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CITATIONS IN *GOOGLE SCHOLAR* PROFILES BY KINESIOLOGY SUBDISCIPLINE

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Knudson. Keywords are important bibliometric tools for classifying, accessing, and summarizing research. Communication in and external recognition of kinesiology research may be limited by inconsistent use of terms. Citations to the top twenty Google Scholar (GS) Citations Profiles were retrieved for 20 kinesiology-related subject keywords used as GS "labels". Total citations to top scholars were largest for the disciplinary labels "physical activity," "exercise," "physical education," "sport science," "sports," "exercise science," "sport," and "kinesiology." Citations to top scholars using professional labels were in "sports medicine" and "coaching." The results confirm previously reported trends of slow growth of use of the term kinesiology primarily in the United States even though the highest citations were to the "physical activity" focus of the field. Strong citation counts to the "exercise," "physical education," and "sport science" GS labels likely result from the diversity of research interests in the field throughout the world. Kinesiology-associated scholars are influential leaders contributing to a majority of highly cited research using kinesiology subdisciplinary keywords as labels in GS Profiles. The study confirmed previous research of inconsistent use of the terms "sport" and "sports." Inconsistent use of terms and keywords are a barrier to recognition of and the search for kinesiology-related research.

Key Words: exercise science, keywords, research line, sport, subject area.

The academic discipline of kinesiology has developed from physical education units in higher education (Knudson & Brusseau, 2021; Renson, 1989). After the 1960's this interdisciplinary field, focused on physical activity or voluntary human movement (Newell, 1990), has continued to grow in diversity of subdisciplinary and professional applications (Greendorfer, 1987; Hoffman, 1985; Lawson, 1991; Lawson & Kretchmar, 2017; Newell, 2021; Thomas, 1987). Over 150 years ago most physical education (a.k.a. kinesiology) research focused on anthropometrics, measurement of fitness and physiological parameters. Other early physical education researchers adapted many "parent" disciplines into unique and somewhat-unique, kinesiology research subdisciplines (e.g., biomechanics, motor development, motor learning, sport and exercise psychology). Examples of recent subdisciplines that have established journals and a relatively consistent nomenclature are physical activity epidemiology, sports analytics, and sports nutrition.

Despite a long history of contributions to physical activity knowledge, the field of kinesiology continues to struggle with academic recognition in academe (Henry, 1964; Knudson, 2016; Kretchmar, 2008; Renson, 1989; Rikli, 2006; Sage, 2013). Kinesiology faculty can publish their research in "parent" discipline, subdisciplinary or multidisciplinary kinesiology journals (Schary & Cardinal, 2016). Whatever the publication outlet, the scholarly use of research is often assessed in academe using citations in subsequent, indexed peer-reviewed publications (Bornmann & Daniel, 2008; Knudson, 2019b). It is

important to remember that bibliometric citations represent academic usage in subsequent scholarship, not impact or quality of the journal or article (Bollen et al., 2009; Franceschet, 2010; Knudson, 2013; Patience et al., 2007; Zhou et al., 2012). Analysis of citation totals also depend heavily on the bibliometric database used (Bar-Ilan, 2018; Harzing, 2019; Martin-Martin et al., 2018, 2021; Rovira et al., 2019), keywords, subject areas, electronic search engine properties, and user skill in searching (Gusenbaur & Haddaway, 2020; Hjørland,2015; Vaughan & Thelwall, 2004).

Despite the complexities of bibliometric indexing, searching, and citation metrics the scholarly visibility and usage of kinesiology research can be examined by analysis of kinesiology-related keywords and citation data. Analysis of keywords related to kinesiology may be important to understanding the visibility and use of research by kinesiology scholars (Knudson, 2022a, 2022b; Morrow & Thomas, 2010; Rikli, 2006). Knudson (2020a) studied 100 kinesiology journals using Web of Science and reported differences in citation rates across kinesiology subdisciplines and database-assigned subject areas. In a subsequent study, Knudson (2020b) examined twenty keywords used for kinesiology department names in Google Scholar Profiles and found inconsistent use of terms in the field based on citations. The purpose of this study was to describe the citation patterns among top scholars using common kinesiology-related subdiscipline keywords to describe their research interests and examine the representation of kinesiology scholars in these subdisciplines.

Method

The GS database was selected for this study because it provides the largest, most comprehensive coverage of scholarly publications of all bibliometric databases (Delgado-Lopez-Cozar & Cabezas-Clavjo, 2013; Gusenbauer, 2019; Halevi et al. 2017: Harzing & Alakangas, 2016; Martin-Martin et al., 2018, 2021; Meho & Yang, 2007) and this is particularly important in a diverse, multidisciplinary field like kinesiology. The GS Citations function has a "Profiles" feature that allow registered users to create citation reports, correct/curate their indexed records, and network with other scholars. Scholars with a GS Profile can select up to five "labels" that serve as keywords describing their areas of research interest. Research using GS Profiles has reported that analysis of keywords used as GS labels provide an understanding of real meanings of research areas that can inform typical database-generated subject categories (Ortega & Aguillo, 2012). GS Profiles also have greater coverage and citations than other scholarly networking sites like Academia.edu, Microsoft Academic Search, or ResearchGate (Ortega, 2017; Ortega & Aguillo, 2014). Knudson (2022b) studied the top ten GS profiles for scholars using twenty general terms used as GS labels aligned with the whole field of kinesiology and found the most citations for "physical activity," "exercise," "physical education," "sport science," "sports," "exercise science," "sport," and "kinesiology."

The current study searched GS Profiles using 20 kinesiology subdisciplinary keywords as GS labels (Table 1). The kinesiology subdisciplinary terms were selected to follow terminology traditions in the subdisciplines of the field as closely as possible (e.g., "label:sport_management") while ensuring the most citations documenting usage and academic visibility in the top twenty GS Profiles. Similar to previous research (Knudson, 2022b), some GS users favor the use of keywords as labels in inconsistent patterns. In contrast to sport management, "sports" was favored over "sport" with the label "sports_nutrition" having the most citations. Another example was the common subdisciplinary name as a GS label "label:sport_and_exercise_psychology" had fewer GS profiles and profile citations than "label:sport_psychology".

Two common kinesiology subdisciplinary searches were somewhat problematic. The search for "label:measurement" was used because there was only one GS profile for the well-known kinesiology subdiscipline of measurement and evaluation: "label:measurement_evaluation" and substantially fewer citations to profiles using "label:measurement_and_evaluation". Two searches were combined ("label:sport_philosophy" and "label:sports_philosophy") for sport philosophy and returned only 11 of the targeted 20 profiles. The dearth of sport philosophy scholar participation in GS Profiles is consistent with the reasoned rejection of citation metrics by philosophy scholars (Feenstra & Lopez-Cozar, 2022).

Table 1

Citation data for the top 20 Google Scholar (GS) Profiles using Kinesiology Subdisciplinary Labels

GS Label (Total *GS* Profiles)	Total C	75%	M_e	25%	γ	PR	PTC
Athletic_Training (122)	85,189	2,786	1,580	1,401	2.9	95	98
Biomechanics (6,895)	850,559	51,907	40,992	34,986	0.3	30	18
Exercise_Physiology (2,315)	880,097	47,309	33,966	26,324	2.9	60	47
Fitness (300)	216,544	12,197	6,757	4.083	1.7	60	46
Measurement (892)	811,121	64,745	23,919	17,373	1.3	0	0
Motor_Behavior (102)	25,168	1,545	1,041	777	1.2	50	52
Motor_Development (208)	216,635	12,799	8,443	6,278	2.4	70	77
Motor_Learning (636)	484,195	27,429	16,992	12,133	2.2	40	37
Physical_Activity_Epidemiology[ϛ]	176,845	9,696	3,864	1,615	4	50	70
Physical_Education (1,643)	535,686	22,944	13,705	11,417	4.2	100	100
Sports_Analytics (166)	274,556	14,997	5,714	2.854	3.8	45	10
Sports_Coaching (49)	20,653	1,539	613	245	1.8	90	58
Sports_History (46)	35,574	1,485	371	200	2.8	20	55
Sport_Management (728)	150,828	8,632	6,392	5,109	1.5	70	73
Sports_Nutrition (268)	250,326	12,907	7,700	5,590	1.8	60	54
Sport_Pedagogy (112)	46,525	3,355	1,941	1,247	0.9	75	85
Sport(s)_Philosophy [*](11)	1,874	445	23	1	1.5	100	100
Sport_Psychology (667)	374,410	26,463	13,092	9,560	0.9	65	72
Sport_Sociology (73)	24,171	1,603	459	299	2	70	46
Strength_and_Conditioning (272)	203,347	11,025	7,264	4,380	3.3	95	97

Note. Top 20 GS profile data for either "sport" or "sports" were based on the most total citations, except for philosophy[*] where the 11 profiles were reported combining searches for "label:sport_philosophy" and "label:sports_philosophy". [ϛ]Total GS Profiles for physical activity epidemiology was n =34. PR is percentage representation of top scholars with kinesiology-related department/unit affiliation (see operational definition in methods) and PTC is percentage total citations representation by these same scholars. Searches completed by March 10, 2022.

Searches were completed by March 10, 2022. To get a sense of the size of each of the 20 kinesiology-related subdisciplinary terms used as GS labels, the author sought out the total number of scholars with GS Profiles using those labels (Table 1). Obtaining a total number of profiles using these labels required onerous manual retrieval of records ten at a time until a final profile was found.

GS citation data were extracted for the top 20 scholars and total citations for each were entered into Microsoft Excel. Images of the returned records were captured and stored to assist in scholar identification, data cleaning, and analysis. In addition to total citations, the investigator classified each scholar as either affiliated with kinesiology or "other" disciplinary department or professional unit. Kinesiology-related affiliations included all variations of health, physical education, recreation and dance; human movement; exercise and sport studies variations of department/unit names for the field (Baker et al., 1996; Custonja et al.,2009; Knudson, 2022b). This qualitative classification of affiliation was based on data in the GS profile and internet searches of university/unit, ResearchGate, Facebook, or corporate websites. Scholars with corporate/consulting positions or in graduate training were classified as kinesiology if at least a master's degree in the field had been completed. Scholar affiliation was primarily based on employment as there were several scholars with doctoral and post-doc training in kinesiology but were classified as other disciplinary affiliation given their appointment in medical, therapy, or dietetic departments. Affiliation for one scholar could not be determined and was, therefore, classified as other discipline.

Descriptive statistics were calculated for all dependent variables with JMP Pro 14 (SAS Institute, Cary, NC). Total citations, median, and 75th and 25th percentile were reported given the high skew ($\gamma = 2.2 \pm 1.1$) of the citation data. Qualitative comparisons of the total citations and median citations were made across subdisciplines given the descriptive nature of the study and heavily skewed citation data. Citation data represent scholarly usage (Bollen et al., 2009; Franceschet, 2010; Knudson, 2013, 2019b; Zhou et al., 2012) and also the visibility of research in the scientific community. In addition, the classification of each scholar was used to calculate two kinesiology representation variables: Percentage representation (PR) was the percentage of top twenty GS Profiles with kinesiology affiliations and percentage total citations (PTC) was the percentage of their citations to the total citations to the top twenty GS profiles. PTC was the percentage of total citations that were attributed to kinesiology-affiliated scholars. Qualitative description and comparisons of the kinesiology representation variables excluded the subdiscipline of "measurement" given no kinesiology-affiliated scholars were ranked in the top 20 records.

Results

Citation totals to the top twenty GS Profiles were highly skewed (γ) for all subdisciplines except biomechanics (Table 1, Column 6). There was great variation in total and median citations to the top GS Profiles between the subdisciplines of kinesiology used as subject area labels. Kinesiology subdisciplinary terms as GS labels with the most citations, excluding measurement, were exercise physiology, biomechanics, physical education, motor learning, and sport psychology. Biomechanics had the highest median citations (40,922) that was 110 and 1782 times greater than sport philosophy and sport history, respectively. Four of the subdisciplines had fewer than 73 total scholars with GS Profiles [sport sociology, sports coaching, sports history, and sport(s) philosophy], while the three largest numbers of profiles were for biomechanics (6,895), exercise physiology (2,315), and physical education (1,643).

The majority of scholars with a GS Profile using kinesiology-related subdisciplinary labels were affiliated with kinesiology departments/units. Excluding measurement, only biomechanics, motor learning, sports analytics, and sports history had kinesiology PR below 50% (Table 1). Mean and variability of PR of kinesiology in the subdiscipline labels (67 ± 24%) were similar to the percentage of total citations (PTR) to those kinesiology scholars (64 ± 27%).

Discussion

Searching GS for twenty common kinesiology subdisciplinary terms used as a subject "label" in GS Profiles returned widely varying citations across subdisciplines. Subdisciplines with large total citations (535,686 to 880,097) for the top twenty GS

profiles were exercise physiology, biomechanics, and physical education. These were 36 to 470 times larger than sport sociology, sports coaching, and sport philosophy. The large variation in citation patterns between different academic disciplines is a common observation and means they cannot be compared across different fields of scholarship (Declaration on Research Assessment [DORA], n.d.; Hicks et al., 2015; Patience et al., 2007; Podlubny, 2005; Seglen, 1992). This large variation in citation patterns between subdisciplines within kinesiology has also been reported along with the additional confounding factor of strongly skewed citation data (Knudson, 2014; 2015a, 2015b, 2022a).

The total citations to the 20 kinesiology subdisciplinary GS labels were strongly skewed in all subdisciplines, except biomechanics. The large skew makes mean citation metrics like the Web of Science impact factor biased and inaccurate, however even use of median data show major differences between subdisciplinary citation patterns in kinesiology. Examination of median citations showed even large differences (89 to 1782 times) from top three to bottom three subsdisciplines. It is clear that comparisons of citation data must be carefully made only within subdisciplinary areas within kinesiology (Knudson, 2019b).

The low number of citations in fields like sport philosophy, sport sociology, and sports coaching, however, does not mean lower scholarly impact. For example, there are numerous, well-cited sport philosophy scholars (e.g., Paul Gaffney, Scott Kretchmar) that do not have a GS Profile or have a GS Profile without these specific subdisciplinary keywords as labels (e.g., Emily Ryall, Sarah Teetzel). In addition, many sport philosophers likely avoid this on logical reasons related to their subdisciplinary expertise (Feenstra, & Lopez-Cozar, 2022). Use of citation metrics in kinesiology should only be interpreted carefully using data within a specific subdiscipline, with database-specific and author-level data (Knudson, 2014, 2015a, 2019b).

Numerous other 'parent" disciplines (e.g., physiology, psychology) and other movement related disciplines (e.g., ergonomics, physical therapy) also publish research relevant to kinesiology. The PR of kinesiology scholars in the top 20 GS profiles in these subdisciplines was normally distributed and indicated a majority (67%) contribution to highly cited research in kinesiology-related subdisciplines. Kinesiology-affiliated scholars were relatively evenly distributed in the top 20 scholars across subdisciplines, so they contributed about equally (64%) to the percentage total citations to these subdisciplines. The current data indicate kinesiology scholars are influential leaders in the scholarly subdisciplines of the field, despite sometimes extensive competition from scholars in other "parent" disciplines or movement-related and professional fields. This indicates greater potential recognition of research by kinesiology scholars than is apparent in use of more general (exercise, kinesiology, sport) GS labels related to the field (Knudson, 2022b). This study also confirmed the inconsistent use of the use of the plural terms of "sport" and "sports" across academe previously reported (Knudson, 2022b; Starosta & Petryuski, 2007). Inconsistent use of terms and keywords can be a barrier to recognition of and the search for kinesiology-related research (Knudson, 2019a, 2022b).

There were several limitations of this study. There is variation and potential bias in scholars who establish GS Profiles and their use of kinesiology-related subdisciplinary keywords as labels for their research interests. There are other kinesiology-related subdisciplines (e.g., performance enhancement, sports law), professional and interdisciplinary areas that were not included in this study. There is also limited data on what scholars create GS Profiles (Kim & Grofman, 2020; Knudson, 2015a, 2015b; Orduna-Malea & Lopez-Cozar, 2017). The substantial number of subdisciplines and skew to citation data limited the data analysis to descriptive observations, however this does not invalidate the trends in scholarly usage of kinesiology subdiscipline research observed in this study that were consistent with previous research on citations in kinesiology (Knudson, 2014; 2015a 2015b, 2022a). Extensive research has documented high skews and uncited articles in most all fields, so focus on top percentiles of cited research is most relevant approach to study usage of scholarly research (Bornmann & Marx, 2014; Leydesdorff & Bornmann, 2011; Leydesdorff & Opthof, 2010; Owlia et al., 2011; Knudson, 2015a, 2015c, 2019b, 2022a; Seglen, 1992; Stern, 1990). The not time-controlled nature of GS, investigator

subjectivity in classifying GS profiles as kinesiology-affiliated, and user profile variation noted above make it impossible to directly replicate this study. Future research could replicate this study in a controlled databases like Scopus, Web of Science, or a conceptual replication/extension (Nosek & Errington, 2020) of this study with GS or other databases like Dimensions.

Conclusion

It was concluded that kinesiology-associated scholars contribute to a majority of highly cited research in most subdisciplinary areas of the field based on keywords used as labels in GS Profiles. Consistent with previous research on citation metrics; there was large variation and skew in citations across twenty subdisciplinary areas of kinesiology and inconsistent use of terms as keywords that may pose a barrier to recognition of and search for kinesiology research.

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