

Retainment of U.S. Orthopaedic Surgeons in Academia from 2016 to 2022

Matthew Weintraub, BSE, David Ahn, BA, Isabel Herzog, BA, Dhruv Mendiratta, BS, Zheshi Zheng, BS, Neil Kaushal, MD, Michael Vosbikian, MD, and Alice Chu, MD

Investigation performed at Rutgers University, Newark, New Jersey

Background: Academic medical centers greatly benefit from retaining their physicians; that ensures continuity in patient care, enhances resident education, and maintains a pool of experienced clinicians and researchers. Despite its importance, little research has been published on the retainment of academic faculty in orthopaedics. To address this gap, this study investigates the demographic trends of academic orthopaedic surgeons from 2016 to 2022. By analyzing data pertaining to gender distribution, years of practice, research productivity, and institutional rankings, we aimed to gain insights into the factors influencing faculty retainment, institution changes, and new entrants into academic orthopaedics.

Methods: A retrospective cross-sectional analysis of U.S. academic orthopaedic surgeons affiliated with programs under the Accreditation Council for Graduate Medical Education (ACGME) in 2016 and 2022 was performed. Faculty present in both the 2016 and the 2022 data were classified as being “retained” in academia; those present only in 2016, as having “left” academia; and those present only in 2022, as being “new” to academia. The retained group was then divided into movers (those who moved to other institutions) and non-movers.

Results: Retained orthopaedists had fewer years of practice, a higher h-index (Hirsch index), and more publications. Non-fellowship-trained orthopaedists had less retainment in academia, and orthopaedists with fellowships in oncology had more retainment in academia. Additionally, movers also had fewer years in practice but an equal level of scholarly productivity when compared with non-movers. Lastly, higher-ranked academic programs retained a greater proportion of orthopaedic surgeons.

Conclusions: Over the study period, a majority of orthopaedists (56.99%) chose to remain in academia. Those retained tended to be in the earlier stages of their careers, yet demonstrated higher research output. Notably, the representation of female orthopaedists in academic orthopaedics is on the rise. Conversely, lower-ranked programs faced higher turnover rates, highlighting the challenges that they encounter in retaining faculty members.

Clinical Relevance: Academic medical centers benefit from retaining orthopaedic surgeons by maintaining patient relationships, having consistency in resident education, and building on clinical and research expertise. Likewise, orthopaedists benefit from understanding the trends in current academic employment, in order to optimize career planning decisions.

Academic medical centers serve a vital role in the U.S. health-care system by providing clinical care, conducting research, and encouraging innovation¹. Prior research has shown a decrease in blunt trauma mortality and intensive care unit stays at academic medical centers compared with community medical centers², with academic medical centers having positive spillover effects on local health-care centers³. Academic medical

centers rely on academic physicians who provide tutelage to trainees and advance their respective fields through research and collaboration⁴. The retainment of faculty is especially important in orthopaedic surgery, historically one of the least diverse fields of medicine^{5,6}. Other benefits of retaining physician faculty include the maintenance of patient relationships, consistent resident education, and building on clinical and research expertise.

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Recently, challenges have arisen to maintaining an attractive workplace environment in academic medical centers. First, the finances of academic medical centers are undergoing a shift putting them in direct competition with nonacademic medical center hospitals. Although academic medical centers account for approximately 6% of U.S. hospitals, they were involved in 20% of all hospital mergers in 2016, many of which were with community hospitals¹⁷. A 2015 article showed that academic medical centers are disproportionately targeted by health-care reform, jeopardizing their funding and increasing costs for providing care⁸. Academia and private groups offer distinct value propositions, and academicians have been less prepared over the past decade to transition from volume to value-based care in the United States, with financial penalties for suboptimal quality, efficiency, or meaningful use of electronic health records. Additional draws to private practice are autonomy, compensation, and flexibility of hours. The departure from academia poses risks to both physicians and institutions; physicians departing academia risk losing the time spent building careers, and institutions risk gaps in leadership, mentoring, and system-specific workflows⁹. To date, there has been little research on academic faculty retention in the present climate of academic medical center mergers and acquisitions, with even less data available on academic orthopaedic surgeons.

In this study, we compared the academic orthopaedic database between 2016 and 2022, a time frame that coincidentally encompassed the COVID-19 pandemic. Although this may have altered the findings, this study may provide a snapshot of employment shifts among academic orthopaedists. We examined factors contributing to retention among academic orthopaedic surgeons between 2016 and 2022, comparing those who left with those who stayed in their institutions, as well as new faculty who joined. Additionally, we examined a subset of faculty who changed academic positions between institutions and ascertained factors unique to this group.

Materials and Methods

A retrospective cross-sectional analysis of academic orthopaedic surgeons in the United States was performed in

2016 and 2022. Orthopaedic surgeons were classified as academic orthopaedic surgeons if they were actively teaching residents and performing research at a program accredited by the Accreditation Council for Graduate Medical Education (ACGME) in the United States. FREIDA (Fellowship and Residency Electronic Interactive Database Access) was used to identify and collect data on active academic orthopaedic surgeons. FREIDA is managed by the American Medical Association (AMA), and program data come directly from the ACGME-accredited programs via the national Graduate Medical Education (GME) Census, an annual online survey jointly conducted by the AMA and the Association of American Medical Colleges. Physicians found in both the 2016 and 2022 data sets were considered retained in academia. Of those retained, if the programs of employment in 2016 and 2022 were different, then that orthopaedist was considered to have moved institutions within academia. Different campuses under the same parent institution were not considered separate; for example, if a physician was employed by Louisiana State University (LSU) New Orleans in 2016 and LSU Shreveport in 2022, they were not considered to have moved.

Several program mergers occurred between 2016 and 2022: Carolinas Medical Center and Wake Forest Baptist Medical Center merged into Atrium Health, and Palmetto Health and Greenville Health merged into Prisma Health. Physicians employed in 2016 by 1 of the programs that had subsequently coalesced in a merger by 2022 were not considered movers. Five programs were only found in 1 data set and were excluded from this study.

Orthopaedists who appeared in 2016 but not in 2022 were considered as having left academic orthopaedics. Whether surgeons retired or transitioned into a community-based position was not explored in this study, as those surgeons no longer met the inclusion criteria and were not tracked; further research is necessary to investigate the trajectory of physicians once they leave academia. Surgeons present in the 2022 data set, but not in the 2016 database, were considered as new to academia. The demographic characteristics of all academic surgeons in 2016 and 2022 were used to determine differences between those who were retained, left, moved, or were new between 2016 and 2022.

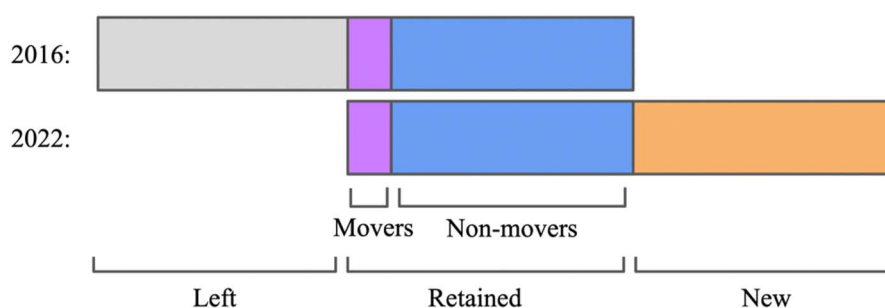


Fig. 1

Representation of the groups of academic orthopaedic surgeons compared in this study. Gray represents all surgeons who were in academic orthopaedics in 2016 but not in 2022, and were thus determined to have left. Purple represents surgeons who were retained between 2016 and 2022 but employed at different institutions at those times, indicating that they moved. Blue represents surgeons who were retained and stayed at the same institution, hence non-movers. Orange represents surgeons who were not in the 2016 database but were in the 2022 database; these were called new.

TABLE I Demographic Data of All Academic Orthopaedic Surgeons Employed in Academia in 2016

Characteristic	Left	Retained
Gender		
Male	1,084 (89.22%)	1,427 (88.58%)
Female	131 (10.78%)	184 (11.42%)
Movers	—	108 (6.70%)
Years in practice*		
0 to 10	351 (29.90%)	560 (36.70%)
11 to 20	309 (26.32%)	448 (29.36%)
21 to 30	252 (21.47%)	340 (22.28%)
≥31	262 (22.32%)	178 (11.66%)
Subspecialty		
Adult reconstruction	135 (11.11%)	184 (11.43%)
Foot and ankle	69 (5.68%)	90 (5.59%)
Hand and upper extremity	149 (12.26%)	192 (11.93%)
Musculoskeletal oncology	44 (3.62%)	91 (5.65%)
Pediatric	142 (11.69%)	159 (9.88%)
Shoulder and elbow	129 (10.62%)	164 (10.19%)
Spine	131 (10.78%)	176 (10.93%)
Sports medicine	180 (14.81%)	258 (16.02%)
Trauma	119 (9.79%)	183 (11.37%)
Other	25 (2.06%)	45 (2.80%)
No fellowship	92 (7.57%)	68 (4.22%)

*There were insufficient publicly available data to determine years in practice for all physicians in the data set.

Demographic and Institutional Factors of Interest

Physician's gender, location of residency training, completed fellowships, years in practice, research productivity, and faculty rank (assistant, associate, or full professor) were recorded. Faculty who were on a clinical track (clinical professors and instructors), research-exclusive faculty, visiting faculty, professor emeriti, and affiliated faculty were not included in this study. Lastly, due to limited public information, we were not able to differentiate between tenure-track professors and educator-track professors.

Years in practice were determined by subtracting the year of the last fellowship or the year of residency completion from 2022. Orthopaedic surgeons were subcategorized by fellowship training as outlined by Herzog et al.¹⁰. Those who did not complete a fellowship were categorized in the "no fellowship" group. Those who completed a fellowship in adult reconstruction, foot and ankle, sports medicine, spine, trauma, pediatrics, hand and upper extremity, musculoskeletal oncology, or upper-extremity reconstruction (shoulder or shoulder and elbow) were categorized accordingly. Those who completed a fellowship but did not fit into any of the aforementioned categories were grouped in the "other" category.

Scopus was used to obtain the h-index (Hirsch index), number of publications, and number of citations for each orthopaedist. In 2022, all variables were recorded again, with the

addition of the Relative Citation Ratio (RCR), a new National Institutes of Health (NIH)-endorsed bibliometric index¹¹, and program rank. The NIH iCite tool was used to calculate the mean RCR (mRCR)¹² for each orthopaedist. Doximity.com data from 2021 to 2022 were used to rank residency programs by reputation, calculated annually with surveys of current and recent residents who select their top 5 programs. Programs were categorized as in the top 20 (T20), ranked 21 to 50 (T21-50), or ranked 51 and poorer (T51+).

Statistical Analysis

SPSS version 28 (IBM) was used to determine statistical differences between those retained from 2016 to 2022 and those who left, as well as between retained movers and retained non-movers. The same test was performed between those previously in and those new to academia in 2022.

A chi-square test was used to compare the percentage of female orthopaedists between the groups, as well as to compare retention among subspecialties. Because the data were not normally distributed, medians and interquartile ranges (IQRs) were reported. A Kruskal-Wallis test was performed to determine differences in years in practice, h-index, mRCR, number of publications, and number of citations among groups.

TABLE II Demographic Data of All Academic Orthopaedic Surgeons Employed in Academia in 2022

Characteristic	Retained	New
Gender		
Male	1,427 (88.58%)	1,116 (85.58%)
Female	184 (11.42%)	188 (14.42%)
Years in practice		
0 to 10	421 (26.13%)	705 (54.06%)
11 to 20	534 (33.15%)	271 (20.78%)
21 to 30	391 (24.27%)	185 (14.19%)
≥31	265 (16.45%)	143 (10.97%)
Subspecialty		
Adult reconstruction	201 (12.48%)	190 (14.57%)
Foot and ankle	109 (6.77%)	102 (7.82%)
Hand and upper extremity	198 (12.29%)	152 (11.66%)
Musculoskeletal oncology	90 (5.59%)	48 (3.68%)
Pediatric	174 (10.80%)	135 (10.35%)
Shoulder and elbow	60 (3.72%)	46 (3.53%)
Spine	180 (11.17%)	157 (12.04%)
Sports medicine	279 (17.32%)	226 (17.33%)
Trauma	197 (12.23%)	152 (11.66%)
Other	22 (1.37%)	19 (1.46%)
No fellowship	101 (6.27%)	77 (5.90%)
School rank		
1 to 20	478 (29.67%)	280 (21.47%)
21 to 50	497 (30.85%)	377 (28.91%)
≥51	636 (39.48%)	647 (49.62%)

TABLE III 2016 Characteristics of Orthopaedists Who Were Retained in or Left Academia Between 2016 and 2022

Characteristic	Retained*	Left*	P Value
Years in practice	15 (8, 24)	18 (9, 30)	<0.001
h-index	9 (4, 17)	7 (3, 15)	<0.001
No. of publications	24 (8, 59)	16 (5, 48)	<0.001
No. of citations	226.5 (44, 1,018)	318.5 (8, 1,089)	<0.001

*The values are given as the median, with the IQR in parentheses.

To determine differences in turnover based on program rank, the percentage of new physicians was calculated for each program and a Kruskal-Wallis test was performed to determine differences between the T20, T21 to 50, and T51+ groups.

Results

Demographic Characteristics

A total of 2,825 academic orthopaedists were identified in 2016; 56.99% of these were retained in 2022 and 43.01% had left. Among those who were retained, 6.71% had moved to a different institution by 2022. In 2022, a total of 2,914 orthopaedists were identified, including 1,304 new to academia. Figure 1 exhibits left, retained, movers and non-movers, and new orthopaedists between 2016 and 2022. The demographic characteristics of academic orthopaedists are outlined in Table I for 2016 and in Table II for 2022.

Effect of Gender

There was no difference ($p = 0.345$) in the proportion of female orthopaedists between those orthopaedists who were retained from 2016 to 2022 and those who left academia during that period. However, there was a greater proportion of female orthopaedists ($p = 0.019$) among movers (20.0%) than non-movers (11.0%). In 2022, female orthopaedists made up 14.42% of new orthopaedists and 11.43% of retained orthopaedists, such that overall, there were proportionally more female orthopaedists entering academia between 2016 and 2022 ($p = 0.022$).

Effect of Experience and Research Productivity 2016 to 2022

Retained physicians and those who left differed in their median years in practice ($p < 0.001$), h-index ($p < 0.001$), and number of publications ($p < 0.001$). Orthopaedists who left academia had more years in practice, a lower h-index, and fewer publications, as shown in Table III. Table IV shows the relationship between movers and non-movers, with movers having fewer years in practice ($p < 0.001$).

2022

Between retained and new physicians in 2022, there were significant differences in median years in practice ($p < 0.001$), h-index ($p < 0.001$), mRCR ($p = 0.005$), number of publications ($p < 0.001$), and number of citations ($p < 0.001$) as shown in Table V.

Subspecialty Breakdown

Figure 2 shows the percentage of surgeons retained in each subspecialty between 2016 and 2022. Proportionally, non-fellowship-

TABLE IV 2016 Characteristics of Orthopaedists Retained Between 2016 and 2022 Who Did and Did Not Move Among Institutions

Characteristic	Movers*	Non-Movers*	P Value
Years in practice	9 (6, 21)	15 (8, 24)	<0.001
h-index	8 (4, 15.75)	9 (4, 18)	0.247
No. of publications	26.5 (9.5, 48.5)	24 (8, 59)	0.735
No. of citations	208.5 (67.25, 829.75)	326 (70.75, 1,096.75)	0.614

*The values are given as the median, with the IQR in parentheses.

TABLE V 2022 Characteristics of Orthopaedic Surgeons Who Were Retained and New to Academia in 2022

Characteristic	Retained*	New*	P Value
Years in practice	17 (10, 27)	9 (4, 21)	<0.001
mRCR	1.66 (1.2, 2.24)	1.58 (1.02, 2.21)	0.005
h-index	13 (6, 24)	7 (3, 14)	<0.001
No. of publications	40 (13, 87)	16 (5, 42)	<0.001
No. of citations	663.5 (174, 2,035.75)	205 (44.75, 778.25)	<0.001

*The values are given as the median, with the IQR in parentheses.

Percent Retained by Subspecialty from 2016-2022

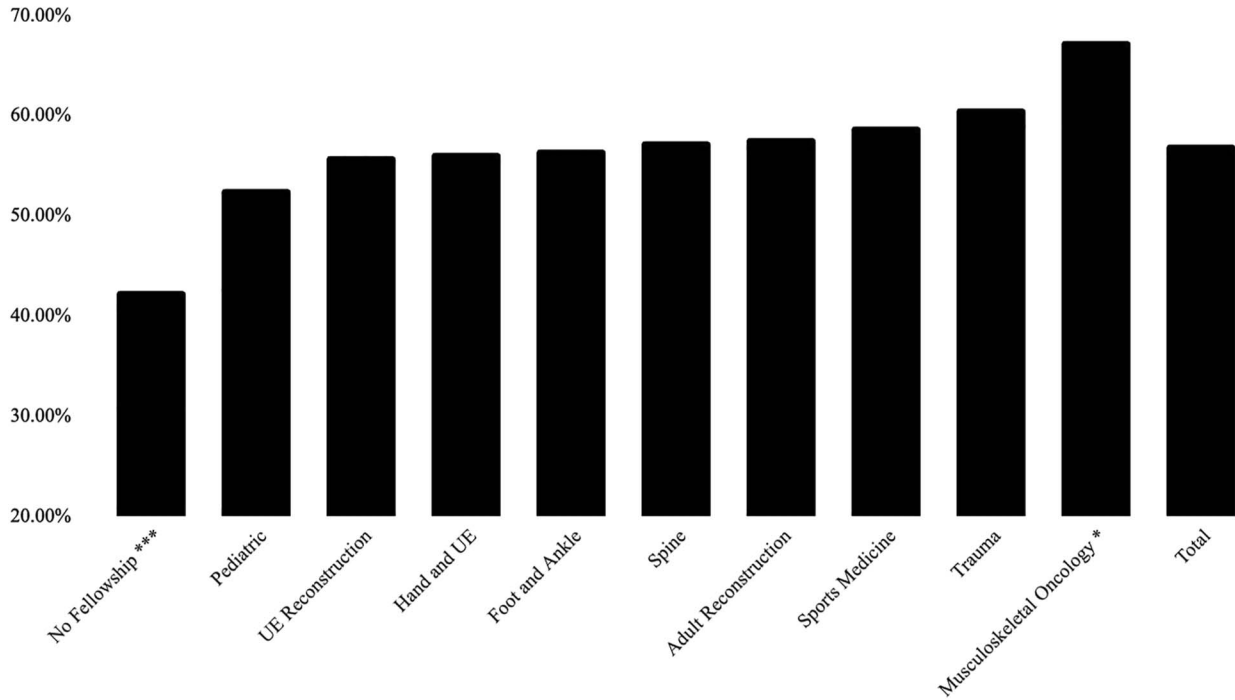


Fig. 2 Percentage of academic orthopaedists retained between 2016 and 2022, categorized by subspecialty. *P < 0.05. ***P < 0.001. UE = upper extremity.

Percent of New Academic Orthopedist by Subspecialty in 2022

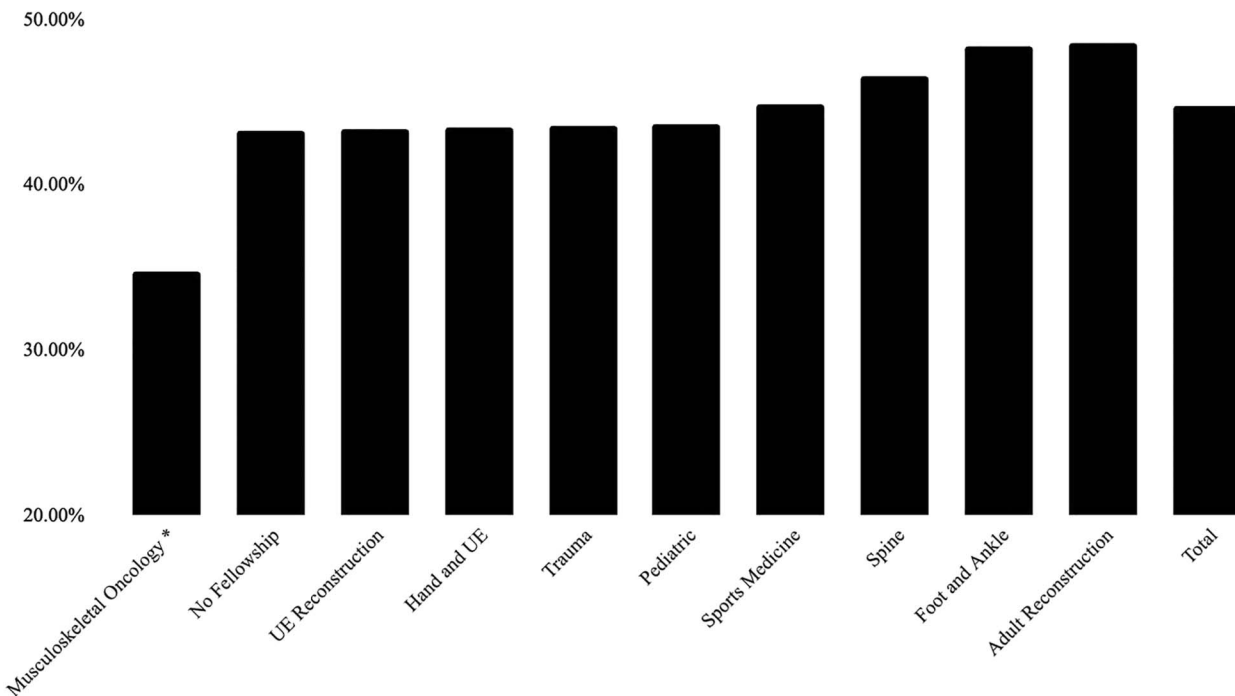


Fig. 3 Percentage of academic orthopaedists new to academia in 2022, categorized by subspecialty. *P < 0.05. UE = upper extremity.

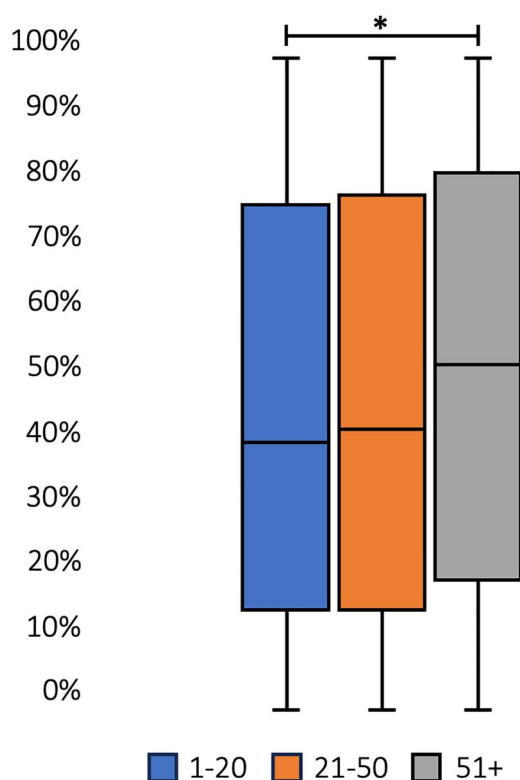


Fig. 4
Box-and-whisker plot showing the percent of academic orthopaedic surgeons retained, categorized by program ranking. Programs were divided into 3 categories: those ranked 1 to 20, 21 to 50, and 51 and lower. The horizontal lines within the boxes indicates the median, the outer borders indicate the interquartile range, and the whiskers indicate the range. * $P < 0.05$.

trained orthopaedists were retained less ($p < 0.001$) and orthopaedic oncologists were retained more ($p = 0.015$) than other specialists.

Figure 3 shows the percentages of new academic surgeons in 2022 by subspecialty. There were proportionally fewer new orthopaedic oncologists ($p = 0.021$).

Impact of Institutional Rank

Figure 4 shows the relationships between program rank and retention. Based on Doximity rankings from 2021 to 2022, the proportion of new faculty increased with higher (less prestigious) program rank ($p = 0.011$). In the T20 programs, new faculty made up 37.84%, T21 to 50 programs had 39.90%, and T51+ programs had 50.00% new faculty.

Discussion

Between 2016 and 2022, more than one-half of orthopaedists remained in academia, similar to U.S. retainment statistics across all fields¹³. The time period of this study presents a unique perspective: the COVID-19 pandemic swept across the world, causing lasting effects in all industries. Institutions experienced diminished funding and research output¹⁴; orthopaedics had a 5.69% decrease in publications, the largest decline in 2 decades¹⁵. Simultaneously, orthopaedic case load reduced greatly,

with elective surgical procedures decreasing by 80%¹⁶. Although personnel changes are not unique to the pandemic, these changes may have applied greater pressure to the orthopaedic job market, affecting turnover and retainment. However, with no comparative data from other time periods, it is difficult to ascertain the specific impacts of the pandemic. This study can serve as a basis for future studies examining the push-and-pull factors affecting academic orthopaedics during this time.

A key factor affecting academic orthopaedics is research productivity. The h-index is a frequently used research output metric and an important factor for academic career progression¹⁷. The documented positive correlation between the h-index and faculty position suggests that the h-index may be a factor in promotion^{18,19}. Although the h-index is used to determine research output, it is also positively correlated with years in practice; more senior physicians have a higher h-index^{19,20}. Physicians with greater research productivity may be more likely to stay in academia as they are presented with more job opportunities at their institution²¹. Hence, it is reasonable to assume that physicians with more years in practice and a higher h-index are more likely to be retained in academia. Although our data are consistent with the expected effects of the h-index, the relationship between retainment and years in practice differs from the current literature. Those who were retained had fewer years in practice. Thus, those leaving academia did not follow the typical trajectory: they left after a longer period of lower research productivity. Although research productivity and year in practice both impact the h-index, our data show that, of these 2 factors, increased research productivity was a better predictor of academic retainment than seniority was. Orthopaedists joining academia in 2022 had a lower h-index and mRCR, but the magnitude of the difference in the mRCR was far smaller than that in the h-index. The mRCR is considered a better estimate of current research output and less influenced by previous work or career duration^{11,22}. Hence, based on mRCR, those joining academia had more similar levels of current research output as those retained in academia.

Fellowship training was another significant factor ($p < 0.001$) in academic retainment: non-fellowship-trained orthopaedists were retained disproportionately less. Orthopaedic employment research identified an increase in the proportion of orthopaedic jobs for subspecialists since the creation of fellowship programs²³. Furthermore, non-fellowship-trained orthopaedists are being retained at low rates²⁴. Accordingly, fellowship training for residents aspiring to work in academia may increase their career longevity, considering the increased research, leadership, and teaching opportunities afforded by a fellowship²⁵.

Gender disparities in orthopaedics have long been established in the literature. Although there exists a low representation of female orthopaedists, our data suggest a trend of increasing female representation in academic orthopaedics. Previous literature found that female orthopaedic chairs, program directors, and division chiefs served for shorter periods than their male counterparts²⁶, and that female orthopaedists had lower research productivity²⁷. In our study, metrics of research output were predictors of retainment overall, but they

did not have an impact on the retainment of female orthopaedists, suggesting that gender research disparity does not impact academic employment. However, movement between institutions was impacted by gender; a higher proportion of female orthopaedists than male orthopaedists moved between institutions during this period. Previous studies identified the influence of geography and institutional demographics on orthopaedic employment; a study showed that female orthopaedic residency applicants are not drawn to institutions with a greater proportion of female faculty²⁷. Although this analysis has not been performed for faculty members, to our knowledge, it can be reasoned that the existing proportion of female faculty is not a substantial factor in choosing where to work. However, there is a documented geographic disparity in the proportion of female faculty in orthopaedic programs, with the greatest prevalence in New England and the lowest prevalence in the Southeastern regions²⁸. A possible explanation for our findings is that location plays a substantial role in female orthopaedists' choice of academic institution; women are either less content with the location of their academic institution or are more compelled to find employment better suited to their geographic preferences. In 2022, female orthopaedists joined academia in a greater proportion. Previous literature identified a 2% annual growth rate of female orthopaedists, but our study had only a 3% increase in the proportion of female orthopaedists from 2016 to 2022²⁹.

Institutional prestige also impacted retainment. Higher-ranked programs retained a greater proportion of faculty than lower ranked programs. As previously established, the h-index is an important predictor of retainment, and higher-ranked institutions employ physicians with higher h-indices³⁰. Our data are consistent with this finding, showing greater retainment at better ranked programs. These findings pose a concern for poorer-ranked institutions with lower retainment rates: faculty retainment is important for a successful academic center. Fortunately, research is only 1 factor attracting academic physicians; increased compensation, leadership appointment, and protected academic time are also valued by academic physicians^{31,32}. Lower-ranked programs may consider offering such policies to bolster their retainment.

Overall, a major strength of this study is its longitudinal design. To our knowledge, this is the only study with a complete data set of academic orthopaedists in the United States created 6 years apart with 30 unique variables. In addition, all of the data were standardized using Doximity, Scopus, and the NIH's iCite tool to identify training history and research productivity. With this approach, we accurately determined the changes across the entire academic orthopaedic sector, without having to make estimates, predictions, or regression models.

There were some limitations to our study. As our data were obtained from publicly available institutional websites, there may be discrepancies between data published online and university employment. Similarly, changes in institutional names, mergers, or closure of institutions can affect longitudinal data. To circumvent this, academic websites were cross-referenced with networks such as LinkedIn and Doximity, and all institutional changes were identified through news reports or official statements. Program rank was determined by Doximity, which does not disclose its methodology. Nonetheless, because it is commonly used in academia, we concluded that it is an effective surrogate for perceived program prestige. Lastly, the COVID-19 pandemic occurred during this study, which may have affected retainment. The findings in the study are still valuable, as they are the only longitudinal study of orthopaedic academic employment of which we are aware. Overall, the methodology was designed to minimize the effects of these limitations.

In conclusion, the retainment rate of academic orthopaedists between 2016 and 2022 was 56.99%. Those retained had fewer years in practice, a higher h-index, and more publications and were more likely to have trained in musculoskeletal oncology. Those who left academia had more years in practice and less research productivity (h-index and number of publications) and were more likely to have no subspecialty fellowship training. Almost one-half of the current orthopaedic faculty in 2022 were new to academia since 2016. Newer orthopaedic faculty were now more likely to be female and have fewer years in practice, a lower h-index, fewer publications, and fewer citations. Higher-ranked institutions retained physicians at a higher rate. ■

Matthew Weintraub, BSE¹
David Ahn, BA¹
Isabel Herzog, BA¹
Dhruv Mendiratta, BS¹
Zheshi Zheng, BS²
Neil Kaushal, MD¹
Michael Vosbikian, MD¹
Alice Chu, MD¹

¹Department of Orthopedics, Rutgers New Jersey Medical School, Newark, New Jersey

²Department of Statistics, Rutgers University, Newark, New Jersey

Email for corresponding author: dba46@njms.rutgers.edu

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