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# Do Citations Reflect Online Influence? A Bibliometric and Altmetric Analysis of Randomised Controlled Trials in Total Hip Arthroplasty

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## Abstract

# Purpose

This study aimed to identify the most influential randomised controlled trials (RCTs) in total hip arthroplasty (THA) from the past decade and examine the relationship between bibliometric and altmetrics.

# Methods

Web of Science was searched between January 2016 to January 2026. Bibliometric and altmetric data were analysed. Citations and AAS were compared across journal impact factors (IF) quartiles. RCTs were analysed by country of origin and journal to identify the leading geographical contributors and journals.

# Results

There were 285 RCTs across 104 journals. Median citation count was 10 (IQR 4–23). Median AAS was one (IQR 0–4). No online attention was recorded for 115 RCTs (40.4%). Citations moderately correlated with AAS ($\rho = 0.483$, $P < 0.001$). Only six RCTs appeared in both top 20 lists. The most cited were older (median 2017 vs. 2020). Journal IF correlated positively with AAS ($\rho = 0.351$) and citations ($\rho = 0.311$). China (17.0%) and the United States (9.9%) occurred the most. The *Journal of Arthroplasty* published the most (n = 37).

# Conclusion

Among RCTs in THA published over the past decade, citations and online attention were moderately correlated. The top 20 contained largely different sets of RCTs. Online attention was mostly driven by activity on X and was greater for RCTs which were published in high impact journals. Altmetrics can be used as a complementary measure of broader dissemination and public engagement of THA research. However, the score itself may need updating to incorporate modern drivers of online attention.

## Introduction

Total hip arthroplasty (THA) is widely regarded as one of the most successful orthopaedic procedures with over 100,000 procedures performed per year in the United Kingdom (UK) [1, 2], [3]. Given the growing volume of THA performed annually, identifying and understanding the research that most influences the academic community, and the wider public discourse is increasingly important. Bibliometric and altmetric measures provide complementary assessments of research impact.

Bibliometrics have long been used to evaluate impact and influence of scientific publications through citation-based metrics [4]. However, traditional bibliometric measures are limited by their focus on scholarly citations which require increased time periods to accumulate, potentially underestimating the immediate dissemination and impact of a publication [5]. In recent years, scientific communication has extended beyond its conventional channels to online platforms such as social media outlets, and blogs. The accessibility and speed of dissemination on these platforms have allowed new avenues of engagement with scientific literature. Altmetric analysis, introduced in 2011, quantifies attention received by online publications on digital platforms such as X and Facebook, [6]. Unlike citations, altmetric capture dissemination beyond academia including clinicians, patients, policymakers and the media. Therefore, the combined use of bibliometric and altmetric analysis may provide a more holistic assessment of both scholarly influence and public dissemination.

The purpose of this study was to establish the most influential randomised controlled trials (RCT) in THA and to examine the relationship between traditional bibliometrics and altmetrics, thereby evaluating whether academic influence is reflected by broader digital dissemination along with public attention. It was hypothesised that citation based and altmetric measures would correlate moderately, which would capture related but distinct dimensions of research impact.

## Materials and Methods

# Search Strategy

A comprehensive literature search was conducted to identify RCTs pertaining to THA. Bibliometric data was acquired from the Web of Science (WoS) database. The altmetric explorer was used to collect online attention metrics. The search was restricted to a 10-year window (01-01-2016 to 01-01-2026) to ensure adequate availability and comparability of altmetric data. The following Boolean search string was used in the WoS:

AB=(("total hip arthroplasty*" OR "total hip replacement*" OR "THA" OR "THR" OR "hip arthroplasty*" OR "hip replacement*") AND ("randomized controlled trial*" OR "randomised controlled trial*" OR "RCT" OR "controlled trial*" OR "clinical trial*") NOT ("knee" OR "TKA" OR "TKR" OR "total knee"))

## Eligibility Criteria and Screening

WoS index restrictions included were article only and sorted by highest citation first. Documents were exported from WoS with all relevant data points. Records retrieved from WoS were screened manually against predefined eligibility criteria. Titles and abstracts were reviewed and records that were ineligible were excluded. The remaining records were then assessed in detail against the full eligibility criteria. Full text reviews were undertaken where the abstract did not provide sufficient information.

Inclusion criteria RCTs were eligible for inclusion if they were: (1) RCTs evaluating adult patients undergoing THA, (2) published between 1 January 2016 and 1 January 2026, (3) Available in full text in English.

Exclusion criteria RCTs were excluded if they were: (1) not primary RCTs, this included meta-analyses, narrative reviews, cohorts, retrospective, cross sectional or observational studies, case studies, surveys, secondary/*post hoc* analysis and reports, (2) Pilot and feasibility studies which assessed the recruitment or feasibility rather than the clinical outcomes along with revisions THA were excluded, (3) RCTs not pertaining to THA were excluded including, total knee arthroplasty, hemiarthroplasty, hip resurfacing, hip arthroscopy, and hip osteonecrosis that was not managed with arthroplasty, were not included, (4) Trial protocols or statistical analysis plans with no clinical outcome data.

## Altmetric Extraction

The altmetric explorer advanced search was used to retrieve altmetric data. The list of DOI's were input using the "Search by scholarly identifiers" function, this ensured the altmetric dataset comprised of the same set of RCTs as the bibliometric dataset. The altmetric attention score (AAS) and the individual components which contributed to that score were recorded. This included mentions in news outlets, blogs, X (formerly Twitter), Facebook, Wikipedia, and other tracked sources along with number of Mendeley readers. All altmetric data were extracted on a single date, 1 July 2026, to provide a consistent cross-sectional snapshot, as the AAS accumulates over time.

## Data Extraction

Bibliometric and alternative metric data were systematically extracted for each included study. The following bibliometric parameters were recorded as follows: (1) total citations, (2) citation density, (3) authors, (4) title, (5) year of publication, (6) source journal of article, (7) article type (therapeutic study, prognostic study, diagnostic study, economic study, or controlled laboratory study). Altmetric details recorded were (1) AAS, (2) Altmetric source category, (3) geographical breakdown, (4) demographic breakdown, and (5) mentions per journal.

Corresponding author country and institution were extracted from the reprint address from each of the RCTs WoS record (matched by DOI; available for 283 of the 285 RCTs), The most frequent countries and institutions were represented.

## Metric Calculation

The AAS is a proprietary weighted index which is provided by (www.altmetric.com**).** Derived based on three primary factors (1) volume, in which the more mentions the study receives, the higher the score, and only one mention from each person per source is counted; (2) sources, wherein each category of

mention contributes a base weight; and (3) authors, in terms of how often the authors mention scholarly content, bias, and who the audience is. Citation density was calculated by dividing total citations by number of years since publication.

# Data Analyses

All analysis was performed using Jamovi (version 2.7). Continuous variables were reported as median and interquartile range (IQR) as a result. The Spearman rank coefficient (ρ) was used to assess the relationship between bibliometric and altmetric impact. Spearman was used based on its suitability to skewed, non-parametric data. Spearman correlations were then used to examine the correlations between the AAS and total citations, citation density, year of publication and number of authors along with associations with AAS and its individual source components (news, X, blog, policy, and Mendeley mentions). Correlation strength was interpreted according to the benchmarks described in Correlation Coefficients: Appropriate Use and Interpretation [7], whereby coefficients of 0.10–0.39 represent a weak, 0.40–0.69 a moderate, 0.70–0.89 a strong and 0.90–1. 00 a very strong correlation. Differences in AAS across source journals were assessed using the Kruskal Wallis test. A two tailed p value < 0.05 was considered statistically significant.

## Results

The literature search identified 642 records. There were 269 records excluded by title and abstract and a further 88 were excluded following a full text assessment against the eligibility criteria. Thus, leaving 285 THA RCTs for inclusion.

## Journal Characteristics

The 285 included RCTs were published across 104 journals. The most represented journals were the *Journal of Arthroplasty (*n = 37), *Hip International* (n = 20), *Acta Orthopaedica (n = 17)*, the *Bone & Joint Journal (*n = 16), and the *Journal of Bone and Joint Surgery (American volume)* (n = 12), followed by *Clinical Orthopaedics and Related Research, BMC Anaesthesiology*, and *International Orthopaedics* (n = 9 each). A further 67 journals (64.4%) contributed a single RCT and 16 journals contributed two. The ten most frequent journals accounted for just under half of the journal level cohort (142/285, 49.8%) and the five most frequent accounted for just over a third (102/285, 35.8%).

# Citation Characteristics

Across the 285 included RCTs, the median number of WoS citations was 10 (IQR 4–23, range 0-160) [10]. The highest citation density was 23.17, with the median citation density being 1.83 citations per year (IQR 0.83–3.50). The median number of authors was 6 (IQR 5–7, range 2–26), and the median year of publication was 2021.

# Altmetric Characteristics, Fig. 1,2

The median AAS was 1 (IQR 0–4, range 0-209). With 115 of the 285 RCTs (40.4%) having no recorded online attention and were therefore assigned an AAS of zero. There was 170 (59.6%) with a recorded AAS. Within the non-zero AAS RCTs (n = 170), the strongest contributor to the overall AAS was activity on X (formerly Twitter) (ρ = 0.608, *P* < 0.001), followed by news mentions (ρ = 0.410, *P* < 0.01), Mendeley readership (ρ = 0.366, *P* < 0.01), blog mentions (ρ = 0.307, *P* < 0.01), and policy mentions (ρ = 0.259, *P* < 0.01). Online attention was geographically concentrated in several countries, led by the UK (20.3%), the United States (US) (11.7%) and Spain (5%) (Fig. 2).

# Correlation Analyses, Table 1, Fig. 3

A statistically significant positive correlation was observed between total citations and AAS (Spearman's ρ = 0.483, *P* < 0.001), representing a moderate association between heavily cited RCTs attracting greater online attention. A moderate positive correlation was also identified using citation density AAS (ρ = 0.402, *P* = 0.001). Both total citations (ρ = -0.679, *P* < 0.001) and AAS (ρ = − 0.401, *P* < 0.001) were both negatively correlated with year of publication, this reflects the accumulation of citations and online attraction over time. The number of authors was only weakly associated with both AAS (ρ = 0.188, *P* = 0.001) and citations (ρ = 0.126, *P* = 0.034).

Table 1
Spearman correlation matrix. Citation density, year, number of authors, and AAS.

| | | Citations_WoS | Citation_Density | Year | Num_Authors |
|---|---|---|---|---|---|
| Citation_Density | Spearman's rho | 0.905 | — | | |
| | df | 281 | — | | |
| | p-value | < 0.001 | — | | |
| Year | Spearman's rho | -0.679 | -0.337 | — | |
| | df | 281 | 281 | — | |
| | p-value | < 0.001 | < 0.001 | — | |
| Num_Authors | Spearman's rho | 0.126 | 0.209 | 0.079 | — |
| | df | 281 | 281 | 281 | — |
| | p-value | 0.034 | < 0.001 | 0.186 | — |
| AAS | Spearman's rho | 0.483 | 0.402 | -0.401 | 0.188 |
| | df | 283 | 281 | 281 | 281 |
| | p-value | < 0.001 | < 0.001 | < 0.001 | 0.001 |

# Journal Impact Factor Analysis Fig. 4, Table 2,3

Journal impact factor (IF) showed a significant positive correlation with both AAS (ρ = 0.351, $P < 0.001$) and total citations (ρ = 0.311, $P < 0.001$). The median journal IF across the cohort was 3.2 (IQR 2.2–4.4, range 0.3–84.5). Both AAS and citations differed across quartiles significantly (Kruskal – Wallis AAS $\chi^2 = 23.4$, df = 3, $P < 0.001$; citations $\chi^2 = 29.7$, df = 3, $P < 0.001$), which follows a clear incline. Median AAS fell from 2 in Q1(n = 162) to 1 in Q2 (n = 59) to 0 in both Q3 (n = 51) and Q4 (n = 11). The median citations fell from 14 in Q1 to 9, 5 and 2 in Q2-Q4 with the highest attention outliers concentrated in Q1 journals, (Fig. 4). Six RCTs appeared in both 20 most cited and the 20 highest AAS cohorts, this indicates only partial overlap between academic and online influence (Table 2,3).

Table 2
Top 20 THA RCTs by Web of Science citations

| Rank | First author (year) | Citations | AAS | In top 20 AAS? |
|---|---|---|---|---|
| 1 | Desmet (2017) | 160 | 13 | Yes |
| 2 | Pascarella (2021) | 139 | 88 | Yes |
| 3 | Renkawitz (2016) | 120 | 5 | no |
| 4 | Logishetty (2019) | 114 | 24 | Yes |
| 5 | Zeng (2016) | 103 | 4 | No |
| 6 | Hooper (2019) | 94 | 5 | No |
| 7 | Hopper (2018) | 84 | 8 | No |
| 8 | Nelson (2020) | 82 | 22 | Yes |
| 9 | Kayupov (2017) | 78 | 6 | No |
| 10 | Luo (2018) | 78 | 4 | No |
| 11 | Watts (2017) | 72 | 11 | No |
| 12 | Rykov (2017) | 68 | 4 | No |
| 13 | Woodhouse (2016) | 67 | 15 | Yes |
| 14 | Hermann (2016) | 59 | 14 | Yes |
| 15 | Mjaaland (2019) | 58 | 7 | No |
| 16 | Nebergall (2017) | 55 | 5 | No |
| 17 | Barrachina (2016) | 54 | 5 | No |
| 18 | Chammout (2017) | 54 | 3 | No |
| 19 | Lin (2022) | 51 | 3 | No |
| 20 | Rosenlund (2017) | 50 | 4 | No |

Table 3
Top 20 THA RCTs by Altmetric Attention Score

| Rank | First Author (year) | AAS | Citations | In top 20 Cited? |
|---|---|---|---|---|
| 1 | Droll (2022) | 209 | 8 | No |
| 2 | Frydendal (2024) | 178 | 31 | No |
| 3 | Pascarella (2021) | 88 | 139 | Yes |
| 4 | Benedetti (2021) | 77 | 18 | No |
| 5 | Mahama (2021) | 69 | 5 | No |
| 6 | Monaghan (2017) | 52 | 19 | No |
| 7 | Westrich (2019) | 40 | 43 | No |
| 8 | Steiness (2024) | 35 | 17 | No |
| 9 | Coulter (2017) | 31 | 30 | No |
| 10 | Ferguson (2018) | 26 | 27 | No |
| 11 | Logishetty (2019) | 24 | 114 | Yes |
| 12 | Nelson (2020) | 22 | 82 | Yes |
| 13 | Schwenk (2020) | 22 | 39 | No |
| 14 | Carella (2022) | 22 | 19 | No |
| 15 | Brixel (2021) | 21 | 49 | No |
| 16 | Flaviano (2023) | 18 | 27 | No |
| 17 | Woodhouse (2016) | 15 | 67 | Yes |
| 18 | Hermann (2016) | 14 | 59 | Yes |
| 19 | Galea (2019) | 14 | 42 | No |
| 20 | Desmet (2017) | 13 | 160 | Yes |

# Geographic Distribution

Corresponding authors were based across wide range of countries. The five most frequent countries of origin were China (n = 48, 17.0%), the US (n = 28, 9.9%), the Netherlands (n = 19, 6.7%), Germany (n = 17, 6.0%) and Japan (n = 17, 6.0%), together accounting for 45.6% of RCTs. At an institutional level, output was more dispersed whereby the biggest output came from Sichuan University (n = 17, 6.0%), followed by Rush University and the Karolinska Institute (n = 5 each).

# Discussion

The principal finding of this analysis of 285 RCTs in THA was that scholarly influence and online attention, although moderately correlated, represent distinct dimensions of research impact. Highly cited RCTs generally attracted greater online attention, however, online attention was generally limited and no recorded attention for more than two-fifths of included RCTs. Attention captured by AAS was predominantly from X, while some major online platforms were not represented.

The discordance between citation counts and AAS observed in our analysis of 285 THA RCTs is consistent with previous orthopaedic literature [8]. Despite moderate positive correlations, only six RCTs appeared among both the 20 most cited and 20 highest-AAS RCTs. Similarly, Collins et al.[9] reported weak or absent correlations between citations and AAS across orthopaedic RCTs, while Sezer et al.[10] found that AAS correlated with recent citation activity but not total citations in anterior cruciate ligament research. Fares et al. also identified no significant association between AAS and citation rate in total shoulder arthroplasty[11]. Collectively, these findings suggest that scholarly influence does not necessarily translate into online visibility. Clinically, this distinction is important, as highly publicised research may not represent the most influential or clinically relevant evidence, highlighting the need for critical appraisal rather than reliance on online attention when informing practice.

X activity was the strongest correlate of AAS among RCTs with non-zero scores. It shows that the AAS recorded in this cohort was strongly shaped by activity on one platform. This is consistent with previous articles similarly noting X as the principal driver of AAS, [12]. This finding is important because a composite score can obscure the source, audience, and context of the attention it records. However, having a greater online presence may help enhance the visibility and reach of research, stimulate academic and public engagement, and increase opportunities for future funding and collaborative research [13]. The reliance of the AAS on X also raises questions about its validity as a measure of contemporary digital dissemination. Altmetric's current documentation lists X, Bluesky, Facebook, Reddit, and YouTube among its tracked social-media sources; it identifies LinkedIn as a historical source for which new mentions are no longer collected, and it does not list Instagram or TikTok as tracked sources[14]. X usership has been declining, which questions whether X and by extension, altmetrics as reliable a marker of that dissemination [15, 16]. Without prominent platforms such as LinkedIn, Instagram and TikTok current altmetric measures may not reflect accurate online attention. A low or zero AAS should consequently be understood as low tracked attention rather than absence of all online discussion.

Both raw citations and AAS correlated negatively with year of publication. As expected, raw citations were higher for earlier publications because they had more time to be cited. The negative association between AAS and year also cautions against treating this cross-sectional score as a purely immediate measure of dissemination. However, the 20 most cited were concentrated early in the study window (median year 2017), whereas the 20 highest AAS RCTs were more recent (median year 2020). Citation density partially adjusts for publication age but cannot completely standardise opportunity for scholarly uptake [6]. This is contrary to common assumption that altmetrics are largely time independent with their use in early indicators of dissemination [17]. The weak correlations with author number suggest

that team size alone contributed little to variation in citations or AAS within this cohort. Intuitively, one may have expected a larger author group to translate to greater online visibility and therefore more contributors with more overlapping academic and social networks. It could be possible that a single author with a large social media presence may generate more attention compared to a team of ten with no social media presence. This would coincide with the dominant role X plays [13].

Journal IF was weakly positively correlated with both AAS and citations with the highest IF quartile showing the highest median values. The highest attention outliers were also almost exclusively in Q1 journals. However, most RCTs in each quartile received little or no online attention, suggesting that the observed association was driven by a relatively small number of highly visible publications rather than a uniform effect across all articles. This finding should not be interpreted as evidence that IF causes dissemination, that highly visible articles are methodologically superior, or that lower-quartile journals publish lower-quality RCTs. Journal readership, editorial promotion, open-access practices, article topic, and study characteristics may all contribute, but the present analysis cannot distinguish among them.

Visibility should also not be conflated with methodological robustness. Orthopaedics retains a recognised reputation for underpowered and methodically weak RCTs [18]. However, the present study did not assess risk of bias, sample-size adequacy, registration, or reporting quality, and cannot determine whether highly cited or highly discussed THA RCTs were more or less robust. Combining future bibliometric work with RCT-level methodological assessment would help determine whether dissemination aligns with evidential strength.

The volume of eligible evidence demonstrates considerable THA RCT activity over the past decade. The 285 included RCTs originated from a broad range of countries and institutions, although China (17.0%), followed by the US (9.9%), the Netherlands, Germany and Japan, accounted for just under half of the total RCTs (45.6%). At institutional level, output was more dispersed, Sichuan University was the single most prolific institution (6.0%). Most centres only contributed one or two pieces of output. These results document international THA research activity but do not establish the causes of geographic differences or the representativeness of RCT populations. Future work should examine multicentre participation, funding sources, recruitment networks, and participant characteristics to evaluate the generalisability of the evidence base dissemination of evidence further.

These findings carry some practical implications. Citation based metrics alone no longer account for the totality of the readership or attention a paper may receive. Authors who are keen to maximise the reach of high-quality THA RCTs may consider active dissemination through social media, particularly in the early period post publication, to engage a more broad, diverse audience. Researchers increasingly compete not only for citations but also for visibility among clinicians, policymakers and patients. The journal IF and citation counts are, perhaps, historical constructs with a drive towards alternative indicators such as SCImago Journal Rank [19]. Although, journal IF still has a major influence on career trajectory and future employment[20]. If traditional bibliometrics inadequately capture modern dissemination and influence, perhaps a new measure of research impact is required. Altmetric analysis

offers a complementary approach; however, whether it encapsulates all mediums of social media dissemination is unclear.

# Limitations

This study has several limitations. The analysis was restricted to English language RCTs indexed in WoS. Alternative citation databases were not analysed. Altmetric data represent a single cross section snapshot as the altmetric analysis accumulates over time values for more recently published RCTs may underestimate the eventual online reach achieved. Similarly, citations can be time biased with citations taking time to accumulate, this was accounted for with citation density calculated to normalise for recently published papers. A large portion of RCTs returned with no altmetric record and were assigned a score of zero; This likely reflects a genuine absence of tracked online attention. However, it is possible that some of this activity may not have been captured by the platform. Relatedly, the AAS is weighted heavily towards X and may under capture engagement on LinkedIn, Instagram and TikTok which are platforms that are ever growing within the world of social media. A useful next study would assess a prespecified sample of journal-owned Instagram, TikTok, and LinkedIn accounts for high-impact THA articles, recording posts, reposts/shares, comments, and views at a defined observation date. Both citation counts and AAS are imperfect proxies for research influence these are affected by factors such as visibility, topic and self-promotion rather than methodical thoroughness alone.

## Conclusion

Among RCTs in THA published over the past decade, citations and online attention were moderately correlated. The top 20 contained largely different sets of RCTs. Online attention was mostly driven by activity on X and was greater for RCTs which were published in high impact journals. Altmetrics can be used as a complementary measure of broader dissemination and public engagement of THA research. However, the score itself may need updating to incorporate modern drivers of online attention.

## Declarations

# Author Contribution

L.O'D. conceived and designed the study. C.O'R. performed the literature search, screening, data collection and statistical analysis, and wrote the first draft of the manuscript. [L.O'D. and T.M.] supervised the analysis and critically revised the manuscript. [L.K., M.S.D. and C.K.] contributed to interpretation of the results and revision of the manuscript. J.T.C. provided senior supervision. All authors reviewed and approved the final manuscript

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## Figures

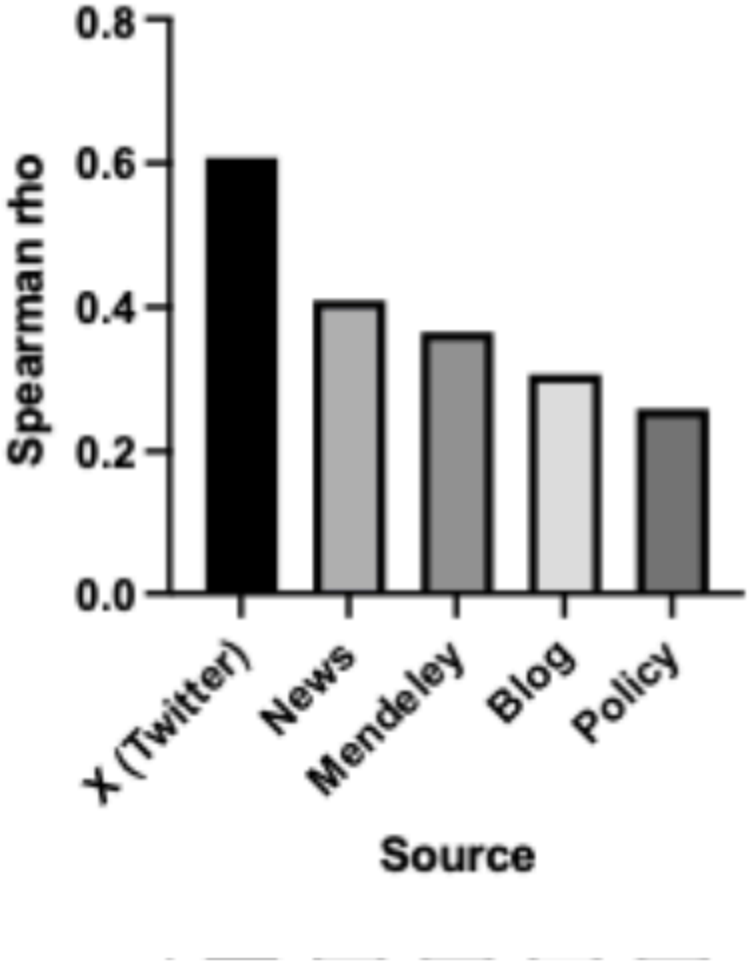


**Figure 1**

The correlation between individual Altmetric source types compared with the overall Altmetric Attention Score (AAS) . Activity on X (formerly Twitter) showed the strongest association (Spearman's ρ = 0.608), followed by news, Mendeley, blog and policy mentions (all P< 0.01)

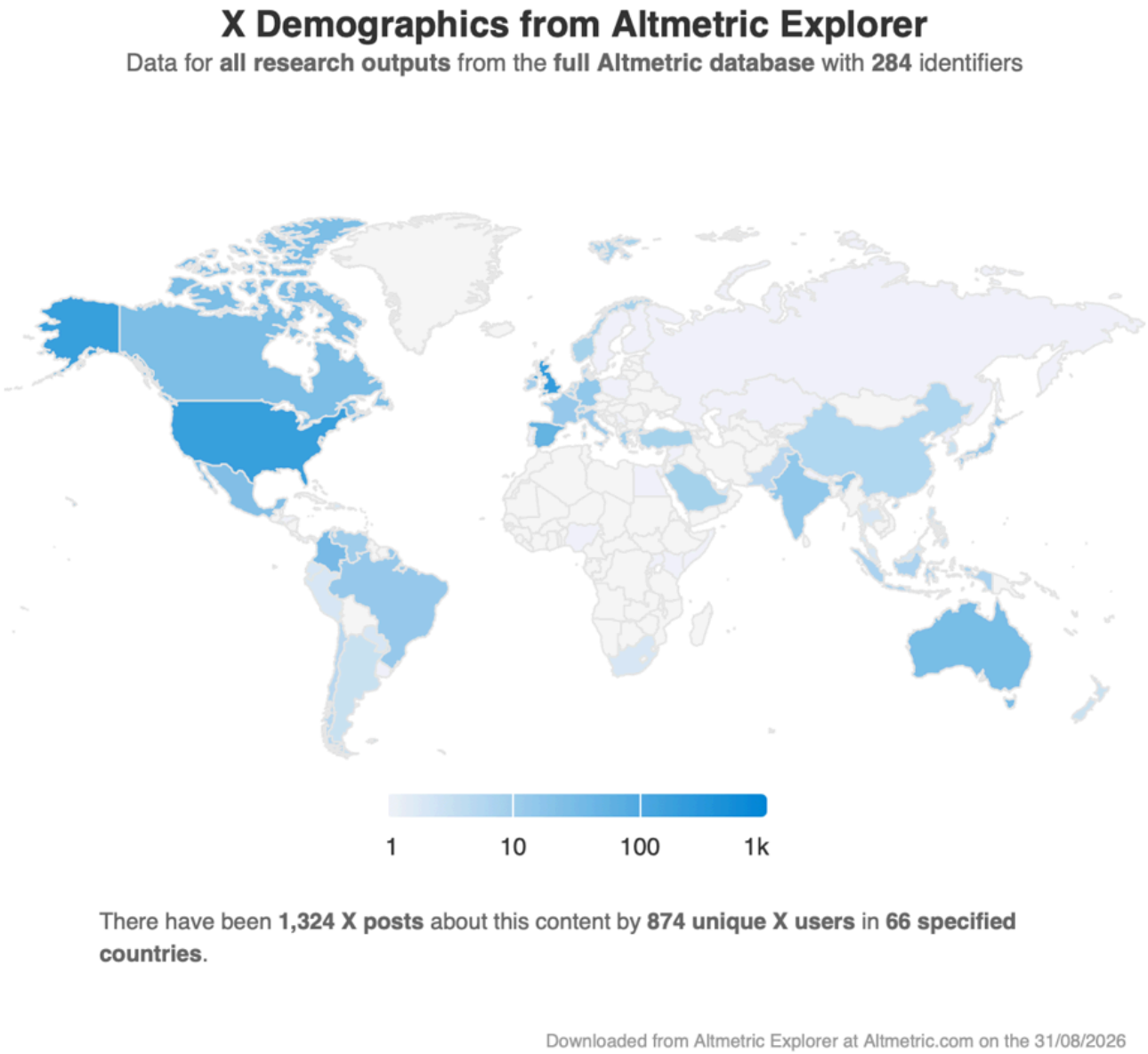



**Figure 2**

Geographic distribution of online attention from X across the cohort, based on the recorded locations of users mentioning the included RCTs

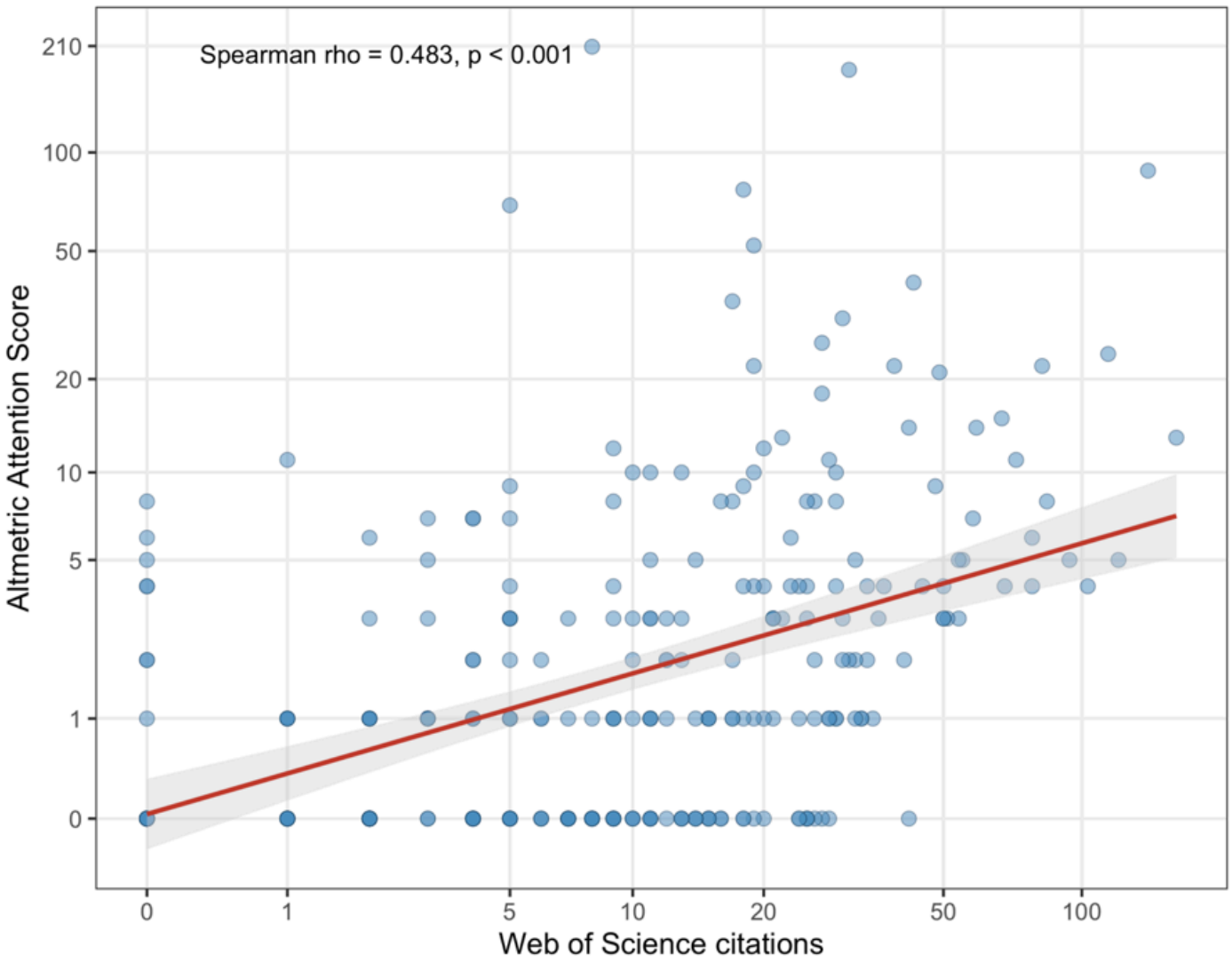



**Figure 3**

Relationship between Web of Science citations and Altmetric attention score (AAS) for 285 included RCTs. Each point represents a single RCT. A significant positive correlation was observed (Spearman's ρ = 0.483, P< 0.001), however several RCTs demonstrated divergence between academic citation and online attention

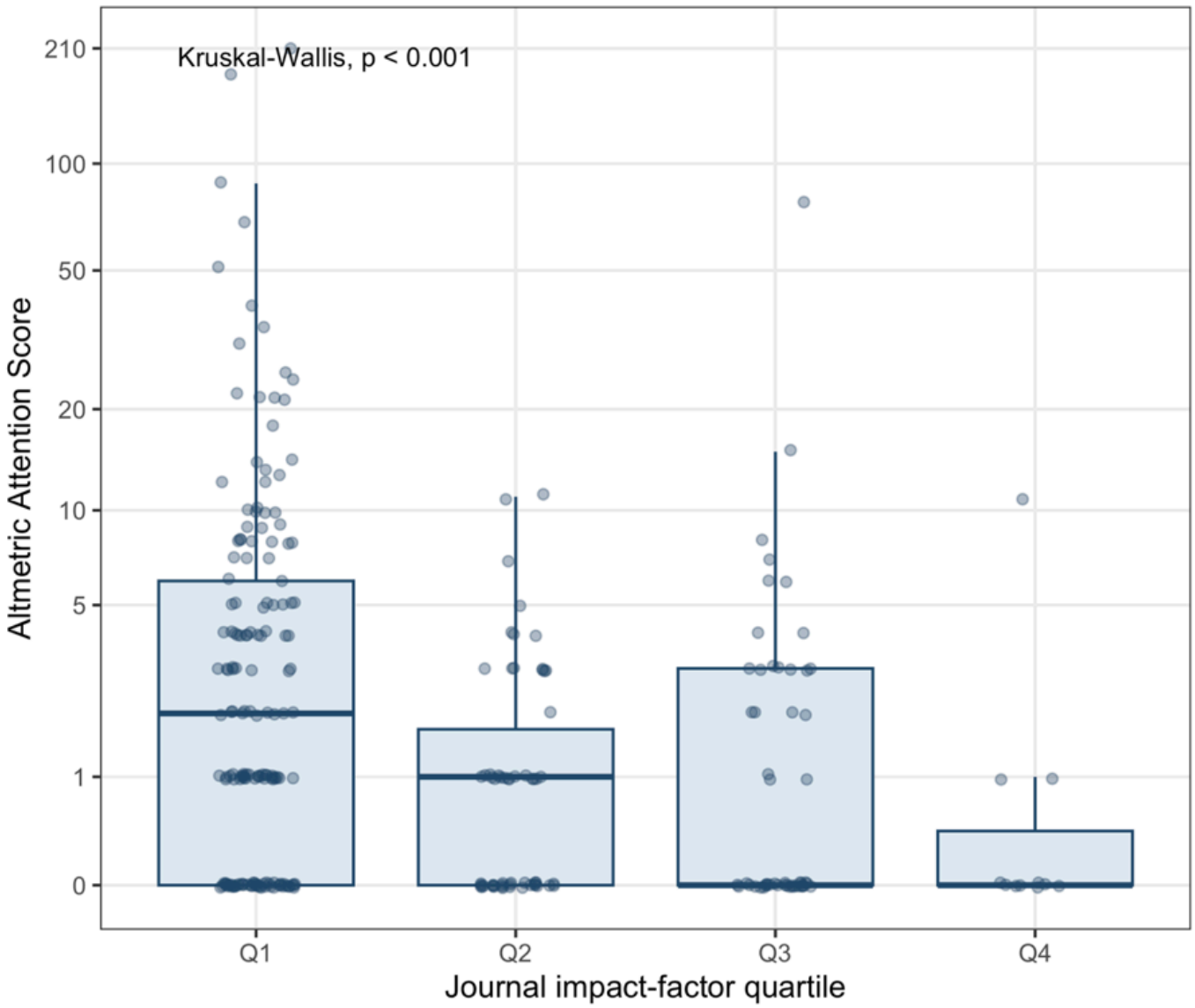



**Figure 4**

Distribution of Altmetric Attention Scores across journal impact factor quartiles. Each point represents an individual RCTs (n = 283 with available impact factor data). AAS differed across quartiles ( Kruskal – Wallis $\chi^2 = 23.4$, df = 3, P< 0.001), the highest attention outliers were concentrated within Q1 journals