Methodological Bias in the Clarivate Highly Cited Researchers List: International Comparisons and the Case of Portugal

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Abstract

The annual list of Highly Cited Researchers (HCR), published by Clarivate Analytics, is widely used as an indicator of scientific excellence and institutional prestige. However, growing evidence suggests that the methodology underlying this ranking contains significant structural limitations that may distort the measurement of research influence. This paper critically examines the methodological foundations of the HCR list and evaluates their implications for international comparisons of scientific performance. Using Portugal as an illustrative case study, the analysis reveals substantial inconsistencies when HCR results are compared with those obtained from the Stanford Scientists Ranking. Evidence from the scientometric literature—together with empirical comparisons involving Nobel laureates—suggests that the HCR list may systematically misrepresent scientific influence across countries and disciplines. The findings indicate that, unless substantial methodological reforms are implemented, the HCR list will continue to distort assessments of scientific excellence and may influence global university rankings that rely on it as a key indicator.

Keywords: Highly Cited Researchers; Bibliometrics; Fractional Counting; Scientific Impact Assessment; Stanford Scientists Ranking

1. Methodological Weaknesses of the Clarivate Highly Cited Researchers List

Each year, Clarivate publishes its list of Highly Cited Researchers (HCR), a ranking intended to identify scientists whose publications fall within the top 1% of citations in their respective fields. Universities, policymakers, and media outlets frequently cite the list as a proxy for scientific excellence

and global research influence. Despite its visibility and apparent authority, however, closer scrutiny of its methodological foundations reveals several weaknesses that raise significant concerns about its reliability as an indicator of individual scientific impact. A central limitation lies in the ranking's reliance on raw citation counts within predefined disciplinary categories combined with the use of whole counting for multi-authored publications. Under this approach, every co-author of a highly cited article receives full credit regardless of the number of contributors. In fields characterized by very large research collaborations—such as certain areas of biomedical science or particle physics—hundreds of researchers may therefore receive identical credit for a single publication. The absence of fractional counting can substantially inflate the apparent influence of individuals and institutions associated with large collaborative networks. Consequently, the ranking risks rewarding structural advantages related to collaboration size and publication practices rather than accurately reflecting intellectual leadership or individual scientific contributions. A further methodological concern relates to disciplinary comparability. Citation practices vary widely across fields due to differences in publication frequency, collaboration patterns, and research culture. Disciplines such as biomedical sciences or chemistry typically produce very large volumes of citations, whereas fields such as mathematics, engineering, or some areas of physics accumulate citations at a slower pace. Although the HCR methodology applies citation thresholds within fields, it does not fully address structural differences in citation behavior. Moreover, aggregating broad domains—such as the social sciences or engineering—under a single indicator obscures important internal variation. Empirical studies demonstrate, for example, that biological engineering generally generates substantially higher citation counts than civil engineering, reflecting distinct publication and citation patterns even within engineering itself (Lillquist & Green, 2010). In response to criticism regarding disciplinary bias, Clarivate introduced a "Cross-Field" category intended to capture interdisciplinary influence. While this modification acknowledges the limitations of strictly disciplinary classifications, it does not fundamentally resolve the underlying methodological problems. The approach still fails to adequately

normalize for differences in citation density and collaboration structures across scientific domains.

The instability of the ranking criteria has also been highlighted in the scientometric literature. Jesús Docampo and Lawrence Cram (2019) show that the procedures used to identify Highly Cited Researchers have evolved over time, shifting from relatively simple citation totals toward more complex metrics based on counts of highly cited papers normalized by disciplinary practices. Such methodological changes can significantly alter which researchers qualify for the list, indicating that inclusion may depend partly on adjustments to the evaluation rules rather than solely on stable measures of research impact. Related concerns have been raised by Aksnes and Aagaard (2021), who demonstrate that the composition of the HCR list is highly sensitive to the method used to allocate credit for multi-authored publications. Because the ranking relies on whole counting, researchers involved in large collaborative projects may appear disproportionately influential. Their analysis shows that adopting fractional counting—where credit is divided among co-authors—would produce substantially different rankings, thereby raising serious questions about the robustness and interpretability of the current methodology. More forceful criticism has been articulated by Chaignon et al.,(2023), who argue that the HCR methodology tends to overlook transformative contributions emerging from unconventional or rapidly developing areas of research. A frequently cited example concerns Alain Aspect, whose pioneering experimental work on quantum entanglement fundamentally reshaped modern physics and led to his receipt of the Nobel Prize in Physics in 2022. Despite the profound influence of his research, Aspect was not included in the HCR list. The absence of a scientist of such stature highlights the limitations of a ranking that claims to identify the world's most influential researchers. Additional empirical evidence reinforcing these criticisms comes from a study published in Scientometrics by researchers from the Fraunhofer Institute for Systems and Innovation Research and the Max Planck Society. Their analysis systematically compares the HCR list with other indicators of scientific excellence. One particularly striking finding is that the HCR ranking includes only about 10% of scientists who have received a Nobel Prize. In other words, roughly 90% of Nobel laureates—

widely recognized as representing the highest level of scientific achievement—do not appear in the list (Frietsch et al., 2025). Such a discrepancy raises fundamental questions about the capacity of the HCR methodology to capture truly outstanding scientific contributions. A revealing comparison can be made with the Stanford Top 2% Scientists Ranking, which adopts a more comprehensive bibliometric methodology (Ioannidis et al., 2019). This ranking incorporates several safeguards designed to address key limitations present in the HCR approach. First, it implements rigorous author disambiguation procedures to ensure that publications and citations are accurately attributed to individual researchers rather than conflating authors with similar names. Second, it excludes self-citations, thereby reducing the possibility that citation counts are artificially inflated through strategic referencing practices. Third, and most importantly, it employs fractional counting to allocate credit among co-authors, ensuring that the contribution assigned to each researcher reflects the scale of the collaboration. These methodological features produce a more balanced and reliable representation of individual scientific contributions. Notably, empirical comparisons indicate that the Stanford ranking identifies more than 90% of Nobel laureates, a striking contrast with the much lower coverage observed in the HCR list. This difference strongly suggests that methodological rigor—particularly the use of fractional counting, exclusion of self-citations, and improved author disambiguation—substantially enhances the ability of bibliometric indicators to capture genuine scientific excellence.

2. Implications for International Comparisons and University Rankings

The implications of these methodological limitations extend well beyond a purely academic debate about bibliometric indicators. Paheco Torgal (2024a) illustrates this point using the case of Portugal as a particularly revealing example of how the Highly Cited Researchers list can misrepresent national scientific performance and distort international comparisons. The 2024 edition of the ranking provides a revealing illustration. According to Clarivate, both Portugal and Norway are credited with 18 Highly Cited Researchers. At first glance, this figure might suggest that the two countries display a comparable

level of scientific influence. However, when the same countries are evaluated using the Stanford Top Scientists Ranking—particularly its Top 0.5% subset representing the most influential researchers globally—the picture changes dramatically. In that ranking, Norway exhibits roughly a 500% advantage over Portugal in the number of researchers belonging to this elite group. Such a pronounced discrepancy strongly suggests that the methodology used in the Clarivate list may produce results that diverge substantially from other, arguably more robust, measures of scientific influence. The broader significance of this issue becomes clearer when considering the role that the HCR list plays in global university rankings. One of the most prominent examples is the Academic Ranking of World Universities (ARWU), which incorporates the number of Highly Cited Researchers affiliated with an institution as a key performance indicator. Consequently, methodological shortcomings in the HCR list can directly affect the perceived prestige and international standing of universities and national research systems. In practice, many institutions devote considerable resources to recruiting or affiliating researchers who appear in the HCR list precisely because such affiliations can improve their positions in global rankings. If the HCR list were revised to incorporate methodological safeguards such as fractional counting and more rigorous cross-disciplinary normalization—similar to the approach adopted in the Stanford Top 2% Scientists Ranking—the consequences for global academic rankings could be substantial. Many universities would likely experience significant shifts in their relative positions, and the international distribution of highly cited researchers might change considerably. In particular, the current dominance of certain countries in citation-based rankings could be notably reduced. This issue is explored in greater detail by Pacheco Torgal (2024b), who examined which countries would be most affected if Clarivate were to revise the relatively permissive criteria underlying its Highly Cited Researchers list. The study compared the seven countries with the largest number of HCRs reported by Clarivate with the proportion of researchers from those same countries appearing in the Top 0.5% of the Stanford Scientists Ranking, using both the annual and career-long datasets (Table 1).

Rank	Country	Clarivate HCR Share (%)	Stanford Ranking (Annual) (%)	Stanford Ranking (Career) (%)
1	United States	36	40	50
2	China	20	9	2
3	United Kingdom	8	10	10
4	Germany	5	5	5
5	Australia	5	4	3
6	Canada	3	4	5
7	Netherlands	3	2	2

Table 1 – Comparison of national shares of HCR across the seven leading countries reported by Clarivate and those represented in the Top 0.5% of the Stanford Scientists Ranking

The results suggest that adopting criteria similar to those used in the Stanford ranking would substantially alter the current global distribution of highly cited researchers. In particular, the share attributed to China would decline dramatically—from approximately 20% of the total HCR population to roughly 2% when evaluated under the more stringent Stanford methodology. Such a shift would likely have significant implications for the international standing of Chinese universities, especially within rankings such as the ARWU, which rely in part on the number of highly cited researchers as an important performance indicator. Ultimately, the issue raised by these findings is not merely technical but also ethical. Bibliometric rankings exert considerable influence over funding decisions, institutional strategies, and public perceptions of scientific achievement. When such rankings are constructed using flawed or insufficiently robust methodologies, they risk misrepresenting the true structure of global scientific performance. Improving the HCR list by incorporating fractional counting, rigorous author disambiguation, and more balanced disciplinary normalization would therefore represent an important step toward enhancing its credibility and analytical value. Until such reforms are implemented, however, the HCR list should be interpreted with considerable caution. The case of Portugal—together with broader evidence drawn from Nobel laureates and alternative

bibliometric rankings—demonstrates that the current methodology does not adequately capture the complex and multifaceted nature of scientific excellence. A ranking that fails to identify the majority of the world's most celebrated scientists can hardly claim to provide a definitive measure of the most influential researchers in the global scientific community.

Conclusion

The analysis presented in this paper shows that the Highly Cited Researchers list produced by Clarivate suffers from important methodological limitations that weaken its reliability as an indicator of scientific excellence. Three core issues appear particularly significant. First, the absence of fractional counting inflates the credit attributed to researchers involved in large collaborative projects, thereby favoring disciplines and research environments characterized by extensive co-authorship. Second, the reliance on citation thresholds within broad disciplinary categories introduces persistent structural biases that advantage certain fields of science over others. Third, insufficient safeguards against self-citation and potential problems of author identification further reduce the robustness of the ranking.

Empirical evidence reinforces these concerns. The fact that the HCR list includes only about 10% of scientists who have received a Nobel Prize suggests that the ranking fails to identify many of the world's most influential researchers. In contrast, the Stanford Scientists Ranking—which incorporates fractional counting and additional methodological safeguards—captures more than 90% of Nobel laureates, indicating a much stronger capacity to reflect widely recognized scientific impact. The implications of these methodological shortcomings extend beyond technical debates in bibliometrics. The HCR list is incorporated into influential global university rankings such as the Academic Ranking of World Universities, meaning that any biases embedded in its methodology directly affect the perceived prestige and comparative standing of universities and national research systems. As a consequence, methodological weaknesses in the HCR list may inadvertently distort institutional strategies, resource allocation, and public perceptions of scientific achievement.

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