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Publication Rates of U.S. Schools and Colleges of Pharmacy: A 22-year History

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Scientific publications are the primary means by which new pharmaceutical information is disseminated. Establishment of the publication output for Schools and Colleges of Pharmacy (SCOP) would be useful in helping to define a normative baseline for assessing trends in the pharmaceutical sciences. The objective of this study is to provide a 5 year update (1993–1997) on previously published data (Pharmacotherapy 1995; 15: 487–494). Taken together, these data provide a 22-year history of publication rates for U.S. SCOP.

Data were obtained from the *Science Citation Index* (SCI) Corporate Index. Citations were counted without regard to publication type (letter, abstract, review, etc.). Duplicative publications were eliminated. Faculty counts of the 78 SCOP included in the study were obtained from the AACP *Roster of Faculty and Professional Staff* for the inclusive years. The main endpoints used were publications/SCOP/year and publications/faculty/year.

Total publication counts for the 1990's have averaged near 30 publications per SCOP per year. Approximately 13 (17%) of SCOP account for half the publications during this period. Medical center based SCOP appear to be more productive than non-medical center based SCOP ($p < .05$) as do public *vs.* private SCOP ($p < .05$). More than half the SCOP continue to be minimally productive, producing less than 20 publications/year or 0.5 publications/faculty/year.

We can conclude from our results that a small group of SCOP produce the majority of publications. More than half of SCOP are minimally productive. During the 1990's, yearly publication counts were similar, averaging close to 30 publications per SCOP per year.

Keywords: Publication rates, Pharmaceutical science

INTRODUCTION

Scholarship can be defined as "discovery and communication of knowledge" (Cloyd, 1988). Most of the science community agrees that peer-reviewed publication is the best measure of scholarly activity (Krumland *et al.*, 1979). Pharmacy scholarship is important for improvement of healthcare and to generate new knowledge

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within schools and colleges of pharmacy (Kinnard *et al.*, 1980). Therefore, publishing has become expected of pharmacy faculty in order to obtain tenure and promotion. Several studies involving medical school faculty (Bateshaw *et al.*, 1988; Gjerde, 1994; Gjerde and Clements, 1982) have shown that promoted faculty had more publications than those not promoted. While data exists in the field of medicine (Bateshaw *et al.*, 1988; Gjerde, 1994; Gjerde and Clements, 1982; Krumland *et al.*, 1979; Rabinowitz, 1987) for quantitative publication rates, little data is available involving schools and colleges of pharmacy (Calligaro *et al.*, 1991; Thompson and Segars, 1995).

The primary objective of this study was to determine faculty publication rates for all schools and colleges of pharmacy in the United States for 1993–1997. The secondary objective was to determine if publication rates differed between public *vs.* private SCOP and health science center-based *vs.* non-health science center-based SCOP. This information was then added to previous data collected for the period 1976–1992, which gives a 22-year history of publication rates.

METHODS

All data pertaining to years 1976 to 1992 were taken from an earlier publication done by Thompson and Segars (1995). Data collection methods for years 1993–1997 were identical to the methods used in the previous study (Thompson and Segars, 1995). Publication counts from 1993 to 1997 for each SCOP were obtained from Science Citation Index (SCI) Corporate Index. Publications can be found in the SCI Corporate Index by searching under country, state, city, institution, and author. For example, to search for the number of publications written by University of Arizona College of Pharmacy faculty in 1995, one would first locate the 1995 index. Then the researcher would search under Arizona, then Tucson, then the University of Arizona, and then under the College of Pharmacy.

The citations are listed in SCI under university name if the faculty member notes his affiliation with the university in his publication. Therefore, if a faculty member did not list his university affiliation, the publication would not be cited in SCI under geographic and institution location and would not be included in the study. All publications, including letters and abstracts, listed under each SCOP in SCI were included in the study. Any publication written by more than one author within the same SCOP was counted only once.

The number of faculty employed by each SCOP for years 1993 to 1997 was obtained from the *Roster of Faculty and Professional Staff* published by the American Association of Colleges of Pharmacy (AACP). Only full-time faculty were included in the study. Five SCOP originated between the years of 1993 to 1997. Data pertaining to these schools were included after they had faculty listed in the *Roster* beyond the Dean.

The number of publications/faculty/year was calculated by using total publications cited in SCI for an institution divided by the number of full-time faculty listed in the *Roster* for the same year. Classification of health science center-based *vs.* non-health science center-based and public *vs.* private was established through data supplied by the American Association of Colleges of Pharmacy (Anon, 1994; personal communication Susan M. Meyer, AACP).

Statistical analysis was performed using a two-tailed t test to determine significant differences between health science center-based and non-health science center based universities and public and private universities. The level of significance was set at $p < .05$.

RESULTS

Figure 1 shows the mean number of publications of SCOP for 1976 to 1997. From 1976 to 1990

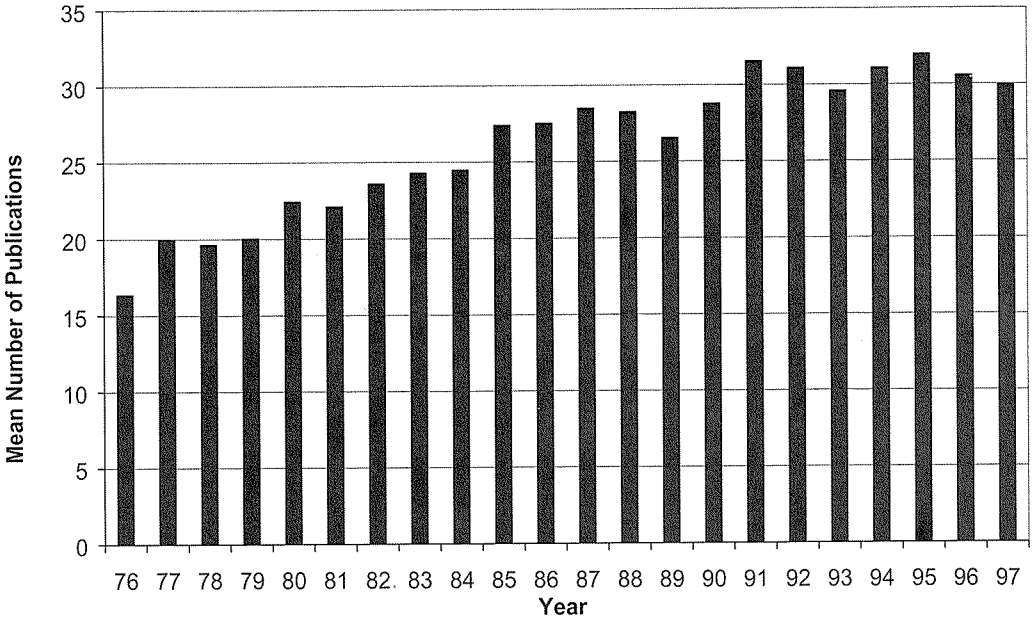

FIGURE 1 Mean publications per year for all schools and colleges of pharmacy (mean ± SD for the inclusive years). '76 = 16.38 ± 18.19; '77 = 19.96 ± 21.86; '78 = 19.66 ± 23.37; '79 = 20.06 ± 21.35; '80 = 22.47 ± 27.02; '81 = 22.14 ± 23.60; '82 = 23.61 ± 26.52; '83 = 24.32 ± 26.08; '84 = 24.50 ± 27.96; '85 = 27.42 ± 29.34; '86 = 27.54 ± 29.41; '87 = 28.52 ± 30.35; '88 = 28.27 ± 30.88; '89 = 26.55 ± 27.77; '90 = 28.81 ± 30.13; '91 = 31.59 ± 34.53; '92 = 31.12 ± 30.31; '93 = 29.60 ± 31.50; '94 = 31.10 ± 30.50; '95 = 32.00 ± 33.20; '96 = 30.60 ± 32.00; '97 = 30.00 ± 29.30.

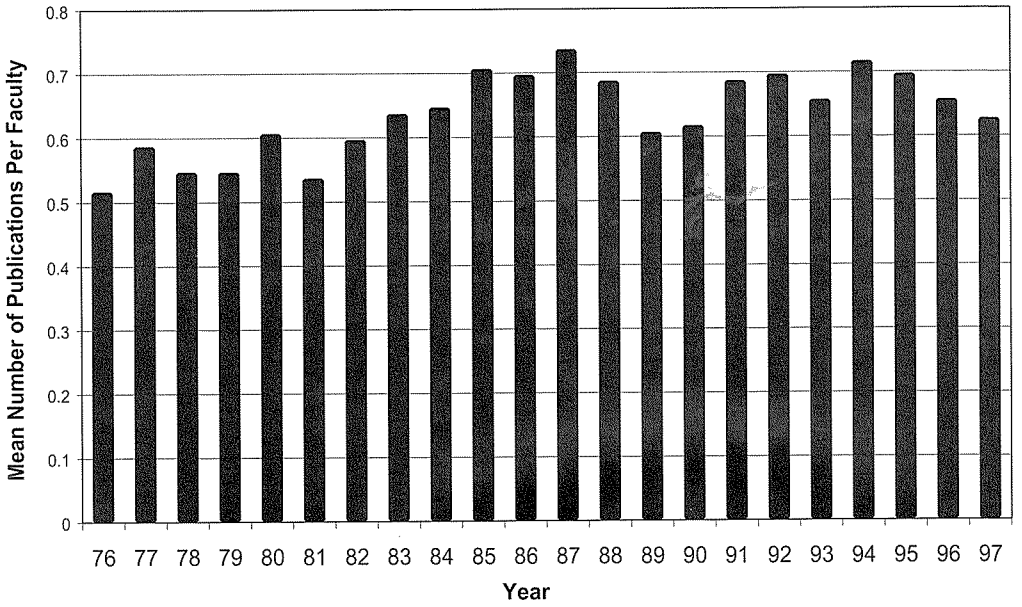

FIGURE 2 Mean publications per faculty per year for all schools and colleges of pharmacy (mean ± SD for the inclusive years). '76 = 0.51 ± 0.53; '77 = 0.58 ± 0.55; '78 = 0.54 ± 0.51; '79 = 0.54 ± 0.44; '80 = 0.60 ± 0.56; '81 = 0.53 ± 0.45; '82 = 0.59 ± 0.54; '83 = 0.63 ± 0.56; '84 = 0.64 ± 0.61; '85 = 0.70 ± 0.66; '86 = 0.69 ± 0.59; '87 = 0.73 ± 0.63; '88 = 0.68 ± 0.62; '89 = 0.60 ± 0.54; '90 = 0.61 ± 0.53; '91 = 0.68 ± 0.58; '92 = 0.69 ± 0.58; '93 = 0.65 ± 0.56; '94 = 0.71 ± 0.55; '95 = 0.69 ± 0.59; '96 = 0.65 ± 0.55; '97 = 0.62 ± 0.55.

a steady increase in publications per SCOP is visible except for 1988. Starting in 1991 and proceeding through 1997, the publication counts appear to have been similar from year to year at approximately 30 publications per SCOP. Figure 2 shows the same trends for number of publication per faculty per year.

The average publications per year for health science center-based and non-health science center-based SCOP are plotted on the line graph in Figure 3. All points are significantly different ($p < .05$) except for 1978 and 1979. The same information is shown in Figure 4 except the data is normalized by the number of full time faculty employed during the respective year. All points are significantly different ($p < .05$) except for 1978, 1981, 1983, and 1992.

The line graph in Figure 5 represents the mean number of publications per year for public and private institutions. All points are significantly different ($p < .05$). The same information is shown in Figure 6 except the data is normalized by the number of full time faculty employed during the respective year. All points are significantly different ($p < .05$) except 1979 and 1981.

Only 18% ($n = 14$) of SCOP produced more than 50 publications per year during the 1976 to 1997 period. Most of the SCOP (61%, $n = 48$) produced less than 20 publications per year. Similar data are evident when normalized by number of faculty. Fifty-four percent ($n = 42$) of the SCOP produced less than 0.5 publications per faculty per year while only 18% ($n = 14$) averaged greater than 1.0 publications/faculty/year.

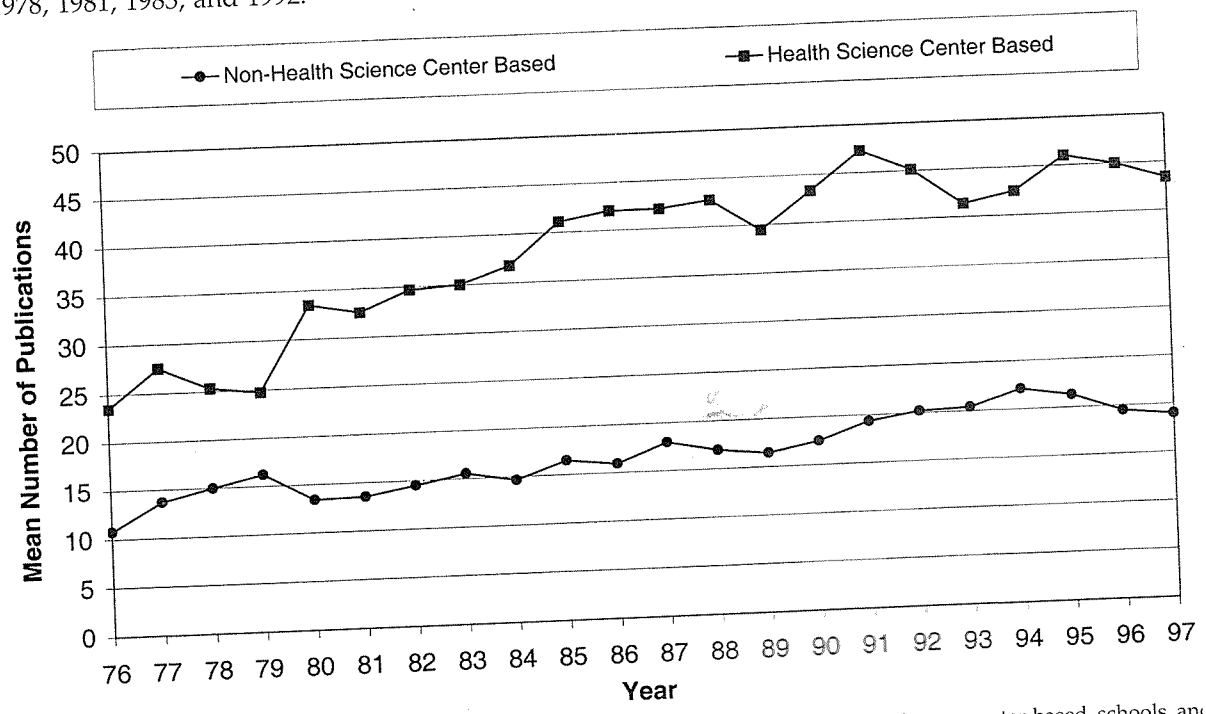

FIGURE 3 Mean publications per year for health sciences center-based vs. non-health sciences center-based schools and colleges of pharmacy (mean ± SD for the inclusive years). ■ = health science center-based schools and colleges of pharmacy ($n = 34$), ● = non-health science center-based schools and colleges of pharmacy ($n = 44$). $p < .05$ for each year except 1978 and 1979. '76 = ■ 23.22 ± 20.89, ● 10.77 ± 13.49; '77 = ■ 27.56 ± 24.57, ● 13.72 ± 17.30; '78 = ■ 25.34 ± 24.57, ● 15.00 ± 17.30; '79 = ■ 24.75 ± 23.74, ● 16.21 ± 18.61; '80 = ■ 33.50 ± 31.68, ● 13.41 ± 18.44; '81 = ■ 32.59 ± 25.05, ● 13.56 ± 18.63; '82 = ■ 34.69 ± 28.99 ● 14.51 ± 20.54; '83 = ■ 35.03 ± 28.29, ● 15.54 ± 20.59; '84 = ■ 36.78 ± 32.13, ● 14.68 ± 19.48; '85 = ■ 41.09 ± 33.76, ● 16.48 ± 19.60 '86 = ■ 42.03 ± 33.22, ● 15.95 ± 19.68; '87 = ■ 42.06 ± 34.89, ● 17.95 ± 21.30; '88 = ■ 42.78 ± 35.72, ● 16.95 ± 20.68; '89 = ■ 39.47 ± 31.12, ● 16.46 ± 19.99; '90 = ■ 43.31 ± 34.25, ● 17.49 ± 20.63; '91 = ■ 47.28 ± 39.78, ● 19.34 ± 23.85; '92 = ■ 45.13 ± 32.9 ● 20.20 ± 23.06; '93 = ■ 41.36 ± 36.50, ● 20.36 ± 23.47; '94 = ■ 42.54 ± 34.80, ● 22.12 ± 23.46; '95 = ■ 46.03 ± 37.73, ● 21.30 ± 24.6 '96 = ■ 45.00 ± 35.58, ● 19.50 ± 23.91; '97 = ■ 43.41 ± 33.49, ● 19.10 ± 20.27.

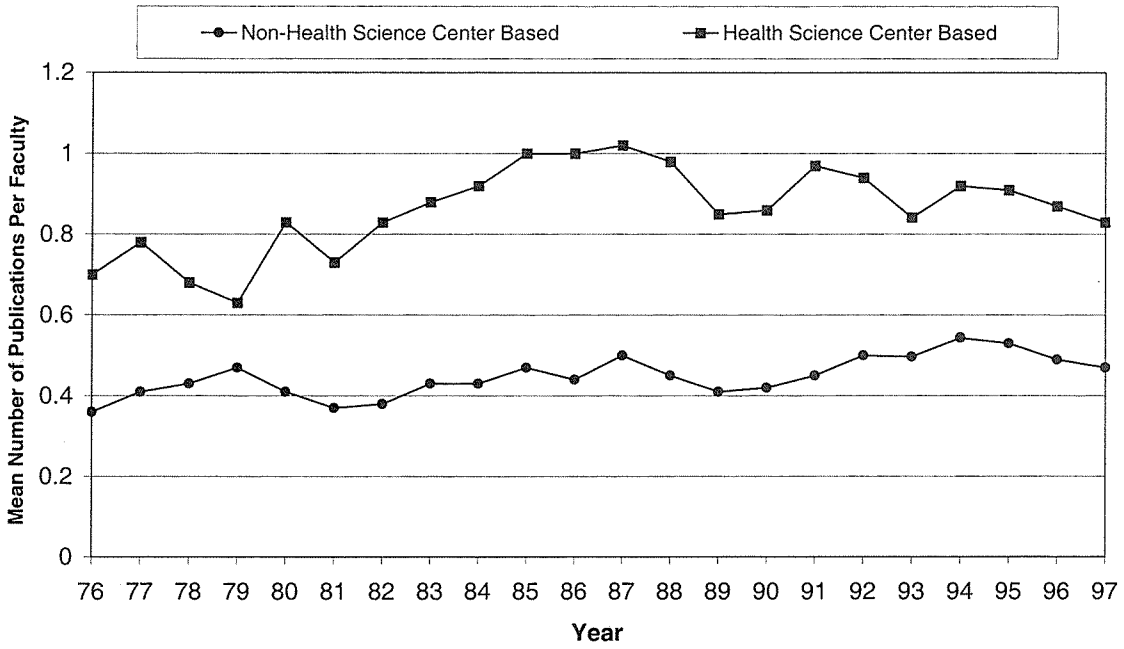

FIGURE 4 Mean publications per faculty per year for health sciences center-based *vs.* non-health sciences center-based schools and colleges of pharmacy (mean ± SD for the inclusive years). ■ = health science center-based schools and colleges of pharmacy ($n = 34$); ● = non-health science center-based schools and colleges of pharmacy ($n = 44$). $p < .05$ for each year except 1979, 1981, 1983, and 1992. '76 = ■ 0.70 ± 0.66, ● 0.36 ± 0.34; '77 = ■ 0.78 ± 0.68, ● 0.41 ± 0.36; '78 = ■ 0.68 ± 0.58, ● 0.43 ± 0.42; '79 = ■ 0.63 ± 0.48, ● 0.47 ± 0.36; '80 = ■ 0.83 ± 0.62, ● 0.41 ± 0.43; '81 = ■ 0.73 ± 0.47, ● 0.37 ± 0.36; '82 = ■ 0.82 ± 0.57, ● 0.38 ± 0.42; '83 = ■ 0.88 ± 0.58, ● 0.43 ± 0.46; '84 = ■ 0.92 ± 0.69, ● 0.42 ± 0.43; '85 = ■ 1.00 ± 0.73, ● 0.47 ± 0.50; '86 = ■ 1.00 ± 0.62, ● 0.44 ± 0.43; '87 = ■ 1.02 ± 0.70, ● 0.50 ± 0.46; '88 = ■ 0.98 ± 0.71, ● 0.45 ± 0.41; '89 = ■ 0.85 ± 0.60, ● 0.41 ± 0.38; '90 = ■ 0.86 ± 0.56, ● 0.42 ± 0.41; '91 = ■ 0.97 ± 0.63, ● 0.45 ± 0.41; '92 = ■ 0.94 ± 0.60, ● 0.50 ± 0.48; '93 = ■ 0.84 ± 0.61, ● 0.49 ± 0.47; '94 = ■ 0.92 ± 0.62, ● 0.54 ± 0.43; '95 = ■ 0.91 ± 0.65, ● 0.53 ± 0.48; '96 = ■ 0.87 ± 0.58, ● 0.49 ± 0.47; '97 = ■ 0.83 ± 0.49, ● 0.46 ± 0.42.

DISCUSSION

According to these data, faculty publication numbers increased steadily over the years from 1976 to 1990. From 1991 to 1997, the numbers appear to be closely the same at about 30 publications per SCOP per year. Only 17% of SCOP appeared to be highly productive during the 22 year period. Most of these highly productive universities are public and health science center-based institutions. The majority of SCOP (61%) had less than 20 publications/year. Sixty-four percent had less than 0.5 publications per faculty per year.

Scholarly productivity is traditionally measured by quantity and quality of publications. However, individual universities may have different expectations of faculty when it comes to measuring productivity. Within SCOP, a diverse group of faculty exist (*e.g.* Ph.D. trained scientists *vs.* Pharm.D. trained clinicians) and thus, a wide range of scholarly expectations may exist for each faculty grouping even within the same institution. Whatever the expectations are for each university, most faculty agree that scholarship is important for the future of SCOP and for the continued advancement of the pharmacy profession (Banker, 1988; Krumland, 1979).

One limitation of our study includes the use of the AACP *Roster* as a means of identifying full-time *vs.* part-time faculty. Some full-time faculty, such as administrators or directors, may not have scholarship expectations as part of their positions. Alternatively, some part-time

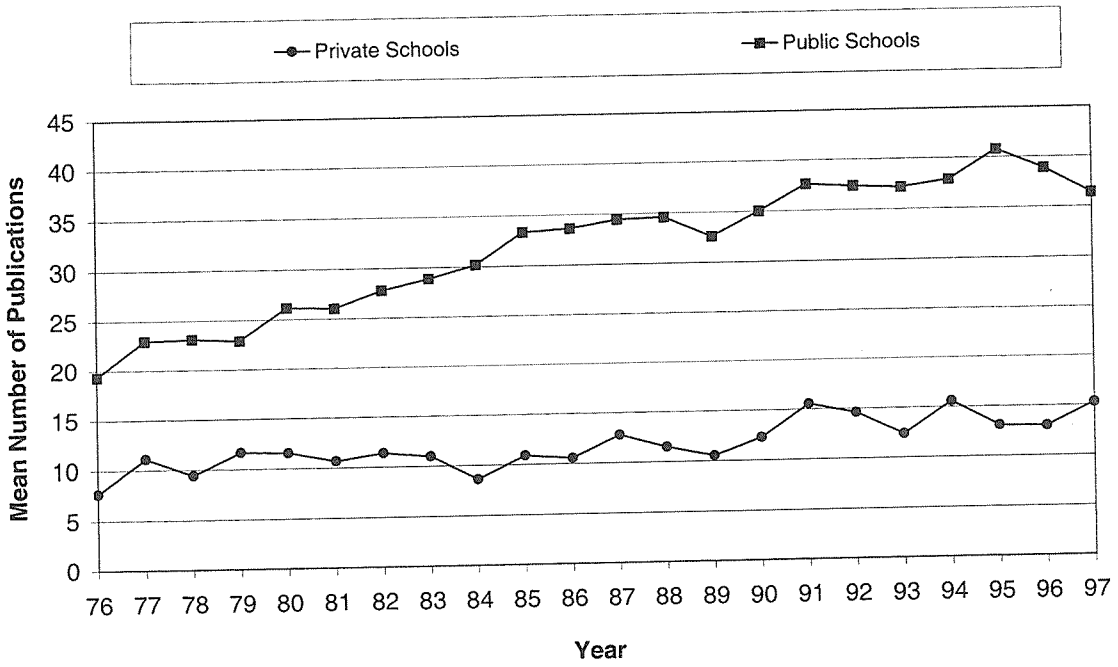

FIGURE 5 Mean publications per year for public *vs.* private school and colleges of pharmacy (mean ± SD for the inclusive years). ■ = public schools and colleges of pharmacy ($n = 53$); ● = private schools and colleges of pharmacy ($n = 25$). $p < .05$ for each year. '76 = ■ 19.34 ± 19.70, ● 7.67 ± 8.27; '77 = ■ 22.96 ± 23.52, ● 11.11 ± 12.79; '78 = ■ 23.13 ± 25.43, ● 9.44 ± 11.07; '79 = ■ 22.91 ± 22.76, ● 11.67 ± 13.91; '80 = ■ 26.17 ± 29.28, ● 11.56 ± 14.67; '81 = ■ 26.04 ± 25.41, ● 10.67 ± 11.52; '82 = ■ 27.76 ± 28.25, ● 11.39 ± 15.61; '83 = ■ 28.85 ± 27.84, ● 11.00 ± 13.32; '84 = ■ 30.19 ± 30.05, ● 8.63 ± 10.61; '85 = ■ 33.34 ± 30.70, ● 10.90 ± 16.74; '86 = ■ 33.62 ± 31.06, ● 10.58 ± 14.53; '87 = ■ 34.45 ± 32.47, ● 12.80 ± 15.73; '88 = ■ 34.60 ± 33.12, ● 11.50 ± 14.25; '89 = ■ 32.59 ± 29.58, ● 10.55 ± 12.47; '90 = ■ 35.04 ± 32.14, ● 12.30 ± 14.79; '91 = ■ 37.64 ± 37.11, ● 15.55 ± 19.35; '92 = ■ 37.36 ± 32.98, ● 14.60 ± 23.06; '93 = ■ 37.17 ± 33.59, ● 12.43 ± 16.47; '94 = ■ 37.94 ± 32.63, ● 15.65 ± 17.57; '95 = ■ 40.77 ± 35.35, ● 13.13 ± 16.47; '96 = ■ 38.90 ± 33.30, ● 13.00 ± 20.19; '97 = ■ 36.45 ± 31.00, ● 15.32 ± 18.90.

clinicians are highly productive in scholarship and would not be counted in the denominator figure of our calculations. Of course, if these faculty did not list their university affiliation, their publications would also not be counted in the numerator. Additionally, although *Science Citation Index* covers a large, diverse collection of scientific and technical journals, it is not totally comprehensive. There are obviously some articles published by pharmacy faculty not covered by *Science Citation Index*. Also, the number of journals included in *Science Citation Index* has increased from 2700 journals in 1976 to almost 3500 journals in 1997. This increase in journal count over the 22-year period could have affected the results.

These data suggest that many SCOP do not have a significant commitment to scholarship and publishing. One survey (Boyer, 1990) reports that 60% of faculty feel that teaching should be the primary criteria for promotion rather than research. Indeed, the public has also questioned the dominant role research plays in our public universities, sometimes at the expense of undergraduate education. Perhaps this explains the "flattening" of the publication curve that appears to be occurring in the 1990's. Another explanation might be the influx of the new SCOP that has occurred in the 1990's. Obviously it takes time for a new SCOP to become research productive. As these new SCOP become more productive, perhaps the upward publication trend will continue. Only time and continued collection of data will reveal which way the current trend is heading.

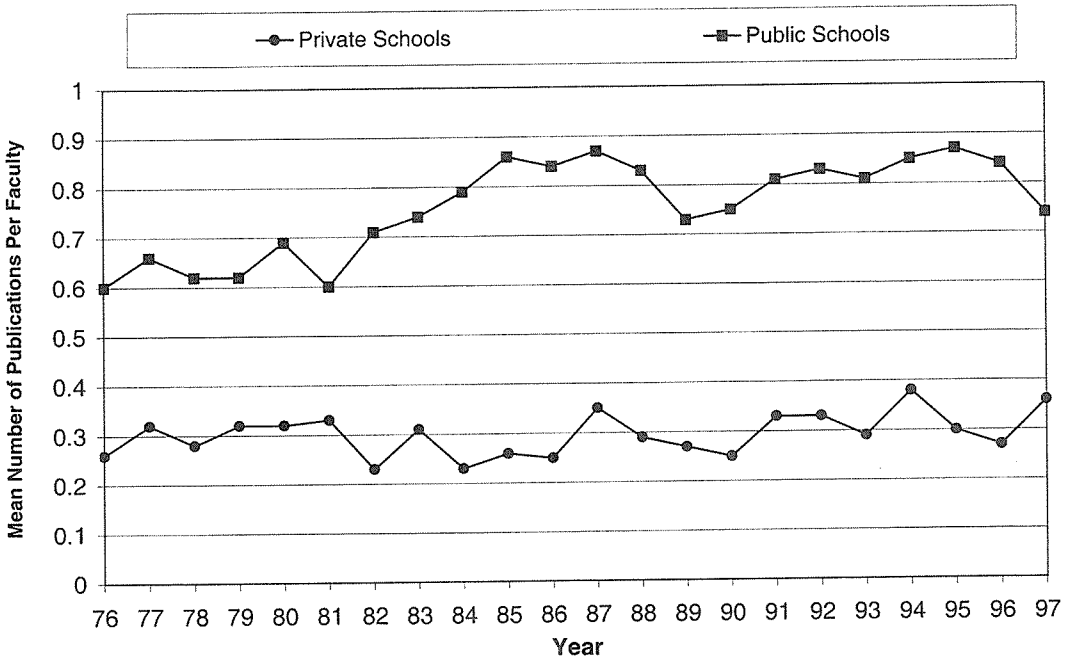

FIGURE 6 Mean publications per faculty per year for public *vs.* private schools and colleges of pharmacy (mean ± SD for the inclusive years). ■ = public schools and colleges of pharmacy ($n = 53$); ● = private schools and colleges of pharmacy ($n = 25$). $p < .05$ for each year except 1979 and 1981. '76 = ■ 0.60 ± 0.58, ● 0.26 ± 0.23; '77 = ■ 0.66 ± 0.59, ● 0.32 ± 0.34; '78 = ■ 0.62 ± 0.54, ● 0.28 ± 0.31; '79 = ■ 0.62 ± 0.45, ● 0.32 ± 0.32; '80 = ■ 0.69 ± 0.60, ● 0.32 ± 0.30; '81 = ■ 0.60 ± 0.46, ● 0.33 ± 0.35; '82 = ■ 0.71 ± 0.56, ● 0.23 ± 0.26; '83 = ■ 0.74 ± 0.59, ● 0.31 ± 0.30; '84 = ■ 0.79 ± 0.64, ● 0.23 ± 0.24; '85 = ■ 0.86 ± 0.68, ● 0.26 ± 0.36; '86 = ■ 0.84 ± 0.59, ● 0.25 ± 0.28; '87 = ■ 0.87 ± 0.66, ● 0.35 ± 0.33; '88 = ■ 0.83 ± 0.65, ● 0.29 ± 0.28; '89 = ■ 0.73 ± 0.56, ● 0.27 ± 0.25; '90 = ■ 0.75 ± 0.54, ● 0.25 ± 0.28; '91 = ■ 0.81 ± 0.60, ● 0.33 ± 0.30; '92 = ■ 0.83 ± 0.59, ● 0.33 ± 0.35; '93 = ■ 0.81 ± 0.58, ● 0.29 ± 0.26; '94 = ■ 0.85 ± 0.58, ● 0.38 ± 0.29; '95 = ■ 0.87 ± 0.61, ● 0.31 ± 0.27; '96 = ■ 0.84 ± 0.55, ● 0.27 ± 0.31; '97 = ■ 0.74 ± 0.49, ● 0.36 ± 0.35.

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