

PROFILES OF YOUNG SCHOLAR AWARD WINNERS IN BIOMECHANICS

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This study documented selected bibliometrics of recent winners of two international young scholar awards in biomechanics. Harzing's Publish or Perish 5.37 software was used to search Google Scholar (GS) for publications and ten bibliometric variables for the five most recent winners of ISBS and ISB young scholar awards. Typical young scholar award winners had outstanding indexed publication records with high mean citation rates (77 citations per year) and 555 estimated citations at award indicating quick usage of their research. Use of multiple bibliometric variables from GS may provide useful support information for award committee subjective evaluations.

KEYWORDS: Bibliometrics, Early Career, Citation, Contribution, Impact.

INTRODUCTION: Science is a collaborative enterprise that relies on the subjective evaluation of research reports and published research contributions for individual disciplinary peers. Concerns about this subjectivity and poor reliability of peer-review (Derrick, Haynes, Chapman, & Hall, 2011; Knudson, Morrow, & Thomas, 2014; Langfeldt, 2001) has resulted in increased use of study-level and researcher-level bibliometric measures of productivity and impact in research evaluation (Cameron, 2005; Wildgaard, Schneider, & Larsen, 2014). Bibliometric studies of excellence in biomechanics research has primarily focused on senior level scholars (Gefen, 2011; Knudson, 2017a, in press) or surveys of influential literature (Knudson, 2013; Knudson & Ostarello, 2010). The only data on early career scholars in biomechanics are the percentiles of citation metric data from *Google Scholar Profiles* of biomechanics faculty world-wide reported by Knudson (2015). There was a need for bibliometric data on excellence in biomechanics research for young scholars, primarily to provide supplementary data for the qualitative evaluations of candidates for outstanding new scholars in the field. Use of these data also need to be based on the consensus of research in the bibliometric community to ensure appropriate metrics are used that take into account the multi-dimensionality of research excellence and the short time frame for new scholars (Knudson, submitted; Lubart & Mouchiroud, 2017). Therefore, the purpose of this study was to document selected *Google Scholar* (GS) bibliometrics for recent winners of two international young scholar awards in biomechanics.

METHOD: *Harzing's Publish or Perish* 5.37 was used to search GS records for the peer-reviewed publications of the last five winners (2013-2017) of the Has Gros Emerging Researcher Award and the last five winners (2007-2015) of the ISB Promising Scientist Award. Five years included all Emerging Researcher Award winners and avoided extensive (>12 years) post-award time if all ten winners of the biennial ISB Promising Scientist Award were analyzed.

The GS database was used because it indexes more journals than other databases and more thoroughly covers other peer-reviewed publications like proceedings papers, chapters, books, and patents (Delgado-Lopez-Cozar & Cabezas-Clavjo, 2013) that are important to broader and applied impact relevant in these biomechanics awards. Searches of the GS database were conducted during the third week of October 2017.

The investigator used the automatic exclusion features of the *Harzing's Publish or Perish* software to clean returned results and exclude authors with similar names. Accuracy of the publication and citation record of each young scholar was sought using multiple and continuously refined searches, along with manual checking of hyperlinks to indexed publications. While GS has improved in screening procedures to remove non-peer reviewed records (Delgado-Loped-Cozar & Cabezas-Clavjo, 2013; Walters, 2009), there still many records that need to be manually excluded from the data for accurate publication and citation totals. This labor-intensive work reduces the chance of bibliometric errors, however the accuracy of the data given the open-time nature of GS and individual researcher

analysis is likely to be 0 to 20% depending on the bibliometric variable and author name (Knudson, in press). Only peer-reviewed biomechanics publications in English were analyzed in this study including journal and proceedings articles, chapters, books, and patents. Indexed publications that were excluded from the analysis include duplicate citations, theses/dissertations, abstracts of presentations, grant/technical reports, webpages, editorials, editorial listings, letters to the editor, book reviews, magazine articles, and records with dead hyperlinks.

Descriptive data were calculated for seven bibliometric variables relevant to the productivity and usage of the research published by early career scholars. The variables examined were the total indexed publications (P), citations (C), estimated citations at time of award (C_{est}), years of publication history (YPH=2018-year first indexed publication), mean citations per year ($C/Y=C/YPH$), mean authors per paper (A/P), and years to award from first indexed publication (YTA). Since GS continuously updates, C_{est} was defined assuming constant C/Y and the formula $C_{est} = C - ((2018 - \text{Award Year}) \cdot C/Y)$. Three more citation metrics were calculated that are more appropriate for senior level scholars for qualitative comparison purposes with previous biomechanics bibliometric research. These three variables, however, are not generally recommended for use by bibliometric scholars for shorter time frames (<10 years) like evaluation of young scholars: Hirsh index (H), g-index (G), individualized Hirsh index (H_i). Definitions and references to these citation metrics are available on Harzing's web site (Harzing, 2017) and the review by Wildgaard et al., (2014).

RESULTS: Recent young biomechanics scholar award winners currently had between 25 and 82 peer-reviewed indexed publications cited 251 to 2,470 times in GS (Table 1) over 9 to 17 years. C/Y to research published by these young scholars ranged between 25 and 134 citations per year resulting in C_{est} between 226 and 1,648 citations. Young scholar award winners were collaborative researchers with a mean of 3 or 4 authors per publication. These scholars also had early (before completion of doctorate) publication records, so the 9 to 17 YPH also supported the stability of the long-term career metrics (H, H_i , G) calculated.

DISCUSSION: The present study indicated that GS citation metrics confirmed outstanding indexed publication records and high rates of citation to research published by recent ISBS and ISB young scholar award winners. C/Y and C_{est} provide good estimates for research usage at the time of award, and the mean values (77 and 555, respectively) were outstanding for any scholar. Mean citation rates were equal to some or about half of the mean reported for biomechanics scholars winning career awards (Knudson, 2017a; in press). Many young scholars' total GS indexed C were likely above the 80th percentile for assistant professor rank biomechanics scholars (Knudson, 2015) given these latter GS *Profile* data are not corrected for errors (Knudson, in press). These data confirm the validity of the qualitative judgments of research impact of these young scholars by the respective awards committees, as well as provide normative data for future awards committees to consider in resolving close qualitative judgments. Given the multi-dimensional nature of research quality, the consensus of bibliometric scholars is that multiple citation metrics should be used to supplement and should not replace peer evaluation of research of individual scholars (Harzing et al., 2014; Hicks et al., 2015; Ioannidis et al., 2016; Lubart & Mouchiroud, 2017).

Recent young scholar award winners appear to have different research and collaboration histories than previous generations of biomechanics scholars. While the two awards studied stipulate that eligible candidates must be within 5 years of earning a doctoral degree, these award winners benefitted from larger (YTA = 5 to 10 years) times to award measured from their first publication. This longer time to publish and receive citations may have also been enhanced by greater collaboration and co-authorship than previous scholars. Typical young scholar award winners had four authors per publication, while early (20-25 years ago) biomechanics and exercise science research reports typically had two authors per publication (Knudson, 2015, 2016, 2017b; Knudson & Bahamonde, 2012).

Table 1: Publication and citation metrics for recent young scholar award winners

	P	C	C/Y	A/P	YPH	YTA	C_{est}	H	H_i	G
ISBS Hans Gros Emerging Researcher										
	80	2,470	165	4.2	15	10	1,647	24	11	49
	59	547	57	4.0	11	8	402	11	5	23
	25	552	43	3.4	13	9	382	10	6	23
	32	307	34	4.1	9	7	239	10	5	17
	31	251	25	4.0	10	9	226	9	4	15
ISB Promising Scientist										
	69	1,506	89	4.4	17	8	709	22	11	37
	82	1,607	134	4.2	12	5	670	22	11	38
	62	1,693	106	3.2	16	5	529	23	11	39
	33	560	51	4.0	11	8	407	12	7	23
	54	680	68	4.1	10	5	340	13	6	25
<i>M</i>	53	1,017	77	4.0	12	7	555	16	8	29
<i>M_e</i>	57	620	63	4.1	12	8	405	13	7	24
<i>SD</i>	21	746	46	0.4	3	2	416	6	3	11

Note: Scholar data within each award ranked by estimated citations at time of award (C_{est}). Primary citation metrics relevant to young scholars in regular typeface, with less short-term relevant metrics in *grey italics*. See method for abbreviations.

The early (pre-doctoral or post-doc) publication record of these young scholars resulted in 9 to 17 years of publication history at the time of this study. This additional time is above the minimum time (10 years) usually considered necessary (Lehmann, Jackson, & Lautrup, 2008) for stability of career bibliometrics like the H and its variants. The H values for the young scholar award winners (9 – 24) were outstanding indicating quick publication and usage of their research in the field. These values were about half the H values for recent career scholar award winners (Knudson, in press). The greater collaboration in these young scholars was apparent with H_i values between 4 and 11. Normalization of the H is recommended to account for differences in citation behavior due to co-authorship (Batista et al., 2006). The young scholar G values (15 – 49) indicated many publications with outstanding usage beyond what would be indicated by their H .

This study was limited to the publication and citations indexed in GS for the five most recent winners to two young biomechanics scholar awards. The study was also delimited to English language research reports, chapter, books, and patents. There were potential errors in indexing of publications and investigator correction of returned records. Even with these limitations the use of GS and multiple citation may be useful as supportive evidence of qualitative judgments made by future award committees.

CONCLUSION: The GS indexed publication and citation records of recent winners of two young biomechanics scholar awards were outstanding compared to normative data of assistant professor rank and many senior scholar award winners in biomechanics and exercise science. The use of multiple bibliometrics from GS may provide useful supportive information to consider by future young scholar awards committees.

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