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Impact of Gap Years Following Medical School Graduation on Resident Research Productivity in Ophthalmology

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Abstract

Background Gap years following medical school graduation have become more common, but research into their tangible career benefit is lacking. Examining the impact of gap years on resident scholarly productivity in ophthalmology may provide insight generalizable to all specialties.

Objective To evaluate whether a gap year following medical school graduation significantly predicts scholarly productivity during ophthalmology residency.

Methods In December 2021, residents were recorded from 110 publicly available American ophthalmology residency program webpages. They were included if educational history was listed on publicly accessible academic and social media profiles. Residents were then stratified into gap year and nongap year cohorts. Publication data were recorded from Scopus and PubMed. Pearson's chi-square, independent sample *t*-tests, and multivariable regression were performed.

Results A total of 1,206 residents were analyzed, with 1,036 (85.9%) residents taking no gap year and 170 (14.1%) residents with at least one gap year. Gap year residents were predicted to have increase in the likelihoods of publishing at least one, two, or five total articles during residency, in addition to at least one article in a high-impact journal. There was no significant relationship between gap years and publications with senior authors affiliated with either the resident's medical school or residency program.

Conclusion Residents taking gap years following graduation may publish more during residency, but these publications are not associated with senior authors at their institutions. Future investigations should continue to evaluate the significance of gap years in medical education.

Keywords
- residency
- education
- gap year
- training
- research productivity

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The ophthalmology residency is one of the most competitive training programs for medical students to match into. Of 600 U.S. allopathic seniors who participated in the 2022 San Francisco match for the first time, 447 individuals successfully matched—a rate of 75%.[1] Match rates have been trending down in recent years, from a match rate of 80% in 2021 and 86% in 2020 for first-time applicants.[1]

In response to increasing competitiveness of matching into ophthalmology residency, medical students may pursue a gap year following medical school graduation to strengthen their application or reapplication for residency. Often, they will participate in scholarly research by taking a dedicated "research year," whether at their home institution or another, with the hopes of bolstering their application through publications and fostering connections with ophthalmology faculty. One study found that among students applying into "competitive specialties" with higher average step scores, much like ophthalmology which had 247 in 2022, the overwhelming majority of students listed "increase competitiveness for residency application" as the primary reason for taking a gap year.[1,2] A review summarizing the enduring value of research in medical education demonstrates why ophthalmology residency directors value research experiences in applicants: "Early involvement equips medical students with research skills needed in residency," "the time spent exploring topics in depth aids in determining if a specialty is of interest to you," and "the balance of research with school obligations promotes time management and punctuality" are just some of the benefits that can make an applicant an asset to any residency program. Beyond residency, prolonged research involvement facilitates the innovation of current care and promotes physician collaborations across the globe.[3]

The Association of American Medical Colleges reports that participation in a nonjoint degree research year is more than doubled from 1998 to 2013 with only 81% of MD students matriculating in 2009 graduating in 4 years.[4] In addition, the mean number of total publications/posters reported by successful ophthalmology applicants has increased by more than 55% from those beginning their residency in 2013 to those beginning in 2018.[5] The h-index is one of the most recognized author-level metrics of scholarship and considers both an author's productivity and the citation impact of their publications. h-indices of medical students at the time of their application to ophthalmology residency were found to be associated with an increased likelihood of matching at higher tier institutions who have higher research output.[6] Particularly, for international medical graduates applying for ophthalmology residency in the United States, having at least one article published in a high-impact journal was associated with nearly a threefold increase in the probability of matching.[7]

While the match rate for U.S. allopathic seniors is 75% in 2022, the match rate drops to just 43% for U.S. allopathic graduates. These graduates are commonly reapplicants who failed to match into ophthalmology the previous year, or alternatively may have decided on applying into ophthalmology only after having graduated, or simply desired a year off for personal reasons. Regardless, little literature is available evaluating factors that may increase the competitiveness of reapplicants and medical school graduates in the ophthalmology match. However, studies in multiple competitive specialties including orthopaedic surgery, plastic surgery, and dermatology point toward research as one of the most critical components for ensuring a successful match for reapplicants.[8]

As resident and alumni research output is a driving factor in the Doximity program rankings and ophthalmology program directors seem to favor applicants and reapplicants who have published more research in their gap year following medical school graduation, the relationship between taking a gap year and continued research productivity is one that should be ascertained.[9] Plastic surgery and orthopaedic surgery residents who completed a research year during medical school have been associated with a greater number of publications during residency.[10] Currently, little research exists for medical school graduates and if their gap year after medical school is associated with increased research productivity in residency. The gap year can be defined as any year-long gap from the time of medical school graduation to the start of intern year of residency. Here, the purpose of our study is to evaluate if taking a gap year following medical school graduation significantly predicts scholarly productivity during ophthalmology residency.

Methods

The study was exempt from review by Johns Hopkins University's Institutional Review Board, and we adhered to the tenets of the Declaration of Helsinki. Informed consent was not possible given the retrospective nature of this study with publicly accessible information. One hundred and ten publicly available U.S. ophthalmology residency program Websites were reviewed for current residents in December 2021. Resident names were recorded alongside their medical school, ranked by U.S. News & World Report.[11] To obtain further information on residents' educational backgrounds, online networking platforms for health care professionals such as Doximity and LinkedIn were reviewed. Determination of whether a resident took at least one gap year was based on the medical school graduation year compared with the matriculation year of training. Residency program information including program reputation, ranking, size, and region was collected from Doximity. Gender was recorded by searching the resident's name in the National Provider Identifier Registry public search tool. If any information was absent, then the resident was excluded from analysis.

Publication data were obtained by searching the residents' names and cross-referencing their works on Scopus and PubMed. Search queries were restricted from July to December 2021. Information on intern year, letters, rapid communications, responses, textbook chapters, and all publications that were not original research articles, case reports, or literature reviews were excluded. For each resident, research impact was based on the following metrics: total number of publications, number of first author publications, number of publications in the top 10 highest

Table 1 Differences in cohort characteristics of gap year and nongap year residents

Variable	No gap year ($n = 1{,}036$)	Gap year ($n = 170$)	*p*-Value
Gender			
Male	593 (57.2)	109 (64.1)	0.092
Female	443 (42.8)	61 (35.9)	
Region			
Midwest	265 (25.6)	37 (21.8)	0.232
Northeast	311 (30.0)	60 (35.3)	
South	323 (31.2)	44 (25.9)	
West	137 (13.2)	29 (17.1)	
Year			
1	344 (33.2)	53 (31.2)	0.823
2	349 (33.7)	61 (35.9)	
3	343 (33.1)	56 (32.9)	
Foreign medical school graduate	3 (0.2)	35 (20.6)	**< 0.001**
Top 50 ranked medical school	528 (51.0)	73 (42.9)	0.052
Top 20 ranked residency program	250 (24.1)	42 (24.7)	0.871
Average program size[a]	16.52 ± 6.126	16.46 ± 6.574	0.915

[a]*t*-test besides chi-square.

impact factor ophthalmology journals, and the number of publications with affiliated senior authors in the resident's medical school or training program. If no publications were extracted from PubMed or Scopus, the resident was listed to have no publications.

Statistical analysis was performed using SPSS Statistics v.24 (IBM, Chicago, IL). Pearson's chi-square and independent samples *t*-tests were used to assess differences between the frequencies of demographic characteristics and research productivity metrics, respectively. Multivariable binary logistic regression was utilized to assess if gap years were a significant predictor of resident research output as measured by odds ratios. In multivariable regression, adjustments were made for program region, resident year, gender, size of the program, program rankings, medical school rankings, and international medical graduate status.

Approximately 50% of residents published no articles during residency, 75% of residents published one or fewer total publications, 85% published two or fewer total publications, and 95% published five or fewer total publications. Hence, regression analysis was performed to discern significant predictors of at least one, two, and five total publications as binary outcomes to evaluate if there were significant findings not only by research categorization but also if trends existed with increasing scholarly activity. For all other research categorizations, regressions were not performed for five publications due to a small subset of residents included.

Results

A total of 1,206 residents were included for analysis, with 1,036 (85.9%) residents going straight from medical school to residency, while 170 (14.1%) residents took at least one gap year following medical school graduation. ►**Table 1** shows the demographic and educational characteristics of each cohort. There was only a significant difference in the

Table 2 Significant differences in mean research productivity between gap year and nongap year residents

Variable	No gap year ($n = 1{,}036$)	Gap year ($n = 170$)	*p*-Value
Total publications	1.07 ± 1.816	2.11 ± 2.837	**< 0.001**
First author publications	0.48 ± 1.024	0.61 ± 1.162	0.166
High-impact journal publications	0.16 ± 0.509	0.36 ± 0.920	**0.005**
Publications with the senior author affiliated with the resident's residency program	0.52 ± 1.193	0.84 ± 1.855	0.663
Publications with the senior author affiliated with the resident's medical school	0.39 ± 0.901	0.42 ± 0.998	**0.034**

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proportion of foreign medical graduates between gap year and nongap year cohorts ($p < 0.001$).

In terms of scholarly output, there was a significant difference between both cohorts in the total number of publications, articles published in the top 10 ranked ophthalmology journals, and publications with senior authors affiliated with the medical school. No significant difference was observed between residents who took gap years and those who did not regarding first author publications or publications with senior authors affiliated with the residency program (►**Table 2**).

After adjusting for potential confounders in multivariable analysis, gap year residents were predicted to have an over twofold significant increase in the probability of publishing at least one, two, and five total articles during residency. Furthermore, there was just under a twofold significant increase in the odds of publishing at least one article in a high-impact journal. Multivariable analysis is shown in ►**Table 3**.

Discussion

Taking gap years after medical school may be for several reasons, such as failing to match, or securing research, employment, or service experience prior to applying for residency.[12] The practice of taking at least one gap year impacts the profile of medical students successfully matching into ophthalmology because not all prospective applicants are able or willing to delay starting residency. For these reasons, understanding the relationship between taking a postgraduation gap year and research productivity among ophthalmology residents is valuable to prospective applicants, career advisors, and other relevant stakeholders in weighing advantages and disadvantages of taking a gap year. Electing to take a gap year has the potential of exacerbating the preexisting financial burden of attending medical school and thereby favoring more socioeconomically advantaged medical students in reapplying and matching into ophthalmology.

However, a survey of radiation oncology resident applicants did not find loan burden, age, or family status to correlate with the usage of gap years, providing reassurance that gap years are not starkly increasing socioeconomic disparities in the applicant pool.[13] Students under significant financial burden or socioeconomic stress may benefit from the relatively smaller additional burden of a gap year that maximizes their chances of matching into their desired residency program and specialty, particularly if there are long-term gains in earning potential.[13] There may be students failing to match into ophthalmology during their first application cycle who elect not to pursue a gap year and subsequently decide to apply into another field, but this cannot be assessed with our data. Of note, there is an upward trend in the total number of applicants per ophthalmology residency position (from 1.3 in 2013 to 1.5 in 2022).[1] While research and gap year expectations may dissuade certain prospective applicants from applying into ophthalmology, a situation in which there are no longer enough applications to fill available slots is unlikely in the foreseeable future.

Residents taking at least one gap year had significantly higher odds of publishing at least one publication than those without any gap years. The magnitude of this odds ratio increased and retained significance after setting the threshold to at least two total publications and then to at least five total publications. Since total publications are a reliable metric for measuring research quantity, our findings confirm the value of taking at least one gap year in gaining research experience and output. The possibility of "research lag" cannot be ignored, where projects were initially started, perhaps even completed, and submitted, in either the gap year or intern year but only published during residency. However, the median time from manuscript submission to acceptance in eight ophthalmology journals in 2020 was 119 days, and most commonly manuscript submissions require going through multiple journals before finally publishing.[14] As such, many of these projects likely required rounds of revisions and resubmissions that occurred during residency and still represent residency scholarly activity.

Table 3 Multivariable regression assessing gap year following medical school graduation as a predictor of research productivity during ophthalmology residency

Variable	At least 1	*p*-Value	At least 2	*p*-Value	At least 5	*p*-Value
Total publications	2.066 (1.394, 3.063)	<**0.001**	2.094 (1.388, 3.159)	<**0.001**	2.424 (1.332, 4.413)	**0.004**
First author publications	1.200 (0.801, 1.800)	0.377	1.254 (0.708, 2.223)	0.438		
High-impact journal publications	1.865 (1.134, 3.069)	**0.014**	1.769 (0.693, 4.518)	0.233		
Publications with the senior author affiliated with the resident's residency program	1.083 (0.709, 1.655)	0.713	1.412 (0.822, 2.437)	0.211		
Publications with the senior author affiliated with the resident's medical school	1.199 (0.791, 1.818)	0.393	1.266 (0.687, 2.332)	0.450		

Residents taking at least one gap year had similar odds for having at least one first author publication and at least two first author publications than those not taking a gap year. These limited differences suggest that residents taking and not taking at least one gap year may demonstrate similar initiative while conducting scholarly activity. As differences in the number of total publications are not driven by differences in the number of first author publications, residents taking at least one gap year likely have the time to make smaller contributions to various research projects that are accepted for publication. The tendency of gap years to increase the number of total publications but not the number of first author publications has been documented among orthopaedic surgery residents.[10]

Residents taking at least one gap year had higher odds for having at least one publication in a high-impact journal but similar odds for having at least two publications in high-impact journals as those not taking a gap year. The number of publications residents have in high-impact journals may reflect the quality of their scholarly activity during their gap years. Choosing to take a gap year may allow residents to learn the skills that are needed to publish higher impact work. The difference between residents taking and not taking at least one gap year diminishes as the threshold of high-impact publications increases.

Residents taking at least one gap year had similar odds of having at least one and at least two publications with a senior author affiliated with their medical school or residency program as those not taking a gap year. This suggests that residents may be completing more research during their gap year at another institution. The gap year may afford additional opportunities for networking and mentorship beyond a resident's home institution.

It is important to determine whether the additional qualifications produced through a gap year are meaningful to the field of ophthalmology. This question has been raised before, specifically if an applicant with more publications because he or she took a gap year is more likely to be a successful resident or to pursue an academic career than one who did not.[13] An applicant who achieves less research output within the standard 4 years of medical school may have superior academic potential than an applicant who achieves more research output after taking at least one gap year.[13] Resident performance is already suggested to poorly correlate with the volume of research published by applicants.[15] The number of articles published by medical students that remain uncited has increased exponentially in recent years, which raises potentially unflattering questions about the quality and rigor of research conducted by medical students prior to starting residency.[16] Worse, some evidence exists indicating that applicants for several medical and surgical specialties report citations of nonexistent articles.[17–19] Assuming this cynical interpretation, the gap year may be an artificial barrier to entry that fails to meaningfully differentiate an applicant's ability to perform scholarship. In the place of research productivity, additional weight in residency admissions may be given to prior graduate degrees including completion of a PhD, but completion of advanced postgraduate degrees does not correlate with ophthalmology residents choosing to pursue academic or research careers following residency.[20] Other metrics for comparing applications, such as board examination scores and *Alpha Omega Alpha* status also have limitations in predicting success during residency, especially after the recent transition of the Step 1 examination to pass/fail grading.[21] However, despite the questions surrounding the value of research productivity, of the 885 U.S. residency program directors surveyed in 2023, 98.9% of them value research to some degree, with 70.1% placing high to moderate importance.[22] Therefore, currently, residency programs still view research bearing some value on the quality of the resident that may not be captured in quantitative studies, and future investigations may explore differences in research productivity by residents within a program. There are several limitations of this study. First, our mode of data collection enabled us to only identify residents who took gap years after graduating from medical school. As a result, residents who took gap years during medical school were not detected. Future studies can utilize surveys in which residents are directly asked about the timing and duration of their gap experience to investigate any significant difference in the impact of gap years taken before, during, and after medical school. Second, we were unable to differentiate obligatory gap years for reapplicants from elective gap years for first-time applicants who decided on ophthalmology late. Additionally, because of limitations in publicly available data and selection bias, our study was unable to identify the activities of the students taking at least one gap year, whether it was a pure research year or spent doing other activities such as obtaining another professional degree. Only a small subset of the residents publicly posted the details of their gap year, and even then, we cannot determine if that which the resident posted was exclusively all they did during their gap year. A more comprehensive understanding of gap year activities would require alternative data collection methods not reliant on publicly available data, and a future survey study exploring gap year activities of ophthalmology applicants would be insightful.

Third, some resident publications may not be recorded in either the Scopus or PubMed databases. Fourth and as previously introduced, while the research lag phenomenon generally still captures scholarly activity during residency as residents continue to revise and resubmit manuscripts started in their gap year, it is important to acknowledge that a few articles may have been completed entirely prior to residency but published during this period, which our current study did not account for. However, eliminating all studies not performed at the resident's residency program presents the risk of excluding not only projects started in the gap year and finished during residency but also projects that were started during residency with faculty from other institutions. Despite these limitations, our study detected differences in research productivity by gap year status in a recent cohort of ophthalmology residents.

Conclusion

Our findings suggest that ophthalmology residents with gap years following medical school graduation may be significantly more likely to publish more total publications during residency compared with their nongap year counterparts. While gap year residents may also be more likely to publish in high-impact journals, these publications may not be affiliated with senior authors at their residency programs and medical schools.

Meeting Presentation
A poster presentation took place from April 23rd to 27th, during the ARVO 2023 conference in New Orleans, LA.

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Conflict of Interest
None declared.

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