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RESEARCH ARTICLE

Research productivity and citation impact of Nigerian academic pharmacists: A cross-sectional study

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Abstract

Background: Research productivity is vital for academic growth and is measured using bibliometrics globally. However, the bibliometric evaluation of academic pharmacy literature in Africa is still developing. This study aimed to evaluate the number and citation impact of publications among Nigerian academic pharmacists and explore their association with sociodemographic characteristics. **Methods:** A bibliometric analysis was conducted on publications of all academic pharmacists at 21 Faculties of Pharmacy from 2000 to 2019 using Scopus, PubMed, and Google Scholar. Descriptive and inferential statistics were conducted. **Results:** Among academic pharmacists, 30.5% were female, 24.3% held professorial ranks, and 72% had at least one publication, with 15 authors contributing 25% of all publications. The H-index was higher in Scopus than in Google Scholar, increasing with academic rank ($p < 0.05$). Both genders produced equal m-quotients in Scopus and Google Scholar. Academics in pharmaceutics had significantly higher productivity and impact in Google Scholar ($p < 0.05$). South-Eastern pharmacists had the highest mean number of publications, while the North-Eastern region had the lowest percentage (14.3%) of publication-active faculty. **Conclusion:** Many Nigerian academic pharmacists were not publication-active and had low citation impacts. Research productivity and citation impact were influenced by academic rank, location, and speciality, but not by gender.

Introduction

Research, teaching, and community services are the primary responsibilities of pharmacy faculty and are used to assess their academic advancement. Assessment of the quality of research, either through research productivity or its impact through bibliometric analysis (Altbach, 2015), is an area still evolving within the academic pharmacy circle in Africa. Research productivity is a comprehensive measure of a researcher's scholarly output regarding volume and quality. The volumetric measurement of research productivity is mainly derived using the number of an author's publications (Oruc, 2021). However, for research citation impact, a subset of overall research impact is described as the effect a publication has on subsequent publications by researchers, mainly the frequency of citations a publication receives (Bornmann & Daniel, 2008).

Bibliometrics, a term first coined by Alan Pritchard in 1969, has evolved in its definition over time. Its core concept consists of quantitatively measuring the productivity, quality, or impact of an individual researcher or a research team (Carpenter *et al.,* 2014). In the field of pharmacy, bibliometric studies have gained global interest over the past two decades, with a well-developed and growing body of literature (Wang *et al.,* 2022). Researchers within pharmacy academia have used bibliometric analyses to explore research productivity (Desselle *et al*., 2018), publication status, gender influence on publication rates, publication output among different pharmacy schools, and trends across various academic ranks (Coleman *et al.,* 2007; Thompson & Nahata, 2012; Thompson, 2019).

In Africa, bibliometric research in health-related disciplines, including pharmacy, is scarce. Most studies have been conducted in North Africa, focusing on

biomedical research and cancer (Nwagwu, 2006; Uthman & Uthman, 2007; Benamer *et al.,* 2009; Zeeneldin *et al.,* 2012; Helal *et al.,* 2014; Boshoff & Akanmu, 2017). Only one has looked at pharmacy by comparing two databases, i.e. Web of Science and Scopus, to evaluate the publications of faculty members in one Nigerian school of pharmacy. The authors suggested using other databases for assessing or benchmarking research performance in developing countries (Boshoff & Akanmu, 2017). Most bibliometric studies on biomedical research mainly use PubMed as a database, although universities in Nigeria encourage their scholars to publish in Scopus-indexed journals and increase their research visibility in Google Scholar, thereby improving institutional rankings.

All pharmacy schools in Nigeria require their academics to publish peer-reviewed papers to advance in their careers. This process, known as promotion, depends on the number of publications and the duration of active research. Most pharmacy schools also require publications in high-impact journals, especially for promotion to the highest academic ranks. While other factors like teaching quality, community services, and grantsmanship are also considered for academic promotion, the number and quality of research publications carry the most weight.

This study is the first attempt to examine the publication rates of academic pharmacists in Nigeria to expand the literature on African pharmacy bibliometrics. Therefore, this study sought to achieve the following objectives: (1) examine the research productivity of Nigerian academic pharmacy faculty in three databases, namely, Google Scholar (GS), PubMed (PM), and Scopus (SC); (2) assess the research citation impact by these academic faculty by way of journal citation analysis; and (3) highlight the influence of the faculty's sociodemographic characteristics on their research productivity and impact over the period surveyed.

Methods

Study design

This study is a bibliometric analysis of peer-reviewed publications of academic pharmacists teaching and/or conducting research in accredited pharmacy schools in Nigeria over 20 years (2000-2019). All the information used in the study was publicly available, and the University of Nigeria Faculty Research Ethics Committee waived the need for approval for use on human subjects. The survey was conducted between January and April 2021.

Study area

The education and training of pharmacists in Nigeria is carried out in 21 fully accredited faculties/schools of pharmacy (undergraduate and graduate levels). The Pharmacists Council of Nigeria (PCN) and the National Universities Commission periodically assess these accredited faculties/schools of pharmacy to ensure the minimum standards for pharmacists' training are met. There are a handful of new pharmacy faculties that had neither applied (n = 3) nor received accreditation (n = 5) to train pharmacists at the time of this survey, and these schools were excluded from this study.

Population

All (n = 900) currently employed academic pharmacists in Nigeria were eligible for this study and were identified and selected through three stages. Firstly, the Nigerian Directory of Academic Pharmacists, the most comprehensive and updated list for all academic pharmacists in the country (Pharmanews, 2018), was sought, and all relevant information was extracted. Secondly, a thorough search of the websites of all accredited schools of pharmacy was conducted to get any additional information about all academic staff not found in the directory. Thirdly, in cases of conflicting, outdated, or inadequate sociodemographic details, the concerned professors and/or heads of each school of pharmacy or department were contacted by phone for clarification. Each academic's full name (first, middle, last, or initials), institutional affiliation(s), gender, highest academic degree, and department or specialty were retrieved from the directory and other search sources described above.

Bibliometrics

The study used two bibliometric measures: the H-index and the m-quotient. The H-index is defined as "the number of papers (*n*) published by an individual that have at least *n* citations" (Hirsch, 2005). This metric shows how often an author's article is cited, focusing on the most cited papers. It estimates the impact of an author's publications on a set body of literature. Google Scholar, Web of Science, and Scopus provide readily available h-indices of authors within their databases. While widely used in bibliometrics and scientometrics as an alternative to journal esteem and impact factor, the H-index faces criticism. It struggles to compare authors from different fields, hierarchies, and positions (Robinson *et al*., 2018). The m-quotient, calculated by dividing an author's H-index by the number of years since that author's first publication from 1990 (the survey's commencement year), normalises the impact of an academic's publications, regardless of their time spent in academia.

The Scopus database, accessible via its website and app, provides the pre-calculated H-index for each faculty member with recorded publication(s). For the period 1990-1996, which predates Scopus's automated calculations, two researchers manually calculated the H-index of faculty members using citation data and the number of publications available in Scopus for that specific time frame.

The survey

The researchers performed a custom search for each eligible faculty member using three databases globally recognised and commonly referenced in Nigerian pharmacy education: Google Scholar (GS), PubMed (PM), and Scopus (SC). The search strategy employed keywords, including the author's full name, initials, department, and institution, using Boolean operators "OR" and "AND" across different search stages. Search filters were set from January 1, 2000, to December 31, 2019, focusing on full-text articles. The duration of a career corresponded to the number of years from the start of publication (from 2000) until 2019. The number of research publications (journal articles only) was quantified. Conference abstracts, letters to editors, reviews, and editorials were excluded.

Two researchers independently performed the initial search across all databases. Duplicates were identified and collectively verified with the help of a third researcher. A publication with more than one academic pharmacist in similar or different departments or faculties was counted for each of the faculty members as a contribution. H-index values were also retrieved from the databases, and the m-quotient was calculated for each faculty member. Additional sociodemographic data collected included gender, current academic rank (as of 2019), postgraduate qualifications (master's or doctoral degree), department, and regional location of the school of pharmacy. It is worthy of mention that all schools of pharmacy in Nigeria use similar faculty ranking systems, i.e. assistant lecturer, lecturer, senior lecturer, associate professor, and full professor, although promotion processes may differ slightly.

Data analysis

Data were entered into a Microsoft 2020 Excel sheet, cleaned for duplicates, and checked for errors. Demographic variables were summarised using frequencies and percentages. Research productivity was assessed through publication activity (classified as "active" for faculty members with at least one published article and "inactive" for those without any publications in any of the three databases), publication counts, and publications per faculty member. For regional analysis of institutions, all pharmacy schools were grouped by geographical regions, and the ratio of total publications to the number of faculty members was calculated for each region. Each faculty's research impact was presented using mean metric values (H-index and m-quotient), as well as these metrics per publication, per faculty, per year, and per database. Mean comparisons were analysed with a t-test for two groups and an ANOVA (followed by a Scheffe post hoc test) for multiple subgroups. Statistical analyses were performed using SPPS version 25, with statistical significance set at $p < 0.05$.

Results

Demographic details

The study examined the publication records of 900 academic pharmacists currently engaged in teaching and/or research in 21 Nigerian schools of pharmacy. The sample comprised significantly more male (n = 626, 69.5%) academic pharmacists. Also, 503 (55.9%) were junior academics (Assistant Lecturer to Lecturer 1), and sex differences were more observed in rank in the Professor academic rank, where males were nearly twice as many (20% *vs* 12%). The departments of pharmacology (171, 9.0%), clinical pharmacy (161, 17.9%), and pharmaceutics (153, 17.0%) accounted for a higher percentage of faculty members. Slightly more than half (57%) of the faculty surveyed had their doctoral degrees as of 2019 (Table I).

A total of 9616, 2327, and 6064 publication records were retrieved from Google Scholar, PubMed, and Scopus, respectively, for all academic pharmacists over 20 years.

Table I: Demographics of academic pharmacists in Nigerian pharmacy schools (N=900)

Demographic	Total, n = 900 n (%)	Male, n = 626 n (%)	Female, n = 274 n (%)
Academic rank			
Assistant lecturer	75 (8.3)	47 (7.5)	28 (10.2)
Lecturer II	228 (25.3)	147 (23.5)	81 (29.6)
Lecturer I	200 (22.2)	135 (21.6)	65 (23.7)
Senior lecturer	178 (19.8)	126 (20.1)	52 (19.0)
Associate professor	56 (6.2)	41 (6.5)	15 (5.5)
Professor	163 (18.1)	130 (20.8)	33 (12.0)
Department/Speciality			
Clinical pharmacy	161 (17.9)	107 (17.1)	54 (19.7)
Pharmacology	171 (19.0)	119 (19.0)	52 (19.0)
Pharmacognosy	146 (16.2)	103 (16.5)	43 (15.7)
Pharmaceutics and drug production	153 (17.0)	103 (16.5)	50 (18.2)
Pharmaceutical microbiology	111 (12.3)	72 (11.5)	39 (14.2)
Pharmaceutical chemistry	158 (17.6)	122 (19.5)	36 (13.1)
Postgraduate degree held			
Master's degree, yes	891 (99.0)	620 (99.0)	271 (98.9)
Doctor of Philosophy, yes	516 (57.3)	368 (58.8)	148 (54.0)

Research productivity

As per the publication history, 27.7% (249) of the academic pharmacists had no publications in any of the three databases. Female researchers were slightly more active than their male counterparts (76.3% *vs* 70.6%; *p* = 0.041). The percentage of inactive faculty members decreased as their rank increased. The departments of pharmaceutics and pharmaceutical chemistry accounted for the lowest proportion (21.6% and 22.8%, respectively) of inactive faculty members. Those with a doctoral degree contributed significantly to the higher percentage of publication activity (Table II).

Table II: Publication status of Nigerian academic pharmacists indexed in the three databases

Demographic	Inactive (#Pubs=0) n (%)	Active (#Pubs>0) n (%)	*p*
All academic pharmacists	249 (27.7)	651 (72.3)	
Sex			0.047
Male	184 (29.4)	442 (70.6)	
Female	65 (23.7)	209 (76.3)	
Academic rank			< 0.0001
Assistant lecturer	44 (58.7)	31 (41.3)	
Lecturer II	87 (38.2)	141 (61.8)	
Lecturer I	43 (21.5)	157 (78.5)	
Senior lecturer	50 (28.1)	128 (71.9)	
Associate professor	12 (21.4)	44 (78.6)	
Professor	13 (8.0)	150 (92.0)	
Department/Speciality			0.206
Clinical pharmacy	49 (30.4)	112 (69.6)	
Pharmacology	52 (30.4)	119 (69.6)	
Pharmacognosy	45 (30.8)	101 (69.2)	
Pharmaceutics and drug production	33 (21.6)	120 (78.4)	
Pharmaceutical microbiology	34 (30.6)	77 (69.4)	
Pharmaceutical chemistry	36 (22.8)	122 (77.2)	
Postgraduate degree held			
Master's degree, no	3 (33.3)	6 (66.7)	0.474
Master's degree, yes	246 (27.6)	644 (72.3)	
Doctor of Philosophy, no	155 (40.5)	228 (59.5)	< 0.0001
Doctor of Philosophy, yes	94 (18.2)	422 (81.8)	

The distribution of authors that accounted for cumulative percentages of publications varied across the three databases. In GS, 9 authors were responsible for 25% of all publications, 35 authors for 50%, and 83 authors for 75%. In PM, 15 authors contributed to 25% of publications, 52 authors to 50%, and 121 authors to 75%. In SC, 18 authors produced 25% of all publications, and 52 authors accounted for 50%.

Table III presents a comparison of mean publication numbers per academic pharmacist across the three databases. GS showed the highest mean number of publications (9.6±29.7), followed by SC (6.0±14.3) and PM (2.3±5.8). Male academics had significantly higher publication numbers in GS (10.8 *vs* 6.8; $p < 0.05$) and SC (6.3 *vs* 5.5; $p < 0.05$). Professors had significantly higher publication counts than other ranks, which positively influenced academic productivity. An exception was noted in GS, where senior lecturers showed higher mean publication rates compared to associate professors. Regarding departments, faculty members in pharmaceutics and pharmacology contributed significantly more publications compared to clinical pharmacy and pharmacognosy across the three databases ($p < 0.05$). Academics with a PhD produced significantly more than those without this qualification.

Table III: Publication and citation rates of Nigerian academic pharmacists in three surveyed databases (2000-2019)

		Mean (Publication/faculty) ± SD			Mean (Citations/faculty) ± SD		
	n	GS	PM	SC	GS	PM	SC
All academic pharmacists	900	9.6±29.7	2.3±5.8	6.0±14.3	81.8±414.7	6.5±45.1	54.5±192.5
Sex							
Male	626	10.8±33.2	2.2±4.8	6.3±15.1	93.6±477.2	5.1±15.2	54.7±169.9
Female	274	6.8±18.9	2.5±7.6	5.5±12.4	54.9±209.8	9.8±78.5	54.5±236.6
Academic rank							
Assistant lecturer	75	0.8±3.7**	0.3±1.2**	0.6±1.8**	1.1±6.3**	0.4±2.0*	1.2±5.1**
Lecturer II	228	1.6±4.8**	1.0±4.5**	1.2±3.0**	5.8±37.3**	1.8±10.0*	6.4±27.6**
Lecturer I	200	6.5±12.8**	1.0±2.2**	2.3±5.0**	30.1±76.4**	1.8±4.9*	9.7±23.9**
Senior lecturer	178	14.3±29.3	2.7±5.3**	6.1±9.5**	100.0±248.6*	6.3±17.6	45.4±95.4**
Associate professor	56	10.2±24.5	2.7±4.7*	6.2±9.5**	74.3±216.6	4.8±9.1	42.9±77.4**
Professor	163	23.2±56.2	5.8±9.8	19.9	271.5±900.0	22.5±102.1	216.0±398.1
Department/Speciality							
Clinical pharmacy	161	5.5±15.1	1.6±3.9	3.5±7.2	39.6±149.1	4.4±14.7	19.8±56.8
Pharmacology	171	10.5±35.4	2.9±6.6	7.5±16.6	133.6±773.2	8.8±31.9	78.1±227.2
Pharmacognosy	146	2.8±9.3*	1.4±3.2	3.8±9.3	16.5±66.8	4.0±10.1	36.7±120.1
Pharmaceutics/Drug production	153	16.3±37.6	2.8±6.2	8.8±18.5	129.7±366.6	5.3±14.8	74.2±208.9
Pharmaceutical microbiology	111	10.1±41.3	2.0±8.6	5.8±17.7	79.4±406.1	14.9±118.8	70.0±337.1
Pharmaceutical chemistry	158	11.9±26.6	2.8±5.6	6.6±13.1	84.5±232.3	3.9±7.65	51.6±123.3
Postgraduate degree held							
Master's degree, yes	891	9.7±29.8**	2.3±5.9*	6.1±14.4*	82.6±416.7*	6.6±45.3*	55.2±193.4*
Doctor of Philosophy, yes	516	15.4±37.9**	3.5±6.9	9.8±17.9	137.4±539.9	10.4±59.1	92.5±247.4

Asterix represents statistically significant differences between smallest *vs* highest sub groups at *$p < 0.05$ and **$p < 0.001$.

Research citation impact

The average citation count per academic pharmacist in Nigerian schools of pharmacy was 81.8 (GS), 6.5 (PM), and 54.5 (SC). The mean number of citations differed between male and female pharmacists in GS (93.6 *vs* 54.9; $p < 0.05$) and PM (5.1 *vs* 9.8; $p < 0.05$). A positive correlation was observed between academic rank and citation count across all three databases ($p < 0.05$). Faculty members in the departments of pharmacology and pharmaceutics accounted for the highest citation count in the GS and SC databases, while microbiology faculty led in PM (Table III). The average annual number of citations per faculty was 3.51 for GS and 3.01 for SC. The average number of citations per publication in each database was higher for SC than GS (2.43 *vs* 1.38).

Faculty research impact bibliometric indicators were limited to GS and SC. The mean H-index and m-quotient for all faculty members were 1.74 and 0.11 for GS and 1.90 and 0.15 for SC. Male faculty demonstrated a significantly higher H-index in GS only but not in m-quotients. When adjusted by ranks, patterns of m-quotient did not increase with faculty rank, with the highest m-quotients in GS observed among Senior Lecturers and Lecturer 1. In contrast, SC showed a

positive correlation between academic rank and both the H-index and m-quotient. Pharmacognosy and clinical pharmacy yielded the lowest H-index of all departments in both databases. Having a PhD degree also had a significant influence on high values of H-index and m-quotients (Table IV).

Table IV: Citation metrics of Nigerian academic pharmacists

	Google Scholar (Mean values)				Scopus (Mean values)			
	H-Index	m-Quotient	Cit/Year	Cit/Pub	H-index	m-Quotient	Cit/Year	Cit/Pub
All academic pharmacists	1.74	0.13	3.51	1.38	1.90	0.16	3.01	2.43
Sex								
Female	1.40	0.16	2.90	1.31	1.85	0.17	3.17	2.43
Male	1.89	0.12	3.77	1.41	1.93	0.15	3.02	2.42
Academic rank								
Assistant lecturer	0.13**	0.16	0.33**	0.06**	0.16**	0.13	0.26**	0.29**
Lecturer II	0.32**	0.09	0.58*	0.43**	0.46**	0.12	0.89**	0.78**
Lecturer I	1.45**	0.11	3.44	1.26*	0.83**	0.13	1.28**	1.37**
Senior lecturer	2.80	0.18	5.32	2.19	2.19**	0.17	3.65**	3.19**
Associate professor	1.73	0.14	4.44	1.37	2.19**	0.21	3.02**	2.97**
Professor	3.69	0.16	6.83	2.58	5.63	0.20	8.98	5.98
Department/Speciality								
Clinical pharmacy	1.13*	0.11	2.51	0.99	1.18	0.12	1.34	1.64
Pharmacology	2.03	0.14	4.30	1.81	2.46	0.20	4.44	3.12
Pharmacognosy	0.59**	0.05*	0.97*	0.76*	1.49	0.11	2.04	2.11
Pharmaceutics and drug production	2.90	0.21	6.09	2.16	2.47	0.19	4.02	2.85
Pharmaceutical microbiology	1.45	0.11	2.89	0.89	1.59	0.13	3.42	1.93
Pharmaceutical chemistry	2.20	0.17	3.93	1.48	2.08	0.17	3.12	2.70
Postgraduate degree held								
Doctor of Philosophy, no	0.40**	0.11*	0.78**	0.42**	0.36**	0.12**	0.61**	0.65**
Doctor of Philosophy, yes	2.75	0.16	5.53	2.11	3.04	0.19	3.76	4.86

Asterix represents statistically significant differences between smallest *vs* highest subgroups at *$p < 0.05$ and **$p < 0.001$.

Geographical location differences

Following the geography of pharmacy schools by region of the country, divided into six regions, the mean publication count was skewed, higher in the Southeast region in two databases: GS (32.68) and SC (12.33). Academic pharmacists in the Southwest region led in PM (3.90). Pharmacy schools in the northern part of the country ranked lowest across all databases. The Northeast region showed the lowest proportion of publication activity (Table V).

Table V: Publication rates and metrics of Nigerian academic pharmacists by geographical region (n = 21)

Geographical region	N	Publication/academic				Google Scholar (Mean values)			Scopus (Mean values)		
		GS	PM	SC	Active Authors	H-index	Citation/ Paper	Citation/ Year	H-Index	Citation/ Paper	Citation/ Year
Southern region											
South-South	6	6.95**	1.75*	3.84**	63.9%	1.2±3.6**	0.8±2.6**	1.85±5.9**	1.3±2.8**	1.9±4.3*	1.9±5.3*
South-West	5	7.77**	3.90	8.53	81.6%	1.7±4.1**	1.7±3.9**	3.66±9.5**	2.9±4.5	3.7±5.6	4.9±12.9
South-East	2	32.68	2.79	12.33**	87.9%	5.3±6.9	3.5±5.3	11.09±20.3	2.9±4.6	2.5±3.5	5.3±11.0
Northern region											
North-West	4	2.67**	1.01**	2.89**	64.6%	0.5±1.8**	0.32±1.3**	0.78**	1.0±2.3**	1.5±3.6**	1.5±4.7*
North-East	1	0.45**	0.09**	0.41**	14.3%	0.05±0.3**	0.03±0.17**	0.05**	0.1±0.4**	0.4±1.9**	0.1±0.23*
North-Central	2	4.49**	2.21	4.79*	71.4%	1.3±3.8**	1.54±4.7*	3.21**	1.9±3.0	2.9±4.8	2.3±4.6

Asterix represents statistically significant differences between smallest *vs* highest subgroups at *$p < 0.05$ and **$p < 0.001$.

Regional analysis of average H-indices revealed that faculty members from the Southeast region had the highest mean values in both GS (5.27) and SC (2.93) than those from pharmacy schools in the Northwest (GS = 0.48 and SC = 1.02) and Northeast (GS = 0.05 and SC = 0.12). Southeast faculty members had the highest performance in GS, with 11.09 citations per year and 3.52 citations per paper.

Discussion

This study evaluated the research productivity and citation impact of publications among academic pharmacists in Nigeria.

Summary of key findings

Overall, a significant number of academics were not involved in research activities, as evidenced by the three databases surveyed, and only a handful of researchers contributed the most publications. Female authors were more active, and higher academic ranks were associated with increased publication counts. Faculty members in the departments of pharmaceutics and pharmacology were the most productive, while those in the clinical pharmacy and pharmacognosy departments were the least productive. Also, research productivity was significantly influenced by gender, academic rank, department, postgraduate degrees, and geographical location. GS yielded higher mean citation counts than SC and PM. However, citations per publication were higher with SC and GS, with PM showing the lowest rate. Male authors produced higher mean citation counts across all databases. Bibliometric analysis revealed higher mean H-indices for male authors, while m-quotients were comparable between genders, except in GS. Additionally, m-quotients were similar across departments and ranks, except in SC.

Geographically, authors from the Southeastern region produced the highest mean publication counts and mean H-indices in both GS and SC. Authors from the Southwestern region had the highest publication count and mean citations per year in the PM database.

Relationship with previous studies

The publication rates and impact of Nigerian academic pharmacy authors have been scarcely recorded in the published literature. The only identifiable study conducted among academic pharmacists in Nigeria (Boshoff & Akanmu, 2017) focused on one institution and employed two search databases, Scopus and Web of Science (WoS). It acknowledged WoS's limited popularity in Nigerian academic literature, justifying the addition of PM and GS in the present study.

This study revealed nearly twice as many male professors as female professors, despite having similar proportions in lower ranks. This imbalance may be attributed to earlier career entry for male academic pharmacists. Notably, while female students continue to outnumber males in undergraduate and graduate pharmacy programmes, only a small fraction are admitted into teaching, a trend reported in other studies (Draugalis *et al.,* 2014; van den Besselaar & Sandström, 2016). However, the higher proportion of female academics in pre-professorial ranks suggests potential for narrowing this gap in the future.

Sex played a role in research productivity and impact among the surveyed Nigerian academic pharmacists. Female authors were more likely to have authored at least one published paper, with no significant differences in their research productivity or impact. This finding contrasts with the limited existing literature on sex influence in pharmacy bibliometrics. A recent study among Deans of US Pharmacy Schools found no significant sex differences in various metrics, including, but not limited to, the total number of publications, publications per year, H-index, m-quotient, and total citations (Thompson, 2019). However, most studies in other medical fields have shown male author dominance in both academic productivity and citation impact (Holliday *et al.*, 2014; Ha *et al.*, 2021). Unlike findings from the present study, female academic anesthesiologists have been found to be less likely to have ever authored a publication or had fewer publications (Hurley *et al.*, 2014). Other studies with such a trend report lower publications by female authors in lower ranks but nearly equal publication rates and impact in upper academic ranks (Khan *et al.,* 2014; Diamond *et al.*, 2016; Ence *et al.*, 2016), aligning with the "publication puzzle" theory described by Summers (Summers, 2013). Some studies suggest that while female researchers may produce fewer publications, their works tend to be of higher quality (Hosseini & Sharifzad, 2021; Campbell & Simberloff, 2022). Other studies have also reported men having higher H-indices in other medical specialities such as paediatrics and urology (Fishman *et al.*, 2017; Mayer *et al.*, 2017).

Publication counts and citation rates were also associated with academic ranks. Professors had higher publication and citation rates across all databases compared with associate professors or lower-rank lecturers. This trend has been reported in other studies in pharmacy and other allied health sciences (Hurley *et al.,* 2014; Khan *et al.,* 2014; Mayer *et al.,* 2016). Generally, higher academic ranks were associated with

increased publication productivity and metrics. However, the significant disparity in citation impact among different ranks of authors was normalised when the duration of research was taken into consideration, as with the m-quotient. Hence, junior and senior-ranked academic pharmacists in this setting had similar citations when their length of active research was taken into account.

Holding a doctoral degree positively influenced research productivity and impact, consistent with previous findings indicating that academic pharmacists with a Ph.D. may be more productive than faculty with only a master's degree within a single department (Wilder *et al.*, 2020). Regarding H-index, a study in anesthesiology reported a similar trend, where Ph.D. holders were more likely to publish, accounting for the difference in median rates of publications. Hence, the difference between the research productivity of medical doctors and those with a Ph.D. may be attributable to differences in absolute non-clinical time (time spent on just patient care). This disparity may also result from the relative lack of research preparation during residency and subspeciality fellowship training (Hurley *et al.*, 2014).

The publication status of academic pharmacists indicates their productivity, showing that the pharmacist had at least one publication in any of the three databases within the years under review. To the best of the researchers' knowledge, this has not been reported in academic pharmacy literature.

In the present study, the number of publications produced by academic pharmacists from different specialities or departments was significantly different, but with nearly similar citation indices. Earlier established departments, such as pharmaceutics and pharmacology, yielded higher mean publication counts, as opposed to newer departments, such as clinical pharmacy. One study reported that medicinal chemists published at higher rates than pharmaceutics faculty members, who, in turn, published more than pharmacologists (Bloom *et al.*, 2015). Similarly, lower publication rates were reported among academics in clinical pharmacy at Obafemi Awolowo University in two different databases: Scopus and Web of Science (Boshoff & Akanmu, 2017). The older the speciality and the longer the career duration, the more significant the impact on productivity and citations. Older specialities often feature a higher number of high-ranked academics, resulting in higher productivity.

This study revealed that the geographical location of pharmacy schools influenced publication counts, citation indices, and citation rates in the databases surveyed. Authors in pharmacy schools in the Southern region outperformed their counterparts in the Northern part of the country across all bibliometric indicators. This regional variation may be attributed to several factors, primarily the concentration of research-intensive pharmacy schools in the Southern regions. Pharmacy schools in the Northen region are newer and relatively more dependent on contract academics for teaching and research, widening the research gap among these new academics, who have limited contact experience with their faculty. These findings align with similar geographical disparities observed in other contexts, such as pharmacy practice programmes across different regions in the US, indicating significant variations in academic productivity and impact (Coleman *et al.*, 2007).

A study in sports medicine proposed several factors that may impact regional variations. These include the age of institutions, cultural factors, research facilities, and population density. The study also postulated that programmes with more fellows with international collaboration might have greater research productivity because of fellow-driven research ideas and manpower (Cvetanovich *et al.*, 2016).

Implications of findings

The gender inequality among academic pharmacists in this study has also been observed in many other academic settings. This imbalance is further pronounced by the decline in the number of women in the upper academic ranks and the slower academic advancement. Also, this inequality may discourage potentially strong female candidates from taking up jobs in academia, but this topic remains to be studied. The low publication impact, evidenced by the majority of academic pharmacists having an H-index below 1.0 across most databases, suggests little or no contributions to the scientific or clinical aspects of pharmacy literature (Thompson, 2019). This finding calls for an improvement in research capacity, especially among middle- and lower-ranked academics in pharmacy. Strategies for improvement could initially focus on direct and intensive research writing training or workshops, followed by well-tailored collaborations and mentorship programmes. These improvement strategies can be driven by the institutions themselves and the professional academic bodies to which these academics belong.

Only a few academic pharmacists, mostly professors, accounted for the bulk of the publications retrieved. While this event is routine in scientometric literature, it leaves the university administration with the complex decision to delay the promotion of middle- and low-ranked academics, who were the most inactive. This finding reinforces the earlier stated need for tailored mentorship programmes targeted at junior academics

in the areas of research writing and publication, as well as collaboration with other colleagues outside the confines of their institutions.

Findings from this study highlight the need to encourage collaboration between pharmacy schools' departments to increase academic pharmacists' research productivity and provide access to grants and scholarships to faculty members of pharmacy schools in Nigeria, especially junior academics.

Strengths of the study

To the authors' knowledge, this bibliometric study is the first to date among Nigerian academic pharmacists. This study employed three databases commonly cited and referenced in pharmacy academic cycles in Nigeria. These different databases differ in context, spread, and direction of bibliometric depth. The adoption of the m-quotient that normalises the duration of academic careers for authors is a significant plus in this study.

Limitations

This study has potential limitations. First, it was restricted to the three international databases, i.e. Scopus, PubMed, and Google Scholar. National and regional journal databases were not included due to difficulties in accessing updated information. Also, the bibliometric analysis involved only published journal articles, excluding books, conference proceedings, and abstracts. While this approach aligns with common practices in bibliometric studies, which typically emphasise journal article productivity and impact, it may not capture the entire spectrum of academic contributions. Thus, readers should be cautious when generalising the findings of this study. Lastly, as with all bibliometric studies, findings are time-sensitive and subject to change. However, the extended period covered in this study provides a baseline for future comparative analyses.

Conclusion

This study reveals significant disparities in research productivity and impact among Nigerian academic pharmacists. A significant number of faculty members, particularly those in lower academic ranks, were not research-active. Mean citation rates were generally low, varying across the databases analysed. The academic rank, geographical location, and speciality of academic pharmacists influenced research productivity and citation impact, although sex had little effect on both metrics. Institutions should explore measures to improve research productivity, such as mentorship and rigorous writing workshops targeted at lower-ranked academics.

Conflict of interest

The authors declare no conflict of interest.

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Ethics approval

Not required.

References

Altbach, P. G. (2015). What counts for academic productivity in research universities? *International Higher Education,* **79**, 6–7. https://doi.org/10.6017/ihe.2015.79.5837

Benamer, H. T., Bredan, A., & Bakoush, O. (2009). Scientific publications pf Libyan medical schools: A bibliometric study of papers listed in PubMed, 1988-2007. *Education and Health (Abingdon, England),* **22**(2), 310. https://pubmed.ncbi.nlm.nih.gov/20029754/

Bloom, T. J., & Schlesselman, L. (2015). Publication rates for pharmaceutical sciences faculty members at nonresearch-intensive US schools of pharmacy. *American Journal of Pharmaceutical Education,* **79**(9), 136. https://doi.org/10.5688/ajpe799136

Bornmann, L., & Daniel, H. (2008). What do citation count measure? A review of studies on citing behaviors. *Journal of Documentation,* **64**(1), 45–80. https://doi.org/10.1108/00220410810844150

Boshoff, N., & Akanmu, A. A. (2017). Scopus or web of science for a bibliometric profile of pharmacy research at a Nigerian university? *South African Journal of Libraries and Information Science,* **83**(2), 12–22. https://doi.org/10.7553/83-2-1682

Campbell, S. E., & Simberloff, D. (2022). The productivity puzzle in invasion science: Declining but persisting gender imbalances in research performance. *Professional Biologist,* **72**(12), 1220–1229. https://doi.org/10.1093/biosci/biac082

Carpenter, C. R., Cone, D. C., & Sarli, C. C. (2014). Using publication metrics to highlight academic productivity and research impact. *Academic Emergency Medicine,* **21**(10), 1160–1172. https://doi.org/10.1111/acem.12482

Coleman, C. I., Schlesslmann, L., White, M. C. (2007). Journal publications by pharmacy practice faculty evaluated by institution and region of the United States (2001-2003). *Pharmacy Practice (Granada),* **5**(4), 151–156. https://doi.org/10.4321/s1886-36552007000400002

Cvetanovich, G. L., Saltzman, B. M., Chalmers, P. N., Frank, R. M., Cole, B.J., Bach Jr, B. R. (2016). Research productivity of sports medicine fellowship faculty. *Orthopaedic Journal of Sports Medicine,* **4**(12), 2325967116679393. https://doi.org/10.1177/2325967116679393

Desselle, S. P., Andrews, B., Lui, J., & Raja, G. L. (2018). The scholarly productivity and work environments of academic pharmacists. Research in Social & Administrative Pharmacy: RSAP, **14**(8), 727–735. https://doi.org/10.1016/j.sapharm.2017.09.001

Diamond, S. J., Thomas, C. R., Jr, Desai, S., Holliday, E. B., Jagsi, R., Schmitt, C., & Enestvedt, B. K. (2016). Gender Differences in publication productivity, academic rank, and career duration among U.S. Academic Gastroenterology Faculty. *Academic Medicine,* **91**(8), 1158–1163. https://doi.org/10.1097/ACM.0000000000001219

Draugalis, J. R., Plaza, C. M., Taylor, D. A., & Meyer, S. M. (2014). The status of women in US academic pharmacy. *American Journal of Pharmaceutical Education,* **78**(10). https://doi.org/10.5688/ajpe7810178

Ence, A. K., Cope, S. R., Holliday, E. B., & Somerson, J. S. (2016). Publication productivity and experience: Factors associated with academic rank among orthopaedic surgery faculty in the United States. *The Journal of Bone and Joint Surgery,* **98**(10), e41. https://doi.org/10.2106/JBJS.15.00757

Fishman, M., Williams, W. A., 2nd, Goodman, D. M., & Ross, L. F. (2017). Gender differences in the authorship of original research in pediatric journals, 2001-2016. *The Journal of Pediatrics,* **191**, 244–249.e1. https://doi.org/10.1016/j.jpeds.2017.08.044

Ha, G. L., Lehrer, E. J., Wang, M., Holliday, E., Jagsi, R., & Zaorsky, N. G. (2021). Sex differences in academic productivity across academic ranks and specialties in academic medicine: A systematic review and meta-analysis. *JAMA Network Open,* **4**(6), e2112404. https://doi.org/10.1001/jamanetworkopen.2021.12404

Helal, R., Abou-ElWafa, H., & El-Gilany, A. (2014). Publication productivity of faculty of medicine, Mansoura University indexed in PubMed. *Annals of Medical and Health Sciences Research,* **4**(Suppl 3), S278–S285. https://doi.org/10.4103/2141-9248.141972

Hirsch J. E. (2005). An index to quantify an individual's scientific research output. *Proceedings of the National Academy of Sciences of the United States of America,* **102**(46), 16569–16572. https://doi.org/10.1073/pnas.0507655102

Holliday, E. B., Jagsi, R., Wilson, L. D., Choi, M., Thomas, C. R., Jr, & Fuller, C. D. (2014). Gender differences in publication productivity, academic position, career duration, and funding among U.S. academic radiation oncology faculty. *Academic Medicine,* **89**(5), 767–773. https://doi.org/10.1097/ACM.0000000000000229

Hosseini, M., & Sharifzad, S. (2021). Gender disparity in publication records: A qualitative study of women researchers in computing and engineering. *Research Integrity and Peer Review,* **6**(1), 15. https://doi.org/10.1186/s41073-021-00117-3

Hurley, R. W., Zhao, K., Tighe, P. J., Ko, P. S., Pronovost, P. J., & Wu, C. L. (2014). Examination of publications from academic anesthesiology faculty in the United States. *Anesthesia and Analgesia,* **118**(1), 192–199. https://doi.org/10.1213/ANE.0b013e3182a91aa9

Khan, N. R., Thompson, C. J., Taylor, D. R., Venable, G. T., Wham, R. M., Michael, L. M., 2nd, & Klimo, P., Jr (2014). An analysis of publication productivity for 1225 academic neurosurgeons and 99 departments in the United States. *Journal of Neurosurgery,* **120**(3), 746–755. https://doi.org/10.3171/2013.11.JNS131708

Mayer, E. N., Lenherr, S. M., Hanson, H. A., Jessop, T. C., & Lowrance, W. T. (2017). Gender differences in publication productivity among academic urologists in the United States. *Urology,* **103**, 39–46. https://doi.org/10.1016/j.urology.2016.12.064

Nwagwu, A. A. (2006). Bibliometric analysis of productivity patterns of biomedical authors of Nigeria during 1967-2002. *Scientometrics,* **69**, 259–269. https://doi.org/10.1007/s11192-006-0152-7

Oruc, A. (2021). Requirements for productivity in the academic environment. *Higher Education Studies,* **11**(4), 40. https://doi.org/10.5539/hes.v11n4p40

Pharmanews. (2018). *Nigerian pharmaceutical directory 2018/2019*. https://pharmanewsonline.com/npd2015/

Robinson, D. B. T., Powell, A. G. M. T., Hopkins, L., Brown, C., James, O. P., Abdelrahman, T., Egan, R., & Lewis, W. G. (2020). Relative value of adapted novel bibliometrics in evaluating surgical academic impact and reach. *British Journal of Surgery Open,* **4**(4), 724–729. https://doi.org/10.1002/bjs5.50307

Summers, L. H. (2005). Remarks at NBER conference on diversifying the science & engineering workforce. *The Office of the President, Harvard University.* https://digitalcommons.usu.edu/advance/273

Thompson, D. F. (2019). Publication records and bibliometric indices of pharmacy school deans. *American Journal of Pharmaceutical Education*, **83**(2), 6513. https://doi.org/10.5688/ajpe6513

Thompson, D. F., & Nahata, M. C. (2012). Pharmaceutical science faculty publication records at research-intensive pharmacy colleges and schools. *American Journal of Pharmaceutical Education,* **76**(9), 173. https://doi.org/10.5688/ajpe769173

Uthman, O. A., & Uthman, M. B. (2007). Geography of Africa biomedical publications: An analysis of 1996-2005 PubMed papers. *International Journal of Health Geographics,* **6**, 46. https://doi.org/10.1186/1476-072X-6-46

van den Besselaar, P., & Sandström, U. (2016). Gender differences in research performance and its impact on careers: a longitudinal case study. *Scientometrics,* **106**, 143–162. https://doi.org/10.1007/s11192-015-1775-3

Wang, Y., Rao, Y., Yin, Y., Li, Y., Lin, Z., & Zhang, B. (2022). A bibliometric analysis of global trends in the research field of pharmaceutical care over the past 20 years. *Frontiers in Public Health,* **10**, 980866. https://doi.org/10.3389/fpubh.2022.980866

Wilder, E. I., & Walters, W. H. (2020). Publishing productivity of sociologists at American Colleges and Universities: Institution type, gender, and other correlates of book and article counts. *Sociological Perspectives,* **63**(2), 249–275. https://doi.org/10.1177/0731121419874079

Zeeneldin, A. A., Taha, F. M., & Moneer, M. (2012). Past and future trends in cancer and biomedical research: a comparison between Egypt and the world using PubMed-indexed publications. *BMC Research Notes,* **5**, 349. https://doi.org/10.1186/1756-0500-5-349