

Ethnic and Gender Diversity in Radiology Fellowships

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Received: 22 January 2016 / Revised: 9 May 2016 / Accepted: 11 May 2016 / Published online: 10 June 2016
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Abstract

Purpose The purpose of the study is to assess ethnic and gender diversity in US radiology fellowship programs from 2006 to 2013.

Materials and Methods Data for this study was obtained from Journal of the American Medical Association supplements publications from 2005 to 2006 to 2012–2013 (Gonzalez-Moreno, *Innov Manag Policy Pract.* 15(2):149, 2013; Nivet, *Acad Med.* 86(12):1487–9, 2011; Reede, *Health Aff.* 22(4):91–3, 2003; Chapman et al., *Radiology* 270(1):232–40, 2014; Getto, 2005; Rivo and Satcher, *JAMA* 270(9):1074–8, 1993; Schwartz et al., *Otolaryngol Head Neck Surg.* 149(1):71–6, 2013; Simon, *Clin Orthop Relat Res.* 360:253–9, 1999) and the US census 2010. For each year, Fisher's exact test was used to compare the percentage of women and under-represented minorities in each Accreditation Council for Graduate Medical Education (ACGME)-certified radiology fellowship to the percentage of women and under-represented minorities in (1) all ACGME-certified radiology fellowships combined, (2) radiology residents, (3) ACGME-certified fellows in all of medicine combined, (4) ACGME-certified residents in all of medicine combined, and (5) graduating medical students. Chi-Squared test

was used to compare the percentage of women and under-represented minorities and the 2010 US census.

Results $p < 0.05$ was used as indicator of significance. Interventional radiology and neuroradiology demonstrated the highest levels of disparities, compared to every level of medical education. Abdominal and musculoskeletal radiology fellowships demonstrated disparity patterns consistent with lack of female and URM medical graduates entering into radiology residency.

Conclusion All radiology fellowships demonstrated variable levels of gender and ethnic disparities. Outreach efforts, pipeline programs, and mentoring may be helpful in addressing this issue.

Keywords Diversity · Radiology fellowships · Ethnicity · Gender

Introduction

Over the past decade, studies have demonstrated that diversity as a core value can significantly drive and improve innovation [1]. Specific to medicine, recent studies have shown convincing evidence of the necessity for a diverse health care workforce to deliver the high-value medical education, advancements in research, and health care access to under-represented minorities (URMs) [2, 3]. For example, URM physicians are more likely to work in URM communities [4]. Further, URM patients perceive higher contentment with medical care received when the care is provided by URM physicians [3].

While the importance of a diverse medical workforce has been established, has medicine met this need? An examination of diversity within graduate medical education might be a

Summary Sentence: This study demonstrates high levels of gender and ethnic disparities in radiology fellowships.

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potential means of assessing future diversity in medicine. The Council on Graduate Medical Education (COGME) was established in 1986 by Congress to provide an on-going assessment of physician workforce trends and training issues. In 1993 and again in 2005, the COGME issued reports specifically examining the advancement of goals to increase under-represented minorities (URMs) in the medical profession. Specifically, the COGME reports emphasized that “increasing the number of URM physicians is an important step for improving health care for minorities and underserved populations” [5, 6].

Partly as a result of these reports, ethnic and gender diversity in medicine has become a subject of considerable attention within several medical specialties [7–9]. Recently, there have been a number of publications examining ethnic and gender diversity in the field of radiology. In 2014, Lightfoote et al. published a two-part article, “Improving Diversity, Inclusion, and Representation in Radiology and Radiation Oncology...,” which, on behalf of the American College of Radiology, examined ways to improve diversity and inclusion within the radiology medical specialty [10, 11].

Among the recommendations of the COGME reports was that “more research is needed to evaluate obstacles or motivations for minority entry into primary care or specialty residency programs.” As a specialty, radiology has begun this process. In 2014, Chapman et al. published a seminal article titled “Current Status of Diversity by Race, Hispanic Ethnicity, and Sex” in Radiology. Using data available from the American Medical Association (AMA), this article demonstrated a statistically significant difference between the percentage of women and under-represented minorities in the US census population and all levels of training in radiology [4]. To date, however, no one has examined diversity in radiology fellowships. The purpose of this article is to examine gender and URM diversity trends in all (Accreditation Council for Graduate Medical Education (ACGME)-certified radiology fellowships.

Material and Methods

Institutional Review Board (IRB) evaluation and exemption were granted for the study, as primary data were obtained from publicly available registry sources, with no identifiable private or protected information. Each year, the American Medical Association (AMA) and the Association of American Medical Colleges (AAMC) administer the National Graduate Medical Education Census. Directors of residency and fellowship programs that are accredited by the Accreditation Council for

Graduate Medical Education (ACGME) are asked to complete the program survey component of the census. The data from these surveys is published each year in the Journal of the American Medical Association (JAMA). For this study, ethnic and gender characteristics of participants in ACGME certified radiology fellowships (as defined in Table 1) and all medical fellowships were obtained from JAMA publications containing the National GME census data from 2005 to 2012 [12–19]. Further, ethnic and gender characteristics of radiology residents and medical students from 2005 to 2012 were obtained from the GME census and from the AAMC, respectively [7, 20–26]. Finally, US ethnic and gender population statistics were obtained from the 2010 US census data [27].

According to the US Department of Health and Human Services, under-represented minorities (URMs) are defined as “racial and ethnic populations who are underrepresented in a designated health profession discipline relative to the percentage of that racial or ethnic group in the total population” [28]. Ethnicity is defined by the categories within the GME survey (National Center for Education Statistics 1997). Black or African American is defined as a person having origins in any of the black racial groups of Africa. Hispanic or Latino is defined as a person of Cuban, Mexican, Puerto Rican, South or Central American, or other Spanish culture or origin, regardless of race. Based on these categories and definitions of ethnicity and previously mentioned definition of URM, Figs. 1, 2, and 3 summarize gender and ethnic fellowship participant demographic percentage distribution for each ACGME certified radiology fellowship as defined above, from 2005 to 2012. Figures 4, 5, and 6 summarize the percentages of females, African-Americans, and Latinos in all radiology fellowships (combined), medical fellowships, radiology residencies, medical residencies, medical school graduates, and US census, respectively.

Using the data contained in these figures, Fisher’s exact test and chi-squared test were used to determine statistically significant differences ($p < .05$) between the percentage ethnic and gender distributions within each radiology fellowship and

1. All fellows in ACGME certified radiology fellowships.
2. All radiology residents in ACGME certified radiology residencies.
3. All medical fellows in ACGME certified fellowships, regardless of specialty.
4. All medical residents in ACGME certified residencies, regardless of specialty.
5. All graduating medical students

Table 1 ACGME-certified radiology fellowships

ACGME-certified radiology fellowships		
Type	Program length in years	Number of programs (2012–2013)
Abdominal radiology	1	10
Endovascular Neuroradiology	1	3
Interventional radiology	1	92
Musculoskeletal radiology	1	14
Neuroradiology	1	85
Nuclear medicine	1	19
Pediatric radiology	1	46

6. US census.

Results

The results of statistical analyses are summarized and displayed for each radiology fellowship in Tables 2, 3, 4, 5, 6, 7, and 8.

Abdominal Radiology

Abdominal radiology demonstrated sporadically lower percentages of women in 2006, 2009, and 2013, particularly when compared to percentage of female medical school graduates. Additionally, in 2013, the percentage of women in abdominal radiology fellowship was significantly lower than the average of all radiology fellows, which had not been seen in any previous years. For African-American URMs, the percentage of abdominal fellows was significantly lower when compared to the US census in 2006, 2009, 2010, and 2013. Latino URMs demonstrat-

ed the least amount of statistically significant variations in percentage of fellows, with statistically lower percentages when compared to the US census in 2006 and 2011.

Endovascular Neuroradiology

Of all of the radiology fellowship, endovascular neuroradiology had the fewest overall fellows each year. Because of this, statistical significance was rarely reached. However, in spite of this, the percentage of women endovascular neuroradiology fellows was significantly lower than the census from 2009 to 2011 and significantly lower than the percentage of female medical residents in 2011. There was no statistically significant difference in the percentage of Latino or African-American URMs in endovascular neuroradiology and any of the subcategories studied.

Interventional Radiology

Of all of the ACGME-certified radiology fellowships, interventional radiology has the largest number of programs. However, interventional radiology demonstrates the least amount of diversity, as measured by this study. At every level of medical education, the percentage of female interventional radiology fellows was comparatively significantly lower, regardless of year. From 2006 to 2008, the percentage of African American interventional fellows only demonstrated a significantly lower percentage, when compared to the US census. However, from 2009 to 2013, the percentages of African-American interventional radiology fellows were significantly lower when compared to all radiology residents and all radiology fellows. The percentages of Latino interventional fellows generally compared favorably. With the notable exception of 2009, the percentage of Latino fellows was only significantly lower than the US census.

Fig. 1 Bar graph comparing the percentages of women in each radiology fellowship type from 2006 to 2013

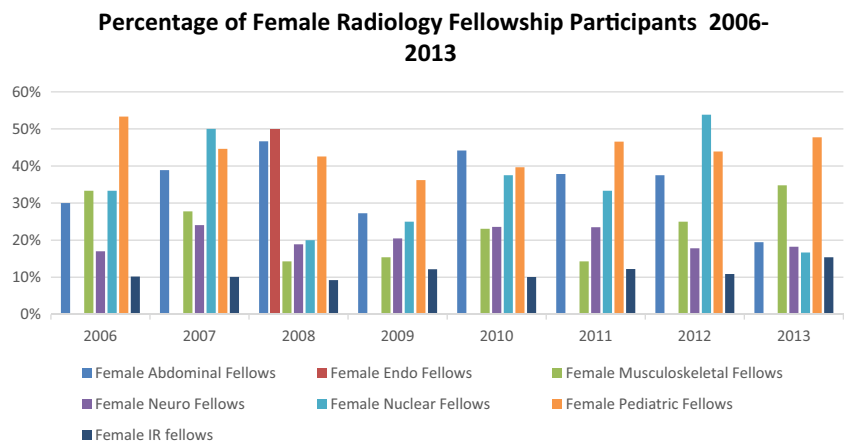
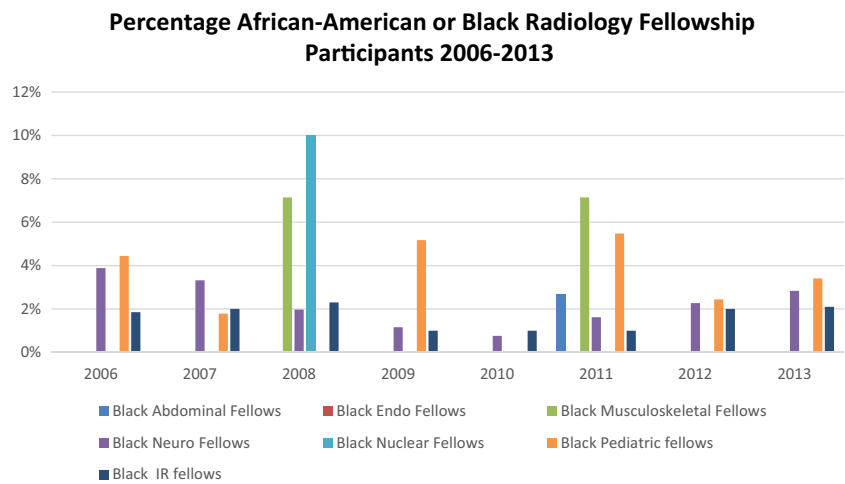


Fig. 2 Bar graph comparing the percentages of African-Americans in each radiology fellowship type from 2006 to 2013



Musculoskeletal Radiology

From 2006 to 2007, there were no statistically significant differences in percentages of female or URM musculoskeletal radiology fellows. However, from 2008 to 2012, the percentage of female musculoskeletal radiology fellows was significantly lower than the US census, medical school graduates, and medical school residents. Further, in 2008 and 2009, female musculoskeletal radiology fellows demonstrated a significantly lower percentage when compared to all medical fellows. African-American and Latino URMs demonstrated significantly lower percentages when compared to the 2012 and 2013 US census, respectively.

of females in neuroradiology are lower than the percentages of women in almost all of the compared levels of medical education, with the notable exception of all radiology fellows. Similarly, the percentages African-American neuroradiology fellows demonstrated significantly lower percentages, when compared to almost all levels of medical education, again, with the notable exception of all radiology fellows. With respect to percentages of neuroradiology fellows, Latinos demonstrated the fewest significant differences across most medical education categories. However, the percentages of Latino neuroradiology fellows are significantly lower than the US census, across all years.

Neuroradiology

Of all radiology fellowships, neuroradiology has the most fellows. However, comparatively, the percentages

Nuclear Medicine

Similar to endovascular neuroradiology, the overall numbers of fellows in nuclear medicine are low, such

Fig. 3 Bar graph comparing the percentages of Latinos in each radiology fellowship from 2006 to 2013

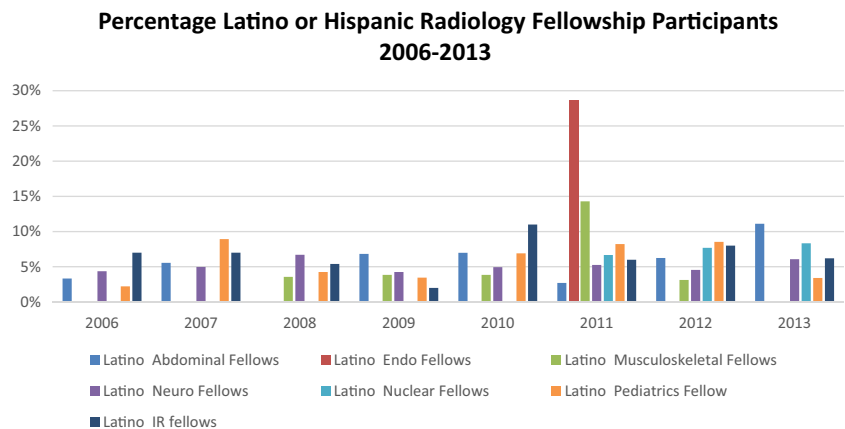
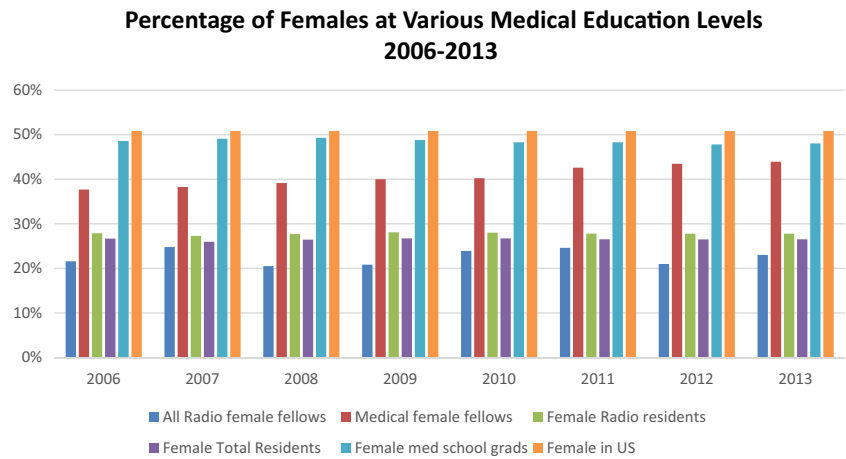


Fig. 4 Bar graph comparing the percentages of women at progressive levels of medical education and from 2006 to 2013 and the US census (2010)



that reaching statistical was difficult. Within this limitation, the only statistically significant percentage differences were seen in 2013, where the percentage of female fellows in nuclear radiology was lower than the US census and medical school graduates.

Pediatric Radiology

In terms of percentages of female fellows, pediatric radiology was the only fellowship subspecialty of radiology to trend differently from the other fellowships. Across almost all years examined, the percentages of female pediatric radiology fellows were significantly higher than all radiology fellows, all medical fellows, and all radiology residents. However, the percentages African-American pediatric radiology fellows demonstrated significantly lower percentages, when compared to the US census. Additionally, in 2009 and 2011, the

percentages of African American pediatric radiology fellows were significantly lower than all radiology fellowships. The percentages of Latino pediatric radiology fellows did not demonstrate any significant differences when compared to any of the medical education levels examined.

Discussion

In 2015, Deville et al. published a study examining gender and ethnicity among all medical specialties. They found that radiology, orthopedics, and otolaryngology demonstrated statistically significant lower numbers of women and URMs, illustrating the diversity problem in radiology [29]. In the second part of their two-part article, “Improving Diversity, Inclusion, and Representation in Radiology and Radiation Oncology,”

Fig. 5 Bar graph comparing the percentages of African Americans at progressive levels of medical education from 2006 to 2013 and the US census (2010)

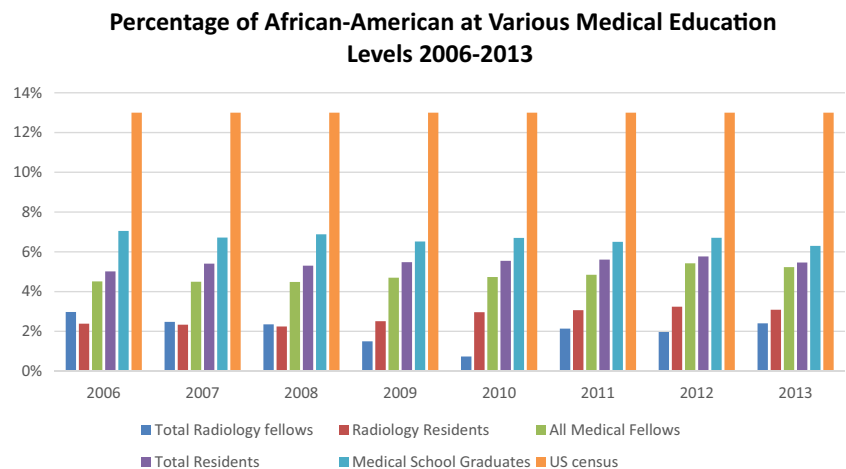
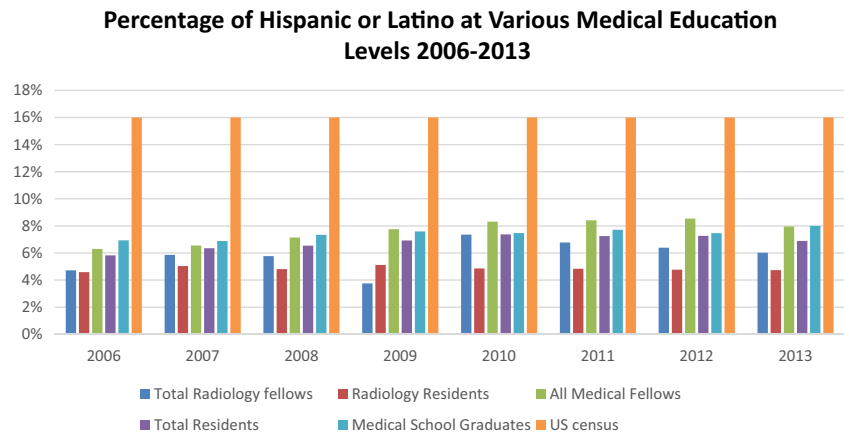


Fig. 6 Bar graph comparing the percentages of Latinos at progressive levels of medical education from 2006 to 2013 and the US census (2010)



Lightfoote et al. discussed the development and implementation of concrete strategies designed to eliminate the current subspecialty disparity [11]. As a part of that discussion, this study examined the percentages of females and under-represented minorities within ACGME certified fellowships.

There are currently seven different ACGME-certified fellowships, ranging from 1 to 3 years in duration. From this study, there is clear evidence of gender disparities within the radiology fellowships. Almost all fellowships demonstrated some levels of gender disparity, with interventional radiology and neuroradiology demonstrating the highest levels of disparity. Pediatric radiology, on the other hand, demonstrated higher than expected percentages of female fellows. In the analysis of the significant differences between the percentages of female fellows and other levels of medical education, a pattern of significantly lower percentage female radiology fellows, compared to all medical residents and fellows, seems to emerge. This may indicate that prospective female medical graduates are choosing specialties other than radiology, limiting the pool of female radiology residents to enter fellowships. Figure 4 further demonstrates the precipitous drop in the percentage of females from medical school to radiology residency. Hewett et al. examined the application processes in one radiology residency program to determine if there was any gender bias in the selection of radiology residents. They found that the pipeline of female medical students pursuing a career in radiology appeared to be the limiting factor rather than bias [30].

African-American radiology fellows demonstrated a similar, albeit less pronounced, pattern of disparity to what was seen in gender. In interventional radiology and neuroradiology fellowships, a pattern of lower percentage African-American radiology residents and fellows, when compared to all medical residents and fellows may again demonstrate the need to recruit more African-American medical school graduates into radiology.

Latino radiology fellows demonstrated the least amount of disparity. Particularly within the larger fellowships (interventional radiology and neuroradiology), significant disparities in the percentage of Latino fellows were mostly seen when compared to the US Census.

In 2015, Phitayakorn et al. demonstrated “that a program’s existing diversity and climate for minorities is weighted more heavily by minority candidates” [31]. The lack of minorities in specialties such as radiology can have a significant effect on the recruitment of other minorities and, thus, have a downstream effect on diversity in fellowships. This illustrates the importance of pipeline initiatives and recruitment of women and URMs into radiology to address the lack of diversity.

Limitations

There are several limitations to the study that should be noted. First, this study only included ACGME-certified fellowships. However, fellowships such as breast imaging are not included. It is of particular significance since as many as 5 % of radiology residents were interested in breast imaging, which was seventh on a choice list of fellowships [32]. Secondly, there is no clear definition of “other” as an ethnic category. For this reason, this category was omitted from this study.

In summary, this study demonstrates high levels of gender and ethnic disparities in radiology fellowships. This study is the first step toward addressing this issue. Potentially, these disparities could be addressed through more aggressive outreach, pipeline programs, and mentoring. Further studies on workforce diversity beyond post-graduate training are also needed. Databases that track gender and ethnic data are needed to further advance the goals of eliminating disparities within the radiology profession.

Table 2 Comparative statistical analysis of percentage female and URM abdominal radiology fellows. Data that demonstrated significant differences between each radiology fellowship and comparison groups were in bold

Comparison groups	Year															
	2006	2007	2008	2009	2010	2011	2012	2013	2010	2011	2012	2013				
	#	%	#	%	#	%	#	%	#	%	#	%	#	%		
Female	9	31.0 %	7	41.2 %	7	46.7 %	12	29.3 %	19	47.5 %	14	38.9 %	6	40.0 %	7	21.9 %
Abdominal radiology fellows	87	22.0 %	110	25.0 %	96	20.5 %	111	21.0 %	130	24.0 %	138	25.0 %	128	21.0 %	134	23.0 %
All radiology fellows	5603	37.6 %	5960	38.0 %	6313	39.0 %	6693	40.0 %	7043	40.0 %	7683	43.0 %	8047	43.0 %	8644	44.0 %
Radiology residents	1180	27.9 %	1192	27.3 %	1221	27.7 %	1251	28.1 %	1257	28.0 %	1260	27.8 %	1259	27.8 %	1233	27.8 %
All medical residents	383,345	43.5 %	39,772	44.5 %	40,746	45.3 %	42,130	46.1 %	43,442	47.1 %	43,792	46.8 %	44,465	46.9 %	44,439	46.6 %
Medical school graduates	7748	48.6 %	7925	49.1 %	7969	49.3 %	8035	48.8 %	8130	48.3 %	8395	48.3 %	8291	47.8 %	8721	48.0 %
US census (2010)	157	50.8 %	157	50.8 %	157	50.8 %	157	50.8 %	157	50.8 %	157	50.8 %	157	50.8 %	157	50.8 %
African-American or Black	0	0.0 %	0	0.0 %	0	0.0 %	0	0.0 %	0	0.0 %	1	2.8 %	0	0.0 %	0	0.0 %
Abdominal radiology fellows	12	3.0 %	11	2.0 %	11	2.4 %	8	2.0 %	4	1.0 %	12	2.0 %	12	2.0 %	14	2.0 %
All radiology fellows	671	4.5 %	700	4.0 %	723	4.5 %	787	5.0 %	828	5.0 %	874	5.0 %	1004	5.0 %	1029	5.0 %
All medical fellows	101	2.4 %	102	2.3 %	99	2.2 %	112	2.5 %	133	3.0 %	139	3.1 %	147	3.2 %	137	3.1 %
Radiology residents	4700	5.3 %	5155	5.8 %	5100	5.7 %	5385	5.9 %	5517	6.0 %	5659	6.1 %	5904	6.2 %	5597	5.9 %
All medical residents	1123	7.1 %	1084	6.7 %	1113	6.9 %	1074	6.5 %	1128	6.7 %	1129	6.5 %	1163	6.7 %	1144	6.3 %
Medical school graduates	36.4	12.9 %	36.4	12.9 %	36.4	12.9 %	36.4	12.9 %	36.4	12.9 %	36.4	12.9 %	36.4	12.9 %	36.4	12.9 %
US census (2010)	1	3.4 %	1	5.9 %	0	0.0 %	3	7.3 %	3	7.5 %	1	2.8 %	1	6.7 %	4	12.5 %
Abdominal radiology fellows	19	5.0 %	26	6.0 %	27	5.8 %	20	4.0 %	40	7.0 %	38	7.0 %	39	6.0 %	35	6.0 %
All radiology fellows	936	6.3 %	1020	7.0 %	1151	7.1 %	1298	8.0 %	1455	8.0 %	1518	8.0 %	1580	9.0 %	1566	8.0 %
All medical fellows	194	4.6 %	220	5.0 %	212	4.8 %	228	5.1 %	218	4.9 %	219	4.8 %	216	4.8 %	210	4.7 %
Radiology residents	5457	6.2 %	6055	6.8 %	6289	7.0 %	6801	7.4 %	7337	8.0 %	7314	7.8 %	7433	7.8 %	7059	7.4 %
All medical residents	1104	6.9 %	1110	6.9 %	1187	7.3 %	1249	7.6 %	1258	7.5 %	1340	7.7 %	1294	7.5 %	1452	8.0 %
Medical school graduates	50.5	16.3 %	50.5	16.3 %	50.5	6.3 %	50.5	16.3 %	50.5	16.3 %	50.5	16.3 %	50.5	16.3 %	50.5	16.3 %
US census (2010)	million	million	million	million	million	million	million	million	million	million	million	million	million	million	million	million

Table 3 Comparative statistical analysis of percentage female and URM endovascular neuroradiology radiology fellows. Data that demonstrated significant differences between each radiology fellowship and comparison groups were in bold

Comparison groups	Year													
	2006	2007	2008	2009	2010	2011	2012	2013						
Female	0	0.0 %	0	0.0 %	1	0.0 %	0	0.0 %	0	0.0 %	0	0.0 %	0	0.0 %
Endovascular surgical neuroradiology fellows	87	22.0 %	110	25.0 %	96	25.0 %	111	20.5 %	130	21.0 %	138	24.0 %	128	21.0 %
All radiology fellows	5603	37.6 %	5960	38.0 %	6313	39.0 %	6693	39.0 %	7043	40.0 %	7683	40.0 %	8047	43.0 %
All medical fellows	1180	27.9 %	1192	27.3 %	1221	27.7 %	1251	27.7 %	1257	28.1 %	1260	28.0 %	1259	27.8 %
Radiology residents	383,345	43.5 %	39,772	44.5 %	40,746	45.3 %	42,130	45.3 %	43,442	46.1 %	43,792	47.1 %	44,465	46.9 %
All medical residents	7748	48.6 %	7925	49.1 %	7969	49.3 %	8035	49.3 %	8130	48.8 %	8395	48.3 %	8291	47.8 %
Medical school graduates	157	50.8 %	157	50.8 %	157	50.8 %	157	50.8 %	157	50.8 %	157	50.8 %	157	50.8 %
US census (2010)	0	0.0 %	0	0.0 %	0	0.0 %	0	0.0 %	0	0.0 %	0	0.0 %	0	0.0 %
African-American or Black	12	3.0 %	11	2.0 %	11	2.4 %	8	2.4 %	4	2.0 %	12	1.0 %	12	2.0 %
Endovascular surgical neuroradiology fellows	671	4.5 %	700	4.0 %	723	4.5 %	787	4.5 %	828	5.0 %	874	5.0 %	1004	5.0 %
All radiology fellows	101	2.4 %	102	2.3 %	99	2.2 %	112	2.2 %	133	2.5 %	139	3.0 %	147	3.1 %
All medical fellows	4700	5.3 %	5155	5.8 %	5100	5.7 %	5385	5.7 %	5517	5.9 %	5659	6.0 %	5904	6.2 %
Radiology residents	1123	7.1 %	1084	6.7 %	1113	6.9 %	1074	6.9 %	1128	6.5 %	1129	6.7 %	1163	6.7 %
All medical residents	36.4	12.9 %	36.4	12.9 %	36.4	12.9 %	36.4	12.9 %	36.4	12.9 %	36.4	12.9 %	36.4	12.9 %
Medical school graduates	0	0.0 %	0	0.0 %	0	0.0 %	0	0.0 %	0	0.0 %	2	0.0 %	0	0.0 %
US census (2010)	0	0.0 %	0	0.0 %	0	0.0 %	0	0.0 %	0	0.0 %	0	0.0 %	0	0.0 %
Latino or Hispanic	19	5.0 %	26	6.0 %	27	5.8 %	20	5.8 %	40	4.0 %	38	7.0 %	39	6.0 %
Endovascular surgical neuroradiology fellows	936	6.3 %	1020	7.0 %	1151	7.1 %	1298	7.1 %	1455	8.0 %	1518	8.0 %	1580	9.0 %
All radiology fellows	194	4.6 %	220	5.0 %	212	4.8 %	228	4.8 %	218	5.1 %	219	4.9 %	216	4.8 %
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Radiology residents	1104	6.9 %	1110	6.9 %	1187	7.3 %	1249	7.3 %	1258	7.6 %	1340	7.5 %	1294	7.7 %
All medical residents	50.5	16.3 %	50.5	16.3 %	50.5	16.3 %	50.5	16.3 %	50.5	16.3 %	50.5	16.3 %	50.5	16.3 %
Medical school graduates	0	0.0 %	0	0.0 %	0	0.0 %	0	0.0 %	0	0.0 %	0	0.0 %	0	0.0 %
US census (2010)	0	0.0 %	0	0.0 %	0	0.0 %	0	0.0 %	0	0.0 %	0	0.0 %	0	0.0 %

Table 4 Comparative statistical analysis of percentage female and URM interventional radiology fellows. Data that demonstrated significant differences between each radiology fellowship and comparison groups were in bold

Comparison groups	Year													
	2006	2007	2008	2009	2010	2011	2012	2013						
Female	11	10.2 %	12	10.1 %	12	10.1 %	16	12.2 %	16	12.2 %	24	10.9 %	30	15.4 %
Interventional radiology fellows	87	22.0 %	110	25.0 %	96	21.0 %	130	21.0 %	138	24.0 %	128	25.0 %	134	23.0 %
All medical fellows	5603	37.6 %	5960	38.0 %	6313	40.0 %	7043	43.0 %	7683	40.0 %	8047	43.0 %	8644	44.0 %
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US census (2010)	157	50.8 %	157	50.8 %	157	50.8 %	157	50.8 %	157	50.8 %	157	50.8 %	157	50.8 %
African-American of Black	2	1.9 %	2	1.7 %	3	2.3 %	2	1.4 %	2	1.3 %	4	0.6 %	4	2.1 %
Interventional radiology fellows	12	3.0 %	11	2.0 %	11	2.4 %	8	2.0 %	4	1.0 %	12	2.0 %	14	2.0 %
All medical fellows	671	4.5 %	700	4.0 %	723	4.5 %	787	5.0 %	828	5.0 %	874	5.0 %	1029	5.0 %
Radiology residents	101	2.4 %	102	2.3 %	99	2.2 %	112	2.5 %	133	3.0 %	139	3.1 %	137	3.1 %
All medical residents	4700	5.3 %	5155	5.8 %	5100	5.7 %	5385	5.9 %	5517	6.0 %	5904	6.1 %	5597	5.9 %
Medical school graduates	1123	7.1 %	1084	6.7 %	1113	6.9 %	1074	6.5 %	1128	6.7 %	1129	6.5 %	1144	6.3 %
US census (2010)	36.4	12.9 %	36.4	12.9 %	36.4	12.9 %	36.4	12.9 %	36.4	12.9 %	36.4	12.9 %	36.4	12.9 %
Interventional radiology fellows	8	7.4 %	8	6.7 %	7	5.4 %	3	2.0 %	18	11.3 %	11	6.1 %	12	6.2 %
All radiology fellows	19	5.0 %	26	6.0 %	27	5.8 %	20	4.0 %	40	7.0 %	38	7.0 %	35	6.0 %
All medical fellows	936	6.3 %	1020	7.0 %	1151	7.1 %	1298	8.0 %	1455	8.0 %	1518	8.0 %	1566	8.0 %
Radiology residents	194	4.6 %	220	5.0 %	212	4.8 %	228	5.1 %	218	4.9 %	216	4.8 %	210	4.7 %
All medical residents	5457	6.2 %	6055	6.8 %	6289	7.0 %	6801	7.4 %	7337	8.0 %	7314	7.8 %	7059	7.4 %
Medical school graduates	1104	6.9 %	1110	6.9 %	1187	7.3 %	1249	7.6 %	1258	7.5 %	1340	7.7 %	1452	8.0 %
US census (2010)	50.5	16.3 %	50.5	16.3 %	50.5	16.3 %	50.5	16.3 %	50.5	16.3 %	50.5	16.3 %	50.5	16.3 %

Table 5 Comparative statistical analysis of percentage female and URM musculoskeletal radiology fellows. Data that demonstrated significant differences between each radiology fellowship and comparison groups were in bold

Comparison groups	Year														
	2006	2007	2008	2009	2010	2011	2012	2013							
Female	Musculoskeletal radiology fellows	5	33.3 %	5	14.8 %	4	16.0 %	6	24.0 %	4	16.7 %	8	25.8 %	8	34.8 %
	All radiology fellows	87	22.0 %	110	20.5 %	111	21.0 %	130	24.0 %	138	25.0 %	128	21.0 %	134	23.0 %
	All medical fellows	5603	37.6 %	5960	39.0 %	6693	40.0 %	7043	40.0 %	7683	43.0 %	8047	43.0 %	8644	44.0 %
	Radiology residents	1180	27.9 %	1192	27.3 %	1221	28.1 %	1257	28.0 %	1260	27.8 %	1259	27.8 %	1233	27.8 %
	All medical residents	383,345	43.5 %	39,772	44.5 %	40,746	45.3 %	43,442	46.1 %	43,792	46.8 %	44,465	46.9 %	44,439	46.6 %
Medical school graduates	7748	48.6 %	7925	49.1 %	7969	49.3 %	8035	48.8 %	8130	48.3 %	8291	47.8 %	8721	48.0 %	
US census (2010)	157 million	50.8 %	157 million	50.8 %	157 million	50.8 %	157 million	50.8 %	157 million	50.8 %	157 million	50.8 %	157 million	50.8 %	
African-American of Black	Musculoskeletal radiology fellows	0	0.0 %	0	0.0 %	2	0.0 %	0	0.0 %	2	8.3 %	0	0.0 %	0	0.0 %
	All radiology fellows	12	3.0 %	11	2.0 %	11	2.0 %	4	1.0 %	12	2.0 %	12	2.0 %	14	2.0 %
	All medical fellows	671	4.5 %	700	4.0 %	723	4.5 %	828	5.0 %	874	5.0 %	1004	5.0 %	1029	5.0 %
	Radiology residents	101	2.4 %	102	2.3 %	99	2.2 %	112	3.0 %	139	3.1 %	147	3.2 %	137	3.1 %
	All medical residents	4700	5.3 %	5155	5.8 %	5100	5.7 %	5385	6.0 %	5659	6.1 %	5904	6.2 %	5597	5.9 %
Medical school graduates	1123	7.1 %	1084	6.7 %	1113	6.9 %	1074	6.5 %	1128	6.7 %	1129	6.5 %	1144	6.3 %	
US census (2010)	36.4 million	12.9 %	36.4 million	12.9 %	36.4 million	12.9 %	36.4 million	12.9 %	36.4 million	12.9 %	36.4 million	12.9 %	36.4 million	12.9 %	
Latino or Hispanic	Musculoskeletal radiology fellows	0	0.0 %	0	0.0 %	1	0.0 %	1	4.0 %	4	16.7 %	1	3.2 %	0	0.0 %
	All radiology fellows	19	5.0 %	26	6.0 %	27	5.8 %	40	7.0 %	38	7.0 %	39	6.0 %	35	6.0 %
	All medical fellows	936	6.3 %	1020	7.0 %	1151	7.1 %	1298	8.0 %	1518	8.0 %	1580	9.0 %	1566	8.0 %
	Radiology residents	194	4.6 %	220	5.0 %	212	4.8 %	228	5.1 %	219	4.8 %	216	4.8 %	210	4.7 %
	All medical residents	5457	6.2 %	6055	6.8 %	6289	7.0 %	6801	7.4 %	7314	7.8 %	7433	7.8 %	7059	7.4 %
Medical school graduates	1104	6.9 %	1110	6.9 %	1187	7.3 %	1249	7.6 %	1340	7.5 %	1294	7.5 %	1452	8.0 %	
US census (2010)	50.5 million	16.3 %	50.5 million	16.3 %	50.5 million	16.3 %	50.5 million	16.3 %	50.5 million	16.3 %	50.5 million	16.3 %	50.5 million	16.3 %	

Table 6 Comparative statistical analysis of percentage female and URM neuroradiology radiology fellows. Data that demonstrated significant differences between each radiology fellowship and comparison groups were in bold

Comparison groups	Year												
	2006	2007	2008	2009	2010	2011	2012	2013					
Female	35	58	48	53	62	58	47	45	19.4 %				
Neuroradiology	35	58	48	53	62	58	47	45	19.4 %				
All radiology fellows	87	110	96	111	130	138	128	134	23.0 %				
All medical fellows	5603	5960	6313	6693	7043	7683	8047	8644	44.0 %				
Radiology residents	1180	1192	1221	1251	1257	1260	1259	1233	27.8 %				
All medical residents	383,345	39,772	40,746	42,130	43,442	43,792	44,465	44,439	46.6 %				
Medical school graduates	7748	7925	7969	8035	8130	8395	8291	8721	48.0 %				
US census (2010)	157	157	157	157	157	157	157	157	50.8 %				
Neuroradiology	8	8	5	3	2	4	6	7	3.0 %				
All radiology fellows	12	11	11	8	4	12	12	14	2.0 %				
All medical fellows	671	700	723	787	828	874	1004	1029	5.0 %				
Radiology residents	101	102	99	112	133	139	147	137	3.1 %				
All medical residents	4700	5155	5100	5385	5517	5659	5904	5597	5.9 %				
Medical school graduates	1123	1084	1113	1074	1128	1129	1163	1144	6.3 %				
US census (2010)	36.4	36.4	36.4	36.4	36.4	36.4	36.4	36.4	12.9 %				
Neuroradiology	9	12	17	11	13	13	12	15	6.5 %				
All radiology fellows	19	26	27	20	40	38	39	35	6.0 %				
All medical fellows	936	1020	1151	1298	1455	1518	1580	1566	8.0 %				
Radiology residents	194	220	212	228	218	219	216	210	4.8 %				
All medical residents	5457	6055	6289	6801	7337	7314	7433	7059	7.4 %				
Medical school graduates	1104	1110	1187	1249	1258	1340	1294	1452	8.0 %				
US census (2010)	50.5	50.5	50.5	50.5	50.5	50.5	50.5	50.5	16.3 %				

Table 7 Comparative statistical analysis of percentage female and URM nuclear medicine fellows. Data that demonstrated significant differences between each radiology fellowship and comparison groups were in bold

Comparison group	Year																
	2006	2007	2008	2009	2010	2011	2012	2013									
Female	Nuclear radiology	2	33.3 %	3	50.0 %	2	20.0 %	2	25.0 %	3	37.5 %	5	35.7 %	7	58.3 %	2	18.2 %
	All radiology fellows	87	22.0 %	110	25.0 %	96	20.5 %	111	21.0 %	130	24.0 %	138	25.0 %	128	21.0 %	134	23.0 %
	All medical fellows	5603	37.6 %	5960	38.0 %	6313	39.0 %	6693	40.0 %	7043	40.0 %	7683	43.0 %	8047	43.0 %	8644	44.0 %
	Radiology residents	1180	27.9 %	1192	27.3 %	1221	27.7 %	1251	28.1 %	1257	28.0 %	1260	27.8 %	1259	27.8 %	1233	27.8 %
	All medical residents	383,345	43.5 %	39,772	44.5 %	40,746	45.3 %	42,130	46.1 %	43,442	47.1 %	43,792	46.8 %	44,465	46.9 %	44,439	46.6 %
Medical school graduates	7748	48.6 %	7925	49.1 %	7969	49.3 %	8035	48.8 %	8130	48.3 %	8395	48.3 %	8291	47.8 %	8721	48.0 %	
US census (2010)	157	50.8 %	157	50.8 %	157	50.8 %	157	50.8 %	157	50.8 %	157	50.8 %	157	50.8 %	157	50.8 %	
African-American of Black	Nuclear radiology	0	0.0 %	0	0.0 %	1	10.0 %	0	0.0 %	0	0.0 %	0	0.0 %	0	0.0 %	0	0.0 %
	All radiology fellows	12	3.0 %	11	2.0 %	11	2.4 %	8	2.0 %	4	1.0 %	12	2.0 %	12	2.0 %	14	2.0 %
	All medical fellows	671	4.5 %	700	4.0 %	723	4.5 %	787	5.0 %	828	5.0 %	874	5.0 %	1004	5.0 %	1029	5.0 %
	Radiology residents	101	2.4 %	102	2.3 %	99	2.2 %	112	2.5 %	133	3.0 %	139	3.1 %	147	3.2 %	137	3.1 %
	All medical residents	4700	5.3 %	5155	5.8 %	5100	5.7 %	5385	5.9 %	5517	6.0 %	5659	6.1 %	5904	6.2 %	5597	5.9 %
Medical school graduates	1123	7.1 %	1084	6.7 %	1113	6.9 %	1074	6.5 %	1128	6.7 %	1129	6.5 %	1163	6.7 %	1144	6.3 %	
US census (2010)	36.4	12.9 %	36.4	12.9 %	36.4	12.9 %	36.4	12.9 %	36.4	12.9 %	36.4	12.9 %	36.4	12.9 %	36.4	12.9 %	
Latino or Hispanic	Nuclear radiology	0	0.0 %	0	0.0 %	0	0.0 %	0	0.0 %	0	0.0 %	1	7.1 %	1	8.3 %	1	9.1 %
	All radiology fellows	19	5.0 %	26	6.0 %	27	5.8 %	20	4.0 %	40	7.0 %	38	7.0 %	39	6.0 %	35	6.0 %
	All medical fellows	936	6.3 %	1020	7.0 %	1151	7.1 %	1298	8.0 %	1455	8.0 %	1518	8.0 %	1580	9.0 %	1566	8.0 %
	Radiology residents	194	4.6 %	220	5.0 %	212	4.8 %	228	5.1 %	218	4.9 %	219	4.8 %	216	4.8 %	210	4.7 %
	All medical residents	5457	6.2 %	6055	6.8 %	6289	7.0 %	6801	7.4 %	7337	8.0 %	7314	7.8 %	7433	7.8 %	7059	7.4 %
Medical school graduates	1104	6.9 %	1110	6.9 %	1187	7.3 %	1249	7.6 %	1258	7.5 %	1340	7.7 %	1294	7.5 %	1452	8.0 %	
US census (2010)	50.5	16.3 %	50.5	16.3 %	50.5	6.3 %	50.5	16.3 %	50.5	16.3 %	50.5	16.3 %	50.5	16.3 %	50.5	16.3 %	

Table 8 Comparative statistical analysis of percentage female and URM pediatric radiology fellows. Data that demonstrated significant differences between each radiology fellowship and comparison groups were in bold

Comparison groups	Year														
	2006	2007	2008	2009	2010	2011	2012	2013							
Female	Pediatric radiology fellows	24	54.5 %	25	44.4 %	21	37.5 %	23	42.6 %	34	50.7 %	36	48.0 %	42	49.4 %
	All radiology fellows	87	22.0 %	110	20.5 %	111	21.0 %	130	24.0 %	138	25.0 %	128	21.0 %	134	23.0 %
	All medical fellows	5603	37.6 %	5960	39.0 %	6693	40.0 %	7043	40.0 %	7683	43.0 %	8047	43.0 %	8644	44.0 %
	Radiology residents	1180	27.9 %	1192	27.7 %	1251	28.1 %	1257	28.0 %	1260	27.8 %	1259	27.8 %	1233	27.8 %
	All medical residents	383,345	43.5 %	39,772	45.3 %	42,130	46.1 %	43,442	47.1 %	43,792	46.8 %	44,465	46.9 %	44,439	46.6 %
African-American of Black	Medical school graduates	7748	48.6 %	7925	49.3 %	8035	48.8 %	8130	48.3 %	8395	48.3 %	8291	47.8 %	8721	48.0 %
	US census (2010)	157	50.8 %	157	50.8 %	157	50.8 %	157	50.8 %	157	50.8 %	157	50.8 %	157	50.8 %
	Pediatric radiology fellows	2	4.5 %	1	0.0 %	3	5.4 %	0	0.0 %	4	6.0 %	2	2.7 %	3	3.5 %
	All radiology fellows	12	3.0 %	11	2.4 %	8	2.0 %	4	1.0 %	12	2.0 %	12	2.0 %	14	2.0 %
	All medical fellows	671	4.5 %	700	4.5 %	787	5.0 %	828	5.0 %	874	5.0 %	1004	5.0 %	1029	5.0 %
Latino or Hispanic	Radiology residents	101	2.4 %	102	2.2 %	112	2.5 %	133	3.0 %	139	3.1 %	147	3.2 %	137	3.1 %
	All medical residents	4700	5.3 %	5155	5.7 %	5385	5.9 %	5517	6.0 %	5659	6.1 %	5904	6.2 %	5597	5.9 %
	Medical school graduates	1123	7.1 %	1084	6.9 %	1074	6.5 %	1128	6.7 %	1129	6.5 %	1163	6.7 %	1144	6.3 %
	US census (2010)	36.4	12.9 %	36.4	12.9 %	36.4	12.9 %	36.4	12.9 %	36.4	12.9 %	36.4	12.9 %	36.4	12.9 %
	Pediatric radiology fellows	1	2.3 %	5	4.4 %	2	3.6 %	4	7.4 %	6	9.0 %	7	9.3 %	3	3.5 %
All medical fellows	All radiology fellows	19	5.0 %	26	5.8 %	20	4.0 %	40	7.0 %	38	7.0 %	39	6.0 %	35	6.0 %
	All medical fellows	936	6.3 %	1020	7.1 %	1298	8.0 %	1455	8.0 %	1518	8.0 %	1580	9.0 %	1566	8.0 %
	Radiology residents	194	4.6 %	220	4.8 %	228	5.1 %	218	4.9 %	219	4.8 %	216	4.8 %	210	4.7 %
	All medical residents	5457	6.2 %	6055	7.0 %	6801	7.4 %	7337	8.0 %	7314	7.8 %	7433	7.8 %	7059	7.4 %
	Medical school graduates	1104	6.9 %	1110	7.3 %	1249	7.6 %	1258	7.5 %	1340	7.7 %	1294	7.5 %	1452	8.0 %
US census (2010)	50.5	16.3 %	50.5	6.3 %	50.5	16.3 %	50.5	16.3 %	50.5	16.3 %	50.5	16.3 %	50.5	16.3 %	

Compliance with Ethical Standards The author denies any conflicts of interest. This study utilized de-identified data from a public source. Informed consent was not deemed necessary. An IRB from the University of Texas Health Science Center was obtained for the conduct of this study.

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