RESEARCH

Scholarly Activity of Tenure-Track Faculty in US Departments of Pharmacy Practice

Ross C. Urry, PharmD,a Emi Radetich,a Casey Tak, PhD,a Mark A. Munger, PharmDab

a University of Utah, Department of Pharmacotherapy, Salt Lake City, Utah
b University of Utah, Department of Internal Medicine, Salt Lake City, Utah

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Objective. To quantitatively determine scholarly activity among tenure-track faculty at US departments of pharmacy practice over a 10-year period.

Methods. A search of PubMed was performed for articles by department of pharmacy practice tenure track (DPP-TT) faculty from January 1, 2010, through December 31, 2019. DPP-TT faculty working in departments of pharmacy practice were identified through faculty rosters published on the American Association Colleges of Pharmacy website or college or school internet sites. Tenure-track faculty listed as working in a department of pharmacy practice, clinical pharmacy, or pharmacotherapy were included. An objective third party confirmed the data obtained. Each publication was classified by scope (eg, clinical pharmacology, health economics/outcome research, biomedical informatics, basic science, review, editorial/letter, or case report). DPP-TT faculty productivity was calculated by dataset frequency distribution. Descriptive statistics and analysis of variance were used to compare data across demographic strata.

Results. One hundred thirty-seven institutions employed 2147 pharmacy practice faculty. These faculty published 20,059 (9.3 ± 6.16.3/10 years/faculty member) papers. Six institutions had no tenure-track designation. There was a 2.5-fold increase in publication rates from 2010-2019 (P < .0001). Public vs private schools’ productivity was 207.8 vs 69.0 publications per institution, respectively (P < .001). The ratio of male to female DPP-TT faculty per institution was 62% to 38%, with male faculty publishing an average of 12.1 ± 19.1 each, and female faculty publishing an average of 7.4 ± 13.8 each (P < .0001). Faculty ranks were 37% assistant professor; 36% associate professor; and 26% professor, with an average of 4.0 ± 7.3, 8.6 ± 12.4, and 17.4 ± 24.6 publications per faculty, respectively. Regionally, US pharmacy practice faculty located in the West produced the most publications, followed by those in the Northeast, South, and Midwest (P < .0001).

Conclusions. These national DPP-TT publication data demonstrate that scholarly productivity increased from 2010 through 2019, across a wide variety of publication scopes.

Keywords: clinical research, outcomes research, outcomes analysis, pharmacometrics, pharmacy practice, tenure

INTRODUCTION

Academic disciplines are defined by a particular object of research and accumulate information in that area which is then generally disseminated within other scholarly disciplines. Accumulated knowledge within an academic discipline is taught in post-secondary educational settings where theories and concepts develop into specialist knowledge. Tenure-track pharmacy faculty in academic disciplines are tasked with making significant contributions to their field to qualify for promotion and advance in rank. Among other duties, scholarly activity, often in the form of conducting research and writing manuscripts for submission to peer-reviewed journals, is an important measure of productivity.

Previous studies have used number of scholarly publications to quantify the academic productivity and research impact within an academic discipline. The ability of pharmacy practice tenure-track (DPP-TT) faculty to actively promote pharmacy practice through published research is vital to the continued existence and future evolution of the field as an academic discipline. Evaluation of scholarly activity of DPP-TT faculty in US schools and colleges of pharmacy is important in...
evaluating and advancing the discipline of pharmacy practice. Scholarly productivity can provide a metric for individual departments of pharmacy practice to use to compare the productivity of their program and faculty members with that of other pharmacy practice departments across the country. Publication data is also used as a metric during the pharmacy accreditation and reaccreditation process to assess faculty productivity. Finally, a pharmacy practice department’s publication metrics can be used to recruit prospective pharmacy students as well as graduate students, residents, and fellows.

Previous research evaluated the publication record of academic pharmacists and pharmacy practice chairs but no other studies on this topic have been published since 2012. To fill this gap, this research study was designed to quantitatively determine the extent to which DPP-TT faculty contribute to the academic discipline of pharmacy practice by searching biomedical retrieval services for publication of scholarly papers.

**METHODS**

This study was deemed exempt by University of Utah Institutional Review Board. A comprehensive literature search for published scholarly papers authored by DPP-TT faculty at US Colleges of Pharmacy as listed on the AACP website was performed. Each DPP tenure-track faculty roster published on the AACP College or School of Pharmacy website was used to identify the faculty members to include in the study. Department of pharmacy practice tenure-track faculty were listed as assistant professor, associate professor, or professor. We confirmed with each institution whether a tenure-track system was in place. Thereafter, each DPP tenure-track faculty member’s name, as recorded by the college or school website, was used as the primary search strategy in PubMed.gov to identify the aggregate number of scholarly publications that faculty member had published from January 1, 2010, through December 31, 2019. Each manuscript was verified for the exact author name as a DPP-TT member at the institution by name, or college or school. If the author’s name could not be confirmed, the publication was omitted from the final dataset. An additional researcher confirmed all scholarly publications and sociodemographic information obtained. A quality-control check that included 50% of the faculty in the study and at least one faculty member from each college or school represented was performed by a third researcher. If a publication was authored by more than one faculty member at the same institution or by another DPP-TT faculty at another institution, the publication was counted once for each DPP-TT faculty to avoid faculty member bias.

DPP-TT faculty demographic information, including gender, degree(s), and faculty rank were collected. If demographic information for a faculty member could not be obtained and confirmed, the data was omitted from the analyzed dataset. AACP college or school of pharmacy data included private versus public institution status as well as location.

Publications were classified by scope based on reviewing publication type across DPP-TT publications. The following classification system was subsequently employed: clinical pharmacology, which is the basic science of pharmacology with a focus on the application of pharmacological principles and methods, including the study of biomarkers, pharmacokinetics, drug metabolism, and genetics; health economics and outcome research, evidence of the value of new therapeutic interventions for reimbursement agencies and local healthcare payers; biomedical informatics, the practical uses of biomedical data, information, and knowledge for scientific inquiry, problem-solving, and decision making, driven by efforts to improve human health; biomedical informatics (qualitative research), a collection of information and published data using qualitative interviewing techniques, either through individual or formal group interviews; basic science, research involving the use of a clinical laboratory; review manuscripts, a collection of information and clinical review of published data on a medical or pharmaceutical topic; editorials and letters to the editor, which are opinions written on a topical issue; case reports, which are detailed reports of an individual patient’s signs, symptoms, diagnosis, treatment, and follow-up care; and scholarship of teaching of learning, which involves faculty undertaking systematic inquiry about student learning.

The scope classification of each publication included was confirmed using PubMed MeSH terms and the professional judgment of the researchers.

Study results were recorded in Microsoft Excel. Results were recorded by author’s institution type, author, author gender, author faculty rank, publication year, and scope of publication. The results were then separated into three separate pages depicted by institution, author, and state to allow cross-checking of numerical outcomes. All data were considered accurate when the totals for each category were in agreement across all Excel spreadsheet pages.

Descriptive statistics were used to characterize the sample, including frequency, percentages, means, and standard deviations. Several comparisons were used across the total sample, including number of faculty by private vs public institution and by gender, and number of assistant, associate, and full professors (professor rank) by private vs public institution and by gender. Comparisons of number of manuscripts published were conducted based...
on private vs public institutions, gender, rank, region, and year of publication. The AACP College/School of Pharmacy DPP-TT faculty productivity rating was based on number of publications produced over the 10-year study period in association with the frequency distribution of the dataset (none: 0; low: 1-10; moderate: 11-20 and high: >20). Student t tests and Mann-Whitney U tests; ANOVA and Kruskal-Wallis tests; and the Jockheere-Terpstra test for trend (based only on year of publication) were applied, respectively. Data were analyzed in SAS statistical software, version 9.4 (SAS Institute, Inc).

RESULTS

A total of 137 US colleges and schools of pharmacy employing 2147 faculty were included in the database. Six schools did not award tenure (4.1%) (Table 1). There were near-equal numbers of public and private schools, with totals of 68 and 69, respectively. The percent of schools in the Northeast region of the United States was 17.5%, in the Southeast was 39.2%, in the Midwest was 22.4%, and in the West was 21%.

Faculty demographics are in Table 1. The number of faculty employed by public colleges and schools was higher than the number employed by private institutions. More female faculty were employed in DPP-TT positions at both public and private institutions, with a ratio of women to men of 60:40 (P < .0001). Faculty ranks were 37% assistant professor, 36% associate professor, and 26% professor. More men than women were employed at the professor rank at public colleges or schools. There was an unequal gender distribution of authors across academic ranks, with more female authors at the assistant or associate professor rank and more male authors at the professor rank (P < .0001).

A total of 20,059 articles were identified as having been published during the 10-year study period. There was a 2.5-fold increase in the publication rate among DPP-TT faculty from 2010-2019 (P < .001) (Figure 1). DPP-TT faculty at public colleges and schools published more than those at private, 207.8 versus 69.0 publications/institution (P < .001) (Table 2). The average number of publications was higher for men than for women (P < .001). Professors published the most often followed by associate professors and assistant professors. Regionally, DPP-TT faculty at colleges and schools in the West produced the most publications per faculty member, followed by those at colleges and schools in the Northeast, South, and Midwest, respectively (P < .001) (Figure 3).

The types of manuscripts published by DPP-TT faculty also varied (Figure 2). The highest percentage of publications were reviews (34%), followed by biomedical informatics (25%), clinical pharmacology (10%), and studies of teaching and learning (10%). The remaining publications were basic science papers, health economics and outcomes research papers, case reports, and biomediccal informatics-qualitative papers.

Faculty productivity was divided into four groups based on number of publications produced over the 10-year study period in association with frequency distribution in the dataset (none: 0; moderate: 1-10; good: 11-20 and excellent: ≥21) (Table 3). The largest number of faculty were in the low productivity group at 56%, followed by 20% in the no productivity group, 12% in the moderate

Table 1. Demographics of Tenure-Track Faculty Included in a Study of Scholarly Activity Within Departments of Pharmacy Practice at US Colleges and Schools

<table>
<thead>
<tr>
<th>Variable</th>
<th>Total</th>
<th>Private college or school</th>
<th>Public college or school</th>
<th>P value (private vs public)</th>
<th>P value (non-parametric)</th>
</tr>
</thead>
<tbody>
<tr>
<td>AACP colleges and schools of Pharmacy, No. (%)c</td>
<td>137 (100)</td>
<td>69 (50.4)</td>
<td>68 (49.6)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Faculty, No.</td>
<td>2147</td>
<td>857</td>
<td>1290</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Faculty per college or school, Mean (SD)</td>
<td>15.7 (11.9)</td>
<td>13.9 (9.0)</td>
<td>16.2 (14.7)</td>
<td>.26</td>
<td>.69</td>
</tr>
<tr>
<td>Men per College or school, Mean (SD)</td>
<td>6.3 (5.0)</td>
<td>5.2 (3.6)</td>
<td>6.8 (6.1)</td>
<td>.055</td>
<td>.12</td>
</tr>
<tr>
<td>Women per college or school, Mean (SD)</td>
<td>9.7 (7.8)</td>
<td>8.7 (6.1)</td>
<td>9.3 (9.4)</td>
<td>.61</td>
<td>.79</td>
</tr>
<tr>
<td>Academic rank, Mean (SD)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Professor</td>
<td>4.1 (3.7)</td>
<td>2.8 (3.3)</td>
<td>5.2 (3.7)</td>
<td>.0001</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Associate professor</td>
<td>5.7 (4.7)</td>
<td>5.5 (4.8)</td>
<td>5.5 (4.8)</td>
<td>.98</td>
<td>.84</td>
</tr>
<tr>
<td>Assistant professor</td>
<td>5.9 (7.2)</td>
<td>5.7 (4.5)</td>
<td>5.6 (9.2)</td>
<td>.93</td>
<td>.10</td>
</tr>
</tbody>
</table>

* Private vs public t-test; bMann-Whitney U; c No Chi-square P value was calculated for the ACCP colleges and schools of pharmacy number or faculty number since there is no comparator (ie, frequencies).
group, and 12% in the high group. Professors had published the highest number of papers, while associate professors were most commonly in the moderate and low paper groups ($P < .0001$). Assistant Professors were the largest faculty group producing no publications ($P < .0001$).

**DISCUSSION**

This study was designed to determine the scholarly contributions of DPP-TT faculty by searching biomedical retrieval services for publication data. This study is unique compared to previous publications because of the 10-year analysis period, categorizations of publication scope, and use of frequency distribution to determine productivity rank.4 Publications by DPP-TT faculty increased over the 10-year time period examined in the study, with a wide scope of publication types. The findings are similar to those of previously published research in this area.5-10,15,19 Research in productivity across disciplines has shown relatively consistent results. Publication rates have been robust but skewed to small numbers of faculty that are highly productive independent of academic discipline.5-10 In 2001-2003, Coleman and colleagues used AACP Colleges of Pharmacy faculty rosters to identify publication citations for all pharmacy faculty members.15 Of all publications identified in the study, 2374 (30.6%) were generated by approximately 2% of the faculty. There were relatively small numbers of faculty who published $\geq 2$ publications during this time. Our study found that, a decade later, productivity of DPP-TT faculty has substantially improved at the upper index, with an approximately five-fold higher rate of faculty producing $\geq 2$ publications. However, there remains a large group of faculty whose productivity was similar to that of faculty included in the earlier 2000 study.5 This pattern is similar in academic pharmacy5 and academic emergency medicine,9 but with higher productivity seen in pharmacy practice chairs7 and in higher professor ranks.8-10 Studies have shown that, among low-rank faculty, approximately 50% are not publishing.5,8-10

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**Table 2. Tenure-Track Faculty Included in a Study of Scholarly Activity Within Departments of Pharmacy Practice at US Colleges and Schools of Pharmacy**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean (SD)</th>
<th>Max</th>
<th>Sum</th>
<th>$P$ value</th>
<th>$P$ value (non-Parametric)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type of Institutiona</td>
<td>69.0 (71.7)</td>
<td>354</td>
<td>5065</td>
<td>&lt;.0001</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Private</td>
<td>207.8 (208.6)</td>
<td>926</td>
<td>14994</td>
<td>&lt;.0001</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Public</td>
<td>12.1 (19.1)</td>
<td>165</td>
<td>10490</td>
<td>&lt;.0001</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Genderb</td>
<td>7.4 (13.8)</td>
<td>147</td>
<td>9650</td>
<td>&lt;.0001</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Academic Rankb</td>
<td>17.4 (24.6)</td>
<td>165</td>
<td>10056</td>
<td>&lt;.0001</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Professor</td>
<td>8.6 (12.4)</td>
<td>122</td>
<td>6784</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Associate Professor</td>
<td>4.0 (7.3)</td>
<td>101</td>
<td>3219</td>
<td>&lt;.0001</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>Assistant Professor</td>
<td></td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

**Figure 1. Jockheere-Terpstra analysis performed to determine the number of publications by US department of pharmacy practice tenure-track faculty, 2010-2019.**
This study found a significant difference in average number of publications between public and private colleges and schools of pharmacy. This difference can likely be attributed to the number of resources available to faculty at public schools through grants and association with academic medical centers. Additionally, there also may be an increased emphasis on scholarly activity within public colleges and schools of pharmacy as compared to private colleges and schools of pharmacy. This difference is intriguing as scholarly productivity is included in the Accreditation Council of Pharmacy Education (ACPE) “Standards 2016.” Standard 19.2 states, “The college or school creates an environment that both requires and promotes scholarship and also develops mechanisms to assess both the quantity and quality of faculty scholarly productivity.”

A significant increase in average publications among faculty at various tenure-track ranks corresponded positively with an increase in faculty rank. This result is not surprising as it is logical for scholarly activity to increase as faculty members ascend the tenure-track ranks. Interestingly, the average number of publications doubled across each academic rank classification. This can be attributed to an increase in overall professional experience and time within a specific field of interest.

A recent systematic review and meta-analysis examined gender differences in productivity across academic ranks and specialties in academic medicine. Women had lower h-indexes (ie, metric for evaluating the cumulative impact of an author’s scholarly output and performance) than men across most medical specialties. Reasons for this gender difference may be lower start-up funding and subsequent additional funding awarded to female faculty compared to male faculty. Women may also encounter greater bias from journals during the peer review process and from professional organizations in their selection of...
faculty for participation in prestigious activities which increase visability.\(^2\) One of the reasons for this bias among institutions and organizations may be their perception that female faculty do not view their scholarly work as being as important as their male colleagues do. A study by Jones and colleagues examining the goals and aspirations of male and female academic medical faculty found that women were significantly more likely to consider the importance of work-life balance than men.\(^2\) Further, sexual harassment and discrimination still exist in academic pharmacy, sometimes resulting in salary and career trajectory disparities.\(^2\)\(^3\)\(^4\) A thorough discussion of these factors is beyond the scope of this manuscript and instead needs to take place at a profession-wide level. Many of the factors are modifiable.

Productive professional discussions should take place to improve publication rates. The focus of such discussions should be on improving the publication rates of historically less productive faculty members who are often younger, female, and in private institutions. One solution may be to develop a universal mentoring program. These programs should be available inside and outside of schools and colleges of pharmacy. The current AACP Practice Section Mentor Match Program is an example of such a program. Major pharmacy organizations could develop mentor programs for faculty and staff across a wide spectrum of practice settings.

The limitations of this study are the use of faculty rosters across time. The results described herein are subject to the larger phenomenon of publication bias. Although for the purposes of this study we defined productivity in terms of published work, we recognize that there is scholarly work that is not accepted for publication that requires significant faculty time and resources to complete. Further, some misclassification may have occurred as many faculty, particularly those in higher ranking positions at the end of the decade included in this study may actually have been promoted earlier in the decade, after their paper(s) had been published. Thus, we may have ascribed productivity that occurred when the faculty member was at a lower academic rank to productivity that occurred when they were at a higher rank. Finally, it is possible that some faculty had moved in and out of tenure-line positions during the decade being assessed, resulting in the inclusion of publications that did not fit within the scope of the study. An additional important limitation of the study is the possible omission or inclusion of some faculty members twice because of name changes that occurred during the study period due to marriage, divorce, or other life events. Cohen found that fewer than half of women scientists with PhDs kept their birth surnames after marriage; this practice is likely common among pharmacy faculty as well and may have impacted our ability to accurately track publications among women across the 10-year period of the study. If inaccurate tracking occurred, it may have contributed to the apparent disparity between men and women.\(^2\)\(^5\) Accounting for publications across multiple members of a department was noted in numerous colleges and schools. To represent the faculty members’ full contribution, we counted all retrievable publications by faculty at each school or college rather than credit publications to individual faculty. We employed a multiple-author approach to verifying the faculty member, gender, professional rank, publication number, and scope. The database was constructed to check that information matched from college to individual.
CONCLUSIONS

These national DPP-TT data demonstrate that scholarly productivity is substantially increasing, with a wide variety of types of publications. Publication rates were higher for male faculty and for those at public institutions. Future research should focus on DPP career or clinical-line faculty publication rates.

REFERENCES

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