Running Head: Top Cited Research

TOP CITED RESEARCH OVER FIFTEEN YEARS IN *SPORTS BIOMECHANICS*

Duane Knudson

Department of Health and Human Performance

Texas State University

San Marcos, TX, USA

In accordance with Taylor & Francis policy and my ethical obligation as a researcher, I am reporting that I serve on the editorial board and publish in the journal under study that may be affected by the research in this report.

Accepted manuscript version reprinted, by permission, from *Sports Biomechanics*
doi:10.1080/14763141.2018.1518478

Abstract

This study tested the hypothesis of the strong scholar perception of the journal *Sports Biomechanics* with a bibliometric analysis of top cited articles. Three major databases, *Google Scholar, Scopus, and Web of Science*, were searched for the most cited articles published in *Sports Biomechanics* for the first fifteen years (2002-2016) of publication. The top twenty (4%) cited articles from each database were qualitatively analysed for research themes and descriptive statistics calculated for citations and citation rates. The top cited articles published in *Sports Biomechanics* had high citation rates and included several citation classics, indicating strong contributions to the advancement of knowledge in applied biomechanics and beyond. The results support previous high ratings of the journal by sport and exercise biomechanics scholars and refute the biased and lower ranking based on the *Web of Science* Impact Factor. There was moderate (40-70%) agreement on the top twenty cited articles between the three databases due to differences in indexing and temporal coverage.

Keywords: bibliometrics, impact, journal, usage

Introduction

The fields of bibliometrics, scientometrics, and informetrics focus on the statistical evaluation of science through examination of publications and citations. A wide variety of citation metrics are available that provide information on the impact or influence of journals, specific publications, and authors (Bornmann & Leydesdorff, 2013; Tahira, Abdullah, Alias, & Bakri, 2016; Wildgaard, Schneider, & Larsen, 2014). Bibliometric analyses of citation metrics have been used to evaluate the influence of research in disciplinary fields (e.g., Khoo, Li, & Ansari, 2018; Shadagan, Roig, HajGhandari, & Reid, 2010), movement activities (e.g., Knudson, 2012; Marquez-Lara, Stone, Luo, Parker, Sharma, & Freehill, 2017), and specific journals (e.g., Coronado, Wurtzel, Simon, Riddle, & George, 2011).

The journal *Sports Biomechanics* is the primary publication of the International Society of Biomechanics in Sports (ISBS), focusing on generating new knowledge and practical applications of that knowledge to benefit sports practitioners. The influence of *Sports Biomechanics* has grown through its acceptance for indexing and impact factor (IF) calculation in Clarivate Analytics *Web of Science*, as well as its growth in numbers of issues and articles published annually. The 2016 5-year IF for the journal (1.4) places it in the 4th quartile of journals in the ‘sports science’ category of *WS*. While the IF has some utility in library science, it suffers from several biases that make it a poor indicator of overall quality of a journal or the articles it publishes (Kurmis, 2003; Moed, 2002; Seglen, 1992, 1997; Zhang, Rousseau, & Siversten, 2017). Numerous commentaries and organizations do not recommend the use of the IF in evaluating the quality of journals or articles published in them (Declaration on Research Assessment, 2015;

Hicks, Wouters, Waltman, de Rijcke, & Rafols, 2015). Use of the IF as a surrogate estimate of the impact of research published in *Sports Biomechanics* is likely biased due to the low citation rate and small size of the field. Overemphasis of the journal IF may disadvantage authors of these scholarly contributions to applied sport and exercise biomechanics in the journal.

Initial evidence supports the hypothesis of greater scholarly influence of *Sports Biomechanics* than indicated by the IF. Analyses of several citation metrics for *Sports Biomechanics* indicate second quartile impact and prestige of the journal within kinesiology/exercise science journals (Knudson, 2013a; Knudson, 2013b). Biomechanics scholar ratings of quality and impact of biomechanics journals also do not correlate well (r^2 between 12 and 23%) with the IF (Knudson & Chow, 2008; Knudson & Ostarello, 2008, 2010). *Sports Biomechanics* has been highly (top 18%) rated for 'quality or impact' by American Society of Biomechanics (ASB) members affiliating with the 'Exercise and Sport Sciences' interest area (Knudson & Chow, 2008) and ISBS members (Knudson & Ostarello, 2008). Disciplinary specificity of citation metrics and perception of prestige are robust observations in journal evaluation research (Seglen, 1992, 1997; Zhang, Rousseau, & Sivertsen. 2017), even within a small field like biomechanics (Knudson & Chow, 2008).

Given the likely difference in the perception of scholarly influence and prestige of the journal *Sports Biomechanics* between biomechanics scholars and the biased use of the IF, additional bibliometric data were needed on the journal. This study tested the strong perception of the influence of *Sports Biomechanics* by biomechanics scholars by examining the bibliometrics of the top cited articles from the first 15 years (2002 – 2016)

of its publication. Secondary purposes included documentation of content areas in sports biomechanics of recent interest and high influence, as well as confirmation of citation rates previously reported for journals (Knudson, 2014, 2015a, 2015b, 2017), citation classics (Knudson, 2014, 2015), and influential scholars (Knudson, 2015c; 2017, Knudson, 2018) in biomechanics. It was hypothesized that top cited articles from *Sports Biomechanics* would have citation totals and citation rates indicating greater influence than the lower quartile influence implied by its most recent IF.

Methods

Timeframe and Sample

The influence of *Sports Biomechanics* was examined using citations in the peer-reviewed literature to articles published in the journal. Citation count is the most common metric documenting scholarly usage, a sub-domain of impact or influence (Bornmann & Daniel, 2008; Moed, 2002). Several large factor analyses also support the interpretation of citation count as a measure of scholarly usage (Bollen, Van de Sompel, Hagberg, & Chute, 2009; Franceschet, 2010; Leydesdorff, 2009; Zhou, Lu, & Li, 2012).

Since citations are time-dependent and accumulate over time, the study of top cited articles in *Sports Biomechanics* was limited to the first fifteen years (2002-2016) of publication. This large span of time provided the best compromise of breadth of time to document influence of the journal in the scientific literature and minimizing the negative effect of not having enough time to receive citations for the most recent articles (2017-2018). The two-year window for the IF calculation may be too short for a field like biomechanics that has a slower rate of citations (Knudson, 2014, 2015a, 2015b, 2017) than many other large and fast moving biomedical fields.

Over this fifteen-year period, *Sports Biomechanics* published 475 articles indexed by the Elsevier *Scopus* database. To focus on the most influential contributions of the journal to the scientific literature, this study examined the 20 most cited (Top 4%) articles.

Databases and Search

To provide the most thorough examination of the potential influence of the journal, the three major bibliometric databases were searched: *Google Scholar* (*GS*), *Scopus* (*SC*), *and Web of Science* (*WS*). *GS* is the most comprehensive scholarly search engine of diverse publications captured in a database by Google search software. Elsevier *SC* is the world's largest scholarly abstract and citation database covering journals, proceedings, and books since 1823, 1980, and 2005, respectively. Clarivate Analytics *Web of Science* is perhaps the most well-known and selective scholarly database. One study estimated the peer-reviewed journal coverage of *GS*, *SC*, and *WS* at approximately 40, 20, and 10 thousand journals, respectively (Delgado-Lopez-Cozar & Cabezas-Clavjo, 2013).

All three databases were searched for articles published in S*ports Biomechanics* from 2002 until 2016. The results were then sorted by citations, checked for errors and the twenty articles with the most citations identified. Authors, titles, total citation count (C), and bibliographic information were recorded for each top 20 article. The mean citation rate [CPY=C÷(2018-year of publication)] until the time of database search was calculated for each article.

Analysis

Descriptive statistics (*M*, M_e, *SD*, and skew) were calculated for C and CPY. Since bibliometric databases index different publications, the percentage agreement to the top 20 cited articles between the databases was calculated. Percentage agreement was the percentage of common articles within the top 20 articles in each database. A content analysis of the most cited articles retrieved from all three databases was performed. The percentage of kinds of articles (original research, review, and technical note) and topics addressed by the most cited articles were collated and reported.

Results

The top 20 cited articles in *Sports Biomechanics* from 2002 to 2016 were consistent across the three databases (Table 1), with 32 unique top cited articles between the databases. Percentage agreement of top cited articles between *GS*, *SC* and *WS* were 70% and 45% respectively. Agreement between *SC* and WS was lower at 40%. Top 20 cited articles in all databases had skewed (γ = 2.5 to 3.5) distributions. Median citations to top articles were the largest from the *GS* database (98), with smaller citations in the *SC* (53) and *WS* (34) databases. Median citation rates for these top articles ranged from 4 to 9 citations per year.

Of the 32 unique, highly cited articles published in *Sports Biomechanics*, most (78%) were original research reports, followed by reviews (19%), and one technical note (3%). The most influential biomechanics topics within the top cited articles in the journal were kicking and running (both 13%), followed by 9% for movement variability swimming, throwing, and training/conditioning.

Discussion and Implications

The current study provided new evidence of the scholarly influence of top twenty cited articles published in the first fifteen years of *Sports Biomechanics*. The top twenty citations to the journal from all databases were positively skewed which was consistent with most all citation data (Knudson, 2015a, 2015b; Seglen 1992, 1997). Eight articles met the usual standard (C>100) for designation as citation classics (Table 1). The high total citation counts from all three databases indicate high usage of this research in the subsequent peer-reviewed literature.

The citation rates to these top cited articles ranged between 2 and 27 citations per year, also indicating consistent annual usage in subsequently published research. Median citation rates of these *Sports Biomechanics* articles were similar to mean and median citation rates to top 20-50 cited articles reported for several biomechanics journals (Knudson, 2014, 2015a, 2015). Typical citation rates in biomechanics journals tend to be above average within the sub-disciplines kinesiology/exercise science (Knudson, 2014, 2015a, 2015b), but lower than some large, fast biomedical fields (Owlia, Vasei, Goliaei, & Nassiri, 2011). These results indicate that articles in *Sports Biomechanics* are strong contributors to the scholarly literature beyond the immediate mission of the journal to advance application in sport and exercise.

The high citation counts and citation rates to these articles in *Sports Biomechanics* supported the hypothesis of greater influence of the journal than indicated by its *WS* IF. The high total C and CPY values, along with numerous citation classics (C>100), indicate strong contributions by the journal to the advancement of knowledge in applied biomechanics and beyond. This strong academic influence is

impressive given the small size of this specialized biomechanics journal and the bias of the *WS* IF against small journals with moderate citation rates (Kurmis, 2003; Moed, 2002; Seglen, 1992, 1997; Zhang, Rousseau, & Siversten, 2017).

The substantial influence of top cited articles in *Sports Biomechanics* from citation metrics were also consistent with the strong perceptions of 'quality or impact' of the journal by scholars interested in sport and exercise biomechanics (Knudson & Chow, 2008; Knudson & Ostarello, 2008). The high citation rate of these *Sports Biomechanics* articles also indicated that the journal might be more influential outside sport and exercise biomechanics than was apparent in the study of ASB scholars who tended to favour journals from their own research specializations within biomechanics (Knudson & Chow, 2008). The current results indicating strong influence of articles in *Sports Biomechanics* should be extended by further research focusing on disciplinary expert review of research quality. To date the only peer reviewed studies of the quality of biomechanics research methods has examined other journals than *Sports Biomechanics* (Knudson, 2005; Vagenas, Palaiothodorou, & Knudson, 2018).

Of interest to ISBS and the field of biomechanics are the influential research topics by articles published in the journal. Numerous original research studies of a wide variety of sports and fundamental movements in the journal were highly cited in these databases. The most common topics to become highly cited articles, however were on kicking and running. Other highly cited article topics included movement variability swimming, throwing, and training/conditioning.

What specific articles were ranked the highest by citations depended on the database searched and time since article publication. The top 20 citations according to

WS only include journals accepted into that database, so results of the search did not consider articles before 2006. *Sports Biomechanics* was not accepted into this database for indexing until that year. *GS* and *SC* searches produced higher citation counts, from both indexing more sources and including older articles than *WS*. These data confirm the influence of Sports Biomechanics in the scholarly literature is greater than is indicated by the biased *WS* IF. Differences in numbers of articles indexed were the likely cause of the moderate agreement in the top 20 cited articles between databases. The effect of time since publication was most obvious in the different ranking of articles based on CPY and C from the *GS* and *SC* databases (Table 1).

Given the applied mission of *Sports Biomechanics*, search results from *GS* and *SC* may be more relevant to documenting widespread and applied influence of articles published in the journal. Researchers should use multiple databases and consider the weaknesses and errors in all databases (Delgado-Lopez-Cozar & Cabezas-Clavjo, 2013; Franceschini, Maisano, & Mastrogiacomo, 2016; Rossner, Van Epps, & Hill, 2007, 2008; The PLoS Medicine Editors, 2006; Walters, 2009) when conducting and interpreting results of bibliometric studies.

This study had limitations that should be considered in interpreting the results. The study focused on the most influential articles (top 4%) published by *Sports Biomechanics*. While this methodology emphasized only highly influential articles, this is likely representative of the usage of all journals, given the large skew of citation distributions (Knudson, 2015a, 2015b; Seglen, 1992, 1997) and numerous uncited articles (Knudson, 2015a, Stern, 1990; Van Dalen & Henkens, 2004). Consequently, these data likely create an accurate representation of the overall scholarly

usage/influence of *Sports Biomechanics*. The time interval of the study was as large as could be considered meaningful, however database search results of citations to articles in a journal will change as time after publication increases and research trends change. Citations of articles also only measure the academic usage domain of influence or impact. The true quality of articles published in a journal are best determined by expert disciplinary review. Despite these limitations, the results provide evidence of the influence of articles and influential topics of research published in *Sports Biomechanics*.

Conclusion

Indexed citations in three databases indicated that the top twenty cited articles published in *Sports Biomechanics* were likely influential in subsequently published peer-reviewed literature. Several citation classics and articles with high mean citation rates published in the journal indicate strong contributions to the advancement of knowledge in applied biomechanics and beyond. These data also support previous high quality and impact ratings of the journal by sport and exercise biomechanics scholars and refute the likely biased, lower ranking based on the *WS* IF.

References

Bollen, J., Van de Sompel, H., Hagberg, A., & Chute, R. (2009). A principle component analysis of 39 scientific impact measures. *PLoS One*, *4*(6), e6022. doi:10.1371/journal.pone.0006022

Bornmann, L., & Daniel, H-D. (2008). What do citation counts measure? A review of studies on citing behavior. *Journal of Documentation, 64*, 45-80. doi:10.1108/00220410810844150

Bornmann, L, & Leydesdorff, L. (2013). The validation of (advanced) bibliometric indicators through peer assessments: A comparative study using data from InCites and F1000. *Journal of Informetrics, 7*, 286-291. doi:10.1016.j.joi.2012.12.003

Coronado, R. A., Wurtzel, W. A., Simon, C. B., Riddle, D. L., & George, S. Z. (2011). Content and bibliometric analysis of articles published in the *Journal of Orthopaedic & Sports Physical Therapy*. *Journal of Orthopaedic & Sports Physical Therapy, 41*, 920-931, doi:10.2519/JOSPT.2011.3808

Declaration on Research Assessment. (2015). *Declaration on research assessment*. http://www.ascb.org/dora/

Delgado-Lopez-Cozar E., & Cabezas-Clavjo, A. (2013). Ranking journals: Could google scholar metrics be an alternative to journal citation reports and Scimago journal rank? *Learned Publishing*, *26*, 101–114. doi:10.1087/20130206

Franceschet, M. (2010). The difference between popularity and prestige in the sciences and in the social sciences: a bibliometric analysis. *Journal of Informetrics*, *4*, 55-63.

Franceschini, F., Maisano, D., & Mastrogiacomo, L. (2016). The museum of errors/horrors in Scopus. *Journal of Informetrics, 10*, 174-182. doi:10.1016/joi2015.11.006

Hicks, D., Wouters, P., Waltman, L., de Rijcke, S., Rafols, I. (2015). The Leiden Manifesto for research metrics. *Nature*, *520*, 429-431. doi:10.1038/520429a

Khoo, S., Li, C., & Ansari, P. (2018). The top 50 most cited publications in disability sport: A bibliometric analysis. *Perceptual and Motor Skills*, doi:10.1177/0031512518760350

Knudson, D. (2005). Statistical and reporting errors in applied biomechanics research. In Q. Wang (Ed.) *Proceedings of XXIII International Symposium on Biomechanics in Sports: Volume 2* (pp. 811-814). Beijing: China Institute of Sport Science.

Knudson, D. (2012). Citation classics in tennis medicine and science. *Journal of Medicine and Science in Tennis*, *17*, 118-122.

Knudson, D. (2013a). Top journals related to kinesiology according to the SCImago database. *Chronicle of Kinesiology in Higher Education, 24*(2), 21-25.

Knudson, D. (2013b). Impact and prestige of kinesiology-related journals. *Comprehensive Psychology*, *2*, 13. doi:10.2466/50.17.CP.2.13

Knudson, D. (2014). Citation rates for highly-cited papers from different sub-disciplinary areas within kinesiology. *Chronicle of Kinesiology in Higher Education*, *25*(2), 9-17.

Knudson, D. (2015a). Citation rate of highly-cited papers in 100 kinesiology-related journals. *Measurement in Physical Education and Exercise Science*, *19*, 44-50. doi:10.1080/1091367X.2014.988336

Knudson, D. (2015b). Evidence of citation bias in kinesiology-related journals. *Chronicle of Kinesiology in Higher Education*, *26*(1), 5-12.

Knudson, D. (2015c). Biomechanics scholar citations across academic ranks. *Biomedical Human Kinetics*, *7*, 142-146. doi:10.1515/bhk-2015-0021

Knudson, D. (2017). Profiles of excellence in sports biomechanics research. In Potthast, W., Niehoff, A., & David, S. (Eds.) *Proceedings of the 35th International Conference on Biomechanics in Sports.* (pp. 831-834). Cologne, Germany: German Sport University Cologne.

Knudson, D. (2018). Citation metrics of excellence in sports biomechanics research *Sports Biomechanics*, doi:10.1080/14763141.2017.1391328

Knudson, D., & Chow, J. (2008). North American perception of the prestige of biomechanics serials. *Gait & Posture*, *27*, 559-563. doi:10.1016/j.gaitpost.2007.07.005

Knudson, D., & Ostarello, J. (2008). International prestige of sports biomechanics serials. In Y.H. Kwon, J. Shim, & I.S. Shin (Eds.) *Proceedings of the XXVIth International Conference on Biomechanics in Sports* (pp. 62-66). Seoul: Seoul National University.

Knudson, D., & Ostarello, J. (2010). Influential literature in applied sports biomechanics. In R. Jensen, W. Ebben, E. Petushek, C. Richter, & K. Roemer (Eds.) *Scientific*

Proceedings of the 28th Conference of the International Society of Biomechanics in Sports (pp.765-768). Marquette, MI: Northern Michigan University.

Kurmis, A. P. (2003). Understanding the limitations of the journal impact factor. *Journal of Bone and Joint Surgery (Am)*, *85A*, 2449–2454.

Leydesdorff, L. (2009). How are new citation-based journal indicators adding to the bibliometric toolbox? *Journal of the American Society for Information Science and Technology*, *60*, 1327 - 1336.

Marquez-Lara, A., Stone, A. V., Luo, T. D., Parker, B. R., Sharma, A., & Freehill, M. T. (2017). Top 50 cited journal articles on overhead throwing athletes: A bibliometric analysis. *JSES Open Access, 1*, 55-62. doi:10.1016/j.jses.2017.06.007

Moed, H. F. (2002). The impact-factors debate: The ISI's uses and limits. *Nature, 415*(6873), 731–732. doi:10.1038/415731a

Owlia, P., Vasei, M., Goliaei, B., & Nassiri, I. (2011). Normalized impact factor (NIF): An adjusted method for calculating the citation rate of biomedical journals. J*ournal of Biomedical Informatics, 44*, 216-220. doi:10.1016/j.jbi.2010.11.002

Rossner, M., Van Epps, H., & Hill, E. (2007). Show me the data. *Journal of Cell Biology, 179*, 1091-1092. doi:10.1083/jcb.2007.11140

Rossner, M., Van Epps, H., & Hill, E. (2008). Irreproducible results: A response to Thompson Scientific. *Journal of Cell Biology, 180*, 254-255.

Seglen, P. O. (1992). The skewness of science. *Journal of the American Society for Information Science, 43*, 628-638. doi:10.1136/bmj.314.7079.497

Seglen, P.O. (1997) Why the impact factor of journals should not be used for evaluating research. *British Medical Journal*, *314*, 497-502.

Shadagan, B., Roig, M., HajGhanbari, B., & Reid, W. D. (2010). Top-cited articles in rehabilitation. *Archives in Physical Medicine and Rehabilitation, 91*, 806-815. doi:10.1016/j.apmr.2010.01.011

Stern, R. E. (1990). Uncitedness in the biomedical literature. *Journal of the American Society for Information Science, 41*, 193–196.

Tahira, M., Abdullah, A., Alias, R. A., & Bakri, A. (2016). Evaluation of new research performance indices at the researcher level. *Information Development*, doi:10.1177/0266666916674251

The *PLoS Medicine* Editors (2006) The impact factor game. *PLoS Medicine 3*(6), e291. doi:10.1371/journal.pmed.0030291

Vagenas, G., Palaiothodorou, D., & Knudson, D. (2018). Thirty year trends of study design and statistics in applied sports and exercise biomechanics research. *International Journal of Exercise Science, 11*, 239-259.

Van Dalen, H. P., & Henkens, K. (2004). Demographers and their journals: Who remains uncited after ten years? *Population and Development Review, 30*, 489–506.

Walters, W. H. (2009). Google Scholar search performance: Comparative recall and precision. *Libraries and the Academy*, *9*, 5–24. doi:10.1353/pla.0.0034

Wildgaard, L., Schneider, J.W., & Larsen, B. (2014). A review of the characteristics of 108 author-level bibliometric indicators. *Scientometrics, 101*, 125-158. doi:10.1007/s11192-014-1423-3

Zhang, L., Rousseau, R., & Sivertsen. G. (2017). Science deserves to be judged by its contents, not by its wrapping: Revisiting Seglen's work on journal impact and

research evaluation. *PLoS ONE, 12*(3), e0174205. doi:10.1371/journal.pone.0174205

Zhou, Y. B., Lu, L., & Li, M. (2012). Quantifying the influence of scientists and their publications: distinguishing between prestige and popularity. *New Journal of Physics*, *14*, 033033. doi:10.1088/1367-2630/14/3/03303

Table 1
Twenty Most Cited *Sports Biomechanics* Articles in Major Bibliometric Databases

Google Scholar 2002-2016

Author(s)	Title	Vol:Page	C	CPY
Bartlett et al.	Is movement variability important . . .	6:224	295	26.8
Fleisig et al.	Variability in baseball pitching . . .	8:10	131	14.6
Wilson et al.	Coordination variability and skill . . .	7:2	140	14.0
Butler et al.	Biomechanical analysis of the different . . .	9:4	92	11.5
Fleisig et al.	Kinematics used by world-class . . .	2:51	170	11.3
Shan & Westerhoff	Full-body kinematic characteristics . . .	4:59	129	9.9
Knudson	Significant and meaningful effects . . .	8:96	87	9.7
Cronin et al.	Effects of weighted vests and sled . . .	7:160	97	9.6
Portus et al.	Technique factors related to . . .	3:263	130	9.3
Michael et al.	Determinants of kayak paddling . . .	8:167	79	8.8
Bixler et al.	The accuracy of computational . . .	6:81	92	8.4
Prassas et al.	Biomechanical research in artistic . . .	5:261	99	8.3
Comyns et al.	Identifying the optimal resistive . . .	6:59	87	7.9
Nilsson et al.	Effects of speed on temporal patterns . . .	3:85	99	7.1
Giatsis et al.	Biomechanical differences in elite . . .	3:145	94	6.7
Stefanyshyn & Fusco	Effect of skill decomposition on . . .	9:296	92	6.6
Blanksby et al.	Biomechanical analysis of the grab . . .	1:11	105	6.6
Escamilla et al.	Kinematics and Kinetics comparison . . .	1:213	104	6.5
Chalmers	Strength training: Re-examination . . .	3:159	65	4.6
Elliott et al.	The RowPerfect ergometer: A training . . .	1:123	82	5.1
M			114.6	9.7
M_e			97.5	8.6
SD			48.4	4.7
Skew			3.0	2.7

Scopus 2002-2016

Bartlett et al.	Is movement variability important . . .	6:224	161	14.6
Wilson et al.	Coordination variability and skill . . .	7:2	81	8.1
Fleisig et al.	Variability in baseball pitching. . .	8:10	68	7.6
Knudson	Significant and meaningful effects . . .	8:96	56	6.2
Fleisig et al.	Kinematics used by world-class . . .	2:51	93	6.2
Portus et al.	Technique factors related to . . .	3:263	73	5.3
Shan & Westerhoff	Full-body kinematic characteristics . . .	4:59	68	5.2
Debraux et al.	Aerodynamic drag in cycling . . .	10:197	35	5.0
Chalmers	Strength training: Re-examination . . .	3:159	65	4.6
Bixler et al.	The accuracy of computational . . .	6:81	50	4.6
Dona et al.	Application of functional principal . . .	8:284	39	4.3
Cronin et al.	Effects of weighted vests and sled . . .	7:160	43	4.3
Stefanyshyn & Fusco	Increased shoe bending stiffness . . .	9:55	54	3.9
Nilsson et al.	Effects of speed on temporal patterns . . .	3:85	53	3.8
Candotti et al.	Effective force and economy of . . .	6:246	41	3.7
Escamilla et al.	Kinematics and Kinetics comparison . . .	1:213	52	3.3
Takagi et al.	Differences in stroke phases, arm-leg. . .	3:15	42	3.0

Giatsis et al.	Biomechanical differences in elite . . .	3:145	42	3.0
Elliott et al.	The RowPerfect ergometer: A training . . .	1:123	45	2.8
Stone et al.	Training principles: Evaluation of modes . . .	1:79	36	2.3
M			59.9	5.1
M_e			52.5	4.4
SD			28.6	2.7
Skew			2.5	2.7
	Web of Science 2006-2016			
Bartlett et al.	Is movement variability important . . .	6:224	148	13.5
Fleisig et al.	Variability in baseball pitching . . .	8:10	67	7.4
Preatoni et al.	Movement variability and skills . . .	12:69	31	6.2
Wilson et al.	Coordination variability and skill . . .	7:2	59	5.9
Sinclair et al.	Three-dimensional kinematic . . .	12:272	29	5.8
Knudson	Significant and meaningful effects . . .	8:96	49	5.4
Butler et al.	Biomechanical analysis of the . . .	9:4	35	4.4
Bixler et al.	The accuracy of computational . . .	6:81	46	4.2
Debraux et al.	Aerodynamic drag in cycling . . .	10:197	27	3.9
Cronin et al.	Effects of weighted vests and sled . . .	7:160	38	3.8
Dona et al.	Application of functional principal . . .	8:284	34	3.8
Reid et al.	Effect of skill decomposition on . . .	9:296	29	3.6
Charnock et al.	Adductor longus mechanics during . . .	8:223	31	3.4
Bradshaw et al.	Biological movement variability . . .	6:246	34	3.1
Comyns et al.	Identifying the optimal resistive . . .	6:59	34	3.1
Ball	Biomechanical considerations of . . .	7:10	30	3.0
Wagner & Mueller	The effects of differential and . . .	7:54	30	3.0
Prassas et al.	Biomechanical research in artistic . . .	5:261	35	2.9
Candotti et al.	Effective force and economy of . . .	6:31	30	2.7
Orloff et al.	Ground reaction forces and kinematics . . .	7:238	27	2.7
M			42.2	4.6
M_e			34.0	3.8
SD			27.1	2.5
Skew			3.5	2.7

Note: Total indexed citations (C) listed by citation rate (citations per year: CPY) at the time of the study. *Web of Science* did not index *Sports Biomechanics* articles before 2006.