**Retrospective Study** 

# Analyzing the Geographical Trends of Pain Fellowship for Residency to Fellowship and Residency/Fellowship to First Job Location Among Recent Fellows

Jimmy Wen, BA<sup>1</sup>, Jared Leapart, BS<sup>1</sup>, Won Jin Choi, BS<sup>1</sup>, Shannon Dwyer, BA<sup>1</sup>, Muhammad Karabala, MS<sup>1</sup>, Ramy Khalil, BS<sup>1</sup>, Daniel Razick, BS<sup>1</sup>, Muzammil Akhtar, BS<sup>1</sup>, and Vinay Reddy, MD<sup>2</sup>

From: 'California Northstate University, College of Medicine, Elk Grove, CA; 'Spine & Nerve Diagnostic Center, Sacramento, CA

Address Correspondence: Jimmy Wen, BA California Northstate University, College of Medicine 9700 W Taron Dr Elk Grove, CA 95757 E-mail: Jimmy.wen10016@cnsu.edu

> Disclaimer: There was no external funding in the preparation of this article.

Conflict of interest: Each author certifies that he or she, or a member of his or her immediate family, has no commercial association (i.e., consultancies, stock ownership, equity interest, patent/licensing arrangements, etc.) that might pose a conflict of interest in connection with the submitted article.

Article received: 08-06-2024 Revised article received: 11-19-2024 Accepted for publication: 01-29-2025

Free full article: www.painphysicianjournal.com **Background:** Pain medicine has transitioned from its original role as opioid medication management into a multidisciplinary field that plays a critical role in caring for patients with various acute and chronic pain-related conditions. Pain fellowships have traditionally been considered a competitive subspecialty, and the coronavirus disease 2019 (COVID-19) drastically shifted the process in which applications to this field of study have been conducted.

**Objectives:** This study aims to analyze publicly available geographical data on pain fellows from 2017 to 2024 and to ascertain the influence of COVID-19 and primary residency on the distribution of these trainees.

**Study Design:** A retrospective study analyzing data on Accreditation Council for Graduate Medical Education (ACGME) pain fellows from 2017 to 2024. The data collected consisted of the individuals' fellowship class, residency program, primary residency specialty, and first job location.

**Methods:** Each pain fellow's relative distance and distribution from residency to fellowship, residency to first job, and fellowship to first job were analyzed. These locations were categorized as within 100 miles, the same state, the same region, or a different region. The odds ratio (OR) was calculated for those relative locations, bearing in mind whether the data referred to a pre- or post-COVID-19 time period (2017-2020 and 2021-2024, respectively). An additional OR was also conducted to determine the effect of primary specialty on relative distance. The chi-square test was used to calculate a *P*-value of 0.05, and confidence intervals were obtained using the Baptista-Pike method.

**Results:** A total of 877 fellows were included, with over half of the fellows (53.6%) staying within the same region as their residency, 51.1% in the same region from residency to first job, and 56.1% in the same region from fellowship to first job. For the residency-to-fellowship period, from pre- to post-COVID-19, fellows were not more likely to stay within 100 miles (OR: 1.16), in the same state (OR: 1.24), or in the same region (OR: 1.08). The residency-to-first-job fellows were not more likely to stay within 100 miles (OR: 0.77) or in the same state (OR: 0.93) or region (CI: 0.89). Similarly, pain fellows did not show more likelihood of staying within 100 miles (OR: 1.02) or the same state (OR: 1.01) as they progressed to their first jobs. Anesthesiology trainees demonstrated a higher likelihood of staying within 100 miles (OR: 1.47) and in the same state for the fellowship-to-first-job period (OR: 1.50).

**Limitations:** We were unable to obtain information from all the ACGME programs because some trainees declined to respond or participate. Additionally, the subjective factors that might have influenced trainees' ranking lists, such as family and personal considerations, were not elucidated in this study.

**Conclusion:** Overall, pain fellows were more likely to stay within the same region they lived in during their residency and for their first jobs. The presence of COVID-19 did not significantly affect the odds of matching within 100 miles, the same state, or the same region. Fellows with an anesthesiology background tend to stay closer to their area of training.

Key words: Pain, interventional pain, education, fellowship, residency, first job, location, relative distance, COVID-19

Pain Physician 2025: 28:E243-E254

Pain medicine is a multidisciplinary field critical in providing care to patients with various underlying conditions by alleviating these patients' pain through medications and minimally invasive procedures such as nerve blocks and devicebased neuromodulation for neuropathic pain (1). Traditionally, pain medicine involved the management of opioid medications. However, the field has recently evolved into a multimodal model that aims to limit the reliance on pain medications. A 2016 analysis of the global disease burden found that pain-related diseases, such as back-pain conditions and migraines, are the leading cause of the disability and disease burden across the world (2).

In the United States, pain physicians become certified through a pain medicine fellowship, which is a one-year training program that becomes available after a residency completed in anesthesiology and physical medicine and rehabilitation (PM&R) or other American Board of Medical Specialties (ABMS) such as neurology, psychiatry, family medicine, radiology, or emergency medicine. Pain fellowships have typically been considered a competitive subspecialty since the inception of pain medicine as an Accreditation Council for Graduate Medical Education (ACGME)-accredited subspecialty in 1993 (3). To address the shortage of available positions, there has been a 10.6% rise in the number of pain medicine programs in the last 5 years. However, the last 3 years have seen a rise in unfilled pain programs from 10% to 30% and a decrease in unmatched applicants from 15% to 7.5%. In the most recent 2024 match, there were over 61 unmatched positions and 35 unfilled programs (3).

The coronavirus disease 2019 (COVID-19) pandemic has left a lasting impact on medicine. Moreover, CO-VID-19 has wielded a significant impact on the process of applying to medical training positions, with many medical education and training programs shifting to a virtual interview format (4-6). The implementation of virtual interviews shifts the dynamic of the application process for many by eliminating travel time and cost restrictions for applicants, which may have implications for where residents choose to go for their fellowships. Furthermore, the COVID-19 pandemic may have prevented students or posed challenges for them from exploring different specialties at away rotations, limiting their exposure to pain medicine and chances of leaving an impression with these programs.

The geographical proximity of a fellowship program to a residency program may be a significant factor on where a resident chooses to go for a fellowship. Previous research in other subspecialty fellowship and residency programs has found that graduates tend to stay within the same region as their training (7,8). Most graduate medical training tends to take place in major cities, which can affect locations with fewer programs, such as rural areas (7,8).

Our study aims to investigate the geographical distribution of pain medicine fellowship programs with respect to the location of the residency program and the trainee's first employment after graduation. By stratifying the data pre-/post-COVID-19, we seek to better understand the impact COVID-19 has had on geographical trends and possible inequity in the distribution of pain fellows across the United States. Additionally, by exploring these relationships in general, we can better understand the aforementioned parameters.

## METHODS

## **Study Design**

This retrospective study reviewed current and previous fellows who completed an ACGME-accredited pain medicine fellowship in the United States from 2017 to 2024. This period was selected because it would reflect the most recent data and allow for the comparison of trends pre- and post-COVID. The data were obtained from information publicized online by each fellowship program or by directly contacting the fellowship coordinator/director for data on residents' fellowship classes, residency programs, primary residency specialties, and first job locations. For the programs with no information available on their Web sites, a standardized process was initiated to gather the necessary details. Three emails at most were sent to each institution, and if no response was received, fellow data from these programs were not included in this study.

#### **Statistical Analysis**

The relative distance of the fellows' residency program location to their fellowship program location and their first job location was categorized to be within 100 miles, in the same state, in the same geographic region, or in a different geographic region. Geographical regions (New England, Middle Atlantic, East North Central, West North Central, South Atlantic, East South Central, West South Central, Mountain, Pacific) were determined by the region classification used by the Association of American Medical Colleges (AAMC) (9).

The significance of COVID-19 before and after 2020 for fellows matching into the aforementioned relative locations was analyzed. The chi-square test was calculated using a P-value of 0.05. Confidence intervals were obtained using the Baptista-Pike method. Odds ratios (OR) were calculated to generate a forest plot. We compared data from pre- (2017-2020) to post-CO-VID (2021-2024). An additional OR was performed to assess the effect of primary residency specialty on relative locations. PM&R and anesthesiology were the only 2 residencies used, since the vast majority of fellows completed a residency in either of those specialties. To determine the OR, the number of fellows specific to each category was calculated and calculations were completed using the GraphPad software (GraphPad Software, Inc.).

Datawrapper Maps Service (Datawrapper GmbH) was utilized to create pinpoint location maps of the longitudinal coordinates for residency, fellowship, and first job locations. Each pinpoint represented a fellow's position and was color coded based on that fellow's geographical location.

# RESULTS

This study investigated 94/114 (82%) ACGMEaccredited pain management fellowship programs. Twenty programs were not included due to being too new (enrolling their first cohort in 2024) or lacking available data on program fellows. From the participating programs, 877 fellows were included in this study. However, we were unable to find the residency program that 20 (2.2%) of the fellows completed. We were also unable to find the first job locations for 384 (42.8%) participants due to a lack of available information.

# **Program Locations**

The largest proportion of fellows attended fellowship programs in the Middle Atlantic region (21.1%), followed by the East North Central (16.7%), South Atlantic (14.9%), Pacific (13.2%), West South Central (10.5%), New England (7.9%), Mountain (5.3%), West North Central (5.3%), and East South Central (5.3%) regions. A similar trend was observed for residencies' program placements, with the largest region represented being the Middle Atlantic (23.3%), followed by residencies in the South Atlantic (15.2%), East North Central (14.9%), West South Central (13.3%), Pacific (11.8%), New England (8.3%), West North Central (8.3%), East South Central (3.2%), and Mountain regions (1.7%). First-job placements showed the largest proportion of fellows received their first jobs in the Pacific region (23.5%), followed by job placements in the South Atlantic (15.7%), Middle Atlantic (15.3%), West South Central (13.8%), East North Central (8.2%), Mountain (7.4%), West North Central (6.8%), New England (6.0%), and East South Central (3.3%) regions. These findings are summarized in Fig. 1. There is a much larger spread of these programs in the eastern half of the United States than in the western half. However, one of the residents in this study completed their residency training outside of the United States and was not included in these maps.

Similarly to the regional maps for fellowship programs and residencies, the majority of first-job locations are located in the Northeast, Southeast, and Midwest, with the first-job placement locations showing additional density in the West/Pacific region. These findings are supported by the pinpoint maps illustrated in Fig. 2, showing a high density of programs in major cities. The spread of these programs is not equal in each respective region. Additionally, not every state has a program, smaller states tend to have fewer programs than do larger states, and a huge density of programs are observed to be within urban areas. A noticeable geographical inequity in program distribution was observed.

# **Relative Distances**

Table 1 shows the average distance breakdown for pain fellows between 2017 and 2024. The average distances from residency to fellowship, residency to first job placement, and fellowship to first-job placement were 710 miles, 755 miles, and 692 miles, respectively. One resident who attended residency outside of the United States was not included in the residency distance calculations, since doing so would skew the results of this data.

Data for a total of 114 pain management fellowship program fellows were available. The specialties were grouped into multidisciplinary, ABMS, not reported, anesthesiology, and other (Fig. 3). Multidisciplinary programs were defined as those accepting residents from any specialty. Other programs were defined as those that accepted anesthesiology and at least one other specialty. Forty-nine (43.0%) advanced fellowship programs accepted a mixed combination of anesthesiology, PM&R, family medicine, psychiatry, neurology, radiology, and emergency residents. Forty one (36.0%) of programs did not state the residencies they accepted on their Web sites or applications.



For the residency-to-fellowship period, the data from 877 residents showed that 41.7% stayed within 100 miles, 44.3% were located within the same state, and 53.6% were within the same region. For the residency-to-first-job period, on which we had data from 503 residents, 35.9% stayed within 100 miles, 43.7% were located within the same state, and 51.1% were within the same region. With respect to the fellowshipto-first-job timeline, we had data from 513 residents. Of those residents, 41.5% relocated within 100 miles, 48.0% were located within the same state, and 56.1% were within the same region. In all 3 pathways analyzed, a greater proportion of residents stayed within the same regions in which they began their residencies, as demonstrated in Fig. 4.

The vast majority of pain fellows (69.6%) came from anesthesiology residencies. PM&R represented the second largest residency, with 23.9% of fellows. Other residencies that participating fellows completed included neurology, family medicine, psychiatry, general surgery, internal medicine, emergency medicine, radiation oncology, radiology, and pediatrics. Fig. 5 shows the proportions of pain medicine fellows and which residencies they completed prior to fellowship.

## **Pre- and Post-COVID Effect**

Table 2 shows the OR of the matching into the predefined relative locations pre- and post-COVID-19. For residency to fellowship, the odds of fellows staying within 100 miles was 1.16 (CI = 0.88 to 1.52), while staying in the same state was 1.24 (CI = 0.94 to 1.64), and staying in the same region was 1.08 (0.82 to 1.42). The calculated *P*-values were 0.308, 0.121, and 0.583, respectively. For residency to first job, the odds of fellows locating within 100 miles was 0.77 (CI = 0.53 to 1.10), while staying in the same state was 0.93 (CI = 0.65



 Table 1. Average distance traveled to fellowship programs and first jobs.

Year	Average Distance from Residency Program to Fellowship Program (miles)	Average Distance from Residency to First Job Placement (miles)	Average Distance from Fellowship to First Job Placement (miles)
2017	828	791	1008
2018	657	703	649
2019	697	745	609
2020	688	670	414
2021	645	726	802
2022	634	640	489
2023	705	734	539
2024	824	1031	1028







Table 2. Relative distance odds ratio for included fellows from pre-to-post-COVID-19 (2016 to 2024).

	Relative Distance	Percentage Within 2016-2020 (n)	Percentage Within 2021-2024 (n)	Odds Ratio (95% Confidence Interval)	P-value
	Within 100 miles	16.4% (144)	25.5% (224)	1.16 (0.88 to 1.52)	0.308
Residency to	Same State	17.8% (156)	26.7% (234)	1.24 (0.94 to 1.64)	0.121
renowship	Same Region	20.4% (179)	33.3% (292)	1.08 (0.82 to 1.42)	0.583
_	Within 100 miles	16.5% (83)	19.5% (98)	0.77 (0.53 to 1.10)	0.154
Residency to	Same State	21.5% (108)	22.3% (112)	0.93 (0.65 to 1.32)	0.690
1 1130 )00	Same Region	24.9% (125)	26.2% (132)	0.89 (0.63 to 1.26)	0.503
	Within 100 miles	20.3% (104)	21.2% (109)	1.02 (0.72 to 1.45)	0.912
Fellowship to	Same State	23.8% (122)	24.2% (124)	1.08 (0.77 to 1.53)	0.646
1130,000	Same Region	27.3% (140)	28.8% (148)	1.01 (0.71 to 1.43)	0.970

to 1.32), and staying in the same region was 0.89 (CI = 0.63 to 1.26). The *P*-values for these ranges were 0.154, 0.690, and 0.503, respectively. For fellowship to first job, the odds of fellows locating within 100 miles was 1.02 (CI = 0.72 to 1.45), while staying in the same state

was 1.08 (CI = 0.77 to 1.53), and staying in the same region was 1.01 (CI = 0.71 to 1.43). The *P*-values for these ranges were 0.912, 0.646, and 0.970, respectively. These findings show no significance for matching into these relative locations from pre- to post-COVID-19. The OR

for relative locations is illustrated on a forest plot in Fig. 6.

## PM&R and Anesthesiology's Effect on Relative Distance

Table 3 shows the OR of primary residency (PM&R/ anesthesiology) on matching into the aforementioned relative distances. For the residency-to-fellowship period, anesthesiology residents had a higher likelihood of staying within 100 miles, with an OR of 1.47 (1.10 to 1.98, P = 0.01). For the fellowship-to-first-job period, anesthesiology had a higher likelihood of staying within the same state, with an OR of 1.50 (1.00 to 2.25, P = 0.047). PM&R residents did not demonstrate a higher likelihood of staying within the predefined relative distances. The forest plot for these results can be found in Fig. 7.

## DISCUSSION

In this study, the relative distances between pre-COVID-19 (2017-2020) and post-COVID-19 (2021-2024) pain fellows were analyzed for the residency-to-fellowship, residency-to-first-job, and fellowship-to-first-job periods. There were a total of 114 pain programs, of which 3 did not participate in the match. We were able to obtain information from a total number of 93 programs. In total, we obtained data from 877 fellows and had data on the locations of 513 (42.8%) of the fellows' first jobs.

As for the total regional spread for residencies, fel-

lowships, and first-job placements, the Middle Atlantic, Pacific, South Atlantic, East North Central, West South Central, New England, West North Central, East South Central, and Mountain regions contained a respective total of 59.7%, 48.5%, 45.8%, 39.8%, 37.6%, 22.2%, 20.4%, 11.8%, 5.3% of the fellows. These findings are supported by the geographical region-mapping of the percentage of programs in a region and the pinpoint maps. The pinpoint maps also show an abundance of programs in urban areas compared to rural areas. Interestingly, the high percentage for the Pacific was explained by first-job location with a larger proportion at 23.5% compared to the next highest at 15.3% in the Middle Atlantic. Notably, East South Central and Mountain were the only 2 regions that contained fewer than 20% of the total programs. There may be an inequality in the number of pain specialists and physicians in these areas. These regional spreads may be explained by personal and family factors such as personal preferences (e.g., location, environment), family connections, and employment market and opportunities. Whether the period under study was pre- or post-COVID-19 also showed no significance in the analysis of matching into the predefined relative locations from residency to fellowship, residency to first job, and fellowship to first job. However, the majority of fellows were found to stay within the same regions as their residencies and for their first-job placements. Similarly, a 10-year crosssectional analysis from 2009 to 2019 also found a 53% in-state retention rate for pain fellows (10).



Residency to Fellowship									
Primary Residency	Relative Distance	Percentage Within Location (n)	Percentage Not Within Location (n)	Odds Ratio (95% Confidence Interval)	P-value				
	Within 100 Miles	30.7% (269)	37.9% (332)	1.47 (1.10 to 1.98)	<i>P</i> = 0.01				
Anesthesiology	Same State	31.8% (279)	36.7% (322)	1.31 (0.98 to 1.75)	<i>P</i> = 0.069				
	Same Region	37.6% (330)	30.9% (271)	1.18 (0.89 to 1.57)	<i>P</i> = 0.249				
	Within 100 Miles	9.2% (81)	14.5% (127)	0.85 (0.62 to 1.17)	<i>P</i> = 0.331				
Physical Medicine & Rehabilitation	Same State	10.4% (91)	13.3% (117)	0.97 (0.71 to 1.32)	P = 0.84				
Renabilitation	Same Region	12.5% (110)	11.2% (98)	0.963 (0.71 to 1.32)	<i>P</i> = 0.815				
Residency to First Job									
	Within 100 Miles	26.8% (135)	49.5% (249)	0.89 (0.58 to 1.36)	P = 0.597				
Anesthesiology	Same State	32.6% (164)	43.7% (220)	0.84 (0.56 to 1.27)	P = 0.404				
	Same Region	37.8% (190)	38.6% (194)	0.76 (0.50 to 1.15)	<i>P</i> = 0.194				
	Within 100 Miles	6.8% (34)	10.5% (53)	1.19 (0.74 to 1.91)	P = 0.481				
Physical Medicine & Rehabilitation	Same State	8.3% (42)	8.9% (45)	1.25 (0.79 to 1.98)	<i>P</i> = 0.349				
Renabilitation	Same Region	9.9% (50)	7.4% (37)	1.36 (0.86 to 2.18)	<i>P</i> = 0.192				
Fellowship to First Job									
	Within 100 Miles	32.7% (168)	41.7% (214)	1.50 (0.99 to 2.27)	<i>P</i> = 0.054				
Anesthesiology	Same State	37.6% (193)	36.8% (189)	1.50 (1.00 to 2.25)	P = 0.047				
	Same Region	42.9% (220)	31.6% (162)	1.26 (0.84 to 1.87)	<i>P</i> = 0.258				
	Within 100 Miles	5.7% (29)	10.9% (56)	0.69 (0.42 to 1.12)	<i>P</i> = 0.131				
Physical Medicine & Rehabilitation	Same State	6.6% (34)	9.9% (51)	0.68 (0.42 to 1.09)	<i>P</i> = 0.109				
Renabilitation	Same Region	8.2% (42)	8.4% (43)	0.72 (0.45 to 1.15)	P = 0.172				

 Table 3. Relative distance odds ratio for included PM&R and anesthesiology fellows.

## **COVID-19 Effect**

COVID-19 caused many fellowship interviews to shift to a virtual format and left many applicants wondering how the new landscape for the application process would affect match rates and program ranking. Additionally, virtual rotations, shortened clerkships, and a decrease in away rotations reduced the opportunities to obtain meaningful evaluations and letters of recommendation (11). Traditional interviewing may shrink in prevalence as nontraditional methods become more utilized in the matching process, possibly altering how institutions and applicants approach the matching in the future. On-site visits and away rotations are regarded as crucial steps in the interview process for evaluating an applicant and program (12). The impact of COVID-19 on several specialties (internal medicine and its subspecialties, orthopedic surgery, sports medicine, and otolaryngology) regarding application and match rates have been investigated (6,12-15). Interestingly, the number of applicants has continued to increase, but there has been a trend for an overall decreased match rate due to a lack of proportionate increases in fellowship positions/ programs. Huppert et al found that the number of applicants and applications submitted for internal medicine and its subspecialties had the greatest rate of increase in 2020 and 2021 over the 5 prior years they studied (15). Those findings were hypothesized to be due to the decreased time and costs associated with virtual interviews as opposed to to in-person interviews. However, the rise in the number of applications may lead to increased congestion and waiting time before applications are reviewed. Iwai et al (16) investigated the effect of the pandemic on 10 surgical specialties in 2021 and found a decrease in the likelihood that students had geographic connections to their programs (P = 0.021). There was also an increase in the number of research experiences but a decrease in the number of honored clerkships (P < 0.001for both) (16).

Virtual interviews, furthermore, bring about their own difficulties. Both applicants and faculty are limited in their abilities to evaluate one another in terms of the program's dynamics for applicants and the sense of how an applicant would fit into the program's team (12). Program directors typically rank in-person performance and evaluations significantly in the final rank lists (17). Surveys with program directors convey a general feel-



ing that the pandemic exerted a negative impact on the quality/amount of clinical training, didactic learning, and well-being and potentially affected the competency of graduates (18,19). The decrease in training guality was attributed to an increase in virtual appointments, interpretations of imaging studies without in-person supervision, access to mentorship, and decreased access to resources for combating burnout. However, it is important to note that the challenges for fellowship are greater than the challenges to residency, since most fellowships are one year in duration. Virtual interviews also help alleviate financial and time burdens because applicants typically invest a large amount of funds to travel across the country for in-person interviews to increase the likelihood of matching (17). A 2016 crosssectional study covering otolaryngology applicants found that 28% of those applicants did not have sufficient funds to apply and interview, despite searching for monetary resources. Additionally, the mean amount spent throughout the process, including away rotations, application fees, and interviewing was \$8,900 (20). Similarly, a 2021 cross-sectional study in orthopedic surgery found an overall savings of \$5000 in the first COVID-19 matching year. Interestingly, a benefit appeared to be

linked to certain geographic regions, with applicants from the West saving the most (\$6,000) (21). This shift to virtual interviews potentially levels the playing field for applicants who may have fewer financial resources than others. The costs of not matching are also high, since going through another cycle will dramatically burden an applicant's finances. The consensus on virtual interviews is mixed, weighing the ability to convey a program's culture versus the benefit of virtual recruitment increasing candidate competitiveness and diversity (18). However, as an alternative, it has been suggested that virtual interviews can be used as a screening tool for in-person interviews instead (17). In a survey of pain program directors (40% response) and applicants (32.3% response) for the 2021-2022 year, 45.7% of applicants and 27.3% of program directors reported positive opinions of virtual interviews (4). Future application cycles may be conducted entirely virtually or via a hybrid format, given the time and cost benefits outlined previously.

#### **Trends in Pain Fellowships**

Although graduates from ABMS residencies can apply for pain fellowships, the majority (69.6%) of the included fellows completed an anesthesiology residency. These findings may be attributed to trainees having less exposure or knowledge that they are eligible to apply for pain fellowships. However, from 2022 to 2023, the percentage of anesthesiology applicants noticeably declined to 48.2%, which was a trend observed in the preceding years of 2019 to 2021. This trend was speculated to be due to the strong anesthesia job market or due to concern surrounding the increased difficulty obtaining insurance authorizations for pain procedures. Meanwhile, the number of PM&R applicants remained consistent from 2019 to 2023 (3).

Some programs can consider graduates from other specialties on a case-by-case basis at the discretion of the program director. For what residencies each fellowship accepted, we documented what the Web sites explicitly stated. These statements may not reflect what the fellowships accept through the match application. Interestingly, a 2024 study that conducted a 10-year analysis for application and match rates for pain fellowships found substantial growth in the number of training positions available (261 to 377, a 44% increase) compared to the number of applicants (398 to 415, 4% increase). For allopathic graduates in the United States, the match rate increased from 71% to 91% (P < 0.001), with more training positions being left unfilled, from 2% to 5% (P = 0.006) (22).

The findings of this study can guide aspiring pain physicians by providing the most recent geographical trends concerning pain fellows, the primary specialty that pain fellows tend to complete, and information on what primary specialties from which pain programs accept applicants. Trainees may have varying educational exposure to pain, which may disadvantage students from institutions with less exposure to this field. Similarly, trainees may also have been provided with varying levels of mentorship opportunities, which can greatly impact an individual's career plans (13).

The trends noted in the pain fellowship match create a potential disproportionate spread of pain physicians across the US. Other factors that applicants could potentially have considered when deciding on their future locations were faculty reputation, accreditation status, salary, and prospective gain in experience. Additionally, personal factors such as family, friends, personal preferences, and connections to a particular area also hold weight in an applicant's decision. Ultimately, the NRMP matches will hold more weight in determining trainees' choices of location and program for their pain fellowships than will personal preferences.

#### Limitations

These findings must be considered within the context of their limitations. First, we were unable to obtain information from all the ACGME-accredited pain programs due to directors who did not respond or who declined to participate. This missing information may lead to non-responder bias, affecting the results shown in this study. Second, this study did not explore the subjective factors that trainees consider when ranking their program lists, such as family, personal life plans, and career goals. Future gualitative studies utilizing personal interviews or surveys can help provide additional elucidation of other factors that influence trainees' locations. Additionally, focusing on underrepresented students who may have been disproportionately affected by the shift to virtual interviews for reasons such as financial inequalities is warranted to promote equity in the matching process.

## CONCLUSION

Our study concludes that pain fellows were more likely to stay within the same region they lived in during their residencies and for their first job placements. In addition, comparing pre- to post-COVID-19 matching showed no changes in the likelihood of matching within 100 miles, the same state, or the same region. Although fellows with an anesthesiology background tended to stay closer to their area of training, fellows with backgrounds in PM&R did not share that same trend. This study provides current pain fellow location trends and demographic data (primary residency, residencies that programs accept) that can inform medical students, residents, and program directors on factors that can influence the career pathways of future pain physicians.

## REFERENCES

- Paladini A, Gharibo C, Khalbous S, et al. Looking back, moving forward in pain medicine. *Cureus* 2023;15:e44716.
- 2. GBD 2016 Disease and Injury Incidence and Prevalence Collaborators. Global,

regional, and national incidence, prevalence, and years lived with disability for 328 diseases and injuries for 195 countries, 1990–2016: A systematic analysis for the Global Burden of Disease Study 2016. *Lancet*  2017; 390:1211-1259.

3.

Christiansen S, Pritzlaff S, Escobar A, Kohan L. A sudden shift for Pain Medicine fellowships – A recount of the 2024 match. *Interv Pain Med* 2024; 3:100404.

- Dale R, Kinch L, Kohan L, et al. Pain medicine fellowship video interviews: A COVID-19 trend or here to stay? *Pain Physician* 2022; 25:125-130.
- Meyer AM, Hart AA, Keith JN. COVID-19 increased residency applications and how virtual interviews impacted applicants. Cureus 2022; 14:e26096.
- Peebles LA, Aman ZS, Kraeutler MJ, Mulcahey MK. The COVID-19 pandemic increased the use of virtual fellowship interviews, reduced case volume, and limited sideline coverage opportunities during sports medicine surgeon training. Arthrosc Sports Med Rehabil 2023; 5:e891-e895.
- Chun R, Preciado D, Brown DJ, et al. Choosing a fellow or fellowship: A survey of pediatric otolaryngologists. JAMA Otolaryngol Head Neck Surg 2014; 140:102-105.
- Quave AA, Ayutyanont N, Akhondi H. The important factors applicants consider when choosing a residency: A survey study. HCA Healthc J Med 2022; 3:13-22.
- 9. Biographical information. Association of American Medical Colleges: Students & Residents. Accessed August 3, 2024. https://studentsresidents.aamc.org/applyingresidencies-eras/publication-chapters/ biographical-information
- 10. Odonkor CA, Leitner B, Taraben S, et

al. Diversity of pain medicine trainees and faculty in the United States: A cross-sectional analysis of fellowship training from 2009-2019. *Pain Med* 2021; 22:819-828.

- Hammoud MM, Standiford T, Carmody JB. Potential implications of COVID-19 for the 2020-2021 residency application cycle. JAMA 2020; 324:29-30.
- Nesemeier BR, Lebo NL, Schmalbach CE, et al. Impact of the COVID-19 global pandemic on the otolaryngology fellowship application process. Otolaryngol Head Neck Surg 2020; 163:712-713.
- Strumpf Z, Miller C, Abbas KZ, Bensken WP, Matta M. Trends in pulmonary critical care fellowship applications and match rates before and after the onset of the COVID-19 pandemic. ATS Sch 2024; 5:154-161.
- Almujarkesh MK, Alsakarneh S, Almeqdadi M, Al Ta'ani O, Mohamad B, Kinnucan J. The effect of the Coronavirus (COVID-19) pandemic on gender and medical school diversity in gastroenterology fellowship matching. *Gastro Hep Adv* 2024; 3:654-658.
- Huppert LA, Santhosh L, Babik JM. Trends in US internal medicine residency and fellowship applications during the COVID-19 pandemic vs previous years. JAMA Netw Open 2021; 4:e218199.
- 16. Iwai Y, Lenze NR, Mihalic AP, Becnel CM, Stitzenberg KB. Effect of the

COVID-19 pandemic on the residency match among surgical specialties. *Surgery* 2022; 171:1512-1518.

- 17. Swendiman RA, Jones RE, Blinman TA, Krummel T. Disrupting the fellowship match: COVID-19 and the applicant arms race. J Surg Educ 2021; 78:1069-1072.
- Cullen MW, Damp JB, Soukoulis V, et al. Program directors survey on the impact of the COVID-19 pandemic on cardiology fellowship training. JACC Adv 2024; 3:101008.
- Johnson J, Chung MT, Stathakios J, Gonik N, Siegel B. The impact of the COVID-19 pandemic on fellowship training: A national survey of pediatric otolaryngology fellowship directors. Int J Pediatr Otorhinolaryngol 2020; 136:110217.
- Polacco MA, Lally J, Walls A, Harrold LR, Malekzadeh S, Chen EY. Digging into debt: The financial burden associated with the otolaryngology match. Otolaryngol Head Neck Surg 2017;156:1091-1096.
- 21. Gordon AM, Conway CA, Sheth BK, et al. How did Coronavirus-19 impact the expenses for medical students applying to an orthopaedic surgery residency in 2020 to 2021? *Clin Orthop Relat Res* 2022; 480:443-451.
- 22. Silvestre J, Nagpal A. A 10-year analysis of application and match rates for pain medicine training in the United States. *Pain Med* 2024; 25:374-379.