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Original Article

Global impacts of scientific publications by academic staff: a case study of College of Medical Sciences, University of Maiduguri, Nigeria

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Abstract

Background: The impacts of scientific research by an individual or institution are measured using various bibliometric indices such as the *h*-index and citations index among others. **Objective:** The present study assessed the global impacts of scientific publications by academic staff of the College of Medical Sciences, University of Maiduguri (CMS-UNIMAID) using selected bibliometric indices. **Methodology:** The data (demographic data, research experience, and the number of publications) of the 202 academic staff of CMS-UNIMAID were obtained from the records submitted for the 2019/2020 annual appraisal. The *h*-index, citations index (CI), number of documents (ND), RG score, research interest (RI), citation/item, and citation/year of the staff were extracted from Google Scholar, Publons, ResearchGate, and Scopus using authors search until 25th December 2020. Staff and publication online visibilities were determined. Descriptive statistics were prepared for all records obtained and subjected to appropriate inferential statistics. **Results:** The mean age and research experience of the staff were 45.4±9.2 and 13.9±9.6 years, respectively. The majority ($p<0.05$) of the staff were male (85.1%), had a PhD/Professional Fellowship (61.4%), and were senior academic staff (53.5%). A total of 4940 publication entries were submitted for the appraisal. Only 2.5% of the staff were visible on all platforms with staff online visibility of 63.9, 55.5, 15.8, and 5.0% ($p<0.05$) on Scopus, ResearchGate, Google Scholar, and Publons, respectively. Male staff (68.0%) were more visible ($p<0.05$) than their female counterparts (40.0%) on Scopus while senior academic staff were more visible ($p<0.05$) than junior academic staff on all platforms except Publons. Publication online visibility was highest ($p<0.05$) in Google Scholar (78.4%) and ResearchGate (65.9%) than Publons (28.0%) and Scopus (25.1%). The mean *h*-index, CI, and ND were 8.3±1.1, 401.8±97.8, and 36.2±4.9, respectively on Google Scholar and 5.0±0.4, 166.4±25.6 and 9.0±0.9, on ResearchGate. Publons showed means *h*-index, CI, and ND of 5.0±0.3, 77.2±13.7, and 25.6±2.1, respectively while Scopus showed 4.0±1.6, 144.4±95.3, and 14.5±6.2, respectively. In addition, the means RG score and RI were 10.0±0.7 and 113.1±15.4, respectively while the means citation/item and citation/year were 3.9±1.7 and 10.7±6.8, respectively. **Conclusions:** Low bibliometric indices indicate poor global impact of scientific publications from CMS-UNIMAID. Concerted efforts are required to improve the quality of research and publication through adequate funding, infrastructure, and mentorship among others.

Keywords: *Bibliometrics, Citation, h-index, Research article, Scientist ranking*

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Introduction

Scientific research has significantly contributed to the socioeconomic, technological, and medical advancement of every nation.[1,2] Most recently, many initially unknown facts about novel SARS-CoV-2 have been unraveled through a series of well-coordinated scientific research.[3,4] This underscores the huge investment in research to ensure sustainable human and capital development. In 2018, the United States, China, and Japan had the three highest research and development expenditures of $581.6 billion, $554.3 billion, and $171.3 billion, respectively.[5] Comparatively, North America and Western Europe accounted for 46.1% of research and development expenditure in 2016 as against 0.8% for sub-Saharan Africa.[6] The impact of scientific research partly depends on the quality of the research (among other factors) which is influenced to an extent by the availability of research funds.[7]

Scientific research findings are disseminated by publications in peer-reviewed journals and presentations at scientific fora. These ensure widespread access creating an avenue for global research impact depending on other factors. For instance, a good article on trending issues published by renowned authors in a well-ranked journal with a wide audience may have a huge impact than a poorly written article published by inexperienced authors in an unindexed journal. It is extremely challenging to use a single model to quantify research impact.[8] However, web-based scientific platforms such as Google Scholar, Publons, ResearchGate, and Scopus, have provided objective indices to evaluate the impact of research outputs of individuals and organizations. Notable among these indices is *h*-index, developed by Jorge E. Hirsch, which is the number of papers with citation number $\geq h$.[9] It has been effectively used for ranking individuals,[10,11] journals,[12,13] academic departments,[14,15] institutions,[16,17] and countries.[18,19] Other indices such as *a*-index, *m*-index, *r*-index, *w*-index, *h5*-index, i10-index, and citations index have also been deployed.[13,20-22] These indices are outcomes of painstaking concerted efforts to globally ensure research and publication excellence among researchers.

Poor funding, obsolete infrastructure, inadequate expertise, insufficient mentorship, and lack of research incentives are some of the factors militating against impactful research in Nigeria.[23,24] Despite these challenges, Nigerian researchers widely publish in peer-reviewed scientific journals. This is driven by multiple factors including personal conviction, international collaboration, availability of research grants, and career advancement among others. In fact, a previous study has shown that Nigeria has relatively more robust research output than many other sub-Saharan African countries.[25] However, this previous study examined Nigeria as an entity without considering individuals and institutions despite that variation in research productivity exists among individuals and institutions.[15,17] Thus, there is a need to evaluate the impact of scientific research from various institutions in Nigeria.

College of Medical Sciences, University of Maiduguri, Nigeria (CMS-UNIMAID), established in 1979, is the first and largest medical school in Northeast Nigeria. It currently has over 4000 registered undergraduates and postgraduates studying medical, dental, and paramedical courses. Over 200 academic staff that are primarily affiliated with CMS-UNIMAID conduct basic, applied, and implementation research and they have authored several publications with some in highly ranked international journals.[26,27] Recently, a descriptive cross-sectional study reported low academic research productivity among the academic staff of the college with an average number of articles published in 3 years put as 6.6 papers.[28] However, the study involved three-year research productivity of only 25% of the staff and determined research productivity and not research impact. The present study assessed the global impact of scientific publications by academic staff of CMS-UNIMAID using some bibliometric indices on Google Scholar, Publons, ResearchGate, and Scopus.

Materials and Method

The descriptive study was conducted between December 2019 – December 2020. A database was created for all academic staff of CMS-UNIMAID who hold permanent or contract appointments with the University of Maiduguri, Nigeria, and whose names appeared on the 2019/2020 annual appraisal exercise. Personal information (name, age, sex,

rank, department, faculty, date of appointment, and year of first publication) were obtained from the staff personal records available in the Office of the Provost. Four web search engines with publication ranking systems, namely: Google Scholar (https://scholar.google.com), Publons (http://publons.com), ResearchGate (https://www.researchgate.net), and Scopus (https://www.scopus.com/search/form.uri?display=basic#author), were selected for the study based on credibility and/or popularity among researchers. Comprehensive authors search on the four selected search engines was conducted for all academic staff in English Language. In other to ensure data validity, reliability, and uniformity, separate individuals (STB, ALO, AAB, and MJT) conducted the search for each search engine. The entries were verified by an independent fellow (MB) using random sampling and disparities resolved by joint-search (MB with STB, ALO, AAB, or MJT). The author names were entered in multiple formats and each format was searched at least three times to avoid omission of valid entries. Search outputs were filtered to remove duplications, authors with multiple outputs were merged and wrong publication entries were removed for all authors. All searches ended on 25th December 2020.

The global impacts of the staff publications were assessed using selected indices presented in Table 1. In addition, staff online visibility (defined as the proportion of staff with a profile on selected platforms irrespective of other indices), and publication online visibility (defined as the proportion of individual publications that is indexed in selected platforms) were determined as given below:

$$\text{Staff online visibility (\%)} = \frac{\text{Number of staff with profile on a platform}}{\text{Total number of staff in our database}} \times 100$$

$$\text{Publication online visibility (\%)} = \frac{\text{Number of publications indexed on a platform}}{\text{Total number of publications submitted for appraisal}} \times 100$$

The data obtained were analysed using IBM SPSS Statistics 21 (IBM Corporation, New York, United States). Data were summarised using descriptive statistics (mean, median, percentage, and number) and presented in tables and figures. Mean and median were compared using analysis of variance (ANOVA) and Kruskal-Wallis test, respectively while proportions were compared using Chi-square. Significance difference was inferred at $p<0.05$.

Results

Description of the academic staff of CMS-UNIMAID

Table 2 presents the description of the 202 academic staff of CMS-UNIMAID whose global impacts of their scientific publications were assessed. The mean age and year of experience of the 202 academic staff were 45.4±9.2 years and 13.9±9.6 years, respectively. They were disproportionately distributed across five faculties and 25 active departments in the college. Significant proportions of these academic staff were from Faculty of Clinical Sciences (FCS) [50.0%; 101/202; $p<0.05$], male (85.1%; 172/202; $p<0.05$), obtained PhD/Professional Fellowship (61.4%; 124/202; $p<0.05$) and were senior academic staff (at least on rank of Senior Lecturer) [53.5%; 108/202; $p<0.05$]. Overall, 4940 publications were declared by the staff during the 2019/2020 appraisal exercise and the staff of FCS accounted for the highest proportion of 59.4% (2935/4940; $p<0.05$).

Online visibility of the academic staff of CMS-UNIMAID

The proportion of academic staff of CMS-UNIMAID with online visibility on selected platforms was 75.0% (152/202) and was higher ($p<0.05$) than those without online visibility (25.0%; 50/202). The staff online visibility was higher ($p<0.05$) on Scopus (63.9%; 129/202) and ResearchGate (55.5%; 112/202) than Google Scholar (16.8%; 34/202) and Publons (5.0%; 10/202). Only 2.5% (5/202) of the staff were visible on all platforms. Academic staff of Faculty of Basic Clinical Sciences (FBCS) [70.6%; 12/17] and FCS (82.2%; 83/101) were the most visible staff ($p<0.05$) on Scopus while those of the FBCS (82.4%; 14/17) were the most visible ($p<0.05$) on ResearchGate (Figure 1). In addition, male academic staff (68.0%; 117/172) are more visible than their female counterparts (40.0%; 12/30) on Scopus (Figure 2). Similarly, academic staff on at least the rank of Senior Lecturer (senior academic staff) were more visible ($p<0.05$) than academic staff on junior ranks in all platforms except Publons (Figure 3).

Global impacts of scientific publications by the academic staff of CMS-UNIMAID

The publication online visibility of the staff presented in Figure 4 indicated that the publications were most visible ($p<0.05$) on Google Scholar

(78.4±24.5%) and ResearchGate (65.9±19.4%). In addition, the majority of the staff had publication online visibility above 50%-midline on Google Scholar and ResearchGate while majority were below the midline on Publons and Scopus. Table 3 presents the summary of the global impacts of scientific publications. The mean *h*-index was highest ($p<0.05$) on Google Scholar (8.3±1.1) than ResearchGate (5.0±0.4), Publons (5.0±0.3), and Scopus (4.0±1.6). Similarly, Google Scholar had the highest ($p<0.05$) citations index of 401.8±97.8 than ResearchGate (166.4±25.6), Publons (77.2±13.7), and Scopus (144.4±95.3). The means RG Score and Research Interest on ResearchGate were 10.0±0.7 and 113.1±15.4, respectively while the means Citation/Item and Citation/Year on Publons were 3.9±1.7 and 10.7±6.8, respectively (Table 3). Furthermore, an inter-faculty comparison shows that the academic staff of the faculty of Allied Health Sciences (FAHS) had the highest Citations ($p<0.05$) in Google Scholar (590.4±247.5) and Scopus (123.6±55.5) than the staff of other Faculties (FD excluded due to limited data) [Table 3].

Table 1: Selected indices used for assessment of the global impact of scientific publications by the academic staff of CMS-UNIMAID

Indicator	Description	Platform
h-index	Largest number h such that h publications have at least h citations	Google Scholar, Publons, ResearchGate, Scopus
i10-index	Number of publications with at least 10 citations	Google Scholar
RG Score	A measure of research contents (published articles, unpublished research, projects, questions, and answers) in an author's profile and how other researchers interact with such contents.	ResearchGate
Citations	Sum of times that publication(s) by an author is/are cited by articles indexed in the platform	Google Scholar, Publons, ResearchGate, Scopus
Citation/Item	The average number of citations per publication	Publons
Citation/ Year	The average number of citations per year from first to last publication	Publons
Research Interest	This variable focuses on research items and scientists' interactions with them, using concepts such as reads, recommendations, and citations with varying weights	ResearchGate
Number of Document	Number of publications by an author indexed in a particular platform	Google Scholar, Publons, ResearchGate, Scopus

Table 2: Description of the academic staff of CMS-UNIMAID whose scientific publications were assessed

Variable	Faculty					Total	*p-value
	FAHS	FBCS	FBMS	FCS	FD		
No of Department	4	5	2	11	5	27	-
No of Staff (%)	60 (29.7)	17 (8.4)	19 (9.4)	101(50.0)	5 (2.5)	202 (100.0)	< 0.05
Mean Age ± SD (years)	38.5±7.1	46.6±9.2	42.1±8.9	50.2±7.2	49.8±10.7	45.4±9.2	< 0.05
Sex (%)							
Male	50	14	14	89	5	172 (85.1)	< 0.05
Female	10	3	5	12	0	30 (14.9)	
Rank (%)							
Professor	2	6	2	40	1	51(25.2)	< 0.05
Reader	2	3	1	23	0	29(14.4)	
Senior Lecturer	4	2	2	18	2	28(13.9)	
Lecturer I	15	5	7	10	0	37(18.3)	
Lecturer II	26	0	1	3	2	32(15.8)	
Assistant Lecturer	9	1	0	0	0	10(5.0)	
Graduate Assistant	2	0	5	0	0	7(3.5)	
Research Fellow	0	0	1	7	0	8(4.0)	
Highest Qualification							
PhD/Fellowship	8	14	7	91	4	124 (61.4)	< 0.05
MSc	41	3	7	6	1	58 (28.7)	
First degree	11	0	5	4	0	20 (9.9)	
No of Publications	1008	637	253	2935	107	4940	< 0.05
Mean Experience ± SD (years)	8.0±3.8	13.5±8.2	13.4±9.4	17.9±10.4	9.2±7.5	13.9±9.6	> 0.05

*Inter-faculty comparison
FAHS - Faculty of Allied Health Sciences, FBCS - Faculty of Basic Clinical Sciences, FBMS - Faculty of Basic Medical Sciences, FCS - Faculty of Clinical Sciences, FD - Faculty of Dentistry, SD - Standard deviation

Table 3: Global impacts of scientific publications by academic staff of CMS-UNIMAID

Academic Platform	Faculty					TOTAL
	FAHS	FBCS	FBMS	FCS	FD	
Google Scholar						
No of staff	11	4	4	14	1	34
h-index	8.6±2.4	7.0±4.0	5.5±2.4	8.6±1.4	15.0	8.3±1.1
i10-index	8.7±3.3	7.0±6.0	3.8±3.4	8.9±2.4	26.0	8.6±1.7
Citations	590.4±247.5	222.0±179.0	128.8±87.1	315.5±87.5	989	401.8±97.8
No of document	38.6±10.8	30.0±22.0	26.8±3.8	35.7±6.6	63	36.2±4.9
Publons						
No of staff	3	1	1	5	0	10
h-index	6.3±4.8	7	0	2.8±1.6	-	4.0±1.6
Citations	328.3±324.3	165	0	58.8±36.8	-	144.4±95.3
Citation/item	5.9±5.1	6.6	0	2.9±1.8	-	3.9±1.7
Citation/year	23.9±22.9	11.8	0	4.7±2.7	-	10.7±6.8
No of document	23.3±18.9	25	1	9.8±5.7	-	14.5±6.2
ResearchGate						
No of staff	33	14	8	55	2	112
RG score	8.7±1.5	9.8±2.2	8.0±1.6	10.9±0.9	14.3±6.6	10.0±0.7
h-index	3.8±0.8	5.8±1.3	3.9±1.1	5.6±0.5	9.5±4.5	5.0±0.4
Citations	165.6±68.3	178.9±52.3	77.67±29.0	166.6±27.4	443±345	166.4±25.6
Research interest	125.6±41.7	111.2±31.4	66.1±17.0	108.6±16.4	233.8±178.5	113.1±15.4
No of document	25.2±4.9	24.4±6.4	16.3±3.51	27.4±2.5	28.0±18.0	25.6±2.1
Scopus						
No of staff	25	12	7	84	2	129
h-index	3.1±0.9	3.9±0.8	2.3±0.8	3.5±0.3	8.0±4.0	3.5±0.3
Citations	123.6±55.5	57.7±17.5	23.1±13.5	66.6±12.0	244.5±192.5	77.2±13.7
No of document	8.6±2.9	11.1±3.1	4.3±1.7	8.8±1.0	25.5±18.5	9.0±0.9

Values are means ± standard deviation
FAHS - Faculty of Allied Health Sciences, FBCS - Faculty of Basic Clinical Sciences, FBMS - Faculty of Basic Medical Sciences, FCS - Faculty of Clinical Sciences, FD - Faculty of Dentistry

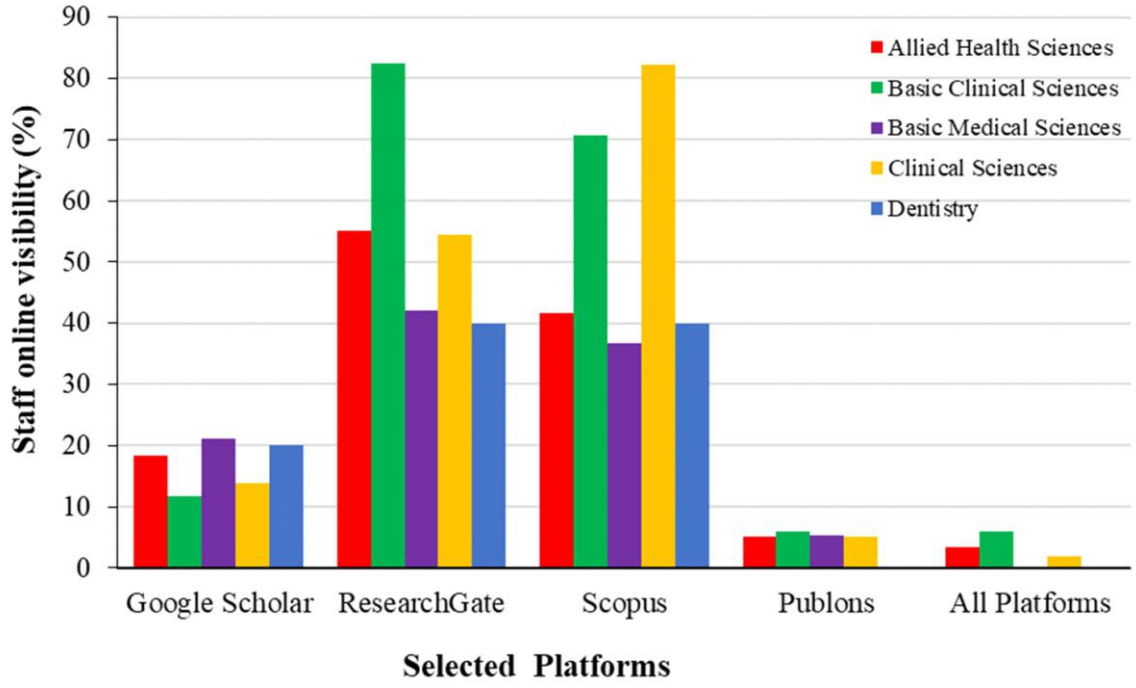

Figure 1: Staff online visibility of academic staff of CMS-UNIMAID on selected platforms

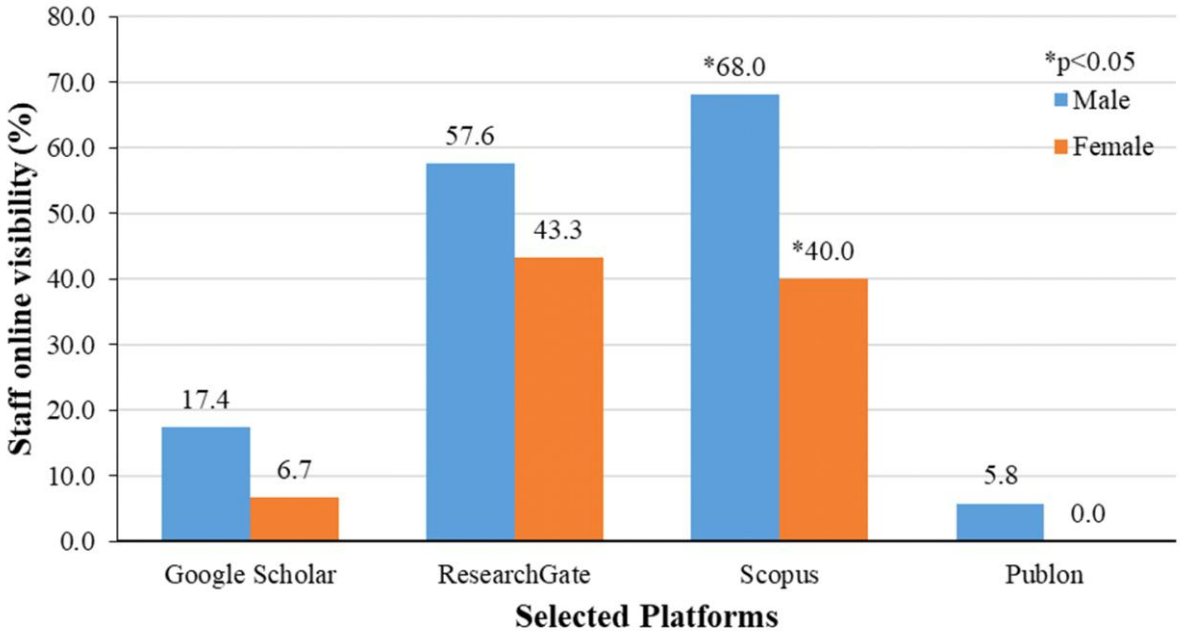

Figure 2: Sex-distribution of staff online visibility of academic staff of CMS-UNIMAID

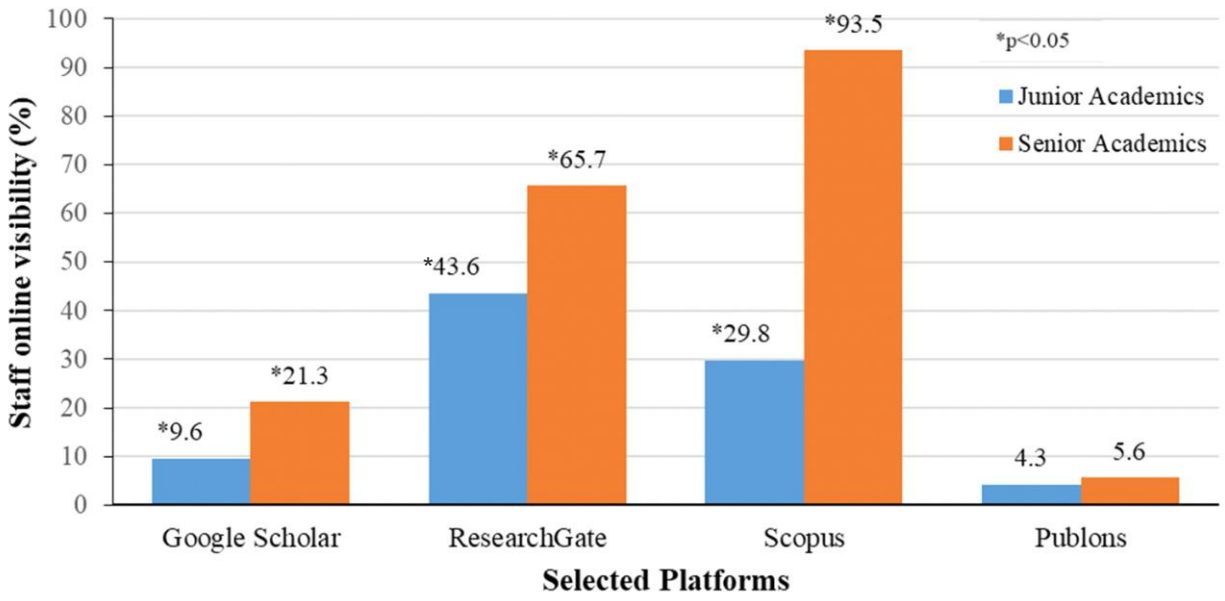

Figure 3: Rank-distribution of staff online visibility of academic staff of CMS-UNIMAID

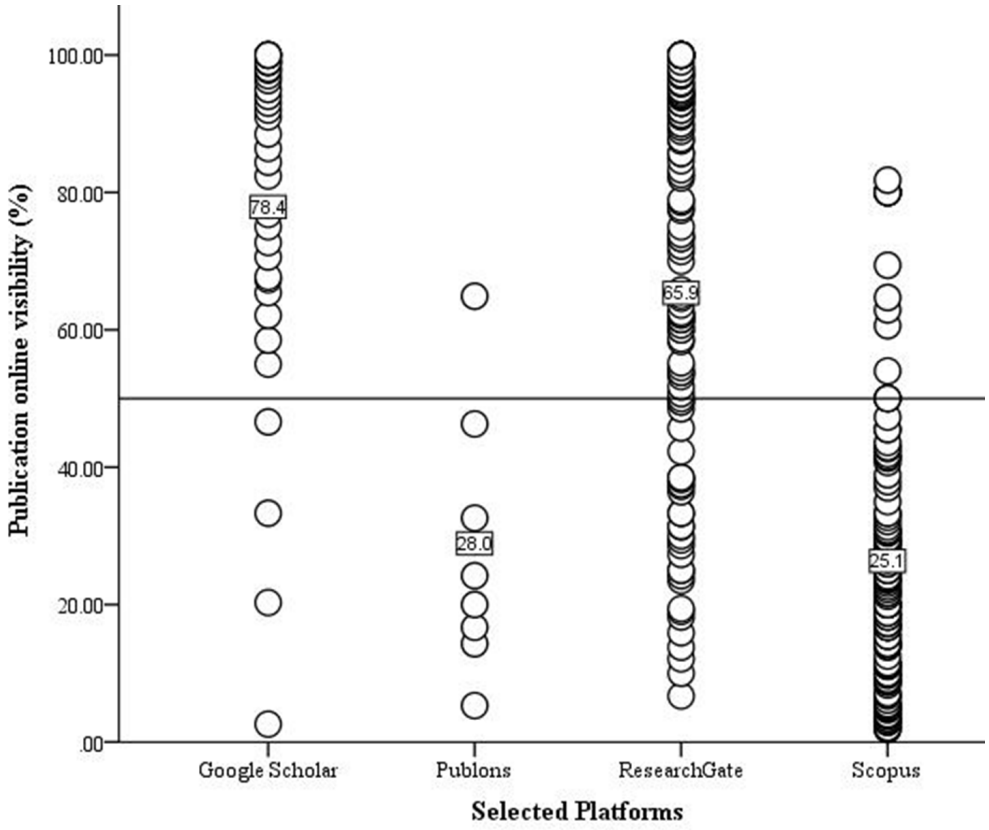

Figure 4: Publication online visibility of academic staff of CMS-UNIMAID (mid line represents 50% and the boxes present mean values, $p<0.05$

Discussion

Online scientific databases provide an objective avenue for assessment of research productivity and global impacts of research. Previous studies have explored varying bibliometric indices to evaluate research activities and research impact of individuals and organizations.[11,29] In this article, we report the global impacts of scientific publications by the academic staff of CMS-UNIMAID with the primary goal of sensitizing the staff on the need for research and publication excellence.

The University of Maiduguri is a second-generation university in Nigeria and the largest in Northeast Nigeria. CMS-UNIMAID, a unit of the university, was established for the training of health professionals, conduct of health research, and provision of community service. Thus, the academic staff of the institution is expected to author scientific publications that will promote their online visibility and enhance global research impacts. On contrary, the online visibility of the academic staff of CMS-UNIMAID is generally low with only five staff present on the four selected platforms and one-quarter not on any of the platforms. However, the good visibility displayed on Scopus (63.9%), especially by the staff of FCS (82.4%) and FBCS (70.6%) may be attributed to spontaneous indexing once a paper is published in a recognized journal. In contrast, the extremely low visibility of the staff on Google Scholar and Publons could be attributed to the registration required of individuals on these platforms. Hence, we opined that the staff may not be aware of the platforms, or they do not appreciate how the platforms could promote their research activities. Whichever way, this finding raises concern about the research and publication culture of the staff and their knowledge, attitude, and perception of online scientific platforms. Our present finding agrees with the low academic research productivity of the academic staff of CMS-UNIMAID previously reported by Oyeyemi *et al.*[28] Previous study has reported underfunding of health research, poor remuneration, lack of interest, poor research culture, limited number of high-impact journals in Nigeria and lack of awareness as some of the contributing factors to poor research productivity in Nigeria.[30] Thus, some of these factors could have contributed to the poor staff and publication online visibility observed in the present study. In addition, we observed that male academic staff and staff in senior academic ranks are more visible online. Other studies have also associated male gender[31,32] and higher academic ranks[33] to research productivity. This could be attributed to several factors such as year of experience, available time for research, domestic responsibility, and lack of research mentorship.[31,32,34]

In other to assess the global impacts of scientific publications of the staff, we determined the publication online visibility and evaluated their bibliometric indices on Google Scholar, Publons, ResearchGate, and Scopus. Generally, the publication online visibility remarkably varied across the platforms. It was excellent for Google Scholar, good for ResearchGate, and poor for Publons and Scopus. However, publication visibility on Google Scholar and ResearchGate may be misleading since the platforms are often criticized for their lenient policies that recognize predatory and poor-quality journals.[35,36] In contrast, Publons and Scopus are highly rated research databases that recognize only credible journals[37] thereby providing a standard benchmark for assessing research visibility. Unfortunately, only one-quarter (1235) of the 4940 publications by the staff are indexed on these platforms negating the global impact. This finding supports a previous report that publishing in predatory journals partly accounts for Nigeria's low contribution to recognized global research resources.[38] Therefore, concerted efforts are required by policymakers, researchers, sponsors, and sundry to change the ugly narrative.

Furthermore, all other indices (*h*-index, i10-index, RG Score, citations, citation/item, research interest, and number of documents) evaluated revealed poor global impacts of scientific publications by most of the academic staff of CMS-UNIMAID. *h*-index remains the most popular and widely used index for research impact assessment.[10,11] The mean Scopus *h*-index (4.0) of the staff in the present study was similar to 4.09 reported from Turkey[19] but two-fold lower than that of medical researchers from Canada[11] and two- to three-fold lower than that of the United States.[39] Canada and United States are developed nations having affluent research environments with extensive research training, funding opportunities, and high-impact journals.

Thus, these could have contributed to the higher *h*-index from these countries. It is noteworthy to state that this observation may limit the wide application of *h*-index, especially when comparing researchers from diverse socioeconomic settings. Other drawbacks to *h*-index have been previously reported.[40] Despite that *h*-index has been associated with academic rank and research experience,[41,42] it is worrying to observe a low *h*-index in an academic unit with good numbers of senior staff (> 50%) and an average experience of about 20 years. This calls for inquiry into the research activities of the senior staff and raises concern over the mentorship being received by the junior ones. Ezeanolue *et al*.[23,24] have identified several gaps in developing health research capacity and challenges of training mid-level researchers in Nigeria. In our view, lack of research grants, inadequate foreign exposure, and poor research orientation could have significantly contributed to the poor global impacts of the scientific publications by the staff of CMS-UNIMAID. The poor impact observed in the present study reflects a previous report of low academic research productivity of academic staff of the college.[28] Notwithstanding the generally poor impact, it is noteworthy to acknowledge a few academic staff of the college with outstanding research impact comparable to other researchers in developed countries. This fit buttresses the fact that with adequate funding, appropriate research zeal, and a conducive research environment, the staff of the college could exert a significant impact on the global research community.

Conclusion and Recommendations

The staff online visibility of the academic staff of CMS-UNIMAID was satisfactory on Scopus but very poor on Publons. Male staff, senior academic staff, and staff of the FBCS and FCS are more likely to be visible online than their counterparts. The publication online visibility and selected bibliometric indices of majority of the staff were poor on Scopus and Publons indicating poor global research impacts. The present study identified a huge gap in the research activities of the staff which requires urgent interventions. Thus, sensitization of the staff on quality research, publishing in high-impact journals, research mentorship, and research "grantsmanship" may provide short- to medium-term remedies. The long-term measures may include increased research funding by governments, improve infrastructure, provision of state-of-the-art equipment, and expanded opportunities for oversea training.

Conflict of Interest

The authors declare that there is no conflict of interest.

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Authors' Contribution

MB conceived the research idea, designed the research, and supervised all activities. STB, ALO, AAB, and MJT collected the data and prepared our research databases. STB analyzed the data and prepared the first draft of the manuscript. MB, AAB, and MJT reviewed the manuscript and adequately contributed to the final draft.

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