Impact of Collaboration on Research Quality: A Case Analysis of Dental Research

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Abstract

Collaboration is a central aspect of research, with variable impact on research output and quality. Its assessment is commonly based on citation count, but this is an inadequate measure in biomedical research. The aim of this preliminary study is to determine the impact of collaboration at three levels on the quality of dental therapy research using a valid and reliable instrument. Ninety-nine papers published in four ISI dental journals were analyzed using the MINCIR scale for methodological quality (MQ). Correlations and a linear regression model were used to determine the impact of collaboration on MQ. There was a positive and significant correlation between MQ and number of authors ($r=0.2991$; $p=0.0026$) and countries ($r=0.2253$; $p=0.0249$), but not institutions ($r=0.1750$; $p=0.0832$). The linear regression model for MQ explains 20.32% of the variance; only the number of authors and journal quartile were significant. Collaboration has little impact on MQ in this area.

Keywords: Research collaboration, Methodological Quality, Medical Sciences, Citations, research quality, dental therapy.

Introduction

Collaboration is a key aspect of research practice, commonly prioritized by public and private research policies (Abramo, D'Angelo & Solazzi, 2011a; Gazni, Sugimoto & Didegah, 2012). This relies on the notion that collaboration has a positive impact on scientific output and quality (Bote, Vicente, Olmeda-Gómez & Moya-Anegón, 2013; Lee & Bozeman, 2005) and vice versa (Abramo, D'Angelo & Solazzi, 2011b), but this has not been confirmed in all fields or regions (Abramo, D'Angelo & Di Costa, 2009; Sooryamoorthy, 2009), and is even a counter-intuitive effect in hyper-authored papers (Franceschet & Constantini, 2010).

Almost all the research on this topic has been undertaken based exclusively on a bibliometric approach, considering output in terms of the number of indexed papers, and quality as represented by the number of citations (Abramo *et al.*, 2011a; Bote *et al.*, 2013; Franceschet & Constantini, 2010). However, a greater number of citations does not necessarily mean better research quality; this is particularly important in the biomedical sciences in which a well-conducted randomized clinical trial is more important and useful than a hundred or thousand clinical case reports (Manterola & Zavando, 2009).

In the biomedical sciences several instruments have been designed to determine research

quality, the most important being the level of evidence (LoE) rankings (Manterola & Zavando, 2009), checklists for reports (Simera, Moher, Hirst, Hoey, Schulz & Altman, 2010), and methodological quality (MQ) scales (Cartes-Velásquez, Manterola, Aravena & Moraga, 2014). These tools offer a novel approach to assess research quality in the context of bibliometric evaluations and its relationship with other concepts in this field, such as research collaboration.

The aim of this preliminary study is to determine the impact of collaboration at the micro (author), meso (institution) and macro (country) levels on the MQ of dental therapy research published in four representative ISI journals.

Methodology

A bibliometric design was implemented to measure the impact of collaboration on the MQ of articles concerning dental therapy in humans published in 2012 and indexed in the category "Dentistry, Oral Surgery and Medicine" of the Science Citation Index Expanded in the Web of Science. This study is a secondary analysis of the previous validation report of MQ for dental therapy research by Cartes-Velásquez *et al*. (2014). The calculation of sample size was undertaken considering a 95% confidence level, one-point accuracy and a 4.9 standard deviation (Manterola, Pineda, Vial & Losada, 2006). Sample size was calculated as 94 and rounded up to 100 articles.

Four representative ISI dental journals were selected according to their general or multi-specialty dental scope (single specialty dental journals were not considered). The selection considered one journal per quartile (Q1 to Q4) according to the Journal Citation Report 2012. The number of articles per journal was proportional to the number of articles in ISI journals for each quartile. Collaboration was measured at three levels: the number of authors, the number of institutions, and the number of countries in the address field. Multiple institutions and/or country affiliations per author were considered.

The MINCIR scale (Manterola *et al.*, 2006) was used to determine the MQ. The scale considers three items: study design, population (amount and justification of sample size), and methodology (objective, design, selection criteria, and sample size calculation). The MINCIR scale has a score range of 6–36 points, with lower scores assigned to poorly reported low-LoE studies, and higher scores assigned to well-reported high-LoE studies. Two evaluators applied the scale independently and consensus was reached with assistance of a third evaluator. The LoE for each article was determined according to the Oxford Center for Evidence-Based Medicine ranking (Zavando & Manterola, 2009).

Data were tabulated on an MS Excel 2003 (Microsoft Corporation, Redmond, USA) spreadsheet and analyzed with STATA 10/SE (STATA Corporation, Texas, USA). Descriptive statistics were calculated and the impact of collaboration on MQ was determined by Pearson correlations and a linear regression model.

Results

One hundred articles were selected, but one article was excluded because it was not on therapy; there was no other therapy research article in the journal to replace it, so the final sample was 99 articles. The journals by quartile and articles selected were as follows: Clinical

Oral Investigations (Q1=30), Oral Surgery Oral Medicine Oral Pathology Oral Radiology and Endodontics (Q2=35), Medicina Oral Patología Oral Cirugía Bucal (Q3=19), and Journal of Dental Sciences (Q4=15). The articles analyzed had a mean of 5.84 ± 2.20 authors, 2.05 ± 1.04 institutions, and 1.19 ± 0.63 countries. Sixty-seven articles (67.68%) related to two or more institutions and 13 articles (13.13%) had affiliations to two or more countries.

There was a positive and significant correlation between MQ and number of authors (r=0.2991; p=0.0026), and between MQ and countries (r=0.2253; p=0.0249), but not MQ and institutions (r=0.1750; p=0.0832). The linear regression model for MQ included number of authors, institutions and countries, and the journal quartile as a confounding variable. The model explains 20.32% of the variance; only the number of authors and journal quartile are significant (Table I).

Discussion

The main rationale employed to support and stimulate collaboration is the intrinsic collaborative nature of research activity and its multiple benefits, such as knowledge sharing, scholarly connectivity, research process acceleration, and others (Bote *et al.*, 2013; Gazni *et al.*, 2012; Lee and Bozeman, 2005). Is supposed that these improvements in the research process should increase the research output and quality, but this correlation is only partially supported by previous research (Abramo *et al.*, 2009; Sooryamoorthy, 2009).

This preliminary study focused on evaluating the impact of collaboration on research quality based on a valid, reliable and *ad-hoc* instrument for dental therapy research (Cartes-Velásquez *et al.*, 2014; Cartes-Velásquez, Manterola, Aravena & Moraga, 2015), which is an advance from the widespread and controversial use of impact factor or number of citations to measure quality (Manterola *et al.*, 2006). However, this is not the first report to use a non-citation-based methodology; previous research has used national peer review exercises to determine the quality of research (Franceschet and Constantini, 2010), which seems to provide an adequate and integral assessment of research, but is costly and lengthy. On the other hand, the use of the MINCIR scale is a relatively simple procedure (Cartes-Velásquez *et al.*, 2014), but useful for only a narrow part of clinical research. This limitation can easily be solved with the use of others tools to assess the quality of biomedical research (Manterola & Zavando, 2009; Simera *et al.*, 2010), covering virtually all kinds of clinical design and specialty. It would even be possible to make comparisons between different tools with the use of normalized ratios.

The results of the study must be analyzed with care, considering the small sample and the little variation in the number of institutions and countries. Despite that, it is interesting to note that the only relevant factor in the correlation and regression analysis is the number of authors, but with a modest impact. An explanation of this exceeds the aim of this preliminary study, but a hypothesis is that methodological quality is a multidimensional concept that relies mainly on the adequate planning and execution of the research (Manterola *et al.*, 2006), giving less importance to physical or economical resources that institutions or countries could share in collaborative projects.

This is a novel approach to assessing the quality of research in the bibliometric field, but has a longer history in the health area with the advent of the evidence-based medicine

paradigm (Manterola & Zavando, 2009). Nowadays, there are several instruments for measuring the quality of health research (Simera *et al.*, 2010), and thus the use of citation counts in this field is to be avoided or at least complemented, preferring instead the use of valid and reliable instruments such as the MINCIR scale (Cartes-Velásquez *et al.*, 2014; Cartes-Velásquez *et al.*, 2015).

Some recommendations for future research in this topic are the use of valid and reliable instruments to evaluate research quality plus peer-assessments, and classify different levels of collaboration, such as: study design, data collection (multicentric studies), data analysis, paper writing or some combinations of these research stages.

Future research should be focused on evaluate the relationship between collaboration and research quality in other fields and type of research, including basic and applied sciences. Currently, there are several guidelines to evaluate the research/report quality in the biomedical sciences, thus the feasibility of this approach is not a problem in this field.

Conclusion.

According to this preliminary results, research collaboration has a little impact on the MQ of dental therapy research published in ISI journals. The number of authors appears as the only relevant factor of this impact.

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Table I

Linear regression model for impact of collaboration on methodological quality of dental therapy research.

Variable	Estimate	Std. Err.	t	p
Authors	0.626	0.270	2.320	0.023
Institutions	0.325	0.621	0.520	0.602
Countries	0.634	1.034	0.610	0.541
Journal-quartile	-1.816	0.559	-3.250	0.002
Constant	11.743	2.359	4.980	0.000