The Changing Representation of Men and Women in United States Medical Residencies from 2014-2022

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Abstract

Research Question:

How have gender trends in US medical residents changed from 2014 to 2022 across all specialties?

Introduction and Significance:

Historically, women have been underrepresented in medicine. While there have been studies on gender trends in certain individual specialties, few studies have examined the overall trends in gender among all specialties for US-based medical residents. This study aims to fill this knowledge gap by examining gender trends in US medical residents from 2014 to 2022 across all specialties.

Materials and Methods:

The data for this study were obtained from the Association of American Medical Colleges (AAMC) Report on Residents annual reports from 2014-2022. The number and proportion of men and women were recorded for each of the 32 primary residency choices. The gender distribution within each residency was then assessed and compared over the nine-year study period.

Results:

Our analysis showed that more women are in medical residencies in 2022 than in any other year during the study period. Over the past nine years, there has been a 2.37% average annual increase in the proportion of women in all surgical specialties. Furthermore, 62% of medical specialties have experienced an increase in the proportion of women filling residency slots in the past nine years. In 2022, the residency with the highest proportion of women was Obstetrics and Gynecology (86.4%), and the residency with the highest proportion of men was Orthopedic Surgery (81.7%).

Conclusions:

These findings highlight the need for further research to understand the factors contributing to these trends and how to continue to improve diversity and representation in the physician workforce.

Research Question

Specific Aims:

1. The primary goal of this analysis was to examine gender trends in US medical residents from 2014 to 2022 across all specialties.
2. We first aimed to modify and rearrange existing datasets to report the gender composition for all years including on:
    1. Each medical specialty (e.g., family medicine, internal medicine, pediatrics, OB-GYN, etc.)
    2. The three types of medical school graduates, American Doctor of Medicine (MD), American Doctor of Osteopathic Medicine (DO), and International Medical Graduates (IMG).
3. We wanted to present the percent of men and women in each specialty for each year and compare trends both across and between specialties.
4. We also sought to understand if any specialties have changed their predominant gender (e.g., were there any specialties that were majority male in 2014, but were majority female in subsequent years, or vice versa).
5. We also explored these trends with an emphasis on changes among surgical vs. non-surgical medical fields by combining and stratifying specialties along these lines.

Using the PICOT format, our research question can be defined as follows:

- Population: All individuals who was a medical resident in the United States
- Intervention: The gender composition over time and at the end of the study period
- Comparison: The gender composition at the beginning of the study period
- Outcome: The proportion of each medical specialty who identify as a woman
- Timeframe: The 12-year period from the year 2014 to the year 2022

We made several hypotheses about the gender distribution of US residencies by specialty, and how these distributions changed over time. Our hypotheses included:

1. We suspected that in 2012, there was more men than women in US residencies
2. We thought that by 2022, the number of men and women in US residencies is likely close to 50% and 50%

3. We hypothesized that for all study years, Family Medicine, Obstetrics & Gynecology (OB-GYN) and pediatrics would be majority female.
4. We presumed that all other specialties besides those listed in hypothesis #3 would be male majority for the study years.
5. We hypothesized that surgical specialties would have a greater male predominance compared to non-surgical specialties, but that the magnitude of this trend would decrease over time

Introduction and Significance

Diversity has long been recognized as an essential component of successful teams in a variety of settings. In particular, diversity in race, ethnicity, gender, and cultural background has been shown to positively impact both team performance[1,2,3] and workplace culture.[4] Deep-level diversity, such as differences in cultural values and worldviews, had been shown to cultivate creativity and innovation.[5] This has led to a growing emphasis on recruiting a diverse and well-balanced team.

In medicine, oftentimes, there is not one "correct" way to solve a problem. With the rise of chronic health conditions such as diabetes[6] and obesity[7], patients are becoming more complex by the year. A report from the 2010 Institute of Medicine concluded that diverse perspectives positively affect both problem-solving of complex medical issues and improve patient satisfaction.[8] Furthermore, research has demonstrated that diverse medical teams foster innovation, enhance financial performance, and most importantly, improve patient outcomes.[9] Despite these benefits, the representation of certain groups within the medical profession has remained limited.

Historically, women have been underrepresented in medicine. In 1980, less than a quarter of medical school graduates matriculating to United States (US) medical residencies were women (24.9%).[10] In 2022, 47.3% of current US medical residents were women.[11] While this represents meaningful progress, certain medical specialties continue to be disproportionate in favor of men. For example, Orthopedic Surgery is well known to be a men-dominated field, with a majority of training programs having women comprise only 10-20% of the class .[12] In fact, one study found that there were no academic differences between men and women applicants to orthopedic surgery programs, suggesting that other factors may be contributing to the underrepresentation of women in this specialty.[13]

The American Association of Medical Colleges (AAMC) has tracked the gender composition of US medical residents since 2014. Despite this transparency, research on gender trends in US medical residencies has largely focused on individual specialties.[14,15,16,17] To our knowledge, only one prior study has examined the gender trends amongst US medical

residents.[18] Thus, our study objective was to serve as an update and provide insight into the progress made in the last 3 years. Additionally, our objective was to add new and important information on the topic, including calculating the average annual change in each residency for men and women and describing the gender trends for each specialty over the last nine years.

[This study intentionally uses the terms “women” and “men” to describe gender, as opposed to “male” and “female” which describe sex.]

Materials and Methods

Study design and data source

We performed a retrospective analysis of data from the Association of American Medical Colleges (AAMC) Report on Residents' annual reports. The data source for this study was Table B3 section of these reports, which records the number of active residents by type of medical school, Graduate Medical Education (GME) specialty, and gender. Data for the study was obtained for a nine-year period, from the first report in 2014 until the most recent report in 2022. The annual reports for the years 2019-2022 were publicly available on the AAMC website, and the reports for the years 2014-2018 were acquired through correspondence with an AAMC representative.

Data collection and analysis

The number and proportion of men and women were recorded for each of the 32 primary residency choices, including transitional years. Our analysis only included residents and excluded trainees in fellowship or in combined specialties (i.e., Med/Peds). The AAMC reports present the number within each residency type separately based on the type of medical school the resident graduated from, which included: 1) international medical school graduates (IMGs), 2) US and Canadian MD graduates, and 3) US DO graduates. The 2022 annual report includes information for the new residency, Aerospace medicine. We excluded the Aerospace medicine residency from this analysis because there was only one year of data available, and thus, we would be unable to compare the gender trends of the residents over time.

To compile our dataset, first, we combined the individual graduate types (IMG, MD, and DO) to generate a single absolute value for the men, the women, and the total residents for each specialty and each year. Second, two specialties (thoracic surgery and plastic surgery) reported the number of residents separately for residents in both integrated and non-integrated residencies. We combined the data from these two training pathways to create one value for each of the respective specialties. Next, using this combined data, we calculated the percent men and percent women for each specialty for each year. To calculate the average percent change through the study period, the percentage point change was calculated between every two-year period. For

example, the percent change from 2014 to 2015 was calculated using [(Number of Women Residents in 2015 / Number of Women Residents in 2014) -1] x 100. This was done between 2014 and 2015, 2016 and 2016, and so on. Up to nine total percentage point changes were calculated and then averaged to get an overall average percentage point change over the 9-year study period.

Data were collected and processed using Google Sheets (Google, Menlo Park, CA) and Microsoft Excel (Microsoft, Fremont, WA). Data entry for each year was verified independently by two authors to ensure accuracy. Tables and figures were created to describe the number and% of men and women residents in each specialty for every year of reporting, as well as the change over time.

Participation and Ethical Statement

This study was an analysis of anonymized, de-identified publicly available data reported by the AAMC. As such, this project did not require IRB approval or consent to participate from research informants.

Results

The AAMC report on residents included 32 unique specialties, 28 of which had data available for all nine years, and four (child neurology, osteopathic neuromusculoskeletal medicine, interventional radiology, and vascular surgery) that reported data after 2014. One specialty (aerospace medicine) had data only for the year 2022 and was intentionally excluded from this study. **Table 1** shows the proportion of women and men in each specialty in the United States residencies for each year. In 2014, there were 94,143 total residents, 53.9% of whom were men and 46.1% of whom were women. In 2022, there were 121,524 total residents, 52.7% of whom were men and 47.3% of whom were women. The number of active residents increased by 27,381 over the nine-year period, and the proportion of women residents increased by 1.2 percentage points.

Table 1. The percent (and number) of women and men in each residency program by year in the United States, 2014-2022

Specialty	**Gender**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
Allergy and Immunology	Women	65.9 (201)	63.9 (193)	66.8 (187)	70.4 (190)	73.2 (208)	73.5 (222)	68.2 (210)	62.7 (198)	64.7 (208)
	Men	34.09 (104)	36.1 (109)	33.2 (93)	29.7 (80)	26.8 (76)	26.5 (80)	31.8 (98)	37.3 (118)	35.3 (114)
Anesthesiology	Women	36.1 (2036)	35.6 (2033)	36.1 (2010)	35.3 (2003)	34.4 (2019)	33.6 (2034)	33 (2054)	33.5 (2129)	34.2 (2255)
	Men	63.89 (3603)	64.4 (3685)	64 (3568)	64.7 (3677)	65.7 (3852)	66.4 (4043)	66.9 (4166)	66.6 (4242)	65.8 (4345)
Child Neurology	Women	N/A	N/A	N/A	67.2 (244)	66.8 (252)	68.4 (266)	68.1 (295)	68.7 (311)	68.8 (335)
	Men	34.62 (116)	N/A	N/A	32.8 (119)	33.2 (125)	31.6 (123)	31.9 (138)	31.3 (142)	31.3 (152)
Colorectal surgery	Women	38.5 (32)	41.2 (35)	37.3 (31)	41.5 (34)	35.5 (30)	44.3 (39)	40 (40)	40.4 (38)	41.2 (40)
	Men	61.44 (51)	58.8 (50)	62.7 (52)	58.6 (48)	65.5 (57)	55.7 (49)	60 (59)	59.6 (57)	58.8 (57)
Dermatology	Women	64.1 (763)	64.4 (781)	64.4 (814)	64.4 (853)	64.5 (891)	61 (877)	59.5 (869)	59.2 (891)	60.8 (920)
	Men	35.88 (427)	35.6 (431)	35.6 (449)	35.6 (470)	35.5 (490)	39 (562)	40.6 (594)	40.8 (615)	39.2 (593)
Emergency Medicine	Women	37.5 (2097)	36.7 (2105)	36.9 (2154)	35.5 (2205)	35.6 (2512)	35.5 (2720)	36 (2885)	37.1 (3085)	39.4 (3409)
	Men	62.55 (3502)	63.3 (3623)	63.1 (3679)	64.9 (4073)	64.5 (4563)	64.5 (4941)	64.1 (5144)	62.8 (5215)	60.7 (5249)
Family Medicine	Women	55.2 (5526)	55.6 (5637)	54.8 (5630)	55 (5814)	54 (6128)	53.7 (6663)	53.7 (7054)	54.2 (7446)	54.7 (7773)

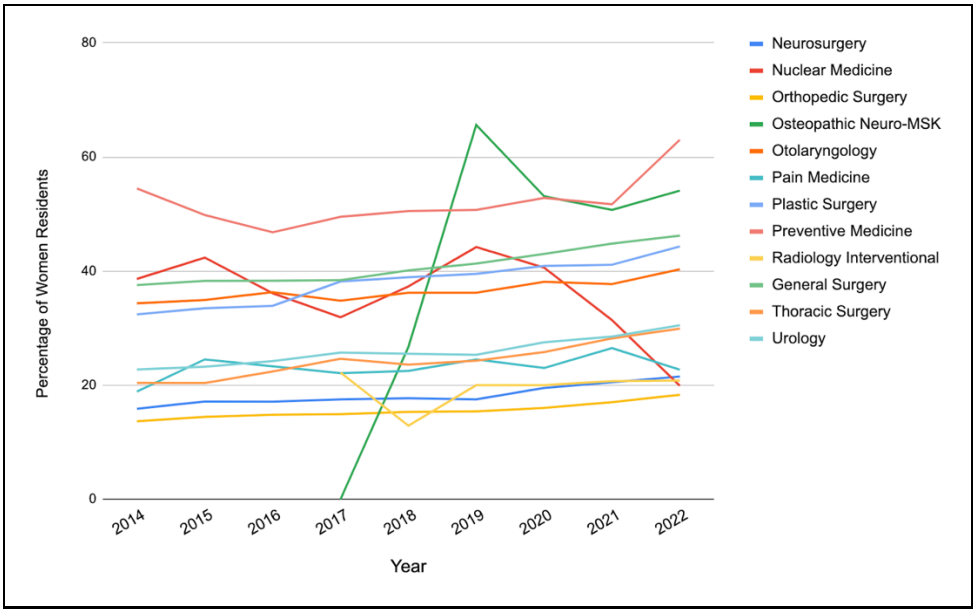
	Men	44.80 (4485)	44.4 (4501)	45.1 (4632)	44.9 (4748)	46 (5221)	46.3 (5753)	46.2 (6074)	45.8 (6288)	45.2 (6402)
Internal Medicine	Women	43.4 (9776)	43.2 (9957)	43.2 (9970)	42.9 (10190)	42.3 (10887)	42.3 (11284)	43.1 (11828)	43.5 (12443)	44.3 (13096)
	Men	56.55 (12726)	56.8 (13117)	56.8 (13076)	57.1 (13586)	57.7 (14851)	57.7 (15389)	57 (15684)	56.4 (16126)	55.7 (16468)
Medical Genetics	Women	61.7 (50)	71.3 (57)	75 (54)	67.1 (51)	67.2 (45)	66.2 (43)	59.2 (36)	53.9 (45)	61.6 (45)
	Men	38.27 (31)	28.8 (23)	25 (18)	32.9 (25)	32.8 (22)	33.9 (22)	40.8 (26)	40.8 (31)	38.4 (28)
Neurosurgery	Women	15.9 (202)	17.1 (225)	17.1(226)	17.5 (236)	17.7 (251)	17.5 (259)	19.5 (298)	20.5 (320)	21.5 (337)
	Men	84.13 (1071)	82.9 (1089)	83 (1097)	82.5 (1112)	82.3 (1167)	82.5 (1218)	80.5 (1233)	79.4 (1243)	78.5 (1231)
Neurology	Women	44.9 (974)	45.0 (1000)	44.4 (1011)	43.4 (1041)	44.7 (1159)	45.5 (1266)	45.8 (1362)	47.2 (1463)	47.9 (1554)
	Men	55.05 (1193)	55.0 (1224)	55.5 (1263)	56.6 (1360)	55.3 (1434)	54.5 (1516)	54.1 (1608)	52.9 (1641)	52.1 (1689)
Nuclear Medicine	Women	38.6 (39)	42.4 (36)	36.1 (30)	31.9 (22)	37.3 (25)	44.2 (30)	40.6 (30)	31.4 (45)	19.9 (13)
	Men	61.39 (62)	57.6 (49)	63.9 (53)	68.1 (47)	62.7 (42)	55.9 (38)	59.5 (44)	68.6 (62)	80 (52)
OB-GYN	Women	82.6 (4041)	82.3 (4114)	83.1 (4116)	82.7 (4151)	82.9 (4332)	83.6 (4495)	83.8 (4599)	85.3 (4738)	86.4 (4950)
	Men	17.45 (854)	17.7 (886)	16.9 (840)	17.3 (866)	17.1 (894)	16.4 (886)	16.2 (887)	14.7 (825)	13.6 (778)
Ophthalmology	Women	44.6 (588)	44.3 (594)	42.8 (574)	41.8 (554)	41.2 (541)	40.4 (538)	41.1 (554)	40.9 (562)	42.1 (605)
	Men	55.39 (730)	55.7 (748)	57.3 (769)	58.1 (554)	58.8 (772)	59.6 (794)	58.8 (791)	59.1 (811)	57.9 (832)
Orthopedic surgery	Women	13.7 (478)	14.4 (512)	14.8 (522)	14.9 (536)	15.3 (586)	15.4 (610)	16 (673)	17 (731)	18.3 (792)
	Men	86.34 (3022)	85.6 (3035)	85.3 (3012)	85.1 (3061)	84.6 (3242)	84.6 (3353)	84 (3541)	82.9 (3571)	81.7 (3542)
Osteopathic Neuro-MSK	Women	N/A	N/A	N/A	0	26.7 (4)	65.6 (21)	53.1 (26)	50.7 (36)	54.1 (40)
	Men	NA	N/A	N/A	100 (2)	73.3 (11)	34.4 (11)	47 (23)	49.3 (35)	46 (34)
Otolaryngology	Women	34.3 (498)	34.9 (509)	36.3 (534)	34.8 (510)	36.2 (558)	36.2 (581)	38.1(623)	37.7 (628)	40.3 (698)
	Men	65.66 (952)	65.1 (949)	63.7 (938)	65.2 (956)	63.8 (984)	63.9 (1025)	62 (1016)	62.2 (1034)	59.7 (1033)
Pain Medicine	Women	18.9 (57)	24.5 (73)	23.3 (69)	22.1 (67)	22.5 (70)	24.5 (78)	23 (84)	26.5 (97)	22.7 (77)
	Men	81.13 (245)	75.5 (225)	76.6 (227)	78 (237)	77.5 (241)	75.5 (241)	77 (280)	73.6 (269)	77.3 (263)
Pathology	Women	54.1 (1237)	53.0 (1202)	51 (1131)	49.8 (1116)	50 (1130)	49.9 (1120)	50.9 (1155)	51.1 (1162)	51.8 (1176)
	Men	45.94 (1051)	47.0 (1068)	49 (1089)	50.2 (1124)	49.9 (1128)	50.1 (1125)	49.1 (1110)	48.8 (1112)	48.2 (1097)
Pediatrics	Women	73.1 (6206)	73.0 (6211)	73.1 (6233)	73 (6302)	72.3 (6323)	72.3 (6419)	72.4 (6508)	72.6 (6615)	73.1 (6738)

	Men	26.85 (2278)	27.0 (2300)	26.8 (2288)	27.1 (2338)	27.7 (2422)	27.7 (2461)	27.6 (2479)	27.3 (2489)	26.9 (2481)
PM&R	Women	38.6 (450)	38.7 (466)	38.8 (485)	39.4 (490)	39.6 (509)	37.4 (503)	35.5 (500)	35.4 (504)	34.3 (513)
	Men	61.41 (716)	61.3 (737)	61.2 (765)	60.6 (754)	60.4 (776)	62.6 (843)	64.5 (909)	64.5 (920)	65.7 (981)
Plastics surgery	Women	32.4 (289)	33.5 (318)	33.9 (364)	38.17 (400)	38.9 (417)	39.5 (435)	40.9 (473)	41.1 (485)	44.3 (537)
	Men	67.60 (603)	66.5 (632)	66.1 (641)	61.83 (648)	61.1 (655)	60.5 (666)	59.1 (684)	58.9 (695)	55.7 (676)
Preventive Medicine	Women	54.5 (134)	49.8 (138)	46.8 (131)	49.5 (154)	50.5 (151)	50.7 (102)	52.8 (152)	51.7 (152)	63 (114)
	Men	45.53 (112)	50.2 (139)	53.2 (151)	50.4 (157)	49.5 (148)	49.3 (142)	47.2 (136)	48.3 (142)	37.1 (67)
Psychiatry	Women	54.5 (2655)	54.4 (2685)	53.7 (2694)	52.2 (2678)	50.5 (2824)	50.1 (2943)	49.1 (3064)	50.2 (3375)	50.7 (3598)
	Men	45.54 (2220)	45.6 (2251)	46.4 (2329)	47.4 (2455)	49.4 (2764)	49.9 (2934)	51 (3184)	49.8 (3350)	49.3 (3495)
Radiation Oncology	Women	29.0 (198)	28.1 (199)	28.5 (203)	29.5 (212)	29.4 (218)	30.2 (225)	30.3 (223)	30.3 (227)	33.3 (250)
	Men	71.01 (485)	71.9 (508)	71.6 (510)	70.5 (505)	70.6 (523)	69.8 (519)	69.7 (513)	69.7 (521)	66.7 (501)
Radiology Diagnostic	Women	27.4 (1218)	27.1 (1186)	26.7 (1177)	26.1 (1155)	26.4 (1179)	30.2 (1178)	27 (1166)	27 (1162)	27.8 (1200)
	Men	72.62 (3231)	72.9 (3196)	73.3 (3229)	73.9 (3267)	73.5 (3276)	73 (3194)	73 (3146)	73 (3145)	72.2 (3126)
Radiology Interventional	Women	N/A	N/A	N/A	22.2 (2)	12.9 (8)	20 (43)	20 (78)	20.7 (156)	20.8 (178)
	Men	NA	N/A	N/A	77.8 (7)	87.1 (54)	80 (172)	80 (313)	79.3 (599)	79.2 (676)
General Surgery	Women	37.5 (2928)	38.3 (3064)	38.3 (3120)	38.4 (3176)	40.1 (3487)	41.3 (3789)	43 (3967)	44.8 (4308)	46.2 (4540)
	Men	62.47 (4873)	61.7 (4943)	61.7 (5035)	(61.5 (5075)	59.8 (5210)	58.7 (5384)	57 (5247)	55.2 (5317)	53.8 (5314)
Thoracic Surgery	Women	20.4 (62)	20.4 (68)	22.4 (82)	24.62 (96)	23.6 (104)	24.3 (110)	25.8 (118)	28.2 (136)	29.9 (153)
	Men	79.61 (242)	79.6 (266)	77.6 (290)	75.38 (294)	76.4 (327)	75.7 (343)	74.2 (339)	71.8 (347)	70.1 (358)
Transitional Year	Women	34.6 (349)	36.8 (350)	34.9 (306)	33.7 (295)	33.8 (376)	36.8 (464)	36.7 (501)	35.1 (516)	34.4 (539)
	Men	65.38 (659)	63.2 (601)	65.1 (571)	66.4 (582)	66.2 (736)	63.2 (798)	63.2 (862)	65 (956)	65.6 (1028)
Urology	Women	22.7 (272)	23.2 (279)	24.2 (296)	25.7 (329)	25.5 (332)	25.3 (342)	27.5 (461)	28.5 (494)	30.5 (543)
	Men	77.26 (924)	76.8 (922)	75.8 (928)	74.3 (954)	74.5 (969)	74.7 (1009)	72.4 (1212)	71.5 (1240)	69.5 (1237)
Vascular Surgery	Women	NA	N/A	39 (96)	35.9 (97)	34.8 (102)	65.2 (107)	35.7 (120)	35.5 (128)	37.3 (142)
	Men	NA	N/A	61(150)	64.1 (173)	65.2 (191)	66.5 (212)	64.3 (216)	64.5 (233)	62.7 (239)

OB-GYN=Obstetrics and gynecology, Osteopathic Neuro-MSK=Osteopathic neuromusculoskeletal medicine, and PM&R=Physical Medicine and Rehabilitation

From 2014 to 2022, there was a 2.37% average annual increase in the proportion of women in all surgical specialties (Neurosurgery, Cardiothoracic Surgery, Plastic Surgery, General Surgery, Obstetrics and Gynecology, Otolaryngology, Ophthalmology, Urology, Orthopedic Surgery, and Colon and Rectal Surgery). Vascular surgery was not included in the AMA report until 2016 and therefore excluded from the preceding analysis. **Figure 1** shows the percent of women in specialties with a rate of change greater than 2 percent per year.

Figure 1. Percentage of women residents in specialties with rate of change greater than 2% per year in the United States, 2014-2022.

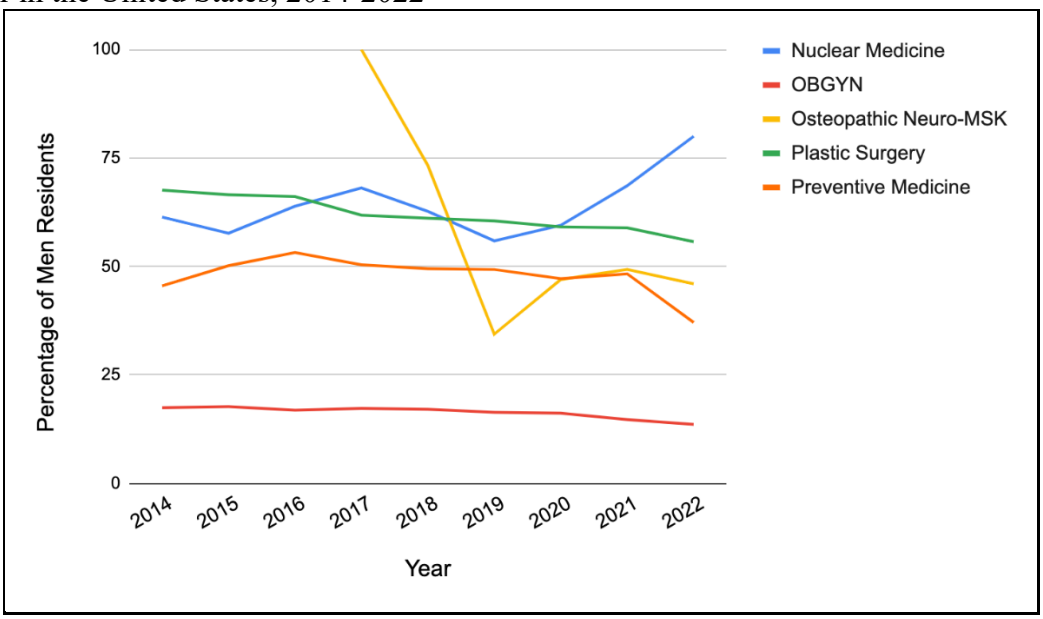


In 2022, the five largest medical residencies (by the total number of residents) were Internal Medicine (29,564), Family Medicine (14,193), General Surgery (9,854), Pediatrics (9,219), and Emergency Medicine (8,658). The proportion of women in these fields was 44.3% for Internal Medicine, 54.7% for Family Medicine, 46.2% for General Surgery, 73.1% for Pediatrics, and 39.4% for Emergency Medicine.

In 2022, the five specialties with the highest proportion of women residents were Obstetrics and Gynecology (86.4% women), Pediatrics (73.1% women), Child neurology (68.8%

women), Allergy and Immunology (64.7% women), and Preventive Medicine (63.0%). In the same year, the specialties with the highest proportion of men residents were Orthopedic Surgery (81.7% men), Nuclear Medicine (80% men), Interventional Radiology (79.2% men), Neurosurgery (78.5% men), and Pain Medicine (77.3% men). **Figure 2** shows the percent of men in residencies with a rate of change greater than 2 percent per year.

Figure 2 Percentage of men residents in specialties with rate of change greater than 2% per year in the United States, 2014-2022



The average annual change among all residents was a 0.46 percentage point increase for women and a 0.21 percentage point decrease for men. Of the 32 specialties, the overall average annual percentage of women decreased in 11 and increased in 21 specialties. For men, the average annual percent decreased in 19 and increased in 13 specialties. The specialties with the highest average increases for women were Osteopathic Neuromusculoskeletal Medicine (32.21), Thoracic Surgery (5.01), and Plastic Surgery (4.06). The specialties with the highest average annual percentage point decrease in women were Nuclear Medicine (-6.09), Physical Medicine and Rehabilitation (-1.43), and Psychiatry (-0.88). The specialties with the highest annual increases for men were Nuclear Medicine (3.86), Medical Genetics (1.40), and Dermatology (1.18). The specialists with the highest average annual percentage point decrease in men were Osteopathic Neuromusculoskeletal Medicine (-4.56), Obstetrics and Gynecology (-2.99), and Plastic Surgery (-2.37).

For each year, we defined a specialty as being "women-majority" if over 50.0% of the total residents were women, and "men-majority" if over 50.0% were men. Of the 32 residencies included in the AAMC report, 21 were men-majority for every year of reporting, 7 were women-majority for every year of reporting, and 4 (Osteopathic Neuromusculoskeletal Medicine, Pathology, Preventive Medicine, and Psychiatry) had alternated between men-majority and women-majority over the years of reporting **(Table 2)**. In every year of reporting, the overall proportion of all residents was majority men. However, 62% of medical specialties have experienced an increase in the proportion of women filling residency slots in the past nine years.

Table 2. Number of residency spots, change, and gender trends across all AAMC residences, 2014-2022

Specialty	**Number of residents, 2014 or first year of reporting*†**	**Number of residents, 2022**	**Residency Growth, Number of seats**	**Residency Growth, %**	**Average annual% change, women**	**Average Annual% change, men**	**Majority trend‡**
Allergy and Immunology	302	322	20	6.6	-0.10	1.05	Consistent women
Anesthesiology	5718	6600	882	15.4	-0.66	0.37	Consistent men
Child Neurology*	363	487	124	34.2	0.48	-0.91	Consistent women
Colorectal surgery	85	97	12	14.1	1.57	-0.21	Consistent men
Dermatology	1212	1513	301	24.8	-0.64	1.18	Consistent women
Emergency Medicine	5728	8,658	2,930	51.2	0.68	-0.36	Consistent men
Family Medicine	10138	14,193	4,055	40.0	-0.11	0.12	Consistent women
Internal Medicine	23074	29,564	6,490	28.1	0.25	-0.19	Consistent men
Medical Genetics	80	73	-7	-8.8	0.45	1.40	Consistent women
Neurosurgery	1314	1568	254	19.3	3.95	-0.86	Consistent men
Neurology	2224	3243	1019	45.8	0.81	-0.68	Consistent men
Nuclear Medicine	85	65	-20	-23.5	-6.09	3.86	Consistent men
OB-GYN	5000	5728	728	14.6	0.57	-2.99	Consistent women
Ophthalmology	1342	1437	95	7.1	-0.70	0.57	Consistent men

Orthopedic surgery	3547	4334	787	22.2	3.75	-0.69	Consistent men
Osteopathic Neuro-MSK*	2	74	72	3600.0	32.21	-4.56	Alternating
Otolaryngology	1458	1731	273	18.7	2.08	-1.16	Consistent men
Pain Medicine	298	340	42	14.1	3.15	-0.53	Consistent men
Pathology	2270	2273	3	0.1	-0.52	0.62	Alternating
Pediatrics	8511	9219	708	8.3	-0.01	0.03	Consistent women
PM&R	1203	1494	291	24.2	-1.43	0.86	Consistent men
Plastics surgery	950	1213	263	27.7	4.06	-2.37	Consistent men
Preventive Medicine	277	181	-96	-34.7	2.19	-2.04	Alternating
Psychiatry	4936	7093	2157	43.7	-0.88	1.02	Alternating
Radiation Oncology	707	751	44	6.2	1.81	-0.77	Consistent men
Radiology Diagnostic	4382	4326	-56	-1.3	0.40	-0.07	Consistent men
Radiology Interventional*	9	854	845	9388.9	3.43	0.56	Consistent men
General Surgery	8007	9854	1847	23.1	2.64	-1.84	Consistent men
Thoracic Surgery	334	510	176	52.7	5.01	-1.57	Consistent men
Transitional Year	951	1567	616	64.8	0.03	0.08	Consistent men
Urology	1201	1780	579	48.2	3.79	-1.31	Consistent men
Vascular Surgery†	247	381	134	54.3	-0.61	0.50	Consistent men
Total	95334	121523	26189	27.5	0.46	-0.21	Consistent men

OB-GYN=Obstetrics and gynecology, Osteopathic Neuro-MSK=Osteopathic neuromusculoskeletal medicine, and PM&R=Physical Medicine and Rehabilitation.

Reporting began in 2017 for Child Neurology, Osteopathic Neuromusculoskeletal Medicine, and Intervention Radiology

Reporting began in 2018 for Vascular Surgery

‡ A specialty was considered “consistent women” if women comprised over 50.0% of residents for every years of reporting, was considered “consistent men” if men comprised over 50.0% for every years of reporting, and was considered “alternating” if the gender majority changes over the years of reporting

Discussion and Innovation

This study was a retrospective analysis of the changing gender distribution among all 32 specialties in United States medical residencies. The purpose of this study was to describe how the representation of men and women has changed over the last nine years. We found that although there has been an overall increase in women in medical residencies, women continue to be less represented than men. Our analysis showed that 12 medical residences had an average annual change of 2% or more per year for the proportion of women. Of these twelve, 11 increased in the annual proportion of women -seven of which were surgical specialties- and only one (Nuclear Medicine) decreased. Similarly, there were five specialties where the proportion of men residents changed by 2% or more per year. The proportion of men increased in Nuclear Medicine and decreased in Obstetrics and Gynecology (OB-GYN), Osteopathic Neuromusculoskeletal Medicine, Plastic Surgery, and Preventative Medicine. Overall, men remain the majority in 22 of the 32 specialties.

Despite the improvement in the proportion of women currently in training, women remain largely underrepresented both in the workforce and among leadership roles.[19] Our study found that although 47.3% of current US residents are women, only 37.1% of total active US physicians are women.[20] Even in Obstetrics and Gynecology, which has the highest proportion of women trainees, only 60.9% of active US physicians, 52.5% of OBGYN physicians with leadership roles, and 36.2% of OBGYN physicians with current professorship positions are women.[21]

The increase of women in medicine has been studied in the past years. Specifically, data from the AAMC showed that the majority of US medical students shifted from male to female for the first time in history in 2019.[22] This shift comes after nearly a decade of growth in the proportion of female medical students.[23,24] However, this has not been reflected in the proportion of females in residency.

Chapman et al.[25] investigated the factors that affect female representation in graduate medical education. Their study found that the three factors that had the greatest predictive value for female representation amongst specialties were female faculty representation, whether the

specialty was a mandatory third-year core rotation, and mean Step1 USMLE score. Additionally, Vassie et al.[26] performed a scoping review and meta-thematic synthesis on the "factors impacting retention, success and equitable participation in clinical academic careers". Among the factors found, those that affected women greater than men were mentoring, networking, career advancement, and research, among others. Durham et al.[27] published an analysis of 1990-2007 neurosurgery match and found that, out of the 18 years study, female applicants were less likely to match into neurosurgery than male applicants for 15 of the years, even after adjusting for USMLE Step 1 score and medical school ranking. Among these publications and more[28], a common theme is the call for increased mentorship and representation of women among specialties.

This study has several limitations. First, the literature on this topic is inconsistent with its use of the term's "gender" and "sex". Second, the data collected from the AAMC, that drove the results discussed in this paper, did not include a non-binary option. Furthermore, nowhere in the AAMC report did it specify whether non-binary individuals were excluded from the data altogether or if applicants' sex, rather than gender, was used. This is a major limitation both for our paper and the growing field of literature as the number of non-binary, gender non-conforming, or agender individuals in the United States has steadily increased through the years.[29] Recent studies have reported that over 1% of matriculating medical students do not identify with "male" or "female".[30] This number has steadily grown compared to the year prior estimating 0.8% of students.[31] Third, the AAMC used the term "sex" to define men vs women in all previous years in the Report on Residents, but in 2022, used the term "gender" without specifying the methodology used to aggregate the data. A fourth limitation is the lack of data regarding the number of applicants for each specialty. This data could have a significant impact on the interpretation of results in terms of the percentage of applicants vs. the percentage of accepted residents by gender per year.

Future Directions

The results of our study lead to several areas for future research as well as educational interventions. First, additional studies should be initiated that focus on understanding the underlying reasons for persistent gender disparities in certain medical residencies. These investigations could involve a variety of methodologies, including qualitative studies, such as interviews, focus groups, and surveys with medical students and active residents, to explore factors like societal norms, educational background, mentorship opportunities, and personal preferences. Additionally, examining the role of institutional policies, mentorship, the gender distribution of home clerkships in the clinical years of medical school, and cultural attitudes within regions, undergraduate colleges and universities, medical schools, and hospitals towards different genders could provide insights. Comparative studies across countries with varying gender representation in medical specialties could also shed light on the influence of different educational and healthcare systems.

Second, we suggest that experts in the field of medical education and curriculum design conduct further studies with the goal of assessing how gender imbalances among medical specialties impact patient care, satisfaction, and clinical outcomes. This could involve analyzing patient data to compare outcomes and satisfaction levels in specialties with varied gender ratios. Although there are issues related to the utility of patient satisfaction as a research outcome, it is still a possibly useful marker for patient experience, regardless of process or outcome variables. Furthermore, research might explore whether the gender of the physician influences patient preferences or the physician-patient relationship, especially in specialties with significant gender disparities. Understanding these impacts could guide initiatives aimed at improving patient care quality and satisfaction and could be important not only for medical students and residents, but also for patients who may benefit from having more gender diverse options for physicians.

Third, we suggest that research should be conducted to understand why some specialties have a more balanced gender distribution while others show significant disparities. This could involve examining the historical evolution of these specialties, their work culture, and the nature of the job demands. Factors such as work-life balance, perceived prestige, financial incentives, and the presence or absence of role models in each specialty could be investigated to understand

these differences. Such studies could also explore how these factors have evolved over time, contributing to the current trends.

Fourth, to address the gender gaps in specialties with significant disparities, research should focus on developing and evaluating targeted and useful interventions to correct these imbalances to maximize gender diversity. These could include mentorship programs, policy changes, awareness campaigns, and educational reforms targeting both early medical education and residency training. Investigating successful strategies from other industries or countries that have managed to reduce similar disparities could provide valuable insights. Pilot programs could be conducted in select specialties to test the effectiveness of these interventions before wider implementation.

In summary, while our study provides valuable insights into gender representation trends in medical residencies, it is important to acknowledge the limitations of a binary gender perspective. Our data was restricted to male and female categories, which oversimplifies the spectrum of gender identities. Future research should strive to include a broader range of gender identities to reflect the diversity of medical residents more accurately. Incorporating this wider spectrum would not only enhance the inclusivity of the research but also provide a more comprehensive understanding of gender dynamics in medical fields. Alongside targeted interventions to address gender imbalances, especially in specialties with significant disparities, it's vital to foster an environment that acknowledges and supports all gender identities. This approach will be instrumental in building a healthcare workforce that is truly representative and equipped to serve a diverse patient population, ensuring that all individuals, irrespective of their gender identity, feel included and valued in the medical community.

Conclusions

Diversity is an asset that strengthens any team. Medical teams, made of diverse personnel, foster creativity and problem-solving – both essential skills to improve patient outcomes. The findings of this study show that although progress is being made, there is significant room for improvement to narrow the gap. To facilitate such changes, a focus should be put on recruiting and retaining women to historically male dominated fields. Additionally, instilling mentoring programs may serve to provide guidance for women navigating the residency application process. Alongside this, increasing the presence of women in leadership positions will add more role models and may impact future decisions for other women in medicine.

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