12.5)	6.2	**.013**	27 (21.3)	36 (26.9)	5.6	.29
Hispanic/Latinx[g]	23 (8.5)	29 (10.0)	1.5	.54	8 (6.3)	8 (6.0)	−0.3	.91
Native Hawaiian/ Pacific Islander	0 (0.0)	1 (0.4)	0.4	.33[e]	0 (0.0)	0 (0.0)	0.0	—[f]
Non-Hispanic Black or African American	5 (1.9)	5 (1.7)	−0.2	.91	5 (3.9)	7 (5.2)	1.3	.62
Non-Hispanic White	223 (82.6)	199 (68.9)	−13.7	**<.001**	86 (67.7)	77 (57.5)	−10.2	.09
Unknown	1 (0.4)	18 (6.2)	5.8	**<.001**	1 (0.8)	5 (3.7)	2.9	.11
Multiracial	0 (0.0)	1 (0.4)	0.4	.33[e]	0 (0.0)	1 (0.8)	0.8	.33[e]

[a]Data source: Association of Schools and Programs of Public Health.[26] Percentages may not total to 100 because of rounding.
[b]Among schools that offer tenure (n = 1 did not grant tenure).
[c]*P* values determined by test for difference in 2 proportions; $P < .05$ considered significant.
[d]The em dash "—" represents "does not apply."
[e]*P* value should be interpreted with caution because of the value of zero in 2011 or 2021.
[f]No data reported for 2011 or 2021.
[g]Includes Hispanic Black or African American and Hispanic White.
Statistically significant *P*-values are bolded.

Table 4. Number and percentage of environmental health science graduate students and faculty (by rank and tenure status) at schools and programs of public health, by race and ethnicity, 2021[a].

RACE AND ETHNICITY	N = 67 REPORTING INSTITUTIONS		N = 68 REPORTING INSTITUTIONS				
	GRADUATE STUDENT, NO. (%)		PROFESSOR, NO. (%)			TENURE STATUS, NO. (%)[b]	
	STUDENTS ENROLLED	GRADUATED	FULL	ASSOCIATE	ASSISTANT	TENURED	TENURE-TRACK
Total	878 (100.0)	452 (100.0)	347 (100.0)	253 (100.0)	249 (100.0)	349 (100.0)	158 (100.0)
American Indian/ Alaska Native	4 (0.5)	4 (0.9)	1 (0.3)	2 (0.8)	0 (0.0)	0 (0.0)	0 (0.0)
Asian	131 (14.9)	67 (14.8)	51 (14.7)	44 (17.4)	57 (22.9)	48 (13.8)	46 (29.1)
Hispanic/Latinx[c]	135 (15.4)	53 (11.7)	19 (5.5)	18 (7.1)	15 (6.0)	30 (8.6)	9 (5.7)
Native Hawaiian/ Pacific Islander	0 (0.0)	3 (0.7)	1 (0.3)	3 (1.2)	0 (0.0)	2 (0.6)	0 (0.0)
Non-Hispanic Black or African American	102 (11.6)	42 (9.3)	1 (0.3)	8 (3.2)	19 (7.6)	6 (1.7)	9 (5.7)
Non-Hispanic White	251 (28.6)	150 (33.2)	248 (71.5)	163 (64.4)	127 (51.0)	237 (67.9)	87 (55.1)
Unknown	193 (22.0)	109 (24.1)	25 (7.2)	14 (5.5)	29 (11.7)	25 (7.2)	6 (3.8)
Multiracial	62 (7.1)	24 (5.3)	1 (0.3)	1 (0.4)	2 (0.8)	1 (0.3)	1 (0.6)

[a]Data source: Association of Schools and Programs of Public Health.[26] Percentages may not total to 100 because of rounding.
[b]Among schools that offer tenure (n = 2 did not grant tenure).
[c]Includes Hispanic Black or African American and Hispanic White.

identified as White (33.2%, n = 150) or Unknown (24.1%, n = 109). The remaining proportions were as follows: Asian (14.8%, n = 67), Hispanic (11.7%, n = 53), Black (9.3%, n = 42), Multiracial (5.3%, n = 24), AI/AN (0.9%, n = 4), or NH/PI (0.7%, n = 3).

Faculty by rank in 2021

In 2021, 68 ASPPH-member institutions reported EHS faculty data (Table 4). Together, these institutions reported that 347 faculty members were full professors, 253 were associate professors, and 249 were assistant professors. White professors represented more than half of the faculty at each rank: full (71.5%, n = 248), associate (64.4%, n = 163), and assistant (51.0%, n = 127). The second largest representation was Asian faculty: full (14.7%, n = 51), associate (17.4%, n = 44), and assistant (22.9%, n = 57). The proportions of Hispanic (full: 5.5%, n = 19; associate: 7.1%, n = 18; assistant: 6.0%, n = 15) or Black (full: 0.3%, n = 1; associate: 3.2%, n = 8; assistant: 7.6%, n = 19) faculty at each rank were all <8.0%. The proportions of AI/AN, NH/PI, and Multiracial faculty members were each <1.5% across professor rank.

Tenured/tenure-track faculty in 2021

Among the 68 institutions that reported faculty data, the number of tenured faculty (n = 349) was more than double that of tenure-track faculty (n = 158). As with the racial and ethnic composition of faculty ranks, White professors represented more than half of the tenured (67.9%, n = 237) and tenure-track (55.1%, n = 87) faculty in 2021. Asian professors represented 13.8% (n = 48) of tenured faculty and 29.1% (n = 46) of tenure-track faculty. The remaining racial and ethnic groups each comprised <10.0% of tenured and tenure-track faculty: AI/AN (both 0.0%, n = 0), Hispanic (tenured: 8.6%, n = 30; tenure-track: 5.7%, n = 9), NH/PI (tenured: 0.6%, n = 2; tenure-track: 0.0%, n = 0), Black (tenured: 1.7%, n = 6; tenure-track: 5.7%, n = 9), Unknown (tenured: 7.2%, n = 25; tenure-track: 3.8%, n = 6), and Multiracial (tenured: 0.3%, n = 1; tenure-track: 0.6%, n = 1).

Discussion

We examined the racial and ethnic composition of students, graduates, and faculty in EHS departments at ASPPH-member institutions that reported data in both 2011 and 2021. We observed several key findings over the study period: (1) the proportion of Hispanic enrolled students increased by 4.8 percentage points overall and by 6.1 percentage points at the master's level, (2) the proportion of Multiracial enrolled and graduating students significantly increased overall (enrolled PPD = 3.8, graduating PPD = 3.0) and at the master's level (enrolled PPD = 3.9, graduating PPD = 3.6), (3) significant decreases were observed among Unknown enrolled students overall (PPD = −6.2), enrolled students at the master's level (PPD = −9.5), and graduating students at the master's level (PPD = −9.2), (4) the proportion of AI/AN enrolled students decreased by 1.6 percentage points overall and at the master's level, (5) the proportions of White full professors (−11.5 percentage points) and White tenured faculty (−13.7 percentage points) decreased, and (6) the proportion of Asian tenured professors increased (6.2 percentage points). Despite these findings, many of the other comparisons across racial and ethnic groups were not statistically significant. This indicates no substantial change in the racial and ethnic composition of these institutions between 2011 and 2021, confirming our hypothesis in relation to other studies of ASPPH-member institutions.[23-25] We also confirmed our hypothesis that the increases in the number of students, graduates, and faculty seen among studies of ASPPH-member institutions (schools of public health and departments of biostatistics and epidemiology) would not be reflected in a study of EHS departments.

A possible explanation for the lack of substantial increases in the racial and ethnic composition and the overall total number of students, graduates, and faculty may be the Council on Education for Public Health (CEPH) accreditation criteria revision in 2016.[28] In this revision, CEPH replaced required coursework in 5 core areas (biostatistics, epidemiology, EHS, health services administration, and social and behavioral sciences) with a competency-based model.[29] Although this model included a learning objective stating that "graduates explain effects of environmental factors on a population's health,"[29] several Master of Public Health programs removed the EH course requirement or no longer offered EH as a degree concentration.[30] Reasons for this include low student enrollment, lack of faculty resources, and difficulties complying with the criteria,[30] which could explain the trends we observed between 2011 and 2021. However, it is important to note that temporal analysis includes a comparable cohort of the same institutions in 2011 and 2021.

As with the data for our study, in the comparison of 1996 and 2016 data from schools of public health,[23] the proportion of Hispanic enrolled students also increased (PPD = 3.4), and the proportion of AI/AN enrolled students also decreased (PPD = −0.3). This study also found a decrease in the proportions of White full professors (PPD = −7.6) and White tenured faculty (PPD = −12.6). The schools of public health study did not include data on those classified as Unknown or Multiracial. In the study of biostatistics and epidemiology departments,[24] statistically significant proportion increases were found among Hispanic students enrolled in biostatistics departments (PPD = 4.4, $P = .01$) but not among Hispanic students enrolled in epidemiology departments (PPD = 1.6, $P = .27$). The authors did not report any statistically significant changes among AI/AN enrolled students in biostatistics (PPD = −0.2, $P = .44$) or epidemiology (PPD = −0.4, $P = .40$). The authors also found statistically significant decreases in White full professors

(biostatistics: PPD = −22.9, $P < .001$; epidemiology: PPD = −17.1, $P < .001$) and White tenured faculty (biostatistics: PPD = −15.9, $P < .001$; epidemiology: PPD = −11.6, $P < .001$). Additionally, increases in the total number of tenured biostatistics (increase = 72 faculty) and tenured epidemiology (increase = 110 faculty) faculty were at least 3 times that of EHS tenured faculty (increase = 19 faculty). The study of biostatistics and epidemiology departments did not separate those who identified as Multiracial from the Unknown group.

Using a larger sample of institutions, we compare our results to the study of EHAC-accredited EHS programs. The EHAC study observed a decrease in the total number of EHS graduate students (−6 students), this study found increases in the total number of EHS enrolled graduate students (67 students). Both the EHAC study (16 professors) and this current study (182 professors) found increases in the total number of faculty. Although the EHAC study observed a substantial increase in the proportion of Black graduate students (PPD = 14.5), our study found a small nonsignificant increase among Black enrolled graduate students (PPD = 1.1, $P = .49$). Another inconsistent finding between the studies was the differences among Asian and Hispanic graduate students. The EHAC study reported substantial decreases in the proportions of Asian (PPD = −10.1) and Hispanic (PPD = −6.5) graduate students, whereas our study observed a nonsignificant increase in Asian (PPD = 1.2, $P = .51$) graduate students, and a statistically significant increase in Hispanic (PPD = 4.8, $P = .01$) graduate students. The authors of the EHAC study reported <1.5 PPDs across all racial and ethnic minority graduate faculty. We observed a similar finding except for Asian graduate faculty (PPD = 3.7). Differences in the results between the EHAC study and our study could be due to different samples of EHS programs. Nonetheless, these mixed findings highlight the need for more studies to better understand the racial and ethnic composition of EHS students, graduates, and faculty over time.

We acknowledge that the study of schools of public health (1996 and 2016 for enrolled students and 1997 and 2017 for faculty),[23] the study of departments of biostatistics and epidemiology specifically (2009-2010 and 2019-2020), and the study of EHAC-accredited EHS programs (2009-2010 to 2020-2021) are based on different academic years than those used in this current study. However, the findings are still worth comparing because the COVID-19 pandemic and changes in admissions requirements could have impacted diversity, and the ASPPH and EHAC studies are the only other available publications for comparison.

Taken together, the lack of substantial increases in minority representation across students, graduates, and faculty highlight the need for more initiatives focused on increasing diversity in academic EHS. In addition to current successful initiatives (eg, diversity recruitment and mentorship) developed by leading EHS organizations,[1-7] more EHS programs (eg, pathway programs, graduate programs, and departments) and faculty positions are needed. Summer pathway programs exposing high school and undergraduate students to EHS courses and research projects may lead to more diverse EHS graduate programs.[31,32]

Leaders of existing and new EHS departments can develop strategic plans that address the hiring, retention, and promotion of minority faculty. Recommendations for these strategic plans can be found in the systematic review by Turner et al.[33] This review covered more than 250 publications over a 20-year period that focused on the experiences of racial and ethnic minorities in academia. Recommendations relevant to increasing diversity in the academic EHS include establishing and maintaining partnerships with minority-serving institutions; providing trainings on structural issues faced by minority faculty; fostering a community that allows for networking and collaborations across academic disciplines; providing research support; and establishing inclusive standards for annual reviews, tenure, and promotion.[33] Turner et al[33] also discuss the importance of reassessing how faculty are evaluated. Faculty from marginalized backgrounds and/or younger generations may be at a disadvantage (eg, poor evaluations) if their unique approaches to research and teaching differ from those of faculty from more privileged backgrounds and older generations.

Limitations

The findings from our study are not without limitations. First, we did not control for age because this variable was not available in the data. Controlling for age would have allowed us to account for generational differences. In addition, this analysis was of the racial/ethnic composition of academic EHS and does not examine other key underrepresented populations (eg, sexual and gender minorities, people with disabilities, first generation students, or those with low SES backgrounds) due to the lack of data on these groups. Second, the institution-level reporting of race and ethnicity could have led to data collection and reporting variability. However, we suspect minimal variability since reporting adhered to standards issued by the National Center for Education Statistics. Third, we used US-based social constructs of race and ethnicity categories, which have evolved over time. As a result, the data may have been susceptible to measurement bias. Fourth, we did not have racial and ethnic data from all ASPPH-member institutions. To address this limitation, we used a comparable cohort of institutions that reported data in both 2011 and 2021. Fifth, data collection and reporting may have been impacted by the COVID-19 pandemic. Program acceptances that were deferred from 2020 to 2021 may have inflated the 2021 student enrollment data. Many graduate programs also removed the Graduate Record Examination (GRE) General Test as an admissions requirement during the pandemic, which could have affected diversity enrollment in 2021.[34] Socioeconomic status (SES) may have also impacted diversity enrollment during the pandemic as those with low SES typically don't have a strong

professional network compared to their high SES counterparts.[35] Those from lower SES backgrounds, particularly racial and ethnic minorities, may have experienced challenges related to building professional relationships with potential EHS mentors, gaining access to EHS career development opportunities, joining EHS research labs, publishing in high impact peer-reviewed journals, and securing strong letters of recommendation. Lastly, as with all secondary data analyses we are limited by type and format of variables collected. Given these limitations, we present trends without the ability to explain changes (or lack thereof) during the study period.

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Author Contributions

Melody Goodman conceptualized the study, developed the methodology, and conducted the data analysis. Jemar Bather drafted the manuscript and tables. Emily Burke and Christine Plepsy collected the data and validated the data and data analysis. All authors reviewed and approved the final draft of the manuscript.

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REFERENCES

1. Oliver P. A call for diversity in environmental health. *J Environ Health*. 2020;82:6-7.
2. Ryan B, Hall K. Strengthening the environmental health professional now and into the future requires a pipeline from education into practice. *J Environ Health*. 2022;84:28.
3. Pinion C, Mitchell LD, Marion JW. It's about communities: the commitment to promoting a culturally competent environmental health workforce. *J Environ Health*. 2018;81:36-39.
4. Gerding JA, Landeen E, Kelly KR, et al. Uncovering environmental health: an initial assessment of the profession's health department workforce and practice. *J Environ Health*. 2019;81:24-33.
5. Long S. The importance of diversity, equity, and inclusion in our profession. *J Environ Health*. 2021;83(8):6-7.
6. National Environmental Health Association. NEHA announces diversity and inclusion awareness award. Accessed July 16, 2022. https://www.neha.org/news-events/latest-news/neha-announces-diversity-and-inclusion-awareness-award
7. Association of Environmental Health Academic Programs. About AEHAP. Accessed July 16, 2022. https://www.aehap.org/
8. Balanay JAG, Richards SL. Insights into diversity in the environmental health science workforce. *Environ Health Insights*. 2022;16:11786302221077513.
9. Chan M, Mita C, Bellavia A, Parker M, James-Todd T. Racial/ethnic disparities in pregnancy and prenatal exposure to endocrine-disrupting chemicals commonly used in personal care products. *Curr Environ Health Rep*. 2021;8:98-112.
10. DeWitt JC, Patisaul HB. Endocrine disruptors and the developing immune system. *Curr Opin Toxicol*. 2018;10:31-36.
11. Bullard RD. *Dumping in Dixie: Race, Class, and Environmental Quality*. 3rd ed. Westview Press; 2000.
12. Lee C. Toxic waste and race in the United States. In: Bryant B and P. Mohai, eds. *Race and the Incidence of Environmental Hazards*. Routledge; 2019:10-27.
13. Payne-Sturges DC, Gee GC, Cory-Slechta DA. Confronting racism in environmental health sciences: moving the science forward for eliminating racial inequities. *Environ Health Perspect*. 2021;129:055002.
14. Kodros JK, Bell ML, Dominici F, et al. Unequal airborne exposure to toxic metals associated with race, ethnicity, and segregation in the USA. *Nat Commun*. 2022;13:6329.
15. Ruiz D, Becerra M, Jagai JS, Ard K, Sargis RM. Disparities in environmental exposures to endocrine-disrupting chemicals and diabetes risk in vulnerable populations. *Diabetes Care*. 2018;41:193-205.
16. Duncan DT, Singham AT, Ompad DC, Goodman MS. Race, ethnicity, and covid-19: the persistence of black-white disparities in the United States. In: Andrews GJ, Crooks VA, Pearce JR, Messina JP, eds. *COVID-19 and Similar Futures: Pandemic Geographies. Global Perspectives on Health Geography*. Springer International Publishing; 2021:331-340.
17. Rubin-Miller L, Alban C, Artiga S, Sullivan S. Covid-19 racial disparities in testing, infection, hospitalization, and death: analysis of epic patient data. September 16, 2020. Accessed October 25, 2022. https://www.kff.org/coronavirus-covid-19/issue-brief/covid-19-racial-disparities-testing-infection-hospitalization-death-analysis-epic-patient-data/
18. Centers for Disease Control and Prevention. Risk for covid-19 infection, hospitalization, and death by race/ethnicity. Accessed October 25, 2022. https://www.cdc.gov/coronavirus/2019-ncov/covid-data/investigations-discovery/hospitalization-death-by-race-ethnicity.html
19. Traylor AH, Schmittdiel JA, Uratsu CS, Mangione CM, Subramanian U. Adherence to cardiovascular disease medications: does patient-provider race/ethnicity and language concordance matter? *J Gen Intern Med*. 2010;25:1172-1177.
20. Strumpf EC. Racial/ethnic disparities in primary care: the role of physician-patient concordance. *Med Care*. 2011;49:496-503.
21. Persky S, Kaphingst KA, Allen VC, Senay I. Effects of patient-provider race concordance and smoking status on lung cancer risk perception accuracy among African-Americans. *Ann Behav Med Publ Soc Behav Med*. 2013;45:308-317.
22. Balanay JAG, Mitchell LD, Richards SL. Racial and gender diversity among students and faculty in EHAC-accredited environmental health sciences programs: trend analysis from 2009 to 2021. *Environ Health Insights*. 2022;16. DOI: 10.1177/11786302221112917.
23. Goodman MS, Plepys CM, Bather JR, Kelliher RM, Healton CG. Racial/ethnic diversity in academic public health: 20-year update. *Public Health Rep*. 2020;135:74-81.
24. Goodman MS, Bather JR, Chu X, Pagano M, Plepys CM, Sebro RA. Racial and ethnic diversity among students, graduates, and faculty in biostatistics and epidemiology, 2010-2020. *Public Health Rep*. Published online June 8, 2022. doi:10.1177/00333549221097653
25. Healton CG. The shape of our river. *Am J Prev Med*. 1999;16:1-4.
26. Association of Schools and Programs of Public Health. ASPPH data center. Accessed October 12, 2022. https://data.aspph.org
27. StataCorp. *Stata Statistical Software: Release 17*. StataCorp LLC; 2021.
28. Levy CR, Phillips LM, Murray CJ, Tallon LA, Caron RM. Addressing gaps in public health education to advance environmental justice: time for action. *Am J Public Health*. 2022;112:69-74.
29. Council on Education for Public Health. Accreditation criteria: schools of public health and public health programs. October 2016. Accessed November 16, 2022. https://media.ceph.org/wp_assets/2016.Criteria.pdf
30. Council on Education for Public Health. Trends in environmental health. 2020. Accessed November 16, 2022. https://media.ceph.org/documents/Environmental_Health.pdf
31. Liburd L, Hsiang Young K, Thorpe RJ. Pedagogy of the CDC undergraduate public health scholars (CUPS) program: cultivating workforce diversity to address health disparities and achieve health equity. *Pedagogy Health Promot*. 2021;7:9S-12S.
32. Thorpe RJ, Young KH, Bentley KM, Liburd L. Roadmap to increase public health and health care workforce diversity: highlights from the first 10 years of the CDC undergraduate public health scholars program. *Pedagogy Health Promot*. 2021;7:5S-8S.
33. Turner CSV, González JC, Wood JL. Faculty of color in academe: what 20 years of literature tells us. *J Divers High Educ*. 2008;1:139-168.
34. Sullivan LM, Velez AA, Longe N, Larese AM, Galea S. Removing the graduate record examination as an admissions requirement does not impact student success. *Public Health Rev*. 2022;43:1605023.
35. Smith SS. "Don't put my name on it": social capital activation and job-finding assistance among the black urban poor. *Am J Sociol*. 2005;111:1-57.