

United States Research Published in Major Surgical Journals Is Decreasing

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Objective

The authors hypothesized that less research performed in the United States was reported in the five major general surgical journals in 1993 than in 1983.

Summary Background Data

Academic surgeons believe they have less time and fewer funds for research than previously.

Methods

Five journals were analyzed for the number of pages and articles devoted to basic and clinical research in 1983 and 1993 and for the country in which the research was performed.

Results

The number of U.S. research pages and articles decreased over the past decade, and the number of non-U.S. pages and articles increased.

Conclusions

The reason(s) for the decrease in U.S. research reported in the general surgical journals should be studied, identified, and, if possible, rectified.

During the past decade, an increasing proportion of medical school revenues has been derived from the clinical practice of faculty, including surgeons, while reimbursement for clinical services has declined with the institution of managed care. In addition, surgical investigators claim to experience increasing difficulty in obtaining extramural funding for research. Accordingly, academic surgeons perceive that they have less time and fewer funds for the performance of research than previously.

Academic general surgeons traditionally publish their work in five major general surgery journals, all of which use the peer review process in accepting articles for publication. All but one of these journals publish research presented at the scientific meetings of the major general surgical societies and organizations (SSO), where much of the best surgical research is presented. Selection of the papers for presentation involves a peer-review process, usually blinded, that is very competitive. Presenters must submit manuscripts that undergo review by the journal or the SSO before acceptance for publication.

If surgeons have less time and fewer funds for research, less research should be published in surgical journals. We hypothesized that less research performed in the United States was reported in the five major general surgical journals in 1993 than in 1983.

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METHODS

Each of the 12 monthly issues of the five major general surgery journals published in 1983 and 1993 was analyzed for the number of basic and clinical research articles, case reports, review articles, editorials, and articles describing a surgical technique. The number of pages devoted to each article was also recorded. The journals were *American Journal of Surgery*, *Annals of Surgery*, *Archives of Surgery*, *Surgery*, and *Surgery, Gynecology and Obstetrics* (now *Journal of the American College of Surgeons*).

Articles were assigned to the categories of basic or clinical research according to the following definitions: Basic research was research performed in a laboratory setting using an animal or other biologic model, cell or tissue culture, or other *in vitro* techniques. Clinical research was research performed using human subjects, including prospective and retrospective outcome studies, cohort studies, and studies involving human tissue or cells. Three articles in 1983 and one in 1993 had elements of both clinical and basic research and were classified as basic research for the study. They represented 0.3% and 0.1% of the total research articles for 1983 and 1993, respectively.

All but one of the journals published articles based on papers presented at the scientific sessions of SSO. Such articles were designated SSO articles.

The country of origin of each article was recorded. Research performed in laboratories or institutions within the United States was designated U.S. research, and all other research was designated non-U.S. research. Research performed in both U.S. and non-U.S. laboratories or institutions was classified as U.S. research.

Statistical analysis was performed using separate log linear models with proportion of U.S. research as the dependent variable. Journal and issue were included in the model to adjust for possible differences in the proportion of U.S. research from journal to journal and issue to issue. Five separate log linear models were fitted to the proportion of U.S. pages of all research articles, basic science articles, clinical research articles, SSO articles, and non-SSO articles. The number of research articles was analyzed using chi square tests. Statistical significance was taken as $p < 0.01$. For reporting the data, the number of pages and articles for all issues of all journals was summed. This sum is reported as total pages or total articles.

RESULTS

The total number of pages devoted to research articles increased slightly (0.4%), from 5499 in 1983 to 5519 in 1993 (Table 1). The total number of research articles in the five journals decreased 12.2%, from 986 in 1983 to

Table 1. TOTAL NUMBER OF RESEARCH PAGES AND ARTICLES PUBLISHED IN 1983 AND 1993

	1983	1993
Total research pages	5499	5519
U.S. research pages (% of total)	4675 (85.0)	4155 (75.3)
Non-U.S. research pages (% of total)	824 (15.0)	1364 (24.7)
Total research articles	986	866
U.S. research articles (% of total)	822 (83.4)	643 (74.2)
Non-U.S. research articles (% of total)	164 (16.6)	223 (25.8)

866 in 1993. Thus, the mean length of research articles increased from 5.6 to 6.4 pages (14.2%) during the decade. The proportion of total U.S. research pages fell significantly and the proportion of non-U.S. research pages increased significantly between 1983 and 1993 ($p = 0.0004$). The total number of research articles decreased by 120 (12.2%), but the proportion of U.S. research articles decreased significantly.

Table 2 shows that the total number of pages devoted to basic research increased by 287 (28.5%). The proportion of basic research that was performed in the U.S. decreased, but not significantly, between 1983 and 1993. Similarly, the total number of basic research articles increased by 14 (8.5%), but the proportion of basic research performed in the U.S. was not significantly different between 1983 and 1993.

The total number of pages devoted to clinical research decreased by 267 (5.9%) (Table 3). There was a marked, significant decrease in the proportion of clinical research performed in the United States when compared with that performed in other countries ($p = 0.0008$). The total number of clinical research articles decreased from 822 to 688 (16.3%). The proportion of U.S. clinical research articles decreased markedly.

The total number of SSO pages reported in 1983 remained approximately the same in 1993 (Table 4). In 1983, 96.1% of this research was performed in the United States, and this did not change significantly in 1993 (94.7%). In contrast, U.S. research reported on non-SSO pages decreased markedly between 1983 and 1993, whereas non-U.S. research reported on non-SSO pages increased. This decrease in the proportion of U.S. non-SSO research pages was highly significant ($p = 0.0004$).

Figure 1 shows the number of non-U.S. basic and clinical research articles reported from each country that produced at least nine articles in either 1983 or 1993. Articles from Denmark, Norway, Finland, and Sweden were combined as Scandinavian articles. A decrease between 1983 and 1993 was found only for Great Britain and the Scandinavian countries. Japan produced the largest increase in research articles, accounting for 56%

Table 2. BASIC RESEARCH PAGES AND ARTICLES PUBLISHED IN 1983 AND 1993

	1983	1993
Total research pages	1008	1295
U.S. basic research pages (% of total)	901 (89.4)	1107 (85.5)
Non-U.S. basic research pages (% of total)	107 (10.6)	188 (14.5)
Total basic research articles	164	178
U.S. basic research articles (% of total)	145 (88.4)	151 (84.8)
Non-U.S. basic research articles (% of total)	19 (11.6)	27 (15.2)

of the research articles lost from the United States to other countries.

Table 5 shows the number of pages devoted to case reports, review articles, editorials, and articles describing surgical techniques. The total number of pages for these articles remained approximately the same between 1983 and 1993. However, pages devoted to case reports and technique articles decreased, whereas review article pages increased.

DISCUSSION

The study shows that less U.S.-performed research was reported in the five major general surgical journals in 1993 than a decade earlier, in 1983. The number of research articles and research pages were analyzed to discern changes in the number of pages contained within each journal during each 12-month period and to detect changes in the mean number of pages per article, factors which could affect the interpretation of data. Although the total number of pages of research published by these journals and the mean length of each article increased slightly between 1983 and 1993, a highly significant increase in the proportions of research pages and articles originated in countries other than the United States. The results for the total number of research articles were similar.

We categorized research as clinical or basic and found that the proportion of pages and articles of clinical re-

Table 3. CLINICAL RESEARCH PAGES AND ARTICLES PUBLISHED IN 1983 AND 1993

	1983	1993
Total clinical research pages	4491	4224
U.S. clinical research pages (% of total)	3774 (84.0)	3048 (72.2)
Non-U.S. clinical research pages (% of total)	717 (16.0)	1176 (27.8)
Total clinical research articles	822	688
U.S. clinical research articles (% of total)	677 (82.4)	492 (71.5)
Non-U.S. clinical research articles (% of total)	145 (17.6)	196 (28.5)

Table 4. SSO AND NON-SSO RESEARCH PAGES PUBLISHED IN 1983 AND 1993

	1983	1993
Total SSO research pages	2690	2603
U.S. SSO research pages (% of total)	2583 (96.1)	2462 (94.7)
Total non-SSO research pages	2809	2917
U.S. non-SSO research pages (% of total)	2092 (74.5)	1693 (58.0)
Non-U.S., non-SSO research pages (% of total)	717 (25.5)	1224 (42.0)

search originating outside the United States increased significantly, in contrast to the proportion of basic research pages and articles, which increased, but not significantly. Precise definitions of clinical and basic research are the subject of debate. In our definition we eliminated case reports, review articles, editorials, and articles describing a technique. Research we categorized as basic was more likely to be performed in a bench research laboratory, but no assessment or implication of quality was intended. Within the definitions we used, our data suggest that basic surgical research has continued at the level observed in 1983.

The most striking finding was the dramatic, significant fall in the number of non-SSO research pages from the United States and the increase in non-SSO pages from countries other than the United States between 1983 and 1993. Surgeons traditionally present their best work at the scientific sessions of surgical societies and organizations. After peer review, most of the best of these papers are published in the five major general surgical journals. Our data show that the total number of SSO research pages remained constant between 1983 and 1993 and that negligible percentages of them, 3.9% in 1983 and 5.3% in 1993, came from non-U.S. countries. Thus, SSO-related research was unchanged over the decade studied. However, a massive increase in non-U.S. re-

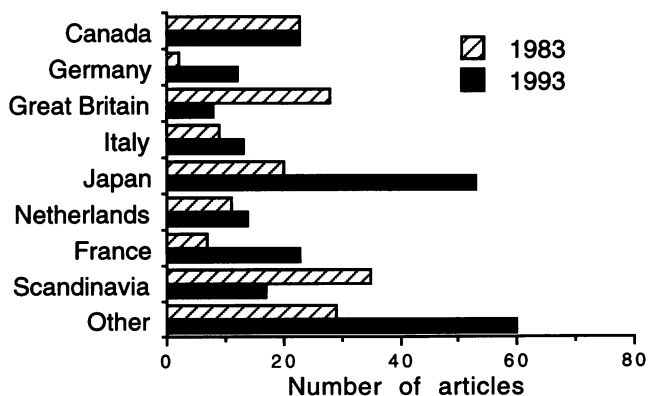


Figure 1. Country of origin and number of articles published in the five general surgical journals in 1983 and 1993. Only those countries from which nine or more articles were published in either year are listed.

Table 5. NONRESEARCH ARTICLE PAGES PUBLISHED IN 1983 AND 1993

	1983	1993
Case report pages	440	244
Review article pages	488	876
Editorial pages	249	230
Technique article pages	335	213
Total	1512	1563

search took place and filled the non-SSO pages of the major surgical journals. In 1993, after the SSO research pages were allocated, 42.0% of the remaining research pages in the major general surgical journals were filled with non-U.S. research, up from 25.5% in 1983.

We made no attempt to assess the quality of surgical research, but the issue of quality cannot be ignored in interpreting the data. More articles are submitted to each of the five journals than can be published. Each journal uses the traditional peer-review process, in which research articles are reviewed by editorial board members and outside reviewers who are experts in the subject of the research. The journal editors, who are distinguished surgical scientists, make the final decision to accept or reject the article for publication. Accordingly, published research articles are those of the highest quality submitted to each journal. Although surgeons tend to present their best work before surgical societies and organizations, the best of which is later published, the finding that the number of SSO pages remained the same between 1983 and 1993 does not indicate that the quality of surgical research remained the same over this decade. However, if the best work is SSO research, then the amount of U.S. quality work remaining after its publication has been seriously challenged by non-U.S. research, which captured an increased percentage of the non-SSO pages during the 1983-to-1993 decade. Whether the quality of SSO research remained the same over the decade we studied is not addressed by our data.

Our study did not address the causes of the decline in U.S. surgical research reported in the five major general surgical journals. As research has become more sophisticated and specialized, investigators may be publishing their work in highly specialized journals rather than in the major general surgical journals. For example, movement of vascular research from the major general surgical journals to specialty journals occurred several decades ago.

Potential reasons for the decline in surgical research can be identified, the most obvious of which is the increasing pressure to generate funds through clinical practice. The extensive time commitment required by patient care leaves less time for the thinking, reading, and

discussions with colleagues so essential for the development of hypotheses and the writing of grant applications. Quality clinical research is inhibited by the necessary institutional review board requirements, informed consent, randomization problems, and access to and supervision of research coordinators. In addition, pharmaceutical firms and medical supply companies are less likely to seek out surgical investigators for research contracts. In some institutions, programs of the Clinical Research Center are not as accessible to surgeons as to other faculty. These problems are shared by many nonsurgical clinical faculty.

The replacement of U.S. research by that performed in Japan and western Europe was also noted by Stossel and Stossel, who analyzed the *New England Journal of Medicine*, the *Journal of Clinical Investigation*, the *Lancet*, and the specialty journal *Blood*. They found a marked increase in the proportion of non-U.S. papers published by these journals, reflecting an increase in high-quality research originating abroad as compared with the United States.¹ This raises issues more global than those confined to the discipline of surgery, but they will affect surgical research in the future. Such issues include the proportion of funds to be allocated for basic as opposed to applied research² and the perceived need to increase funding for patient-oriented research.³ All research will be affected by the declining number of students entering science careers and by the fact that in a given year three of four M.D.s or Ph.D.s will not receive funding from the National Institutes of Health for their research proposals.

Our data show a decline in surgical research. The reasons for this decline must be studied, analyzed, and rectified. This will require the collective wisdom and energy of the leadership in surgery and the support of our surgical organizations. Avoidance of this responsibility may bring harm to our patients and our profession.

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Discussion

DR. JOHN A. WALDHAUSEN (Hershey, Pennsylvania): I think this paper is a very important one and Dr. Nahrwold deserves credit for bringing the subject to our attention.

I briefly reviewed the data from the *Journal of Thoracic and Cardiovascular Surgery*, and you can see a similar trend occurring. Briefly in 1984, 78% of manuscripts came from the United