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Assessment of literature growth in Anthropometric measurement research: A bibliometric analyses of Scopus indexed publications

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Abstract:

Purpose: To evaluate the global published literature in anthropometric measurement research between 1971-2021. Anthropometry is the study of the size and shape of the human body generally refers to the measurements and data used to characterize the size of human users.

Method: Scientometric and bibliometric tools applied to analyze the research published indexed in the Scopus database. The study focused on indices, namely annual research growth, impactful author, relevant source, country collaboration, productive organization, country, etc. MS Excel, Bibexcel, RStudio (Biblioshiny), Scientopy, CiteSpace, and VOSviewer are used for the quantitative analysis.

Results: There is steady growth in the literature of 483 from 1971 till date. 2020 was the most productive year with 58 publications, more than thirteen hundred authors participated in the research, and three authored collaborations were found more popular. The journal articles are the most preferred form. *Applied Ergonomics* recorded as the highly impactful source, and the USA observed as the most productive country. The 'National natural science foundation of China' represented as the most active and potent funding agency.

Keyword: *Anthropometric; Ergonomic; Furniture; human posture; musculoskeletal disorder trauma; Bibliometric, Scientometric; Research assessment.*

1. Introduction:

Anthropometric data is about collecting the human body's measurement; it is beneficial for apparel sizing, physical anthropometric, ergonomic design of the workplace, as well as useful for forensics investigation. Similarly, some researchers defined anthropometric data as that can be used in ergonomics to clarify the physical dimensions of certain places, equipment, furniture, and clothing (Kayis & Özok, 1991). Many studies have investigated the ergonomic problem associated with the use of furniture, such as office furniture and its design (Parcells et al., 1999). Their studies have confirmed that office workers spend a longer part of their office hours in the seated posture. Sitting position for a long time and static posture in an inappropriate manner such as bending has been the leading cause of low back pain (musculoskeletal disorder trauma – MSD). In his research, Mandal (Mandal 1985) wrote that 60 percent of office workers claimed pangs in their back, neck, and shoulder, for which they blamed the furniture they have been using for a long hour. Salminen et al. (1992) also noted that low back pain was at least, to some extent, due to an unsuitable design of the office table. In addition, Evans, O., Collins, B. & Stewart (1992) stated that a mismatch in the seated elbow height with the table height was significantly related to the shoulder and neck pain. Furthermore, improper design of office furniture is one of the contributing factors to back pain between the office workers, as indicated in some investigations (Aagaard & Storr-Paulsen, 1995). To get an appropriate anthropometric, the researcher studies the communication between the furniture and the user to achieve a successful ergonomic design.

Ergonomic refers to the process of designing or adjusting the furniture, product, workplace, or certain spaces, also service that suitable for human comfort level. Generally, a product should have ergonomic features to be more user-friendly and comfortable in practical. Likewise, the chairs and study tables in school. For furniture as chairs and study tables, ergonomic features needed are anthropometric aspects of the user. This is supported by Jan Dul & Bernard Weerdmeester, (2001) statement, which states that '*ergonomic design is a branch that studies the interaction between everyday life and works with objects used*.' However, few studies have focused on the effect of school furniture on the body posture of students when performing the tasks required in the classroom (Soares MM, 1998). Consideration of ergonomics has added a new dimension in the field of industrial design and development. There is a combination between psychology, anthropometry, biomechanics, engineering, science, and many other areas. Generally, ergonomics' primary focus and concern are providing human safety, reaching

comfortable, and increasing productivity. The anthropometric measurement is necessary to identify the correct measurement of human body parts to achieve an ergonomic design.

2. Literature review:

Ergonomics and Design: The International Ergonomics Association defines ergonomics as follows: Ergonomics is employed to fulfill the two health and productivity goals. It is relevant in designing such things as safe furniture and easy-to-use interfaces to machines. Moreover, ergonomic is the science focusing on the ability to work as per the demand of the job (Arefi et al., 2021).Besides that, an ergonomically redesigned workstation served as an effective intervention program in reducing female fabrication workers' awkward shoulder postures and other discomfort symptoms (Reza, 2020).The term ergonomics refers to designing products and systems that accommodate the physical limitations of the human body. Ergonomics researcher needs to learn from practical experience and get feedback on theories and techniques' applicability and usefulness. According to Kate Gleason ergonomics is the design of products and systems to fit the people who use them. Maximize the physical compatibility between the product or system and the people who use it.

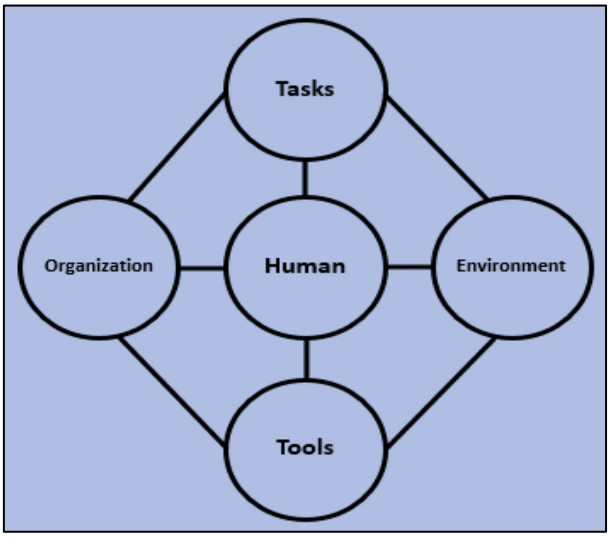


Figure 1: Balance model

The balance model above shows that human working depends on following these factors, i.e., Environments, Tasks, Organizations, and Tools. Also, Gavriel Slavendy mentioned aspects of ergonomics in any field: safety, comfort, ease of use, productivity or performance, and aesthetic.

Anthropometry Measurement: According to Scott Openshaw 2006, Anthropometry measurement is the science that measures the range of body sizes in a population. Anthropometric data varies considerably between regional populations. Percentiles: used to

quantify anthropometric measurements, for an individual of the Xth percentile for a particular dimension, X% of the population is smaller (thus, the 95th percentile for height is a very tall person since 95% of the population is shorter). Through anthropometry, ergonomics collects information about people to work, machines, tools, and environment are fitted to humans. Since its emergence at the end of the 1940s, various sections of the population (i.e., military men, industrial workers, women, the elderly, and agricultural workers) have been(Mokdad & Al-Ansari, 2009). The dimensional anthropometric differences in different generations, the standards should be revised periodically. For example, previous studies in Nigeria have revealed a paucity of anthropometric data and low ergonomic suitability of classroom furniture.

Application and Ergonomic Workplace: Applications ergonomics to be successfully applied in aerospace, aging, health care, IT, product design, transportation, training, nuclear and virtual environments, and others. Additionally, work tasks may be causing problems, and what to do, the question is to become aware of the workplace which contributing factors may lead to fatigue, musculoskeletal disorder, symptoms and injuries, and other types of problem. For example, from a classroom and education perspective, improper seating posture is potentially unhealthy and considered as one of the major contributing factors for several MSD, such as pain in the lower back part (Ebe & Griffin, 2001), neck (Schneider, 1989), and shoulder (Magnusson M., Wilder D., Pope M., 1993).

Ergonomic Education: Several studies have shown among practicing dental hygienists, those who received ergonomics education, which emphasizes the importance of client and operator positioning (Beach & DeBiase, 1998). One of the most fundamental concerns in revising the school environment is the observance of ergonomics in school. In other words, a school is a large house in which many children and adolescents spend long hours of their lives. Based on ergonomics principles, schools are divided into four sections of students, educational environment, educational organization, and education. In each of these four sections, the environmental conditions of the educational facilities are crucial. Environmental variables such as school temperature, noise, lighting, dimensions of the classroom (Martelli & Traebert, 2006, Schneider, 1989), temperature, air quality, wall colors (Santos et al. 2009), (Magnusson M.,Wilder D., Pope M., 1993) ventilation, bench layout, adequate space, and classroom layout are the factors affecting students' learning performance (Schneider, 1989) During growth, and body proportions gradually change as the adult body takes the form (Martelli & Traebert, 2006). According to Santos et al. (2009), growth is most significant during childhood and slows during early adolescence.

Generally, several design standards and guidelines have been proposed for developing classroom furniture in the past. An early effort to develop a general standard and guidelines for ergonomic-centered classroom furniture designs includes the ISO 5970 e 1979 (Standards for Tables and Chairs for Educational Institutions).

3. Research Questions

- What are the annual global research trends and their citations impact on anthropometric measurement during 1971-2021?
- Which research form, researchers preferred to publish their work?
- Which is the most preferred source by the author to publish anthropometric measurement research?
- Which organization and country are most productive in anthropometric measurement?
- Who were the most prolific authors and pattern of authorship in anthropometric measurement?
- What keywords did the researcher of anthropometric measurement mostly use?
- What were the most active funding agencies in anthropometric measurement?
- What was the most collaborative country in anthropometric measurement research?

4. Research Methodology

For a detailed and biased free review, the bibliometric method applied to evaluate the anthropometric measurement research produced during 1971-2021. The bibliometric method is based on the statistical techniques used to analyze books, papers, and other documents. It has a significant role in the field of library and information science. Scopus is one of the most extensive peer-reviewed indexing and abstracting literature databases since it offers on-site analysis tools to process publications' structured data and export the structured data. For data collection, the Scopus accessed at imam Abdurrahman bin Faisal University, Dammam, Saudi Arabia, as of June 5, 2021. Ergonomics is considered an umbrella theme, resulting in 58,599 documents, then refined using keywords "Design" and "Anthropometric Measurement" and 483 documents retrieved. The following search query involved:

(TITLE-ABS-KEY ("Ergonomics")) AND ((design)) AND ("Anthropometric Measurement")

Therefore, for this study, a total of 483 documents considered to analyze. All the research data then downloaded in BibTeX, RIS, and MS Excel (CSV) format. In addition, MS Excel,

scientometric and bibliometric tools, namely Bibexcel (Persson, 2016), Biblioshiny (Aria & Cuccurullo, 2017), Scientopy, Citespace, and VOSviewer (van Eck & Waltman, 2010), have been used to analyze the data.

5. Results and Discussion:

One thousand three hundred sixteen authors contributed 483 anthropometric measurement publications in 199 sources during 1971-2021. The average years from publication, average citation per document, and average citations per year per document were 8.22, 9.911, and 0.9587, respectively. A total of 14121 references, 2763 keywords plus, and 1160 authors keywords have appeared in the analysis. The results reveal 53 single authors authored documents, 0.355 documents per author, 2.82 authors per document, 3.43 co-authors per document, and 3.06 collaborations index in anthropometric measurement research publications.

5.1. Annual research productivity and yearly citation impact on anthropometric measurement during 1971-2021:

The first paper in anthropometric measurement was recorded in 1971 with 32 citations. The analysis interpreted as during the first three decades (1971-2001), research productivity was insignificant (yearly ranged 1-8 publications). After 2007 (NP=10), research productivity increased rapidly (yearly ranged 10-58 publications). 2020 noted as the most productive year (58 publications, 39 citations), followed by 2019 (55 publications, 119 citations) and 2018 (44 publications, 145 citations). Additionally, 2004 identified as the most cited year (434 citations for 8 publications), followed by the year 2007 (374 citations and 10 publications) and 2006 (328 citations and 7 publications). (Refer to table 1)

Table 1: Annual search growth on anthropometric measurement

Year	NP	TC	Citation sum within h-core	h-index
1971	1	32	32	1
1975	2	4	4	1
1981	3	24	22	2
1982	2	50	50	2
1983	2	9	9	1
1984	1	0	0	0

1985	2	0	0	0
1987	1	34	34	1
1988	1	11	11	1
1989	5	51	51	2
1990	2	77	77	2
1991	1	8	8	1
1992	1	5	5	1
1995	2	29	29	2
1996	2	53	53	2
1997	2	34	34	2
1998	2	37	37	2
1999	8	272	267	5
2000	5	143	143	5
2001	3	88	88	3
2002	4	29	27	2
2003	4	44	44	1
2004	8	434	433	6
2005	6	213	213	6
2006	7	328	324	4
2007	10	374	369	8
2008	11	197	193	7
2009	12	229	221	8
2010	14	203	182	7
2011	19	170	144	6
2012	18	265	239	9
2013	23	278	243	7
2014	30	211	142	9
2015	31	246	186	10
2016	29	125	85	6
2017	29	170	125	7
2018	44	145	80	7
2019	55	119	58	6
2020	58	39	13	3

2021	23	7	2	1

5.2. Type of research on anthropometric measurement:

Figure 2 shows the type of research published in anthropometric measurement during 1971-2021. The results show that most of the researchers preferred to publish their work as journal articles (311 publications, 4265 citations).This results is the agreement with (Rahaman et al., 2021) Then conference papers found as the second most preferred form of research (140 publications, 296 citations), followed by review (17 publications, 182 citations), book (11 publications, 13 citations), conference review (2 publications), and data paper and book one publications each.

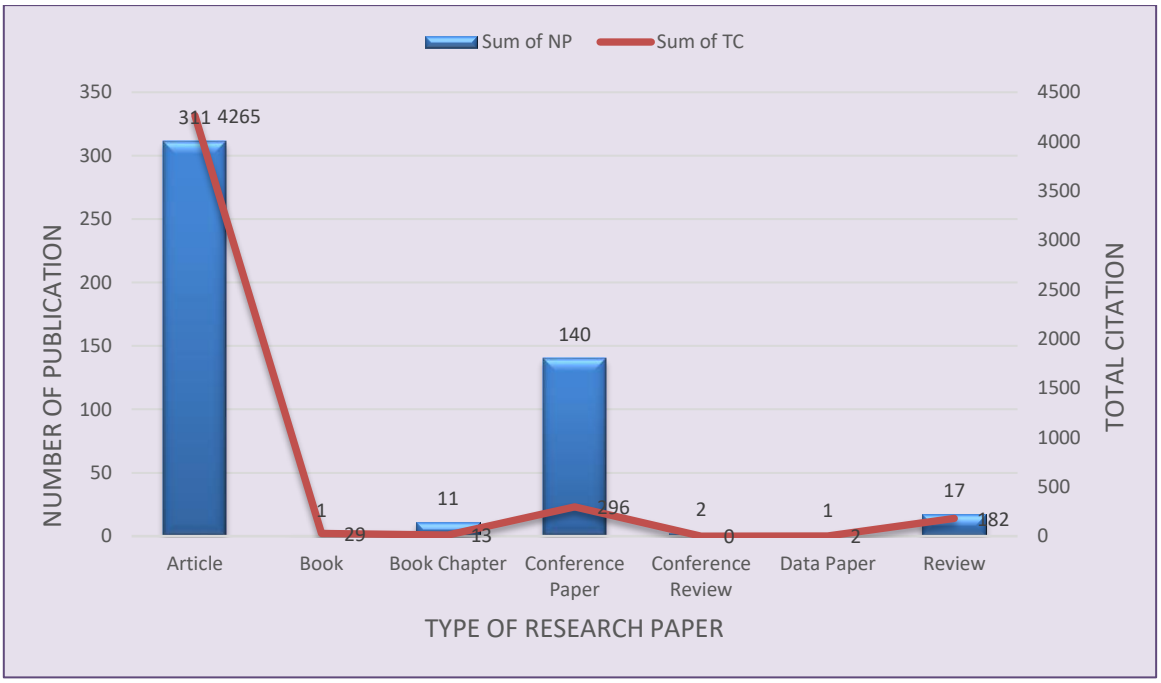


Figure 2: Type of research with publications and citations

5.3. Pattern of authorship on anthropometric measurement:

The analysis showed the authorship pattern ranged from one to fourteen (refer to figure 3). The single-authored papers are only 53 (554 citations). On the contrary, multiple authorship begged 430 publications (4233 citations). Hence there is a tendency to produce research on collaborative work on anthropometric measurement. The highly active authorship pattern rang varied between one author to five authors. The analysis reveals that three authorship produced the highest research with 117 publications (1078 citations), followed by four authorship with116 publications (921 citations), two authorship with 98 publications (1384 citations), and

five authorship with 51 publications (294 citations). The authorship pattern of 10, 11, and 14 contributed to one publication, respectively. A similar type of analysis was conducted by (Kumar et al., 2021).

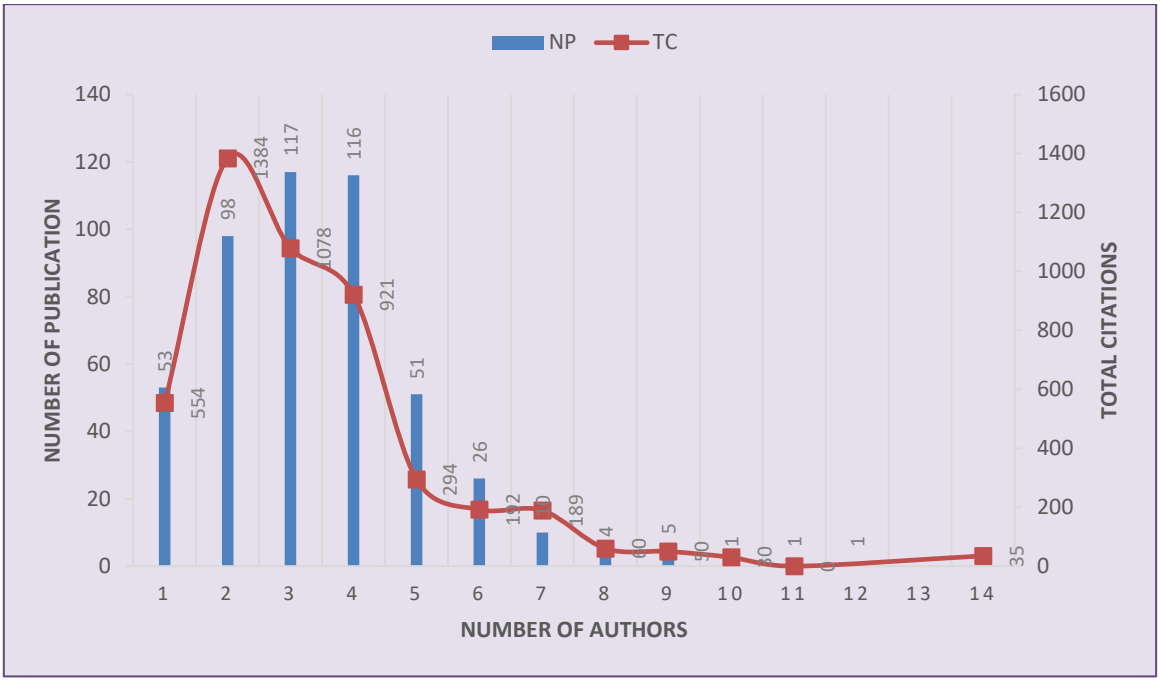


Figure 3: Authorship pattern with publications and citations

5.4. Prolific authors in anthropometric measurement:

The publication of the top ten authors ranged from eight to four publications with 13-146 citations (See table 2). You H, who affiliated with Pohang University of Science and Technology, found as the most prolific author in the top ten list (8 publications, 50 citations), followed by Lee W and Molenbroek JFM from Delft University of Technology with 6 publication each and 30 and 87 citation, respectively. Li Z, Tsinghua University also has 6 publications with 146 citations, Karmakar S, Indian Institute of Technology with 5 publications and 13 citations. Adeyemi AJ, Arezes Pm, Case K, and Castellucci HI were the minor productive authors in the top ten list (contributed four each). Li Z was the most cited author with 146 citations for six publications, followed by Arezes PM with 128 citations for four research papers. Most of the authors belong to the Netherlands, followed by one author from South Korea, China, India, Hong Kong, Portugal, UK, and Chile, respectively.

Table 2: Top ten most prolific authors on anthropometric measurement

Rank	Authors	Affiliations	Country	NP	TC	h_index	g_index	PY_start
1	You H	Pohang University of Science and Technology	South Korea	8	50	4	7	2010
2	Lee W	Delft University of Technology	Netherlands	6	30	3	5	2010
3	Li Z	Tsinghua University	China	6	146	6	6	2007
4	Molenbroek JFM	Delft University of Technology	Netherlands	6	87	4	6	1987
5	Karmakar S	Indian Institute of Technology	India	5	13	2	3	2019
6	Luximon Y	The Hong Kong Polytechnic University,	Hong Kong	5	16	3	3	2017
7	Adeyemi AJ	Waziri Umaru Federal Polytechnic	Nigeria	4	16	2	4	2014
8	Arezes Pm	School of Engineering of the University of Minho	Portugal	4	128	4	4	2005
9	Case K	Loughborough University	UK	4	73	3	4	2006
10	Castellucci HI	Universidad de Valparaíso	Chile	4	55	4	4	2015

5.5. Relevant source in anthropometric measurement:

The top 10 sources identified (refer table 3) with the help of analysis in Biblioshiny for anthropometric measurement, listed here "*International journal of industrial ergonomics*" (43 publications, 983 citations), followed by "*Applied ergonomics*" (38 publications, 1315 citations), "*Ergonomics*" with 26 publications (728 citations), "*Advances in intelligent systems and computing*" with 18 publications and 29 citations and "*Work*" also have 18 publications with 176 citations. "*International journal of industrial and systems engineering* "contributed least in the list with 5 publications and 29 citations. "Measurement: journal of the international measurement confederation" was the most impactful source with 3.36 JIF, followed by "Applied ergonomics" (JIF=3.14). Most of the sources originated from UK (four sources), followed by the USA and Netherlands (each two). The analysis also reveals that Elsevier was the dominant publisher in the top ten list.

Table 3: Top ten most relevant source in anthropometric measurement

Rank	Source	NP	TC	JIF	Q	Country	Publisher	h_index	g_index	PY_start
1	International journal of industrial ergonomics	43	983	1.66	Q3	Netherland	Elsevier	19	30	1989
2	Applied ergonomics	38	1315	3.14	Q2	UK	Elsevier	21	36	1981
3	Ergonomics	26	728	2.19	Q3	UK	Taylor & fran	15	26	1981
4	Advances in intelligent systems and computing	18	29	NA	Q3	Germany	Springer	3	3	2016
5	Work	18	176	1.13	Q4	Netherland	IOS press	7	12	2002
6	Proceedings of the human factors and ergonomics society	16	60	NA	NA	USA	Sage	4	6	1995
7	Measurement: journal of the international measurement confederation	8	84	3.36	Q1	UK	Elsevier	6	8	2007
8	International journal of occupational safety and ergonomics	7	68	1.60	Q3	Poland	Elsevier	4	7	2001
9	Human factors and ergonomics in manufacturing	6	24	0.42	Q4	USA	John Wiley	3	4	2014
10	International journal of industrial and systems engineering	5	29	NA	Q3	UK	Inderscience	4	5	2010

5.6. Most active organization:

The analysis to recognize the topmost organizations shows that the Delft University of Technology, Netherlands is the most active and influential organization in the list (15 publications, 215 citations). The Hong Kong Polytechnic University, China, and University Putra Malaysia, Malaysia, with 12 publications each and 300, 54 citations, respectively. Finally, Loughborough University, UK (10 publications, 150 citations), and Tsinghua University with 9 publications, 110 citations. Eventually, Universidad Del Norte and the University of California contributed seven publications and 99 and 150 citations. Table 4 also shows that organization of china was the most active organization on the list. At the same time, the Hong Kong Polytechnic University verified as the most cited organization in the top ten list (TC=300).

Table 4: Top ten most productive organization in anthropometric Measurement

Rank	Organization	Country	NP	TC
1	Delft University of Technology	Netherland	15	215
2	The Hong Kong Polytechnic University	China	12	300
3	University Putra Malaysia	Malaysia	12	54
4	Loughborough University	UK	10	150
5	Tsinghua University	China	9	110
6	Dalhousie University	Canada	8	45
7	National Cheng Kung University	Taiwan	8	78
8	Pohang University of Science and Technology	South Korea	8	69
9	Universidad Del Norte	Colombia	7	99
10	University Of California	USA	7	150

5.7. Productive country:

The United States found the most productive country with 60 publications, 981 citations, 2.5 average documents per year, and 8.3 percentage of documents in last years. China listed second with 42 publications, 336 citations, 3 average documents per year (ADY), and 14.3 percentage of documents in last years (PDLY). India (ranked 3rd) has 34 publications, 171 citations, 7.5 average documents per year, 44.1 percentage of documents in last years followed by Malaysia w (33 publications, 196 citations), Philippines (27 publications, 111 citations). Canada was the

least productive country among the top ten list, contributed 17 publications with 285 citations. (Refer to figure 4 below)

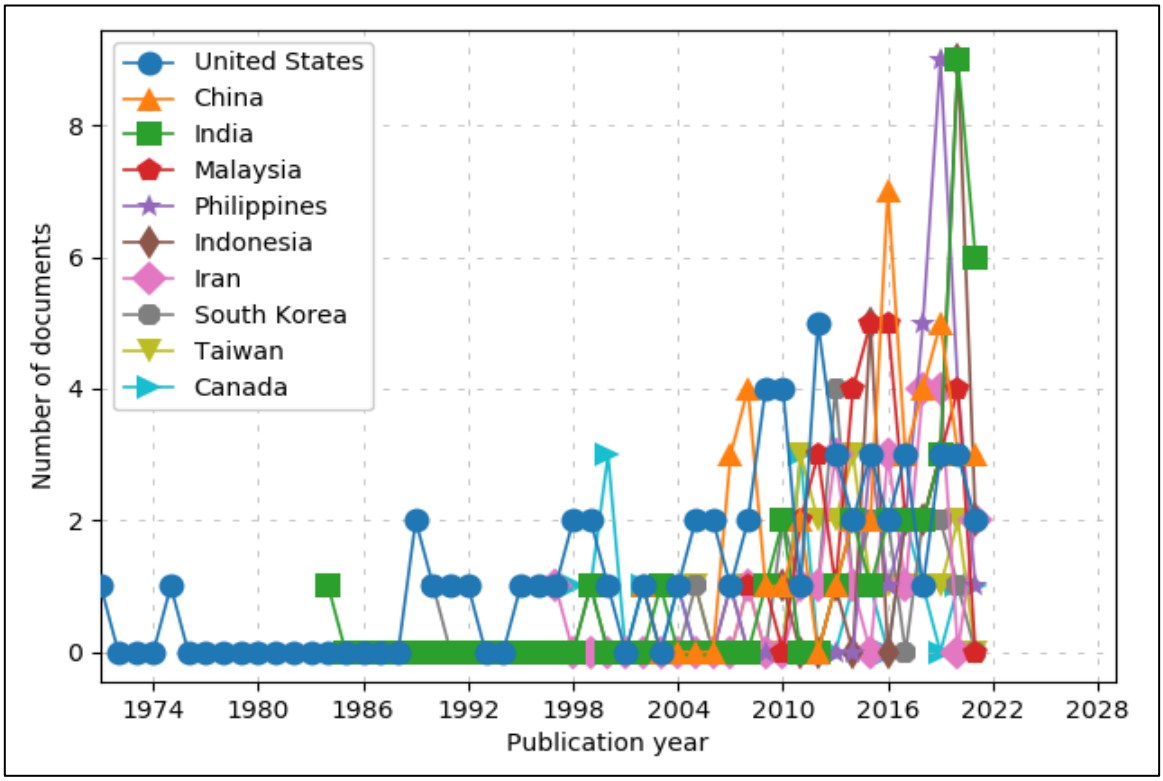


Figure 4: Top ten productive country timeline from Scientopy software

5.8. Analysis of Author keywords:

The figure 5 evident that most of the authors used the keyword "anthropometric" (Freq. =104, AGR (average growth rate)=5, ADY=18, PDLY=34.6 and H-Index=22), followed by "Ergonomics" (Freq. =69, AGR (average growth rate)=3, ADY=11.5, PDLY=33.3 and H-Index=16), "Ergonomic design" (Freq. =21, AGR (average growth rate) =0, ADY=4, PDLY=38.1 and H-Index=7), "Anthropometric measurements" (freq.=16), and "Musculoskeletal disorders" (freq.=16). The other keywords, like, Ergonomic, School furniture, Design, Anthropometric data, and Anthropometric Measurement, are also listed in the top ten.

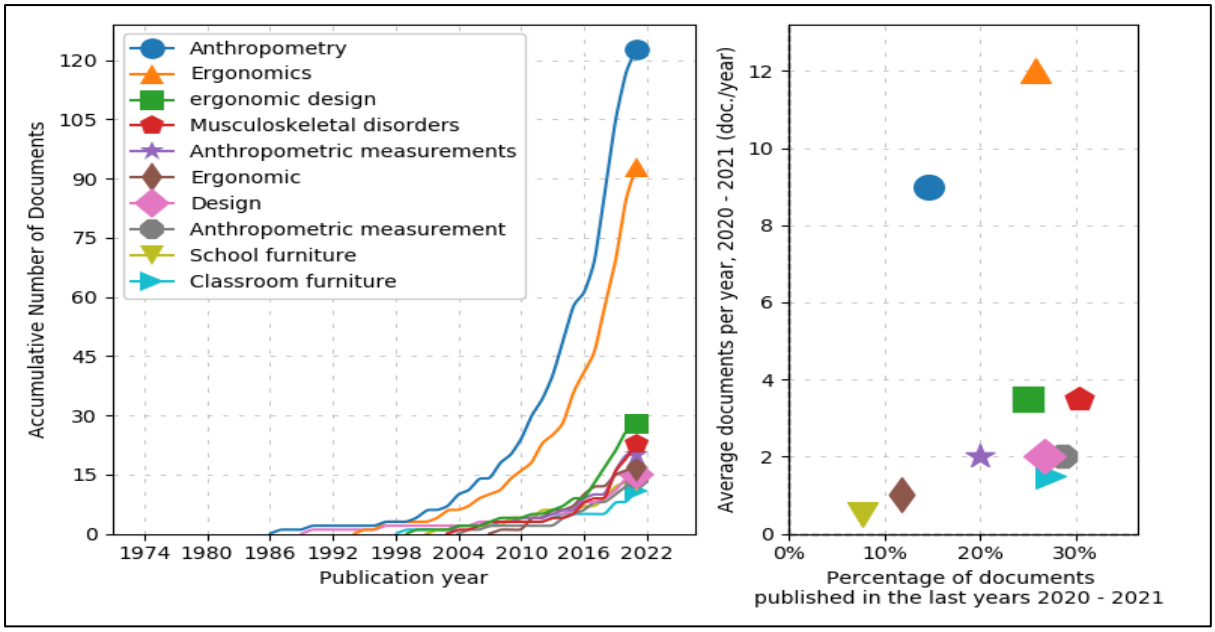


Figure 5: Ton ten-author keyword evolution from Scientopy software

5.9. Mapping co-occurrence of all keywords:

Minimum 10 occurrences of keywords have been considered for present analysis to map all keywords on anthropometric measurement literature. Although out of 3401 all keywords, only 94 keywords were meet the criteria, all the selected keywords represented in five clusters with 2860 links and 16783 total link strength. *(Refer to figure 6).*

Cluster 1 consist of 31 keywords: Accident Prevention, Anthropometric Data, Anthropometric Dimensions, Anthropometric Measurement, Anthropometric Measurements, Anthropometry Body Dimensions, Database Systems, Design, Ergonomic Design, Ergonomics, Furniture Design, Health, Health Risks, Human Bodies, Human Computer Interaction, Human Factors, Musculoskeletal Disorders, Musculoskeletal System, Occupational Risks, Population Statistics, Principal Component Analysis, Product Design, Productivity, Risk Assessment, Risk Management Seats, Standard Deviation, Statistics, Surveys, and Workplace.

Cluster 2 comprises of 21 keywords: Bioengineering, Body Posture, Carpal Tunnel Syndrome, Equipment Design, Human, Human Engineering, Humans, Major Clinical Study, and Methodology, Middle Aged, Musculoskeletal Disease, Occupational Diseases, Posture, Procedures, Questionnaire, Review, Risk Factor, Standards, United States, Upper Extremity and Young Adult.

Cluster 3 represented 18 keywords: Adult, Age, Aged, Anthropometric Parameters, Article, Body Height, Body Mass, Body Size, Body Weight, Chinese, Comparative Study, Controlled Study, Female, Male, Priority Journal, Sex Difference, Wheelchairs and Work Environment.

Cluster 4 includes 15 keywords: Adolescent, Child, Classroom Furniture, Education, Ergonomic, Furniture, Interior Design and Furnishings, Mismatch, Regression Analysis, School, School Child School Furniture, Schools, Sitting and Students.

Cluster 5 comprises of nine keywords: Biomechanics, Body Position, Comfort, Hand, Hand Anthropometry, Human Experiment, Normal Human, Physiology, and Three-Dimensional Imaging.

The size of the ball shows the strong network of the keywords. The top 20 keywords in anthropometric measurement are shown in the figure according with their number of occurrence (frequency) and their total link strength (TLS) i.e. ergonomics (freq=328,TLS=2214), anthropometry(freq=286,TLS=2163) , Human (freq=176,TLS=2086),, article (freq=135,TLS=1671), male(freq=129,TLS=1666),, female(freq=120,TLS=1555), adult (freq=102,TLS=1289), anthropometric measurement (freq=101,TLS=675), humans, anthropometric data, product design, human engineering, controlled study, equipment design, priority journal, ergonomic design, human experiment, design , Adolescent and anthropometric dimensions etc.

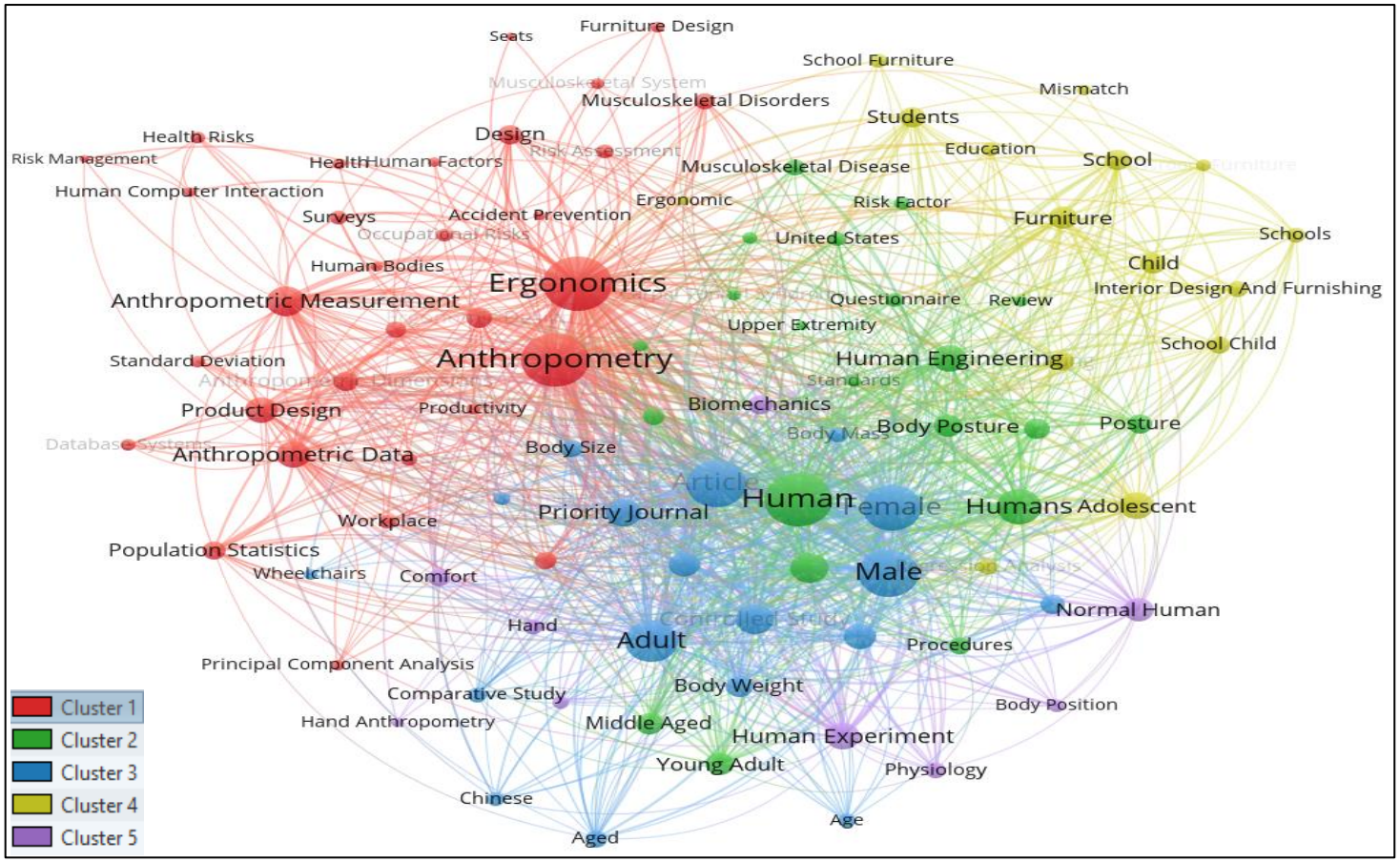


Figure 6: Keyword analysis of anthropometric measurement from VOSviewer

5.10. Most cited papers in anthropometric measurement:

The top ten most cited articles in anthropometric measurement are highlighted in table 5. Apparently, the article entitled "Mismatch of classroom furniture and student body dimensions" (1999) by Parcells C, published in J Adolesc Health, begged more citations (181 total citations) (Parcells

et al., 1999), followed by the "Classroom furniture dimensions and anthropometric measures in primary school" (2004) by Panagiotopoulou G with 151 citations (Panagiotopoulou et al., 2004). "Match between school furniture dimensions and children's anthropometry" (2006) by Gouvali MK (141 citations) (Gouvali & Boudolos, 2006), "Back pain in school children—Where to from here?" (2006) by Trevelyan FC (108 citations) (Trevelyan & Legg, 2006), and "A cross-sectional study of self-reported back and neck pain among English schoolchildren and associated physical and psychological risk factors" (2007) by Murphy S (102 citations) (Murphy et al., 2007). "Anthropometrics for the design of Bahraini school furniture" (2009) by Mokdad M received the lowest citations (TC=69) among the top ten articles (Mokdad & Al-Ansari, 2009).

Table 5: Top ten most cited research papers in anthropometric measurement

Rank	Title	Author	Year	Source	TC	TC/Year	NTC
1	Mismatch of classroom furniture and student body dimensions(Parcells et al., 1999)	Parcells C	1999	J Adolesc Health	181	7.87	5.32
2	Classroom furniture dimensions and anthropometric measures in primary school(Panagiotopoulou et al., 2004)	Panagiotopoulou G	2004	Appl Ergon	151	8.39	2.78
3	Match between school furniture dimensions and children's anthropometry(Gouvali & Boudolos, 2006)	Gouvali MK	2006	Appl Ergon	141	8.81	3.01
4	Back pain in school children—Where to from here?	Trevelyan FC	2006	Appl Ergon	108	6.75	2.30
5	A cross-sectional study of self-reported back and neck pain among English schoolchildren and associated physical and psychological risk factors(Murphy et al., 2007)	Murphy S	2007	Appl Ergon	102	6.80	2.73
6	School furniture and the user population: an anthropometric perspective(Milanese & Grimmer, 2004)	Milanese S	2004	Ergonomics	98	5.44	1.81
7	Anthropometric study of Portuguese workers(Barroso et al., 2005)	Barroso MP	2005	Int J Ind Ergon	95	5.59	2.68
8	Dimensional differences for evaluating the quality of footwear fit(Witana et al., 2004)	Witana CP	2004	Ergonomics	90	5.00	1.66

9	Anthropometric measurement of Filipino manufacturing workers(Del Prado-Lu, 2007)	Del Prado-Lu JL	2007	Int J Ind Ergon	74	4.93	1.98
10	Anthropometrics for the design of Bahraini school furniture(Mokdad & Al-Ansari, 2009)	Mokdad M	2009	Int J Ind Ergon	69	5.31	3.62

5.12. Most used references with strongest citations burst: A citation burst is a valuable analytic approach for identifying articles that receive significant attention from the relevant scientific community over a period. In other words, it highlights a document's most active time, when it gets the most attention among the researchers. The **blue color** reflects the citation burst's overall duration, while the **red color** reflects the active time of the citation burst. Nature Switzerland ag has the highest strength (36.24), then Proposed design (24.71), Lower body (19.92), Seat dimensions (18.91), Publishing ag (18.37), and Anthropometric characteristics (15.86 strength). The risk factor had the lowest strength in the top 13 references (5.54 strength).

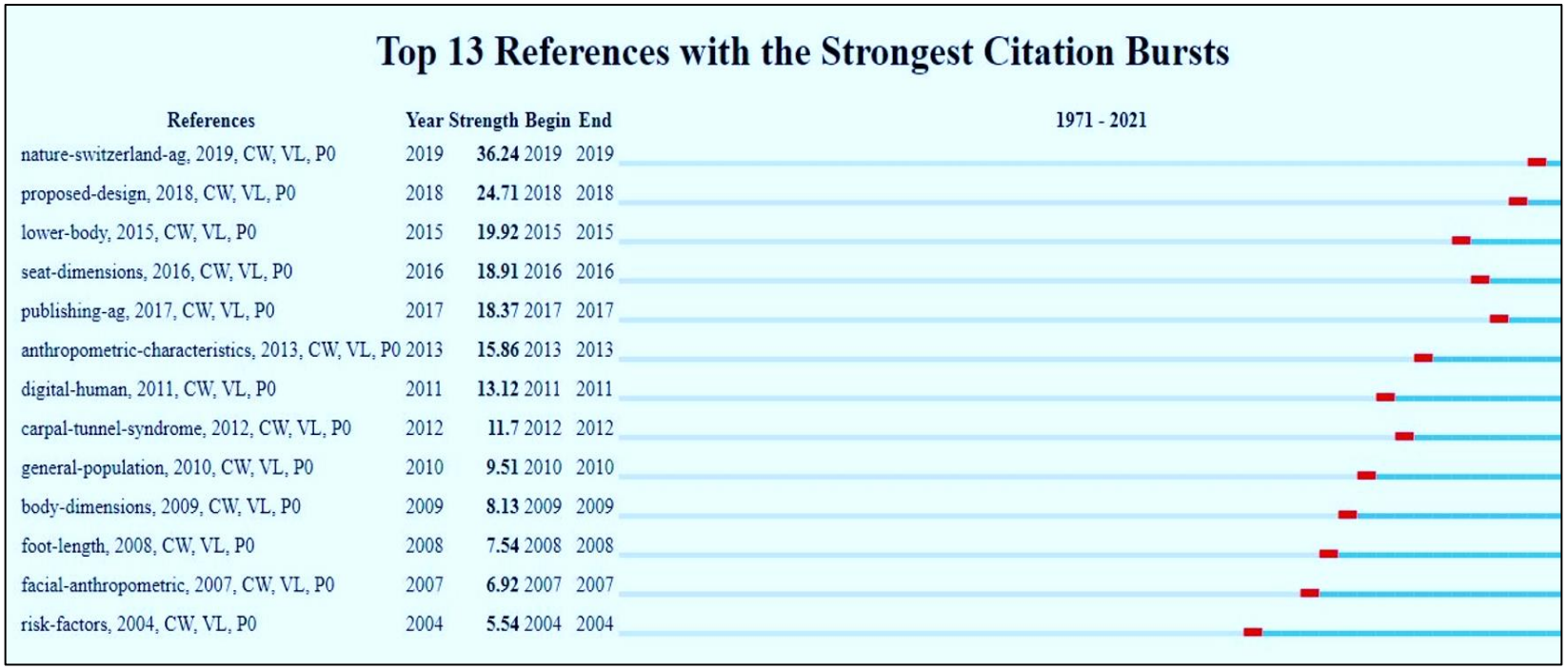
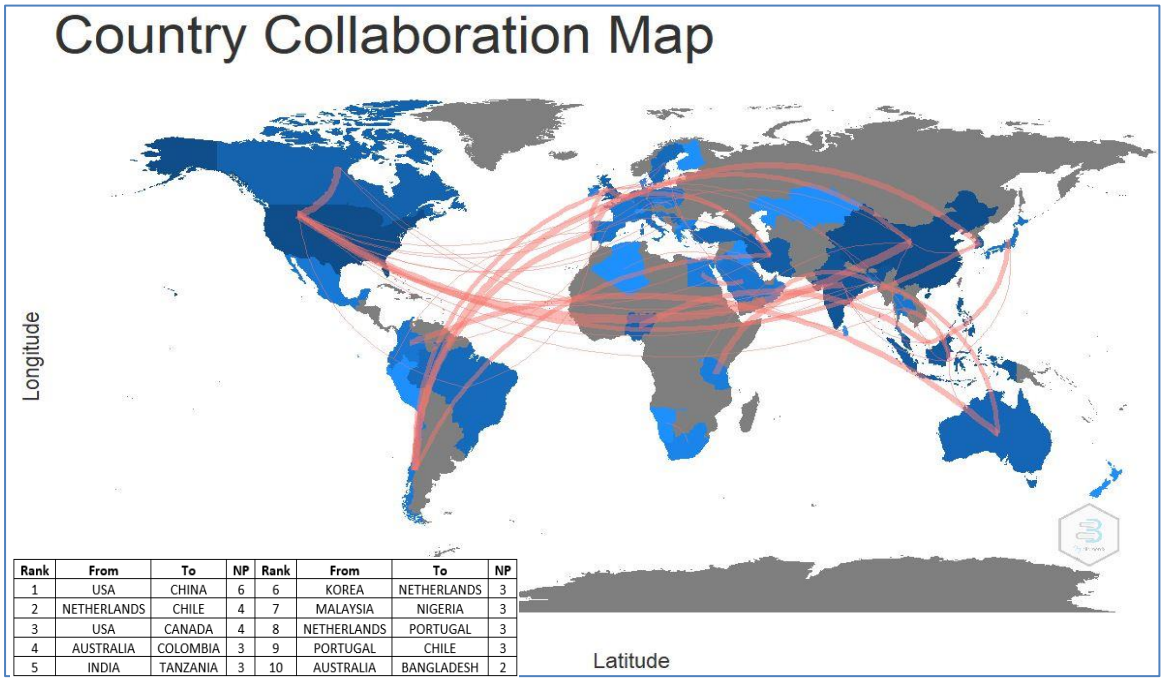


Figure 7: Top 13 references with strongest citations burst used by CiteSpace

5.12. Country collaboration map:

As disclosed in figure 8, the USA and China (NP=6) are the most collaborative nation on the list, followed by the Netherlands with China, the USA with Canada has four publications each. Australia with Colombia, India with Tanzania, Korea with the Netherlands, Malaysia with Nigeria, and the Netherlands with Portugal with three papers, respectively. Australia and Bangladesh were the least collaborative among the top ten countries with two publications only.



Rank	From	To	NP	Rank	From	To	NP
1	USA	CHINA	6	6	KOREA	NETHERLANDS	3
2	NETHERLANDS	CHILE	4	7	MALAYSIA	NIGERIA	3
3	USA	CANADA	4	8	NETHERLANDS	PORTUGAL	3
4	AUSTRALIA	COLOMBIA	3	9	PORTUGAL	CHILE	3
5	INDIA	TANZANIA	3	10	AUSTRALIA	BANGLADESH	2

Figure 8: Country collaboration

5.13. Funding agencies in anthropometric measurement:

The top then most active funding agencies in anthropometric measurement research have been sorted and visualized in figure 9. The figure evident that the "National natural science foundation of china" performed as the most influential and active funding agencies in anthropometric measurement during 1971-2021 (8 publications). Then "China Scholarship council" (5 publications), "Centers for disease control and prevention," "Hong Kong polytechnic university," "Ministry of educations," "Ministry of higher educations, Malaysia," and National Institute of for occupational safety and health" with four publications each. "Engineering and physical sciences research council, European Commission and Ministry of education, science and technology were the minor influential funding agencies in the top ten list, only funded three each.

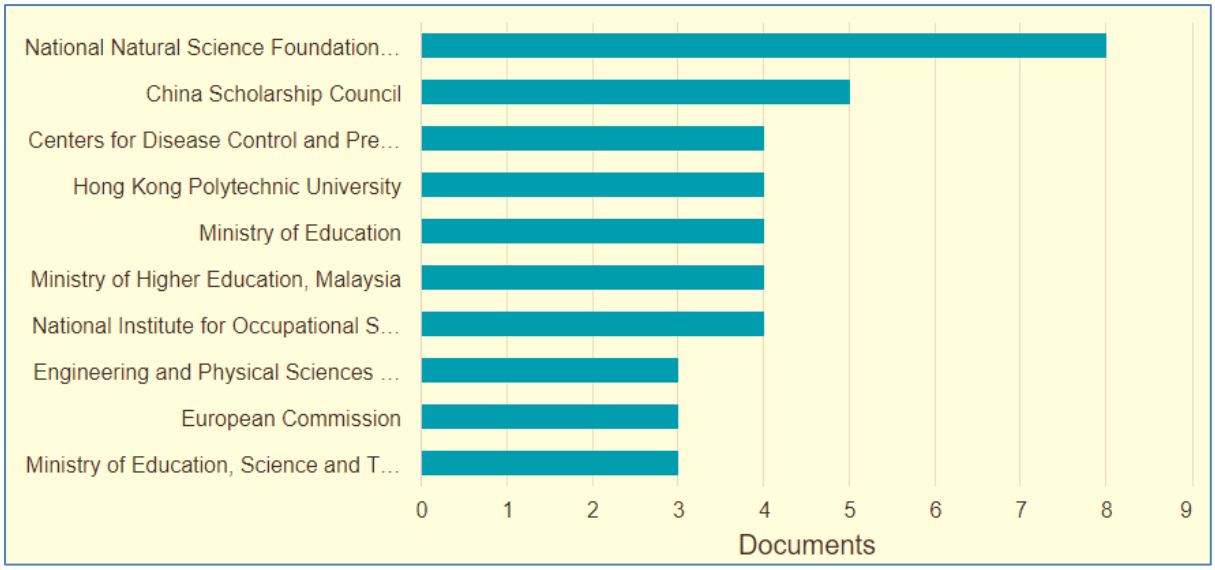


Figure 9: Top 10 Funding agencies

The highlights of the assessment of the published papers in anthropometric measurement research:

- One thousand three hundred sixteen authors contributed 483 anthropometric measurement papers in 199 sources and 4787 citations.
- The year 2020 produced 58 papers and begged 39 citations. On the contrary, the year 2004 identified as the most cited year begged 434 citations for only eight publications)
- There are just 53 single-authored papers (554 citations). Multiple authorship, on the other hand, generated 430 publications (4233 citations). As per the findings, three authorship produced the most research, with 117 publications (1078 citations).
- You H, a professor at Pohang University of Science and Technology, was discovered to be the most prolific author among the top 10. (8 publications, 50 citations).
- "*International journal of industrial ergonomics*" found as the most productive source, which has 43 publications, 983 citations.
- "Applied ergonomics" (JIF=3.14) has been the most influential source, at 3.36 JIF (38 publications, 1315 citations)
- The most important and dominant organization on the list is the Delft University of Technology in the Netherlands (15 publications, 215 citations).
- With 60 publications, 981 citations, 2.5 average papers per year, and an 8.3 proportion of papers, the United States was perhaps the most productive country.

- Anthropometric, Ergonomics, Ergonomic design, Anthropometric measurements, and Musculoskeletal disorders are mostly preferred author keywords.
- "Mismatch of classroom furniture and student body dimensions" (1999) by Parcells C, published in J Adolesc Health, begged more citations (181 total citations).
- The United States (NP=6) and China (NP=6) are the most collaborative countries.
- The "National Natural Science Foundation of China" was the most potent and active financing agency in anthropometric measurement from 1971 to 21.

Conclusion:

The systematic approach of the study demonstrated the significance of employing the scientometric method to investigate anthropometric measurement research. The study filled up the gaps and pointed researchers to new avenues for future research. Moreover, no other comprehensive bibliometric review of the literature in this area of anthropometric measurement research has been done from 1971 to 2021. There are only 58 research papers published in 2020 and 23 papers in 2021 (till date); therefore, we can say that despite the consistent expansion in research growth, the study's findings show that the output of research is insufficient to meet growing demands, especially when people of all age groups spend their time on the system. The pandemic also impacts this area of the study, because of the global lockdown, the professional and educational organizations operating in clouds; therefore, many related issues are required to address.

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