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Bibliometric analysis of psychometrics in sports and physical education

Analisis bibliometrik psikometri dalam olahraga dan pendidikan jasmani

Andika Triansyah[1], Herman Subarjah[2], Yusuf Hidayat[3], Suci Lukitowati[4]
[1,2,3] Universitas Pendidikan Indonesia, Bandung, Indonesia.
[4] Universitas Tanjungpura, Pontianak, Indonesia.
Email: andika.triansyah@upi.edu[1], hermansubarjah@upi.edu[2], yusuf_h@upi.edu[3], suci.lukitowati@fisip.untan.ac.id[4]

ABSTRACT

The study of psychometrics in sports and physical education has developed over time and has become an international concern. So, this study aims to find trends in themes that are popularly used in psychometric studies in sports and physical education based on Scopus-indexed articles. The research method used to conduct the analysis is bibliometrics. Search and filtering strategies use PRISMA flowcharts. The research review used data in Comma-Separated Values (CSV) format, which was then exported to Microsoft Excel to visualize the search results of bibliometric analysis, the tool used was VOSviewer. The results of the analysis of the development of psychometric publications in sports and physical education explain the trend of publications, journals, and authors with the highest citations, the publication network between countries, and the most widely used keywords. The conclusion of the study results in the development of psychometric publications in sports and physical education in the period 1981-2023 tends to increase. This shows that the trend of research with psychometric topics in sports and physical education is of international concern.

Keywords: psychometrics; sport; physical education.

Kajian psikometrik dalam olahraga dan pendidikan jasmani berkembang seiring waktu dan menjadi perhatian dunia internasional. Sehingga penelitian ini memiliki tujuan untuk mencari tren tema yang popular digunakan dalam kajian psikometrik dalam olahraga dan pendidikan jasmani berdasarkan artikel terindeks scopus. Metode penelitian yang digunakan untuk melakukan analisis adalah bibliometrik. Strategi pencarian dan penyaringan menggunakan diagram alir PRISMA. Tinjauan penelitian menggunakan data dalam format Comma-Separated Values (CSV), yang kemudian diekspor ke Microsoft Excel dan untuk memvisualisasikan hasil pencarian analisis bibliometrik, alat yang digunakan adalah VOSviewer. Hasil analisis perkembangan publikasi psikometrik dalam olahraga dan pendidikan jasmani menjelaskan tren publikasi, jurnal dan penulis dengan kutipan tertinggi, jaringan publikasi antar negara dan kata kunci yang paling banyak digunakan. Kesimpulan penelitian menghasilkan perkembangan publikasi psikometrik dalam olahraga dan pendidikan jasmani pada periode 1981-2023 cenderung meningkat. Hal ini menunjukkan bahwa tren penelitian dengan topik psikometrik dalam olahraga dan pendidikan jasmani menjadi perhatian internasional.

Kata kunci: psikometrik; olahraga; pendidikan jasmani.

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Correspondence Address:

Herman Subarjah
Department of Sport Education, Postgraduate Program, Universitas Pendidikan Indonesia, Bandung, Indonesia.
Email: hermansubarjah@upi.edu

INTRODUCTION

Scientific studies that study behavior, mental functions, and human mental processes are scientifically called psychology. Psychological science includes various factors that influence human behavior, such as environmental, genetic, and social factors. The goal of psychology is to understand and explain how the

human mind and behavior are formed, as well as how these factors interact with each other (Asrori, 2020). Expert in the field of psychological measurement Edward Lee Thorndike stated that anything in this world must have a number, so to find out it is necessary to calculate both quantity and quality or quality. This is the development of psychology became the basis for improving the quality of quantitative psychology or what is now known as psychometry (Supratiknya, 2014). Here are some expert quotes about psychometrics: According to Anne Anastasi in her book Psychological Tests; Psychometrics; Psychological Testing explains Psychometrics is the science of measuring psychological aspects, such as abilities, talents, personality, and interests (Neubauer & Opriessnig, 2014). This measurement is carried out using tests specifically designed to measure these aspects (Maroco et al., 2014). These measurements are made using tests specifically designed to measure these aspects. Psychometrics focuses on the development and use of tests to measure various psychological aspects, such as intelligence, aptitude, personality, and interests (Yamagata & Sugawara, 2014). Psychometrics is the science of tests and measurements in psychology. Psychometrics focuses on the development and use of tests to measure various psychological aspects, such as intelligence, aptitude, personality, and interests. Another understanding is conveyed by Lee J Cronbach in his book ability testing psychometrics psychological tests deliver psychometrics is a branch of psychology that studies the ins and outs of measuring and analyzing various differences between individuals, so it can be said that psychometrics studies differences between individuals and between groups (Teske et al., 2014). Psychometrics is one branch of psychology that studies the ins and outs of measuring and analyzing various differences between individuals, so it can be said that psychometrics studies differences between individuals and between groups (Cocca et al., 2022).

Psychometrics supports the paradigm of evidence-based psychological assessment (*EBPA*), who consider good psychometric quality as a requirement, but not yet adequate to produce good assessments or assessments (Wright et al., 2022). A good assessment is expected to be a combination of the best psychometric characteristics and the contextual characteristics of the individual or group subjected to measurement (McPherson et al., 2010). One of the results of psychometric activity is a psychological test or psychological test (Bornstein, 2017). There are also many psychometric studies in the development of sports science and physical education, among others. Psychometric parameters of an inventory of intrinsic motivation adapted in physical education (Cocca et al., 2022). Contextualized Planning Scale in Physical Education (Cuevas-López et al., 2023). Create and test a psychometric-based life ability assessment scale for physical education in China (Ji et al., 2022). Develop and test grit scales for physical education (Guelmami et al., 2022). Questionnaires to Measure Inter-

Individual Interpersonal Behavior in Sports (Alexe et al., 2023). Assess the stability of measurements and psychological characteristics of the scale of tendency to avoid physical activity and exercise (Saffari et al., 2023). Quality assessment of the Awareness Inventory for Sport: German Version (Wieczorek et al., 2022). Adapting and validating the Indonesian version of the Sports Anxiety Scale-2 (SAS-2) in elite Papuan athletes (Putra et al., 2021). The accuracy of an Italian translation of a survey on sports team belief in their ability to succeed (Santi et al., 2021). Assessment of the validity and accuracy of the collective observational confidence scale for sport in Turkish form (Sezer et al., 2020). The study of the validity and accuracy of brand questionnaires is strong in the world of sports (Rezaei et al., 2018). Psychometric assessment, a measure of sports imagination ability (Watt et al., 2018). This study examined how well a Malaysian version of a sports anxiety test measures anxiety in young athletes (Hashim et al., 2017). Psychometric evaluation of eating disorder scales in athletes (Fortes et al., 2016). A study examining the reliability and validity of a questionnaire that measures how physical education teachers in Mexico interact with their students (Duarte-Félix et al., 2020). Some of the studies above show that research topics related to psychometrics in sports and physical education are important and attract researchers so that they become international attention.

By considering these studies, this study is believed to be important to map bibliographic information from certain fields, especially reviewing the direction of research related to psychometrics in sports and physical education. Therefore, this research aims to explore the literature on psychometrics in sports and physical education based on articles indexed in Scopus. To achieve this goal, an analysis was carried out regarding international research developments, publication and citation growth patterns, the most famous papers, top authors, journals, countries, and the most frequently appearing search keywords. The subsequent sections of this research are structured as follows: The first section contains an introduction that explains the importance of the research. The research methodology is explained in the second section. The third section describes the bibliometric research findings. At the end of the research, there is a conclusion which also contains suggestions for further research.

METHOD

The analysis is based on the data of scientific publications, which are researched using bibliometric methods. This method, first developed by Wyndham Hulme, allows us to track trends and relationships between scientific publications. In essence, bibliometrics is the study of scientific publications using statistical and mathematical approaches (ŞahİN et al., 2023). The data source was collected from the Scopus database on 2023. As an important source of

search information, Scopus offers a comprehensive overview of global research results in a variety of fields. However, in bibliometric analysis, the selection of the right keywords becomes very important because this has a direct impact on the results obtained (Gazali & Saad, 2023). To achieve that goal, data searches are performed using Boolean logic such as "AND" and "OR" in Scopus (Simbolon et al., 2023), leads to searches with the following keywords: TITLE (psychometric AND sport*OR"physical education") AND (LIMIT-TO (SUBJAREA, "PSYC") OR LIMIT-TO (SUBJAREA, "MEDI") ORLIMIT-TO (SUBJAREA, "HEAL") OR LIMIT-TO (SUBJAREA, "SOCI") OR LIMIT-TO (SUBJAREA, "ARTS")) AND (LIMIT-TO (DOCTYPE, "ar")) AND (LIMIT-TO (PUBSTAGE, "final")) AND (LIMIT-TO (SRCTYPE, "j")) AND (LIMIT-TO (LANGUAGE, "English")). This search yielded 133 documents. The search and filtering strategy using the PRISMA flow chart can be seen in Figure 1. Initially, 198 documents were identified through a Scopus data search. After going through the screening process and exemption criteria, 133 documents were obtained that were ready for review.

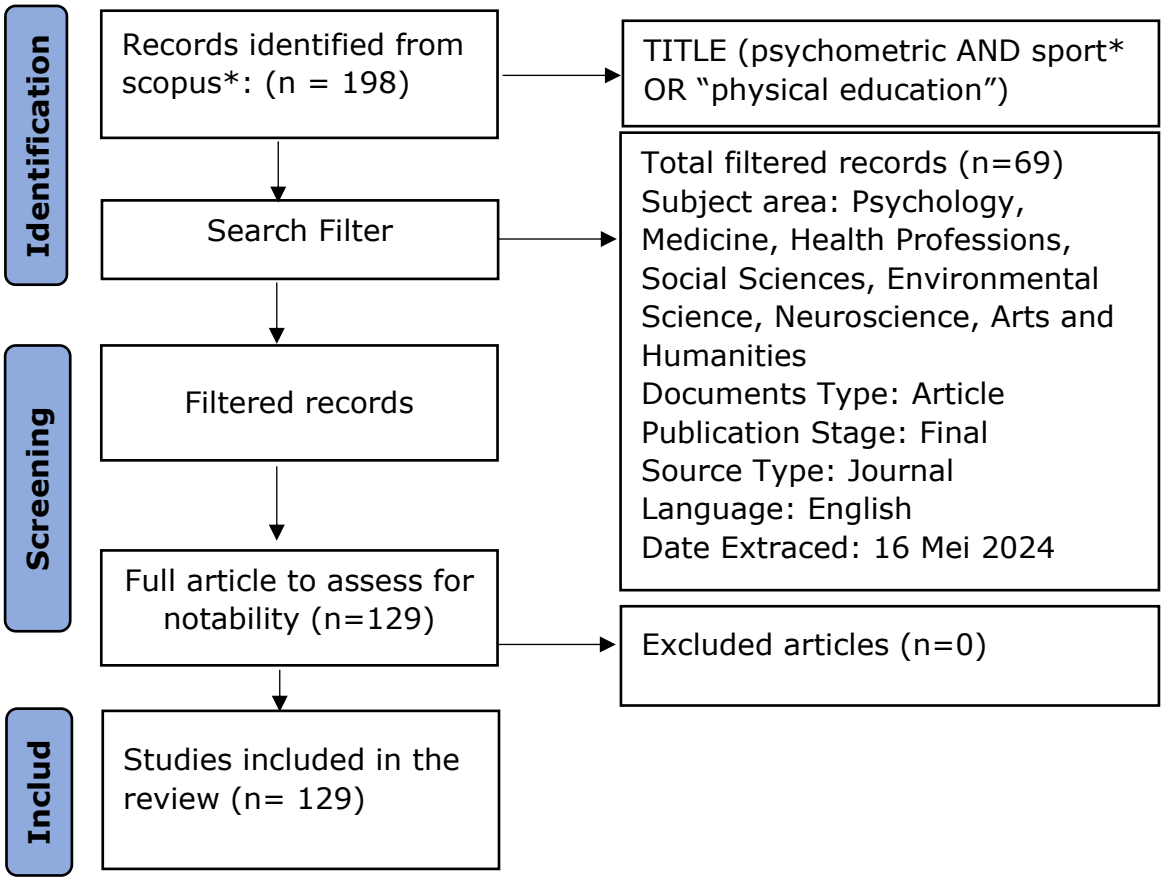

Figure 1. Prisma flow chart

The data analyzed in this study used a comma separated values (CSV) format obtained from Scopus exports. As for visualizing search results, the tool used is VOSviewer (Van Eck & Waltman, 2010), an app developed by Van Eck

and Waltman affiliated with Leiden University (Burhaein et al., 2023). One benefit of utilizing VOSviewer is its ability to swiftly evaluate bibliometric information extracted from significant academic repositories like Scopus, Web of Science, and PubMed (Jeong et al., 2020). VOSviewer is like a mapping tool that helps researchers explore the research landscape by visualizing relationships between scientific papers, such as author, country, and dominant keywords. More than just a map, VOSviewer is able to parse a complex network of citations, showing who cited whom, and which works are interrelated.

FINDINGS AND DISCUSSIONS

Findings

This section dives into the findings of our bibliometric analysis. We'll start with a breakdown of the literature, looking at how publications on this topic have evolved over time. Next, we'll identify the journals, authors, and research papers that have been most influential in the field. We'll also explore research collaboration and authorship patterns across different countries. Finally, we'll analyze the key terms that frequently appear in sports and physical education psychometric studies.

Publication Trends

Publications on the Scopus search on psychometrics in sports and physical education first began in 1981 under the title Psychometric Note on the Reliability of the Sport Competition Anxiety Test: Form C (Rupnow & Ludwig, 1981). The development of the number of publications from 1981 to 2023 tends to increase. The increase looks stable from 2014 (4 documents) to 2018 (16 documents). In 2019 (8 documents) it decreased, but the increase occurred again until 2022 (19 documents). In 2023 it decreased slightly to 17 documents. The number of publications on psychometrics in sports and physical education has fluctuated over time. However, there has been an upward trend in the past decade, reaching a peak of 19 documents in 2022.

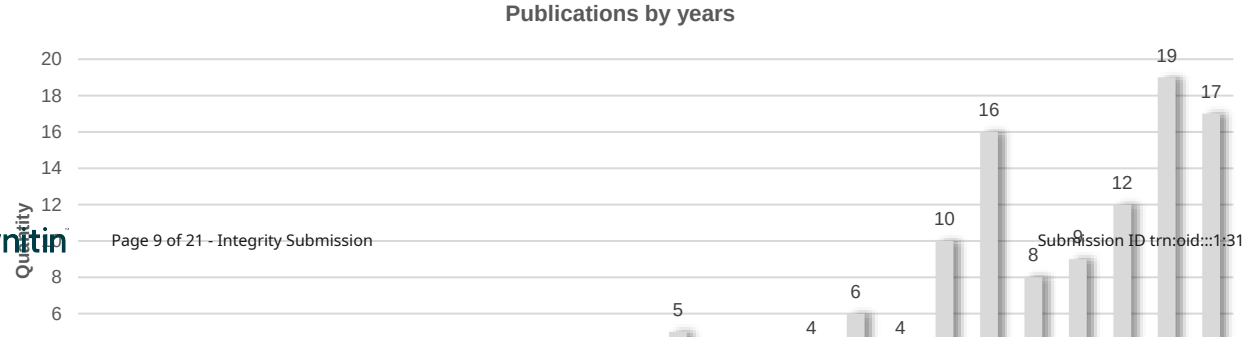

Figure 2. Total publications by years

Journals, authors, and highest citations

Journals that publish articles on psychometric topics in sports and physical education have as many as 72 journals. However, for this purpose, 10 journals with the highest article productivity are displayed, which can be seen in table 1. International Journal of Environmental Research and Public Health became the most by publishing 10 articles. The journal Cuadernos De Psicologia Del Deporte published 8 articles. Frontiers In Psychology and Perceptual and Motor Skills published 6 articles each, while other journals published under 6 publication articles.

Table 1. Top ten journals with the highest article productivity

No	Author	Document
1	International Journal of Environmental Research and Public Health	10
2	Cuadernos de Psicologia del Deporte	8
3	Frontiers in Psychology	6
4	Perceptual and Motor Skills	6
5	Psicothema	5
6	Measurement in Physical Education and Exercise Science	4
7	Psychology of Sport and Exercise	4
8	Sustainability (Switzerland)	4
9	International Journal of Sport and Exercise Psychology	3
10	Journal of Physical Education and Sport	3

In table 2 are displayed the 10 most prolific authors with publication citations with psychometric research topics in sports and physical education. Antonio Baena-Extremera (Spain) became the most prolific writer by producing 4 documents (22 citations). Then Verónica Morales-Sánchez (Spain) produced 4 research documents (11 citations) and Isabel Balaguer (Spain) produced 3 documents (44 citations). Furthermore, in full can be seen in the following table:

Table 2. Top ten most prolific authors with publication citations

No	Author	Country	Document	Citations

1	Baena-Extremera, Antonio	Spanish	4	22
2	Morales-Sánchez, Verónica	Spanish	4	11
3	Balaguer, Isabel	Spanish	3	44
4	Fiorese, L	Brazil	3	23
5	Granero-Gallegos, A.	Spanish	3	22
6	Gómez-López, M.	Spanish	3	22
7	Burgueno, Rafael	Spanish	3	16
8	Guelmami, N.	Tunisia	3	15
9	Franquelo, María Auxiliadora	Brazil	3	4
10	Hernández-Mendo, A.	Spanish	3	4

Furthermore, in table 3 displayed 10 influential articles with the most citations on the topic of philosophy and sports. Article title Psychometric properties of the intrinsic motivation inventory in a competitive sport setting: A confirmatory factor analysis (McAuley et al., 1989) became the most influential with a total citation of 1690. Next Examination of the psychometric properties of the perceived motivational climate in sport questionnaire-2 in a sample of female athletes (Newton et al., 2000) with 445 citations and psychometric and measurement properties of concussion assessment tools in youth sports (Valovich McLeod et al., 2006) A total of 101 citations. The rest of the articles with citations under 100 citations can be seen in Table 2.

Table 3. Top ten best influential articles in psychometric studies

No	Document Title	Authors and years	Journal	Citations
1	Psychometric properties of the intrinsic motivation inventory in a competitive sport setting: A confirmatory factor analysis.	(McAuley et al., 1989)	Research Quarterly for Exercise and Sport	1690
2	Examination of the psychometric properties of the perceived motivational climate in sport questionnaire-2 in a sample of female athletes.	(Newton et al., 2000)	Journal of Sports Sciences	445
3	Psychometric and measurement properties of concussion assessment tools in youth sports.	(Valovich McLeod et al., 2006)	Journal of Athletic Training	101
4	Measuring student motivation for physical education: Examining the psychometric properties of the Perceived Locus of Causality Questionnaire and the Situational Motivation Scale.	(Lonsdale et al., 2011)	Psychology of Sport and Exercise	76
5	Preliminary psychometric evaluation of a measure of adherence to clinic-based sport injury rehabilitation.	(Brewer et al., 2000)	Physical Therapy in Sport	65

6	The revised perceived locus of causality in physical education scale: Psychometric evaluation among youth.	(Vlachopoulos et al., 2011)	Psychology of Sport and Exercise	55
7	Evaluating the psychometric properties of the Social Identity Questionnaire for Sport (SIQS).	(Bruner & Benson, 2018)	Psychology of Sport and Exercise	46
8	Psychometric quality supporting the Spanish adaptation of the behavioral regulation in sport questionnaire.	(Viladrich et al., 2011)	Psicothema	44
9	Psychometric properties of the Spanish version of the controlling coach behaviors scale in the sport context.	(Castillo et al., 2014)	Psicothema	41
10	Psychometric evaluation of the Drive for Muscularity Scale in a community-based sample of Scottish men participating in an organized sporting event.	(McPherson et al., 2010)	Body Image	40

Interstate publication network

Based on the number of published documents, the following is a complete list of the top 10 countries in Table 4. The country that has the most published documents on psychometric topics in sports and physical education is the United States with 28 documents and 2525 citations. Next, the second country is Spain with 28 publication documents and 277 citations. Brazil has 20 publication documents and 91 citations. The next state document is issued under 20 documents. In this case, during the span of 1981 to May 2024, The United States and Spain became the countries that published the most research on psychometrics in sports and physical education.

Table 4. Countries with the most published documents

No	Country By Documents	Documents	Citations
1	United States	28	2525
2	Spanish	28	277
3	Brazil	20	91
4	Canada	15	253
5	United Kingdom	14	690
6	Australia	12	224
7	Portugal	11	58
8	China	10	41
9	Iran	7	10
10	Mexico	7	17

To get a publication collaboration network, a co-authorship feature is used in the VOSviewer application with a minimum criterion of 1 document per country. As a result, there are 41 countries that have publication documents, but not all countries have cooperation networks. Based on the search, there are

33 countries that have cooperative relationships in publications on psychometric topics in sports and physical education, as shown in figure 3. This visualization showcases a network of psychometric research and publication collaborations in sports and physical education between countries. The node size represents the number of articles submitted from each country. The presence of lines connecting nodes indicates research collaboration. Meanwhile, the colors on the nodes distinguish groups of countries that have a similar research focus. The distance between nodes represents the degree of similarity of research topics. This network analysis identified seven clusters of countries that cooperate with each other in research and publications. The main countries in the cluster are as follows: Cluster #1, Canada; French; Greek; Norwegian; Portugal: Sweden. Cluster #2, China; Hong Kong; Iran; Polish; Singapore; Taiwan. Cluster #3, Brazil; Estonian; Mexico; Peru; Romania; Spanish. Cluster #4, Bahrain; German; Ghana; Italian; Tunisia. Cluster #5, Austria; South Korea; Turkiye; United States; Vietnamese. Cluster #6, Australia; Finnish; Malaysia. Cluster #7, Chile; English.

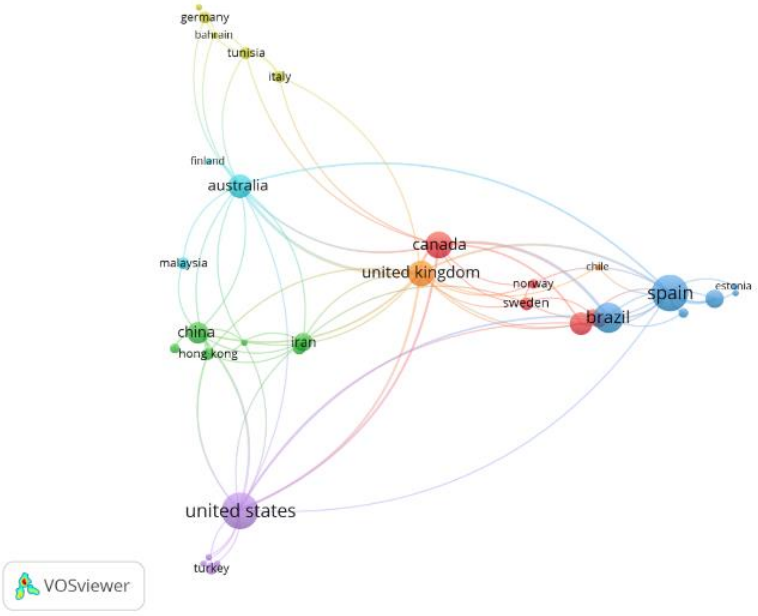

Figure 3. Network visualization citation by country

Most used keywords

This study looks at important research topics and organizes them in a clear way. Keywords, like clues about the article's content, can be used together to identify frequently discussed themes. These connections between keywords are called keyword co-occurrence (Lee & Su, 2010). Keyword co-emergence analysis can be used to find popular research topics and track the direction of research trends (Phuong et al., 2023). In this study, keyword search used co-occurrence analysis with author keywords analysis unit in VOSviewer. Of the 133 documents

analyzed, 365 emerged. There are thirty-two clusters consisting of similar keywords that appear marked in the same color. An analysis of the research sample reveals the most frequently used terms. Words like "psychometrics" (35), "validity" (33), and "sports" (21) appear most often. For a more detailed look at these high-frequency keywords, along with additional information like how often they're linked to other terms, refer to Table 5.

Table 5. Top ten frequently used keywords

Keyword	Occurrences	Total link strength
Psychometrics	35	82
Validity	33	84
Sports	21	53
Reliability	20	48
Self-determination theory	15	42
Physical education	14	31
Motivation	13	29
Measurement	7	17
Sport psychology	7	17
Confirmatory factor analysis	7	14

Figure 4 shows a detailed map of research topics created using VOSviewer's analysis of keywords appearing together in publications.

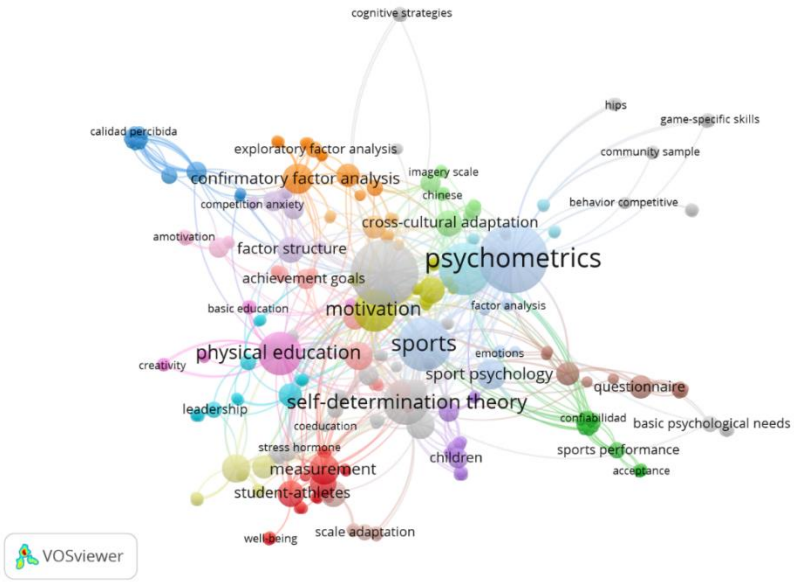

Figure 4. Network of co-occurrences

The terms that appear mostly in the analysis of co-occurrence data using VOSviewer are shown with large nodes, while the lines show the relevance of keywords. For keywords related to physiology studies, the keywords that are often used include self-determination theory, motivation, group dynamics, satisfaction, team sport, team cohesion, anxiety, intrinsic motivation, positive

youth development, trait anxiety, stress, and well-being. However, another keyword that appears in figure 4 also shows a popular word used in psychometric research in sports and physical education.

Discussion

Based on bibliometric searches, it can be seen that the research trend with the topic of psychometric studies in sports and physical education shows an increase, which means that the topic remains a popular theme for researchers around the world. Furthermore, the most productive journal that publishes psychometric topics in sports and physical education is the International Journal of Environmental Research And Public Health with 10 scientific article publications. Furthermore, Antonio Baena-Extremera from Spain became the most prolific writer by producing 4 documents and 22 citations. Article title Psychometric properties of the intrinsic motivation inventory in a competitive sport setting: A confirmatory factor analysis oleh McAuley et al. (1989) became the most influential with a total citation of 1690. Based on the number of published documents, The country that has the most published documents on psychometric topics in sports and physical education is the United States with 28 documents and 2525 citations.

Furthermore, the keywords that often appear in scientific publications with the theme of psychometrics in sports and physical education are self-determination theory, motivation, group dynamics, satisfaction, team sport, team cohesion, anxiety, intrinsic motivation, positive youth development, trait anxiety, stress, and well-being.

Well-being or mental health can be used as a research study in the future, as done by Sood & Puri (2023) This research investigated whether psychological capital (PsyCap) could act as a mental strength for student-athletes and improve their overall well-being. They also tried to adjust the Psychological Capital Questionnaire (PCQ-24) specifically for sports psychology, but this adaptation wasn't effective. However, the study found that the PCQ-21 questionnaire remains a reliable tool for measuring PsyCap in athletes.

Other studies related to anxiety such as those conducted by (Rawat et al., 2023) This study was conducted to evaluate the quality (psychometrics) of the Polish version of the Sports Anxiety Scale-2 (SAS-2). They also validated this scale using the Task Orientation and Ego in Sport (TEOSQ) questionnaires and the State and Trait Anxiety Inventory (STAI). The results showed that the Polish version of SAS-2 had good internal reliability, with a high Cronbach Alpha coefficient value on all subscales. Results from measurement invariance testing are also adequate, indicating that this scale can be used reliably on different gender groups and types of athletes. It also does not rule out the possibility for

future research to conduct similar studies based on their respective country of origin.

Imagery scale is also an emerging keyword in psychometric research trends such as those conducted by Lee and Horino (2023) This study examined the underlying structure (factor structure) of the Japanese version of a sports imagery questionnaire (SIAQ-J). They also investigated whether scores on the SIAQ-J differed based on athletes' sex, competition level, sport type, and experience. Their findings showed that the SIAQ-J is a valid and reliable measure, and that scores did vary depending on an athlete's competition level and experience. There were no significant differences based on sex or sport type. The breadth of psychometric studies presented in this study can be an illustration for future research.

CONCLUSION

This research examines articles about using psychological tests (psychometrics) in sports and physical education. The search covered articles in the Scopus database from 1981-2023. The findings show that the number of publications in this area has gone up and down over time. However, there's been a trend of increasing publications in the last decade. Keywords that appear most in VOSviewer search analysis are Psychometrics, Validity, Sports, Reliability, Self-determination theory, Physical education, Motivation, Measurement, Sport psychology, and Confirmatory factor analysis. While keywords related to physiology studies and often used include, self-determination theory, motivation, group dynamics, satisfaction, team sport, team cohesion, anxiety, intrinsic motivation, positive youth development, trait anxiety, stress, and well-being. By observing the development of psychometric topics in sports and physical education, this research can be used as a reference to conduct research in the future.

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