




FOOTBALL RESEARCH IN BRAZIL: ANALYSIS OF SCIENTIFIC RESEARCH GROUPS AND RECENT SCIENTIFIC PRODUCTION

A PESQUISA SOBRE O FUTEBOL NO BRASIL: ANÁLISE DOS GRUPOS DE PESQUISA E DA PRODUÇÃO CIENTÍFICA RECENTE 

LA INVESTIGACIÓN SOBRE EL FÚTBOL EN BRASIL: ANÁLISIS DE LOS GRUPOS DE INVESTIGACIÓN Y DE LA PRODUCCIÓN CIENTÍFICA RECIENTE 

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Abstract: This study aimed to identify, map, and analyze the research groups (RG) on football in Brazil, through the quantity and quality of the scientific production of research leaders. This is a systematic and descriptive study carried out in the database of the Directory of Research Groups of Brazil of the National Council for Scientific and Technological Development (CNPq). We analyzed the scientific production (2016 and 2022) of the Lattes of the leader's curriculum. In total, 46 groups were identified, the majority located in the Southeast and South regions of Brazil (n=22/47.8%). The first non-specific RG appeared in 1984 and the first specific RG was registered in 2006. In recent years, these RGs have been responsible for 409 publications about football. It is concluded that there has recently been an increase in RGs, with a trend towards stability in publications, indicating advances in research on football in Brazil.

Keywords: Soccer. Bibliometrics. Sports. Science, Technology and Innovation Indicators.

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1 INTRODUCTION

Football is the most popular sport in the world (GIULIANOTTI, 2012). It has been estimated that approximately 260 million players are registered in football clubs, from professional to amateur levels (DVORAK *et al.*, 2004). However, although recent studies often indicate this number of registered athletes, it is likely that the number is underestimated (DVORAK; FULLER; JUNGE, 2012; JANSEN *et al.*, 2019). In addition, football is not only the most practiced sport in the world in moments of leisure and recreation (HULTEEN *et al.*, 2017), but also the most studied sport (KIRKENDALL, 2020).

Football as a sporting phenomenon has important social relevance and arouses great interest in the scientific community in different parts of the world (CROSSLEY *et al.*, 2020; ERMIDIS *et al.*, 2019; FORD *et al.*, 2020, VIGNESHWARAN *et al.* 2014). To illustrate this dimension, in a basic search carried out on the Web of Science™, maintained by Clarivate Analytics, the main multidisciplinary database of citations and scientific studies in the world, using the terms “soccer OR football OR Fútbol” in English, Spanish, and Portuguese, without descriptor or date limitations, identified a total of 43,707 studies; 15,056 in the last four years alone. Kirkendall (2020) recently identified approximately 14,000 citations listed in the PubMed database, surpassing by almost 60% the studies related to tennis, the second most investigated sport.

Although a large volume of scientific production is observed in much of the world, Brazil, commonly described as “the country of football” for its prominent position in the FIFA team rankings and for having large prestigious clubs, does not have equal representation in the scientific scenario when analyzing the production of knowledge on the subject, since in relation to scientific production it occupies a position far below that occupied by the national team (ESCAMILLA-FAJARDO *et al.*, 2020; KIRKENDALL, 2020).

In addition, since the 2000s, football in Brazil, which has a great tradition and historical and cultural representation, has stimulated a new generation of researchers on the sport, giving rise to the emergence of new questions, discussions, and analyses in the most diverse areas (CURI, 2014). However, although previous studies performed interesting analyses with different approaches and theories in relation to the scientific production on football, to date, no studies were identified that carried out a recent comprehensive quantitative survey, with current documentary analyses referring to research on football in Brazil (ALABARCES, 2011; GIGLIO; SPAGGIARI, 2010; SILVA, *et al.* 2009; TOLEDO, 2001). Recently, Toledo (2020) observed the flow of research inserted in Social Sciences and followed the variety of demands that tension the thematic centrality about football historically (TOLEDO, 2021). Even so, it is necessary to carry out studies that analyze the state of the art of football research in Brazil, using a more comprehensive approach, including thematic analyses of existing RGs, in addition to analyzing the quality and quantity of Brazilian scientific production, the network of researchers registered, and teaching institutions and universities engaged in research, as well as scientific production in the field of football (FERRAZ *et al.*, 2018).

Thus, the present study aims to provide a current original assessment and identify, map, and analyze the research groups on football in Brazil, especially their characteristics, evolution, and geographic distribution, as well as to analyze the quantity and quality of scientific production published in recent years, by researchers registered in research groups in Brazil.

2 METHOD

2.1 STUDY CHARACTERISTICS

This is a systematic and descriptive research, with bibliometric analysis (ANDRADE; DOMINSKI; COIMBRA, 2017, VILARINO *et al.*, 2017), through the application of techniques similar to the analyses of the RGs by Ferraz *et al.*, (2018) and Dominski *et al.*, (2020). Due to the specificity of this study, focused on football RGs, the basis for the search for data was the Directory of Research Groups in Brazil (DRG) of the CNPq. Since 1993, the CNPq has kept this information updated through biannual censuses. The database contains information about the lines of research of the research groups, their area of concentration, human resources, and partnerships between the institutions to which they belong. In this way, it is possible to identify the state of the art in a given area, in addition to detecting gaps that will serve as a basis for future research. According to the most recent DRG census, carried out in 2016, there are more than 37,000 research groups in the country and more than 147,000 research lines, with approximately 200,000 registered researchers.

In addition, for the analysis of the scientific production of the research groups, the academic curriculum of the research leader of each group was consulted, which is publicly available on the CNPq Lattes Platform (CNPq, 2022)¹. This platform brings together the academic production of researchers, students, and professors from public and private institutions in Brazil.

2.2 SELECTION OF RESEARCH GROUPS

The terms used in the search strategy were “football”, “field football”, “futsal”, “7-a-side football”, “sandball football”, “beach soccer”, “footvolley”, “blind football”, “Paralympic football”, “adapted football”. Parameterized queries were carried out using the terms in isolation and the following fields were selected: “group name” and “research line name”, “keyword” without using filters in relation to location, time of existence of the group, area of knowledge, academic training, CNPq scholarship holders, or professors, in order not to restrict the survey. In addition, no outdated or excluded groups were selected.

2.3 ELIGIBILITY CRITERIA

All groups with certification from the home institution were included, excluding non-updated, extinct, and non-certified groups. This authentication is the responsibility

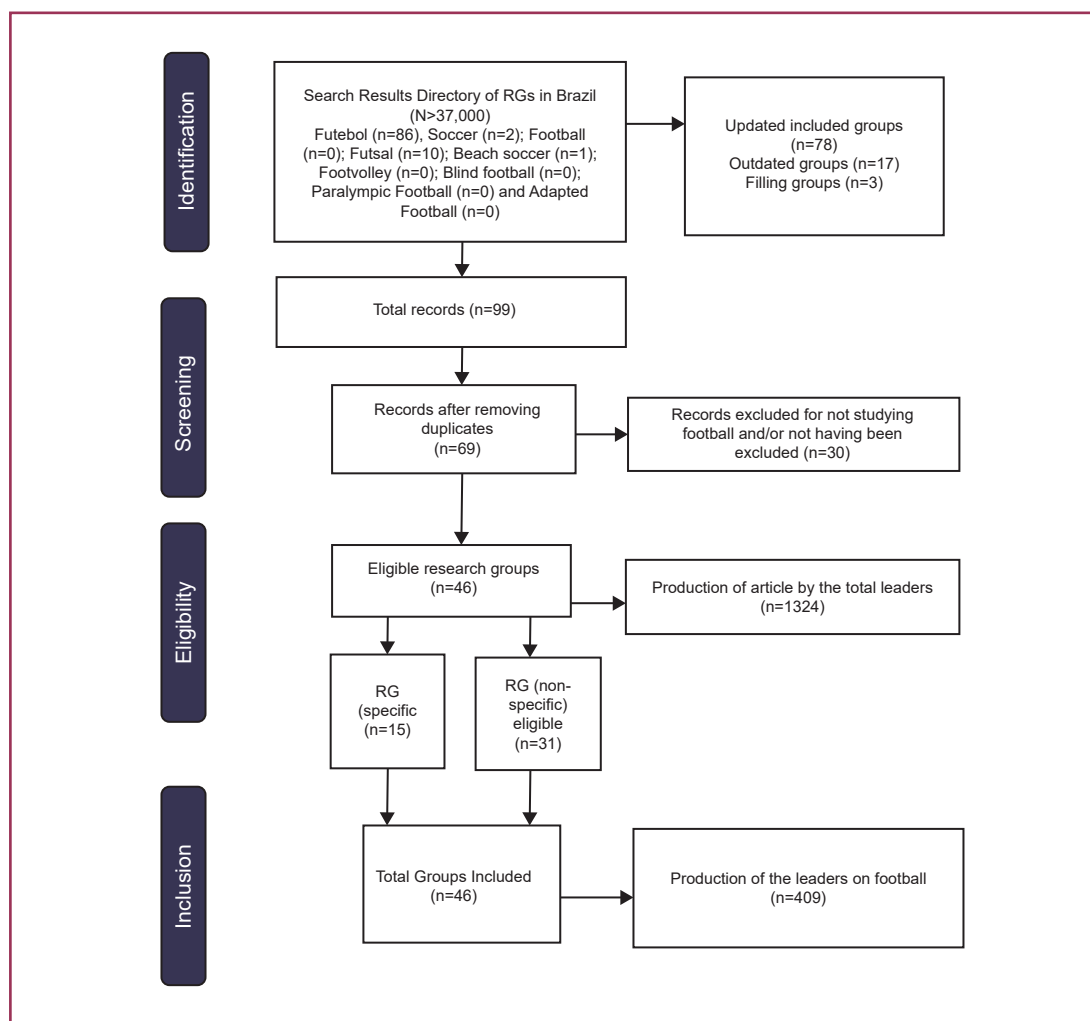
¹ Lattes PLATFORM. Available at: <https://lattes.cnpq.br/>. Accessed on: Sept. 15, 2022.

of the directors of the research activities of the institution to which the group is linked. The searches took place in May 2022.

The research lines of the RGs were included and analyzed based on themes related to football and their variations, according to the terms used in the search strategy. Lines of research in which there was no type of application of the themes were excluded.

Regarding the specificity of the RGs, those which presented any of the search terms used in the name of the registered group were considered as specific groups (SG) for research on football. The others were classified as non-specific groups (GNE).

Figure 1 – Flowchart of the method used in the analysis of research groups and in the scientific production of leaders on football in Brazil between the years 2016-2022.



Source: research data

2.4 ANALYSIS OF INFORMATION

The information from the RGs selected for the analysis were: year of graduation, area and subarea of knowledge, higher education institution (public or private), federation unit, demographic region, lines of research, number of members (teachers, students, technicians, and national and international collaboration network), and the

scientific production of the groups (articles, journals, impact factor, and authors). For the analysis of scientific production, the curriculum of the research leader of each group was individually examined through the CNPq Lattes Platform. Two reviewers (MS and WC) independently searched and selected only complete and accepted articles according to eligibility criteria. Any disagreements were resolved by a third reviewer (AA).

The scientific production of the leaders of the analyzed groups was limited to the most recent production of articles published in peer-reviewed journals in recent years, from January 2016 to May 2022, regardless of the year of creation of the RG. As shown in other studies, this period proved to be sufficient for the analysis of scientific production through the most current bibliometric indicators (DOMINSKI *et al.*, 2020, AQUINO *et al.*, 2017). In addition, key metrics, such as 5-Year Impact Factor, Eigenfactor, and Google Scholar Metrics linked to the Journal Citation Report® consider the last five years involving recent publications and citations. In the present study, the analysis time of the RG leaders' production was longer than this recommendation. Another factor that justified our decision was that funding agencies (e.g. CNPq) use a five-year period to evaluate the production of researchers and RGs. In our study, we used the Table of Equivalence and classification of Specialty Areas of Knowledge, available on the CNPq/Capes Knowledge Tree (2020)². In addition, there is currently a set of procedures used by Capes to stratify the quality of the intellectual production of graduate programs, based on publications in scientific journals of articles by professors affiliated with Brazilian Higher Education Institutions (HEIs).

For the analysis of the quality of the scientific production, only complete articles and accepted articles on football and futsal and modalities that present the same characteristics and adopt the same procedures for the terms used in the survey of the RGs were considered. The classification of articles was through the Qualis periodicals of the Sucupira Platform - classification of four-year periodicals 2013-2016. The evaluation of the scientific production of each leader of the RGs was carried out in the journals of the corresponding subareas, classified into strata A1, A2, B1, B2, B3, B4, B5, and C. Articles published in unclassified journals were also considered, establishing the legend - w/o- without Qualis.

The updated impact factor of journals was analyzed using the JCR (Journal Citation Reports®) - ISI Web of Science metric, based on the scientific production of the RG leaders. Subsequently, the total number of articles on football, futsal, and similar modalities was analyzed to identify the productivity of the RG leaders and the quality of the publications. Keywords were considered in the original language of publication of each article and synonyms were grouped, as applied in the analysis models of the studies by Andrade *et al.*, (2017).

The relevance in the world sports scenario that Brazil represented during this period is also highlighted, especially after hosting the 2014 World Cup and the Rio

² Table of Knowledge Areas. Available at: <http://lattes.cnpq.br/documents/11871/24930/TabladeAreasdoConhecimento.pdf/d192ff6b-3e0a-4074-a74d-c280521bd5f7>. Accessed at: Sept. 15, 2022.

2016 Olympic Games. These factors aroused interest as a starting point to examine the importance of these mega-events on scientific development (SPAGGIARI, MACHADO; GIGLIO, 2016; VIVEIROS *et al.*, 2015).

To process the statistical data, the Statistical Package for the Social Sciences - SPSS - IBM® version 20.0 and Microsoft Excel were used. Descriptive statistics were used with measures of central tendency (mean), measures of dispersion (standard deviation), and frequencies. To assemble the word clouds, a tool available on the website <http://www.wordart.com> was used and the Piktochart application (for Google Chrome) was used to create the infographics and maps.

3 RESULTS

The preliminary analysis tracked 79 registered RGs across the entire database in Brazil. A total of 46 RGs registered until May 2022 in the DRG were selected according to the terms and inclusion criteria adopted in this study, of which 15 were classified as specific groups (SG) and 31 as non-specific groups (NSG) (Table 1).

Table 1 - Research groups on soccer in Brazil registered in the DRG.

Research Groups *	Year of Formation	Type	HEI	A. F. Production Grand total	A. F. Production Total about football**	R.F. of production on football in relation to the leader's total	R.F. of the leader's production in relation to the total production on football (n=409)	A. F. Articles with IF	R.F. of the total production on football with general IF (n=184)	R.F. Production with IF in relation to the leader's own production
Psicologia Transcultural: funcionamento psicológico entre grupos de diferentes etnoculturas	1984	NSG	UFAM	41	0	0,00%	0,00%	0	0,00%	0,00%
Termorregulação e Mecanismos de Fadiga	1989	NSG	UFMG	32	0	0,00%	0,00%	0	0,00%	0,00%
Laboratório de Psicologia do Esporte - LAPES	1991	NSG	UFMG	42	8	19,05%	1,96%	4	0,98%	50,00%
NAVI - NÚCLEO DE ANTROPOLOGIA VISUAL E ESTUDOS DA IMAGEM/Grupo de Antropologia Urbana e Marítima	1994	NSG	UFSC	24	8	33,33%	1,96%	1	0,24%	12,50%
Espaço e sociabilidades	1997	NSG	UFPR	5	4	80,00%	0,98%	0	0,00%	0,00%
Centro de Estudos da Performance Física - CEPEFIS	2000	NSG	UFPR	41	6	14,63%	1,47%	3	0,73%	50,00%
Laboratório de Fisiologia Renal	2000	NSG	UFPR	8	2	25,00%	0,49%	2	0,49%	100,00%
GRECCO - Grupo de Estudos sobre Esporte, Cultura e História	2002	NSG	UFRGS	22	2	9,09%	0,49%	1	0,24%	50,00%
Energia, Espaço e Sociedade - EES	2004	NSG	UFRJ	0	0	0,00%	0,00%	0	0,00%	0,00%
CORPO (COtidiano, Resgate, Pesquisa e Orientação)	2005	NSG	UFBA	13	1	7,69%	0,24%	0	0,00%	0,00%
Neurologia Cognitiva e do Comportamento	2006	NSG	UFMG	101	2	1,98%	0,49%	2	0,49%	100,00%
Grupo de Estudos sobre Futebol e Torcidas - GEFuT	2006	SG	UFMG	19	13	68,42%	3,18%	3	0,73%	23,08%
Grupo de Pesquisa em Robótica da UFS	2010	NSG	UFS	14	1	7,14%	0,24%	1	0,24%	100,00%
FULIA - Núcleo de Estudos sobre Futebol, Linguagem e Artes	2010	SG	UFMG	56	5	8,93%	1,22%	0	0,00%	0,00%
Grupo de Pesquisa em Atividade Física, Esporte e Tecnologia (GEPAFETec)	2010	NSG	UTFPR	16	6	37,50%	1,47%	0	0,00%	0,00%
Bases Biológicas da Atividade Física e Saúde	2010	NSG	UFV	19	5	26,32%	1,22%	3	0,73%	60,00%
Núcleo de Pesquisa e Estudos em Futebol (UFV)	2010	SG	UFV	87	70	80,46%	17,11%	37	9,05%	52,86%

GECEF - Grupo de Estudos em Comunicação sobre Esporte e Futebol	2010	SG	UNESP	29	13	44,83%	3,18%	0	0,00%	0,00%
Grupo de Estudos de Dinâmica territorial (GEDITE)	2010	NSG	UEMA	20	1	5,00%	0,24%	0	0,00%	0,00%
Hermenêutica e[m] Filosofia e Literatura	2010	NSG	UNISINOS	14	0	0,00%	0,00%	0	0,00%	0,00%
Laboratório de Estudos em Pedagogia do Esporte (LEPE) - Futebol	2011	NSG	UNICAMP	87	36	41,38%	8,80%	12	2,93%	33,33%
Laboratório de Biomecânica Aplicada	2012	NSG	UEL	64	32	50,00%	7,82%	22	11,96%	68,75%
Gepecs - Grupo de Estudos e Pesquisas em Esporte, Cultura e Sociedade	2012	NSG	UFMT	7	1	14,29%	0,24%	0	0,00%	0,00%
ProFut - Grupo de Estudos e Pesquisa dos Aspectos Pedagógicos e Sociais do Futebol	2014	SG	UFSCAR	12	7	58,33%	1,71%	1	0,24%	14,29%
UFMG Soccer Science Center	2014	SG	UFMG	41	18	43,90%	4,40%	11	2,69%	61,11%
Grupo de Estudos e Pesquisas Aplicadas em Futebol - GEPAFUT	2014	SG	UEM	38	22	57,89%	5,38%	8	1,96%	36,36%
Grupo de Pesquisa e Estudo sobre o Futsal e o Futebol - GPEFF	2015	SG	UFMA	28	10	35,71%	2,44%	0	0,00%	0,00%
GRUPO DE ESTUDOS EM ESPORTES PARA PESSOAS COM PARALISIA CEREBRAL	2015	NSG	UNICAMP	57	13	22,81%	3,18%	3	0,73%	23,08%
Grupo de Pesquisa e Desenvolvimento do Futebol e do Futsal	2015	SG	UFSC	23	23	100,00%	5,62%	14	3,42%	60,87%
INTEGRAFUT - Integração das dimensões Físico, Técnico e Tática do Futebol e Futsal	2015	SG	UFRJ	9	5	55,56%	1,22%	2	0,49%	40,00%
Centro de Traumatismo Dentário da FOC/UNIFLU (linha de pesquisa em futebol)	2015	NSG	UNIFLU	1	0	0,00%	0,00%	0	0,00%	0,00%
Grupo de Estudos em Atividade Física, Saúde e Desempenho	2015	NSG	UFPE	5	2	40,00%	0,49%	0	0,00%	0,00%
Grupo de Estudo e Pesquisa dos Esportes (GEPEs)	2016	NSG	UNESP	12	2	16,67%	0,49%	1	0,24%	50,00%
Núcleo de Futebol Competente	2016	SG	UEFS	3	1	33,33%	0,24%	0	0,00%	0,00%
ESTUDOS AVANÇADOS EM DIREITO EMPRESARIAL (linha de pesquisa em futebol)	2016	NSG	UNIVALI	13	0	0,00%	0,00%	0	0,00%	0,00%
Laboratório de Estudos sobre Violência, Esporte e Educação Física (LEVEEF)	2017	NSG	UNIVERSO	43	2	4,65%	0,49%	0	0,00%	0,00%
EXERCÍCIO FÍSICO: SAÚDE E DESEMPENHO HUMANO	2017	NSG	UFMA	31	6	19,35%	1,47%	1	0,24%	16,67%

Football research in Brazil: analysis of scientific research groups and recent scientific production

Laboratório de Estudos da Ciência do Futebol de Campo, Futsal e Beach Soccer	2017	S	UFRJ	77	7	9,09%	1,71%	2	0,49%	28,57%
RAI - Robotics And Artificial Intellingence	2019	NSG	UFRB	2	0	0,00%	0,00%	0	0,00%	0,00%
Le´FUT (Laboratório de Estudos de Futsal e Futebol)	2019	SG	UNIMEP	9	3	33,33%	0,73%	2	0,49%	66,67%
Grupo de Estudos e Pesquisa em Ciência no Futebol (GECIF)	2019	SG	UFES	69	55	79,71%	13,45%	42	10,27%	76,36%
Grupo de Estudos e Pesquisas em Esporte e Humanidades (GEPEH)	2019	NSG	UNICAMP	18	7	38,89%	1,71%	0	0,00%	0,00%
Grupo de Pesquisa em Cineantropometria e Treinamento (vice-líder mais produtivo)	2020	NSG	UFPE	26	3	11,54%	0,73%	2	0,49%	66,67%
Gestão da Informação e Evidenciação Contábil	2020	NSG	UFS	5	0	0,00%	0,00%	0	0,00%	0,00%
Atuação multiprofissional no futebol de alto rendimento	2021	SG	UNIS/MG	14	0	0,00%	0,00%	0	0,00%	0,00%
Grupo de Pesquisa, Inovação e Tecnologia Aplicada ao Esporte (GSporTech)	2022	NSG	UFPI	27	7	25,93%	1,71%	4	0,98%	57,14%
-	-	-	-	1324	409	-	100%	184	51,57%	-

Source: research data

* Analysis carried out by the leaders of the groups

**Total football production of RG leaders between 2016 and 2022.

*** First specific football group registered.

Subtitles:

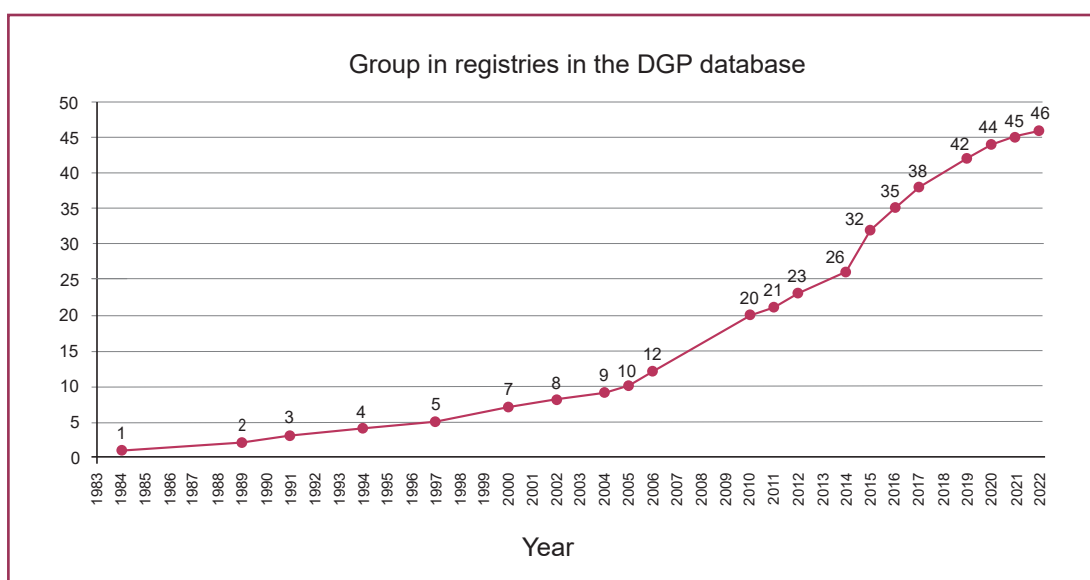
HEI – Higher Education Institution; S – Specific Group; N – Non-Specific Group; I.F- Impact Factor; A.F – Absolute Frequency; R.F - Relative Frequency

3.1 YEAR OF FORMATION OF RESEARCH GROUPS

The record of the first RG covering the topic of football was in 1984, with the name Transcultural Psychology: psychological functioning between groups of different ethnocultures, from the Federal University of Pernambuco. However, the first specific RG, the Study Group on Football and Supporters – GEFuT, was registered 22 years later, in 2006 (Table 1).

In the last ten years the number of RGs in football has doubled, from 23 in 2012 to 46 in the last year included, 2022. The years 2010, with the registration of eight RGs in football, and 2015, with six stand out. Figure 2 shows the annual growth of RG training from 1984 to 2022, considering the total number of football RGs accumulated in this 38-year period.

Figure 2 - Year of formation of research groups related to soccer in Brazil.

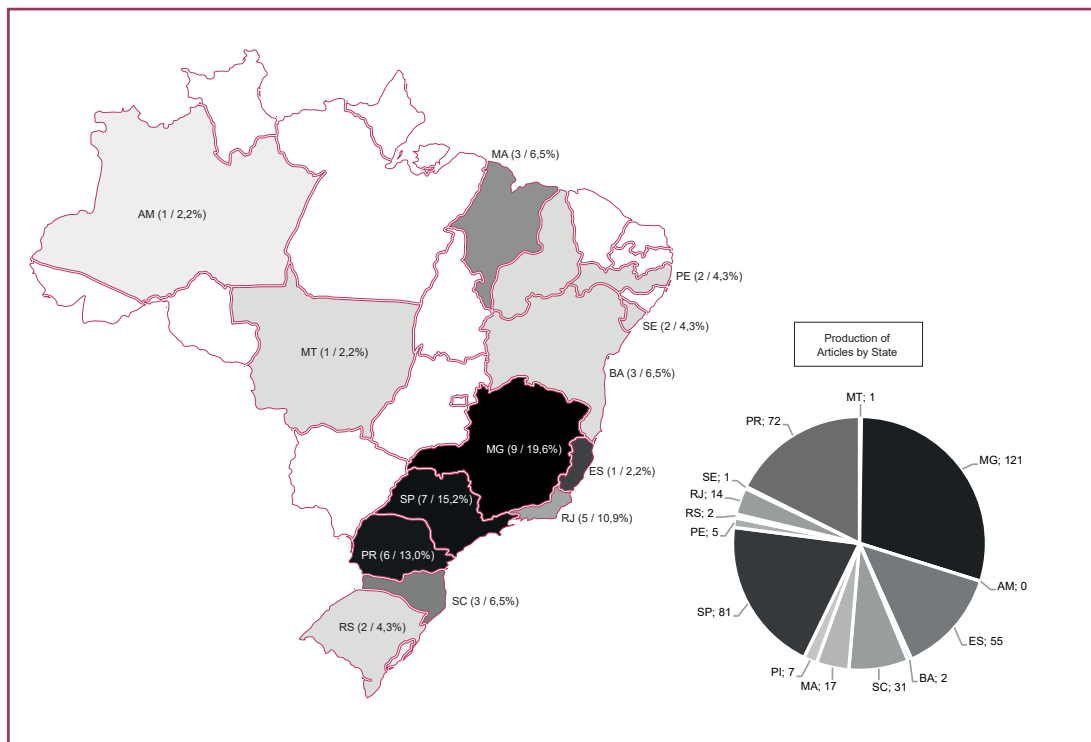


Source: research data

3.2 GEOGRAPHIC DISTRIBUTION OF RESEARCH GROUPS

The RGs are located in 14 Brazilian states, with most football groups concentrated in the Southeast Region (n=22/47.8%). There was a predominance of RGs in the states of Minas Gerais (n=9/19.6%), São Paulo (n=7/15.2%), Paraná (n=6/13.0%), and Rio de Janeiro (n=5 10.9%) (Figure 3). Few RGs on football were found in states in the Northeast and Central-West regions, in addition, in the Northern Region of Brazil, only the state of Amazonas presented RGs on football.

Figure 3 - Geographical distribution and the number of articles published by football research groups in Brazil by 2022.



Source: research data

3.3 CHARACTERISTICS OF RESEARCH GROUPS

The RGs which investigate football are predominantly from public educational institutions ($n=40/87\%$), and only six groups are linked to private institutions ($n=6/13\%$). The Federal University of Minas Gerais presented six registered RGs, the Federal University of Paraná and the Federal University of Rio de Janeiro each presented three registered groups, the State University of Campinas, the Federal University of Viçosa, the Federal University of Santa Catarina, the São Paulo State University, the Federal University of Maranhão, the Federal University of Pernambuco, and the Federal University of Sergipe each presented two groups, and the other 19 HEIs presented one registered RG each, as shown in Table 1.

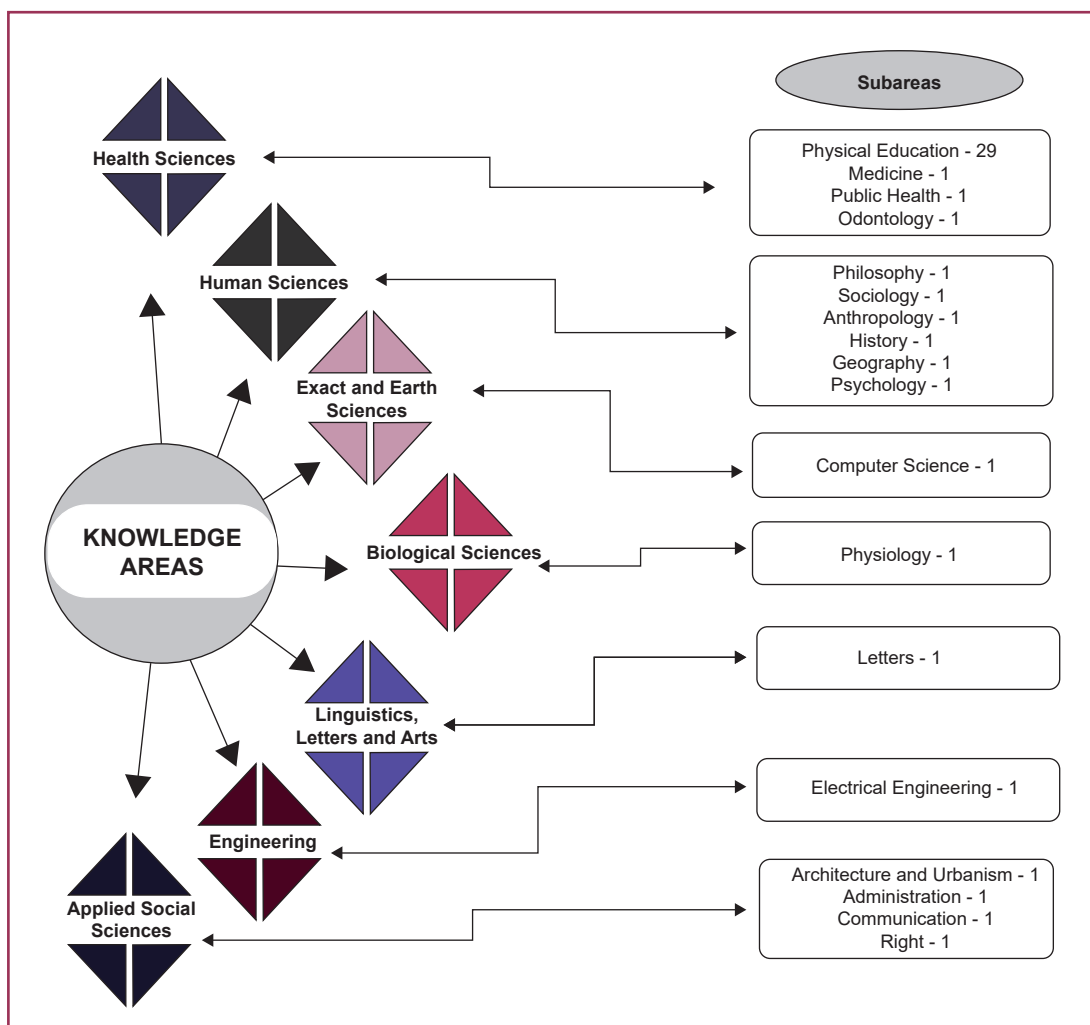
Regarding the leaders, there is a predominance of males ($n=39$). In addition, most of the RG members are students from courses linked to HEIs ($n=547$). In all, there are 1,029 people involved in the scientific production in the area, 459 researchers, 15 technicians, and eight foreign collaborators. The predominant area of knowledge of RGs about football is linked to Health Sciences and related to the area of Physical Education (Figure 4). The RGs presented a total of 226 lines of research, ranging from one to 15 lines of research per group; the majority of groups have four to six lines of research (Table 2).

Table 2 - Distribution of members, institutions, area of knowledge and research lines of research groups on football in the year 2022 at the DRG in Brazil.

Characteristics of research groups	n	%
<i>Higher Education Institution</i>		
Private	6	13,0
Public	40	87,0
<i>Leaders</i>		
Men	38	82,6
Women	8	17,4
<i>Members</i>		
Researchers	459	44,6
Students	547	53,2
Technical	15	1,5
Foreign Employees	8	0,7
Total	1029	100
<i>Knowledge area</i>		
Biological Sciences	1	2,2
Health Sciences	32	69,5
Exact and Earth Sciences	1	2,2
Human Sciences	6	13,1
Applied Social Sciences	4	8,6
Engineering	1	2,2
Linguistics, Letters and Arts	1	2,2
Total	46	100
<i>Research lines</i>		
1 a 3	15	32,6
4 a 6	23	50,0
7 a 9	4	8,6
10 a 12	2	4,3
13 a 15	2	4,3
Total	46	100

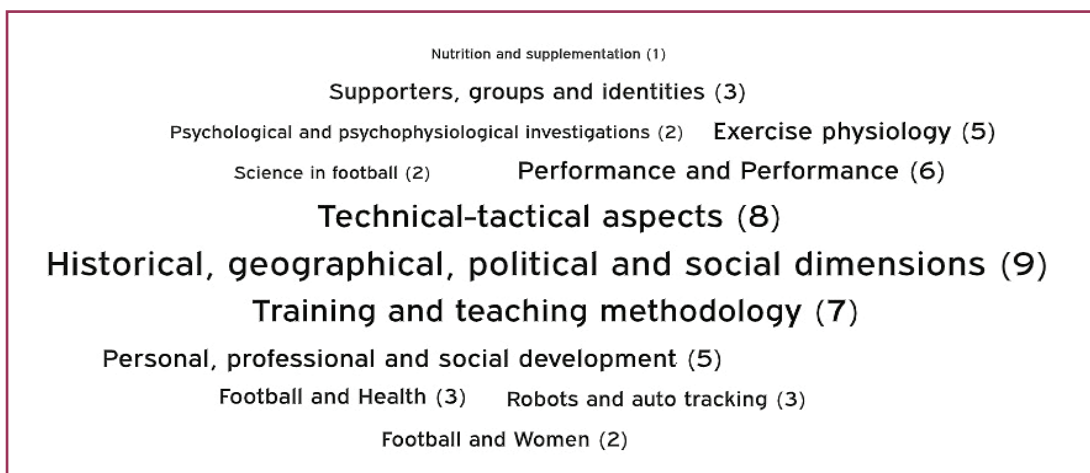
Source: research data

Figure 4 - Knowledge areas and their sub-areas of RG leaders on football in Brazil until 2022.



Source: (adapted from MACIEL *et al.* 2019).

Figure 5 - Categorization and thematic frequency of RG/DRG research lines on football in the year 2022.



Source: research data

In total, 227 lines of research were found in the RGs, however, some of the lines were not football related. Thus, it was decided to select only the specific lines of research related to football for the categorization and thematic frequency analysis of

Figure 5. In total, 57 lines of specific research on football were found. Among these, there is a predominance of research related to historical, geographical, political, and social dimensions, technical-tactical aspects, and training and teaching methodology. The other lines of research can be seen in Figure 5.

3.4 SCIENTIFIC PRODUCTION OF RGs AND CHARACTERISTICS OF PUBLICATIONS

The RG leaders published 1,324 studies between January 2016 and May 2022, with 30.8% (n=409) of the publications identified being related to football. Specific RGs concentrated 61.6% of all production on football (n=252). In the analyzed period (2016-2022), the largest production on football was concentrated in five RGs (52.8%) and the most productive group published 70 studies. The majority of RGs (n=35) had a low production of articles, with less than ten publications in the analyzed period. Although identified as football RGs, a significant number of leaders (n=9) did not publish studies on the topic (Table 1).

Another relevant factor refers to the impact factor of journals in the JCR (Journal Citation Reports, Web of Science, Clarivate Analytics, 2022), revealing that most of the scientific production was published in journals without indexing in WoS and that do not have an impact factor (n=225; 55%), which may indicate low international visibility and greater regionalization of Brazilian national research. In total, 184 studies on football were published in 57 journals with an impact factor, representing 44.9% of the entire production (n=409). There was an average impact factor of 2.04 (± 1.34) for the journals; the highest with 11.14 and the lowest with 0.02.

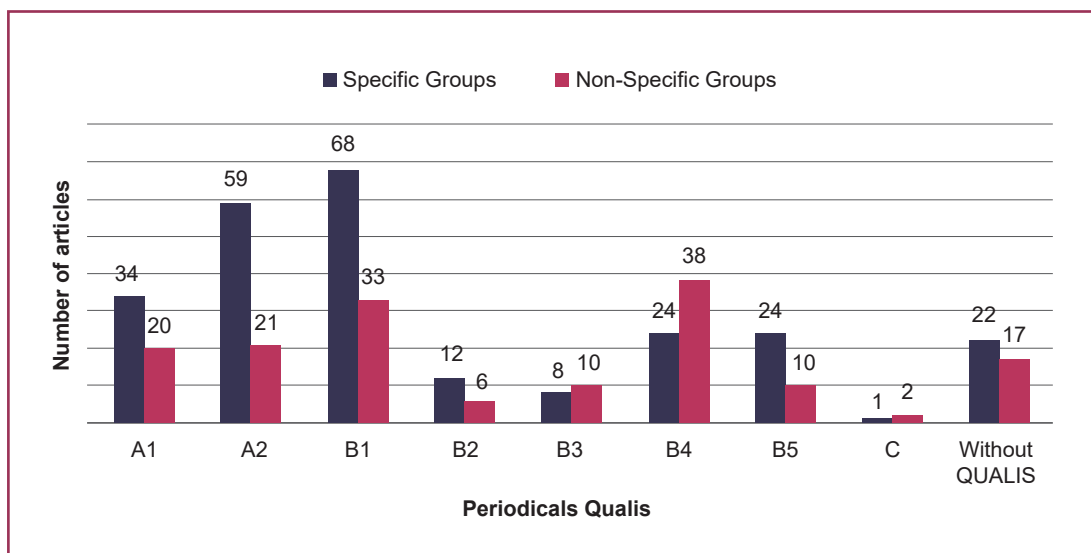
The relative frequency of scientific production with an impact factor in relation to the total production on football indicated that only two RGs presented values greater than 10% when considering the sum of all publications by all leaders, concentrating 51.57% of the scientific production published in IF magazines. Of these, the RG named Laboratory of Applied Biomechanics – UEL obtained 11.96% of all publications in these journals with IFs between 2016 and 2022. Approximately 47.8% of the RGs did not publish studies on football in journals with an impact factor (Table 1).

The highest productivity on football is concentrated in the Southeast region of Brazil, totaling 271 studies (66.2%), with the Federal University of Viçosa in the state of Minas Gerais and the Federal University of Espírito Santo being the most productive, with 125 publications (30.6%).

The leader of the RG Núcleo de Pesquisa e Estudos em Futebol (UFV) presented the highest number of publications in the analyzed period (n=70) (Table 1), with 54 studies classified in strata A1, A2, and B1. The researchers with the highest number of articles in stratum A1 were the leader of the RG of the Laboratory of Applied Biomechanics (n=11) and the leader of the Study and Research Group on Science in Football (GECIF) (n=11).

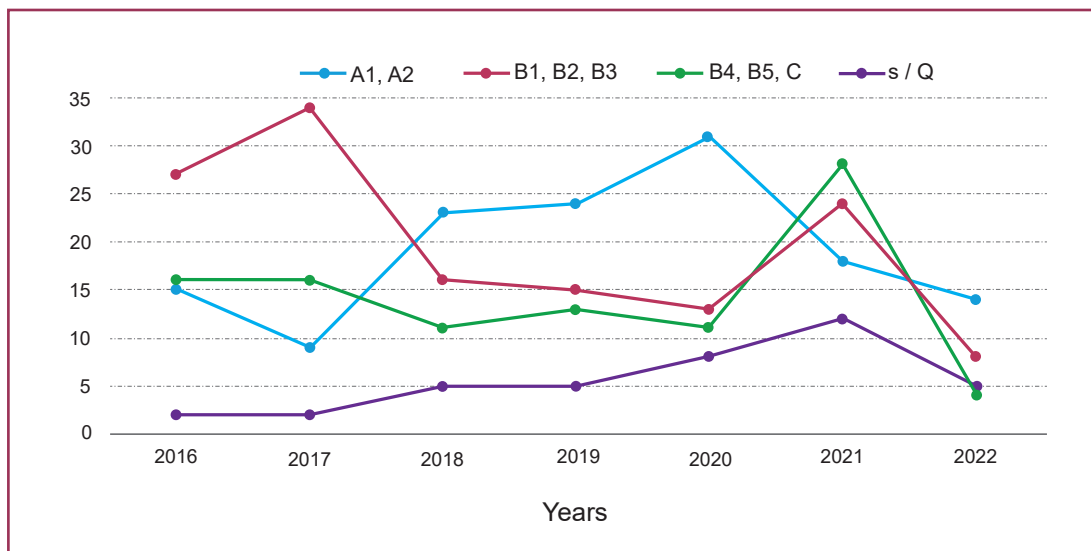
As for Qualis, 235 publications were identified in strata A1, A2 (n=134), and B1 (n=101), representing 57.5% of all publications (n=409), with specific RGs responsible for most of these publications in these strata (n=173; 76.6%) (Figure 6).

Figure 6 - Production classification of specific and non-specific RGs on football from 2016 to 2022



Source: research data

Figure 7 - Quantity and quality of scientific production of RGs on football per year in Brazil from 2016 to 2022.



Source: research data

Figure 7 presents the quantity and quality of scientific production of RGs on football per year in Brazil from 2016 to 2022. There is a drop in production in strata B1, B2, and B3 between 2018, 2019, and 2020 with a slight increase in 2018. On the other hand, publications in strata A1 and A2 increased between the years 2018, 2019, and 2020, with a reduction in 2021 (Figure 7).

The highest productivity of articles occurred in 2021, with 82 published studies. According to the classification of RG production on football, we observed a predominance of scientific production published in journals in strata A1, A2, and B1, totaling 235 publications (57.4%) (Table 3).

Table 3 - Classification of RG production on football according to the year.

Year	Strata Qualis									Total
	A1	A2	B1	B2	B3	B4	B5	C	s/Q	
2016	7	8	21	3	3	11	5	0	2	60
2017	2	7	27	5	2	10	6	0	2	61
2018	11	12	9	3	4	6	5	0	5	55
2019	10	14	12	1	2	8	4	1	5	57
2020	8	23	8	2	3	8	3	0	8	63
2021	11	7	19	2	3	17	9	2	12	82
2022	5	9	5	2	1	2	2	0	5	31
Total	54	80	101	18	18	62	34	3	39	409

Source: research data

Figure 8 - Journal and frequencies used in publications by RG leaders on football in Brazil.



Source: research data

Studies on football were published in 142 different journals, highlighting the *Revista Brasileira de Futsal e Futebol* (n=22), followed by the *Human Movement* (n=18) and *Motriz: Revista de Educação Física* (online) (n=17). Most journals (n=100) published between one and two studies in the period from 2016 to 2022 (Figure 8).

Table 4 - Main keywords of studies published in national and international journals by RG leaders on football in Brazil until 2022.

Journal Nationals		Journal International	
Keywords	Frequency	Keywords	Frequency
Football	104	Soccer	132
Sports	24	Tactics	64
Performance	18	Performance	40
Sports Training	17	Sport science	34
Futsal	16	Youth players	27
Tactic	13	Team sport	23
Athletes	9	Association football	20
World Cup	9	Athletic performance	20
Physical Education	9	Cognition	18
Play	8	Training	16
Cognition	6	Decision-making	15
Sport Psychology	6	Match analysis	15
Performance Analysis	5	Physical Fitness	13
Leisure	5	Body composition	11
Task Analysis	4	Task	11

Source: research data

A total of 1,671 keywords were identified. After analyzing the 15 most frequent keywords in the articles published by the RG leaders on football in Brazil, in national and international journals, it was observed that the most cited terms were “football/soccer”, present in 236 articles. Our survey also revealed that the most commonly used keywords in the articles are related to sports performance, performance, and tactics, evidencing similar trends regarding the publication of studies in both national and international journals (Table 4).

4 DISCUSSION

This study aimed to identify, map, and analyze football research groups in Brazil, especially their characteristics, evolution, geographic distribution, and the quantity and quality of scientific production produced in recent years (2016-2022) by leading researchers registered in the research groups in Brazil. Investigating and analyzing this information and producing current knowledge about the state of the art of RGs on football in Brazil are strategic and fundamental steps in the process of developing sports science applied to this modality, and can contribute to the orientation of scientific policies, and strong or lacking aspects, indicating points of interest and areas for scientific investment.

4.1 CURRENT SCENARIO OF RESEARCH GROUPS ON FOOTBALL IN BRAZIL

The results obtained showed 46 research groups on football registered in the DRG and their respective leaders and 409 studies on the subject. The predominance

of public HEIs involved in the study of football stands out, demonstrating the academic-scientific relevance that these institutions represent in the production, innovation, and dissemination of knowledge, in addition to contributing to professional training in various areas applied to football (ROCHA *et al.*, 2017).

Although there is some discussion about the characteristics and different demands between men's and women's football (PEDERSEN *et al.*, 2019) and the increasing total number of football players (FIFA, 2021), the impact on scientific production in women's football is outdated, deserving more attention in the scientific context of sport (KIRKENDALL, 2020).

There is a predominance of males in the RGs on football; of the 46 leaders of the RGs, eight are women (17.4%), and of these, three researchers have published studies on football (n=13), which represents 3.2% of all production. There is also low production of knowledge about women's football. According to Barreira *et al.* (2018), studies on women's football and futsal represent less than 4% of all articles published in an exclusive journal for these modalities. These data reveal the imbalance between publications and may be related to the delay in the insertion of the genre in major competitions in these sports, which occurred gradually between the 1980s and 1990s (GOELLNER, 2005). These factors could reduce the interest of researchers, since in Brazil the first edition of the Brazilian Women's Football Championship took place in 2013 (PASSERO *et al.*, 2020). It is essential to realize that the phenomenon of strengthening women's football in the world is underway through greater visibility, awards, sponsorship interest, investment, and economic and professional interest, with an increase in international scientific production. There have also been no rapid changes in women's participation in training, research, and quality publications in football, which constitutes another harmful factor in this context in Brazil.

In previous research, Giglio and Spaggiari (2010) verified the state of São Paulo as having the highest number of publications related to football. In our study, from a more recent clipping, Minas Gerais appears with the highest number of RGs and publications on football in Brazil. As confirmed by other studies, in the Southeast Region there is a predominance of RGs in other areas of sport sciences, such as, for example, RGs on strength training in Brazil (DOMINSKI *et al.* 2020). These studies were published by researchers who are linked to Area 21 of Capes, formed by *stricto sensu* graduate programs, involving Physical Education. The Southeast Region has the highest number of master's and doctoral courses in the country (BRASIL, 2016).

It should be noted that the RGs on football are formed by links to the area of Health Sciences, being mostly linked to the subarea of Physical Education, which stands out in the sports field. In Brazil, the degree in Physical Education includes football and sport sciences in its curricula and trains professionals for physics as well as acting in the baccalaureate. These factors can also impact on sports initiative, in addition to providing possibilities for professional performance as well as high-performance participation in research (RAYA-CASTELLANO; URIONDO, 2015).

In the current study, a surprise was 15 RGs that projected economic, only taking into account the historical importance of football in Brazilian society, more than a century of history in economy, arts, and literature, among other factors. On the

other hand, it was evident that RGs presented greater quantity and quality in scientific production in relation to non-specific RGs. This may indicate that organizational factors dedicated to an investigation, such as greater availability of resources and time in a modality, tend to impact the productivity of knowledge in sports science (COIMBRA *et al.*, 2019). The Brazilian football team and the influence of Brazilian football, new studies, reflection and the international quantity of football studies in the area are urgent, articulating universities and laboratories, clubs and entities, promoting quality in training and in the production of scientific and technical knowledge.

It is important to highlight that nine groups registered in the DRG, identified as RGs on football, did not publish studies related to football in the analyzed period. All are classified as non-specific groups and four of them are from a private institution. As shown in Figure 6, non-specific groups have lower production when compared to specific groups, demonstrating the organizational importance of research topics.

4.2 RECENT PRODUCTION OF RESEARCH ON FOOTBALL IN BRAZIL

Scientific production on Brazilian football began to be established in the mid-1980s (HELAL, 2011). However, the importance of thesis and dissertation panels between 1990 and 2009, linked to postgraduate programs stands out, related to the growth, productivity, and advancement of research in the field of football (HELAL, 2011). Recently, using the term “soccer”, in the PubMed database, a record of 11,301 studies was identified, with tennis being the second most commonly investigated sport, with 8,714 records. Although it appears as a prominently investigated sports modality in the world, the recent scientific production on football in Brazil (2016 and 2022), although evolving, is considered discreet compared to other countries (KIRKENDALL, 2020).

In our study, when analyzing the 409 articles published by the RG leaders, the terms that appeared most frequently and were most investigated were related to “sports performance” and “physical, technical, and tactical aspects” as well as terms related to sciences applied to the sport training, strategies, and methods of teaching and learning football. It is known that high-performance sport encourages a large amount of research in the world and, in football, a significant amount of time is devoted to training and preparation of the athlete, aiming to improve the physical and technical capacity of the players, which generates interest through different proposals to improve performance (CLEMENTE; AFONSO; SARMENTO, 2021; PEDERSEN; AKSDAL; STALSBERG, 2019).

Although Brazil shows progress in relation to RGs and the research performed is broad, with diversified themes, the internationalization of publications is still a challenge. We found that in only five of the 46 RGs in Brazil, most of the published production is concentrated in journals with an impact factor. This may reveal that the other groups have difficulties and have not published (more than half of the RGs) studies in journals with an impact factor.

In a bibliometric analysis of the 100 most cited studies in sport and exercise sciences in the world, football was highlighted, however surprisingly the United States

was responsible for most articles on football, even though this modality has relatively low popularity compared to other important sports, such as American football, baseball, and basketball (KHATRA *et al.*, 2021).

Our analysis of the research topics published by the RGs in Brazil demonstrates a lack of research on topics that are very sensitive to sport, such as, for example, psychological aspects of sport applied to Brazilian football and futsal and the mental health of the athlete (ANDRADE *et al.*, 2019; BRANDT *et al.*, 2014). This suggests that, despite relevant themes in the sports scenario, there is still a lot of room for progress, especially in the production of knowledge about football.

5 LIMITATIONS AND FUTURE STUDIES

Although an analysis of the recent scientific production of RG leaders in recent years was carried out, our study has limitations as we may have excluded other RG researchers who are not leaders. The analysis of recent production took into account the terms about football by the title of the publications available in the Lattes curricula of the RG leaders, however it is important to consider the possibility that studies involving different sports may have included football in a secondary way in the analyses.

Even analyzing all 46 football RGs registered in the DRG, independent groups that were not linked to this public platform of the CNPq were not included. We must consider that the exclusive use of the DRG database may not cover all existing groups, as the analysis of production and publications is subject to updates under the responsibility of the researcher.

Our study analyzes the quantitative and qualitative aspects of scientific production. It is known that researchers in Brazil are relatively pressured in terms of scientific productivity, with special emphasis on the production of scientific articles, since the researcher with the most production is benefited by incentive programs, which favors fundraising and research grants, as well as other direct and indirect investments. However, although we have an understanding of the importance and relevance for research and groups in Brazil of the Qualis and Impact Factor of journals, which partially assess this production, this system may present flaws, as there are excellent quality studies that are published in journals of less visibility and that do not have an impact factor.

In addition, possible procedural flaws must be considered, which can generate over or undervaluation in some journals to the detriment of others, thus being able to generate better or lower grades for the master's and doctorate courses of some institutions (SESTREM, 2020). Often, the choice of the scientific journal to which the manuscript to be published is submitted is justified by several reasons. Brazilian HEIs have been suffering from budget reductions and high amounts are charged by publishers so that the publication has free access. It is important to consider that the publication of scientific articles in journals with the best evaluation in Qualis and with the best impact factor, although it is currently the most valued, is not the only option. We understand that other forms of publications such as books and book chapters on

football are highly relevant, and research published in conference proceedings can be considered in future analyses.

We recommend future studies that compare the status and evolution of research according to the characteristics and specificities of production by areas and themes of other sports, considering the scope of publications beyond the articles published in journals.

Undoubtedly, an international study with a global analysis of scientific production on football will complete the picture and allow further analysis. Considering the increase in production analysis time and a greater number of researchers, regardless of RG position, will also expand our knowledge.

6 INNOVATIONS, STRENGTHS AND FUTURE APPLICATIONS OF THE STUDY

Our study maps and updates the scenario of football research in Brazil from innovative approaches. There was strong participation of public institutions in the production of scientific knowledge about football in Brazil. However, in previous decades, with football and sport adopted for political use, there was great apprehension in the academic environment about production with a political bias, especially from the 1960s, generating several intellectual manifestos within universities that expressed opposition regarding the use of sport as an instrument of political propaganda (ALVES; PIERANTI, 2007). Furthermore, it is important to highlight that the likely reflection of the discreet participation of football clubs and the private sector in research related to football in Brazil reinforces the importance of public institutions. From a practical point of view, it is known that there are barriers of a multifactorial nature in partnerships between public and private institutions, and their results are still unknown under the applied scientific aspect. Problems such as the competitive context and constant need for positive results from teams and athletes, as well as the urgencies in the routine of professional and amateur football can inhibit and reduce expectations regarding the time needed for responses and results to materialize into actions. Future studies may emerge allowing a greater contribution to the construction of scientific knowledge and raising the importance and investment of institutions that direct football in research.

7 CONCLUSION

Our results allow us to conclude that structured and organized scientific research on football in Brazil is relatively recent, with a relevant increase in the number of specific RGs that positively impacted the production of articles published in journals with better quality and Qualis strata. Just over half of the Brazilian states have RGs on football, however, important growth was observed, doubling the creation of new groups in the last ten years, which demonstrates evolution and possible expansion in other states in the medium and long term.

The most organized and productive groups are located in the Southeast Region, supported by public HEIs. The groups considered specific in relation to the study of football concentrated most of the production of knowledge in the publication

of articles in scientific journals, demonstrating the role of the organization of these RGs in research and in the production of knowledge on the topic of football. As for national and international production, we can conclude that there are no thematic differences in the production of articles on football. Our research indicates that there is growth and improvement in the development of scientific research on football in Brazil, based on the analysis and production of RG leaders.

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Resumo: Este estudo teve como objetivo identificar, mapear e analisar os grupos de pesquisa (GP) sobre futebol no Brasil, a quantidade e a qualidade da produção científica dos pesquisadores líderes. Trata-se de um estudo sistemático, descritivo, realizado na base de dados do Diretório de Grupos de Pesquisa no Brasil do Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq). Analisou-se a produção científica recente (2016 e 2022) disponível no currículo Lattes dos líderes. Identificaram-se 46 GP, a maioria deles localizados nas regiões Sudeste e Sul do Brasil (n=22/47,8%). O primeiro GP não específico surgiu em 1984 e em 2006 foi cadastrado o primeiro GP específico. Nos últimos anos, foram 409 publicações sobre futebol. Conclui-se que houve um aumento de GP recentemente, com tendência de estabilidade nas publicações, melhora na qualidade dos artigos em periódicos com melhor estratificação Qualis e fator de impacto, indicando avanços nas pesquisas sobre futebol no Brasil.

Palavras-chave: Futebol. Bibliometria. Esportes. Indicadores de Produção Científica.

Resumen: Este estudio tuvo como objetivo identificar, mapear y analizar los grupos de investigación científica sobre el fútbol en Brasil, la cantidad y la calidad de la producción científica de los investigadores líderes. Se trata de un estudio sistemático y descriptivo realizado en la base de datos del Directorio de Grupos de Investigación de Brasil del Consejo Nacional de Desarrollo Científico y Tecnológico (CNPq). Se analizó la producción científica reciente (2016 y 2022) disponible en el curriculum Lattes de los líderes. Se identificaron 46 grupos de investigación, la mayoría ubicados en las regiones Sudeste y Sur de Brasil (n=22/47,8%), el primer GI no específico surgió en 1984, y el primer GI específico fue registrado en 2006. En los últimos años, se registraron 409 publicaciones sobre fútbol. Se concluye que recientemente hubo un aumento de grupos de investigación, con una tendencia hacia la estabilidad en las publicaciones, mejoría en la calidad de los artículos en revistas con mejor calificación Qualis y mayor factor de impacto, lo que indica avances en la investigación sobre el fútbol en Brasil.

Palabras clave: Fútbol. Bibliometría. Deportes. Indicadores de Producción Científica.

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CONFLICT OF INTERESTS

The authors declare that there is no conflict of interest in this work.

AUTHORS' CONTRIBUTIONS

Whyllerton Mayron da Cruz: Conceptualization; Formal analysis; Supervision, Validation, Writing the original draft - proofreading and editing.

Maryon Gotardo dos Santos: Conceptualization; Data Curation Analysis formal; Writing the original draft.

Anderson D'Oliveira: Formal analysis; Data Curation Validation, Writing the original draft.

Bruno Manoel Medeiros e Silva: Data curation; original draft writing.

Ian Umberto Ouriques: Data curation. Original draft writing.

Lucas Wollinger da Silva: Data curation; Original draft writing.

Alexandro Andrade: Conceptualization; Data curation; Formal analysis; Acquisition of funding; Research methodology; Project administration; supervision, Validation, Visualization, Writing - original draft writing - proofreading and editing.

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RESEARCH ETHICS

The research followed the protocols in force in Resolutions 466/12 and 510/2016 of the National Health Council of Brazil.

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EDITORIAL RESPONSIBILITY

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