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Original Article

Assessing How Male and Female Nigerian Dental and Oral Science Researchers Differ in Their Dentistry and Oral Sciences Research Productivity

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ABSTRACT

This study set out to investigate whether men and women engaged in dentistry and oral sciences research in Nigeria differ in how much they publish, the influence of their work, the types of collaborative networks they form and the roles they occupy in authorship. Using publication data gathered from the Web of Science (WoS), we compared gender patterns across several dimensions, including research productivity, citation impact, collaboration behaviour and authorship positions such as first author, last author and corresponding author. Journal standing was assessed through the field's quartile system (Q1–Q4). Gender contrasts were examined with Chi-square tests, applying a significance threshold of $p < 0.05$. Between 2012 and 2021, 413 individual researchers produced 1,222 WoS-indexed papers relating to dentistry and oral sciences. Female researchers generated more documents per person than their male counterparts (3.7 vs. 2.6, $p = 0.03$). Women appeared slightly more often in Q2 and Q3 journals, whereas men were more represented in Q4 journals, although these differences did not reach statistical significance. Citation counts favoured female authors (25.0 vs. 14.9, $p = 0.04$), and women occupied first-author roles more frequently than men (26.6% vs. 20.5%, $p = 0.048$). Men, however, were more often found in last-author positions (23.6% vs. 17.7%, $p = 0.04$). For women, the proportion of papers in which they appeared as first authors correlated significantly with the proportion in which they were listed last ($p = 0.002$), whereas the same pattern was not significant for men ($p = 0.06$). Women also had a slightly higher—though not significant—share of corresponding authorship (26.4% vs. 20.6%), while men participated marginally more often in both domestic (46.8% vs. 44.7%) and international collaborations (27.4% vs. 25.1%). Gender differences were not observed for open access publishing (52.5% vs. 52.0%). Although gender-related contrasts in productivity, scholarly influence and collaborative tendencies were evident among Nigerian dentistry and oral sciences researchers, the greater output and citation impact observed among women may reflect deeper cultural dynamics that require additional investigation.

Keywords: Author position, Dentistry and oral sciences research, Collaboration pattern, Open access publishing, Papers published, Total citations

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Introduction

The question of what drives research productivity has long captured the attention of scholars, largely because a nation's scientific output is closely interwoven with its intellectual capacity and overall economic trajectory [1, 2]. In turn, the advancement of a country's intellectual and economic landscape influences the physical and psychosocial well-being of its population [3], a process that is continually shaped and strengthened by research activity [4]. These layers of interconnection highlight a reciprocal cycle in which research, societal health, and economic growth reinforce one another. Given this tightly linked relationship, there is an increasing need for academic

institutions and regulatory bodies to examine the conditions that enhance or hinder biomedical, socio-epidemiological, and clinical research performance within university systems [5].

Research performance is most commonly assessed through the production of academic publications. Published work serves as tangible evidence of scholarly engagement, institutional achievement, and academic reputation [6]. Faculty performance is often evaluated through the volume of their publications indexed in recognized databases [7, 8]. Among the many elements influencing research productivity, gender remains a persistent determinant. Extensive literature from both high-income and low-income contexts demonstrates ongoing gender gaps in academia. These disparities span access to competitive funding, representation in the scientific workforce, the attainment of leadership roles, and differences in publication and citation patterns [9-13]. Across disciplines, men consistently publish and accumulate citations at higher rates than women—a pattern described as the "Matilda Effect" [14, 15].

Several explanations have been proposed for this phenomenon. Women frequently face heavier family-related responsibilities [16], devote more time to university service roles such as committee work, teaching, and student mentoring [17, 18], and encounter gender bias in peer review processes [19]. Inequities in resource allocation further contribute to the gap [20]. Additionally, women tend to publish fewer papers in highly funded research areas [20], participate less in collaborations that yield publications [21], and are less frequently named as first or last authors on research outputs [21]. They also receive fewer publication points than their male counterparts—roughly 10% less per publication [22]. These patterns persist even among elite scientific groups, including those in Africa [23].

Within the Nigerian context, research productivity grew by approximately 60% between 2008 and 2017 [24, 25]. Interestingly, women produced a slightly higher average number of publications than men (10.8 vs. 9.7) during that period [26]. The country's research landscape is dominated by fields associated with environmental, health, public, and occupational domains [26], such as Agriculture, Veterinary sciences, Immunology, and Medicine [1], areas that reflect national priorities in food security and infectious disease control [27]. This contrasts with high-income countries, where multiple research disciplines tend to hold more balanced significance in national development strategies [1].

In Nigeria, dentistry remains a relatively young biomedical field; formal academic training in dentistry and oral sciences began only in 1965 with the establishment of the School of Dentistry at the University of Lagos. Despite its youth, the discipline is critically important, as national human development indicators show a positive correlation with dental research productivity [28]. Advancements in oral health research also contribute directly to population health [29]. It is plausible, therefore, to wonder whether dentistry in Nigeria—much like medicine during its early developmental stages and like patterns observed in high-income settings—may show a male-favored research productivity trend [29]. Examining gender patterns in dental and oral sciences publications in Nigeria, along with the factors shaping these patterns, could support the creation of gender-responsive dental schools across West Africa and in countries with comparable academic profiles.

This study is grounded in academic literacies theory, which frames reading and writing as socially situated practices influenced by culture, context, and disciplinary conventions [30], and acknowledges that universities are spaces where power is unequally distributed [31, 32]. In this work, research productivity is understood as the volume of publications produced for academic audiences [25]. Although our bibliometric indicators treat authors' publications equivalently regardless of gender, we recognize that cultural structures—including ethnicity, class, and ability—can shape gender norms in academia. Such forces often lead women to shoulder a disproportionate share of academic housekeeping roles and low-prestige responsibilities [33-37], potentially influencing their research output.

This study investigates gender disparity in dental science research productivity in Nigeria. Its overarching goal is to examine gender differences in publication output among dentistry and oral sciences researchers. We evaluated gender variations in productivity, research impact, collaboration networks, open-access publishing, and authorship positioning. The results provide the foundation for the next phase of our work—a qualitative exploration into the mechanisms through which academic structures perpetuate gender inequities in dental and oral sciences research productivity in Nigeria.

Materials and Methods

This investigation employed a bibliometric approach to examine 1,222 publications authored by 413 researchers across a decade (2012–2021). The bibliometric assessment took place in June 2022,

drawing exclusively on data retrieved from the WoS InCites electronic database, which was selected due to its global standing as an authoritative and wide-ranging resource for bibliometric research [38, 39].

To identify the relevant body of work, we interrogated the WoS InCites dataset using the Web of Science classification for the Research Area Dentistry, Oral Surgery & Medicine. Search filters were applied to restrict the records by publication year (2012–2021), geographic origin (Nigeria), and document type (Article). Materials such as meeting abstracts, book chapters, proceedings papers, summaries, and other non-article formats were purposefully excluded.

Data acquisition unfolded in three sequential stages. In the initial stage, MET performed the database search and exported the retrieved records as a comma-separated values (CSV) file. These records were examined to verify that all necessary bibliometric fields were present. In the second stage, MET and MOF independently screened the titles and abstracts to confirm that each record met the inclusion criteria. Discrepancies in article selection were resolved through consensus discussions between the two reviewers. A final verification step was then carried out by ES, who reviewed the collated dataset; publications were retained only when all three reviewers agreed on their eligibility. The extracted dataset included information about authors (name, identity, publication title, year, journal details, page range, and citation counts), along with bibliographic descriptors (institutional affiliations, journal identifiers, document language, and publisher), and author-assigned keywords.

Authorship was defined as the pairing of an individual and a publication for which that individual is listed as a co-author [23]. Our dataset incorporated all authors recorded in the WoS InCites system for articles in Dentistry, Oral Surgery, and Medicine linked to Nigerian institutions. This was feasible because WoS InCites organizes publications into disciplinary categories and uses citation metrics to classify outputs. As a comprehensive repository covering scholarly literature across the life sciences, biomedical sciences, engineering, social sciences, and the humanities from 1900 onward [40], the WoS InCites platform contained, at the time of the analysis, more than 82 million records spanning articles, reviews, editorials, abstracts, chronologies, and proceedings across 256 disciplines. We restricted our attention to journal articles because they represent the main currency for university ranking systems [41]. These articles originate from an extensive source base comprising over 21,894 journals, 126,000 books, and approximately 226,000 conference proceedings [42].

Figure 1 presents the workflow used to identify authors contributing to publications in Dentistry, Oral Surgery, and Oral Medicine. For authors whose names appeared multiple times under the same institution, we summed their publication counts and calculated a mean Category Normalized Citation Impact (CNCI). When an author appeared with affiliations spanning more than one institution, the publication counts were aggregated and the CNCI averaged under the most recent affiliation—verified through personal communication with institutional leadership or designated representatives. A subset of authors listed with both University of Ibadan and University of Ibadan Teaching Hospital affiliations were consolidated under the university, as the teaching hospital operates as an administrative component of the parent institution.

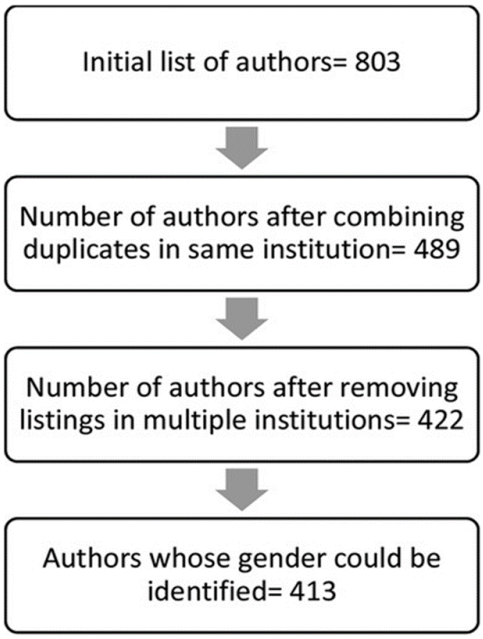

Figure 1. Number of authors identified at different stages.

To determine the sex of each author, we relied on several complementary strategies. MOF's prior familiarity with a number of individuals in the field informed the identification process, and additional gender assignments were made by interpreting the cultural or religious associations embedded in first names [21, 43]. Names traditionally understood to belong to one sex—for example, male-associated names such as "Joseph," "Mustapha," and "Babatunde," and female-associated names such as "Victoria," "Shekeerah," and "Yetunde"—were used to guide the classification. These assignments were

further cross-checked by conducting online image searches that paired the author's first name with their institutional affiliation. When the identity of an author remained uncertain, we reached out directly to institutional leaders or designated focal persons listed in the publication. For authors with dual institutional affiliations, we contacted representatives from both institutions to verify the individual's workplace and confirm their sex. This systematic institutional verification supported the accuracy of culturally inferred classifications; all culturally assigned identifications were confirmed to be correct. Following the confirmation process, we calculated the proportion of female authorships as the number of female authorships divided by the combined total of male and female authorships, expressed as a percentage.

The published manuscripts were categorized according to the journal rankings provided in the WoS InCites system. Journals were grouped by quartile (Q1–Q4), reflecting their relative position within their subject area: Q1 journals fall within the top 25% of the field, whereas Q4 journals represent the bottom 25%. Additional authorship characteristics were examined, including placement as first author, last author, and corresponding author. In cases where an article had only one author, that individual was counted as the first author.

A 10-year observation window was used to ensure sufficiently large, stable datasets for each contributing researcher. Indicators relating to productivity, research impact, collaboration structures, open-access publishing behavior, and authorship roles were extracted, with the listing of these indicators summarized in **Table 1** [44, 45].

Table 1. Definition of research indicators used in the study

Indicator	Definition
Productivity	
WoS documents	Total count of journal articles indexed in the Web of Science (WoS) attributed to an author or institution.
Percentage in Q1 journals	Proportion of publications appearing in journals ranked in the top quartile (Q1), calculated as: (number of Q1 papers ÷ number of papers in journals with an impact factor) × 100.
Percentage in Q2 journals	Share of papers published in second-quartile (Q2) journals among all papers in journals with an impact factor, expressed as a percentage.
Percentage in Q3 journals	Percentage derived by dividing the number of Q3 publications by the total number of publications in impact-factor journals, multiplied by 100.
Percentage in Q4 journals	Percentage of outputs placed in fourth-quartile (Q4) journals relative to all impact-factor publications.
Impact	
Times cited	Total number of citations received by the entire set of publications.
Category normalized citation impact (CNCI)	Ratio of observed citation counts to the expected number of citations for documents of the same type, year, and subject category. This metric allows unbiased comparison across disciplines and publication ages; a value of 1 indicates alignment with the global average, while values above 1 signify citation performance above the world standard.
Percentage cited	Proportion of publications that have received at least one citation, reflecting the degree to which the scholarly community engages with the work.
Collaboration	
Percentage international collaboration	Percentage of publications co-authored with contributors from institutions outside the country, representing the ability to form global research partnerships.
Percentage domestic collaboration	Percentage of publications produced through collaboration with researchers within the same country.
Open access	
Percentage open access	Proportion of articles made freely available through any open-access pathway—including gold, hybrid gold, bronze, free-to-read, green published, green accepted, green submitted, and all green routes.
Author position	
First author	Number of publications in which the focal author or institution is listed as the first author.
Last author	Number of publications where the final authorship position is attributed to the focal author or institution.
Corresponding author	Count of publications for which the focal author or institution is designated as the reprint or corresponding author.

Derived from articles indexed under the research category Dentistry, Oral Surgery and Medicine within the Web of Science Core Collection covering the years 2012–2021.

Chi-square tests were employed to examine gender differences in the proportion of publications across

Q1–Q4 journals. Similarly, gender differences in the percentage of cited articles, international collaboration, domestic collaboration, open access publications, and authorship positions (first, last, corresponding) were assessed using chi-square tests. Independent t-tests were applied to compare the number of WoS documents, citation counts, and CNCI values between genders. Pearson correlation coefficients were calculated to assess the relationship between the percentages of papers where authors were listed as first or last authors, with analyses stratified by gender. Statistical significance was set at $p < 0.05$, and analyses were conducted using SPSS version 23.0.

Table 2 presents the evaluation of 1,222 articles authored by researchers affiliated with Nigerian institutions and indexed in the WoS database. On average, each author produced three publications, with a higher proportion appearing in Q4 journals compared to Q3, Q2, and Q1 (22.1 percent, 15.6 percent, 14.2 percent, and 10.7 percent, respectively). Most articles (77.3%) were cited, averaging 18.6 citations per author, though the CNCI value of 0.60 was below the global mean of 1. Domestic collaborations were more common (45.8%) than international collaborations (26.4%), and 52.2% of publications were in open access journals. Less than 25% of articles listed authors as first (23.2 percent), last (20.9 percent), or corresponding authors (23.2 percent).

Table 2. Comparison between male and female authors affiliated with Nigerian institutions regarding research productivity, impact, collaboration patterns, open access publishing and authorship patterns in dentistry and oral sciences.

Variables	Combined papers in the study			*p*-value
	All papers	By females	By males	
Productivity				
Number of Web of Science document (per author)¶	1,222 (3.0)	553 (3.7)	669 (2.6)	0.03
Percentage in Q1 journals	131 (10.7%)	59 (10.7%)	72 (10.8%)	0.96
Percentage in Q2 journals	174 (14.2)	87 (15.7%)	87 (13.0%)	0.24
Percentage in Q3 journals	191 (15.6%)	94 (17.0%)	97 (14.5%)	0.31
Percentage in Q4 journals	270 (22.1%)	113 (20.4%)	157 (23.5%)	0.31
Impact				
N citations (per author)¶	7,671 (18.6)	3,779 (25.0)	3,892 (14.9)	0.04
CNCI¶	0.60	0.59	0.61	0.84
Percentage cited	77.3%	79.0%	75.8%	0.63
Collaboration				
Percentage with international collaboration	26.4%	25.1%	27.4%	0.50
Percentage with domestic collaboration	45.8%	44.7%	46.8%	0.65
Percentage published in open access journal	52.2%	52.0%	52.5%	0.91
Author position				
Percentage first author	23.2%	26.6%	20.5%	0.048
Percentage last author	20.9%	17.7%	23.6%	0.04
Percentage corresponding author	23.2%	26.4%	20.6%	0.06

¶ : *t* test used for comparison and χ^2 test used for all other comparisons.

Table 2 shows that of the 1,222 articles analyzed, 669 (54.7%) were authored by men and 553 (45.3%) by women, with total citations slightly higher for male-authored papers (3,892) than for female-authored papers (3,779). Female authors, however, had a significantly higher average number of publications per author compared to their male counterparts (3.7 vs. 2.6, $p = 0.03$) and also received significantly more citations per author (25.0 vs. 14.9, $p = 0.04$). While women tended to publish slightly more in Q2 and Q3 journals, and men slightly more in Q4 journals, these differences were not statistically meaningful. Similarly, CNCI was marginally higher for males (0.61 vs. 0.59) and the percentage of cited articles slightly lower (75.8 percent vs. 79.0 percent) than for females, but neither difference reached statistical significance.

Regarding collaborations, a greater share of male-authored articles involved international (27.4 percent vs. 25.1 percent) and domestic collaborators (46.8 percent vs. 44.7 percent), though these variations were not significant. There was also no meaningful gender difference in the proportion of articles published in open access journals (52.5 percent vs. 52.0 percent, $p = 0.91$). Females were significantly more likely to be listed as first authors than males (26.6 percent vs. 20.5 percent, $p = 0.048$), whereas males were more frequently last authors (23.6 percent vs. 17.7 percent, $p = 0.04$). The correlation between first- and last-author roles was not significant among men (Pearson $r = 0.12$, $p = 0.06$) but was significant among women (Pearson $r = 0.25$, $p = 0.002$). A slightly higher proportion of female authors were listed as corresponding authors compared to males (26.4% vs. 20.6%), although this difference did not reach statistical significance ($p = 0.06$).

Results and Discussion

The results of this study indicate that, although Nigerian male authors published more articles than female authors in the WoS category of dentistry and oral sciences, the manuscripts authored by females appear to have higher quality, as evidenced by their significantly greater citation counts. A slightly higher proportion of male-authored articles included both international and domestic collaborators, and men were significantly more often listed as last authors, suggesting that male researchers may engage more actively in mentorship, networking, and partnership-building. Conversely, the significantly higher proportion of females listed as first authors may indicate that female dental researchers in Nigeria predominantly occupy more junior roles.

This study provides a gender-focused evaluation of research within a specialty for a lower middle-income country and is among the few studies examining the productivity and impact of oral health researchers in such contexts. To the best of our knowledge, it is the only bibliometric review focusing on dental and oral sciences research in Nigeria. Several limitations should be noted. Each article was counted for every eligible author listed, so if two authors collaborated on a single paper, it was counted twice, potentially leading to an overestimation of publication numbers. Data on confounders such as career length [46] were unavailable due to lack of employment status information, though this limitation likely affected both genders similarly and introduced minimal bias. Additionally, we lacked information on factors such as parental leave, the gender composition of the research workforce (which would allow productivity weighting by sex), and the complex cultural, geographic, political, and religious diversity of Nigeria, all of which could influence gender differences in research output. Despite these constraints, the findings provide insights that could inform gender-sensitive support for oral health researchers.

Consistent with previous research, we observed sex differences in productivity, research impact, and collaboration patterns. However, unlike studies conducted in high- and upper middle-income countries [47-51], female researchers in Nigeria exhibited significantly higher research productivity and impact than their male counterparts, whereas prior reports in oral and maxillofacial surgery had found no gender differences [46]. This reversal of gender trends compared with higher-income countries may be linked to societal gender roles: in many Nigerian households, men are the primary breadwinners [52], and economic challenges over the past decade may have diverted male attention away from academic publishing. Additionally, article processing fees are generally not covered by Nigerian research institutions, and the country invests less than 0.22% of its GDP in research funding [53].

Collaborative research, which provides access to publication funding, may explain why more males were engaged in domestic and international partnerships. Conversely, the higher productivity and impact of female researchers could be related to the fact that many women in Nigerian dental academia are less burdened by household income responsibilities during economic hardships, potentially allowing them to allocate more time to research activities during work hours. This hypothesis warrants further investigation.

The proposition that personal economic considerations may influence the productivity of male researchers in Nigeria carries multiple interpretations and implications. First, we hypothesize that in a favorable research funding environment, male dominance in the Nigerian oral health research sector may be amplified, whereas financial pressures from family responsibilities, community expectations, and national economic challenges may reduce the prioritization of research among men. Previous evidence indicates that political and economic stability can impact oral health research productivity [28], suggesting that male researchers' competence could surpass that of females under stable conditions. Consequently, our findings should be interpreted cautiously and within context.

Second, the significantly higher proportion of females as first authors and males as last authors may indicate that male researchers predominantly occupy senior positions, supporting the earlier hypothesis. First authorship typically reflects the researcher responsible for the core work of the study [54], whereas last authorship denotes the individual providing critical financial and intellectual support for the research [54-56]. Comprehensive prior studies have consistently shown lower odds of females being last authors across continents, countries, journals, and disciplines [47], and our findings corroborate these trends.

It is also possible that the observed higher number of publications per female author, higher first authorship rates, and greater citations per publication suggest progress toward gender equity in Nigerian dental and oral health research, although this does not reflect broader gender equality in the country. Nigeria had a low gender equality index of 0.33% in 2020 [57]. Historically, female productivity in dental research has been lower regardless of discipline, country, or authorship position [48, 58]. Globally, however, the

proportion of women entering, qualifying, and practicing dentistry has increased over the past fifty years in the global North due to equitable educational and professional opportunities [59-61]. In Nigeria, female representation in dental institutions rose from 36.2% in 2003 to 42.5% in 2013 [62], yet increased access to education does not automatically translate to higher female academic productivity [63, 64], nor does a rise in female first authorship ensure growth in senior female researchers over time [65, 66]. Further investigation is needed to fully understand these trends. Third, the dominance of male senior researchers, reflected by last authorship and greater involvement in collaborative research, may have implications for mentorship. Early-career female researchers may face challenges accessing female mentors, who are better positioned to encourage and challenge women mentees to engage fully in research experiences [67]. Sartori *et al*. showed that having a woman as last author increased female representation in first authorship by 16% in dental research articles [58]. Our study's findings, which show a correlation between first authorship and female last authorship—but not male last authorship—support this observation. Addressing gender disparities in first and last authorship could accelerate progress toward gender equity across dentistry and oral sciences research in Nigeria.

Conclusion

Overall, the gender distribution observed suggests a positive movement toward gender equity in Nigerian dentistry and oral sciences research, with female researchers demonstrating relatively high productivity and impact. However, the notable gender disparities in first and last authorship highlight the need for cautious interpretation, as socioeconomic and cultural factors may influence these outcomes. Future studies are warranted to further explore and contextualize these findings.

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