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ORIGINAL

ABFR-INDEX: CORRELATION BETWEEN “SOCCER” SCIENTIFIC PRODUCTION AND RANKING

ABFR-INDEX: CORRELACIÓN ENTRE PRODUCCIÓN CIENTÍFICA EN “FÚTBOL” Y RANKING



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ABSTRACT

Introduction: Society asks for solutions to science to get return on investment in research. **Objective:** To analyze the relationship between the ranking of a bibliometric indicator, scientific production of “soccer” topic, and the ranking of an indicator of the influence of the results of research on this topic in society, soccer rankings. **Results:** Moderately significant direct correlation between ranking WoS publications 2010 and FIFA ranking 2010 with an $r_s = .520$, $p = .000$, $R^2 = .238$. ABFR-Index = .575 remains positive and moderately significant. **Conclusions:** There is a direct influence on society of the results of research on the “soccer” topic. Therefore ABFR-Index will be in future a reference to interpret the relationship and influences between the scientific world and society

KEY WORDS: Bibliometric indicator, Sports Sciences, Soccer rank, Basketball rank, H-Index, Spearman rank, Scientific performance.

RESUMEN

Introducción: La sociedad reclama a la ciencia aporte de soluciones que reviertan las inversiones en investigación. **Objetivo:** Analizar la relación existente entre el ranking de un indicador bibliométrico, producción científica del tópico “fútbol/soccer” y el ranking de un indicador de la influencia de los resultados de la investigación de este tópico en la sociedad, rankings de Fútbol. **Resultados:** Correlación directa y moderadamente significativa entre ranking de n^o publicaciones WoS 2010 y ranking FIFA 2010 con un $r_s = 0,520$, $p = 0,000$, y $R^2 = 0,238$. Siendo positivo ABFR-Index = 0,575 y moderadamente significativo. **Conclusiones:** Hay influencia directa de los resultados de la investigación en la sociedad en relación al tópico “fútbol/soccer”; ABFR-Index será un referente para interpretar las relaciones e influencias entre mundo científico y sociedad.

PALABRAS CLAVE: Indicadores bibliométricos, Ciencias del deporte, Ranking fútbol, Ranking baloncesto, H-Index, Correlación Spearman, Rendimiento científico.

INTRODUCTION

Research and bibliometric indicators

This article continues with the aim of quantifying the influence of a research topic and the transmission of knowledge to society (Fernández-Revelles, 2012), when scientists won a Nobel Prize, it is clear the relevance of their research and their work to society (Hirsch, 2005). To quantify the significance of a scientist in the scientific world we can accounting it through the H-Index (Hirsch, 2005). If the authors analyzed more scientific productivity, with the most cited papers and

also very important discoveries have been made in relation to a research topic, you can build a ranking of these scientists and contrast ratio of this ranking with awards Nobel in this area (Garfield, 1980, 1987; Garfield & Welljamsdorof, 1992).

For a scientist, his research topic, his research group, their area of expertise, the institution for which he works, his country.... etc, are vital scientific communication (Borgman & Furner, 2002), their publications and contributes to society generates knowledge of the results of their research. Through analysis of these publications, and through its publications scientists are evaluated using bibliometric indicators (Bordons & Zulueta, 1999).

Bibliometric indicators are generally linking data from publications, such as the number of times it is cited, few authors appear in research, few publications have a researcher or an institution, etc....(Batista, Campiteli, Kinouchi, & Martinez, 2006); And from the extraction of these indicators and the relationship between these indicators are indices. The rates are far more widespread impact factor of journals (Bordons & Zulueta, 1999; Borgman & Furner, 2002; Garfield, 1998), and H-Index (Hirsch, 2005; Vanclay, 2007) this index being widely used for its robustness, and the relationship between publications and citations, an index widely used for scientific evaluation and establishing rankings among scientists, institutions, countries etc... (Ball, 2005, 2007; Bar-Ilan, 2008; Bornmann & Daniel, 2005, 2007; Braun, Glanzel, & Schubert, 2006; Burrell, 2007; Costas & Bordons, 2007; Cronin & Meho, 2006; Lehmann, Jackson, & Lautrup, 2006; Meho & Yang, 2007; Torres-Salinas, Moreno-Torres, Delgado-Lopez-Cozar, & Herrera, 2011).

Each day still appear different indicators that modify the previous, or analyze data complementing, supplementing, restricting etc ..., to get a different result (Alonso, Cabrerizo, Herrera-Viedma, & Herrera, 2009; Bergh, Perry, & Hanke, 2006; Egghe, 2006, 2008; Lane & Bertuzzi, 2011; Quindos, 2009; Schreiber, 2008; Woeginger, 2009), but remain indexes and indicators that relate bibliometric data and indicators, but these indicators and data related to the influence of bibliometric results of research in society..

Research and society

The scientific results and their influence on society are not immediate nor so easily measured by the cuts which go directly toward scientific investment and university teaching (Macilwain, 2010a, 2010b, 2011a, 2011c). But in times of crisis the company claims the world of science, and scientists who provide direct transmission solutions to society, the economy, etc..., wants to reverse all investments made in research and occurs in an almost automatic (Macilwain, 2010c, 2011b).

One concern that is emerging today is how to relate and how to integrate scientific investment with the influence of these research results in society

(Frank & Nason, 2009). In all areas of knowledge or research topics is not in the same way or at the same time the relationship between research and investment in research and influence or impact on society (Cooke et al., 2009).

Because of this difficulty structures are being created as START METRICS (Lane & Bertuzzi, 2011; Sutherland, Fleishman, Mascia, Pretty, & Rudd, 2011), with these structures is to make visible the relationship between investment in research and influence and impact in society, but these structures are very complex in their implementation, implementation and monitoring.

Soccer and scientific production

Analyze scientific output from a research topic is a methodology widely used (Banks, 2006; Giles, 2006), even for research in sport like basketball bibliometric analysis in Spain (Fernández-Revelles, 2005).

The soccer is a topic of study or research topic so we can include within the Sports Science or Science of Physical Activity and Sport. Although given the multidisciplinary nature of the research topics related to Physical Activity Sciences and Sports also makes their study from other subject areas (Devis-Devis, Valcarcel, Villamon, & Perez-Samaniego, 2010; Valcarcel, Devis-Devis, Villamon, & Peiro-Velert, 2010; Valcarcel, Villamon, & Devis-Devis, 2008). So because of the multidisciplinary nature of the research topics in sport science data collection in bibliometric studies is not limited to the Subject Categoríe "Sports Sciences" but that is usually done in all categories of Web of Science (WoS) as occurs in other areas (Banks, 2006).

In sport the use of statistics, rankings, rankings of all kinds is very widespread especially in sports like basketball (Federation International Basketball Association (FIBA), 2012); well there are rankings for the competition, after the competition or even doing various competitions rankings together, as we see in the Olympics (Olympic-Movement, 2012). In soccer the most important competition in the world facing to different countries every four years is the FIFA World Cup (Fédération Internationale de Football Association (FIFA), 2011), at the end of the FIFA World Cup is set where each team has been ranking in the championship based on their performance in the world, and also has a FIFA ranking of all countries is calculated based on the position held competition in each country, using different percentages depending on the difficulty or level estimated in each competition (Macmillan & Smith, 2007).

In the WoS database the term most used for research in soccer is "soccer", as evidenced in some work (Fernández-Revelles et al., 2009), although it may be errors in the descriptors used by the authors (Gil-Leiva & Alonso-Arroyo, 2007), but the result is very approximate to the exact value (Banks, 2006).

The database used in most studies was bibliometric WoS and Scopus because WoS collects only high impact publications Scopus collecting face publications also lower impact (de-Granda-Orive, Alonso-Arroyo, & Roig-Vazquez, 2011).

ABFR-index: An index relates bibliometric ranking and ranking of the influence of this topic as a result of research in society

Based on two rankings of a research topic "football / soccer", one of the rankings is a bibliometric indicator, the scientific, and the other relations ranking of research topic that has on society in this case the classification the FIFA World Cup or the FIFA ranking. It will analyze their correlation through Spearman ρ (also used r_s) or Spearman correlation between rankings (Spearman, 2010).

For calculating ABFR-Index, the following data are needed (Fernández-Revelles, 2012):

- Ranking of bibliometric indicator of research topic (in this case number of publications in WoS or H-Index in "soccer").
- Ranking indicator research topic in society (in this case FIFA World Cup or the FIFA ranking).
- Results of the Spearman correlation (r_s) between the two rankings and check their statistical significance.
- N used in the calculation of Spearman ρ .
- A = Number of ranges in the ranking of bibliometric indicator is better or equal to the indicator ranking research topic in society.
- B = Number of ranges in the ranking of bibliometric indicator is worse than the indicator ranking research topic in society.

With these data, the corresponding formula is applied in each case to calculate ABFR-Index, according (Fernández-Revelles, 2012):

If $A \geq B$:

$$ABFR - Index = \frac{\left(\frac{A}{N}\right) + r_s}{2}$$

If $A < B$:

$$ABFR - Index = \frac{-\left(\frac{B}{N}\right) + r_s}{2}$$

Thus ABFR-Index is a dimensionless index can take values between -1 and 1. Being Index ABFR interpretation similar to Spearman correlation, although with nuances (Fernández-Revelles, 2012).

Objectives

The objectives of this work are:

To analyze the relationship between the ranking of a bibliometric indicator, topical scientific production "soccer" and the ranking of an indicator of the influence of the results of research on this topic in society, ranking in the FIFA World Cup in South Africa 2010 and 2010 FIFA ranking, we must note the temporary restraining order until 2010, and that the beginning is the one with default WoS 1898.

MATERIAL AND METHODS

For this study, we followed the procedure used in (Fernández-Revelles, 2012) and are summarized below. We used the database WoS (Thomson Reuters Web of Science, 2011) being consulted on 23 December 2011. We used all databases including WoS.

To get the data into the field Topic of the WoS database research topic "soccer". Using bibliometric analysis tools provided by WoS and results are collected from all countries following bibliometric indicators:

- Number of papers published in each country.
- H-Index of each country.

Data classification South Africa World Cup and the FIFA rankings are published on the website of the Fédération Internationale de Football Association known as FIFA (Fédération Internationale de Football Association (FIFA), 2011) and collected from this.

From the data collected in WoS and FIFA rankings are for ordering the list of countries with their results from best to worst accounting for each country a rank number in each ranking, this process was performed using Microsoft Excel 2007.

The rankings were:

- (Indicators of topic influence in society) Classification of FIFA World Cup South Africa 2010 and 2010 FIFA ranking.
- (Bibliometric indicators) Number of published papers and H-Index of each country with the topic "Soccer" each in an 1898 periods 2010-2010.

To calculate ABFR-Index corresponding to this topic calculations were made according to the above formula (Fernández-Revelles, 2012), after calculating correlations between rankings using Spearman correlation (Spearman, 2010), was performed using the SPSS 18th edition.

RESULTS

The results show, Table 1 and Figure I, a moderate direct and significant correlation between the ranking of number of WoS publications 2010 and 2010 with a FIFA ranking $r_s=.520$, $p=.000$, and coefficient of determination $R^2=.238$; obtaining a $r_s=.415$, $p=.000$, $R^2=.138$; moderate direct and significant correlation between H-Index ranking of 2010 and the 2010 FIFA ranking. Being a positive sign the ABFR-Index and moderately significant with ABFR-Index=.575 and ABFR-Index=.528 respectively.

However, after statistical analysis relating the rankings, Table 1, no direct relationship between the number of publications ranking WoS ranking 2010 and FIFA World Cup 2010 with a $r_s=.251$, $p=.182$, and coefficient of determination $R^2=.057$; and obtaining a $r_s=-.114$, $p=.548$, $R^2=.01$; and there is no relationship between the ranking of H-Index 2010 and ranking of FIFA World Cup 2010. Being negative sign for the ABFR-Index means the ranking of countries is worse in WoS publications number 2010 and H-Index in the FIFA World Cup 2010.

Table 1. Relationship between the rankings of bibliometric indicators and ranking relates the influence of topic in society

| | <i>N</i> | <i>r_s</i> | <i>Z</i> | <i>p</i> | <i>R²</i> | ABFR-Index |
|--|----------|----------------------|----------|----------|----------------------|------------|
| Number of publications WoS and FIFA World Cup 2010 | 30 | .251 | 1.352 | .182 | .057 | -.191 |
| H-Index and FIFA World Cup 2010 | 30 | .114 | .614 | .548 | .01 | -.293 |
| FIFA 2010 y WoS 2010 | 89 | .520* | 4.878 | .000 | .238 | .575 |
| FIFA 2010 y H-Index 2010 | 89 | .415* | 3.893 | .000 | .138 | .528 |

* Significant correlation $p < .01$

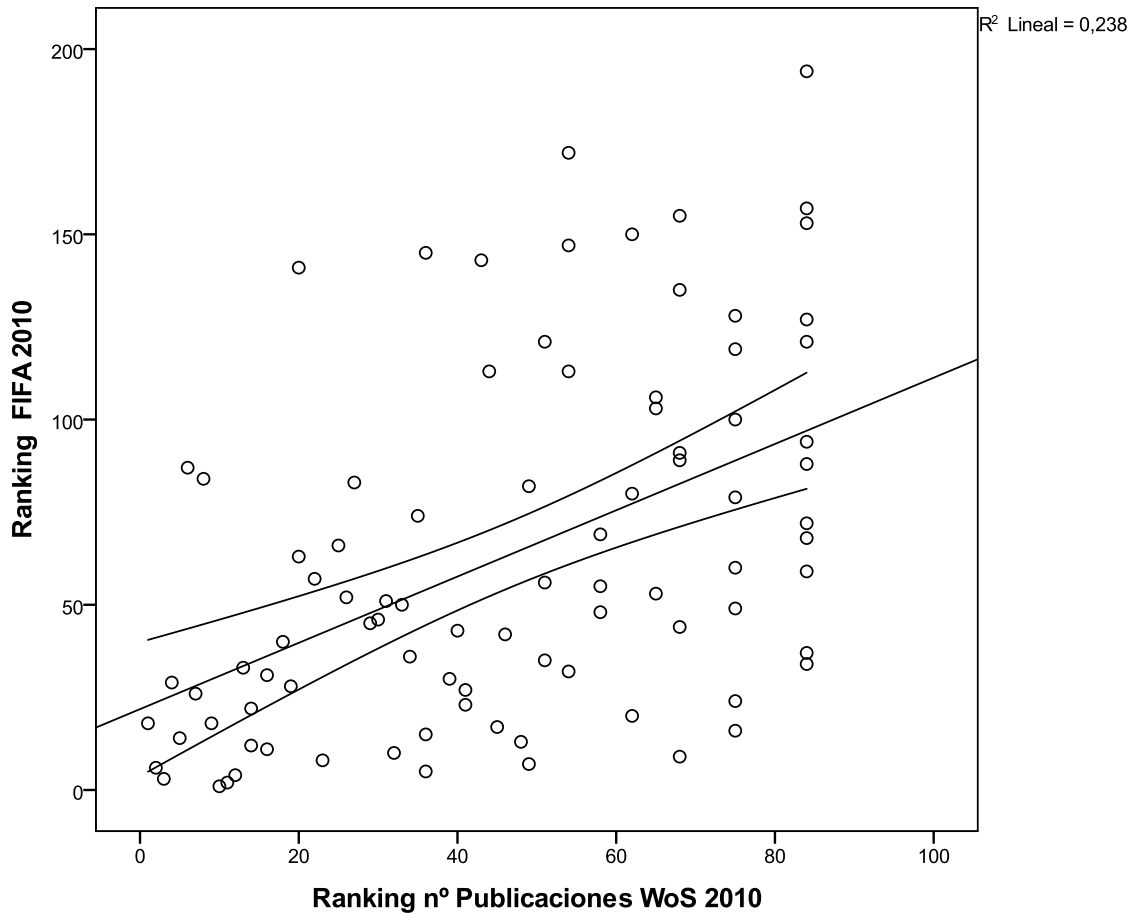


Figure I. Relationship between bibliometric indicator ranking (WoS publications number 2010) and indicator that relates the influence of topical ranking in society (FIFA 2010)

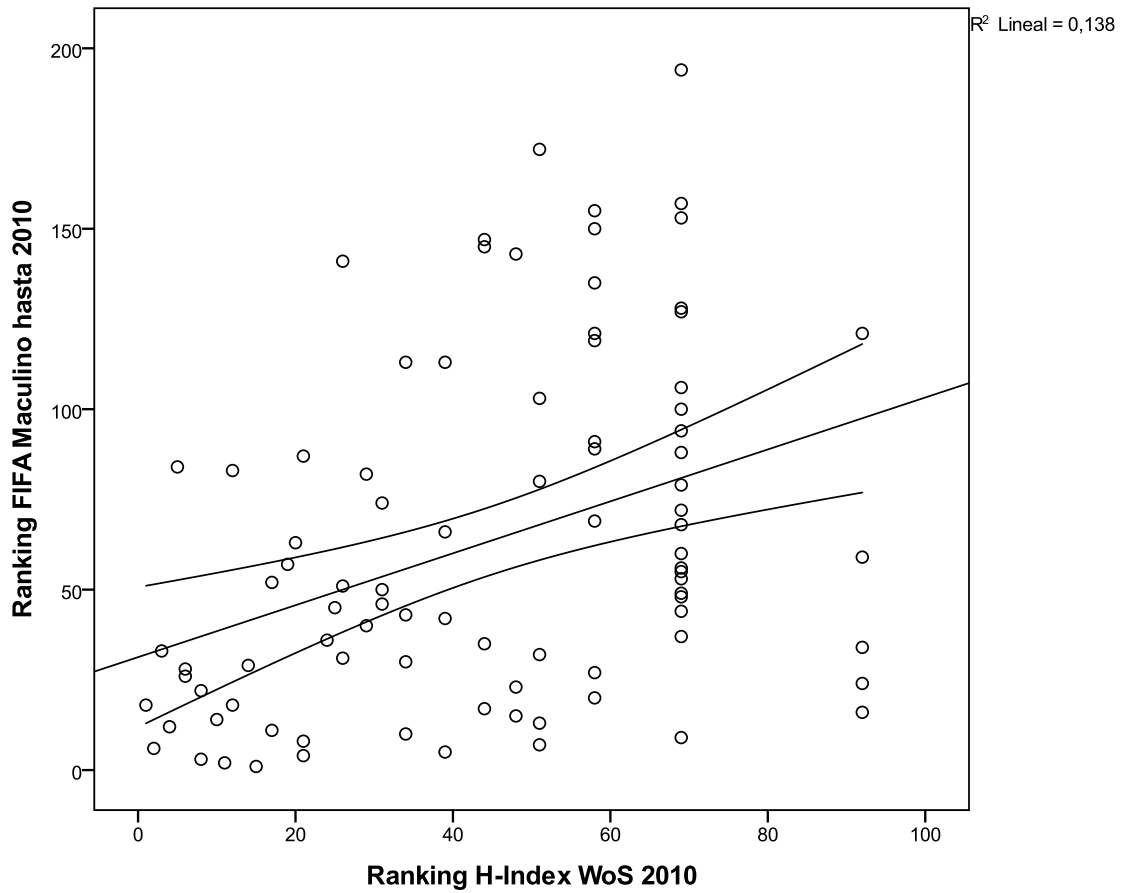


Figure II. Relationship between bibliometric indicator ranking (H-Index 2010) and ranking indicator that relates the influence of topic in society (FIFA 2010)

Table 2. Differences country positions between the rankings and percentages

| Ranking | Countries | % |
|---|-----------|------|
| Better or equal to the number of publications in WoS World Cup 2010 | 11 | 36.7 |
| Worse in number of publications in WoS World Cup 2010 | 19 | 63.3 |
| Better or equal to H-Index in 2010 World WoS | 9 | 30.0 |
| Worse in H-Index in 2010 World WoS | 21 | 70.0 |
| Better or equal in number of publications in 2010 FIFA WoS | 56 | 62.9 |
| Worse in number of publications in 2010 FIFA WoS | 33 | 37.1 |
| Better or equal to H-Index in 2010 FIFA WoS | 57 | 64.0 |
| Worse in WoS H-Index in FIFA 2010 | 32 | 36.0 |

DISCUSSION

The data show that there is a direct and significant correlation moderate between (Rank number of WoS publications 2010 and 2010 FIFA ranking) with a $r_s=.520$, $p=.000$, and determination coefficient $R^2=.238$; obtaining a $r_s=.415$, $p=.000$, $R^2=.138$; slight direct and significant correlation between H-Index ranking of 2010 and the 2010 FIFA ranking. Being a positive sign the ABFR-Index and moderately significant with ABFR-Index=.575 and ABFR-Index=.528,

respectively, thus indicate that the percentage of the ranks is best for bibliometric indicators 67.5% and 65.0% which for sport indicators.

The ABFR-Index=.575 based on the number of publications has a relatively high value because part of a $r_s=.520$, and a 67.5% (56 countries) are better in the range of number of publications in WoS 2010 FIFA 2010. ABFR-Index still significant being obtained from the relation between rankings H-Index 2010 and a ranking FIFA $r_s=.415$, $p=.000$, influence is tempered by the low value of r_s although 64% (57 countries) are best in the range of H-Index 2010 than in FIFA ranking. Therefore we can say that there is influence of the results of research in society with regard to the topic "soccer", research is ahead.

However there is no direct relationship between bibliometric indicators, 2010 and the related indicator of topic influence in society (Ranking of FIFA World Cup 2010). Also the value of the ABFR-Index=-.191, and ABFR-Index=-.293 warns of the negative sign of these indices that the percentage rank is better for sports ranking 63.3% and 70.0% respectively. Several factors can affect the low $N=39$ and how to select the participants in the World Cup (Fédération Internationale de Football Association (FIFA), 2011) since they are made to go groups representatives from all continents but not involving top teams in the world.

To allow comparison with some data but few to be a research emerging (Fernández-Revelles, 2012), you can see the interesting ABFR-Index value for the sign to know if the ranking of bibliometric indicator or indicator relative to the dominant society is based on the value and quantify the relationship of this research topic with society.

It is the beginning of the implementation of ABFR-Index will certainly be in the future a reference to interpret the relationship between the scientific world and the influence of their results in society, which will be enriched with studies of other sports categories, gender, or other matter.

CONCLUSIONS

There is a moderate relationship between ranking a bibliometric indicator, topical scientific production of "soccer" 2010 and 2010 FIFA ranking as an indicator of the influence of the results of research on this topic "soccer" in society. Therefore we can say that there is influence of the results of research in society with regard to the topic "soccer".

The relationship between research and society in relation to the topic football is stronger than I expected at baseline.

REFERENCES

- Alonso, S., Cabrerizo, F. J., Herrera-Viedma, E., & Herrera, F. (2009). h-Index: A review focused in its variants, computation and standardization for different scientific fields. [Review]. *Journal of Informetrics*, 3(4), 273-289. doi: 10.1016/j.joi.2009.04.001
- Ball, P. (2005). Index aims for fair ranking of scientists. [News Item]. *Nature*, 436(7053), 900-900. doi: 10.1038/436900a
- Ball, P. (2007). Achievement index climbs the ranks. [News Item]. *Nature*, 448(7155), 737-737. doi: 10.1038/448737a
- Banks, M. G. (2006). An extension of the Hirsch index: Indexing scientific topics and compounds. [Article]. *Scientometrics*, 69(1), 161-168. doi: 10.1007/s11192-006-0146-5
- Bar-Ilan, J. (2008). Which h-index? - A comparison of WoS, Scopus and Google Scholar. [Article]. *Scientometrics*, 74(2), 257-271. doi: 10.1007/s11192-008-0216-y
- Batista, P. D., Campiteli, M. G., Kinouchi, O., & Martinez, A. S. (2006). Is it possible to compare researchers with different scientific interests? [Article]. *Scientometrics*, 68(1), 179-189.
- Bergh, D. D., Perry, J., & Hanke, R. (2006). Some predictors of SMJ article impact. [Article]. *Strategic Management Journal*, 27(1), 81-100.
- Bordons, M., & Zulueta, M. A. (1999). Evaluation of scientific activity through bibliometric indicators. [Article]. *Revista Espanola De Cardiologia*, 52(10), 790-800.
- Borgman, C. L., & Furner, J. (2002). Scholarly communication and bibliometrics. [Review]. *Annual Review of Information Science and Technology*, 36, 3-72.
- Bornmann, L., & Daniel, H. D. (2005). Does the h-index for ranking of scientists really work? [Article]. *Scientometrics*, 65(3), 391-392.
- Bornmann, L., & Daniel, H. D. (2007). What do we know about the h index? [Article]. *Journal of the American Society for Information Science and Technology*, 58(9), 1381-1385.
- Braun, T., Glanzel, W., & Schubert, A. (2006). A Hirsch-type index for journals. [Article]. *Scientometrics*, 69(1), 169-173.
- Burrell, Q. L. (2007). Hirsch's h-index: A stochastic model. [Article]. *Journal of Informetrics*, 1(1), 16-25. doi: 10.1016/j.joi.2006.07.001
- Cooke, I. R., Queenborough, S. A., Mattison, E. H. A., Bailey, A. P., Sandars, D. L., Graves, A. R., . . . Sutherland, W. J. (2009). Integrating socio-economics and ecology: a taxonomy of quantitative methods and a review of their use in agro-ecology. *Journal of Applied Ecology*, 46(2), 269-277. doi: 10.1111/j.1365-2664.2009.01615.x
- Costas, R., & Bordons, M. (2007). The h-index: Advantages, limitations and its relation with other bibliometric indicators at the micro level. [Article]. *Journal of Informetrics*, 1(3), 193-203. doi: 10.1016/j.joi.2007.02.001

- Cronin, B., & Meho, L. (2006). Using the h-index to rank influential information scientists. [Article]. *Journal of the American Society for Information Science and Technology*, 57(9), 1275-1278. doi: 10.1002/asi.20354
- de-Granda-Orive, J. I., Alonso-Arroyo, A., & Roig-Vazquez, F. (2011). Which data base should we use for our literature analysis? Web of Science versus SCOPUS. [Letter]. *Archivos De Bronconeumologia*, 47(4), 213-213. doi: 10.1016/j.arbres.2010.10.007
- Devis-Devis, J., Valcarcel, J. V., Villamon, M., & Perez-Samaniego, V. (2010). Disciplines and themes of study in physical activity and sport science. [Article]. *Revista Internacional De Medicina Y Ciencias De La Actividad Fisica Y Del Deporte*, 10(37), 150-166.
- Egghe, L. (2006). Theory and practise of the g-index. [Article]. *Scientometrics*, 69(1), 131-152. doi: 10.1007/s11192-006-0144-7
- Egghe, L. (2008). Examples of simple transformations of the h-index: Qualitative and quantitative conclusions and consequences for other indices. [Article]. *Journal of Informetrics*, 2(2), 136-148. doi: 10.1016/j.joi.2007.12.003
- Federation International Basketball Association (FIBA). (2012). Federation International Basketball Association (FIBA) Retrieved 10/01/2012, from <http://www.fiba.com/pages/eng/fc/p/openNodeIDs/888/selectedNodeID/888/index.html>
- Fédération Internationale de Football Association (FIFA). (2011). Fédération Internationale de Football Association (FIFA), Retrieved 23 dic 2011, from <http://FIFA.com>
- Fernández-Revelles, A. B. (2005). Análisis de la producción científica de baloncesto en España. In R. Martínez de Santos, S. Ibáñez & L. M. Sautu (Eds.), *III Congreso Ibérico de Baloncesto. Libro de Actas* (pp. 48). Vitoria-Gasteiz: Avafiep.
- Fernández-Revelles, A. B. (2012). ABRF-Index: correlación entre producción científica y Juegos Olímpicos 2008. [Article]. *Habilidad Motriz*, 38, 51-57. doi: <http://hdl.handle.net/10481/29520>
- Fernández-Revelles, A. B., Robles, A., Dafos, J., Soto Hermoso, V. M., Pérez Cortés, A. J., Latorre, P. Á., . . . Heredia, J. M. (2009). Actividad física: Evaluación de la investigación en España. *Gaceta sanitaria*, 23(EC1), 204 - 204.
- Frank, C., & Nason, E. (2009). Health research: measuring the social, health and economic benefits. *Canadian Medical Association Journal*, 180(5), 528-534. doi: 10.1503/cmaj.090016
- Garfield, E. (1980). Are the 1979 prizewinners of Nobel class. [Article]. *Current Contents*(38), 5-13.
- Garfield, E. (1987). 50 classics from the journal-of-clinical-investigation-over 60 years of Nobel-Class research. [Article]. *Current Contents*(8), 3-11.
- Garfield, E. (1998). Random thoughts on citationology. Its theory and practice - Comments on theories of citation? [Article]. *Scientometrics*, 43(1), 69-76. doi: 10.1007/bf02458396

- Garfield, E., & Welljamsdorof, A. (1992). Of nobel class - a citation perspective on high-impact research authors. 2. (Reprinted from theoretical medicine, vol 13, pg 117, 1992). [Reprint]. *Current Contents*, 35, 4-12.
- Gil-Leiva, I., & Alonso-Arroyo, A. (2007). Keywords given by authors of scientific articles in database descriptors. [Article]. *Journal of the American Society for Information Science and Technology*, 58(8), 1175-1187. doi: 10.1002/asi.20595
- Giles, J. (2006). How the topics were ranked. [News Item]. *Nature*, 441(7091), 265-265.
- Hirsch, J. E. (2005). An index to quantify an individual's scientific research output. [Article]. *Proceedings of the National Academy of Sciences of the United States of America*, 102(46), 16569. doi: 10.1073/pnas.0507655102
- Lane, J., & Bertuzzi, S. (2011). Measuring the Results of Science Investments. *Science*, 331(6018), 678-680. doi: 10.1126/science.1201865
- Lehmann, S., Jackson, A. D., & Lautrup, B. E. (2006). Measures for measures. [Editorial Material]. *Nature*, 444(7122), 1003-1004.
- Macilwain, C. (2010a). ERA of austerity. [Editorial Material]. *Nature*, 466(7304), 314-314. doi: 10.1038/466314a
- Macilwain, C. (2010b). Scientists vs engineers: this time it's financial. [Editorial Material]. *Nature*, 467(7318), 885-885.
- Macilwain, C. (2010c). What science is really worth. [News Item]. *Nature*, 465(7299), 682-684.
- Macilwain, C. (2011a). Europe lines up hefty science-funding hike. [News Item]. *Nature*, 475(7354), 14-15.
- Macilwain, C. (2011b). Science's attitudes must reflect a world in crisis. [Editorial Material]. *Nature*, 479(7374), 447-447.
- Macilwain, C. (2011c). University cuts show science is far from saved. [Editorial Material]. *Nature*, 469(7329), 133-133. doi: 10.1038/469133a
- Macmillan, P., & Smith, I. (2007). Explaining international soccer rankings. [Article]. *Journal of Sports Economics*, 8(2), 202-213. doi: 10.1177/1527002505279344
- Meho, L. I., & Yang, K. (2007). Impact of data sources on citation counts and rankings of LIS faculty: Web of science versus scopus and google scholar. [Article]. *Journal of the American Society for Information Science and Technology*, 58(13), 2105-2125. doi: 10.1002/asi.20677
- Olympic-Movement. (2012). Olympic.org. Official website of the Olympic Movement Retrieved 10/01/2012, from <http://www.olympic.org/>
- Quindos, G. (2009). Confusing the confused: thoughts on impact factor, h(irsch) index, Q value, and other cofactors that influence the researcher's happiness. [Article]. *Revista Iberoamericana De Micologia*, 26(2), 97-102.
- Schreiber, M. (2008). A modification of the h-index: The h(m)-index accounts for multi-authored manuscripts. [Article]. *Journal of Informetrics*, 2(3), 211-216. doi: 10.1016/j.joi.2008.05.001

- Spearman, C. (2010). The proof and measurement of association between two things. [Editorial Material]. *International Journal of Epidemiology*, 39(5), 1137-1150. doi: 10.1093/ije/dyq191
- Sutherland, W. J., Fleishman, E., Mascia, M. B., Pretty, J., & Rudd, M. A. (2011). Methods for collaboratively identifying research priorities and emerging issues in science and policy. *Methods in Ecology and Evolution*, 2(3), 238-247. doi: 10.1111/j.2041-210X.2010.00083.x
- Thomson Reuters Web of Science. (2011). Web of Science (WoS). Retrieved 23/11/2011 <http://isiknowledge.com>
- Torres-Salinas, D., Moreno-Torres, J. G., Delgado-Lopez-Cozar, E., & Herrera, F. (2011). A methodology for Institution-Field ranking based on a bidimensional analysis: the IFQ(2)A index. [Article]. *Scientometrics*, 88(3), 771-786. doi: 10.1007/s11192-011-0418-6
- Valcarcel, J. V., Devis-Devis, J., Villamon, M., & Peiro-Velert, C. (2010). Scientific cooperation in the field of Physical Activity and Sport Science in Spain. [Article]. *Revista Espanola De Documentacion Cientifica*, 33(1), 90-105. doi: 10.3989/redc.2010.1.726
- Valcarcel, J. V., Villamon, M., & Devis-Devis, J. (2008). Assessment and classification of Spanish scientific-technical journals of Physical Activity and Sport Sciences. [Article]. *Revista Espanola De Documentacion Cientifica*, 31(3), 396-412.
- Vanclay, J. K. (2007). On the robustness of the h-index. [Article]. *Journal of the American Society for Information Science and Technology*, 58(10), 1547-1550.
- Woeginger, G. J. (2009). Generalizations of Egghe's g-Index. [Article]. *Journal of the American Society for Information Science and Technology*, 60(6), 1267-1273. doi: 10.1002/asi.21061

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