Impact factors of orthopaedic journals between 2010 and 2016: trends and comparisons with other surgical specialties

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Background: With increased legislative efforts to utilize evidence-based medicine as a guide for clinical practice, orthopaedists feel increasing pressure to publish research in higher-quality journals that reach a larger audience. Impact factor (IF) is used to quantify and rank journal apparent quality, and is the most standardized method for journal appraisal. In this study, we assessed the trends for IF among orthopaedic journals and compared these trends to those of medicine and general surgery journals.

Methods: Journal IFs from *Journal Citation Reports* (*JCR*) between the years 2010 to 2016 were obtained and analyzed for trends. Only journals that were considered primarily orthopaedic journals were included. The top 10 journals by IF in both internal medicine and surgery were also included for comparison. Each journal was analyzed by IF, and trends across time were noted. The differences in mean IF between orthopaedic specialty groups were analyzed using an independent samples *t*-test.

Results: The mean IF of orthopaedic increased from 1.4 (range, 0.0–3.9) in 2010 to 1.9 (range, 0.5–5.7) in 2016. In 2016, the percentage of English journals increased to 87.3% (n=48), while the percentage of journals published in the United States was 47.3% (n=26). There was a significant difference between the IF of journals published in English and those published in other languages (P=0.004). The mean IF of both general and specialized orthopaedic journals increased from 2010 to 2016, but the difference was nonsignificant. The mean IF of the top 10 journals in both surgery and internal medicine also increased from 2010 to 2016, but the increase was also nonsignificant.

Conclusions: Overall, the mean IF for peer-reviewed orthopaedic journals has increased in the past years, as has the number of journals. English journals from the United States continue to have the largest impact when compared to non-English journals and journals from outside the United States. Future studies should aim to better qualify journal impact, while limiting confounders such as self-citation.

Keywords: Orthopaedics; research; impact factor (IF)

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Introduction

Increasing legislative efforts to improve quality of care has led to a rejuvenated emphasis on utilizing evidence-based medicine as a guide for clinical practice (1,2). These efforts have spurred an increased demand for the academic community to publish high-quality studies. To meet this demand, there has been a significant rise in the number of scientific medical journals. According to *Journal Citation Report (JCR)—Thomson Reuters*, the number of "clinical medicine journals" published between the years 1999 and 2010 grew from 1,291 to 1,986 (3). However, despite the increase in the total number of scientific journals, investigators still seek to publish in journals that garner the largest audiences and potential impact. Particularly for orthopaedics, in which new research findings often dictate healthcare policy and reimbursement, the pressure to publish in journals with the largest impact is of paramount importance.

In 1951, Eugene Garfield developed an algorithm, designated "impact factor" (IF), to quantify and rank journal quality (4). IF is calculated by measuring the frequency with which articles from a journal are cited over the total number of published articles from the same journal in a particular year (*Figure 1*). This algorithm was devised with the intent of controlling for journals with a larger number of publications. Despite some objection against the use IF as a means to measure journal quality, IF remains the most standardized method for journal appraisal and is commonly used by medical librarians in selecting journals for their institutions (5-9).

Moverley *et al*. (10) investigated IF trends among orthopaedic journals between the years 2000 and 2010 and reported an increase in the mean IF for orthopaedic journals. We aimed to update their study by assessing IF trends in orthopaedic journals between the years 2010 to 2016. More specifically, we assessed trends for IF trends among orthopaedic journals and aimed to compare these trends to that of medicine and general surgery journals.

Methods

Journal IFs were obtained directly from JCR for the years 2010–2016 and analyzed for trends. Two authors (NS Mohamed and CU Gwam) screened and categorized each journal into either general, or subspecialty journals, based on whether the journal covered broad topics in orthopaedics or contained focused deeper knowledge (*Table 1*). Only

$$\text{Impact factor} = \frac{\text{Citation in 2016 of articles published in 2014-2015}}{\text{Number of citable articles published in 2014-2015}}$$

Figure 1 Impact factor equation.

Table 1 Journals in 2016 primarily focusing on orthopaedics, subdivided into general and specialist journal (accepted JCR abbreviations were used)

Title	Language	Published
General orthopaedic journals (n=27)		
Acta CHIR ORTHOP TR	Czech	Czech Republic
Acta Orthop	English	UK
Acta Orthop Belg	English	Belgium
Acta Orthop Traumato	Turkish	Turkey
Acta Ortop Bras	English	Brazil
Am J Sport Med	English	USA
Arch Orthop Traum Su	English	Germany
Bmc Musculoskel Dis	English	UK
Bone Joint J	English	UK
Bone Joint Res	English	UK
Clin Orthop Relat R	English	USA
Eklem Hast Cerrahisi	Turkish	Turkey
Indian J Orthop	English	India
Int Orthop	English	USA
J Am Acad Orthop Sur	English	USA
J Bone Joint Surg Am	English	USA
J Orthop Res	English	USA
J Orthop Sci	English	USA
J Orthop Surg Res	English	UK
J Orthop Surg-Hong K	English	China
J Orthop Trauma	English	USA
Oper Orthop Traumato	German	Germany
Orthop Clin N Am	English	USA
Orthop Surg	English	China
Orthop Traumatol-Sur	English	France
Orthopade	German	Germany
Orthopedics	English	USA

Table 1 (*continued*)

Table 1 (*continued*)

Title	Language	Published
Specialist orthopaedic journals (n=28)		
Arthroscopy	English	USA
Cartilage	English	USA
Chir Main	French	France
Connect Tissue Res	English	UK
Eur Spine J	English	USA
Foot Ankle Clin	English	USA
Foot Ankle Int	English	USA
Foot Ankle Surg	English	UK
Hand Clin	English	USA
Hip Int	English	Italy
Int J Shoulder Surg	English	India
J Arthroplasty	English	USA
J Foot Ankle Res	English	UK
J Foot Ankle Surg	English	USA
J Hand Surg-Am	English	USA
J Hand Surg-Eur Vol	English	UK
J Knee Surg	English	USA
J Pediatr Orthop B	English	USA
J Pediatr Orthoped	English	USA
J Plast Surg Hand Su	English	Sweden
J Shoulder Elb Surg	English	USA
Knee	English	Netherlands
Knee Surg Sport Tr A	English	Germany
Osteoarthr Cartilage	English	UK
Skeletal Radiol	English	USA
Spine	English	USA
Spine J	English	USA
Z Orthop Unfallchir	German	Germany

JCR, *Journal Citation Report*.

journals that were considered primarily orthopaedic journals were included, as with previous studies (11,12). We also included the top 10 journals by IF in both internal medicine and surgery for comparison (*Table 2*).

Each journal was analyzed by IF, and trends across time were evaluated. The differences in mean IF between orthopaedic specialty groups, geographical regions, and language of publication were analyzed using an independent samples *t*-test. The trends in mean IF for internal medicine and surgery were analyzed using a one-way Analysis of Variance (ANOVA). Significance was set at a value of $P<0.05$. All analysis was conducted using SPSS version 24 (IBM corporation, Armonk, New York, USA).

Table 2 Journals focusing on orthopaedics added and removed between 2010 and 2016 (accepted JCR abbreviations were used)

Title	Language	Published
Orthopaedic journals added (n=14)		
Acta Ortop Bras	English	Brazil
Acta Chir Orthop Tr	Czech	Czech Republic
J Orthop Surg-Hong K	English	China
J Plast Surg Hand Su	English	Sweden
Foot Ankle Clin	English	USA
Int J Shoulder Surg	English	India
Orthop Surg	English	China
Foot Ankle Surg	English	UK
J Foot Ankle Res	English	UK
J Orthop Surg Res	English	UK
J Knee Surg	English	USA
Cartilage	English	USA
Bone Joint Res	English	UK
Bone Joint J	English	UK
Orthopaedic journals removed (n=7)		
Minerva Ortop Trauma	Italian	Italy
Med Chir Pied	French	France
Eur J Orthop Surg Tr	English	France
Osteologie	German	Switzerland
Rev Bras Fisioter	Portuguese	Brazil
Rev Chir Orthop	Multi-language	France
J Bone Joint Surg Br	English	UK

JCR, *Journal Citation Report*.

Results

In 2010, the number of orthopaedic journals with IF totaled

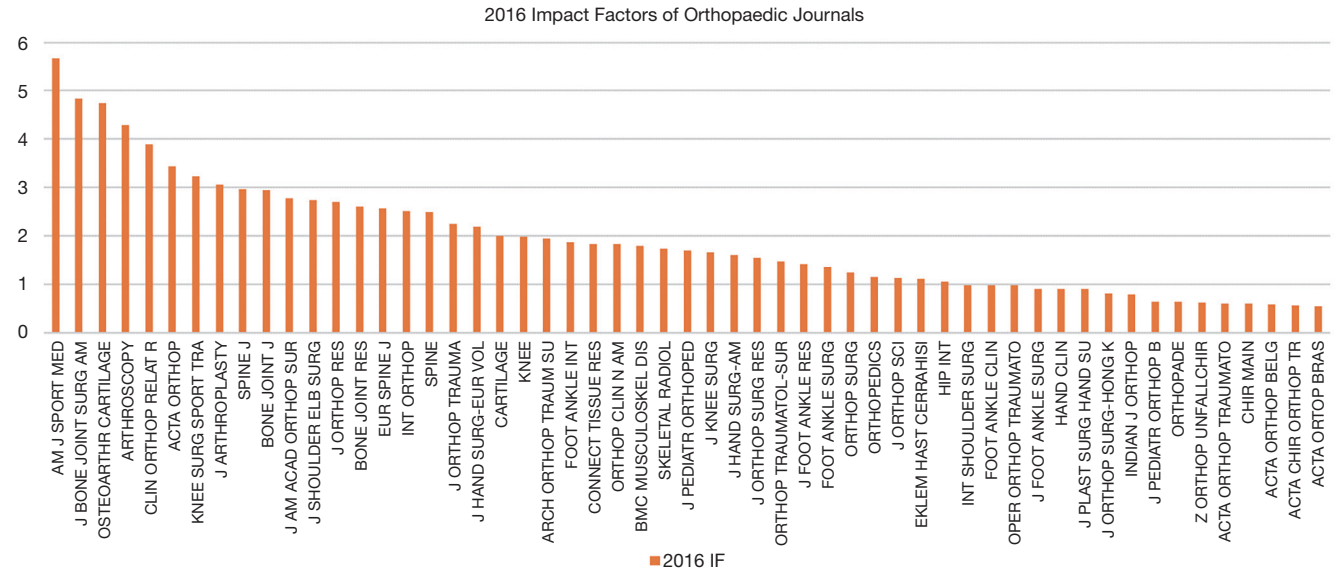

Figure 2 2016 impact factors of the journals listed in the JCR deemed to be primarily orthopaedic journals (as per *Table 1*), listed by accepted JCR abbreviation. JCR, *Journal Citation Report*.

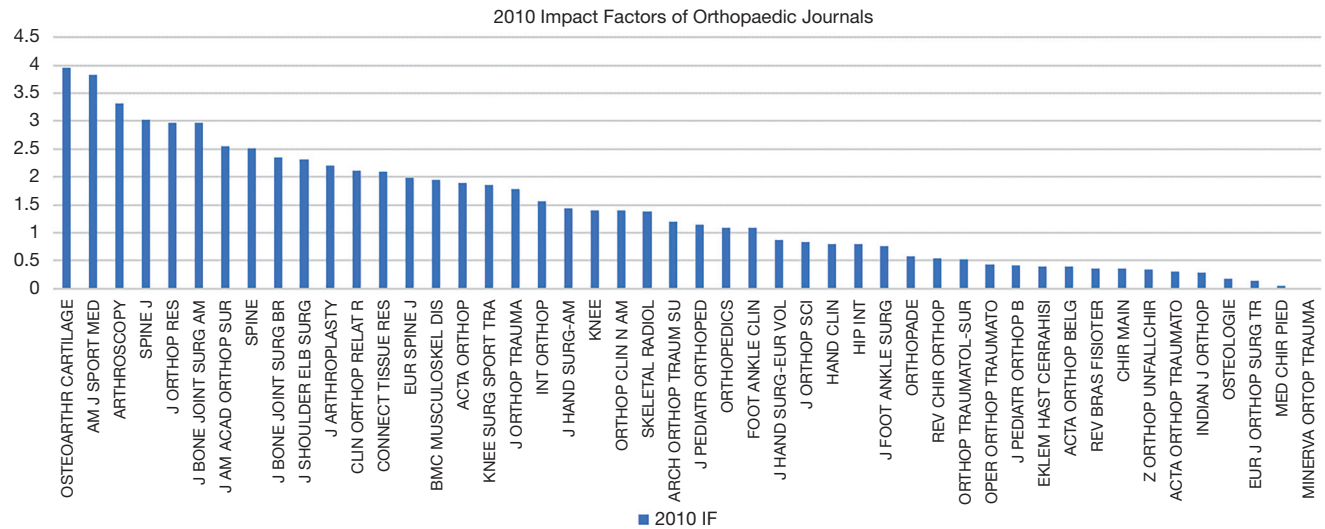

Figure 3 2010 impact factors of the journals listed in the JCR deemed to be primarily orthopaedic journals (as per *Table 1*), listed by accepted JCR abbreviation. JCR, *Journal Citation Report*.

48, and increased to 55 in 2016 (*Table 1*). There were 27 general orthopaedic journals published, and 28 specialist journals published. The mean IF increased from 1.4 (range, 0.0–3.9) in 2010 to 1.9 (range, 0.5–5.7) in 2016. In 2010, English was the most common language of publication (n=37, 77.1%), followed by German (n=4, 8.3%). The majority of journals were published in the United States (n=23, 47.9%). In 2016, the percentage of English journals increased to 87.3% (n=48), while the percentage of journals published in the United States remained about the same (n=26, 47.3%). A significant difference found between the IF of journals published in English and those published in other languages (P=0.004). IFs for 2016 ranged from 5.7 for the *American Journal of Sports Medicine* to 0.5 for the *Acta Ortopedica Brasileira* (*Figures 2,3*).

The mean IF of both general and specialized orthopaedic

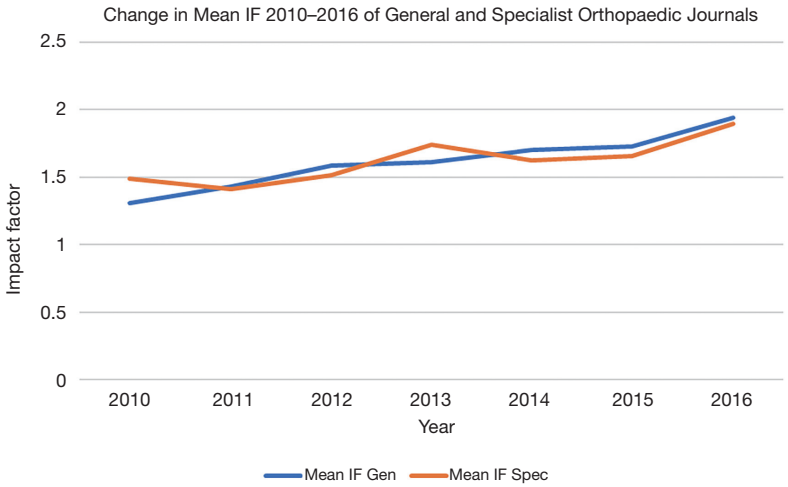

Figure 4 Change in mean impact factor of orthopaedic journals between 2010 and 2016. Orthopaedic journals (as per *Table 1*), listed by accepted JCR abbreviation. JCR, *Journal Citation Report*.

journals increased from 2010 to 2016 (*Figure 4*). There was no significant difference found between the mean IF of these groups in any of the years included (2010: P=0.563; 2011: P=0.945; 2012: P=0.807; 2013: P=0.689; 2014: P=0.807; 2015: P=0.812; 2016: P=0.889).

The majority of journals published in both 2010 and 2016 experienced an increase in IF (range, 0.04–1.9), while 5 journals had a decrease in IF: *Spine* (–0.011); *Spine Journal* (–0.062); *BMC Musculoskeletal Disorders* (–0.148); *Connective Tissue Research* (–0.261); and *Journal of Orthopaedic Research* (–0.284) (*Figure 5*).

The mean IF of the top 10 journals in both surgery and internal medicine increased from 2010 to 2016 (*Figure 6*). However, the increase within each specialty was found to be nonsignificant [internal medicine (IM): P=0.202; surgery: P=0.573] (*Figure 7*). The surgical journal with the highest IF, *Annals of Surgery*, experienced an increase in IF similar to the top orthopaedic journals (1.506). The internal medicine journals with the highest IF had major increases in IF from 2010 to 2016: *Journal of the American Medical Association* (JAMA) (14.394); *Lancet* (14.198), and *New England Journal of Medicine* (18.92) (*Figure 8*).

The field of orthopaedics has added at least 14 new journals since 2010, but concomitantly, approximately 7 journals ceased publication and no longer had any publication data (*Table 3*).

Discussion

Legislative efforts to improve healthcare quality have led to an increased demand for high quality research as a means of directing clinical practice (1,2). For orthopaedists, the importance of publishing the latest research in journals that garner large audiences is crucial, as both private and government insurance institutions look to improve care value by utilizing data from high impact journals (13,14). Currently, the most widespread method for assessing a journal's impact on the scientific community is through Eugene Garfield's "IF" algorithm. Therefore, this study was a continuation of Moverley *et al.*'s 2013 study (10), which assessed the IF trends in orthopaedics and provided comparisons to trends in major internal medicine and general surgery journals. Our findings revealed a mean increase in IF among orthopaedic journals, similar to the increase demonstrated among internal medicine and general surgery journals. Additionally, our study revealed an increase in the total number of orthopaedic journals published between 2010 and 2016, with a significant portion of journals published in English and in the United States.

This study was not without limitations. By utilizing an amalgamated database created by the Journal of Citation reports website (3), our results are subject to the same documentation and data collection errors that may have persisted on the website. Furthermore, this study is retrospective and does not denote causality, nor does it offer conclusive rationale to explain the phenomenon. At best, we are able to offer a hypothesis based on evidence in order to explain our findings. Despite these limitations, our study is a useful addition to the current literature and demonstrates an increase in orthopaedic journal IF between 2010 and 2016.

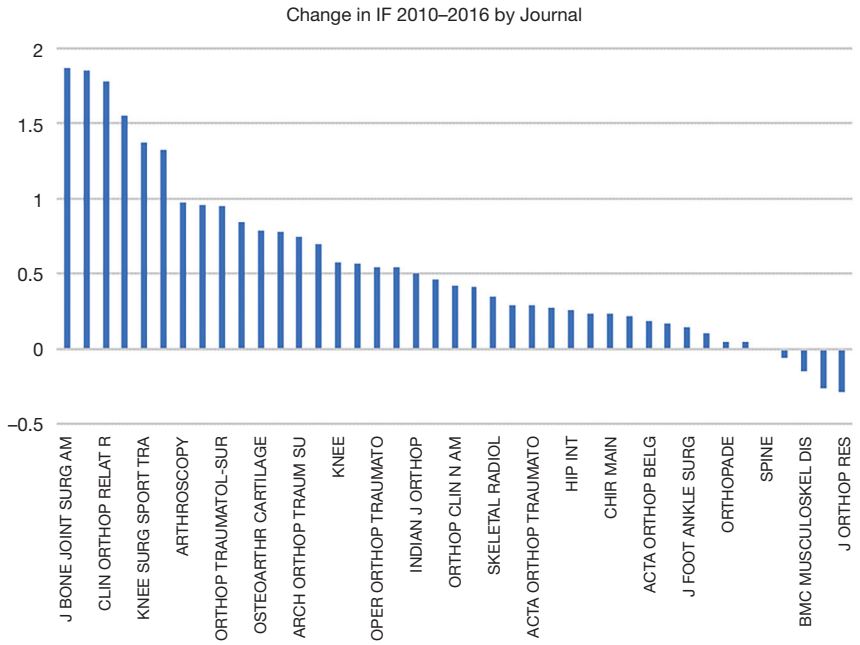

Figure 5 Change in impact factor from 2010 to 2016 for orthopaedic journals.

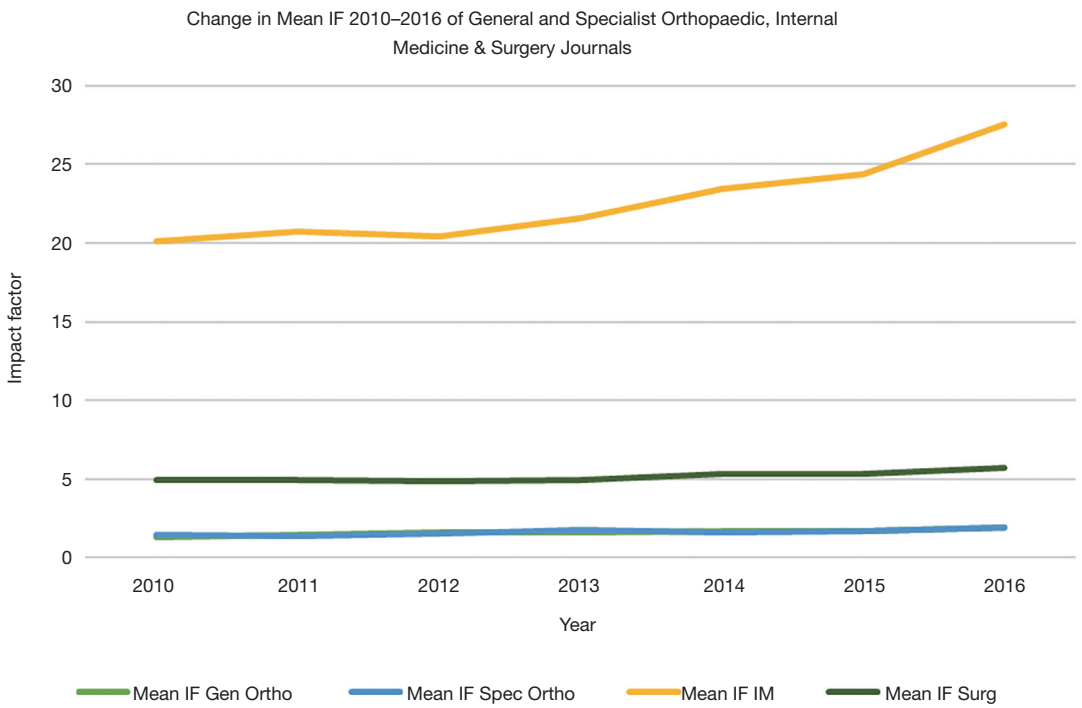

Figure 6 Change in mean impact factor of orthopaedic, internal medicine, and surgery journals from 2010 to 2016.

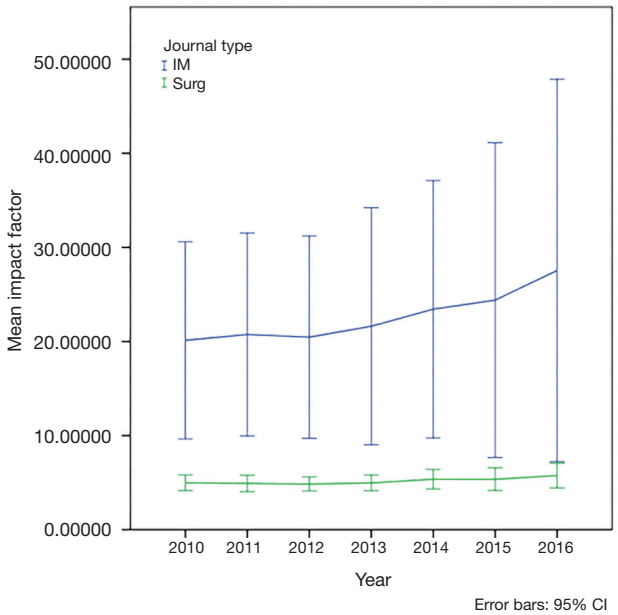

Figure 7 Change in mean impact factor of internal medicine and surgery journals from 2010 to 2016 (IM: P=0.202; surgery: P=0.573). IM, internal medicine.

Similar to our study, Moverley *et al*. (10) reported an increase in the number of orthopaedic journals (+17) and mean IF between the years 2000 and 2010. However, this increase may be the result of an increased number of inter-citations and self-citations between orthopaedic journals. Hakkalamani *et al*. (11) evaluated seven general orthopaedic journals {*Journal of Bone and Joint Surgery [JBJS (Am)]*, *the British volume of the Journal of Bone and Joint Surgery [JBJS (Br)]*, *Clinical Orthopaedics and Related Research (CORR)*, *Acta Orthopedica Scandinavica (Acta Orthop Scand)*, *International Orthopaedics (Int Orthop)*, *Orthopaedic Clinics of North America (OCNA) and the Archives of Orthopaedics and Trauma Surgery (Arch Orthop Trauma Surg)*} and reported a self-citation rate greater than 20%. Additionally, the authors reported a strong correlation between journal self-citation and reported IF (r=0.613; P<0.001). This may indicate that, while the amount of orthopaedic literature may be increasing, this literature may not be permeating non-orthopaedic audiences.

Despite the demonstrated increase in mean IF, its use as a measure of journal quality has been highly contested.

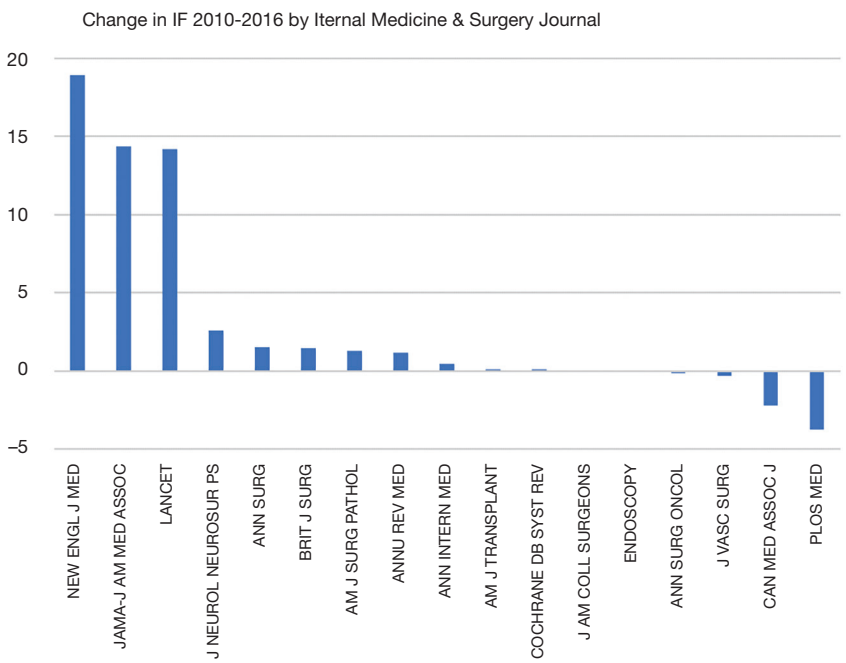

Figure 8 Change in impact factor from 2010 to 2016 for internal medicine and surgery journals.

Table 3 Top 10 journals in 2010, primarily focusing on internal medicine and surgery (accepted JCR abbreviations were used)

Title	Language	Published
Internal medicine journals (n=10)		
Ann Intern Med	English	USA
Annu Rev Med	English	USA
Arch Intern Med	English	USA
Brit Med J	English	UK
Can Med Assoc J	English	Canada
Cochrane Db Syst Rev	English	UK
Jama-J Am Med Assoc	English	USA
Lancet	English	UK
New Engl J Med	English	USA
Plos Med	English	USA
Surgery journals (n=10)		
Am J Surg Pathol	English	USA
Am J Transplant	English	Denmark
Ann Surg	English	USA
Ann Surg Oncol	English	USA
Arch Surg-Chicago	English	USA
Brit J Surg	English	UK
Endoscopy	English	Germany
J Am Coll Surgeons	English	USA
J Neurol Neurosur Ps	English	UK
J Vasc Surg	English	USA

JCR, *Journal Citation Report*.

Kodumuri *et al*. (15) evaluated publications from the top thirteen IF ranked journals in trauma and orthopaedics between the years 2007 and 2008, and assessed the number of citations at 2 and 5 years after publication. The authors revealed lower rates of mean citation among surgical papers at 2 years when compared to basic science papers (2.18 *vs*. 4.68, respectively). However, by 5 years post-publication, the citation rates were similar (26.57 for surgery, 30.35 for basic science/medical). The authors concluded that it may be necessary to adjust IF to measure citation rate at 5 years post-publication in order to be a more appropriate indicator of journal impact. The limitations housed by IF were further exemplified by a 2008 publication in *Acta Crystallographica* in which the authors explicitly asked readers to cite their publication. This resulted in over 10,000 citations, thus inflating the journal's IF from 2.051 (in 2008) to 49.926 (in 2009) and 54.333 (in 2010) (16,17).

Despite these objections, in the absence of a better system, IF is still largely used as a surrogate marker for excellence among universities and research funding institutes (15). Unfortunately, this places orthopaedic literature at a marked disadvantage when compared to medicine and surgery journals that also report on outcomes following orthopaedic intervention. Delanois *et al*. (13) evaluated all publications from *JAMA*, *NEJM*, and *Lancet* between January 1976 and December 2016 and found that 56% of orthopaedic publications reported on complications. Furthermore, the authors reported potential policy impact from nearly half (46%) of the publications that reported conclusively about the efficacy and/or advisability of orthopedic intervention. This effect may be augmented due to rise in IF among major IM journals, as demonstrated by our study.

Conclusions

Despite concerns, a journal's IF remains the most commonly used measure for evaluation of journal quality and impact. Between the years 2010 and 2016, there has been a significant increase in the number of peer-reviewed orthopaedic journals, and in mean orthopaedic journal IF. Furthermore, English journals from the United States continue to have the largest impact when compared to non-English journals and journals from outside the United States. However, this increased IF does not seem to translate to increased non-orthopaedic audiences, as health-care policy makers, and private institutions still utilize higher impact internal medicine journals to shape health-care. Future studies should aim to better qualify journal impact, while limiting confounders such as self-citation.

Acknowledgements

None.

Footnote

Conflicts of Interest: The authors have no conflicts of interest to declare.

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