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Influence of the International Journal of Exercise Science

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ABSTRACT

International Journal of Exercise Science 17(2): 265-273, 2024. The *International Journal of Exercise Science* (*IJES*) publishes research from numerous subdisciplines of exercise science and health. This study documented the scholarly influence of the initial 15-year history (2008-2022) of the *IJES*. Publication, indexing, from the *IJES* website and four database services: *Dimensions*, *Google Scholar* (*GS*), *PubMed*, and *SCImago Journal & Rank*. The *IJES* has published 1055 articles in 79 issues in the first 15 years. The top 106 (10%) cited articles received a total of 7,195 citations according to *GS*. Top-cited *IJES* articles had median citations and citation rates (CR) of 48 citations and 6.5 citations/per year, respectively over a median of 8 years since their publication. Most top-cited articles were original research (68%) and reviews (9%). Top-cited articles were most often on Fitness Assessment (28%) and Technology, Epidemiology, and Physical Activity (15%) topics. In addition to its mission to support scholarly expertise of students, *IJES* is consistently indexed in *GS* with CR to top 5% cited articles similar to many journals in kinesiology/exercise science and higher than professional and highly specialized journals. The most cited articles have been in the areas of Fitness Assessment, Biomechanics and Neural Control, and Cardiovascular and Pulmonary Physiology. The *IJES* makes influential contributions to subsequent research in kinesiology, exercise science, and health, primarily through highly cited original research and review articles.

KEY WORDS: Bibliometrics, contribution, impact, informetrics, knowledge, scientometrics

INTRODUCTION

Exercise science is the interdisciplinary study of evidence-based exercise prescription for a variety of objectives including physical health/wellness promotion, physical fitness, and sport performance. There are a wide variety of journals publishing research in exercise science, kinesiology, and related professional fields of human performance and health/medicine (18, 23). The collaboration of kinesiology/exercise science scholars with allied health/medical scholars to promote health benefits of exercise are common throughout the world (e.g., American College of Sports Medicine, British Association of Sport and Exercise Sciences, Scandinavian Foundation of Medicine and Science in Sports, Sports Medicine Australia) and all typically sponsor multidisciplinary journals. In 2008, Dr. T. Scott Lyons and Dr. James W. Navalta founded the *International Journal of Exercise Science* (*IJES*) to contribute to this global initiative, with a specific emphasis on publication of research led by or with contributing

graduate and undergraduate students. On the forefront of the open access journal movement, the *IJES* has had impressive initial success with over 50,000 article downloads from 45 countries in the first three years (28).

The contribution of scientific journals to knowledge development has been primarily based on analysis of citations to published articles in the three knowledge science fields: bibliometrics, informetrics, and scientometrics. The term bibliometrics will be used in this article to refer to all citation-based research from all these knowledge science fields, although this research also includes analysis of other measures (e.g., expert ratings, subscriptions). Bibliometric studies help scholars understand the development of scientific journals, fields, and the research topics they focus on.

In kinesiology/exercise science, for example, some studies have reported subjective scholar ratings of the prestige of journals in the field (26, 32, 36). There have been some citation-based studies published on exercise and sport science journals. These studies have focused on the most influential publications in athletics (13), physical therapy (3, 40), and sports and exercise medicine (14, 22). Other studies use bibliometric variables to document the influence of specific journals in biomechanics (20, 28), kinesiology (2, 17, 18, 25, 37), and sports medicine specializations (21, 27). To the author's knowledge, no bibliometric study, since the Lyons commentary (28) and recent examination of participant and author sex bias (8), has been published on the *IJES*. Little is known about the scholarly influence of *IJES* articles contributions to knowledge creation in exercise and health.

The purpose of this study was to document scholarly influence of the *IJES* using bibliometric data extracted from *Google Scholar* (*GS*). It was hypothesized that the majority of *IJES* articles would be indexed by *GS* and top-cited articles would have citation rates similar to median values reported for exercise and sports science/kinesiology journals and higher than specialized, sport-specific medicine and science journals. The study was important to understanding the recent development of *IJES* and documenting its influence on the field of kinesiology/exercise science beyond scholarly development of students through research. As the study did not involve human participants it did not require institutional IRB approval but did adhere to the ethical policies of *IJES* (33).

METHODS

Search

The investigators searched the *IJES* website, *PubMed*, and *GS* (https://scholar.google.com/) for publication data on the first 15 years (2008-2022) of the journal's history. The journal website was used to find the number of research articles (*N*=1055) and issues (*N* =79) published in this 15-year period. Articles included original research, technical notes, reviews, and editorials/position stands. Articles recognizing reviewers and retractions (n=1) were excluded. *PubMed* indexed 833 (79%) of *IJES* articles, while *GS* indexed over 95% (1000÷1055). The exact number would be prohibitively difficult to manually search for because *GS* will return only the

first 1000 records for any search. Searches for IJES in *GS* over these 15 years resulted in over 6000 records, primarily due to published conference proceedings abstracts that are rarely cited and are not part of this study. Two additional free database services *Dimensions* (https://www.dimensions.ai/products/all-products/dimensions-free-version/) and *SCImago Journal & Country Rank* (https://www.scimagojr.com/) were used to take advantage of recent indexing and citation metrics of *IJES* for the year 2021.

Google Scholar was searched several times in April and May of 2023 to extract bibliometric variables for the most cited (top 10%) articles indexed. The large positive skew of citations (17, 20, 34, 35) and numerous uncited articles (25, 38) in journals result in bibliometric research focusing on analysis on top (75^{th} to 99^{th}) percentiles (1). The "Advanced search" option of *GS* using "Return articles published in" *International Journal of Exercise Science* and "Return articles dated between" 2008 and 2022 was implemented. The investigators reviewed all 1000 records, extracting, entering, reviewing, and triple-checking data pasted into an Excel spreadsheet for the top 106 (top-cited 10%) *GS* records. The *GS* page rank algorithm generally returns record in descending order by citations, so the investigators were able to identify the top 10% cited *IJES* articles (Martin-Martin et al., 2017). Despite the greater requirement of manual data extraction and processing with *GS* compared to curated databases, *GS* is the bibliometric service with the most extensive indexing of peer-reviewed publications (5, 10, 11, 12, 30, 31), with outstanding performance for systematic reviews (9).

Variables

The bibliometric variables extracted from *GS* and verified with *PubMed* or the *IJES* website included: Authors, article title, number of authors, year of publication, article age (Age = 2023-year of publication), citations (C), and citation rate (CR = C/Age). C for all 1000 returned *IJES GS* records were recorded to identify the percentage of uncited articles (%UCGS). Additional journal metrics recently available for *IJES* for 2021 based on 2-years of *Scopus* citation data were also retrieved from *Dimensions* and *SCImago Journal & Country Rank*: external C per document (Impact Score2), Hirsh index (h2), Source Normalized Impact per Paper (SNIP2), SCImago Journal Rank (SJR2), and the percentage of uncited articles (%UCScopus2). *SCImago Journal & Country Rank* uses a standard 3-year window of *Scopus* data for these metrics, but the recent indexing of *IJES* by *Scopus* allow only two-years (2020-2021) for journal metrics that can be qualitatively compared with other journals in the field with 3-year metrics. The numeral in metric abbreviations in this report indicate the number of years used for citation analysis and it is common to have time windows of 2, 3 and 5 years.

Subject categories of *IJES* published research were examined by content analysis of the top-cited *GS* articles and database service-assigned categories. First, one investigator (DK) classified the top-cited research for article type and research category. Article types were either Editorial/Position Statement, Original Research, Review, or Technical Note. The investigator reviewed all abstracts and some full articles to subjectively classify the primary subdisciplinary topic as subject categories using the most recent *IJES* research sections: Biomechanics and Neural Control; Cardiovascular and Pulmonary Physiology; Clinical Exercise Physiology;

Fitness Assessment; Metabolism and Nutrition; Technology, Epidemiology, and Physical Activity; Physical Therapy and Athletic Training; Psychology and Behaviour; Quantitative; Sport Management; Sport Science; and an Other category. Subject categories for 2021 *IJES* articles were extracted from two database services: *Dimensions* and *SCImago Journal & Country Rank*.

Statistical Analysis

Given the strong positive skew of the citation data, the continuous variables descriptive statistics reported were the median, maximum, minimum, and 75th and 25th percentiles. Kendall's Tau (τ) was calculated to document associations between metrics for the top-cited articles given τ is the best statistic for skewed data with outliers (4). Statistical significance was accepted at $p < .01$ and interpretation of the size of significant τ values was made by converting them to correlations [r] (38) and calculating coefficients of determination. Categorical data were analyzed with frequency distributions. Statistical analyses were performed with *JMP Pro 14* (SAS Institute, Cary, NC).

RESULTS

The *GS* service likely indexes more than 95% (1000 return record limit ÷ 1055 articles published) of the *IJES* articles published from 2008 until 2022. Eighty-five percent (%UCGS = 15%) of the indexed articles were cited by subsequent research indexed by *GS*. The top 106 (10%) cited articles received a majority (7,195 or 52%) of the *GS* citations to all the 1000 indexed articles (C = 13,900) due to the large positive skew of the data. The top-cited articles typically (Median) had 4 authors, 48 citations, 6.5 citations per year, over 8 years since their publication (Table 1). The *Dimensions* and *PubMed* databases indexed 833 *IJES* articles. Journal citation metrics for *IJES* in 2021 were 1.15 C/document, h2 = 5, %UCScopus2 = 41, SJR2 = 0.351, and SNIP2 = 0.463. Two of six associations were significant ($p < .001$), with CR having τ values equal to correlations of 0.705 with C and -0.645 with Age for top-cited *IJES* articles.

The top 10% cited *IJES* articles were primarily original research (68%), with fewer reviews (9%), technical notes (17%), and editorials/position statements (4%). The most common research categories of top-cited articles were in Fitness Assessment (28%), Cardiovascular and Pulmonary Physiology (16%), Technology, Epidemiology, and Physical Activity (15%), and Biomechanics and Neural Control (11%). Citations, article type, and research subject for the top 15 cited *IJES* articles are presented in Table 2. Almost all represent a "citation classic" using the smaller field standard of C > 100 recommended by Garfield (n.d.), although this standard was proposed for C from *Journal Citation Reports*. The Navalta et al. (2019) article dominates citation totals due to its required citation by the *IJES* editors to support ethical research and reporting practices in articles published in the journal.

Table 1. Descriptive statistics for the 106 top-cited (10%) *International Journal of Exercise Science* articles indexed in *Google Scholar*.

Variable	Max	75%	50%	25%	Min	Skew
N Authors	8	5	4	2.8	2	0.7
C	526	71	48	35	30	4.6
Year	2020	2017	2015	2012	2008	-0.4
Age	15	11	8	6	3	0.4
CR	132	9.8	6.5	4.6	2.4	6.4

Note: Abbreviations: Maximum-Max, Minimum-Min, Number of authors-N Authors, Citations-C, Year of publication-Year, Time since publication-Age=2023-Year, and Citation Rate-CR=C/Age.

Dimensions classified the 833 indexed *IJES* articles into five subject categories: Health Science (99%), Sports Science and Exercise (76%), Public Health (16%), Psychology (16%), and Allied Health and Rehabilitation Science (14%). *SCImago Journal & Country Rank* reported that *Scopus* classified *IJES* articles into "Occupational Therapy" and "Physical Therapy, Sports Therapy and Rehabilitation" within Health Sciences and "Health (social science)" within Social Sciences.

Table 2. Top 15 cited *International Journal of Exercise Science* articles indexed in *Google Scholar*.

Author(s)	Year	C	CR	Article Type	Category
Navalta JW et al.	2019	526	132	ED/PS	Other
Bishop PA et al.	2015	435	54	Tech Note	Quant
Peacock CA et al.	2014	206	23	Org Research	FA
Barkley JE et al.	2020	168	56	Org Research	TE&PA
Siegel SR et al.	2009	167	12	Org Research	C&PP
Calestine J et al.	2017	157	26	Org Research	FA
Bunn JA et al.	2018	152	30	Review	TE&PA
Petrella JK et al.	2008	149	10	ED/PS	Other
Gaedtke A et al.	2015	148	19	Org Research	FA
Scribbans TD et al.	2016	141	20	Review	FA
Brudzynski L et al.	2010	119	9	Org Research	P&B
Del Porto H et al.	2012	119	11	Review	B&NC
Fountaine CJ et al.	2011	117	10	Org Research	TE&PA
O'Donnell S et al.	2017	110	18	Org Research	C&PP
Barreira TV et al.	2009	99	7	Tech Note	TE&PA

Note: Article types include: Editorial/Position Stand–ED/PS, Original Research–Org Research, Review, and Technical Note–Tech Note. Research subject categories: Biomechanics and Neural Control–B&NC, Cardiovascular and Pulmonary Physiology–C&PP, Fitness Assessment–FA, Technology, Epidemiology and Physical Activity–TE&PA, Psychology and Behavior–P&B, Quantitative–Quant, and Other.

DISCUSSION

The hypothesis of a majority of *IJES* articles being indexed by *GS* was supported with likely more than 95% coverage. In addition, the open access, indexing in *Dimensions*, *PubMed*, and now *Scopus* help contribute to the visibility of articles published in the journal. The 15% of articles indexed in *GS* but not receiving citations was similar to the 10-20% uncited for many sports medicine journals over 6 to 10 years in studies of 60 and 85 kinesiology-related journals (16, 19). The 41% uncited in two years for 2021 from *SCImago Journal & Country Rank* is also good compared to the three-year *Scopus* median uncited percentage reported (42 – 44%) for

kinesiology-related journals (17, 19). The smaller size, number of references, and slower cited half-life in many subdisciplines of kinesiology/exercise science likely results in slower citation of *IJES* research relative to other, faster biomedical sciences.

The hypothesis that top-cited *IJES* articles would have citation rates similar to median values previously reported for exercise and sports science/kinesiology journals and higher than specialized, sport-specific medicine and science journals was partially supported. The median CR for top-cited *IJES* articles of 7 citations per year was within the range (1 to 18 C/year) of median *GS* CR for top 30 cited articles of multidisciplinary kinesiology-related journals. For example, the *IJES* CR was also similar to the *GS* CR of other subdisciplinary journals: *Pediatric Exercise Science* (7.7) and *International Journal of Sports Medicine* (7.9) previously reported (18). The CR to *IJES* articles is likely higher than (1 - 2 C/year) specialized (e.g., *Isokinetics and Exercise Science; Sports Engineering*) and professional (e.g., *Strength and Conditioning Journal*) journals (18). *JESP* CR are also likely higher than CR (2 - 4 C/year) for top articles in specialized tennis sports medicine journals (21, 27).

Journal citation metrics for 2021 *IJES* supported developing use of this new journal relative to the subject categories assigned to it by *Scopus*. The *Scopus* based *IJES* usage values for 2021 (SRJ2 = 0.351 and SNIP2 = 0.463) were lower than the mean *Scopus* journal value of 1.0 and the median values (SJR3 = 0.8 & SNIP3 = 1.2) reported in a study of 114 kinesiology-related journals (25). The 2021 *IJES* Impact Score2 of 1.15 C/document was lower than the Impact Score3 for the *Measurement in Physical Education and Exercise Science* (2.30) but was similar to an open access journal of similar age (*International Journal of Kinesiology and Sports Science* = 1.05) and larger than *Isokinetics and Exercise Science* (0.74). The initial 2-year journal h-index is difficult to interpret because of the influence of additional time (3 or 5-years) typical of journal h-index values. In totality, the indexing, citation, and citation metric results in this study support the growing influence of *IJES* articles in contributing to current research in exercise, sport, and health sciences among a hyper-competitive world of scholarly journals. This subsequent citation of most articles published by the journal indicates meaningful and growing influence of the journal.

The contributions of top-cited *IJES* articles were primarily through original research and review studies. Top-cited articles came from nine of the twelve subdisciplinary subject areas, with none from Clinical Exercise Physiology, Sport Management, or Sport Science. Top-cited articles were most often from Fitness Assessment and Technology, Epidemiology, and Physical Activity. Citation patterns to articles in journals vary widely by research topics, which in turn influence the highly variable subject categories assigned to journals by databases (22, 24). *Dimensions* and Scopus assign *IJES* articles most often to health professions/sciences, followed by sport and exercise science, public health and psychology/social science which was generally consistent with the distribution of the subdisciplinary sections of the top-cited articles in *GS* (Table 2). While a multidisciplinary journal like *IJES* makes contributions in most all subdisciplines of the field, it is likely to be assigned to a variety of subject categories by bibliometric database services (22) related to their indexing/coverage, the nomenclature they use, and the top-cited articles from the journal.

Results of this study should be interpreted considering its limitations. The study was limited to bibliometrics data from *GS*, however it is the most comprehensive bibliometric database. In addition, citation data in *GS* are not curated and citations are continuously being updated over time. Analysis of other databases would find different levels of scholarly usage due to different time points, curation/indexing, data and searching errors. The study is also limited by the unknown content validity and reliability of the investigator's classification of article type and research category. There is likely inconsistency in how other scholars might classify technical note study focusing on measurement issues of wearable sensors as primarily FA, Q, or TE&PA. Another limitation is the common bias of databases toward research reported in the English language. Considerable research is published in other languages, and although *GS* does index some of this work more than other databases, most top-cited research is primarily written in English. Given the limitations of all databases, the scholarly influence of *JSEP* articles is likely greater than what is documented by analysis of indexing and citations of four databases. The very high correlations ($r > 0.9$) between citation metrics of different databases (6, 18, 23, 30) and consistency of *GS* results with the 2-year *Scopus* journal metrics for the journal, however, support the validity of the current results.

In addition to its mission to support scholarly expertise of students, the *IJES* is consistently indexed in *GS* with CR to top 10% cited articles similar to many journals in kinesiology/exercise science, and higher than professional and highly specialized journals. The *IJES* makes meaningful and growing contributions to subsequent research in kinesiology, exercise science, and health, primarily through highly cited original research and review articles. The most cited articles have been in the areas of Fitness Assessment, Biomechanics and Neural Control, and Cardiovascular and Pulmonary Physiology.

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