Forensic Science International: Synergy 5 (2022) 100280

Contents lists available at ScienceDirect

Forensic Science International: Synergy

journal homepage: www.sciencedirect.com/journal/forensic-science-international-synergy

Diversity in forensic sciences: Black, Indigenous, and People of Color (BIPOC) representation in different medicolegal fields in the United States

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ARTICLE INFO

Keywords:
Diversity
Representation
Medicolegal
Forensic science

ABSTRACT

The benefits of a diverse and inclusive working environment are well documented. This study examined forensic science literature, demographic data reported from professional organizations, and demographic surveys to compile information regarding racial and ethnic diversity within different subdisciplines of forensic science. Results showed that practitioners self-identified as Black or Hispanic were underrepresented in scientific fields closely related to forensic science. Moreover, Black, Indigenous, and People of Color (BIPOC) students were underrepresented at the undergraduate level, despite increasing college enrollments. This lack of representation may have consequences on knowledge production and innovation. By recognizing the current status of diversity in forensic science, this study is the first step toward mitigating the trend of underrepresentation. We encourage professional organizations to be transparent about the diversity in their membership and provide actual practitioner demographic statistics. These data are beneficial to studying the effects of underrepresentation and developing effective strategies to improve representation.

1. Introduction

The benefits of a diverse working environment are well documented [e.g., Refs. [1–7]. In academia, all measures of diversity, including gender identity, institutional affiliation, and ethnicity, are directly related to the impact of research (5-year citation count) across all fields of science [7]. Diverse research groups tend to produce more novel findings that interest a wider audience [8]. As a result, diverse research teams and collaborators produce research that is more often cited, with more than 10% differences in citation count [7]. In more practical settings, research consistently found that technological innovations are linked to diversity [e.g., Refs. [2,9–11]. Diverse teams are better problem solvers [4], more productive [12,13], and more creative [1,13].

Forensic science is often considered to be a "mixed" field of science, with several subdisciplines that directly or indirectly contribute to or support its research and development [14]. Diversity in forensic science can lead to new scientific advances and technological innovations that improve the justice system and public safety, thus directly benefiting society [15]. Wagstaff and LaPorte [16] highlighted the importance of such diversity in forensic sciences for the National Institute of Justice. Forensic science as a field can be considered to be diverse because of its multi- and interdisciplinarity. However, most forensic scientists were trained in the science, technology, engineering, and mathematics (STEM) fields, which lack significant diversity [17]. Compared with the United State demographics, whites or European Americans and Asians are well represented (and sometimes overrepresented) while Hispanics or Latinos, Blacks or African Americans, and American Indians or Alaska Natives are still underrepresented. In the American Academy of Forensic Sciences (AAFS), only approximately 12–14% of the membership self-identified as being a member of a minority group based on either gender identity, racial identity or ethnicity, national origin, or sexual orientation as of 2011 [18,19]. In terms of racial and ethnic diversity, the Anthropology Section of AAFS is at least 87% white based on survey results [19,20]. However, no demographic statistics for other Sections in the AAFS are publicly available. While these statistics are helpful in elucidating the current status of diversity, they are uninformative in identifying the exact areas or avenues to advance diversity in the field of forensic science, as multiple minority identities were grouped together.

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https://doi.org/10.1016/j.fsisyn.2022.100280
Received 26 June 2022; Received in revised form 25 July 2022; Accepted 1 August 2022
Available online 8 September 2022

Understanding the current status of diversity is only a first step toward building a more diverse and inclusive professional environment.

Forensic scientists work within the greater medicolegal community which includes law enforcement agencies. Systemic and organizational barriers to increasing diversity in law enforcement agencies include but are not limited to: a lack of outreach and community engagement activities, insufficient recruitment efforts, biased hiring practices, and lack of diversity in leadership roles [21–23]. These same factors can impact the recruitment and retention of minority forensic scientists as well. Moreover, entry-level positions in forensic science occupations often require at least a bachelor's degree. Impediments in diversifying STEM higher education and the subsequent workforce, such as the structure, design [24], and ultimately the availability [25] of curriculum and educational pathways that lead to STEM careers, likely affect practitioners in forensic science as well. It is therefore imperative that forensic science as a field examines its current status of diversity. Similar studies have been previously conducted in other forensic science-adjacent fields (subdisciplines), including biological anthropology [26], forensic anthropology [19], pathology [27], and dentistry [28]. However, there is currently no systematic assessment of diversity in other subdisciplines of forensic science. The purpose of this study is to assess the current status of racial and ethnic diversity across all fields of forensic science by comparing demographic statistics among different medicolegal fields and related fields supporting forensic science. Additionally, we consider the education and training of forensic scientists by studying the demographic statistics of undergraduate and graduate students in related fields, as well as profiles of forensic science educational programs.

2. Materials and methods

The definition of diversity varies among individuals and organizations. Here, we refer to diversity as a group-level phenomenon [29]. In the workplace, diversity means that an organization employs a team of people that is reflective of the current society. In the scientific field, diversity means that the field consists of diverse talents across all of the different dimensions that define society [30]. While there are many different aspects of diversity, including gender, disability status, nationality, religious affiliation, socioeconomic background, and sexual orientation, this research focuses on diversity in racial/ethnic identity, as it is one of the dimensions in STEM fields that is most lacking in diversity [17].

To evaluate the status of diversity in forensic science with regards to racial/ethnic identity, we conducted a SCOPUS database search to survey existing literature about racial/ethnic diversity within different subfields of forensic science in the United States (U.S.). We used keywords such as "diversity," "demographics," "race," and "ethnicity" in combination with a forensic science subdiscipline (including "pathology," "death investigation," "psychology," "toxicology," and "forensic DNA") to find studies reporting demographic statistics among practitioners in the subdiscipline. In addition, we surveyed the websites and reports of professional organizations in different forensic science subfields (including the American Dental Association, the American Psychological Association, the American Association of Biological Anthropologists, the American Society for Investigative Pathology, the American Board of Pathology, the American College of Toxicology, and the Society of Toxicology.) to find membership statistics of these organizations.

Moreover, data from the 2020 American Community Survey (ACS) [31] were used to estimate the current racial/ethnic diversity of forensic science-related occupations. The ACS is the U.S. Census Bureau's annual survey that samples about 1% of the U.S. population to provide detailed population-level information on race/ethnicity, occupation, housing, geography, and language, among others. Race and ethnicity in the ACS were self-reported. More information about the ACS can be found at https://www.census.gov/programs-surveys/acs. In the 2020 ACS, a "Forensic Science Technicians" occupation is categorized under the umbrella category "Miscellaneous Life, Physical, and Social Science Technicians." However, the primary areas of forensic science (e.g., forensic biology and DNA, forensic toxicology, forensic odontology, forensic pathology, and forensic anthropology) can be classified into other occupation categories. As a result, this study includes data from related occupations such as "Biological Scientists"/"Biological Technicians", "Chemists"/"Chemical Technicians", and "Psychologists." Together, these sources of data yielded some demographic statistics of the greater scientific community supporting forensic science. To further understand the demographics of specific practitioner occupations (e.g., medical examiners, coroners, criminalists), we surveyed the "Demographics" section of the professional career service and job search platform Zippia. Data from Zippia are based on reports from the U.S. Bureau of Labor Statistics as well as its own "proprietary" collection of data from resumes and job postings [32].

We also ascertained the educational impacts on diversity in forensic science. As highlighted by the National Science Foundation, historically Black colleges and universities (HBCUs) have an important role in preparing Black or African American students for science and engineering doctoral programs and the subsequent job market [17,24]. We surveyed the lists of HBCUs and the Forensic Science Education Programs Accreditation Commission (FEPAC) accredited programs to find out the characteristics of undergraduate forensic science programs. In addition, we reported data from the Integrated Postsecondary Education Data System (IPEDS) on the racial/ethnic statistics of students completing postsecondary education programs related to forensic science in the 2020 academic year [33]. Race and ethnicity in the IPEDS were self-reported. More information about the IPEDS can be found at https://nces.ed.gov/ipeds/. Forensic science-related programs at the undergraduate level (Bachelor's degree or certificate) with at least two students completing the program in the IPEDS include "Cyber/Computer Forensics," "Forensic Chemistry," "Forensic Psychology," and "Forensic Science and Technology."

Different studies, professional organizations, and surveys may take different approaches in obtaining and/or assigning social race categories to individuals. For consistency, we largely followed the standardized race and ethnicity labels designated by the U.S. Census Bureau when reporting our results. Thus, the following categories were used throughout the study: "Asian," "Black or African American," and "white or European American." For this study, "Indigenous American/Pacific Islander" includes all individuals who self-identified as Native Americans, Alaskan Natives, Native Hawaiians, or Pacific Islanders. "Hispanic" includes individuals of all races. "Two or more races" were not retained as a category for comparison but the individuals self-reported as "Two or more races" in the ACS and IPEDS surveys were included in the total tally when calculating relevant demographic statistics.

3. Results

With the exception of the few studies described previously [19, 26–28], there is currently no other scientific literature investigating the racial and ethnic diversity in forensic science-related disciplines. No forensic-specific professional organizations (including the American Academy of Forensic Sciences, the American Board of Forensic Odontology, and the National Association of Medical Examiners) report membership statistics relating to race and ethnic identities. Fig. 1 shows the aggregated racial and ethnic diversity data across different broader scientific disciplines reported by these studies, supplemented with demographic statistics published by the American Psychological Association (APA) [34]. Compared with the U.S. population [35], Asians are underrepresented in the social science fields (anthropology and psychology) and overrepresented in medicines (pathology and dentistry), Black and Hispanic individuals are unrepresented across all fields, while Indigenous individuals are underrepresented in pathology and psychology. While these broader scientific disciplines all have a subfield supporting forensic science, we note that these general demographic

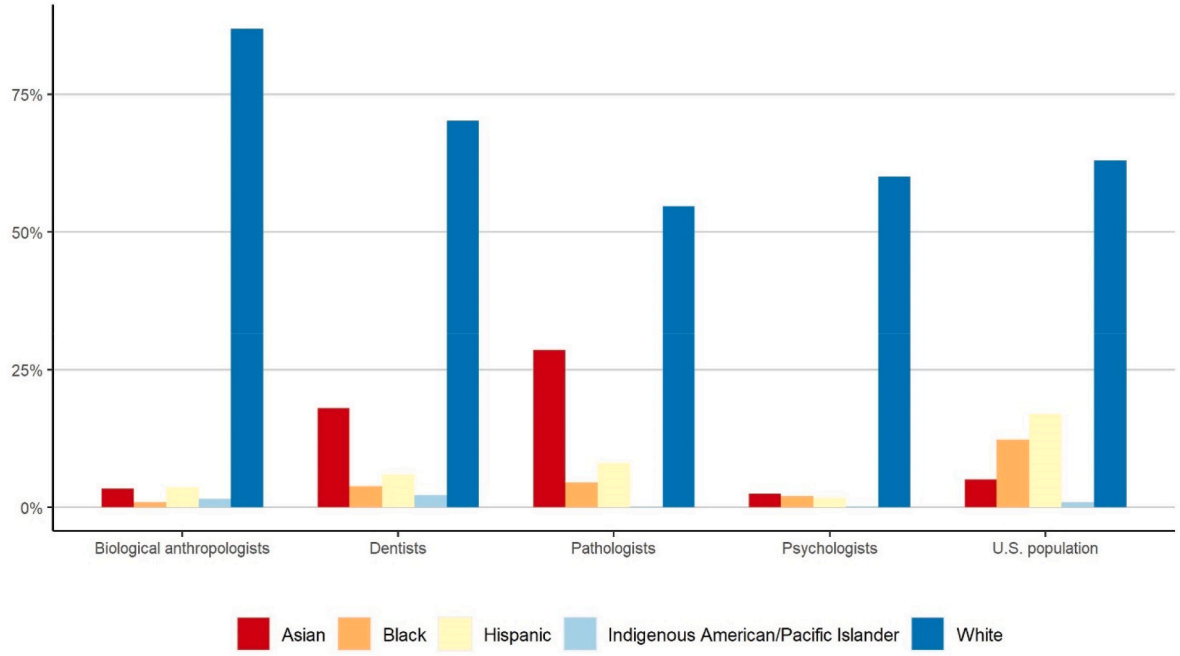

Fig. 1. Racial and ethnic diversity among selected broader scientific fields supporting forensic science. Demographic statistics are derived from published studies and membership statistics reported by professional organizations.

statistics may not be representative of the actual forensic practitioners in these related fields. For example, only approximately 1% of the APA members identified their specialty as forensic psychology [34], 12% of the membership of the American Association of Biological Anthropologists (AABA) identified their specialty as forensic anthropology [26], and about 11% of the board-certified pathologists practice forensic pathology in any (part-time or full-time) capacity [36]. Nonetheless, the statistics reported here provide a macrocosmic view of the forensic practitioners within these fields.

Demographic statistics among forensic science-related occupations are presented in Fig. 2, while specific forensic practitioner statistics are presented in Fig. 3. Forensic science-related occupation statistics are derived from the ACS. As described previously, the ACS grouped "Forensic Science Technicians," "Social Science Research Assistants," and "Forest Conservation Technicians" together and reported these occupations as "Other life, physical, and social science technicians" (presented as "Technician, other" in Fig. 2). Similarly, "Forensic Psychologists" is combined with "Industrial-Organizational

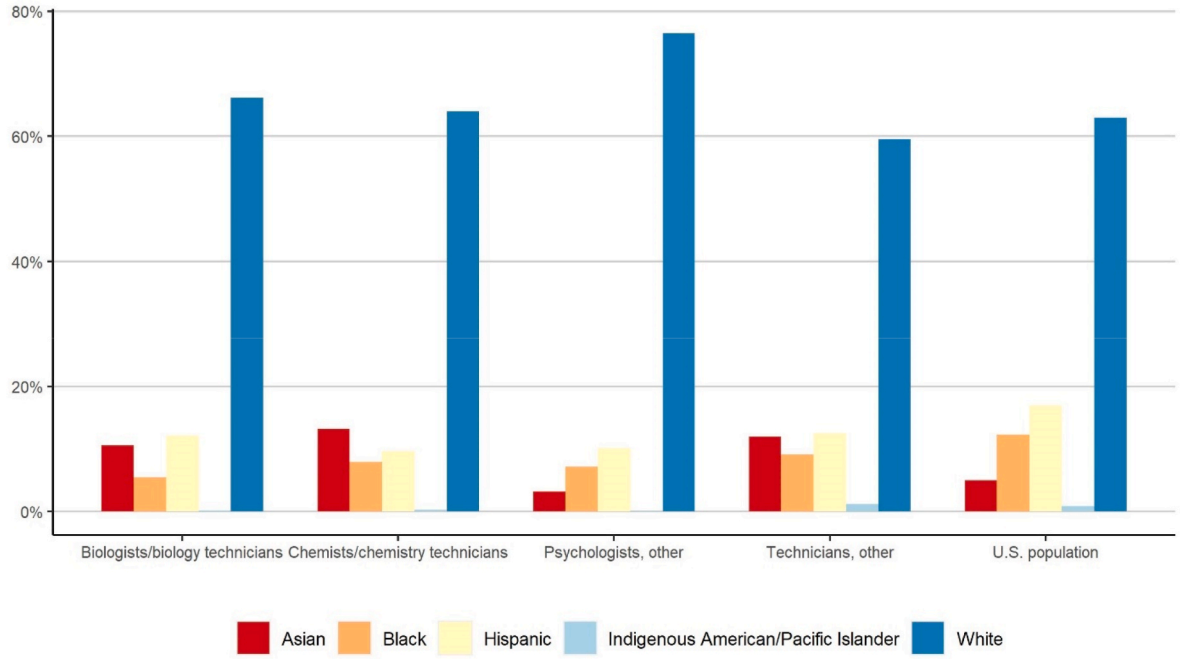

Fig. 2. Racial and ethnic diversity among forensic science-related occupations in the 2020 American Community Survey. "Technicians, other" include forensic science technicians, forest conservation technicians, and social science research assistants, while "Psychologists, other" include both forensic psychologists and industrial-organizational psychologists.

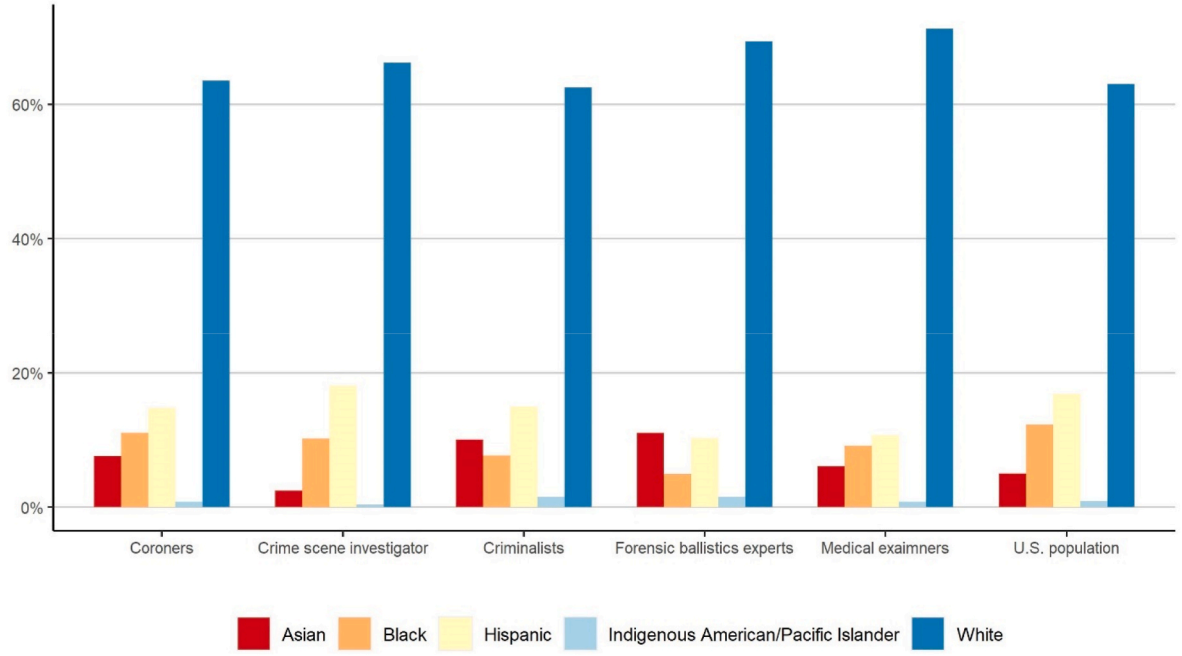

Fig. 3. Racial and ethnic diversity among forensic science practitioners.

Psychologists" into the "Other Psychologists" (reported as "Psychologists, other" in Fig. 2). Therefore, the statistics reported here for these particular categories may be exaggerated and may not reflect the demographics of actual forensic science practitioners. Again, we observed that Asian individuals are overrepresented across most forensic science-related occupations, except as specialized psychologists. Black, Hispanic, and Indigenous individuals are largely underrepresented. For forensic practitioners (Fig. 3), similar trends of underrepresentation for Black and Hispanic individuals can be observed. One important caveat to note here is that we are unable to verify the demographic statistics collected and reported by Zippia. However, the results presented here indicate that Black, Hispanic, and Indigenous individuals are underrepresented across most forensic science and related disciplines.

Of the 104 operating colleges in the U.S. that are classified by the U.S. Department of Education as HBCUs, only 13 (12.5%) offer forensic science-related programs, The majority only offer forensic science minor or concentration (seven institutions, 6.7%), five (4.8%) offer a bachelor's degree in forensic science, and one institution only offers a forensic science certificate. Similarly, of the 46 programs accredited by FEPAC in the U.S., only two such programs are offered by an HBCU. Fig. 4 shows the racial and ethnic diversity of the 2020 college graduates with a degree or a certificate in forensic science-related disciplines derived from the IPEDS. Compared with the U.S. population statistics, Asian, Black, and Indigenous individuals are largely underrepresented in these

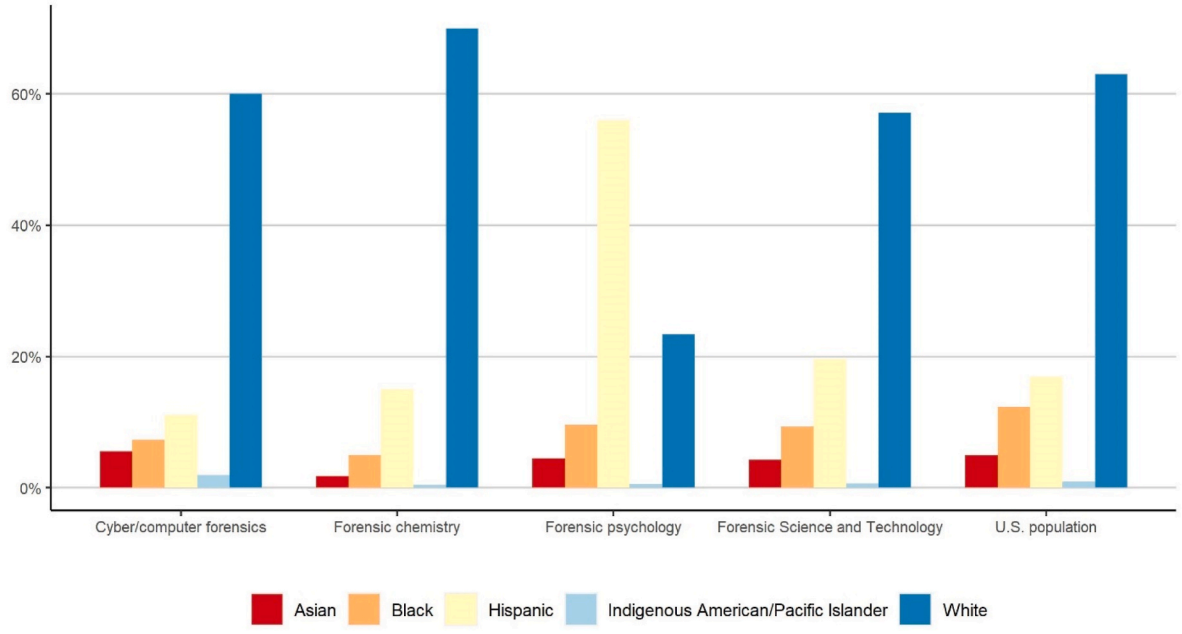

Fig. 4. Racial and ethnic diversity among 2020 graduates in forensic science-related programs as collected by the Integrated Postsecondary Education Data System. Only programs with more than two graduates and are directly related to forensic science are presented here.

disciplines, while Hispanic individuals are well-represented in Forensic Science and Technology and Forensic Psychology but underrepresented in Cyber/Computer Forensics and Forensic Chemistry.

4. Discussion

This study investigates the representation of BIPOC in different medicolegal fields in the U.S. We aim to highlight the lack of diversity in these fields. While limited by the lack of actual practitioner demographic statistics, we showed that BIPOC individuals were largely underrepresented in scientific fields supporting or closely related to forensic science. Our findings are in agreement with previous studies on racial and ethnic diversity in STEM and other fields which generally reported an overrepresentation of Asians in STEM and healthcare occupations [37–39] and an underrepresentation of other BIPOC groups [38–41]. Considering that forensic science-related occupations are only a small subfield of the different occupation categories in our study, the actual demographic statistics among forensic practitioners may show greater disparity among different races and ethnicities. The lack of representation at the professional level may also affect knowledge production and technological innovation [42], as the scientific areas or topics relating to the lived experiences and social identities of minority scientists become less studied [43]. Internationally, studies have shown Indigenous cultural values are often at odds with forensic science during crime scene processing, postmortem examination of the remains, and sample handling [44,45]. Knowledge pertaining to cultural practices can also provide useful tools in forensic identification [46]. In the U.S., despite DNA being considered the most accurate amongst all forensic evidence by the general public [47], African Americans tend to express strong distrust towards DNA evidence [48,49], while the Indigenous communities are ambivalent towards DNA technology in general [50]. Furthermore, scholars have argued that forensic practices such as DNA phenotyping [51–54] and ancestry estimation in forensic anthropology [55–57] reinforce the idea of race and potentially contribute to stigmatization and racial disparity in the criminal justice system. For forensic science, the lack of diversity can thus have far-reaching societal consequences that disproportionately affect people of color, as the development of new technologies and protocols without consideration of their impacts on the BIPOC communities can exacerbate existing issues of inequity in the criminal justice system.

As pointed out by Wagstaff and LaPorte [16], the multi- and interdisciplinarity of forensic science is well-suited to drive the increase in participation in the STEM fields. Individuals from different races and ethnicities can find some areas of forensic science that are attractive and compelling and in which they can excel [16]. However, our findings indicate that at the undergraduate level, all BIPOC individuals are generally underrepresented in forensic science-related fields, despite increasing college enrollments [58]. In addition to traditional barriers to recruitment and retention in STEM, the lack of forensic science-related program offerings and accredited programs in HBCUs likely exacerbates the disproportionate lack of representation of Black/African American students. Systemic racism, cultural and social values, and historical mistreatment of the BIPOC groups may also prevent them from engaging with scientific fields in general [59–61], and forensic science-related fields more specifically [62]. Moreover, forensic science as a field has its own challenges when it comes to the recruitment and retention of BIPOC individuals. First, the "myth of objectivity" prevents meaningful engagement with diverse perspectives and creates a culture that discourages BIPOC practitioners from practicing [63–65]. Second, leading professional organizations in forensic science are not proactive in diversity, equity, and inclusion (DEI) efforts [66,67], which creates further barriers for entry and success. In forensic anthropology, some of these barriers were discussed recently [68]. BIPOC individuals from other subdisciplines in forensic science likely share these experiences. Interestingly, Asian individuals are also underrepresented as graduates with forensic science-related degrees or certificates despite Asians not traditionally being considered an underrepresented minority (URM) in STEM education [17,69–71]. The possible reasons for this observation are likely the intersection of family, culture, and social values [72]. First, Asian students tend to choose majors and careers with a high representation of Asians and with higher earning potentials [73,74]. The lack of Asians in forensic science occupations and the lower wages of these occupations may detract students from pursuing them. Second, many Asian cultures consider death to be a taboo [e.g., 75, 76] and therefore may discourage a career related to its study. Alternatively, our results regarding the broader scientific fields supporting forensic science also showed that Asians tend to be underrepresented in the social sciences, echoing the previous findings that Asians are not overrepresented in all STEM fields [37,74,77,78], and that the "one-size-fits-all" approach to STEM recruitment and retention may be ineffective in addressing the specific needs to different disciplines [74,79,80]. Together, these findings point to the need for both forensic science- as well as subdiscipline-specific diversity initiatives and retention efforts in order to address the specific lack of representation in forensic science and its various subdisciplines.

The larger representation of students who self-identified as Hispanic with forensic science-related degrees versus the underrepresentation of individuals belonging to the same ethnic group in forensic science-related professions is an interesting phenomenon. There are a few possible reasons for this observation. First, the contrasting statistics signify the long-standing problem in STEM education: the progressively smaller number of URM at each milestone in the trajectories towards a STEM degree or career [25,81]. Graduates with a degree in forensic science-related fields may not transition into a forensic science-related job due to barriers such as biased hiring practices. Second, it could be attributable to the rapid growth of the Hispanic population, as the Hispanic population accounts for more than 50% of the population gain post-2000 and is expected to make up 29% of the total population in the U.S. by 2025 [82–84]. Finally, it could be due to the varying data collection and reporting practices employed by different surveys and organizations. Although considered to be an ethnicity label, surveys and organizations sometimes include Hispanic as a race label. In addition, while most Hispanic individuals self-identify as white, a large number of people of Hispanic origin self-identify as "Some Other Races" in the 2020 U S. Census [84]. As individuals who self-identify as other races or more than one race are only included in our total tally but not analyzed as a group label, this could deflate the number of individuals belonging to other races and inflate the number of individuals identified as Hispanic.

Furthermore, forensic scientists work closely with law enforcement agencies, which are also dealing with underrepresentation, especially at the leadership level [23,85]. Lack of representation in law enforcement agencies in the local communities they serve is one of the contributing factors to the lack of trust towards the police [86–89], which further contributes to the reluctance to cooperate when a crime does occur [90]. Conversely, Ba and colleagues [89] found that increased diversity can make law enforcement agencies more open to reform, and more responsive to the residents they serve, especially in minority communities. In addition, systemic racism is prevalent in the criminal justice system (see recent publications [e.g. Refs. [91–93], for more detailed discussions), which no doubt also plagues forensic science and further contributes to the lack of representation. The close relationship between forensic science and law enforcement means similar outcomes for the lack of representation may affect forensic science as well. As discussed previously, people of color express similar distrust toward forensic DNA technology [48,49]. A disproportionate number of people of color are in the forensic DNA databases [94,95], which mirrors the disproportionate number of BIPOC individuals in the criminal justice system [96]. However, without a comprehensive understanding of the real scope of diversity (or the lack thereof) in forensic science, it is challenging to assess the effects. Therefore, we advocate for professional forensic science organizations in the U.S. to be open about diversity and inclusion

and actively report data regarding different aspects of diversity (e.g., gender, race and ethnicity, sexual orientation, disability) within their membership, as this is one of the most straightforward ways to understanding diversity in forensic science.

In order to improve the representation of BIPOC individuals in forensic science, we need effective strategies for recruitment, retention, and promotion. While meaningful discussion of field- and subdiscipline-specific strategies cannot happen without understanding the scope of the issue, previous studies have shown quality mentorship, internship, and research experience all contribute to the effective retention of BIPOC individuals in STEM education [71,97]. Initiatives such as targeted scholarship programs [98] or hiring practices [99] are also effective ways to increase representation across all levels. However, it is worth noting that diversity among employees is often not reflected at the leadership level in many occupations [100], as biases in promotion practices exist across STEM fields [101–103]. Minority scientists are also less likely to hold influential academic positions, as their scientific contributions are often discounted [103]. The results presented in this study mark an important first step to identifying the current status of diversity in forensic science. In addition to specific subdiscipline demographic statistics, future research should focus on identifying barriers specific to forensic science, understanding the current status of diversity at education (faculty and student) and professional (employee and leadership) levels, and identifying effective strategies specific to forensic science to improve BIPOC representation and retention.

5. Conclusions

This study showed the current status of racial and ethnic diversity in forensic science by presenting demographic statistics on BIPOC representation in forensic science as well as related scientific fields at professional and postsecondary education levels. At the professional level, Black and Hispanic individuals are underrepresented across all the related scientific fields. BIPOC are also underrepresented in graduates in forensic science-related programs at the undergraduate level. The lack of representation may have consequences on knowledge production and innovation in forensic science and may affect community trust in forensic scientists. However, the effects of lack of diversity require actual practitioner statistics as well as further study. We call for professional organizations in forensic science to report demographic statistics of their membership to provide a more comprehensive understanding of diversity in forensic science.

CRediT authorship contribution statement

An-Di Yim: Conceptualization, Investigation, Writing – original draft, Writing – review & editing, Visualization. **Jessica K. Juarez:** Conceptualization, Writing – review & editing. **Jesse R. Goliath:** Conceptualization, Writing – review & editing. **Isabel S. Melhado:** Writing – review & editing.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgement

We thank the organizers and the participants of the “Pioneers of Color: A Diverse Narrative of Forensic Anthropology” symposium at the 74th Annual Scientific Meeting of the American Academy of Forensic Sciences. This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

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