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Are mega-journals a publication outlet for lower quality research? A bibliometric analysis of Spanish authors in *PLOS ONE*

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Abstract

Purpose – Open-access mega-journals (OAMJs), which apply a peer-review policy based solely on scientific soundness, elicit opposing views. Sceptical authors believe that OAMJs are simply an easy target to publish uninteresting papers that would not be accepted in more selective traditional journals. The purpose of this paper is to investigate any differences in scholars' considerations of OAMJs by analysing the productivity and impact of Spanish authors in *Biology and Medicine* who publish in *PLOS ONE*.

Design/methodology/approach – Scopus was used to identify the most prolific Spanish authors in *Biology and Medicine* between 2013 and 2017 and to determine their publication patterns in *PLOS ONE*. Any differences in terms of citation impact between Spanish authors who publish frequently in *PLOS ONE* and the global Spanish output in *Biology and Medicine* were measured.

Findings – Results show a moderate correlation between the total number of articles published by prolific authors in *Biology and Medicine* and the number of articles they publish in *PLOS ONE*. Authors who publish frequently in *PLOS ONE* tend to publish more frequently than average in Quartile 1 and Top 10 per cent impact journals and their articles are more frequently cited than average too, suggesting that they do not submit to *PLOS ONE* for the purpose of gaining easier publication in a high-impact journal.

Research limitations/implications – The study is limited to one country, one OAMJ and one discipline and does not investigate whether authors select *PLOS ONE* for what they might regard as their lower quality research.

Originality/value – Very few studies have empirically addressed the implications of the soundness-based peer-review policy applied by OAMJs.

Keywords Open access, Spain, Mega-journals, *PLOS ONE*

Paper type Research paper

Introduction

Open-access mega-journals (OAMJs) share four main features: a large size in terms of articles published; a broad disciplinary scope; a peer-review policy based solely on scientific soundness; and an OA business model based on authors paying article processing charges. Although Wakeling *et al.* (2016) have shown that there is no such a thing as a typical OAMJ – pinpointing large differences in size and scope of subject among currently existing OAMJs – the four features above may be used to characterise this type of journal.

Spezi *et al.* (2017) have recently published an excellent review of the OAMJ phenomenon organised around the four main features noted above. Readers are referred to that review for further details on the OAMJ phenomenon. After discussing the four features, the review addresses the varied attitudes towards OAMJs in the academic community. Some authors have expressed positive views on OAMJs, arguing that they democratise knowledge by facilitating the publication of methodologically sound papers and allowing the scientific community to determine which are relevant. However, other authors take a more sceptical view and believe OAMJs may simply be a publication outlet for lower quality papers that would not pass the stricter peer-review criteria applied by more selective traditional journals (Tredennick, 2013).

Certainly, some studies suggest that OAMJs have higher acceptance rates than traditional journals. On its website, *PLOS ONE* used to report an acceptance rate of 69 per cent



(Sugimoto *et al.*, 2013; Björk, 2015), although the figure has recently declined to roughly 50 per cent (Davis, 2017). These figures are higher than those observed for traditional journals by Sugimoto *et al.* (2013), who also found a direct correlation between the number of articles published by a journal and its acceptance rate.

Additionally, some publishers seem to have established OAMJs to accommodate manuscripts rejected by their more selective journals in a system described as “cascading reviews”. Thus, Solomon (2014) observed from a survey of authors that nearly half (49.8 per cent) of the articles published in *PLOS ONE* were resubmissions of manuscripts the authors had previously attempted to publish elsewhere.

Despite being a widely criticised proxy for measuring research quality, the impact factor strongly mediates the perception of journal quality. OAMJs perform well in terms of impact factor. *PLOS ONE* and *Scientific Reports*, the largest OAMJs (Wakeling *et al.*, 2016), both have relatively high-impact factors and rank in the first quartile in the “Multidisciplinary sciences” category in the 2016 edition of Journal Citation Reports. Davis (2014) has suggested that the rapid growth of *PLOS ONE* was propelled in large part by having a relatively high-impact factor. Indeed, when surveying authors who had published in four OAMJs, Solomon (2014) observed that the quality of the journal (27.7 per cent) and the impact factor (20.7 per cent) were the most important factors in choosing *PLOS ONE* for publication.

In short, OAMJs may be perceived as an opportunity to publish more easily in a top journal in terms of impact factor. This line of thought can be especially tempting for researchers in countries and institutions where research evaluation is heavily based on bibliometric indicators. This, for instance, is the case with Spain. The Leiden Manifesto for research metrics (Hicks *et al.*, 2015, p. 430) explicitly cites a Spanish law that expresses “the desirability of Spanish scholars publishing in high-impact journals”.

This paper aims to investigate whether any differences in authors’ considerations of OAMJs may be observed by analysing the profile of the most productive authors in a discipline and determining their publication patterns in an OAMJ. If no differences exist in their considerations of OAMJs, one would expect prolific authors to publish a fraction of their total output in an OAMJ that is similar to the fraction of their discipline’s global output appearing in the same OAMJ. Similarly, the most prolific authors in a discipline would be expected to be among the most productive authors in the OAMJ. The paper also aims to determine whether any differences exist between the average citation impact in the discipline and that of the authors who publish frequently in the OAMJ. A lower than average citation impact among frequent authors in the OAMJ would suggest that they submit to the OAMJ to get published more easily in a journal that has a high-impact factor. By contrast, a similar or higher than average citation impact would suggest otherwise.

Specifically, the paper analyses the profile of top Spanish authors publishing in *Biology and Medicine* and compares them to the most productive Spanish authors in an OAMJ: *PLOS ONE*. The journal was chosen as a case study because it has become a typical example of an OAMJ since its launch in 2006. *PLOS ONE* was the largest OAMJ identified in the bibliometric study by Wakeling *et al.* (2016) and, according to Scopus data, it was the most popular publication outlet for Spanish authors in the past five years, accounting for 5,339 articles between 2013 and 2017. The second-most popular publication outlet for authors affiliated with a Spanish institution was another OAMJ, *Scientific Reports*, which published 2,219 articles in the same period. Although we explored the possibility of including *Scientific Reports* in the study, the option was finally discarded since the two journals cover different topics. Even though *PLOS ONE* and *Scientific Reports* claim to cover all scientific disciplines, Wakeling *et al.* (2016) have shown that *PLOS ONE* focusses on life sciences and medicine, whereas *Scientific Reports* publishes a far greater proportion of articles in the physical sciences.

The study is underpinned by three research questions:

- RQ1. To what extent do the most prolific Spanish authors in *Biology and Medicine* publish in *PLOS ONE*?
- RQ2. To what extent does the set of the most prolific Spanish authors in *Biology and Medicine* overlap with that of the most prolific Spanish authors in *PLOS ONE*?
- RQ3. Are there any differences in terms of citation impact between Spanish authors who publish frequently in *PLOS ONE* and the global Spanish output in *Biology and Medicine*?

Methods

In February 2018, we retrieved from Scopus the articles by authors affiliated with Spanish institutions that were published between 2013 and 2017. Other document types, such as reviews, letters, editorials, proceedings, etc., were not considered. Out of the 322,366 articles published in the five-year period, the three most popular subject categories were “Medicine” (88,412 articles), “Biochemistry, Genetics and Molecular Biology” (43,989) and “Agricultural and Biological Sciences” (42,591). The total output in the three subject areas was 145,093 articles, since some articles were simultaneously classified in several categories. For practical purposes, we refer to this set of articles as “Biology and Medicine” throughout the paper.

Using the “Analyse search results” tool provided by Scopus, we identified the 137 most prolific authors, with each author having published at least 80 articles in the five-year period. Affiliation data revealed that some authors were not affiliated with a Spanish institution but had been retrieved because they frequently co-authored publications with researchers who were Spanish-affiliated. The list of prolific authors in *Biology and Medicine* affiliated with a Spanish institution was reduced to 89 authors with at least 80 articles in the five-year period. For each author, we accessed their Scopus profile and retrieved the number of articles published during their scientific career, their h-index and the number of citations received.

As stated above, *PLOS ONE* was the favourite outlet for publication among authors affiliated with Spanish institutions between 2013 and 2017, accounting for 5,339 articles. Scopus classified the 5,339 articles in three subject categories: all were classified in “Agricultural and Biological Sciences” and “Biochemistry, Genetics and Molecular Biology”, while 2,562 were additionally classified in “Medicine”. Again, we used the “Analyse search results” tool to identify the 118 authors with seven or more articles published in *PLOS ONE* in the five-year period between 2013 and 2017. The threshold had to be set at seven articles because the tool ranks only the top 160 authors. Again, some authors were not affiliated with a Spanish institution, but frequently co-authored publications with researchers who were affiliated with a Spanish institution. For the 107 authors affiliated to a Spanish institution, we accessed their Scopus profiles and retrieved the number of articles published during their scientific career, their h-index and the number of citations received. We also refined the search to retrieve their output published between 2013 and 2017, including the number of citations received by each article.

CiteScore is a journal metric based on Scopus data that is similar to the impact factor provided by Clarivate Analytics. The two main differences between the metrics are that CiteScore is based on a three-year citation window and regards all document types as citable items, whereas the impact factor looks only at two years and considers only articles and reviews as such. In order to identify the journals ranked in Quartile 1 and the Top 10 per cent according to their CiteScore, we downloaded the 2016 edition of CiteScore Metrics (version 6 February 2018) from <https://journalmetrics.scopus.com>. Journals classified in several subject areas were considered if ranked in Quartile 1 and/or the Top 10 per cent in at least one of them.

Results

Publication patterns in PLOS ONE for prolific Spanish authors in Biology and Medicine

The publishing behaviour in *PLOS ONE* for the most prolific Spanish authors in *Biology and Medicine* reveals differences among researchers. Figure 1 shows a moderate correlation (Pearson = 0.42) between the number of articles published in the five-year period by researchers with a large output in *Biology and Medicine* (≥ 80 articles between 2013 and 2017) and the number of articles published in *PLOS ONE* in the same period. The figure also reveals that prolific Spanish authors in *Biology and Medicine* do not avoid OAMJs. The overwhelming majority of the researchers have experience of publishing in *PLOS ONE*, with only 9 authors – out of 89 – having never published in it.

Figure 1 shows astonishingly high productivity figures for some authors, with one researcher having published 214 articles in the five-year period and eight between 150 and 200. These figures are heavily influenced by high levels of collaboration: for example, the articles published by the top author have an average of 20 co-authors, and five articles have more than 200 authors each.

Comparison between prolific Spanish authors in Biology and Medicine and prolific Spanish authors in PLOS ONE

We compared the list of the 89 most productive Spanish authors in *Biology and Medicine* between 2013 and 2017 with that of the 107 most productive Spanish authors in *PLOS ONE* in the same period. Combining the two sets resulted in a list of 156 researchers, with 40 appearing in both lists. The circles in Figure 2 proportionally illustrate the size of the two sets and their moderate overlap.

The analysis reveals three different groups of authors. There is a group of 49 (31 per cent) prolific authors (in black in Figure 2) who publish more than 80 articles in the five-year period, but do not publish frequently in *PLOS ONE*. However, as stated above, most members of this group do have experience of publishing in *PLOS ONE*, with only nine having no output published there. The intersection in Figure 2 (in grey) represents a further

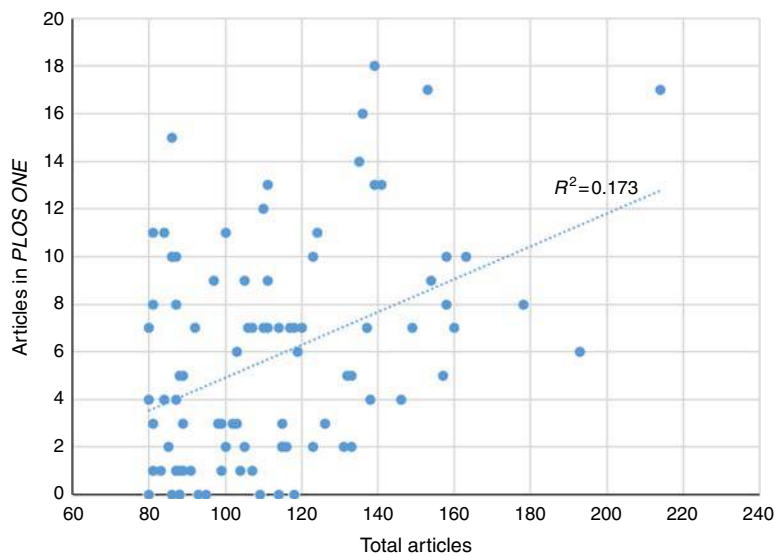


Figure 1. Correlation between total articles and articles in *PLOS ONE* for prolific Spanish authors in *Biology and Medicine* (2013–2017)

Note: $n = 89$

group of 40 (26 per cent) prolific authors in *Biology and Medicine* who also publish frequently in *PLOS ONE*, i.e., seven or more articles in the five-year period.

Finally, the largest set contains 67 (43 per cent) authors who are not among the most prolific Spanish authors in *Biology and Medicine* but do publish frequently in *PLOS ONE* (in white in Figure 2). A possible explanation for the existence of this group would be that its authors do not specialise in *Biology and Medicine*, but do publish in *PLOS ONE* because one of the features of an OAMJ is its large subject scope. However, an analysis of the individual profiles of the authors in Scopus says otherwise. The most frequent subject area for the outputs published by the 67 authors was either “Agricultural and Biological Sciences”, “Biochemistry, Genetics and Molecular Biology” or “Medicine”, i.e., the three subject areas in which *PLOS ONE* articles are classified by Scopus. Only five authors had published most of their output in other areas: one in “Immunology and Microbiology”, two in “Psychology” and two in “Veterinary”.

Table I compares the output and citation impact of the three groups of authors identified in Figure 2, leaving aside the five authors specialising in areas other than *Biology and Medicine*. The data refer to their whole scientific careers and were obtained from their profiles in Scopus. Prolific authors in *PLOS ONE* who are not among the most prolific authors in *Biology and Medicine* (third column) show a smaller output and less impact in terms of citations than prolific authors in *Biology and Medicine* – both those who do not publish frequently in *PLOS ONE* (first column) and those who do (second column).

Citation impact of prolific Spanish authors in PLOS ONE

This section focusses on the analysis of the output of the 102 most prolific Spanish authors in *PLOS ONE*, leaving aside the five authors specialising in areas other than *Biology and Medicine*. The purpose is to understand the extent to which these authors publish frequently in high-impact journals and *PLOS ONE* is merely one of their publication outlets, or whether they could be using *PLOS ONE* as an easier target for publication in a high-impact journal.

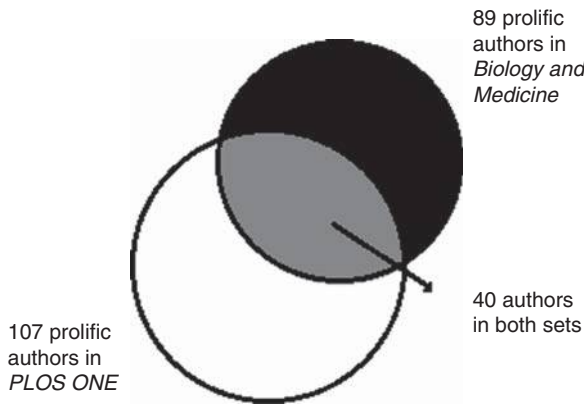


Figure 2. Overlap between the sets of prolific Spanish authors in *Biology and Medicine* and prolific Spanish authors in *PLOS ONE* (2013–2017)

	Prolific authors in <i>Biology and Medicine</i> not prolific in <i>PLOS ONE</i> (<i>n</i> = 49)	Prolific authors in <i>Biology and Medicine</i> also prolific in <i>PLOS ONE</i> (<i>n</i> = 40)	Prolific authors in <i>PLOS ONE</i> but not prolific in <i>Biology and Medicine</i> (<i>n</i> = 62)
Median articles	398 (IQR = 260)	426 (IQR = 267)	150 (IQR = 131)
Median h-index	55 (IQR = 28)	57 (IQR = 31)	27 (IQR = 19)
Average citations per article	37.3	33.0	24.0

Table I. Output and citation impact of Spanish prolific authors in *Biology and Medicine* and in *PLOS ONE*

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Table II compares the total Spanish output in *Biology and Medicine* between 2013 and 2017 with the output of the 102 Spanish prolific authors in *PLOS ONE* in the same period. Over the five years, *PLOS ONE* published 3.7 per cent of the Spanish output in *Biology and Medicine*, although the figure may include articles in other disciplines that were automatically classified by Scopus in *Biology and Medicine*. In the same period, the 102 most prolific Spanish authors in *PLOS ONE* published 9.7 per cent of their output in the OAMJ.

Over the five years, 54 per cent of Spanish articles in *Biology and Medicine* appeared in journals ranked in Quartile 1 of their discipline according to their CiteScore and 32 per cent appeared in journals ranked in the Top 10 per cent. Among the 102 most prolific Spanish authors in *PLOS ONE*, the percentages rise to 64 per cent of articles appearing in journals ranked in Quartile 1 and 38 per cent appearing in Top 10 per cent journals. The percentages exclude articles published in *PLOS ONE* that rank in Quartile 1 in three of their subject areas and among the Top 10 per cent in two of them.

We also compared the citation impact of the two sets of articles. According to the results, Spanish articles in *Biology and Medicine* published between 2013 and 2017 had received, on average, 8.4 citations per article at the time of data collection (median = 3), whereas articles by prolific authors in *PLOS ONE* had received, on average, 13.4 citations per article (median = 5). Nearly one-quarter (24.9 per cent) of the Spanish output in *Biology and Medicine* published between 2013 and 2017 had not yet been cited at the time of data collection, whereas the percentage only reached 14.8 per cent among prolific authors in *PLOS ONE*.

Figure 2 and Table I show that the set of Spanish prolific authors in *PLOS ONE* comprises two groups: prolific authors in *Biology and Medicine* who also publish frequently in *PLOS ONE*, and those who are not among the most prolific authors in *Biology and Medicine* but publish frequently in *PLOS ONE*. Table III compares the output and citation impact of these two groups of authors, breaking down the results in the last column of Table II.

Table II.
Spanish output in *Biology and Medicine* and output of prolific Spanish authors in *PLOS ONE* (2013–2017)

	<i>Biology and Medicine</i>		Prolific authors in <i>PLOS ONE</i> (n = 102)	
	n	%	n	%
Articles	145,093	100	6,101	100
Articles in <i>PLOS ONE</i>	5,339	3.7	593	9.7
Articles in CiteScore Quartile 1 (excluding <i>PLOS ONE</i>)	78,137	54	3,926	64
Articles in CiteScore Top 10% (excluding <i>PLOS ONE</i>)	45,828	32	2,310	38
Average citations per article	8.4 (SD = 27.0)		13.4 (SD = 55.9)	
Median citations	3 (IQR = 8)		5 (IQR = 11)	
Articles with 0 citations	36,115	24.9	903	14.8

Table III.
Output and citation impact of Spanish prolific authors in *Biology and Medicine* and in *PLOS ONE* (2013–2017)

	Prolific authors in <i>Biology and Medicine</i> also prolific in <i>PLOS ONE</i> (n = 40)		Prolific authors in <i>PLOS ONE</i> but non-prolific in <i>Biology and Medicine</i> (n = 62)	
	N	%	n	%
Articles	3,968	100	2,812	100
Articles in <i>PLOS ONE</i>	268	6.8	423	15.0
Articles in CiteScore Quartile 1 (excluding <i>PLOS ONE</i>)	2,695	68	1,707	61
Articles in CiteScore Top 10% (excluding <i>PLOS ONE</i>)	1,654	42	943	34
Average citations per article	15.9 (SD = 68.2)		10.3 (SD = 38.1)	
Median citations	6 (IQR = 12)		5 (IQR = 11)	
Articles with 0 citations	552	13.9	425	15.1

However, the sum of the articles published by both groups in Table III is higher than the figure shown in Table II because some articles were written in collaboration by authors pertaining to both groups.

Table III reveals differences between prolific authors in *Biology and Medicine* and those just prolific in *PLOS ONE*. The former group tends to publish more, but do not use *PLOS ONE* so frequently as a publication outlet. Over the five-year period, they published 6.8 per cent of their output in *PLOS ONE* – well below the rate of 15 per cent observed among prolific authors in the OAMJ.

In these five years, 68 per cent of the articles by prolific authors in *Biology and Medicine* were published in journals ranked in Quartile 1 of their discipline according to their CiteScore, and 42 per cent in journals ranked in the Top 10 per cent. These percentages fell to 61 and 34 per cent among prolific authors in *PLOS ONE*, though these rates are still higher than those observed for the whole of Spanish output in *Biology and Medicine*.

In terms of citation impact, articles by prolific authors in *Biology and Medicine* published between 2013 and 2017 had received, at the time of data collection, an average of 15.9 citations per article (median = 6); 13.9 per cent of the articles had not yet been cited. In the case of prolific authors in *PLOS ONE*, their output had received an average of 10.3 citations per article (median = 5), and 15.1 per cent of the articles had not been cited. Again, these figures are better than those recorded for the whole Spanish output in *Biology and Medicine*.

Discussion and conclusions

There are opposing views on the peer-review policy applied by OAMJs. Spezi *et al.* (2017, p. 264) reported that some authors believe the policy facilitates the publication of methodologically sound papers whose scientific relevance will be determined by readers, whereas other authors are more sceptical and believe that OAMJs might simply be an easy target to publish less interesting papers that would not be accepted in more selective traditional journals. An OAMJ might then become an attractive option for authors whose research is evaluated using bibliometric indicators, since some OAMJs perform well on impact metrics.

In order to investigate any differences in scholars' considerations of OAMJs, we identified the most prolific Spanish authors in *Biology and Medicine*, compared them with the set of the most prolific Spanish authors in an OAMJ and contrasted the citation impact of the most productive Spanish authors in the OAMJ with the global Spanish citation impact in the discipline.

Results show a moderate correlation between the total number of articles published by prolific Spanish authors in *Biology and Medicine* and the number of their articles in *PLOS ONE*. A comparison of the set of prolific authors in *Biology and Medicine* with that of prolific authors in *PLOS ONE* reveals three different sets of researchers. The first group of prolific authors does not publish frequently in *PLOS ONE*. However, results show that they do not avoid the OAMJ and nearly all of them have experience of publishing in it. This suggests that the journal is established among consolidated scientists as a usual publication outlet. A second set of prolific Spanish authors also publishes frequently in *PLOS ONE*, reinforcing the previous conclusion. Finally, the authors in the third set are not among the most prolific Spanish authors in *Biology and Medicine*, but do publish frequently in *PLOS ONE*. This set does not include authors in fields other than *Biology and Medicine* who could submit to *PLOS ONE* because of its multidisciplinary scope. Indeed, most of them do publish in *Biology and Medicine*, confirming the life sciences focus of the journal (Wakeling *et al.*, 2016). Prolific Spanish authors in *PLOS ONE* who are not among the most prolific authors in *Biology and Medicine* exhibit a smaller output and impact than prolific authors in the discipline, both those who do not publish frequently in *PLOS ONE* and those who do.

In terms of citation impact, authors who publish frequently in *PLOS ONE* tend to publish more frequently than average in Quartile 1 and Top 10 per cent impact journals. Their articles are also more frequently cited than average, suggesting that they do not need to submit to *PLOS ONE* to gain easier publication in a high-impact journal, but simply see *PLOS ONE* as another publication outlet. To some extent, these differences are distorted by the presence among *PLOS ONE* prolific authors of a set of prolific authors in *Biology and Medicine* who exhibit a greater tendency to publish in Quartile 1 and Top 10 per cent impact journals. However, even after removing this set of researchers, the citation impact of prolific authors in *PLOS ONE* remains higher than that of the total Spanish output in *Biology and Medicine*.

OAMJs show higher acceptance rates than traditional journals (Sugimoto *et al.*, 2013; Björk, 2015) and may be perceived as an opportunity to publish more easily in a top journal in terms of impact factor. This trend is especially notable in countries, such as Spain, where evaluation policies incentivise publication in high-impact journals (Hicks *et al.*, 2015). However, our results do not seem to support this hypothesis, since prolific authors in *PLOS ONE* tend to publish more frequently than average in Quartile 1 and Top 10 per cent impact journals. Their articles are also more frequently cited than average.

Another issue of concern is whether prolific authors in *PLOS ONE* are prolific precisely as a result of the OAMJ's peer-review policy, which allows them to publish articles that would not get published in other outlets. Again, the fact that prolific authors in *PLOS ONE* have a higher than average citation impact does not seem to support this hypothesis.

The study suffers from several limitations. It is limited to a single country and a single OAMJ and the results can hardly be generalised. Another limitation lies in the disciplinary scope of the study. The fact that Scopus indiscriminately classifies all *PLOS ONE* articles in *Biology and Medicine* implies a distortion, given the broad disciplinary scope of a journal that publishes articles in many other disciplines. Additionally, our study focusses on prolific authors and most of their articles were written in collaboration, so we do not know the extent to which the authors we have analysed are responsible for choosing the journal for manuscript submission.

Björk and Catani (2016) compared the citation distributions for articles in traditional journals and in OAMJs and found that elite journals with very low acceptance rates had far fewer articles with no or few citations. However, the long tail of articles with two citations or fewer was actually bigger in a sample of selective traditional journals compared to OAMJs. Instead of comparing journals, our study analysed the citation impact of prolific authors in one OAMJ and compared it to the global citation impact in the discipline. Results show that frequent Spanish authors in *PLOS ONE* have a larger than average citation impact in *Biology and Medicine*, reinforcing the idea that they do not need to submit to *PLOS ONE* for the purpose of publishing in a high-impact journal. However, our results do not investigate whether authors select *PLOS ONE* for what they might consider their lower quality papers. This question will require further investigation using participatory research methods such as surveys and interviews.

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