Scholarly Productivity Related to Academic Rank in Optometric Faculty

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Abstract

Background: *Achievement in scholarship has become an integral component in a faculty member's success within an institution. The purpose of this study was to evaluate optometric faculty productivity specifically in the area of peer-reviewed journal publications with regard to success in academic achievement.* ***Methods:*** *Survey questionnaires were emailed to 198 optometric faculty members to elicit information related to career facts such as dates of promotions, tenure and type(s) of advanced degree(s). Scholarly productivity then was assessed using an Internet database search.* ***Results:*** *The data indicated several trends and characteristics of faculty who have reached the level of full professor. The median number of publications associated with advancement from assistant to associate was: 2.5 for the OD group, 1.5 for the Master's group, 6 for the OD/Other Doctorate group, and 5 for the PhD group. The median number of additional publications in advancing from associate to full was: 4.5 for the OD group, 7 for the OD/Master's group, 8.5 for the OD/Other Doctorate group, and 8 for the PhD group.* ***Conclusion:*** *Information provided by this study can be used as a guide for junior faculty, review boards and mentors.*

Key Words: *scholarly productivity, optometric faculty, scholarship, academic promotion*

Introduction

At most optometric institutions, advancement in academic rank and tenure require that faculty members contribute in the areas of teaching, service, scholarship and clinical practice. These expectations have the potential to impact faculty retention rates, a faculty member's success within a particular institution and ultimately a student's education. In most healthcare professions, achievement in scholarly activity (scholarship) has become an integral component of a faculty member's success within an institution.[1] Richard Kennedy defines scholarship as the "creation, discovery, advancement or transformation of knowledge."[2] He notes that "The fruits of such efforts are evidenced only when that knowledge is assessed for quality by peer review and made public."[2]

Scholarly achievements were not always an integral component of a faculty member's responsibilities. Historically, the responsibilities of teachers focused on teaching and the growth of the intellectual and moral minds of students.[3] The early colonial college focused on "building character and preparing new generations for civic and religious leadership."[3] At that time the primary responsibility of a professor was teaching. The evolution of higher education followed the development of the country. As the country progressed through the agricultural and industrial revolution, the need developed for educational institutions to support and serve the public. Consequently, the concept of faculty providing service to the community was added to the teaching responsibilities of faculty.

The development of scholarship paralleled the development of service. Early researchers such as Thomas Jefferson and mathematician Nathaniel Bowditch were outside of the academic institutions.[3] Educator Dael Wolfle wrote "Professors were hired to teach the science that was already known − to add to that knowledge was not expected."[4] As the country evolved, the need for new discoveries that could enhance industrial and agricultural productivity began to emerge. In 1895, University of Chicago President William Rainey Harper required "each appointee to sign an agreement that his promotions

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in rank and salary would depend chiefly upon his research productivity."[5] In addition to service, scholarship was now a component of a faculty member's responsibilities. In a 1989 national survey by the Carnegie Foundation for the Advancement of Teaching, 42% of the nation's faculty members strongly agreed that it is difficult to achieve tenure without publishing.[3]

The expectation for most faculty members is to contribute to the knowledge base of the profession. At most optometric institutions, success in the promotion/tenure process requires contributions and leadership in all relevant areas evaluated: teaching, service, scholarship and clinical practice. Promotion and tenure is the process of formal evaluation, which recognizes a faculty member's contributions.[2] Tenure has the added feature of an indefinite term of appointment.[2] Optometric institutions independently determine the criteria and weight of each of these accomplishments in regard to promotion and tenure. In the medical literature, academic promotion is closely linked to scholarly productivity represented by peer-reviewed publications.[6,7] Personal experience and informal conversations with other optometry faculty members across the nation have revealed that peer-reviewed journal publications are heavily weighted in evaluating the scholarly contributions involved in promotion and tenure decisions in optometric education. Peer-reviewed articles represent publications that have been reviewed by impartial experts (peers) in the topical area of the publication.[8] The reviewers evaluate accuracy of information as well as methodology and procedure. Peer-reviewed articles exemplify scholarly validity and rigor and the best research practices in a field.[8] The focus of this study was on scholarship, specifically peer-reviewed journal publications.

The area of scholarship can be challenging to optometric faculty because most are chosen for their clinical expertise and receive little formal training in scholarship. Lack of experience in scholarship has the potential to impact a junior faculty member's ability to be successful within the promotion system. Success in promotion and tenure often impacts the entire institution as well as the faculty member. Having a team of mid- and upper-level faculty who can act as mentors, academic historians and leaders within an institution is often beneficial to the institution. Retention of faculty can be impacted by the success of faculty within the promotion/tenure system. Many institutions have a limited or terminal contract associated with the failure to achieve tenure.

In the professions of pharmacy and medicine, some research has been done in the area of faculty productivity and academic rank.[9,10] Within the profession of optometry there is a paucity of information available on faculty productivity and academic rank. A search of PubMed, VisionCite and Educational Research Information Center (ERIC) using the mesh terms "optometric faculty" or "optometry faculty" and/or publications, academic achievement, scholarship revealed only a few articles, none dealing with the topic of faculty productivity related to academic achievement. The purpose of this study was to evaluate optometric faculty productivity specifically in the area of peer-reviewed journal publications with regard to success in academic achievement. The goal was to provide career-planning guidance to junior faculty and guidance to review committees establishing criteria for advancement.

Methods

Faculty members from optometry schools in the United States, including Puerto Rico, who achieved the rank of full professor (tenure or non-tenure track) by July 2013 were eligible for inclusion in this study. The faculty members were identified through the Association of Schools and Colleges of Optometry (ASCO) faculty database. The study did not include faculty identified by the ASCO database as clinical full professors. Survey questionnaires were emailed to 198 optometric faculty members who met the criteria. The survey sought information about dates for promotions, tenure if applicable, type(s) of advanced degree, postgraduate residency, institution at time of advancement and current institution. Information was also solicited on names used in publications, such as a maiden name, middle name or middle initial. A second and third survey were sent out 1 month and 4 months later to non-responders.

The scholarly productivity of faculty members was assessed in two ways. Survey respondents had the option of providing the principal investigator with a complete list of their publications. Five percent of the respondents chose this option. Alternatively, a literature search for scholarly publications was conducted using Google Scholar and three databases: PubMed/Medline, VisionCite and ERIC. PubMed/Medline, developed and maintained by the National Center for Biotechnology Information at the National Library of Medicine, was chosen because of its comprehensiveness.[11] Medline contains citations and abstracts from more than 5,600 biomedical journals dating back to 1946.[11] The majority of publications in Medline are scholarly journals.[12] The VisionCite database was chosen because of its concentration in vision science literature and its ability within a search strategy to identify types of articles such as editorials, letters to the editor, etc. The VisionCite database is maintained by the Illinois College of Optometry.[13] It indexes 114 journals containing more than 320,000 articles from 1984 to the present.[13] The database focuses on vision science literature including optometry, ophthalmology, reading and learning disabilities, practice management and other vision-related subjects.[13] The ERIC database contains educational literature, more than 1 million abstracts of documents on education and practice, and 900 journals dating back to 1966.[14] It was included because education articles contained in ERIC are not contained in PubMed/Medline and may not be included in VisionCite. Google Scholar was included because of its ability to crawl other databases to produce articles and information, which insured completeness.[15] Google Scholar, which is part of the Google search engine, has been available since 2004. Google Scholar produces information and citations on a wide range of topics but is particularly strong in the sciences.[15]

Each of the databases and Google Scholar were searched using the faculty member's name and any variation of the name, such as last name with first and middle initials for peer-reviewed

publications. Peer-reviewed publications were recognized as publications in peer-reviewed journals. Peer-reviewed journals were identified in several ways. When possible, only peer-reviewed journals were searched within a database. Unfortunately, this was only available on a limited basis. Journals not recognized by the author as peer-reviewed were evaluated by comparison to the American Academy of Optometry's (AAO) list of acceptable peer-reviewed journals for maintenance of AAO fellowship,[16] researched on the journal's website, or the journal's editor was contacted. The following types of publications were excluded: books, editorials, meeting abstracts, letters to the editor, book chapters, articles in non-peer-reviewed journals and teaching manuals. Publications from clinical studies where authorship for the publication was listed as a study or writing group were also excluded. The list of articles from all the databases and Google Scholar were manually reviewed to determine a unique database of peer-reviewed publications for each of the respondents.

The list of publications was then categorized into rank of authorship and chronologically categorized according to the information provided by each respondent for dates of promotion/tenure. The categories were "before rank of assistant," "assistant to associate," "associate to full," "assistant to tenure" and "post full." Post full indicates achievement of the rank of full professor until the end of the data gathering, December 2013. To allow for consistency, all ranges of years for a specific rank were broken up in the same manner. For example, if a professor became assistant professor in 1998 and became an associate in 2004, the range for assistant was documented as 1998-2003, and then the range of associate began with 2004.

The data provided by some respondents (randomly chosen) were spot-checked for accuracy in identification of peer-reviewed articles, categorization and the counting of the articles. This entailed the primary investigator rechecking databases to identify peer-reviewed articles and recounting numbers of articles in each time frame (assistant to associate, etc.) and category (first author, second author). A 100% accuracy rate was found for the identification of peer-reviewed articles and categorization. A 90% accuracy rate was achieved in the counting of articles. An estimate of the inaccuracies in counting was +/-2 articles.

Three faculty members who represented unique specialty areas (vision science research, public health/low vision and optometric education) were used as test cases to refine the search process and determine the accuracy of the process. Their submitted lists of publications were evaluated against the lists generated by the search process. In each case, 100% of the publications were accurately retrieved using the search strategy.

Descriptive statistics and non-parametric Wilcoxon rank sum test were used to analyze the data. The alpha level for Wilcoxon analyses was equal to 0.05.

This study was reviewed by the Institutional Review Board at the New England College of Optometry and was given an exempt status.

Results

One hundred and ninety-eight surveys were distributed to faculty members who met the study criteria. Seventy-four completed surveys were returned. Of the 74 responses, two were eliminated from the analysis because the respondents obtained promotion from institutions outside the field of optometry. The response rate for usable data was 36%. Respondents' entries into academia were as follows: 35% (25/72) entered from 1966-1981; 39% (28/72) from 1982-1992; and 26% (19/72) from 1993-2003.

The data were analyzed utilizing several different categories, degree obtained, gender and tenure status. Degrees obtained were identified as Doctor of Optometry (OD) only, OD plus any Master's-level degree (OD/Master's), OD plus any other Doctorate-level degree (OD/Other Doctorate), and Doctor of Philosophy (PhD) only.

Table 1 and **Table 2** indicate the total and first-authored publications over a faculty member's entire career up to December 2013. This includes publications before entry into academia. Data analysis showed that total publications independent of degree ranged from 1-320 publications. When broken into degree earned, faculty in the PhD group demonstrated the highest median with 69 total publications. For first-authored publications, faculty with a PhD published a median of 16 publications, and those with an OD/Other Doctorate had a median number of 20 publications.

Table 1
Total Articles Over Entire Career

	N	Min	Max	Median	Mean (SD)
OD	20	1	92	17	24.35 (24.07)
OD/Master's	19	4	82	24	31.79 (24.55)
OD/Other Dr.	22	7	320	32	72.59 (80.27)
PhD	11	9	85	69	53.82 (28.95)

Table 2
First-Authored Articles Over Entire Career

	N	Min	Max	Median	Mean (SD)
OD	20	0	57	7	13.45 (14.81)
OD/Master's	19	0	65	15	18.37 (18.77)
OD/Other Dr.	22	2	106	20	31.41 (29.97)
PhD	11	1	43	16	17.91 (13.22)

Table 3 indicates the total number of articles published before level of assistant, between assistant and associate, between associate and full, before achievement of tenure (assistant professor to tenure), and post full professor until December 2013. **Table 4** represents the same categories for first-authorship articles. Before the level of assistant professor **(Table 3a)** the OD and OD/Master's groups had similar numbers of total publications with a median of 0. The OD/Other Doctorate and PhD groups had more publications at that point, with medians of 3 and 9.5 respectively.

In advancing from assistant to associate **(Table 3b)**, the median numbers of publications associated with advancement were 2.5 for the OD group, 1.5 for the OD/Master's group, 6 for the OD/Other Doctorate group, and 5 for the PhD group. For additional publications in advancing from associate to full **(Table 3c)**, the OD group had a median of 4.5, the OD/Master's group a median of 7, the OD/Other Doctorate group a median of 8.5, and the PhD group a median of 8.

In the group that achieved tenure, (assistant to tenure, **Table 3d**), the median numbers of publications were 5 for the OD group, 3 for the OD/Master's group, 7 for the OD/Other Doctorate group, and 10 for the PhD group. **Table 5** represents comparisons between genders in total articles, first-authored articles and years to reach academic rank. The Wilcoxon analysis did not reveal a statistically significant gender difference for total articles to achieve the level of full professor, Wilcoxon rank sum (p = 1.0), or first-authored articles, Wilcoxon rank sum (p = 0.94). Additionally, the Wilcoxon analysis did not reveal a statistically significant dif-

Table 3
Total Articles Published

Total articles published before level of assistant (3a), between promotions, assistant to associate (3b), associate to full (3c), achievement of tenure (assistant professor to tenure) (3d) and post full professor (3e)							
3a Before Level of Assistant Professor including Before Entry as an Optometric Educator							
	N	**Min**	**Max**	**1st Quartile**	**Median**	**3rd Quartile**	**Mean (SD)**
OD	20	0	6	0	0	1	0.95 (1.54)
OD/Master's	19	0	10	0	0	1	1 (2.36)
OD/Other Dr.	22	0	29	0	3	6.25	4.32 (6.30)
PhD	11	0	33	0.75	9.5	20.5	11.7 (11.78)
3b Assistant to Associate Professor							
	N	Min	Max	1st Quartile	Median	3rd Quartile	Mean (SD)
OD	18	0	11	0.75	2.5	5.25	3 (3.03)
OD/Master's	18	0	8	0	1.5	3.25	2.44 (2.71)
OD/Other Dr.	21	0	24	2	6	11	7.52 (6.77)
PhD	6	0	16	2.25	5	13	6.83 (6.01)
3c Associate to Full Professor							
	N	Min	Max	1st Quartile	Median	3rd Quartile	Mean (SD)
OD	20	0	28	1	4.5	15.25	8.05 (8.39)
OD/Master's	19	0	35	3	7	11	9.21 (9.31)
OD/Other Dr.	22	0	42	4	8.5	15.5	10.77 (9.37)
PhD	8	4	13	4.25	8	12	8.25 (3.73)
3d Achievement of Tenure (Assistant Professor to Tenure)							
	N	Min	Max	1st Quartile	Median	3rd Quartile	Mean (SD)
OD	11	0	13	3	5	7	5.45 (3.91)
OD/Master's	16	0	25	1	3	5	4.94 (6.18)
OD/Other Dr.	17	0	45	4.5	7	15	10.88 (10.66)
PhD	7	2	21	6	10	12	10.14 (5.96)
3e Post Full Professor Status							
	N	Min	Max	1st Quartile	Median	3rd Quartile	Mean (SD)
OD	20	0	63	0.25	2	14	9.65 (15.67)
OD/Master's	19	0	73	2	9	26	15.11 (19.35)
OD/Other Dr.	22	0	200	2.75	11.5	66.25	41.91 (59.29)
PhD	11	5	67	11	21	35	27 (20.75)

Table 4
First-Authored Articles Published

First-authored articles published before level of assistant, (4a), between promotions, assistant to associate (4b), associate to full (4c), achievement of tenure (assistant professor to tenure) (4d) and post full professor (4e)							
4a Before Level of Assistant Professor including Before Entry as an Optometric Educator (first author)							
	N	**Min**	**Max**	**1st Quartile**	**Median**	**3rd Quartile**	**Mean (SD)**
OD	20	0	5	0	0	0	0.55 (1.32)
OD/Master's	19	0	6	0	0	0	0.53 (1.42)
OD/Other Dr.	22	0	13	0	1	4.25	2.5 (3.35)
PhD	10	0	28	0.75	4.5	7.75	6.5 (8.89)
4b Assistant to Associate Professor							
	N	Min	Max	1st Quartile	Median	3rd Quartile	Mean (SD)
OD	18	0	6	0	1	3	1.67 (1.75)
OD/Master's	18	0	8	0	1	3	1.94 (2.48)
OD/Other Dr.	21	0	19	1	3	7	4.76 (5.01)
PhD	6	0	5	1.5	2.5	4.25	2.67 (1.75)
4c Associate to Full Professor							
	N	Min	Max	1st Quartile	Median	3rd Quartile	Mean (SD)
OD	20	0	23	1	2.5	10.25	5.55 (6.5)
OD/Master's	19	0	27	1	3	8	6.42 (8.11)
OD/Other Dr.	22	0	14	2	3	9	5.05 (4.09)
PhD	8	0	9	1.25	3	7.25	3.88 (3.27)
4d Achievement of Tenure (Assistant to Tenure)							
	N	Min	Max	1st Quartile	Median	3rd Quartile	Mean (SD)
OD	11	0	11	2	2	5	3.36 (3.04)
OD/Master's	16	0	21	1	3	4	3.88 (5.12)
OD/Other Dr.	17	0	21	3	5	10	6.65 (6.00)
PhD	7	0	9	1	4	6	4 (3.06)
4e Post Full Professor							
	N	Min	Max	1st Quartile	Median	3rd Quartile	Mean (SD)
OD	20	0	25	0	1	3	4 (7.44)
OD/Master's	19	0	36	0	3	9	6.32 (9.32)
OD/Other Dr.	22	0	73	1.75	4.5	16	14.18 (21.38)
PhD	11	0	18	2	4	7	5.18 (4.90)

Table 5
Gender Comparison

Gender Comparison (Total Articles, Achievement of Full Professor) Wilcoxon rank sum (p = 1.0)					
	N	**Min**	**Max**	**Median**	**Mean (SD)**
Male	52	0	66	9.5	13.56 (13.30)
Female	20	0	25	11	11.55 (7.83)
Gender Comparison (First-Authored Articles, Achievement of Full Professor) Wilcoxon rank sum (p = 0.94)					
	N	Min	Max	Median	Mean (SD)
Male	52	0	33	4.5	8.08 (8.45)
Female	20	0	20	5.5	6.80 (5.94)
Gender Comparison of Years from Assistant to Associate Wilcoxon rank sum (p = 0.38)					
	N	Min	Max	Median	Mean (SD)
Male	47	1	13	4	4.49 (2.30)
Female	16	2	8	4	4.88 (1.96)
Gender Comparison of Years from Associate to Full Professor Wilcoxon rank sum (p = 0.49)					
	N	Min	Max	Median	Mean (SD)
Male	51	2	19	6	7.37 (4.05)
Female	18	2	14	7	7.33 (2.68)

Table 6
Tenure Comparison

Total Articles to Achieve Full (Assistant to Full) Wilcoxon rank sum (p = 0.02) significant					
	N	**Min**	**Max**	**Median**	**Mean (SD)**
Not Tenured	21	0	35	7	8.61 (9.38)
Tenured	51	0	66	12	14.80 (12.58)
First-Authored Articles to Achieve Full (Assistant to Full) Wilcoxon rank sum (p = 0.01) significant					
	N	Min	Max	Median	Mean (SD)
Not Tenured	21	0	29	2	5.24 (7.10)
Tenured	51	0	33	6	8.75 (7.93)
Publication Rate to Achieve Full (Assistant to Full) Wilcoxon rank sum (p = 0.01) significant					
	N	Min	Max	Median	Mean (SD)
Not Tenured	21	0	6.25	0.54	1.00 (1.56)
Tenured	51	0	7.33	1.00	1.60 (1.54)
Years to Achieve Level of Full Professor (Assistant to Full) Wilcoxon rank sum (p = 0.76)					
	N	Min	Max	Median	Mean (SD)
Not Tenured	21	0	20	11	10.10 (5.52)
Tenured	51	2	27	10	11.47 (5.25)
Years (Assistant to Associate) Wilcoxon rank sum (p = 0.19)					
	N	Min	Max	Median	Mean (SD)
Not Tenured	16	2	13	5	5.19 (2.64)
Tenured	47	1	11	4	4.38 (2.04)
Years (Associate to Full) Wilcoxon rank sum (p = 0.62)					
	N	Min	Max	Median	Mean (SD)
Not Tenured	18	2	12	7	7.17 (2.36)
Tenured	51	2	19	6	7.43 (4.12)

ference between the male and female gender for number of years to achieve the level of assistant to associate, Wilcoxon rank sum (p = 0.38), or associate to full, Wilcoxon rank sum (p = 0.49).

The comparison between tenured and non-tenured faculty **(Table 6)** revealed the tenured group consistently had more publications than the non-tenured group with statistical significance being obtained in total articles to achieve the level of full professor (assistant to full), Wilcoxon rank sum (p = 0.02), first-authored articles to achieve full, Wilcoxon rank sum (p = 0.01), and publication rate (articles per year) to achieve the level of full professor, Wilcoxon rank sum (p = 0.01). The number of years to achieve academic rank was similar between tenured and non-tenured faculty.

Table 7 compares publication rates at the level of achieving full professor (from level of assistant to full) and post full. The median publication rate per year decreased post full for all groups except the PhD group. The Wilcoxon signed-rank test did not show a statistically significant difference between faculty achieving full and faculty after achieving the level of full professor, with p = 0.33.

The number of years to achieve academic rank shown by degrees **(Table 8)** indicated a consistent median and mean from assistant to associate level and a range of 5-8 years from associate to full. The median total years to achieve the level of full professor (assistant to full) ranged from 6 years in the PhD group to 12 years in the OD group.

Discussion

Scholarly productivity is an integral component of the promotion and tenure process at most optometric institutions. Scholarship includes the creation, discovery advancement or transformation of knowledge.[2] This definition of scholarship takes into account Ernest Boyer's broad concept of scholarship, which includes the scholarship of discovery (research), the scholarship of integration, the scholarship of application and the scholarship of teaching.[2] The process of peer review helps to insure quality of the publication. Dissemination allows scholarly information the opportunity to impact the profession.

The data indicated that in the early career years before obtaining the level of assistant professor, the group of faculty with a PhD degree had more experience in publication. This group, along with the OD/Other Doctorate group, continued to demonstrate consistently higher numbers of publications as their careers advanced. The Doctor of Philosophy degree implies specific coursework within a discipline and original research leading to a thesis. Therefore, it is expected that this group enters with a specific skill set in research/publication. Additionally, faculty members in this group do not have clinical responsibilities and may have more time allotted to research over the course of their careers.

Table 7
Publication Rate Comparison (publication rate per year)
Wilcoxon signed-rank, p = 0.33

Assistant to Full					
	N	Min	Max	Median	Mean (SD)
OD	20	0	4.375	0.74	1.03 (1.05)
OD/Master's	19	0.083	2.15	0.71	0.85 (0.67)
OD/Doctorate	22	0.111	7.33	0.94	2.19 (2.13)
Doctorate	11	0	4	1.33	1.58 (1.63)
Post Full					
	N	Min	Max	Median	Mean (SD)
OD	20	0	3.32	0.4	0.68 (0.91)
OD/Master's	19	0	4.29	0.5	1.00 (1.15)
OD/Doctorate	22	0	6.90	0.84	1.96 (2.13)
Doctorate	11	0.33	5	2.33	2.34 (1.44)

Table 8
Years to Achieve Academic Rank

Total Years to achieve Full (Assistant to Full)					
	N	Min	Max	Median	Mean (SD)
OD	20	2	20	12	12.25 (4.33)
OD/Master's	19	8	21	11	13.11 (4.34)
OD/Doctorate	22	4	27	9	10.41 (5.29)
Doctorate	11	0	18	6	6.73 (6.390
Years from Assistant to Associate					
	N	Min	Max	Median	Mean (SD)
OD	18	1	13	4	4.94 (2.90)
OD/Master's	18	2	9	4.5	4.78 (2.05)
OD/Doctorate	21	2	11	4	4.29 (1.98)
Doctorate	6	3	5	4	4.00 (0.89)
Years from Associate to Full					
	N	Min	Max	Median	Mean (SD)
OD	20	2	19	7	7.80 (3.41)
OD/Master's	19	4	14	8	8.58 (3.56)
OD/Doctorate	22	2	16	5	6.32 (3.80)
Doctorate	8	2	13	6	6.25 (4.23)

The group of OD/Other Doctorate in most categories had similar numbers of publications to the PhD group. Publication levels in the OD/Other Doctorate group occurred despite Doctorate degrees that may not be research-driven and clinical responsibilities throughout a career.

In contrast, faculty members with OD or OD/Master's degrees in the years before the level of assistant professor had very few or no publications in peer-reviewed journals. This indicates the need for immediate faculty development and support to address the limited experience and skills within this group. To help insure success within the academic environment, continual faculty development, mentorship/collaboration, a supportive infrastructure and strategic planning are important support services to provide.[2] Faculty development can give all faculty new or additional skills and knowledge in the areas of research design, implementation, professional writing and funding.

It is interesting that in many categories the OD and OD/Master's groups had similar numbers of publications. In total publications, from assistant to tenure the OD/Master's group had fewer publications with a median of 3 than the OD group with a median of 5 and only slightly more for first authorship. This trend may indicate a diversity of requirements for the Master's-level degree that may not necessarily include research and publication. It could also indicate that those with the OD/Master's degrees undertook more basic science research, which yielded more long-term publications.

The results indicated that some faculty were promoted with no peer-reviewed publications. This may be attributed to differences in expectations at different institutions, significant publications in areas not researched in this project, e.g., in books or non-peer-reviewed journals, or peer-reviewed publications in databases not researched. In conducting

research for this project, it was noted that many faculty had significant publication in non-peer-reviewed journals or were part of a clinical trial that did not specifically list the authors for the publication, e.g., the authors were listed as the Pediatric Eye Investigator Group (PEDIG) writing group.

Intervals between advancement are independently determined by individual institutions. The median length of time to advance from assistant to associate level was consistent between degrees. However, the median time did vary slightly when advancing from associate to full with a range of 5-8 years. The need for strategic planning exists at all levels of advancement because time intervals between promotion steps and tenure are structured and in some cases not flexible.

Strategic planning should take into account types of project, time frame, where to publish and target audience. A combination of short- and long-term projects may be beneficial for demonstrating continual productivity. The scholarship of discovery, which usually represents research, focuses on discovery, creation and advancement of knowledge. This type of scholarship is important to move a profession forward and in career advancement. However, research projects are often more long-term projects. Projects that can be completed in a shorter time also need to be utilized. Case reports, teaching case reports, review articles, etc., which represent the scholarship of application and integration, address important topics and questions such as "what does it all mean?" and "how can it improve patient care, quality of life or teaching?"[2] These projects can usually be completed in a shorter time frame than some research projects. Projects involving the scholarship of teaching usually reflect creative delivery of material, assessment of outcomes, or novel innovation within teaching. These projects can be either short- or long-term.

Studies have demonstrated that faculty are more likely to publish if they are involved in a collaborative effort.[17] Collaborative efforts can involve peers, consultants or mentors. Mentors are usually in a more advanced stage of their careers with skills and experience in a particular area. Successful faculty members should be expected to serve as mentors to more junior faculty. Mentors have the opportunity to offer networking opportunities, provide advice, offer research opportunities, offer practical suggestions for career development and provide insight into the academic environment.

Guidelines are in place for establishing authorship of a manuscript when the project is collaborative. Authorship implies a fundamental role in the creation of the product, which may include contributions to "conceptualization and design, data collection, data analysis, and creation of the product."[18] In publications with multiple authors, each author should clearly identify his or contribution and role in the product. The guidelines for determination of rank of authorship are vague and left to individual disciplines or professional organizations. In most organizations, first authorship is related to the magnitude of contributions to the final product and is perceived as the most prestigious.[18] First authorship for publications can be a means of demonstrating leadership and should be part of a strategic plan for promotion and tenure.

When determining where to publish, faculty should take into consideration the type of journal (general vs. specialty), likelihood of manuscript acceptance, turnaround time, type of review process (peer, editor, none), indexing and impact factor. In the profession of optometry, when considering where to publish, faculty value the peer-review process and target readership in their area of focus.[19] Indexing, impact factor, turnaround time and overall size of readership are reported to be less important factors.[19] At all times, institutional expectations for faculty must be communicated in a concrete, specific and clear manner.[2] Expectations for publication and promotion must be transparent and clearly set by the institution or faculty review boards.[2]

There does not appear to be any large differences in number of publications or time interval between ranks between male and female faculty. The findings suggested in regard to peer-reviewed publications that institutions follow the same criteria independent of gender. This would contribute to a fair and equitable promotion process. Years to achieve promotion also remained consistent between genders, which may reflect a structured time frame set by the institution. Faculty composition with regard to gender has been changing. ASCO reports that over the past 10 years there has been a 50.9% increase in 1.0 full time equivalent (FTE) female faculty (from 232 to 350) and a 2.6% decrease in 1.0 FTE male faculty (from 351 to 342), while the increase in 1.0 FTE faculty of both genders was 18.9% during that same period.[20,21]

Publication rates for tenured faculty were higher than for non-tenured faculty, which was statistically significant. Eighty-one percent of the optometry institutions in the continental United States and Puerto Rico offer tenure track positions.[20] The achievement of tenure usually represents additional accomplishments and the institution's investment in the future of a faculty member.

After achieving the level of full professor, most faculty were still productive but at a lesser rate. The exception was the group who held a PhD. The decrease in publication rates may reflect projects that are more complex with a longer time frame or it may reflect a shift in senior faculty members' responsibilities. Senior faculty may direct time away from research and publication and into other areas such as mentorship or administration.

The limitations of this study included response rate and human error. The response rate could indicate a bias; only faculty with higher numbers of publications may have chosen to participate. Therefore, the results may not be representative of all successful faculty. Additionally, the relatively small size of this study limited the power of the study. Every precaution was taken to ensure accurate counting and searching for publications; however, despite these efforts it is possible that publications were overlooked or miscounted.

Conclusion

Faculty have many responsibilities in the areas of service, scholarship, teaching and clinic. They are evaluated for promotion based on individual institutions' criteria applied to these categories. A successful portfolio for promotion should be diverse with demonstration

of impact and leadership qualities in all areas. The concept of scholarship is broad. Peer-reviewed publications are one contributing component in this area. This study was designed to provide data from successful faculty members on scholarly productivity as it relates to promotion and tenure. Median, mean and quartile information related to number of publications was reported as a guide for faculty.

To further help faculty achieve their goals, more research is needed. Research into productivity in the areas of service, teaching and clinical practice would be beneficial. Additionally, investigating scholarly productivity from a broader perspective that would include non-peer-reviewed publications and authorship of books and other scholarly material would be useful. This project did not evaluate impact or quality of publications but used successful acceptance into a peer-reviewed journal as a benchmark.

Faculty development, mentorship/collaboration, clear expectations, strategic planning and supportive infrastructure are key elements in supporting junior faculty and all faculty members who wish to advance in academic rank and achieve tenure. Quantity of peer-reviewed journal publications is one important piece of the overall portfolio. Evaluating productivity in successful faculty may provide a useful guide for setting expectations for current and future faculty.

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