

Trends in publication of general surgery research in Australia, 2000–2020

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Abstract

Background: The significance of evidence-based surgery has resulted in a shift towards producing high-quality surgical research. The aim of this bibliometric analysis was to evaluate trends in publication of general surgery research in Australia from 2000 to 2020.

Methods: General surgery publications including clinical trials, randomized controlled trials (RCTs), systematic reviews and meta-analyses by Australian-affiliated authors between 2000 and 2020 were extracted from PubMed. Titles, abstracts, journals and authors were independently screened by two investigators and arbitrated by a third. Publication type and area of focus were manually entered. Quality of articles was measured by trends in impact factor (IF) and SCImago Journal Rank (SJR). Descriptive statistics were used to summarize data and identify trends.

Results: Three hundred and ninety-eight articles met inclusion criteria for this study, with a progressive increase in publications over the study period. RCTs and systematic reviews accounted for 109 and 234 publications, respectively. The median number of authors remained constant ($p = 0.060$). There was a significant increase in publication of clinical trials and RCTs ($p < 0.001$) as well as systematic reviews and meta-analyses ($p < 0.001$). The median IF increased from 1.93 to 3.08, whilst median SJR increased from 1.11 to 1.16, equivalent to organic growth of journal IF and SJR over this period. Female authorship significantly increased over time ($p < 0.001$).

Conclusion: There is a trend towards increased quantity, quality and diversity in Australian general surgery publications, which is indicative of the progression and importance of robust modern surgical research.

Introduction

Evidence-based medicine (EBM) began as a movement in response to limitations in the understanding and use of published evidence. It has since progressed to critical appraisal of available evidence with shared decision making. The strongest level of evidence should inform surgical management because surgery is often definite and irreversible. Quality surgical research faces many barriers including clinical demands, interest and funding.

The Royal Australasian College of Surgeons (RACS) outlines the importance of EBM in its ‘Scholarship and Teaching’ core competency, which is required for all subspecialties.¹ Trainees are expected to provide critical appraisal of new trends in surgery whilst

contributing to the development, dissemination, application and translation of new knowledge.

Bibliometric analyses of surgical research have demonstrated increased publication rates and quality of evidence in the past decades. International analyses of surgical publications have previously ranked Australia as eleventh in the world based on publications adjusted for population and tenth in the world based on the mean impact factor of the journals published in Reference 2,3. The recent analysis of general surgical research in New Zealand demonstrated seven-fold increase in number of publications per year, six-fold increase in publications of RCTs and a 13-fold increase in number of systematic reviews.⁴

The aim of this study was to analyse general surgical research publications by Australian authors from 2000 to 2020, and to identify trends in research quality and publication practices.

Methods

A search was conducted using PubMed, from January 2000 to December 2020, with language restricted to English. The following search terms were used: 'surgery' and 'surgical' in title and abstract, 'Australian' in authors and affiliation, using the Boolean operators 'AND' and 'OR'. Articles were restricted to clinical trials, randomized controlled trials (RCTs), systematic reviews and meta-analyses, and basic science articles by Australian-affiliated authors. Articles were exported into data management software Google Sheets. Two authors (SI and GB) independently screened and reviewed titles and abstracts from the search. Publication type, area of focus (subspecialty), number of authors and state of publication were manually entered.

Publications were included if relevant to general surgery and its subspecialties. Duplicate articles were removed. Papers were excluded if they were specialty-specific publications other than in general surgery. Case reports and reviews, papers not published in English nor had first or last authors that were not affiliated to an Australian institution were also excluded.

Impact factor (IF) and SCImago Journal Rank (SJR) for each article was included after cross-checking with Journal Citation Reports. Each score was included from the year prior to publication to best represent the standing of the journal at the time of article submission. The mean annual increase in IF and SJR for the 10 most commonly published journals was calculated over this period then used to project an expected growth rate over the 20-year period.

Descriptive statistics were used to summarize data. Univariate analysis was used to identify significant trends over the investigated period. Categorical data was analysed using the χ^2 test. The difference between observed and expected change in both IF and SJR from 2000 to 2020 was determined using the Wilcoxon signed-rank test. A p -value of <0.05 was considered statistically significant. This project was exempt from ethics review by the Gold Coast Hospital and Health Service Human Research Ethics Committee and categorized as a quality activity.

Table 1 Frequency of publications in the 10 most common journals

Journal	n (%)
ANZ Journal of Surgery	53 (26.63%)
Diseases of the Colon and Rectum	22 (11.06%)
Annals of Surgery	19 (9.55%)
British Journal of Surgery	18 (9.05%)
Colorectal Disease	18 (9.05%)
Annals of Surgical Oncology	17 (8.54%)
Surgical Endoscopy	16 (8.04%)
World Journal of Surgery	13 (6.53%)
Cochrane Database of Systematic Reviews	12 (6.03%)
Journal of Gastrointestinal Surgery	11 (5.53%)

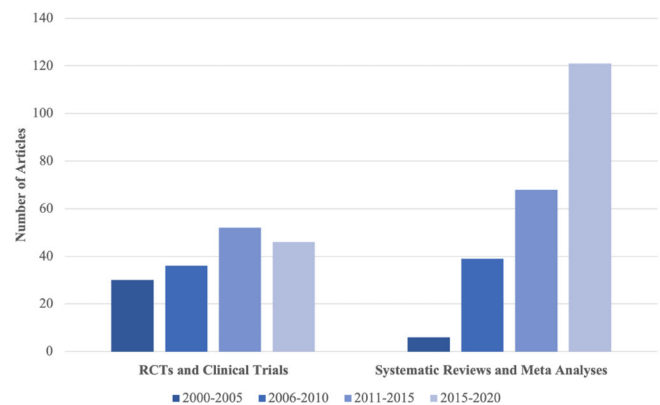


Fig. 1. Trend in increase of number of RCTs and clinical trials, systematic reviews and meta-analyses. RCT; randomized controlled trials.

Results

The initial literature search yielded 3151 articles, of which 398 articles met the inclusion criteria for this study. The majority of these were systematic reviews and/or meta-analyses [$n = 233$ (58.5%)], followed by RCTs [$n = 109$ (27.4%)], clinical trials [$n = 55$ (13.8%)] and a comparative study [$n = 1$ (0.25%)]. Colorectal, hepatobiliary and upper gastrointestinal surgery made up the majority of the area(s) of focus for the included studies. Other studies including cohort studies and case series were not included as part of the data analysis. The articles were published in a total of 114 different journals. The 10 most common journals accounted for 50% of all identified articles (Table 1).

There was a 13-fold increase in publications per year. There was a significant increase in publication of clinical trials and RCTs from 30 in 2000 to 2005 to 46 between 2016 and 2020 ($p < 0.001$) and systematic reviews and meta-analyses, from 6 in 2000 to 2004 to 121 between 2016 and 2020 ($p < 0.001$) (Fig. 1). 19.2% of RCTs referenced CONSORT guidelines in their studies, and 53.85% of systematic reviews and meta-analyses referenced the PRISMA statement over the study period.

The number of articles published per year increased from 3 in 2000 to 41 in 2020. Median number of authors remained constant with no significant increase ($p = 0.060$) (Fig. 2). Highest number of publications by state was New South Wales (35.9%) The proportion of female first or last authors identified overall was 145 (36.5%), with a significant upward trend over time ($p < 0.001$) (Fig. 3).

IF and SJR data was available for 95.3% and 97.9% of all included articles respectively. The median IF increased from 1.93 in 2000 to 3.08 in 2020, whilst median SJR increased from 1.11 in 2000 to 1.16 in 2020. The mean annual increase in IF and SJR for the 10 most commonly published in journals was 2.75% and 1.69% respectively, and the expected IF and SJR over a 20 year period is 3.31 and 1.55 each (Fig. 4). The observed increase in median IF and SJR were not significantly different from the expected organic growth of journal IF/SJR over time ($p = 0.575$, $p = 0.603$).

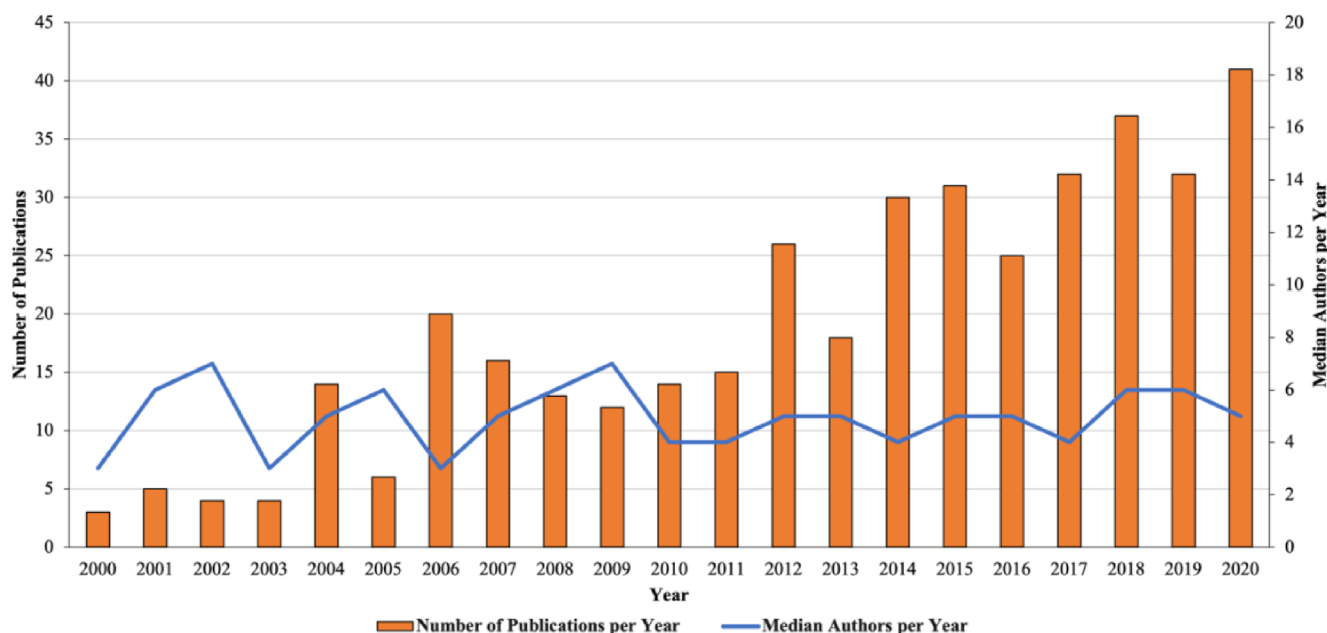


Fig. 2. Trend in number of publications and median authors per year.

Discussion

Within the surgical field, the ideal level of evidence to inform management should be the highest level of research, yet standardizing surgical interventions for the purposes of a clinical trial can be problematic given the precise, technical nature of surgery.⁵ There is the opinion that RCTs remain the gold standard in academic research. However, it is important to recognize the merits of each study design are complementary, rather than contradictory in addressing the surgical question.^{5,6} Where RCTs are unable to safely investigate a research question, or because it potentially disadvantages a patient population, a cohort or observational study then becomes valuable in addressing the same question.

This research paper arose following a publication of the increase in the number of general surgical publications attributed to New Zealand authors over a 20-year period. Wells *et al.* demonstrated a trend towards publication of higher-level evidence with an increase in median IF equivalent to the expected organic growth of journal IF.⁴ New Zealand ranks 14th globally with respect to general surgical publications per 10⁶ inhabitants from 2000 to 2005, whereas Australia, comparably, ranks 11th globally.³ The development of guidelines including the Consolidated Standards of Reporting Trials (CONSORT)⁷ and Preferred Reporting Items of Systematic reviews and Meta-Analyses (PRISMA)⁸ Statements is reflective of the need for standardized approaches to rigorous reporting of medical research. This was reflected in our analysis where there was increasing adherence to these guidelines over the study period.

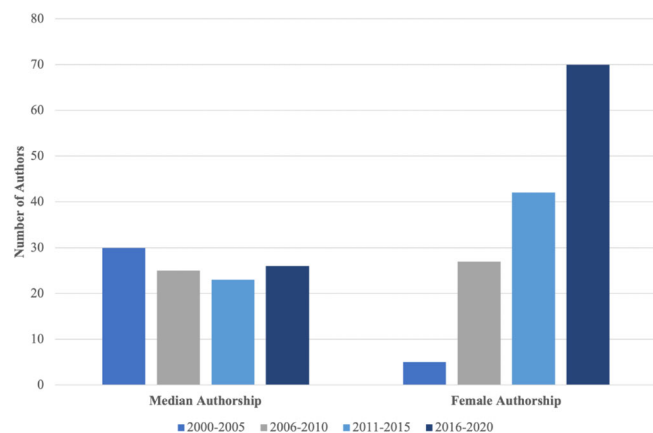


Fig. 3. Trend in authorship over time. There was a significant increase ($p < 0.001$) in the proportion of female first or last authors in 2016–2020 compared to 2000–2005.

Research growth

Other studies that have investigated trends in publication of general surgical research demonstrated an improvement in data quality over time associated with an increased proportion of RCTs (26% versus 48%, $p < 0.05$).⁹ Factors that have contributed towards the trend in increasing research growth in the surgical field have previously been discussed.^{4,9,10} There is a strong encouragement for participation for accreditation within departmental surgical units¹¹ and publications are highly encouraged from pre-occupational surgical trainees in order to meet prerequisites of applying for surgical training, which is similar across many medical specialties.

The Wells study suggested that an increase in median number of authors per article was suggestive of a trend towards increased international collaborative research.⁴ The first trainee-led research collaborative arose from the United Kingdom (UK) in 2007. Since then, many UK-based trainee-led research collaboratives have

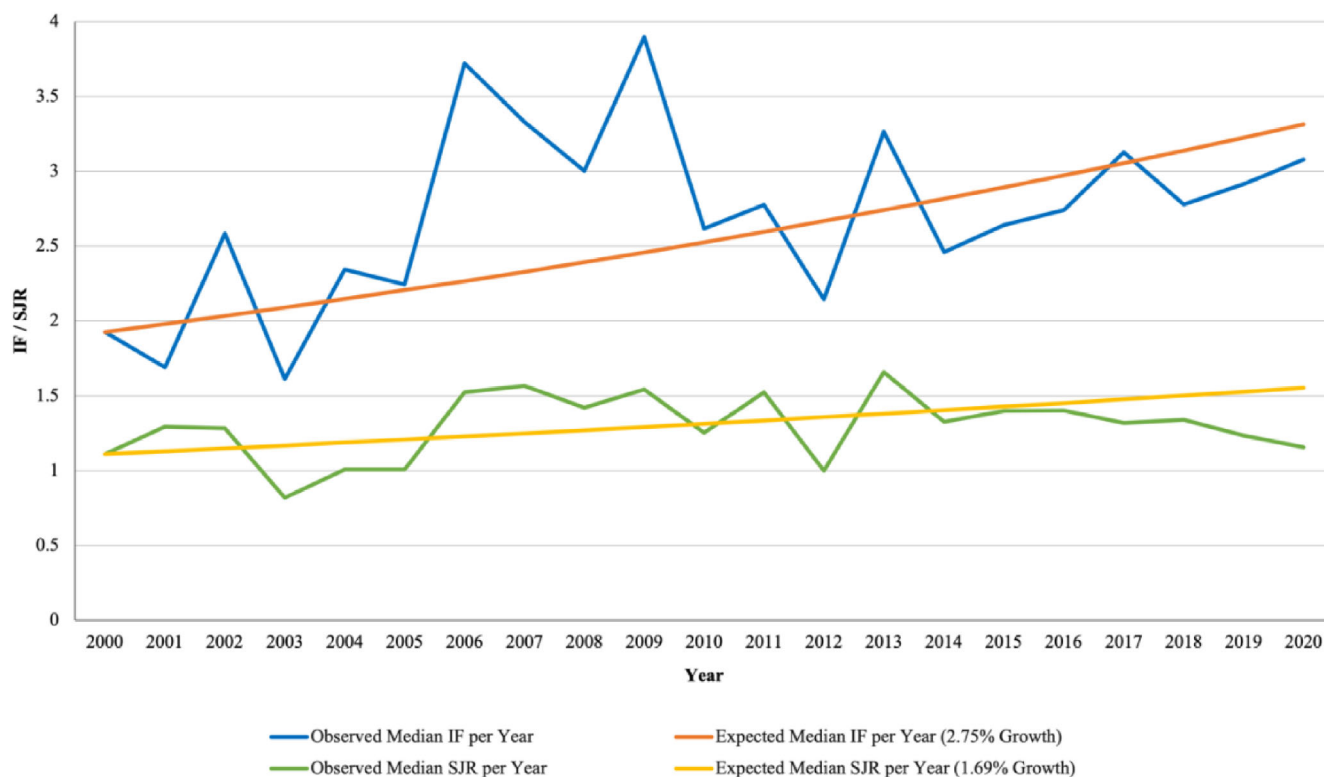


Fig. 4. Observed median IF and SJR per year versus expected median IF and SJR per year.

disseminated research outcomes from important clinical studies that have shaped modern surgical practice and have encouraged the same in Australia and New Zealand. In 2017, the Section of Academic Surgery within RACS recognized the value of such collaborations and in addition to being one of the 10 core competencies of training standards for surgeons, and has created many initiatives targeted at junior doctors, trainees and Fellows into engagement with surgical research including Research Scholarships, Learning and Development Grants, prizes and others.¹²

Outside the College of Surgeons, the introduction of the graduate-entry Doctor of Medicine (MD) program nationwide in all tertiary education centres except for the University of Adelaide¹³ has embedded research into the medical student curriculum. Critical appraisal of the literature is introduced in preclinical years, and students are afforded the option for engagement with research during their clinical placements. The merit in this system is two-fold: it allows the unit to recruit a team and it creates the opportunity for students to meet with academic mentors early in their careers and start on research in a supervised environment.

Barriers to surgical research specifically

In 1971, Silen¹⁴ expressed strong criticism of the quality and over-production of surgical research in the editorial 'Publish or Perish' which was similarly addressed in the Lancet article by Horton¹⁵ in his commentary 'Surgical Research or Comic Opera: Questions, but Few Answers'. Horton questioned the usefulness of case series as a predominant form of communication amongst surgeons, yet

each surgical case brings with them a different perspective, and in the two decades since, there has been a shift in perspectives of many towards academic surgery driving ideas about patient care. Other barriers to approaching robust clinical trials in surgical patients include the complexities of disease in these patients, in addition to them being more heterogeneous than non-surgical patients, difference in skill levels of surgeons (consultants, trainees and junior registrars) and the ethics of implementing RCTs in surgical patients.

Trends in general surgery

IF was chosen to guide assessment of published surgical research as it represented the significance of journal citation frequencies^{16,17} and SJR acted as an indirect measure of prestige of journals and therefore as a proxy of quality of articles published. The use of both IF and SJR metrics provided our study with a dual analysis and increased the strength of our conclusions. Despite an increase in median IF and SJR over time, this was attributed to the organic growth of journals rather than a true indication of an increase in the quality of publications.

Diversity in authorship

Sixty percent of Australian medical students are women, and yet women account for just 13 % of senior surgeons.¹⁸ A key element of the RACS Diversity and Inclusion Plan is to increase the number of female surgeons.¹⁹ There was an increasing diversity in

authorship over the study period, with an increasing trend in female first and last authorship, which is comparable with the increasing trend in female representation in surgery. There is a definite positive progress towards gender parity on the whole, with significantly increased women as first and last authors.²⁰

Limitations

The number of publications for this study were comparable, but less than data used in the New Zealand study,⁴ due to the exclusion of cohort and observational studies. There was no single international study that was similar to act as a control, and we were unable to directly compare trends in the Australian surgical research space. For ease of searching and reproducibility, our bibliographic search was restricted to PUBMED articles only. Future studies could include other search engines to expand the breadth of articles studied, in addition to cross-checking all Australian general surgery publications, and including more in-depth analyses of other types of research articles, including qualitative studies.

Conclusion

There is a trend towards increased quantity, quality and diversity in Australian general surgery publications, which is indicative of the progression and importance of robust modern surgical research. Over the last 20 years, there has been a significant increase in the number of publications per year, and an increase in the number of RCTs and systematic reviews, which is comparable to the trend demonstrated by the New Zealand study. Future directions should explore the correlation between the publication of EBM and its applicability for management in clinical practice.

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Author contributions

Sara Izwan: Conceptualization; data curation; formal analysis; investigation; methodology; writing – original draft; writing – review and editing. **Erick Chan:** Conceptualization; data curation; formal analysis; investigation; methodology; writing – original draft; writing – review and editing. **Christian Ibraheem:** Supervision; writing – original draft; writing – review and editing. **Gayatri Bhagwat:** Data curation; formal analysis; writing – review and editing. **David Parker:** Conceptualization; supervision; writing – review and editing.

Conflict of interest

None declared.

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