Original Article (short paper)

Analysis of factors related to the H Index of CNPq scientific productivity researchers in the field of Physical Education in Brazil

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Abstract - Aim: To verify the association between sociodemographic, academic background, professional performance, bibliographic production and training of human resources factors with the H Index of CNPq scientific productivity researchers in the field of Physical Education. **Methods:** This cross-sectional study included 94 researchers with scientific productivity grants (PQ) in the field of Physical Education in Brazil distributed into academic prestige level: PQ 1A-1D (n = 41) and PQ 2 (n = 53). For this, the H Index of these researchers was analyzed in the Scopus database. Related factors were sociodemographic, academic background, professional performance, bibliographic production, and training of human resources (student supervisor). Simple and multiple linear regression was used with a 5% significance level. **Results:** The H Index, number of citations, number of scientific articles in the last 10 years, number of books in the last 10 years, and the training of students at graduate levels of PQ 1A-1D was higher than that of PQ 2 ($p < 0.05$). The H Index of PQ 1A-1D scholarship researchers was directly related to the number of scientific articles [H index = 8.48 + 0.11 * (Articles)]. The H index of PQ 2 scholarship researchers was directly related to the number of scientific articles and academic books and, inversely to the student supervision at master level [H index = 15.19 + 0.06 * (Articles) + 2.45 * (Books) - 0.34 * (Masters)]. **Conclusion:** H Index of researchers in the field of Physical Education in Brazil varied according to the academic recognition level.

Keywords: physical education; productivity; researcher.

Introduction

The academic recognition of a researcher can be manifested in several ways, among which research funding stands out[1]. In Brazil, the Fields of Knowledge are defined and evaluated by agencies that manage Graduate studies and research (i.e., Coordination for the Improvement of Higher Education Personnel - CAPES; and the National Council for Scientific and Technological Development - CNPq). Brazilian researchers are evaluated by these agencies and evaluation criteria are defined by peers as state policies that define the allocation of public investments in the Fields of Knowledge and in priority research[2,3].

One of the criteria most frequent in research funding public notices in Brazil for the distribution of public resources is the researcher being a CNPq Scientific Productivity Researcher (PQ). PQ scholarship has the particularity of being aimed at researchers who enjoy high recognition among peers (based on criteria defined by peers themselves)[4] and grants the researcher a monthly financial resource, according to the scholarship level[3]. In order to apply for PQ scholarship, the researcher must compete in a public notice, annually launched, and be classified in the share of scholarships for a specific Field of Knowledge. Once classified, the researcher becomes a fellow in one of the following categories (order of academic prestige): 1A, 1B, 1C, 1D, and 2. The entry door as a PQ scholarship researcher is category 2. Categories 1A-1D are for researchers who have already gone through category 2 and who presented academic performance (defined by peers and exposed in the public notice) sufficiently relevant in comparison to peers in that Field of Knowledge[4].

The field of Physical Education has scholarship quota in the PQ public notice, and in 2019, ninety-four researchers linked to educational institutions in Brazil were PQ scholarship researcher[3], who benefited from academic prestige. The condition of being ad hoc reviewers of funding agencies in Brazil is among assignments of these researchers, so that they evaluate the research projects of the entire field of Physical Education submitted to these agencies; they have priorities in some research notices and define the evaluation criteria of other researchers[4], that is, they define the allocation of public money to finance research in the field of Physical Education.

Scientific production stands out among evaluation criteria for researchers in Brazil and worldwide[1,5]. Scientific production, by itself, is a very broad dimension, being considered the way in which the university or research institution (and even researchers) is present in the production of science[5]. In other words, it is the basis for the development and overcoming of dependency between countries and regions of the same country, being considered a vehicle for improving people's quality of life and the way of being present in society[5]. Kunsch[5] reinforces that scientific production is linked to almost all things, events, places with which individuals are involved in their daily lives. Thus, scientific production must be the object of evaluation by researchers.

A debate that gains space within science is what to consider as scientific production[5-7]. According to the Fields of Knowledge in Brazil, different products can be considered scientific production[3]. In Physical Education, one of these products that are also an evaluation criterion in the PQ scholarship public notice is the production of scientific articles in journals indexed in the Institute for Scientific Information (ISI) and in SciELO/SCOPUS databases[3]. Thus, the production of scientific articles is a state policy for Brazilian Physical Education researchers. The debate about the quantity and quality of these products is associated with the production of scientific articles, which must be taken into consideration to reflect on the quality of the researcher, the quality of products developed in the Field of Knowledge.

Different metrics (scientometrics) have been developed to guide or assess the quality of scientific production[6]. All of these metrics have advantages and disadvantages, so that a metric that has been equitable for the different Fields of Knowledge and the different theoretical and methodological perspectives of the same Field of Knowledge, as is the case of Physical Education, known as an inter and multidisciplinary area, has not yet been achieved[8,9]. Among these scientometric measures, the H Index stands out[10]. This index was proposed in 2005, by scientist Jorge Hirsch, as a tool capable of combining quantity and quality of academic production[10] and soon became a parameter in evaluations by researchers and universities around the world[6,7,11]. The H Index is defined as the largest ("h") number of scientific articles by this researcher that have at least the same ("h") number of citations each. A researcher with H Index of 10, for example, has published at least 10 scientific articles that have been cited in at least 10 other works. Weighting excludes poorly cited works and also disregards highly cited articles if they are isolated examples[6,7,11].

In a recent discussion on this index, it was argued that having cited article (s) depends on different factors, such as Field of Knowledge, the size of this field, the vehicle for scientific dissemination used, how respected this researcher is the respective area, among others[6,7,11]. Additionally, Yang et al.[12] compared the H Index of researchers from the United States and Canada in relation to sex and identified that different factors of academic life were related to the H Index in both sexes and that such factors should be taken into account for a more detailed analysis of the academic performance. For this reason, the H Index value is linked to different correlated factors that may explain, at least in part, why a given researcher has cited works.

The gap that this work aims to fill is in the possibility of the Brazilian academic community to know the academic factors that are related to the H index of researchers considered as references in the field of Physical Education. Searching until April 2019 in PUBMED, Scopus, Web of Science, LILACS, and SciELO databases, no articles investigating this topic with researchers in the field of Physical Education in Brazil were found. In this search, an article was found that aimed to characterize the profile of these researchers[13], however, no analysis of the H index was made. This information will serve for reflection within the Field of Knowledge itself and for debate on which factors are associated with this metric in Brazil.

This article aimed to verify the association between sociodemographic, academic training, professional performance, bibliographic production and training of human resources (student supervisor) factors with the H Index of researchers with scientific productivity grants (PQ) in the field of Physical Education in Brazil.

Methods

This research surveyed data in March/2020 and is characterized as descriptive, with a cross-sectional design. For the development of this study, public domain data obtained from the information contained in official websites of the Brazilian government were used. For this reason, it did not have direct contact with human beings and did not need approval by an ethics committee on research with human beings.

Research subjects

The subjects of this research were researchers with scientific productivity grants (PQ) in the field of Physical Education in Brazil in the year 2020[3]. In 2020, there were 94 researchers with scientific productivity grants (PQ) in the field of Physical Education in Brazil distributed into prestigious level as follows: 1A (n = 09), 1B (n = 05), 1C (n = 05), 1D (n = 22) and 2 (n = 53).

For the present study, in order to increase the power in statistical analysis, categories PQ 1A-1D were grouped into a single category (n = 41). This stratification was also chosen because categories PQ 1A-1D are recognized for researchers with greater experience and/or academic prestige compared to category 2, which is the first level of entry for researchers[4].

Dependent Variable

The dependent variable of this study was the H index[10] in the Scopus database. We chose the H Index of the Scopus database, as this base is used in the evaluations of research public notices in Brazil[3]. This variable was continuously analyzed.

Independent variables

One of the independent variables in this study was the researcher's sex (male/female). This information is considered important because there are several international gender equity movements in science[14,15]. Another variable investigated was the geographic region of the researcher receiving a scholarship. Brazil is divided into five geographic regions (Midwestern, Northeastern, Northern, Southeastern, and Southern), which present social and economic discrepancies[16] that reflect formal education opportunities.

Another independent variable was the researcher's training area at the doctoral level. This information is important because Physical Education is considered an area that interrelates with different fields of knowledge[8,9].

Other variables in this study were the place where the doctorate was held (Brazil or abroad) and the time the researcher has the doctorate title. Both variables can bring reflections on the relationship between scientific productivity and academic background, as addressed in studies from other fields of knowledge[14,17,18]. The variable time the researcher has the doctorate title (in years) had the reference year 2019 as it was the year of the last public notice that researchers participated until the survey of this study[3]. This variable was categorized as 8-10 years, 11-15 years, 16-20 years, 21-25 years, ≥ 25 years.

The type of university in which the researcher works (Public or Private) was a study variable, as there is a decrease in investments from the Brazilian government in public education in Brazil[19].

Another variable investigated was whether the researcher works in Graduate Programs in the field of Physical Education or not, as inter and multidisciplinary area[8,9], there may have researchers working in Graduate Programs from different fields of knowledge.

The bibliographic production indicators investigated the number of scientific articles, academic books, and chapters of academic books published in the last five (2015-2019) and in the last 10 years (2010-2019) of the researcher's evaluation in the 2019 public notice[3]. In addition, the number of citations in the Scopus bibliographic database was analyzed.

The training of human resources by researchers with scientific productivity grants (PQ) was analyzed through the number of masters, doctors, and post-doctors that they have trained/supervised in the last five years (2015-2019) and 10 years (2010-2019), of the evaluation in the 2019 public notice. The training of human resources at the Graduate level is one of the criteria for the evaluation of CNPq public notices for PQ scholarship researchers[3].

Procedures

Information obtained in this research came from official websites of the Brazilian government, in the public domain, with free and free access. Information on PQ researchers, such as sex, geographic region, and type of institution was accessed on the website http://cnpq.br/bolsistas-vigentes in the week of March 23 to 27/2020. Information on professional performance, bibliographic production, graduation year and field, and training of human resources, were taken from the researchers' curricula registered in the Lattes Platform of public domain (http://lattes.cnpq.br/), in the week of March 23 to 27/2020.

Statistical analysis

For inferential statistics, the Chi-square test of heterogeneity or Fisher's Exact test, Student's *t*-test for independent samples or equivalent non-parametric Mann-Whitney U test were used. In addition, Spearman's correlation coefficient (rho) was used to test the linear relationship between the H index and the other variables. In this verification, high multicollinearity was identified between H Index and the number of citations (rho> 0.90), for this reason, the number of citations did not follow linear regression analyses.

In the simple and multiple linear regression analysis, associations between the H Index and variables significantly related in the Spearman correlation were tested, estimating regression coefficients (B0), regression coefficient related to the predictor (B1), 95% confidence interval (95% CI) and determination coefficient (R2). In the multiple linear regression analysis, the multicollinearity of models was tested using variance inflation factors (VIF). Additionally, the independence of errors was tested and/or if the model errors were independent using the Durbin-Watson test (DW). Finally, a prediction equation for the H Index was estimated based on analyzed variables. This study considered 5% significance level and all analyses were performed using the Statistical Package for the Social Sciences software (IBM®, Armonk, NY), version 22.0.

Results

The characteristics of the sample are shown in table 1. When comparing the sample distribution in relation to PQ scholarship level, it was observed that most PQ 1A-1D scholarship researchers had doctorate time over 20 years, while PQ 2 scholarship researchers had doctorate time from 8 to 15 years ($p < 0.01$). In addition, of the total of researchers with doctorate degree obtained abroad (n = 17), most were PQ 1A-1D scholarship researchers (n = 12), and of those with doctorate degree obtained in Brazil (n = 77), most were PQ 2 scholarship researchers (n = 48) ($p = 0.013$) (Table 1).

The H Index, number of citations, number of scientific articles in the last 10 years (2010-2019), and number of books in the last 10 years (2010-2019) of PQ 1A-1D scholarship researchers were higher compared to PQ 2 ($p < 0.05$). The guidance of students at the master level in the last five years (2015-2019) was higher in PQ 2 compared to PQ 1A-1D ($p < 0.05$). PQ 1A-1D scholarship researchers had a greater number of guidance of students at the doctoral and postdoctoral level (2010-2019) than PQ 2 scholarship researchers ($p < 0.05$) (Table 2).

When comparing the H Index of researchers according to sex, geographic region, doctorate area, time of doctorate completion, place of doctorate completion, the educational institution working and participating in Graduate Programs in the field of Physical Education, there were no differences between categories of these variables, neither for the group of PQ 1A-1D and PQ 2 scholarship researchers ($p > 0.05$) (Table 3).

The H Index of PQ 1A-1D was directly related to the number of citations (rho = 0.92, $p < 0.01$), and scientific articles published in the last five years (rho = 0.34, $p < 0.01$) and 10 years (rho = 0.50, $p < 0.01$). The H Index of PQ 2 was directly related to the number of citations (rho = 0.91, $p < 0.01$), scientific articles in the last 10 years (rho = 0.29, $p = 0.03$), and books in the last five years (rho = 0.26, $p = 0.05$). However, the H Index of PQ 2 was inversely related to the guidance of students in the last 10 years (rho = -0.31, $p = 0.02$) (Table 4).

Simple linear regression analysis for PQ 1A-1D scholarship researchers showed that the publication of a scientific article in the last five years (2015-2019) and a scientific article in the last 10 years (2010-2019) reflected an increase of 0.13 (95% CI: 0.03; 0.23) and 0.11 (95% CI: 0.07; 0.15) units in the H Index, respectively. When performing multiple linear regression modeling, it was observed that these predictors (Step 1) violated the assumption of multicollinearity of the model (VIF = 4.95) and, for this reason, the predictor publication of the scientific article in the last five years (2015-2019) was removed from the model. Thus, the final explanatory model (Step 2) of the H Index of PQ 1A-1D scholarship researchers remained with variable the publication of the scientific article in the last 10 years (2010-2019) [H index = 8.48 + 0.11 * (Articles)], and the number of scientific articles published in the last 10 years explained variation of around 43% (R2 = 0.43) of the H Index of these researchers (Table 5).

For the group of PQ 2 fellowship researchers, predictors in simple linear regression demonstrated that the publication of one scientific article in the last 10 years (2010-2019) and one book in the last five years (2015-2019) reflected an increase of 0.06 (95% CI: 0.03; 0.09) and 2.78 (95% CI: 0.01; 5.55) units in the H Index, respectively. On the other hand, the guidance of students at the master level in the last 10 years (2010-2019) reflected in a decrease of 0.30 (95% CI: -0.56; -0.02) units in the H Index. All these predictors were significant in the multiple linear regression (Step 1) and explained variation in the H index by 38% [H index = 15.19 + 0.06 * (Articles) + 2.45 * (Books) - 0.34 * (Masters)] (Table 5).

Table 1 - Distribution of CNPq Productivity Researchers in the field of Physical Education, Brazil.

	Scholarship level (PQ)				p
	1A-1D		2		
	n	(%)	n	(%)	
Sex					0.888
Female	09	(22.0)	11	(20.8)	
Male	32	(78.0)	42	(79.2)	
Geographic Region					0.303
Midwestern	04	(9.8)	05	(9.4)	
Northeastern	00	(0.0)	04	(7.5)	
Southeastern	26	(63.4)	28	(52.8)	
Southern	11	(26.8)	16	(30.3)	
Doctorate Area					0.105
Physical Education	21	(51.3)	34	(64.2)	
Food Science	01	(2.4)	00	(0.0)	
Biological Sciences	09	(22.0)	05	(9.4)	
Education	02	(4.9)	00	(0.0)	
Engineering	00	(0.0)	01	(1.9)	
Pharmaceutics	01	(2.4)	00	(0.0)	
Medicine	03	(7.3)	11	(20.7)	
Nutrition	01	(2.4)	01	(1.9)	
Collective Health	03	(7.3)	01	(1.9)	
Doctorate completion (years)					<0.001
8-10	00	(0.0)	19	(35.8)	
11-15	07	(17.0)	19	(35.8)	
16-20	12	(29.3)	06	(11.3)	
21-25	17	(41.5)	07	(13.3)	
≥ 25	05	(12.2)	02	(3.8)	
Doctorate Location					0.013
Brazil	29	(70.7)	48	(90.6)	
Abroad	12	(29.3)	05	(9.4)	
Work institution					0.703
Public	37	(90.2)	49	(92.5)	
Private	04	(9.8)	04	(7.5)	
Works in PPG in the field of Physical Education					0.974
Yes	36	(87.8)	46	(88.7)	
No	05	(12.2)	06	(11.3)	

PQ: CNPq Productivity Scholarship; PPG: Graduate Program; p: p-value of the Chi-square test or Fisher's exact test.

Table 2 - Average values, standard deviation, median and interquartile range of the bibliographic production and training of human resources indicators of CNPq Productivity Researchers in the field of Physical Education. Brazil.

	Scholarship level (PQ)			
	1A-1D		2	
	M (SD)	Median (P25-P75)	M (SD)	Median (P25-P75)
Bibliographic production				
H Index	22.3 (10.4)	22.0 (16.5 – 25.5)	17.9 (6.3)	16.0 (14.0 – 21.0)
Citations	2,490.3 (3,842.7)	1,536.0 (1,032.0 – 2,415.5)	1,485.6 (2,373.5)	864.0 (672.0 – 1,517.5)
Articles (2015-2019)	56.6 (31.0)	44.0 (36.0 – 74.5)	55.9 (32.4)	49.0 (31.5 – 68.5)
Articles (2010-2019)	122.1 (60.2)	107 (79.5 – 148.5)	100.1 (50.0)	85.0 (65.0 – 129.0)
Books (2015-2019)	1.0 (1.9)	0.0 (0.0 – 1.0)	0.3 (0.6)	0.0 (0.0 – 1.0)
Books (2010-2019)	3.0 (6.0)	1.0 (0.0 – 3.0)	0.7 (0.9)	0.0 (0.0 – 1.0)
Chapters (2015-2019)	4.7 (7.6)	1.0 (0.0 – 5.5)	1.8 (2.2)	1.0 (0.0 – 2.5)
Chapters (2010-2019)	12.3 (17.1)	5.0 (1.0 – 15.5)	4.2 (4.1)	3.0 (1.0 – 7.0)
Student supervisor				
Master (2015-2019)	4.1 (2.4)	4.0 (2.0 – 6.0)	6.3 (3.5)	6.0 (3.5 – 8.5)
Master (2010-2019)	12.0 (5.6)	12.0 (8.0 – 15.0)	11.9 (6.2)	11.0 (7.0 – 16.0)
Doctorate (2015-2019)	4.5 (2.6)	4.0 (3.0 – 6.0)	3.2 (2.2)	3.0 (1.5 – 4.5)
Doctorate (2010-2019)	8.5 (3.7)	8.0 (6.0 – 11.5)	4.7 (3.2)	4.0 (2.0 – 7.0)
Post- Doctorate (2015-2019)	1.5 (1.7)	1.0 (0.0 – 2.0)	1.1 (1.7)	0.0 (0.0 – 1.0)
Post- Doctorate (2010-2019)	2.7 (2.4)	2.0 (1.0 – 4.0)	1.4 (2.2)	1.0 (0.0 – 2.0)

PQ: CNPq Productivity Scholarship; M: mean; SD: standard deviation; P25: 25th percentile; P75: 75th percentile; p: p-value of the comparison between PQ 1A-1D with PQ 2; * p-value of Student's T test for independent samples; † p-value for the Mann-Whitney U test.

Table 3 - Comparison of the H Index according to the characterization variables for CNPq Productivity Researchers in the field of Physical Education, Brazil.

	H Index - Scopus					
	PQ 1A-1D			PQ 2		
	M (SD)	Median (P25-P75)	p	M (SD)	Median (P25-P75)	p
Sex						
Female	20.8 (9.5)	22.0 (14.5-26.5)	0.81*	15.6 (5.4)	15.0 (13.0-20.0)	0.17*
Male	22.7 (10.7)	21.5 (17.2-25.0)		18.4 (6.4)	16.0 (14.0-21.3)	
Geographic Region						
Midwestern	22.8 (1.7)	22.5 (21.2-24.5)	0.34†	18.0 (2.5)	18.0 (15.5-20.5)	0.36†
Northeastern	–	–		14.7 (4.5)	14.5 (10.5-19.2)	
Southeastern	22.9 (8.9)	22.0 (16.5-27.5)		18.6 (6.5)	16.0 (14.2-22.7)	
Southern	20.8 (15.2)	19.0 (10.0-23.0)		17.2 (7.1)	15.0 (12.2-20.7)	
Doctorate Area						
Physical Education	21.1 (8.7)	21.0 (15.0-25.5)	0.20†	17.7 (7.0)	15.5 (13.0-21.0)	0.70†
Food Science	35.0 (–)	35.0 (–)		–	–	
Biological Sciences	20.7 (4.8)	21.0 (16.5-24.0)		18.0 (3.8)	16.0 (15.0-22.0)	
Education	6.5 (3.5)	6.5 (–)		–	–	
Engineering	–	–		15.0 (–)	15.0 (–)	
Pharmaceutics	21.0 (–)	21.0 (–)		–	–	
Medicine	28.3 (11.8)	22.0 (–)		17.5 (4.2)	16.0 (14.0-21.0)	
Nutrition	27.0 (–)	27.0 (–)		31.0 (–)	31.0 (–)	
Collective Health	35.0 (22.5)	22.0 (–)		16.0 (–)	16.0 (–)	
Doctorate completion (years)						
8-10	–	–	0.27†	20.4 (7.6)	16.0 (16.0-28.0)	0.27†
11-15	29.3 (14.7)	25.0 (22.0-30.0)		16.0 (4.8)	15.0 (12.0-21.0)	
16-20	22.1 (6.5)	22.0 (18.2-23.7)		18.1 (5.7)	19.0 (12.2-23.5)	
21-25	20.8 (10.2)	21.0 (16.0-25.5)		16.5 (5.6)	15.0 (14.0-21.0)	
≥ 25	18.0 (10.6)	15.0 (9.5-28.0)		14.5 (0.7)	14.5 (–)	
Doctorate Location						
Brazil	23.5 (11.4)	22.0 (16.5-28.0)	0.41*	18.1 (6.3)	16.0 (14.0-21.0)	0.36*
Abroad	19.3 (7.2)	20.5 (12.0-24.7)		15.8 (5.5)	15.0 (12.0-20.0)	
Work institution						
Public	22.1 (10.9)	21.0 (15.5-25.5)	0.35*	17.9 (6.5)	16.0 (14.0-21.0)	0.85*
Private	24.3 (3.8)	22.5 (22.0-28.2)		16.5 (3.0)	15.0 (15.0-19.5)	
Works in PPG in the field of Physical Education						
Yes	22.7 (10.5)	22.0 (17.2-25.0)	0.71*	17.7 (6.5)	16.0 (14.0-21.0)	0.28*
No	19.2 (10.4)	21.0 (9.0-28.5)		19.1 (4.4)	18.5 (15.0-23.5)	

PQ: CNPq Productivity Scholarship; PPG: Graduate Program; M: mean; SD: standard deviation; P25: 25th percentile; P75: 75th percentile; * p-value of the Mann-Whitney U test; † p-value of the Kruskal-Wallis test.

Table 4 - Correlation coefficient between H Index and sociodemographic, professional training/performance indicators, bibliographic production and guidance of CNPq Productivity Researchers in the field of Physical Education, Brazil.

	Scholarship level (PQ)			
	1A-1D H Index		2 H Index	
	rho	p	*rho*	p
Sociodemographic and training / professional performance indicators				
Sex	-0.04	0.82	-0.19	0.17
Geographic region	-0.22	0.15	-0.12	0.35
Doctorate area	0.12	0.44	0.12	0.38
Year of doctorate completion	0.17	0.28	0.25	0.07
Doctorate location	-0.13	0.41	-0.13	0.35
Working institution	0.15	0.33	0.15	0.34
Works in PPG in the field of Physical Education	-0.06	0.71	-0.06	0.71
Bibliographic production				
Citations	0.92	<0.01	0.91	<0.01
Articles (2015-2019)	0.34	<0.01	0.21	0.13
Articles (2010-2019)	0.50	<0.01	0.29	0.03
Books (2015-2019)	-0.08	0.62	0.26	0.05
Books (2010-2019)	-0.04	0.80	0.25	0.07
Chapters (2015-2019)	-0.01	0.97	0.23	0.09
Chapters (2010-2019)	0.02	0.88	0.18	0.19
Student supervisor				
Master (2015-2019)	-0.16	0.31	-0.18	0.20
Master (2010-2019)	-0.12	0.45	-0.31	0.02
Doctorate (2015-2019)	-0.12	0.44	-0.18	0.17
Doctorate (2010-2019)	-0.09	0.56	-0.18	0.21
Post-Doctorate (2015-2019)	0.08	0.61	0.15	0.27
Post-Doctorate (2010-2019)	0.09	0.58	0.07	0.61

PQ: CNPq Productivity Scholarship; PPG: Graduate Program; rho: Spearman's correlation coefficient.

Table 5 - Simple and multiple linear regression analysis between H Index and respective predictors for CNPq Productivity Researchers in the field of Physical Education, Brazil.

	Simple					Multiple						
	B0	B1	IC (95%)	p	R2	B0	B1	IC (95%)	p	R2	VIF	DW
PQ 1A-1D												
Step 1												
Articles (2015-2019)	14.72	0.13	(0.03; 0.23)	<0.01	0.15	8.61	-0.31	(-0.46; -0.15)	<0.01	0.59	4.95	1.63
Articles (2010-2019)	8.48	0.11	(0.07; 0.15)	<0.01	0.43		0.25	(0.17; 0.33)	<0.01		4.95	
Step 2												
Articles (2010-2019)						8.48	0.11	(0.07; 0.15)	<0.01	0.43	1.00	1.67
PQ 2												
Step 1												
Articles (2010-2019)	12.14	0.06	(0.03; 0.09)	<0.01	0.20	15.19	0.06	(0.03; 0.08)	<0.01	0.38	1.02	1.61
Books (2015-2019)	16.97	2.78	(0.01; 5.55)	0.05	0.07		2.45	(0.12; 4.78)	0.04		1.00	
Master (2010-2019)	21.31	-0.30	(-0.56; -0.02)	0.03	0.08		-0.34	(-0.57; -0.11)	<0.01		1.01	

PQ: Productivity Scholarship; B0: regression constant; B1: regression coefficient related to the predictor; CI: confidence interval; R2: determination coefficient; VIF: variance inflation factors; DW: Durbin-Watson test; Prediction equation for the PQ 1A-1D group - H index = [8.48 + 0.11 * (Articles)]; Prediction equation for the PQ 2 group - H index = [15.19 + 0.06 * (Articles) + 2.45 * (Books) - 0.34 * (Masters)].

Discussion

This research found that PQ 1A-1D scholarship researchers in the field of Physical Education in Brazil presented higher amounts in bibliographic production and training of human resources indicators than PQ 2 scholarship researchers, which can be explained by the criteria adopted to apply for PQ 1A-1D and PQ 2 scholarships[3]. One of the criteria established to apply for PQ 1A-1D scholarship is to have completed the guidance of at least 10 masters or doctors, with at least three doctors[3]. One of the results identified in the present research was that the majority of PQ 1A-1D scholarship researchers have doctorate time of more than 20 years, which allows establishing a relationship between the time since doctorate completion with bibliographic production and training of human resource[1,20]. Thus, to become a PQ 1A-1D scholarship holder, it is necessary to have more time in the career and adequacy of the interests of research funding agencies. Having completed the guidance of at least three doctors, the scholarship applicant has a greater number of trained researchers working together to publish researches, which increases the possibility of having greater bibliographic production. With the high quantity and quality of human resources trained for research, there is a tendency for a greater number of publications. Thus, PQ 1A-1D the scholarship researchers, researchers with more than 20 years of doctoral completion and with at least three doctorate students under their guidance, form new agents in the scientific field, products of the social world that they are inserted[21,22], which has the diffusion of knowledge-centered in journals[23], which increases the likelihood of these researchers of being cited in comparison to PQ 2 scholarship researchers.

For PQ 1A-1D scholarship researchers, the number of scientific articles published in the last 10 years was the only among factors investigated in this research that directly reflected the variation in the H Index. This result demonstrates that for researchers in the field of Physical Education in Brazil with greater experience and academic insertion, the quantity and quality of the production of scientific articles (i.e., Index H) exclusively depends on the quantity of these publications. Other studies have already shown that the H Index is linked to the amount of publication, that is, the quality and quantity of scientific research go together[11]. What can explain this in this group of researchers (PQ 1A-1D) is that as they have a greater number of trained masters, doctors, and post-doctors, and such researchers establish a tradition in research, in which students, after being trained, become new agents in the scientific field[21,22]. That is, these trained human resources become new advisors, who create new groups of researchers with the same or similar epistemological bias, which start to cite studies previously carried out, generating several citations.

For PQ 2 scholarship researchers in the field of Physical Education in Brazil, the number of scientific articles also reflected in the variation of the H Index, as presented in the group of PQ 1A-1D scholarship researchers, and also presented in other studies on the H Index[7,11]. Due to the regression coefficient of the number of scientific articles published by PQ 2 scholarship researchers (B1 = 0.06), the magnitude of influence of these scientific articles in the variation of the H Index was lower than for PQ 1A-1D scholarship researchers (B1 = 0.11). This result demonstrates that PQ 2 scholarship researchers have to publish a larger number of scientific articles in order to be cited and increase their H Index. On the other hand, each article published by PQ 1A-1D scholarship researchers is more likely to be cited than those of PQ 2 scholarship researchers. This difference in the magnitude of scientific articles in the variation of the H Index reinforces the fact that PQ 2 scholarship researchers are in career consolidation, at the same time that the careers of PQ 1A-1D scholarship researchers are already consolidated.

For the group of PQ 2 scholarship researchers, the number of books published in the last five years was a factor directly associated with the variation in the H Index. Books are an effective strategy for disseminating knowledge produced by researchers in the process of career consolidation[24]. Unlike articles, which must be short and respect a standard systemization, academic books have a more extensive textual presentation, enabling the greater collection of information, in which aesthetic, academic, and social values are incorporated[24]. Such elements of symbolic capital collaborate to legitimize researchers in the academic scenario[21]. In Brazil, there is an additional element in relation to the publication of academic books, which is the fact that such books, in general, are written in Portuguese, and articles, in turn, have English as the official language in most journals. Thus, books reach a larger number of people who intend to start training in research, such as students at the master and doctorate levels. This fact is necessary for researchers who are still in career consolidation, as is the case of PQ 2 researchers, who still need to increase training of human resources to consolidate themselves in the scientific field.

The number of students that were supervised at the master level in the last 10 years has been inversely reflected in the H Index of PQ 2 scholarship researchers. Unlike PQ 1A-1D scholarship researchers, most PQ 2 scholarship researchers have between eight and 15 years of doctoral training and have supervised more master students in the last five years, and these numbers identify the beginning of the training of human resources for research since the master's degree is the period in which students enter the Graduate Program and begin to acquire experience[22] to improve it in the doctorate degree. The first master's degrees require more time from the advisor[20,25,26] since the training of new researchers is at the beginning, which may be related to the inverse relationship with the H index, as it influences in the period of dedication to the publication of articles with quality to be cited.

The limitations of this research are numerous, for example, the analysis of the H Index of the Scopus database, considering that other databases also present the researcher's H index. However, it was decided to analyze the H Index of the Scopus database because this base is taken into account in the assessment of the quantity and quality of PQ scholarship researchers by CNPq[3]. Another limitation of this research is the fact that it analyzed only PQ scholarships in the field of Physical Education, since other fields of knowledge may have predictors of the H Index different from those of Physical Education. The fact that it did not analyze researchers that applied in the PQ 2019

scholarship notice[3], but that were not contemplated is another limitation of this research, as it does not allow knowing the H Index of these researchers or the factors related to that index. However, information from non-contemplated researchers is not public, so there is no access to that information. Another limitation of this study is its design (cross-sectional), which prevents any causal inference among variables.

Conclusions

PQ 1A-1D scholarship researchers in the field of Physical Education in Brazil have higher amounts in indicators of bibliographic production and training of human resources than PQ 2 scholarship researchers. For PQ 1A-1D scholarship researchers, the number of scientific articles published in the last few 10 years directly reflected the variation in the H Index of these researchers. On the other hand, for PQ 2 scholarship researchers, the number of the scientific articles published in the last 10 years and books published in the last five years directly reflected the variation in their H Index. In addition, for PQ 2, the amount of guidance of students at the master level in the last 10 years inversely reflected in their H Index.

This system demonstrates the logic of the distribution of PQ scholarships in the field of Physical Education in Brazil, which is related to scientific experience and a standardized structure of the systematized organization of the academic career, as well as a sequential perspective, in which the time of involvement with research is related to the type of scholarship that one can apply for, according to the current structured system.

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