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Trends in Orthopaedic Surgery Workforce Diversity: Analyzing Changes Over Time

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ABSTRACT

Introduction: There are many reasons why orthopaedic surgeons move or change careers. We asked the questions: (1) What is the geographic distribution of orthopaedic surgeons with respect to age, sex, and race and ethnicity? (2) How has our workforce changed over time with regard to these factors? (3) Are there any patterns or trends detected regarding policy or regulatory events that coincide with these differences?

Methods: The American Academy of Orthopaedic Surgeons surveys over 30,000 members, collecting data on demographics, age, race sex, and practice statistics. We calculated geographic distributions and evaluated these differences over time—potential influences from malpractice suits or tort reform were investigated.

Results: Overall surgeon density increased over time. The largest negative changes were noted in District of Columbia, Wyoming, and North Dakota and positive changes in Colorado, South Dakota, and West Virginia. Age across all states increased (mean 1.7 years). Number of female surgeons increased in most states (4.6% to 5.7%). Number of African Americans increased from 1.6% to 1.8%, Hispanic/LatinX from 1.8% to 2.2%, Asian from 5.5% to 6.7%, and multiracial from 0.8% to 1.2%. No change was noted in the percentage of Native American surgeons.

Discussion: Surgeon density increased from 2012 to 2018; the cause for this change was not evident. Small increases in surgeon population, female surgeons, and in some underrepresented minorities were seen.

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This study utilized de-identified data, so institutional review board approval was not obtained.

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There are many reasons why orthopaedic surgeons move or change careers, including career opportunities, personal circumstances, or geographic preference. One study found that half of the orthopaedic surgeons in their cohort relocated by 5 years, with two-thirds for financial reasons or because the practice was not as advertised, with practice location, practice type, and family proximity being top three reasons for selecting a practice.[1] However, there may be other additional driving factors outside of the surgeons' control such as

regulatory, malpractice or financial incentives, or market demand that may result in relocation.[2-4]

In 2014, the American Academy of Orthopaedic Surgeons (AAOS) developed a new strategic plan heading toward 2020, called "Vision 20/20".[5] This plan contained five core values that included excellence, professionalism, leadership, collegiality, and lifelong learning. Within these values, unity and diversity were determined to be contained within the strategic plan and part of collegiality. This move revealed that the AAOS was moving toward implementing change from its diversity deficiency. During this same time, from 2012 to 2018, the AAOS has also collected demographic data on all of its orthopaedic surgeon members, including age, sex, and practice location. Because race and ethnicity was not automatically collected, these were collected in a separate optional survey for their members to fill out. One of the purposes of this census was to monitor orthopaedic surgeon practice patterns and possibly identify strategies to improve environmental changes and anticipate challenges to its orthopaedic surgeon membership, in line with their Vision 20/20 strategic plan.

Since then, the AAOS has developed a new strategic plan with core values representing the 2019 to 2023 timespan with leading to serve, shaping the future and excellence together. The new diversity plan has focused intention to increase diversity throughout the organization and pipeline initiatives to increase underrepresented groups including women, African Americans, Hispanic/LatinX, Hawaiian/Pacific Islanders, Native Americans, and others. Because of these disparities, we sought to ask the questions: (1) What is the geographic distribution of orthopaedic surgeons with respect to age, sex, and race and ethnicity? (2) How has our workforce changed over time with regard to these factors? (3) Are there any patterns or trends detected regarding policy or regulatory events that coincide with these differences?

Methods

The American Academy of Orthopaedic Surgeons conducts a bi-annual survey among its over 30,000 members. They collect data on their members' demographics, age, race and sex, and practice statistics. The report is published every other year and is publicly available to its members. We obtained reports from 2012 to 2018 (the latest report). Although the AAOS only surveyed around 6,500 (22%) of its members, it has age, sex, and geographic location on all of its over 30,000 members. We calculated geographic density map distributions from 2012 to 2018 and evaluated differences between these over time. We calculated this by both regional geography and state. We also calculated age, gender, and racial and ethnicity differences over these time periods. For states that had the highest density changes, we queried state tort reform laws and the National Practitioner Database (NPDB) to see whether malpractice suits or tort reform may have had influence on the changes. We hypothesized that modifications to the tort law or policy might lead to unfavorable working conditions, potentially diminishing the number of surgeons per state. While a correlation might be present, establishing direct causation for this trend is not feasible.

Changes from 2012 to 2018 were calculated by state and distributed over a heatmap representing the 50 states of the United States. Changes were reported for age, sex, and density of orthopaedic surgeon per 100,000 population. The states with the largest three changes by densities in growth and decline were examined during that period for any regulatory or legal changes from 2010 to 2020. The NPDB was used to check the number of each states malpractice claims, awards, and orthopaedic surgeons in the area. The amount of awards per physician was calculated per state to come up with an average number of awards per surgeon. This number was compared to investigate whether states with larger density declines correlated with more malpractice awards per surgeon.

Racial and ethnicity census collection was also done during the AAOS Census. This data was voluntarily and required additional steps for its members to complete. Race and ethnic groups collected by AAOS included White, African American, Hispanic/LatinX, Asian, Native American, multiracial, and other. Racial and ethnicity changes over time were calculated and plotted.

Statistical Analysis

Repeated-measures analysis of variance was performed on 2012 to 2018 orthopaedic surgeon density changes. Chi square testing was conducted to detect differences between amount of claims per provider in the state and states with the largest migration changes (highest and lowest density changes). Statistical software used was Jamovi (The Jamovi Project) v2.3.21.0.

Results

A gradual small increase was noted in overall surgeon density over the period (0.44 ± 0.74 surgeons per 100,000

population, $P < 0.001$; Supplemental Figure A, http://links.lww.com/JG9/A334). States with the largest density declines were District of Columbia, Wyoming, and North Dakota, and largest density growths were noted in Colorado, South Dakota, and West Virginia (Figures 1 and 2; Table 1).

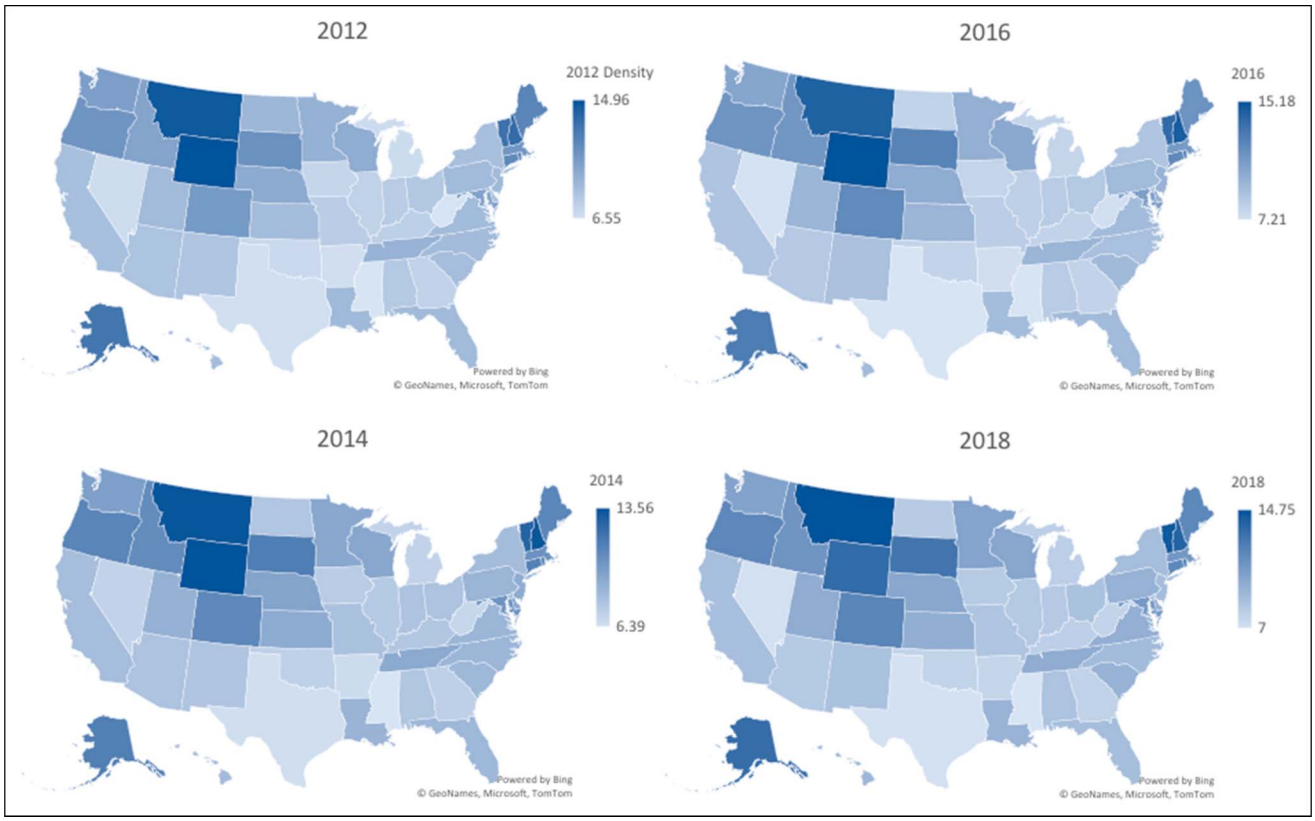
All states had an increase in age (mean 1.7 years) of their orthopaedic surgeons, except North Dakota, while the median age for all national workers during this time did not change (Figure 3). Female surgeons had a gradual increase in most states (mean 4.6% to 5.7%) while male surgeons had higher densities in North Dakota, Alaska, and New Mexico (Figures 4 and 5). By 2018, areas with the highest percentages of female orthopaedic surgeons were Vermont, Maine, and District of Columbia (Figure 6). For the race/ethnicity data, surgeon density among Whites decreased from 88.5% to 84.7% while African Americans had a minimal change from 1.6% to 1.8%, Hispanic/LatinX changed from 1.8% to 2.2%, Asian changed from 5.5% to 6.7% (Asian female surgeons had a change from 6.3 to 9.0%), Native Americans had no change from 0.3% to 0.3%, and multiracial changed from 0.8% to 1.2% (Figures 7 and 8; Table 2).

Two of the three states with the largest density declines, District of Columbia and Wyoming, had no tort reform medical malpractice cap as of 2018.[6] When surveying the NPDB for actual claims per provider by state, we found no difference in the rate nor amount of claim per provider by state ($P = 0.22$). In addition, when extending comparison of malpractice claims data from the American Medical Association Practice Benchmark Survey, although orthopaedic surgeons had higher risk compared with nonsurgical specialties, it had not increased over time.[7]

Discussion

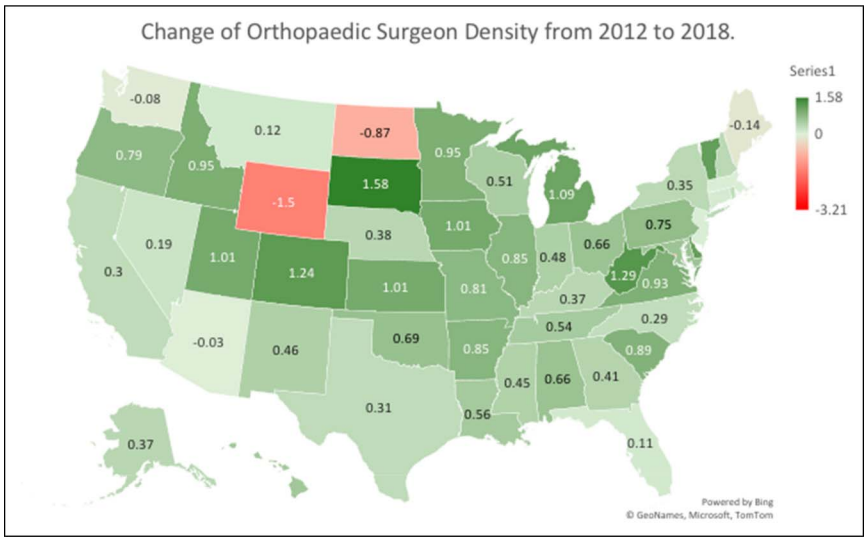
During the time period, there was an overall small increase in orthopaedic surgeons per capita nationwide. The increase may be because of the increasing demand for specialized musculoskeletal care or that aging orthopaedic surgeons are staying in the profession longer. This slightly addresses the demand or need of orthopaedic surgeons.[8] States with the largest density changes, growth and decline

Figure 1



Heatmaps of orthopaedic surgeon density from 2012 to 2018. Blue states are more dense, and white states are less dense. The numbers represent number of orthopaedic surgeons per 100,000 people population.

Figure 2



Map showing change of density over time from 2012 to 2018, with green representing increase and red loss of density. The numbers represent number of orthopaedic surgeons per 100,000 people population.

were noted, but were unable to determine why they had such large changes. While two of the three states, Wyoming and District of Columbia, had no tort reform, actual claims per provider were not different than the states with the largest density growth. This may be due to the threat of material claims rather than actual material claims, which can have profound psychological effects on surgeons.[9,10]

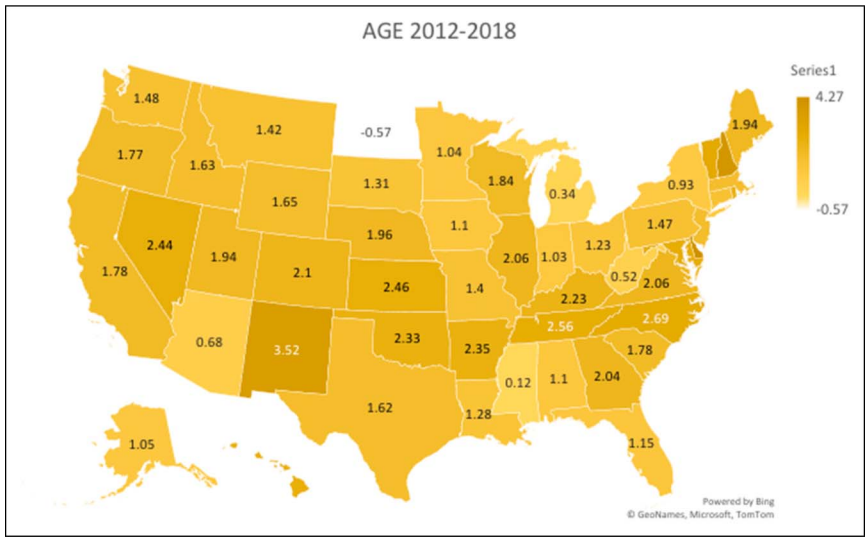
As the median age of the US population increased by 0.8 years from 2012 to 2018, the average age of the

Table 1. Density Difference From 2012 to 2018

State	Density change	State	Density change	State	Density change
Alabama	0.66	Kentucky	0.37	North Dakota	−0.87
Alaska	0.37	Louisiana	0.56	Ohio	0.66
Arizona	−0.03	Maine	−0.14	Oklahoma	0.69
Arkansas	0.85	Maryland	0.64	Oregon	0.79
California	0.3	Massachusetts	0.03	Pennsylvania	0.75
Colorado	1.24	Michigan	1.09	Rhode Island	0.28
Connecticut	0.08	Minnesota	0.95	South Carolina	0.89
Delaware	1.17	Mississippi	0.45	South Dakota	1.58
District of Columbia	−3.21	Missouri	0.81	Tennessee	0.54
Florida	0.11	Montana	0.12	Texas	0.31
Georgia	0.41	Nebraska	0.38	Utah	1.01
Hawaii	0.59	Nevada	0.19	Vermont	1.18
Idaho	0.95	New Hampshire	0.35	Virginia	0.93
Illinois	0.85	New Jersey	0.04	Washington	−0.08
Indiana	0.48	New Mexico	0.46	West Virginia	1.29
Iowa	1.01	New York	0.35	Wisconsin	0.51
Kansas	1.01	North Carolina	0.29	Wyoming	−1.5

Numbers represent number of orthopaedic surgeons per 100,000 population.

Figure 3

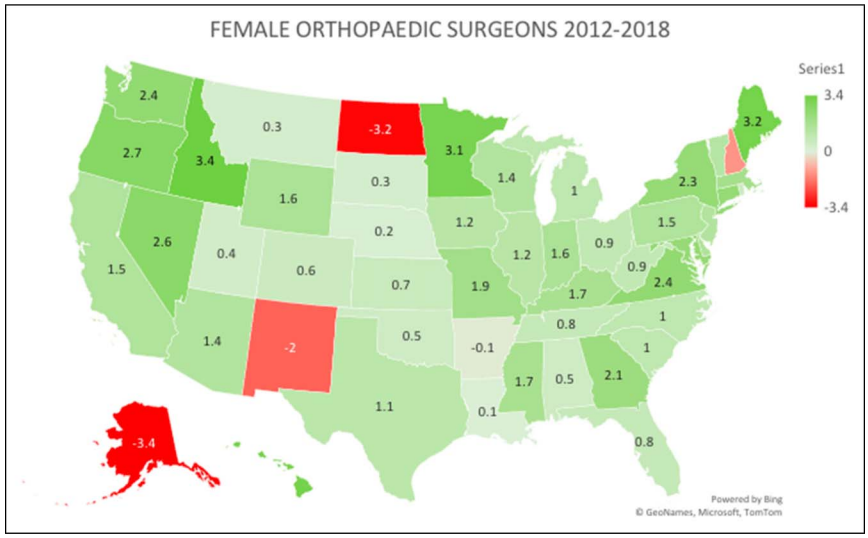


Map showing difference in age of orthopaedic surgeons from 2012 to 2018. All orthopaedic surgeons had increased in age. In 2012, the BLS (Bureau of Labor Statistics) median employed age was 42.2 years; in 2018, it was 42.2 years also, suggesting there was no increase in national employed age; however, the average orthopaedic surgeon age has increased, representing an aging workforce compared with the national workforce.

practicing orthopaedic surgeon increased by 1.7 years.[11] Compared with the median age of the average worker from the US Bureau of Labor Statistics, this did not increase (42.2 years for both 2012 and 2018), representing orthopaedic surgeons worked longer into their careers, which may be because of the demand forces or job satisfaction.[8,12,13] A study by Farley et al reported high job satisfaction in orthopaedic surgeons older than 50 years and that their average planned retirement age was 65 years compared with 61 years for the average American worker,[13] possibly suggesting one reason the orthopaedic surgeon workforce is older and works longer, in addition to usually a later starting career because of the years of training.

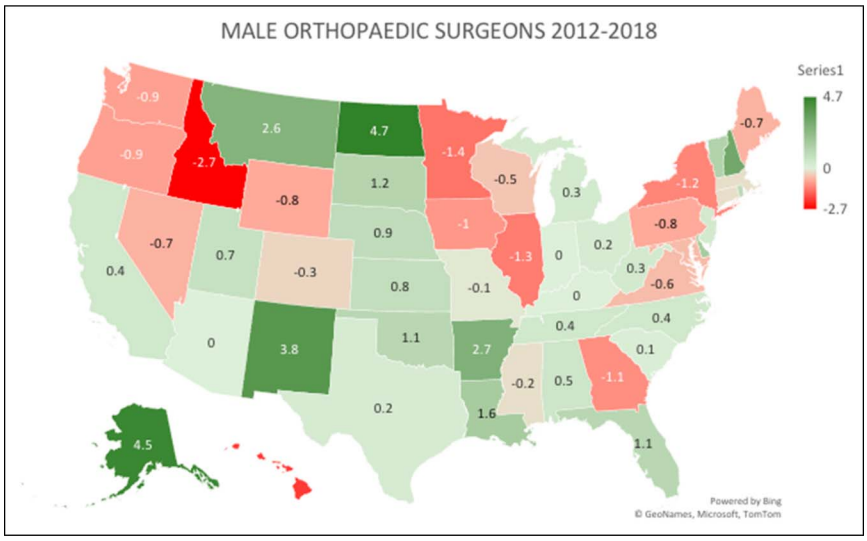
Although female orthopaedic surgeon numbers are dramatically disproportionate to their male colleagues,

Figure 4



Female heatmap. These density maps represent the percentage change from 2012 to 2018 with green representing an increase in percentage and red representing a decrease in percentage of overall orthopaedic surgeons. This survey was conducted with approximately 29,000 members, 1,700 female and 27,300 male.

Figure 5

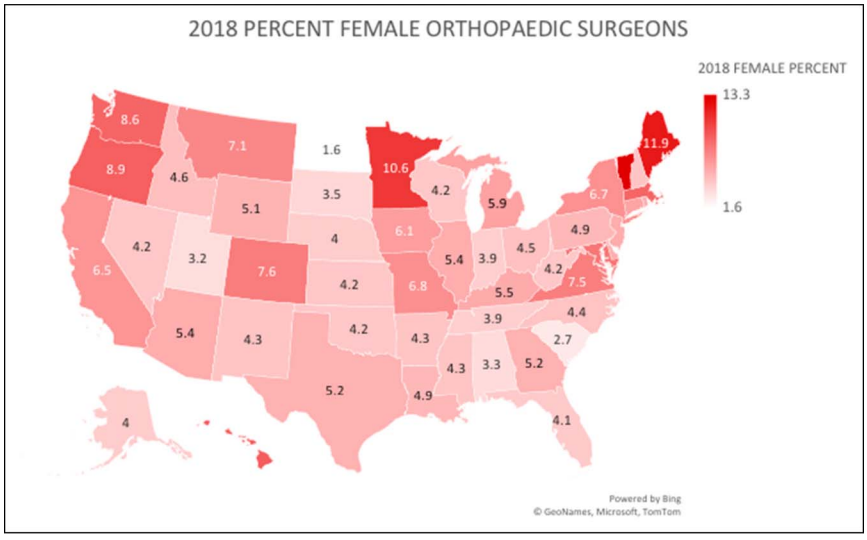


Male heatmap. These density maps represent the percentage change from 2012 to 2018 with green representing an increase in percentage and red representing a decrease in percentage of overall orthopaedic surgeons.

their numbers are mildly improving (4.5% to 5.9%). States with the largest density growth were Hawaii, Idaho, and Maine. In 2018, the states with the highest female surgeon densities overall were Vermont (13.3%), Maine (11.9%), and District of Columbia (11.3%). These positive effects may be the results of pipeline initiatives and mentorship programs such as Nth Dimensions, the J Robert Gladden Society, the Perry Initiative, or the Ruth Jackson Society. A study by Mason et al[14] reported 51 times higher rates than the national average for women applying to orthopaedics. This likely has cumulated into more female applicants at 23%, residents at 20%, and recently graduated female orthopaedic surgeons at 22% as reported by the ACGME and others (new ACGME fellows were a surrogate used for recent graduates).[15,16]

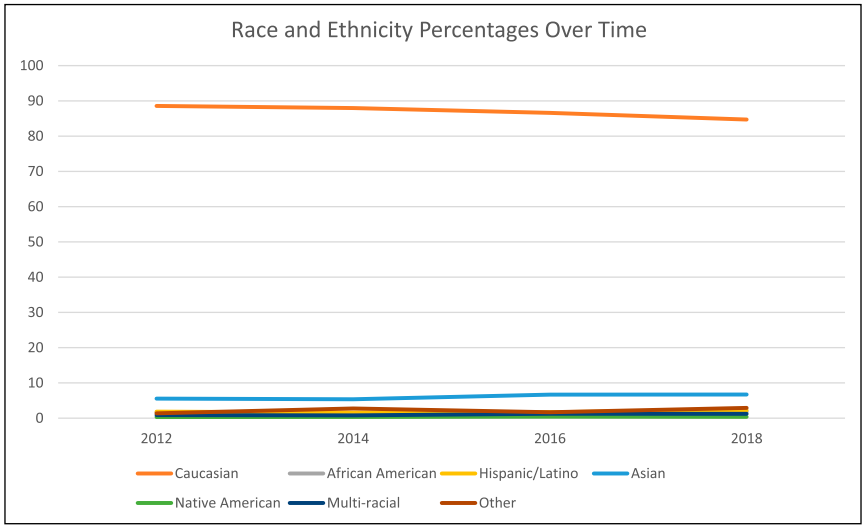
Race and ethnicity overall had mixed changes. Surgeon density among Whites decreased from 88.5% to 84.7% while African Americans had minimal increases from 1.6% to 1.8%, Hispanic/LatinX changed from 1.8% to 2.2%,

Figure 6



Map showing the 2018 Census of percentage of female orthopaedic surgeons. This is from the AAOS Census of 1781 orthopaedic surgeons who identified as female. States with the highest percentage were Vermont (13.3%), Maine (11.9%), and District of Columbia (11.3%).

Figure 7

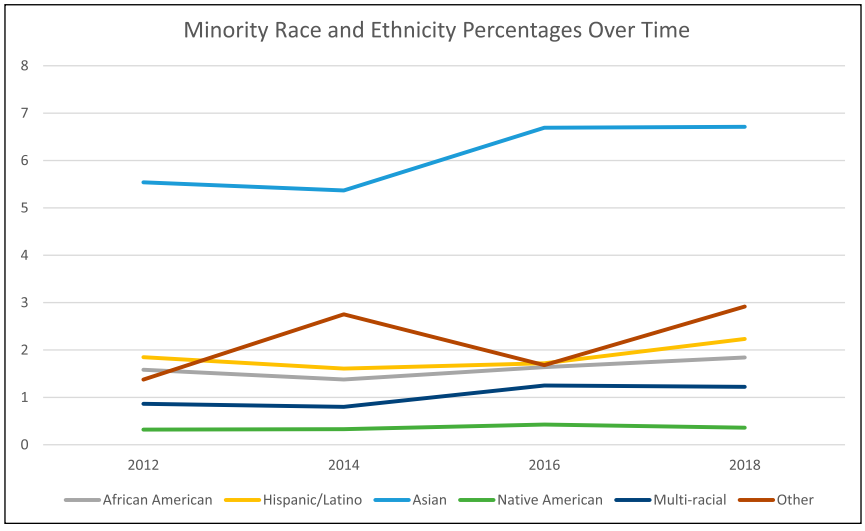


Graph based on survey response, which was approximately 20% of responses compared with the over 30,000 AAOS surgeon membership. Percentage of Whites decreased from 88.5% to 84.7% while African Americans had minimal change from 1.6% to 1.8%, Hispanic/LatinX changed from 1.8% to 2.2%, Asian changed from 5.5% to 6.7% (Asian female surgeons had a change from 6.3 to 9.0%), Native Americans had no change from 0.3% to 0.3%, and multiracial changed from 0.8% to 1.2%.

Asians changed from 5.5% to 6.7% (Asian female surgeons had a change from 6.3 to 9.0%), Native Americans had no change from 0.3% to 0.3%, and multiracial changed from 0.8% to 1.2%. These mildly positive effects may be also reflected from pipeline initiatives previously described [14, Mason CORR 2016]. This has also resulted in an increasingly diverse active resident class at 5.1% African American, 7.4% Hispanic/LatinX, and 13.3% Asian and recently graduated orthopaedic surgeons at 3.7% African American, 5.1% Hispanic/LatinX, and 12.4% Asian.[16] Unfortunately, there were significant declines in active residents among Native American and Hawaiian/Pacific Islander populations, with decreases of 0.06% and 0.002%, respectively. Additionally, there were no Native American recently graduated attendings, and only 0.02% of attendings were Hawaiian/Pacific Islander, highlighting the substantial representation gap for these communities and underscoring the urgent need for targeted efforts in this area.[17]

The benefits of using the AAOS Census data is that this captures a large majority of orthopaedic surgeons. Other studies attempt to use surrogates for orthopaedic surgeons

Figure 8



Graph represents changes in surgeon race/ethnicity excluding White.

Table 2. Racial/Ethnicity Differences From 2012 to 2018 Census

Race/Ethnicity	2012	2014	2016	2018
White %	88.5	88.0	86.6	84.7
F %	84	81	82.2	79.1
M %	88.8	88.4	86.9	85.1
African American %	1.6	1.4	1.6	1.8
F %	3.2	2.6	2.2	3.1
M%	1.5	1.3	1.6	1.8
Hispanic/LatinX %	1.7	1.6	1.7	2.2
F%	1.8	3.3	2	3.1
M%	2.8	1.5	1.7	2.2
Asian %	5.2	5.4	6.7	6.7
F %	6.3	8	8	9.0
M %	5.5	5.2	6.6	6.5
Native American %	0.3	0.3	0.4	0.4
F %	0.7	0.8	0.8	0.5
M %	0.3	0.3	0.4	0.4
Multiracial %	0.7	0.8	1.3	1.2
F %	2.1	0.8	3.4	2.6
M %	0.8	0.8	1.1	1.1
Other %	1.3	2.8	1.7	2.9

Male and female race and ethnicity percentages are expressed in comparison with that specific sex. Race and ethnicity percentages express combined male and female percentage.

by capturing CPT codes of orthopaedic surgery procedures; however, this will confound the data by including physicians who perform orthopaedic or sports medicine procedures (injections, musculoskeletal diagnoses) and exclude other orthopaedic surgeons who no longer operate or perform captured CPT-coded procedures.[18-20]

The limitations of our study are that the data are restricted to the Census time frame, which only was from 2012 to 2018. The AAOS no longer conducts the census, and therefore, these changes may not reflect current dynamics of its members. In addition, race and ethnicity data are voluntarily collected, and only had a 20 to 22% response rate, which may not accurately reflect the true racial/ethnic demographics of its members. In addition, we were not able to concretely determine the cause for these orthopaedic surgeon density changes. Although we postulate that they may have been because of tort reform, there may be other smaller regulatory factors that played roles we did not take into consideration.

In conclusion, there was a modest increase in orthopaedic surgeon density, suggesting a potential response to the demand for orthopaedic care. While some states exhibited notable changes in density, the underlying causes remained unclear, with tort reform and psychological factors being possible contributing factors. Female representation in the field improved slightly, likely influenced by pipeline initiatives and mentorship programs. By contrast, the data indicated mixed changes in race and ethnicity, with disparities persisting among certain populations such as American Indian/Alaskan Native and Hawaiian/Pacific Islander. Continued efforts are needed to address disparities—promoting diversity in the field by supporting outreach programs and encouraging involvement by colleagues will help practitioners be able to serve their patients in favorable environments, thereby ensuring access to health care.

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