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Plagiarism in research: a survey of regional medical journals

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Abstract

Objectives

To examine whether regional biomedical journals in Africa had policies on plagiarism and procedures to detect it; and to measure the extent of plagiarism in their original research articles and reviews.

Design

Cross-sectional survey

Setting and participants

We selected journals with an editor-in-chief in Africa, a publisher based in a low-or middle-income country (LMIC), and with author guidelines in English, and systematically searched the Africa Journals Online database (AJOL). From each of the 100 journals identified, we randomly selected five original research articles or reviews published in 2016.

Outcomes

For included journals, we examined the presence of plagiarism policies and whether they referred to text-matching software. We submitted articles to Turnitin and measured the extent of plagiarism (copying of someone else's work) or redundancy (copying of one's own work) against a set of criteria we had developed and piloted.

Results

Of the 100 journals, 26 had a policy on plagiarism, and 16 referred to text-matching software. Of 495 articles, 313 (63%; 95%CI 58 to 68%) of articles had evidence of plagiarism: 17% (83) had at least four linked copied or more than six individual copied sentences; 19% (96) had three to six copied sentences, and the remainder had one or two copied sentences. Plagiarism was more common in the introduction and discussion, and uncommon in the results.

Conclusion

Plagiarism is common in biomedical research articles and reviews published in Africa. Whilst wholesale plagiarism was uncommon, moderate text plagiarism was extensive. This can rapidly be eliminated if journal editors implement screening strategies including text-matching software.

Strengths and Limitations

- We examined plagiarism policies and practices of African biomedical journals and measured plagiarism in articles.
- Our framework is unique in classifying the extent of plagiarism beyond the overall similarity index.
- Our approach is limited to plagiarism of text and does not take into account plagiarism of images and data, which is also a limitation of text-matching software.
- Although the African Journals Online database contains a large number of biomedical journals, it is not representative of all African journals.
- This study is the first to show that plagiarism of text is common in African biomedical journals.

Introduction

Plagiarism is a serious form of research misconduct when authors copy text, ideas or images from another source, without properly referencing the source.[1] The severity varies from copying short phrases to copying of a whole paper. Besides the amount of text that is copied, assessors should consider how it was referenced, whether it was intentional or not, as well as whether the copied text is a commonly used or an original phrase.[2 3] Redundant publication is an umbrella term for reusing one's own work and ranges from reusing large parts of already published text (text-recycling), to publishing parts of the same study in more than one paper (salami slicing) and republishing entire papers (duplicate publication) and is also considered poor practice.[4 5]

The availability of material on the internet facilitates mosaic writing and plagiarism, and the widespread availability of text-matching software has improved detection so there is now more awareness of research integrity and research misconduct, including plagiarism. Large publishing houses now use Turnitin/the CrossRef Similarity Check routinely.[6 7] However, publishing practices in some low-and middle-income countries (LMICs) are still embedded in small volunteer editorial teams in university or professional society journals and may have fallen behind policies and procedures adopted in the USA, Europe and other high-income regions. Thus, science is at risk as researchers are under pressure to publish for promotion and short cuts can include plagiarism - particularly if they know that journals do not have policies or procedures to implement them.[8] Yet these are the very journals publishing research relevant to the region, which are avidly advocated to help demonstrate regional research excellence.[9]

Policies are clearly available through the Committee on Publication Ethics (COPE), encouraging journal editors to screen submitted manuscripts for plagiarism.[10] Publishing systems and standards have advanced rapidly with online publishing in a global world, and there are some cooperative programmes between the big and local players to help local players keep up with advances. An example of this is the African Journals Partnership Project (AJPP), a programme that partners African journals with mentor journals from the USA and UK.[11]

Estimates of the occurrence of plagiarism are largely based on studies conducted in high-income countries. Self-reported plagiarism estimates reported in a systematic review are 1.7% (95%CI 1.2 to 2.4) for participants admitting to having plagiarised and 30% (95% CI 17 to 46) for participants knowing about others who had done so.[12] However, none of the included studies were conducted in LMICs, although we know from our own work that Cochrane authors in Africa and other LMICs report plagiarism is common in host institutions.[8] Any self-reported estimate is probably not an accurate reflection of actual practice, mainly due to social-desirability bias.[13]

We sought to examine whether regional biomedical journals in Africa had policies on plagiarism and procedures to detect it; and to measure the extent of plagiarism in their original research articles.

Methods

Study design and sample

We surveyed original research articles published in biomedical journals indexed on Africa Journals Online database (AJOL). Journals were eligible if their current editor-in-chief was based in Africa, the publisher was based in a LMIC (according to the World Bank),[14] if policies and author guidelines were available in English and if the journal published an issue in 2016. All eligible journals were selected. From each eligible journal, we selected published articles published in 2016 as original research articles, including qualitative and quantitative primary studies, literature reviews and systematic reviews, published in English. We excluded editorials and letters. We used a computer-generated list of random numbers to select five articles from each eligible journal. We selected five articles per

journal, as initial scoping of journals indexed on AJOL revealed substantial variation in the number of published articles per issue, as well as the number of published issues per year.

Data collection

For eligible journals, we downloaded policies and author instructions from the journal's website. We extracted data on the presence and content of policies and guidelines on plagiarism. For original research articles, we downloaded the full text (PDF) of each article. We extracted data on the number of authors, country of corresponding author and type of study. One author (AR) extracted data using a pre-specified, piloted data extraction form (Supplementary file 1) and entered it into Excel.

We measured the presence and extent of plagiarism (copying of someone else's work) and redundancy (copying of one's own work) in all included research articles. We submitted the PDFs of all articles to Turnitin text-matching software. Turnitin generated a similarity report containing the overall similarity index (OSI), expressed as the percentage of matching text,[15] excluding quotations and references. We manually reviewed all similarity reports with the plagiarism framework (Table 1). As we were not able to find any existing guidance to objectively assess the extent of plagiarism, we developed a framework based on suggestions from COPE[2] and Wager (2008),[3] that propose differentiating between clear plagiarism and minor copying of someone else's (plagiarism) and one's own text (redundancy). We assessed the extent of plagiarism and stratified by which section of the research paper it appeared in.

We identified copied sentences from the similarity reports. Sentences had to be substantially or completely copied. When a sentence had been clearly copied and prefixed by "However" or "Researchers found that…" this was classed as copying; and where plagiarised strings of sentences were detected joined together with conjunctions this was classed as copying (Supplementary file 2). Once we identified a copied sentence, we checked the source of the original sentence, as stated in the similarity report. If the source of the original sentence contained one or more of the authors of the article under investigation, we classified it as redundancy, whereas if the source of the original sentence was from other authors, we classified it as plagiarism.

For each section of the article, we counted the number of copied sentences and assigned one of three levels, depending on the number of copied sentences (Table 1). We then assigned an overall plagiarism category, using the same criteria for each section of the article, to describe the extent of plagiarism, namely "some", "moderate", or "extensive" plagiarism (Table 1). As methods copying was common, and can happen when people are using standard methods, we adjusted the definition to take this into account. Overall redundancy was scored in an equivalent way and for each article separate scores were given for plagiarism and redundancy.

Development of the framework was an iterative process, and piloted by AR and EW who independently assessed similarity reports of 10 articles and discussed results with the entire research team. Once the team had agreed on the framework, one author (AR) scored all similarity reports using the framework and another author (EW) independently scored a random selection of 10% of reports. Any disagreements in rating were resolved by consensus.

Table 1: Plagiarism framework

	Number of copied sentences detected		
	Level 1	Level 2	Level 3
Abstract	1 to 2	3 to 6	6+; or 4 + linked
Background	1 to 2	3 to 6	6+; or 4 + linked
Methods	1 to 2	3 to 6	6+; or 4 + linked
Results	1 to 2	3 to 6	6+; or 4 + linked
Discussion	1 to 2	3 to 6	6+; or 4 + linked
Overall score	**Some plagiarism**	**Moderate plagiarism**	**Extensive plagiarism**
Definition	One or more sections with plagiarism of one to two sentences; or level 2 plagiarism in the methods section	One or more sections with plagiarism of three to six sentences; or level 3 plagiarism in the methods section	One or more sections with plagiarism of four or more linked sentences, or plagiarism of more than six sentences

Data analysis

We used SPSS (version 25)[16] for analysis and report categorical data as frequencies and proportions and continuous data as medians, means and standard deviations, or modes and ranges. As this study aimed to generate rather than test hypotheses, we did not test statistical significance between categories. For plagiarism and redundancy, we calculated 95% confidence intervals (CI), adjusted for clustering at the journal level using robust standard errors, with STATA (version 15).[17]

Ethical issues

All data used in this study was available online and is thus in the public domain. To ensure anonymity of authors, we did not include information identifying individual research articles in our report. We obtained an ethics exemption from the Stellenbosch University Health Research Ethics Committee (X17/08/010). Where we detected serious plagiarism in published papers, we identified the journal editors and are currently writing to them, informing them of our findings.

Results

Of the 179 biomedical journals indexed on AJOL, 100 met the eligibility criteria and were included in the study (Figure 1). Detailed characteristics of journals are reported in the table of included journals (Supplementary file 3), while excluded journals are listed in the table of excluded journals (Supplementary file 4).

We selected five original research articles published in the 2016 issue of each journal. Some had not published this number (one journal only published two research articles, and two journals published four research articles). For these we included all research articles published in 2016, giving a total of 495 research articles included (Figure 1).

Plagiarism policies in included journals

Twenty six percent of the journals had a policy on plagiarism mentioned on their website (Table 2). More journals with open (35%) compared to paid (6%) access and more specialised (38%) compared to general (13%) journals mentioned a policy. Journals with a plagiarism policy included both those from non-commercial (22%) and commercial (32%) publishers. Journals with the same commercial publisher generally had similar policies. All journals published by 'AOSIS publications' or 'Health and Medical Publishing Group' had a policy and referred to text-matching software. None of the journals published by 'Medknow publications' (19 journals) and 'In House publications' (2 journals) mentioned a policy. For 'Medpharm publications', three of the four journals had a plagiarism policy,

but only one of these also referred to text-matching software. Of the nine journals with an impact factor, three did not have a policy on plagiarism and six of the seven AJPP member journals had no policy.

Only 16 journals said they used text-matching software to check for plagiarism, of these, there were more journals from commercial (24%) than non-commercial publishers (10%); more journals with open (20%) than paid access (3%); and more specialised (25%) than general (6%) journals (Table 2).

Table 2: Plagiarism policies in included journals (n=100)

	Publisher		Access		Scope		Total (n=100)
	Non-commercial publisher (n=59)	Commercial publisher[1] (n=41)	Open access (n=69)	Paid access (n=31)	General (n=48)	Specialised (n=52)	
Plagiarism policy available	13 (22%)	13 (32%)	24 (35%)	2 (6%)	6 (13%)	20 (38%)	26
Definition of plagiarism	5 (8%)	9 (22%)	13 (19%)	1 (3%)	2 (4%)	12 (23%)	14
Reference to plagiarism software	6 (10%)	10 (24%)	14 (20%)	2 (6%)	3 (6%)	13 (25%)	16
Consequences of plagiarism described	11 (19%)	10 (24%)	20 (29%)	1 (3%)	6 (13%)	15 (29%)	21
Reference to COPE flowchart	2 (3%)	2 (5%)	3 (4%)	1 (3%)	0	4 (8%)	4

[1]Medknow Publications, based in India (19 journals); Health & Medical Publishing group (6 journals), Medpharm Publications (4 journals), AOSIS Publishing (3 journals) In House publications (2 journals) and LAM publications limited (1 journal), all based in South Africa; Bookbuilders Africa (1 journal), Michael Joanna Publications (1 journal), Fine Print and Manufacturers (1 journal), CME ventures (1 journal) and SAME ventures (1 journal) based in Nigeria; and AKS publications (1 journal), based in Mauritius.

Characteristics of included research articles (n=495)

Characteristics of included research articles are summarised in Table 3. Most articles were published in open-access journals (69%), and about half (48%) in a journal with a general scope; 41% were published in journals from a commercial publisher. Non-commercial publishers included research institutions and academic organizations that published their journals themselves.

Nine journals had an impact factor, and accounted for 9% of the papers included, and seven journals were members of the AJPP (7% of research articles). Articles had a median of three authors (min 1, max 10). Overall, half of the included articles had corresponding authors based in Nigeria. Half (50%) of the included articles represented cross-sectional studies.

Table 3: Summary of characteristics of included articles (n=495)

Characteristic	n (%)
Published in journal with:	
Impact factor	45 (9%)
Open access	342 (69%)

General scope	239 (48%)
Commercial publisher	205 (41%)
AJJP membership	35 (7%)
Country of corresponding author	
Nigeria	250 (51%)
South Africa	83 (17%)
Other African country	99 (20%)
Non-African country	63 (13%)
Type of study	
Cross-sectional study	247 (50%)
Retrospective study	65 (13%)
Case Report	42 (9%)
Trial	36 (7%)
Cohort study	22 (4%)
Review	21 (4%)
Case-control study	12 (2%)
Other	50 (10%)

Overall similarity index (OSI) of included articles

The OSI's for all included articles are reported in Table 4. Of all included papers, 90% had an OSI of 30% or less. All five articles with an OSI of 50% or more were published in non-commercial journals.

Table 4: OSI's of included articles (n=495)

OSI	Number of articles (%)
0 to 10%	137 (28)
11 to 20%	202 (41)
21 to 30%	104 (21)
31 to 40%	34 (7%)
41 to 50%	13 (3)
51 to 60%	2 (0.4)
61 to 70%	3 (0.6)
71 to 100%	0

Rates and extent of plagiarism and redundancy per section of article

The presence of plagiarism varied across different sections of the articles (Supplementary file 5). We did not find widespread plagiarism or redundancy in the results sections of included articles. Plagiarism was mostly in the introduction of articles (47%) followed by the discussion (39%) and the methods section (30%). The extent of plagiarism also varied across sections, and plagiarism of one to two sentences occurred most commonly. Plagiarism in the introduction comprised one to two copied sentences in 23% of articles, three to six copied discrete sentences in 14% and at least four linked or more than six discrete copied sentences in 11% of articles. In the discussion section, plagiarism comprised one to two copied sentences in 18% of articles, three to six copied sentences in 13% and at least four linked or more than six discrete copied sentences in 9% of articles.

Redundancy was mostly seen in the methods section of included articles (11%), comprising one to two copied sentences in 3% of articles, three to six copied sentences in 4% and at least four linked or more than six discrete copied sentences in 3% of articles (Supplementary file 5).

Overall plagiarism in included articles

We found plagiarism (any level) in 63% articles, comprising some plagiarism in 27%, moderate plagiarism in 19% and extensive plagiarism in 17% of articles (Table 5).

Table 5: Overall plagiarism (n=495)

Plagiarism score	Definition	n	% (95 CI)
Any level of plagiarism	At least one or more sections with plagiarism of one to two sentences; or level 2 plagiarism in the methods section	313	63% (58 to 68%)
Some plagiarism (Level 1)	One or more sections with plagiarism of one to two sentences;	134	27% (23 to 32%)
Moderate plagiarism (Level 2)	One or more sections with plagiarism of three to six sentences; or level 3 plagiarism in the methods section	96	19% (16 to 23%)
Extensive plagiarism (Level 3)	One or more sections with plagiarism of four or more linked sentences, or plagiarism of more than six separate sentences	83	17% (13 to 21%)

We explored the characteristics of articles with plagiarism (Supplementary file 6). The most important factor that appeared to influence plagiarism was whether the journal referred to text-matching software or not. Of all included articles published in a journal that did not refer to text-matching software, 67% contained any level of plagiarism and 19% had extensive plagiarism; while 43% of articles published in a journal with reference to text-matching software had any level of plagiarism and 6% had extensive plagiarism. Having a policy only (without reference to text-matching software) did not appear to influence plagiarism. The most striking finding in terms of type of study was linked to reviews. Although the proportion of reviews with any plagiarism was comparable to other study designs, almost half of all included reviews (48%) had extensive plagiarism.

Redundancy was less common than plagiarism. Overall, 11% of articles had any level of redundancy, comprising 4% of articles with some redundancy, 4% with moderate redundnacy and 2% with extensive redundancy (Table 6).

Table 6: Overall redundancy (n=495)

Redundancy score	Definition	n	% (95 CI)
Any level of redundancy	At least one or more sections with redundancy of one to two sentences; or level 2 redundancy in the methods section	54	11% (8 to 15%)
Some redundancy (Level 1)	One or more sections with redundancy of one to two sentences; or level 2 redundancy in the methods section	21	4% (3 to 7%)
Moderate redundancy (Level 2)	One or more sections with redundancy of three to six sentences; or level 3 redundancy in the methods section	22	4% (3 to 7%)
Extensive redundancy	One or more sections with redundancy of	11	2% (1 to 4%)

(Level 3)	four or more linked sentences, or redundancy of more than six sentences		

Accuracy of various OSI thresholds

We explored the accuracy of various thresholds of OSI's according to our plagiarism framework (Table 7). With an OSI threshold of 5%, sensitivity was high, meaning that 97% of articles with any level of plagiarism were correctly identified as such and only 3% of articles with any level of plagiarism were missed. However, specificity was low, meaning only 17% of articles without any plagiarism were correctly identified as such and the rate of false positives was high (83%). Increasing the threshold led to a decreased sensitivity and increased specificity.

Table 7: Sensitivity and specificity of various OSI thresholds

OSI threshold	Sensitivity	Specificity
OSI >5%	97%	17%
OSI >10%	84%	51%
OSI >15%	66%	83%

Discussion

Our study is the first to explore actual levels of plagiarism in biomedical journals from Africa. We proposed a framework to measure plagiarism, as an OSI generated by text-matching software on its own is not sufficient to describe the presence and extent of copied text. Indeed, the OSI is only an indication of the proportion (%) of copied text and there is no consensus of an acceptable threshold. In our sample, the sensitivity for an OSI threshold of 10% was 84%, compared to 97% for a threshold of 5%. Taylor and colleagues found an even lower sensitivity of 67% for an OSI threshold of 11.5%, excluding citations and references.[18] Zhang (2010) used text-matching software to screen manuscripts submitted to a Chinese journal for plagiarism [19] and found that 23% contained high levels of plagiarism, although is it not clear how plagiarism was defined. A study from Pakistan that assessed plagiarism of submitted manuscripts[20] found that 39% of papers contained plagiarised text, defined as the presence of one or more copied sentences. They reported similar results for papers from Turkey and China. In our sample, 72% of articles had an OSI above 10%, and 63% (95% CI 58 to 68%) had any level of plagiarism according to our framework, a much higher rate compared to the findings of other studies.

In line with recommendations for best practices, [5 10 21] more and more journal editors and publishers make use of text-matching software to screen submitted manuscripts for copied text.[22] But, software licences are expensive and some smaller journals, especially institutional journals and those with non-commercial publishers, may not be able to afford them.[23] Indeed, we found that of the 26% of journals that had a policy of plagiarism, most were from commercial publishers. In addition, only 16% of journals mentioned the use of text-matching software.

Our framework is limited in that is only measures plagiarism in terms of number of copied sentences, although it does take into account where in the article the copied text was found. We considered plagiarism in the methods section to be less serious than plagiarism in other sections of the articles, as it is sometime difficult to avoid repeating standard descriptions of methods. It does however, not consider other aspects of plagiarism, such as how the text was referenced and whether plagiarism was intentional or not,[3] which are important aspects to consider when making judgements about plagiarism. It is also limited to plagiarism of text and does not take into account plagiarism of data or images (which is also a limitation of text-matching software). To test our framework, one author (AR) checked all the articles, and another author (EW) checked a random sample of 10% of articles. While our scores for overall plagiarism were mostly consistent we found that variations depended on how we scored borderline cases in terms of what was considered a

completely copied sentence. The framework therefore may lack precision in terms of interrater reliability and test-retest reliability and needs further testing. However, we found that the framework was still a useful tool which facilitated assessment across articles and represented the extent of plagiarism well.

We were interested in regional journals and wanted to examine smaller and non-mainstream journals based in Africa. We considered various sampling frames, but few met our requirements. We chose AJOL to sample journals, as it hosts over 500 journals, including 179 biomedical journals, from over 30 African countries. In light of the known challenges in identifying African biomedical journals,[24 25] we thus considered AJOL to be a comprehensive and pragmatic sampling frame, although it does not represent all African biomedical journals.

The need to build capacity of African journals to improve the quality and visibility of African research has previously been recognised. In an attempt to address this need, the AJPP was initiated in 2004.[25,11] In addition to building capacity of specific member journals, the project has also envisaged that the African members become "regional leaders and share their acquired knowledge and experience with other editors and journals on the continent".[25] Although only seven of our included journals were members of AJJP, the proportion of articles with any level of plagiarism was the same for member and non-member journals. Only one of the seven AJJP member journals mentioned a policy on plagiarism. It is possible that journals had plagiarism policies but did not mention them on their online information; however, given the actual amount of plagiarism we found, we think this is unlikely, and since one purpose of such policies is to act as a deterrent we believe they should be clearly publicised by journals.

The level of plagiarism in African biomedical journals is concerning. African journals should aim to meet global expectations and follow best practices with regards to their policies and guidelines on plagiarism. This includes using text-matching software to detect plagiarism in submitted manuscripts. Not only will this help to verify originality of submitted work, but it also has the potential to deter poor practices. However, although text-matching software is a useful screening tool, editors should not rely on the OSI on its own. A high similarity score should trigger detailed assessment by a knowledgeable editor, but the possibility of false positives and false negatives should always be borne in mind. Our plagiarism framework provides an approach to classify the extent of plagiarism. Further testing of the tool is necessary to determine validity and reliability.

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Contributions of authors

All authors contributed to the design of the study and the development of the plagiarism framework. AR collected and analysed data from journals and articles with input from TY, PG, and EW. AR reviewed all manuscripts using the plagiarism framework and EW independently reviewed 10% of included articles. AR drafted the manuscript. TY, PG and EW critically engaged with the manuscript and provided input. All authors approved the final version of the manuscript.

Competing interests

Paul Garner is part of Cochrane, an organization that routinely uses Turnitin. Elizabeth Wager has given workshops on plagiarism and spoken at a conference funded by Turnitin. Anke Rohwer and Taryn Young do not have any known conflicts of interest.

Data sharing

Unpublished data from the study is available upon request from AR.

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Figures

Figure 1: Flow diagram of included journals and research articles

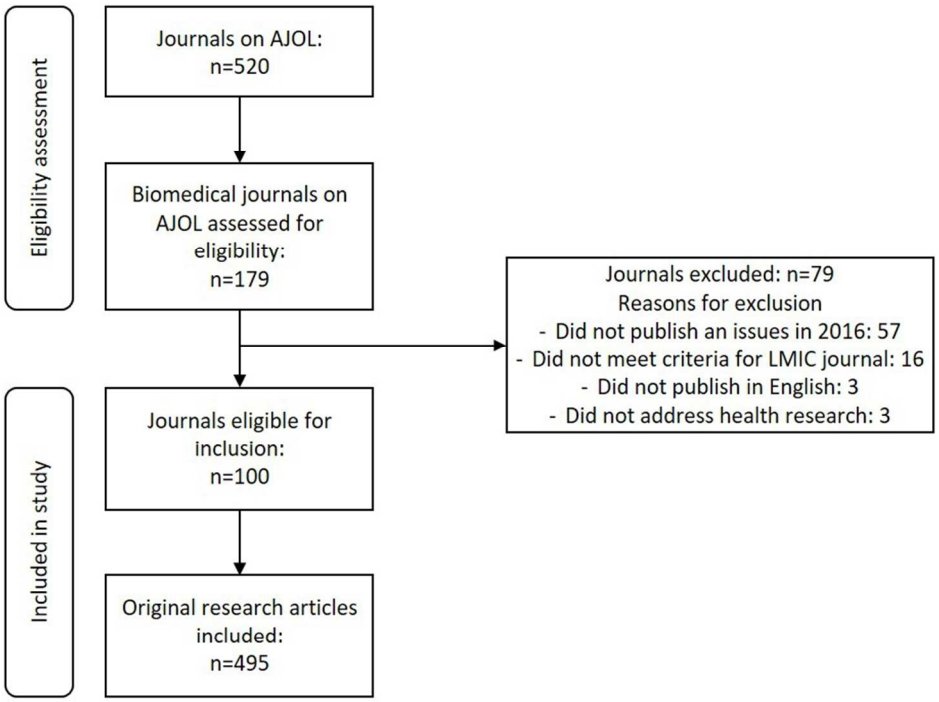

Figure 1: Flow diagram of included journals and research articles

165x129mm (150 x 150 DPI)

Supplementary file 1: Data extraction forms

1.1 Data extraction form for journal policies and guidelines

General information		
Journal name		
Website		
Scope		
Publisher		
Country where publisher is based		
Country where editor in chief is based		
LMIC journal?	Yes	
	No	
Impact factor	Yes	
	No	
Publication frequency		
Open access	Yes	
	No	
Scope general?	Yes	
	No	
Plagiarism		
Policy available	Yes	
	No	
Description on what constitutes plagiarism?	Yes	Describe:
	No	
Reference to plagiarism software?	Yes	
	No	
Consequences of plagiarism described?	Yes	Describe:
	No	
Reference to COPE flow-diagram?	Yes	
	No	
Authorship		
Guideline available	Yes	Describe:
	No	
Guideline in line with updated ICMJE crietira (i.e. 4 criteria)?	Yes	
	No	
Guideline in line with old ICMJE crietira (i.e. 3 criteria)?	Yes	
	No	
Contributorship policy	Yes	Describe:
	No	
Information on acknoweldgement practices	Yes	Describe
	No	
Conflict of interest		
Guideline available	Yes	
	No	

Definition of a conflict of interest	Yes	Describe
	No	
Guidance on what to declare	Yes	
	No	
Funding sources		
Guideline available	Yes	
	No	
Information on what to declare	Yes	Describe
	No	
Guidance on how to declare funding	Yes	Describe
	No	
Funding statement in publication	Yes	
	No	
ICMJE		
Do they mention ICMJE recommendations?	Yes	
	No	
Is there a link to the ICMJE website?	Yes	
	No	
Is there a link to the ICMJE document?	Yes	
	No	
Notes		

1.2 Data extraction form for all research articles

General information		
Study ID		
Type of study		
Number of authors		
Country of contact author		
Authorship		
Did authors disclose contributions of authors?	Yes	Describe
	No	
For each author: Which ICMJE criteria are met?	Yes	
	No	
Are any other contributors listed in the acknowledgement section?	Yes	Describe
	No	
Conflicts of interest		
Did authors declare conflicts of interest	Yes	None known
		Financial conflicts of interest
		Non-financial conflicts of interest
	No	
Funding sources		
Did authors disclose funding sources?	Yes	Commercial funding
		Non-commercial external funding e.g. grants, NPOs, private funders
		No external funding
	No	
Plagiarism		
Turnitin similarity score		

Score >10%?	Yes	
	No	
No plagiarism	Yes	
	No	
Abstract	Plagiarism	Level 1
		Level 2
		Level3
	Redundancy	Level 1
		Level 2
		Level3
Introduction	Plagiarism	Level 1
		Level 2
		Level3
	Redundancy	Level 1
		Level 2
		Level3
Methods	Plagiarism	Level 1
		Level 2
		Level3
	Redundancy	Level 1
		Level 2
		Level3
Results	Plagiarism	Level 1
		Level 2
		Level3
	Redundancy	Level 1
		Level 2
		Level3
Discussion	Plagiarism	Level 1
		Level 2
		Level3
	Redundancy	Level 1
		Level 2
		Level3
Overall	Plagiarism	Mild
		Moderate
		Severe
	Redundancy	Mild
		Moderate
		Severe
Notes		

Supplementary file 2: Dummy OSI report generated by Turnitin

We submitted a dummy text linked to our own work to Turnitin, that generated an OSI report. In this hypothetical example, we demonstrate how we counted copied sentences.

There are few empirical studies on irresponsible research practices from low-and middle income countries (LMICs). Only one of the systematic reviews mentioned above [8] included studies conducted in LMICs – three of the 14 studies that contributed data to the meta-analysis. Published literature focuses on high-income countries and research misconduct in terms of data falsification, data fabrication and plagiarism [6, 9]. In LMICs research outputs are increasing (both locally and with international collaborations), national policies on research integrity are lacking [10] and the pressure to perform and live up to global standards is rising. In this context, adequate systems, processes and guidelines are needed to ensure ethical behaviour, address poor research reporting practices and promote research integrity [11]. Understanding researchers' perceptions of and experiences with good and poor reporting practices is key to inform activities that promote research integrity and further research in this field.

We counted 4 linked copied sentences in this paragraph

We developed and piloted an online questionnaire (Supplementary file 1). We created nine hypothetical scenarios related to guest authorship, ghost authorship, plagiarism, redundant publication and declaration of conflicts of interest. After each scenario, we asked participants to answer three questions in order to elicit responses on participants' understanding and occurrence of acceptable and unacceptable reporting practices. Questions followed a similar pattern for all scenarios. In addition, there was an opportunity to add free-text comments or clarifications after each scenario.

We did not count this sentence as being plagiarised

Results from the survey indicated that guest authorship is a common occurrence. Participants commented extensively on these scenarios, alluding to the relevance and complexity of the problem and providing some reasons for engaging in this practice. Results from the interviews mirrored those of the survey and provided further insight into the magnitude of the problem. Interviewees told many stories describing what happened at institutions and elaborated on the reasons already provided in the survey. Survey respondents thought that omitting an author who had made substantial contributions was unacceptable – yet, they indicated that this did occur at their institutions. Free-text comments on this practice showed that respondents had strong feelings about this, especially where they themselves had experienced omission from publications in the past. These feelings were echoed in the interviews and participants elaborated on the power play between junior and senior researchers. Indeed, this was one of the main themes that emerged from the data.

Survey respondents thought that plagiarism was unacceptable. Quantitative responses were underlined by free-text comments and respondents seemed to be very clear about this form of misconduct. Interviewees reiterated these views. They were very aware of the consequences of plagiarism, one interviewee appropriately saying: *"it's like doping in sports"*.

Of all the irresponsible practices explored, perceptions and occurrence of guest authorship stood out. In light of the availability of international guidelines [20] and journal requirements on contributions of authors, this result is striking although not unexpected when considering results of other studies. A meta-analysis on the misuse of authorship [8] found a self-reported prevalence of 55% (95%CI 45% to 64%) amongst health researchers from countries outside of the USA and UK, including South Africa, India and Bangladesh. A survey conducted amongst medical professionals in India [21] found a high prevalence of guest authorship (65%; 101/155), while in a study conducted in Nigeria, 36% (47/133) of participating health professionals indicated that they had encountered disagreements about authorship [22]. In our survey, 77% (153/198) of respondents indicated that guest authorship occurred at their institutions.

We counted 6 linked copied sentences in this paragraph

Supplementary file 3: Characteristics of included journals

Journal ID	Journal Name	Publisher	Type of publisher	Country		Scope	Open access	First online issue	Impact Factor	Issues/ year	AJPP member	Member of COPE	
				Publisher	Editor-in-Chief							Journal	Publisher
AJOL_1	African Health Sciences	Faculty of Medicine, Makerere University	Non-commercial	Uganda	Uganda	General	Yes	2001	0.642	4	yes	no	no
AJOL_2	African Journal for Physical Activity and Health Sciences	LAM publications Limited	Commercial	South Africa	South Africa	General	No	2002	no	4	no	no	no
AJOL_3	African Journal of Anaesthesia and Intensive Care	Mirral Printing Press	Non-commercial	Nigeria	Nigeria	Specialised	No	2008	no	2	no	no	no
AJOL_4	African Journal of Biomedical Research	Biomedical Communications Group	Non-commercial	Nigeria	Nigeria	General	Yes	1999	no	3	no	no	no
AJOL_5	African Journal of Clinical and Experimental Microbiology	AJCEM Life line publishers	Non-commercial	Nigeria	Nigeria	General	Yes	2002	no	3	no	no	no
AJOL_6	African Journal of Drug and	African Centre for Research and Information	Non-commercial	Nigeria	Nigeria	Specialised	Yes	2008	no	not reported	no	no	no

	Alcohol Studies	on Substance Abuse (CRISA)											
AJOL_7	African Journal of Health Professions Education	Health and medical publishing group	Commercial	South Africa	South Africa	Specialised	Yes	2009	no	2	no	no	no
AJOL_8	African Journal of Health Sciences	Kenya Medical Research Institute and African Forum for Health Sciences	Non-commercial	Kenya	Kenya	General	No	2002	no	4	no	no	no
AJOL_9	African Journal of Infectious Disease	Obafemi Awolowo University	Non-commercial	Nigeria	Nigeria	Specialised	Yes	2007	no	2	no	no	no
AJOL_10	African Journal of Paediatric Nephrology	African Paediatric Nephrology Association (AFPNA)	Non-commercial	Nigeria	Nigeria	Specialised	No	2014	no	2	no	no	no
AJOL_11	African Journal of Paediatric Surgery	Medknow Publications	Commercial	India	Nigeria	Specialised	Yes	2004	no	2	No	No	yes
AJOL_12	African Journal of Reproductive Health	Women's Health and Action Research Centre (WHARC)	Non-commercial	Nigeria	Nigeria	Specialised	No	1999	no	4	no	no	no
AJOL_13	African Journal of Rheumatology	African League of Associations for	Non-commercial	Africa (regional offices in Africa)	South Africa	Specialised	No	2013	no	2	no	no	no

		Rheumatology (AFLAR)											
AJOL_14	African Journal of Traditional, Complementary and Alternative Medicines	African Networks Ethnomedicines	Non-commercial	Nigeria	Nigeria	Specialised	No	2004	0.553	3	no	no	no
AJOL_15	Anatomy Journal of Africa	Association of Anatomical Societies of Africa	Non-commercial	Kenya	Kenya	Specialised	Yes	2012	no	2	no	no	no
AJOL_16	Annals of African Medicine	Medknow Publications	Commercial	India	Nigeria	General	Yes	2002	no	2	no	no	yes
AJOL_17	Annals of African Surgery	The Surgical Society of Kenya/Medics Management services	Non-commercial	Kenya	Kenya	Specialised	Yes	2007	no	2	yes	no	no
AJOL_18	Annals of Ibadan Postgraduate Medicine	Bookbuilders Africa	Commercial	Nigeria	Nigeria	General	Yes	2003	no	2	no	no	no
AJOL_19	Annals of Medical and Health Sciences Research	Medknow Publications	Commercial	India	Nigeria	General	Yes	2011	no	not specified	no	no	yes
AJOL_20	Annals of Nigerian Medicine	Medknow Publications	Commercial	India	Nigeria	General	Yes	2005	no	2	no	no	yes
AJOL_21	Central African	University of Zimbabwe	Non-commercial	Zimbabwe	Zimbabwe	General	No	1999	no	not specified	no	no	no

	Journal of Medicine												
AJOL_22	East African Medical Journal	Kenya Medical Association	Non-commercial	Kenya	Kenya	General	No	1999	no	12	no	no	no
AJOL_23	East African Orthopaedic Journal	Kenya Orthopaedic Association	Non-commercial	Kenya	Kenya	Specialised	Yes	2007	no	2	no	no	no
AJOL_24	East and Central African Journal of Surgery	Association of Surgeons of East Africa/College of surgeons of East Africa (COSECSA)	Non-commercial	Tanzania	Uganda	Specialised	Yes	1996	no	2	no	no	no
AJOL_25	Egyptian Journal of Pediatric Allergy and Immunology (The)	The Egyptian Society of Pediatric Allergy and Immunology	Non-commercial	Egypt	Egypt	Specialised	Yes	2003	no	2	no	no	no
AJOL_26	Ergonomics SA	Ergonomics Society of South Africa	Non-commercial	South Africa	South Africa	Specialised	No	2008	no	2	no	no	no
AJOL_27	Ethiopian Journal of Health Development	Ethiopian Public Health Society	Non-commercial	Ethiopia	Ethiopia	General	Yes	2000	no	3	no	no	no
AJOL_28	Ethiopian Journal of Health Sciences	Jimma University	Non-commercial	Ethiopia	Ethiopia	General	Yes	1999	no	6	yes	yes	no
AJOL_29	Ghana Medical Journal	Ghana Medical Association	Non-commercial	Ghana	Ghana	General	Yes	2004	no	4	yes	yes	no

AJOL_31	Highland Medical Research Journal	Highland Medical Research Limited	Non-commercial	Nigeria	Nigeria	General	No	2002	no	2	no	no	no
AJOL_32	IFE PsychologIA	The Ife Center for Psychological Studie	Non-commercial	Nigeria	Nigeria	Specialised	No	1998	no	2	no	no	no
AJOL_33	International Journal of Basic, Applied and Innovative Research	Anthonio Research publications	Non-commercial	Nigeria	Nigeria	General	Yes	2012	no	4	no	no	no
AJOL_34	International Journal of Herbs and Pharmacological Research	Anthonio Research publications	Non-commercial	Nigeria	Nigeria	Specialised	Yes	2012	no	4	no	no	no
AJOL_35	International Journal of Medicine and Biomedical Research	Michael Joanna Publications	Commercial	Nigeria	Nigeria	General	Yes	2012	no	3	no	yes	no
AJOL_36	Internet Journal of Medical Update - EJOURNAL	AKS publication	Commercial	Mauritius	Mauritius	General	Yes	2006	no	2	no	no	no
AJOL_37	Jos Journal of Medicine	Association of Resident Doctors of Jos University Teaching Hospital	Non-commercial	Nigeria	Nigeria	General	Yes	2009	no	3	no	no	no

AJOL_38	Journal of Basic and Clinical Reproductive Sciences	Nigerian Medical Association	Non-commercial	Nigeria	Nigeria	Specialised	Yes	2012	no	2	no	no	no
AJOL_40	Journal of Community Medicine and Primary Health Care	Association of Community Physicians of Nigeria	Non-commercial	Nigeria	Nigeria	Specialised	Yes	2004	no	2	no	no	no
AJOL_41	Journal of Endocrinology, Metabolism and Diabetes of South Africa	Medpharm Publications	Commercial	South Africa	South Africa	Specialised	Yes	2004	no	3	no	no	no
AJOL_42	Journal of Experimental and Clinical Anatomy	Medknow Publications	Commercial	India	Nigeria	Specialised	Yes	2003	no	2	no	no	yes
AJOL_43	Journal of Medical and Biomedical Sciences	School of Medicine and Health Science, University for Devel-opment Studies	Non-commercial	Ghana	Ghana	General	Yes	2012	no	not specifie d	no	no	no
AJOL_44	Journal of Medicine and Biomedical Research	Fine Print and Manufacturer Ltd	Commercial	Nigeria	Nigeria	General	Yes	2002	no	2	no	no	no
AJOL_45	Journal of Medicine in the Tropics	Medknow Publications	Commercial	India	Nigeria		Yes	2002	no	2	no	no	yes
AJOL_46	Journal of Obstetrics and	Kenya Obstetrical	Non-commercial	Kenya	Kenya	Specialised	No	2011	no	4	no	no	no

	Gynaecology of Eastern and Central Africa	and Gynaecological Society (KOGS)											
AJOL_47	Journal of Pharmaceutical and Allied Sciences	Department of Pharmaceutics University of Nigeria	Non-commercial	Nigeria	Nigeria	General	No	2004	no	2	no	yes	no
AJOL_48	Malawi Medical Journal	College of Medicine, University of Malawi and Medical Association of Malawi.	Non-commercial	Malawi	Malawi	General	Yes	1986	0.837	4	yes	yes	no
AJOL_49	Medical Journal of Zambia	Zambia Medical Association	Non-commercial	Zambia	Zambia	General	Yes	2008	no	3	no	yes	no
AJOL_50	Nigerian Health Journal	Nigerian Medical Association	Non-commercial	Nigeria	Nigeria	General	Yes	2008	no	4	no	no	no
AJOL_51	Nigerian Hospital Practice	CME Ventures	Commercial	Nigeria	Nigeria	General	No	2007	no	24	no	no	no
AJOL_52	Nigerian Journal of Clinical Medicine	Association of Resident Doctors of the Lagos State University Teaching Hospital Ikeja	Non-commercial	Nigeria	Nigeria	General	No	2008	no	2	no	no	no
AJOL_53	Nigerian Journal of Clinical Practice	Medknow Publications	Commercial	India	Nigeria	General	Yes	2001	0.524	6	no	no	yes

AJOL_54	Nigerian Journal of Family Practice	Society of Family Physicians of Nigeria. (SOFPON).	Non-commercial	Nigeria	Nigeria	Specialised	No	2012	no	2	no	no	no
AJOL_55	Nigerian Journal of Gastroenterology and Hepatology	Society for Gastroenterology & Hepathology	Non-commercial	Nigeria	Nigeria	Specialised	No	2009	no	4	no	no	no
AJOL_56	Nigerian Journal of General Practice	Medknow Publications	Commercial	India	Nigeria	General	Yes	2011	no	2	no	no	yes
AJOL_57	Nigerian Journal of Guidance and Counselling	Department of Counsellor Education, University of Ilorin, Ilorin, Nigeri	Non-commercial	Nigeria	Nigeria	Specialised	No	1998	no	1	no	no	no
AJOL_58	Nigerian Journal of Medicine	University of Nigeria	Non-commercial	Nigeria	Nigeria	General	No	2005	no	4	no	no	no
AJOL_59	Nigerian Journal of Natural Products and Medicine	Nigerian Society of Pharmacognosy	Non-commercial	Nigeria	Nigeria	Specialised	No	1997	no	1	no	no	no
AJOL_60	Nigerian Journal of Ophthalmology	Medknow Publications	Commercial	India	Nigeria	Specialised	Yes	2000	no	2	no	no	yes
AJOL_61	Nigerian Journal of Paediatrics	Paediatric Association of Nigeria	Non-commercial	Nigeria	Nigeria	Specialised	Yes	2001	no	4	no	yes	no

AJOL_62	Nigerian Journal of Parasitology	Parasitology and Public Health Society of Nigeria	Non-commercial	Nigeria	Nigeria	Specialised	No	2000	no	2	no	no	no
AJOL_63	Nigerian Journal of Physiological Sciences	Physiological Society of Nigeria	Non-commercial	Nigeria	Nigeria	Specialised	Yes	2003	no	2	no	no	no
AJOL_64	Nigerian Journal of Plastic Surgery	Medknow Publications	Commercial	India	Nigeria	Specialised	Yes	2006	no	2	no	no	yes
AJOL_65	Nigerian Journal of Psychiatry	Associations of Psychiatrists in Nigeria	Non-commercial	Nigeria	Nigeria	Specialised	No	2005	no	3	no	no	no
AJOL_66	Nigerian Journal of Surgery	Medknow Publications	Commercial	India	Nigeria	Specialised	Yes	2009	no	2	no	no	yes
AJOL_67	Nigerian Journal of Surgical Research	Medknow Publications	Commercial	India	Nigeria	Specialised	Yes	2000	no	4	no	no	yes
AJOL_68	Nigerian Journal of Surgical Sciences	Medknow Publications	Commercial	India	Nigeria	Specialised	Yes	2005	no	2	no	no	yes
AJOL_69	Nigerian Medical Journal	Medknow Publications	Commercial	India	Nigeria	General	Yes	2005	no	4	no	no	yes
AJOL_70	Nigerian Medical Practitioner	SAME ventures	Commercial	Nigeria	Nigeria	General	No	2003	no	12	no	no	no
AJOL_71	Nigerian Quarterly Journal of	Lagos University Medical Society	Non-commercial	Nigeria	Nigeria	General	No	2003	no	4	no	no	no

	Hospital Medicine												
AJOL_72	Obstetrics and Gynaecology Forum	In House Publications	Commercial	South Africa	South Africa	Specialised	No	2002	no	4	no	no	no
AJOL_73	Orient Journal of Medicine	Nigerian Medical Association of South-East Nigeria	Non-commercial	Nigeria	Nigeria	General	Yes	2003	no	4	no	no	no
AJOL_74	Pan African Medical Journal	PAMJ-Center for Public Health Research and Information African Field Epidemiology Network	Non-commercial	Kenya	Kenya	General	Yes	2008	no	not specified	no	yes	no
AJOL_75	Port Harcourt Medical Journal	Medknow Publications	Commercial	India	Nigeria	General	Yes	2006	no	3	no	no	yes
AJOL_76	Research Journal of Health Sciences	Osun State University	Non-commercial	Nigeria	Nigeria	General	Yes	2013	no	4	no	no	no
AJOL_77	Rwanda Journal	University of Rwanda	Non-commercial	Rwanda	Rwanda	General	Yes	2013	no	4	yes	no	no
AJOL_78	SA Journal of Radiology	AOSIS publishing	Commercial	South Africa	South Africa	Specialised	Yes	2004	no	4	no	no	yes
AJOL_79	Sahel Medical Journal	Medknow Publications	Commercial	India	Nigeria	General	Yes	2002	no	4	no	no	yes
AJOL_80	Savannah Journal of Medical Research and Practice	University of Ilorin Teaching Hospital	Non-commercial	Nigeria	Nigeria	General	No	2012	no	2	no	no	no

AJOL_81	Sierra Leone Journal of Biomedical Research	College of Medicine and Allied Health Sciences, University of Sierra Leone	Non-commercial	Sierra Leone	Sierra Leone	General	Yes	2009	no	3	yes	yes	no
AJOL_82	South African Family Practice	Medpharm Publications	Commercial	South Africa	South Africa	Specialised	Yes	2002	no	12	no	no	no
AJOL_83	South African Gastroenterology Review	In House Publications	Commercial	South Africa	South Africa	Specialised	No	2003	no	4	no	no	no
AJOL_84	South African Journal for Research in Sport, Physical Education and Recreation	Stellenbosch University	Non-commercial	South Africa	South Africa	Specialised	No	2001	no	2	no	no	no
AJOL_85	South African Journal of Child Health	Health & Medical Publishing Group	Commercial	South Africa	South Africa	Specialised	Yes	2008	no	4	no	no	no
AJOL_86	South African Journal of Clinical Nutrition	Medpharm Publications	Commercial	South Africa	South Africa	Specialised	Yes	2004	no	4	no	no	no
AJOL_87	South African Journal of Obstetrics and Gynaecology	Health & Medical Publishing Group	Commercial	South Africa	South Africa	Specialised	Yes	2005	no	3	no	no	no
AJOL_88	South African Journal of Psychiatry	AOSIS publishing	Commercial	South Africa	South Africa	Specialised	Yes	2002	0.193	1	no	yes	yes
AJOL_89	South African Journal of	South African Sports	Non-commercial	South Africa	South Africa	Specialised	Yes	2003	no	3	no	no	no

	Sports Medicine	Medicine Association											
AJOL_90	South African Journal of Surgery	Health & Medical Publishing Group	Commercial	South Africa	South Africa	Specialised	Yes	2004	0.462	4	no	no	no
AJOL_91	South African Medical Journal	Health & Medical Publishing Group	Commercial	South Africa	South Africa	General	Yes	1983	1.5	12	no	no	no
AJOL_92	South Sudan Medical Journal	South Sudan Doctors' Association	Non-commercial	South Sudan	South Sudan	General	Yes	2008	no	4	no	no	no
AJOL_93	Southern African Journal of Anaesthesia and Analgesia	Medpharm publications	Commercial	South Africa	South Africa	Specialised	Yes	2002	no	6	no	no	no
AJOL_94	Southern African Journal of Critical Care	Health & Medical Publishing Group	Commercial	South Africa	South Africa	Specialised	Yes	2004	no	2	no	no	no
AJOL_95	Southern African Journal of HIV Medicine	AOSIS publishing	Commercial	South Africa	South Africa	Specialised	Yes	2000	0.529	1	no	yes	yes
AJOL_96	Sudan Journal of Medical Sciences	Omdurman Islamic University	Non-commercial	Sudan	Sudan	General	Yes	2006	no	3	no	no	no
AJOL_97	Tanzania Journal of Health Research	National Institute for Medical Research	Non-commercial	Tanzania	Tanzania	General	Yes	2001	no	4	no	no	no
AJOL_98	Tropical Journal of	College of Medicine,	Non-commercial	Nigeria	Nigeria	General	No	2005	no	2	no	no	no

	Health Sciences	University of Ilorin											
AJOL_99	Tropical Journal of Medical Research	Medknow Publications	Commercial	India	Nigeria	General	Yes	2004	no	2	no	no	yes
AJOL_100	Tropical Journal of Obstetrics and Gynaecology	Medknow Publications	Commercial	India	Nigeria	Specialised	Yes	2001	no	2	no	no	yes
AJOL_101	Tropical Journal of Pharmaceutical Research	Pharmacotherapy Group	Non-commercial	Nigeria	Nigeria	Specialised	Yes	2002	0.543	24	no	no	no
AJOL_102	West African Journal of Radiology	Medknow Publications	Commercial	India	Nigeria	Specialised	No	2000	no	1	no	no	yes

Supplementary file 4: Table of excluded journals

Journal Name	Reason
1. Abia State University Medical Students' Association Journal	Last issue in 2015
2. Africa Sanguine	Last issue in 2015
3. African Journal for the Psychological Study of Social Issues	Not health research
4. African Journal of AIDS Research	Not LMIC journal – Editor in chief not in LMIC
5. African Journal of Cross-Cultural Psychology and Sport Facilitation	Last issue 2008
6. African Journal of Environmental Science and Technology	Not LMIC journal – Editor in chief not in LMIC
7. African Journal of Neurological Science	Not LMIC journal – Editor in chief not in LMIC
8. African Journal of Oral Health	Last issue in 2006
9. African Journal of Oral Health Sciences	Last issue in 2008
10. African Journal of Physiotherapy and Rehabilitation Science	Last issue in 2015
11. African Journal of Urology	Not LMIC journal – Publisher not in LMIC
12. Afrimedic Journal	No issue in 2016
13. Alexandria Journal of Medicine	Not LMIC journal – Publisher not in LMIC
14. Annals of Pediatric Surgery	Not LMIC journal – Publisher not in LMIC
15. Arab Journal of Nephrology and Transplantation	Last issue in 2014
16. Archives of Ibadan Medicine	Last issue in 2006
17. Archives of Medical and Biomedical Research	Not LMIC journal – Editor in chief not in LMIC
18. Benin Journal of Postgraduate Medicine	Last issue in 2010
19. Clinics in Mother and Child Health	Not LMIC journal – Editor in chief and publisher not LMIC
20. Continuing Medical Education	Not LMIC journal – Publisher not in LMIC
21. Counsellor (The)	Last issue in 2014
22. Dar Es Salaam Medical Students' Journal	Last issue in 2012
23. East African Journal of Public Health	Last issue in 2015
24. East and Central African Journal of Pharmaceutical Sciences	Last issue in 2013
25. Ebonyi Medical Journal	Last issue in 2012
26. Edo Journal of Counselling	Last issue in 2011
27. Edo Journal of Counselling	Last issue 2011
28. Egyptian Journal of Medical Human Genetics	Not LMIC journal – Publisher not in LMIC
29. Egyptian Journal of Medical Laboratory Sciences	Last issue in 2001
30. Ethiopian Pharmaceutical Journal	Last issue in 2015
31. Gender and Behaviour	Not health research
32. Global Journal of Community Medicine	Last issue in 2009
33. Global Journal of Medical Sciences	Last issue in 2011
34. Health SA Gesondheid	Not LMIC journal – Publisher not in LMIC
35. IMTU Medical Journal	Last issue in 2015
36. Indo-Pacific Journal of Phenomenology	Not LMIC journal – Publisher not in LMIC

37. International Journal of Emotional Psychology and Sport Ethics	Last issue 2008
38. International Journal of Health Research	Last issue in 2012
39. International Journal of Malaria and Tropical Diseases (IJMTD)	Last issue in 2005
40. International Journal of Medicine and Health Development	Last issue in 2014
41. Journal of Biomedical Investigation	Last issue 2009
42. Journal of Child and Adolescent Mental Health	Not LMIC journal – Publisher not in LMIC
43. Journal of Ethiopian Medical Practice	Last issue in 2002
44. Journal of Health and Visual Sciences	Last issue in 2015
45. Journal of Medical Investigation and Practice	Last issue 2015
46. Journal of Medical Laboratory Science	Last issue 2012
47. Journal of Medicine and Medical Science	Last issue in 1999
48. Journal of Phytomedicine and Therapeutics	Last issue 2015
49. Journal of Psychology in Africa	Not a LMIC journal – Publisher not in LMIC
50. Journal of Surgical Technique and Case Report	Last issue 2015
51. Journal of the Eritrean Medical Association	Last issues 2009
52. Journal of the Nigerian Infection Control Association	Last issue 2001
53. Journal of the Nigerian Optometric Associatio	Last issue in 2010
54. Journal of the Obafemi Awolowo University Medical Student's Association (IFEMED)	Last issue in 2014
55. Journal Tunisien d'ORL et de Chirurgie Cervico-Faciale	Publishes in French.
56. Libyan Journal of Medicine	Not LMIC journal – Editor in chief and publisher not in LMIC
57. Mary Slessor Journal of Medicine	Last issue 2013
58. Nigerian Dental Journal	Last issue 2014
59. Nigerian Endocrine Practice	Last issue 2013
60. Nigerian Journal of Clinical and Counselling Psychology	Last issue 2002
61. Nigerian Journal of Health and Biomedical Sciences	Last issue 2010
62. Nigerian Journal of Nutritional Sciences	Last issue 2012
63. Nigerian Journal of Orthopaedics and Trauma	Last issue in 2013
64. Nigerian Journal of Otorhinolaryngology	Last issue in 2006
65. Nigerian Journal of Pharmaceutical Research	Last issue 2011
66. Nigerian Journal of Postgraduate Medicine	Last issue 2010
67. Revue Africaine de Chirurgie et Spécialités	Publishes in French
68. Revue de Médecine et de Pharmacie	Publishes in French
69. Rwanda Journal of Health Sciences	Last issue 2013
70. SAHARA-J: Journal of Social Aspects of HIV/AIDS	Not LMIC journal – Publisher not in LMIC
71. Science et Technique, Sciences de la Santé	Last issue in 2015.
72. Scientific Medical Journal	Last issue 2001
73. Sokoto Journal of Veterinary Sciences	Veterinary Medicine
74. Sudanese Journal of Dermatology	Last issue 2010
75. Tanzania Dental Journal	Last issue 2014
76. Tanzania Medical Journal	Last issue 2015

77. West African Journal of Medicine	Last issue in 2013
78. West African Journal of Pharmacology and Drug Research	Last issue in 2015
79. Zagazig Journal of Occupational Health and Safety	Last issue 2010

Supplementary file 5: Levels of plagiarism and redundancy per section

Total n=495	Any	Level 1: 1-2 sentences copied	Level 2: 3-6 separate sentences copied	Level 3: 4+ linked or 6+ separate sentences copied
Plagiarism				
Abstract	49 (10%)	42 (8%)	6 (1%)	1 (0.2%)
Introduction	232 (47%)	113 (23%)	67 (14%)	52 (11%)
Methods	148 (30%)	86 (17%)	53 (11%)	9 (2%)
Results	15 (3%)	8 (2%)	6 (1%)	1 (0.2%)
Discussion	195 (39%)	89 (18%)	64 (13%)	42 (9%)
Redundancy				
Abstract	16 (3%)	9 (2%)	5 (1%)	2 (0.4%)
Introduction	16 (3%)	7 (1%)	4 (1%)	5 (1%)
Methods	52 (11%)	16 (3%)	20 (4%)	16 (3%)
Results	13 (3%)	5 (1%)	7 (1%)	1 (0.2%)
Discussion	13 (3%)	6 (1%)	6 (1%)	1 (0.2%)

Supplementary file 6: Characteristics of original articles and reviews with plagiarism (n=495)

Characteristic	Overall plagiarism n (%)			
	Any	Some	Moderate	Extensive
Impact factor				
Yes (n=45)	23 (51%)	9 (20%)	10 (22%)	4 (9%)
No (n=450)	290 (64%)	125 (28%)	86 (19%)	79 (18%)
Open Access				
Yes (n=342)	206 (60%)	85 (25%)	64 (19%)	57 (17%)
No (n=153)	107 (70%)	49 (32%)	32 (21%)	26 (17%)
Scope general				
Yes (n=239)	171 (72%)	71 (30%)	58 (24%)	42 (18%)
No (n=256)	142 (55%)	63 (25%)	38 (15%)	41 (16%)
Member of AJPP				
Yes (n=35)	22 (63%)	12 (34%)	6 (17%)	4 (11%)
No (n=460)	291 (63%)	122(27%)	90 (20%)	79 (17%)
Plagiarism policy available				
Yes (n=127)	69 (54%)	31 (24%)	21 (17%)	17 (13%)
No (n=368)	244 (66%)	103 (28%)	75 (20%)	66 (18%)
Reference to text-matching software				
Yes (n=80)	34 (43%)	18 (23%)	11 (14%)	5 (6%)
No (n=415)	279 (67%)	116 (28%)	85 (20%)	78 (19%)
Commercial publisher				
Yes (n=205)	112 (55%)	51 (25%)	33 (16%)	28 (14%)
No (n=290)	201 (69%)	83 (29%)	63 (22%)	55 (19%)
Country of corresponding author				
Nigeria (n=250)	175 (70%)	63 (25%)	63 (25%)	49 (20%)
South Africa (n=83)	32 (39%)	19 (23%)	6 (7%)	7 (8%)
Other African country (n=99)	67 (68%)	33 (33%)	17 (17%)	17 (17%)
Non-African country (n=63)	39 (62%)	19 (30%)	10 (16%)	10 (16%)
Type of study				
Cross-sectional study (n=247)	164 (66%)	78 (32%)	50 (20%)	36 (15%)
Retrospective study (n=65)	40 (62%)	22 (34%)	10 (15%)	8 (12%)
Case Report (n=42)	27 (62%)	10 (24%)	9 (21%)	8 (19%)
Trial (n=36)	23 (64%)	6 (17%)	10 (28%)	7 (19%)
Cohort study (n=22)	9 (41%)	1 (5%)	4 (18%)	4 (18%)
Review, (n=21)	14 (67%)	4 (19%)	0	10 (48%)
Case-control study (n=12)	8 (67%)	0	5 (42%)	3 (25%)
Case Series (n=12)	5 (42%)	3 (25%)	0	2 (17%)
Qualitative study (n=9)	6 (67%)	3 (33%)	3 (33%)	0
Laboratory study (n=8)	6 (75%)	2 (25%)	2 (25%)	2 (25%)
Mixed-methods (n=7)	2 (29%)	1 (14%)	0	1 (14%)
Before-after (n=7)	3 (43%)	2 (29%)	1 (14%)	0
Controlled before-after (n=7)	6 (86%)	2 (29%)	2 (29%)	2 (29%)

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Plagiarism in research: a survey of African medical journals

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Plagiarism in research: a survey of African medical journals

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Abstract

Objectives

To examine whether regional biomedical journals in Africa had policies on plagiarism and procedures to detect it; and to measure the extent of plagiarism in their original research articles and reviews.

Design

Cross-sectional survey

Setting and participants

We selected journals with an editor-in-chief in Africa, a publisher based in a low-or middle-income country (LMIC), and with author guidelines in English, and systematically searched the African Journals Online database (AJOL). From each of the 100 journals identified, we randomly selected five original research articles or reviews published in 2016.

Outcomes

For included journals, we examined the presence of plagiarism policies and whether they referred to text-matching software. We submitted articles to Turnitin and measured the extent of plagiarism (copying of someone else's work) or redundancy (copying of one's own work) against a set of criteria we had developed and piloted.

Results

Of the 100 journals, 26 had a policy on plagiarism, and 16 referred to text-matching software. Of 495 articles, 313 (63%; 95%CI 58 to 68%) had evidence of plagiarism: 17% (83) had at least four linked copied or more than six individual copied sentences; 19% (96) had three to six copied sentences, and the remainder had one or two copied sentences. Plagiarism was more common in the introduction and discussion, and uncommon in the results.

Conclusion

Plagiarism is common in biomedical research articles and reviews published in Africa. Whilst wholesale plagiarism was uncommon, moderate text plagiarism was extensive. This could rapidly be eliminated if journal editors implemented screening strategies including text-matching software.

Strengths and Limitations

- This study is the first to systematically research plagiarism in African biomedical journals.
- We developed a method for reporting the extent of plagiarism beyond the overall similarity index.
- Our analysis was limited to text and excluded images and data.
- The high level of plagiarism we identified could easily be solved by screening all articles with text-matching software and automatic rejection of articles showing plagiarism.
- We used an online source, the African Journals Online database, as the sampling frame for our study.

Introduction

Plagiarism is a serious form of research misconduct when authors copy text, ideas or images from another source, and take credit for it.[1 2] The severity varies from copying short phrases to copying of a whole paper. Besides the amount of text that is copied, assessors should consider how it was referenced, whether the deception was intentional or not, as well as whether the copied text is a commonly used or an original phrase.[3 4] Redundant publication is an umbrella term for reusing one's own work and ranges from reusing large parts of already published text (text-recycling), to publishing parts of the same study in more than one paper (salami slicing) and republishing entire papers (duplicate publication) and is also considered poor practice.[5 6]

The availability of material on the internet facilitates mosaic writing and plagiarism, but the widespread availability of text-matching software has improved detection so there is now more awareness of research integrity and research misconduct, including plagiarism. Policies are clearly available through the Committee on Publication Ethics (COPE), encouraging journal editors to screen submitted manuscripts for plagiarism.[7] Publishing systems and standards have advanced rapidly with online publishing in a global world, and there are some cooperative programmes between the big and local players to help local players keep up with advances. An example of this is the African Journals Partnership Project (AJPP), a programme that partners African journals with mentor journals from the USA and UK.[8]

Estimates of the occurrence of plagiarism are largely based on findings from a systematic review by Pupovac and Fanelli (2014), who reported self-reported plagiarism estimates of 1.7% (95%CI 1.2 to 2.4) for participants admitting to having plagiarised and 30% (95% CI 17 to 46) for participants knowing about others who had done so.[9] However, none of the included studies were conducted in LMICs, although we know from our own work that Cochrane authors in Africa and other LMICs report plagiarism is common in host institutions.[10] Any self-reported estimate is probably not an accurate reflection of actual practice, mainly due to social-desirability bias.[11] Some studies have examined plagiarism more objectively by using text-matching software to screen manuscripts[12-15], however mostly these examined manuscripts submitted to journals (before publication) and none of them included manuscripts submitted to or published in African journals.

We sought to examine whether regional biomedical journals in Africa had policies on plagiarism and procedures to detect it; and to measure the extent of plagiarism in their published original research articles.

Methods

Study design and sample

We surveyed original research articles published in biomedical journals indexed on African Journals Online database (AJOL).[16] Journals were eligible if their current editor-in-chief was based in Africa, the publisher was based in a LMIC (according to the World Bank),[17] if policies and author guidelines were available in English and if the journal published an issue in 2016. All eligible journals were selected. From each eligible journal, we selected articles published in 2016 as original research articles, including qualitative and quantitative primary studies, literature reviews and systematic reviews, published in English. We excluded editorials and letters. We used Microsoft Excel to generate a list of random numbers to select five articles from each eligible journal. We selected five articles per journal, as initial scoping of journals indexed on AJOL revealed substantial variation in the number of published articles per issue, as well as the number of published issues per year.

Data collection

For eligible journals, we downloaded policies and author instructions from the journal's website. We extracted data on the presence and content of policies and guidelines on plagiarism. For original

research articles, we downloaded the full text (PDF) of each article. We extracted data on the number of authors, country of corresponding author and type of study. One author (AR) extracted data using a pre-specified, piloted data extraction form (Supplementary file 1) and entered it into Excel.

We measured the presence and extent of plagiarism (copying of someone else's work) and redundancy (copying of one's own work) in all included research articles. We submitted the PDFs of all articles to Turnitin text-matching software. Turnitin generated a similarity report containing the overall similarity index (OSI), expressed as the percentage of matching text,[18] excluding quotations and references. We manually reviewed all similarity reports with the plagiarism framework (Table 1). As we were not able to find any existing guidance to objectively assess the extent of plagiarism, we developed a framework based on suggestions from COPE[3] and Wager (2014),[4] that propose differentiating between clear plagiarism and minor copying of someone else's (plagiarism) and one's own text (redundancy). We assessed the extent of plagiarism, stratified by which section of the research paper it appeared in.

We identified copied sentences from the similarity reports. Sentences had to be substantially or completely copied. When a sentence had been clearly copied but prefixed by "However" or "Researchers found that…" this was classed as copying; and where plagiarised strings of sentences were detected joined together with conjunctions this was classed as copying (Supplementary file 2). Once we identified a copied sentence, we checked the source of the original sentence, as stated in the similarity report. If the source of the original sentence contained one or more of the authors of the article under investigation, we classified it as redundancy, whereas if the source of the original sentence was from other authors, we classified it as plagiarism.

For each section of the article, we counted the number of copied sentences and assigned one of three levels, depending on the number of copied sentences (Table 1). We then assigned an overall plagiarism category, using the same criteria for each section of the article, to describe the extent of plagiarism, namely "some", "moderate", or "extensive" plagiarism (Table 1). As methods copying was common, and can happen when people are using standard methods, we adjusted the definition to take this into account. Therefore, copying of one to two sentences in the methods section was not regarded as plagiarism, copying of three to six sentences was regarded as some plagiarism and copying of more than six sentences or at least four linked sentences was regarded as moderate plagiarism (Table 1). Overall redundancy was scored in an equivalent way and for each article. Separate scores were given for plagiarism and redundancy.

Development of the framework was an iterative process, and piloted by AR and EW who independently assessed similarity reports of 10 articles and discussed results with the entire research team. Once the team had agreed on the framework, one author (AR) scored all similarity reports using the framework and another author (EW) independently scored a random selection of 10% of reports. Any disagreements in rating were resolved by consensus.

Table 1: Plagiarism framework

	Number of copied sentences detected		
	Level 1	Level 2	Level 3
Abstract	1 to 2	3 to 6	6+; or 4 + linked
Background	1 to 2	3 to 6	6+; or 4 + linked
Methods	1 to 2	3 to 6	6+; or 4 + linked
Results	1 to 2	3 to 6	6+; or 4 + linked
Discussion	1 to 2	3 to 6	6+; or 4 + linked
Overall score	**Some plagiarism**	**Moderate plagiarism**	**Extensive plagiarism**
Definition	One or more sections with plagiarism of one to two sentences; or level 2 plagiarism in the methods section	One or more sections with plagiarism of three to six sentences; or level 3 plagiarism in the methods section	One or more sections with plagiarism of four or more linked sentences, or plagiarism of more than six sentences

Data analysis

We used SPSS (version 25)[19] for analysis and report categorical data as frequencies and proportions and continuous data as medians, means and standard deviations, or modes and ranges. For plagiarism and redundancy, we calculated 95% confidence intervals (CI), adjusted for clustering at the journal level using robust standard errors, with STATA (version 15).[20]

Patient and public involvement

We did not involve patients or the public in this study.

Ethical issues

All data used in this study was available online and is thus in the public domain. To ensure anonymity of authors, we did not include information identifying individual research articles in our report. We obtained an ethics exemption from the Stellenbosch University Health Research Ethics Committee (X17/08/010). Where we detected serious plagiarism in published papers, we identified the journal editors and are currently writing to them, informing them of our findings.

Results

Of the 179 biomedical journals indexed on AJOL, 100 met the eligibility criteria and were included in the study (Figure 1). Detailed characteristics of journals are reported in the table of included journals (Supplementary file 3), while excluded journals are listed in the table of excluded journals (Supplementary file 4).

We selected five original research articles published in the 2016 issue of each journal. Some had not published this number (one journal only published two research articles, and two journals published four research articles). For these we included all research articles published in 2016, giving a total of 495 research articles included (Figure 1).

Plagiarism policies in included journals

Twenty six percent of the journals had a policy on plagiarism mentioned on their website (Table 2). More journals with open (35%) compared to paid (6%) access and more specialised (38%) compared to general (13%) journals mentioned a policy. Journals with a plagiarism policy included both those from non-commercial (22%) and commercial (32%) publishers. Journals with the same commercial publisher generally had similar policies. All journals published by 'AOSIS publications' or 'Health and Medical Publishing Group' had a policy and referred to text-matching software. None of the journals

published by 'Medknow publications' (19 journals) and 'In House publications' (2 journals) mentioned a policy. For 'Medpharm publications', three of the four journals had a plagiarism policy, but only one of these also referred to text-matching software. Of the nine journals with an impact factor, three did not have a policy on plagiarism and six of the seven AJPP member journals had no policy.

Sixteen journals stated that they used text-matching software to check for plagiarism, of these, there were more journals from commercial (24%) than non-commercial publishers (10%); more journals with open (20%) than paid access (3%); and more specialised (25%) than general (6%) journals (Table 2).

Table 2: Plagiarism policies in included journals (n=100)

	Publisher		Access		Scope		Total (n=100)
	Non-commercial publisher (n=59)	Commercial publisher[1] (n=41)	Open access (n=69)	Paid access (n=31)	General (n=48)	Specialised (n=52)	
Plagiarism policy available	13 (22%)	13 (32%)	24 (35%)	2 (6%)	6 (13%)	20 (38%)	26
Definition of plagiarism	5 (8%)	9 (22%)	13 (19%)	1 (3%)	2 (4%)	12 (23%)	14
Reference to text-matching software	6 (10%)	10 (24%)	14 (20%)	2 (6%)	3 (6%)	13 (25%)	16
Consequences of plagiarism described	11 (19%)	10 (24%)	20 (29%)	1 (3%)	6 (13%)	15 (29%)	21
Reference to COPE flowchart	2 (3%)	2 (5%)	3 (4%)	1 (3%)	0	4 (8%)	4

[1]Medknow Publications, based in India (19 journals); Health & Medical Publishing group (6 journals), Medpharm Publications (4 journals), AOSIS Publishing (3 journals) In House publications (2 journals) and LAM publications limited (1 journal), all based in South Africa; Bookbuilders Africa (1 journal), Michael Joanna Publications (1 journal), Fine Print and Manufacturers (1 journal), CME ventures (1 journal) and SAME ventures (1 journal) based in Nigeria; and AKS publications (1 journal), based in Mauritius.

Characteristics of included research articles (n=495)

Characteristics of included research articles are summarised in Table 3. Most articles were published in open-access journals (69%), and about half (48%) in a journal with a general scope; 41% were published in journals from a commercial publisher. Non-commercial publishers included research institutions and academic organizations that published their journals themselves.

Nine journals had an impact factor, and accounted for 9% of the papers included, and seven journals were members of the AJPP (7% of research articles). Articles had a median of three authors (min 1, max 10). Overall, half of the included articles had corresponding authors based in Nigeria. Half (50%) of the included articles represented cross-sectional studies.

Table 3: Summary of characteristics of included articles (n=495)

Characteristic	n (%)

Published in journal with:	
Impact factor	45 (9%)
Open access	342 (69%)
General scope	239 (48%)
Commercial publisher	205 (41%)
AJJP membership	35 (7%)
Country of corresponding author	
Nigeria	250 (51%)
South Africa	83 (17%)
Other African country	99 (20%)
Non-African country	63 (13%)
Type of study	
Cross-sectional study	247 (50%)
Retrospective study	65 (13%)
Case report	42 (9%)
Trial	36 (7%)
Cohort study	22 (4%)
Review	21 (4%)
Case-control study	12 (2%)
Other	50 (10%)

Overall similarity index (OSI) of included articles

A summary of the OSIs for all included articles is reported in Table 4. The median OSI was 15%, with a minimum OSI of 0% and a maximum of 68%. Of all included papers, 90% had an OSI of 30% or less. All five articles with an OSI of 50% or more were published in non-commercial journals.

Table 4: OSI's of included articles (n=495)

OSI	Number of articles (%)
0 to 10%	137 (28)
11 to 20%	202 (41)
21 to 30%	104 (21)
31 to 40%	34 (7)
41 to 50%	13 (3)
51 to 60%	2 (0.4)
61 to 70%	3 (0.6)
71 to 100%	0

Rates and extent of plagiarism and redundancy per section of article

The presence of plagiarism varied across different sections of the articles (Supplementary file 5). We did not find widespread plagiarism or redundancy in the results sections of included articles. Plagiarism was mostly in the introduction of articles (47%) followed by the discussion (39%) and the methods section (30%). The extent of plagiarism also varied across sections, and plagiarism of one to two sentences occurred most commonly. Plagiarism in the introduction comprised one to two copied sentences in 23% of articles, three to six copied discrete sentences in 14% and at least four linked or more than six discrete copied sentences in 11% of articles. In the discussion section, plagiarism comprised one to two copied sentences in 18% of articles, three to six copied sentences in 13% and at least four linked or more than six discrete copied sentences in 9% of articles.

Redundancy was mostly seen in the methods section of included articles (11%), comprising one to two copied sentences in 3% of articles, three to six copied sentences in 4% and at least four linked or more than six discrete copied sentences in 3% of articles (Supplementary file 5).

Overall plagiarism in included articles

We found plagiarism (any level) in 63% articles, comprising some plagiarism in 27%, moderate plagiarism in 19% and extensive plagiarism in 17% of articles (Table 5).

Table 5: Overall plagiarism (n=495)

Plagiarism score	Definition	n	% (95 CI)
Any level of plagiarism	At least one or more sections with plagiarism of one to two sentences; or level 2 plagiarism in the methods section	313	63% (58 to 68%)
Some plagiarism (Level 1)	One or more sections with plagiarism of one to two sentences;	134	27% (23 to 32%)
Moderate plagiarism (Level 2)	One or more sections with plagiarism of three to six sentences; or level 3 plagiarism in the methods section	96	19% (16 to 23%)
Extensive plagiarism (Level 3)	One or more sections with plagiarism of four or more linked sentences, or plagiarism of more than six separate sentences	83	17% (13 to 21%)

We explored the characteristics of articles with plagiarism (Table 6). Articles published in journals that referred to text-matching software tended to have less plagiarism than those in journals that did not refer to text-matching software with rates of 43% vs. 66% respectively for any level of plagiarism and 6% vs. 19% for extensive plagiarism. The difference in plagiarism rates for articles published in a journal with a policy on plagiarism (54%) compared to those published in a journal without a policy on plagiarism (66%) was smaller. Although the proportion of reviews with any plagiarism was comparable to other studies, almost half of all included reviews (48%) had extensive plagiarism.

Table 6: Characteristics of original articles and reviews with plagiarism (n=495)

Characteristic	Overall plagiarism n (%)			
	Any	Some	Moderate	Extensive
Impact factor				
Yes (n=45)	23 (51%)	9 (20%)	10 (22%)	4 (9%)
No (n=450)	290 (64%)	125 (28%)	86 (19%)	79 (18%)
Open Access				
Yes (n=342)	206 (60%)	85 (25%)	64 (19%)	57 (17%)
No (n=153)	107 (70%)	49 (32%)	32 (21%)	26 (17%)
Scope general				
Yes (n=239)	171 (72%)	71 (30%)	58 (24%)	42 (18%)
No (n=256)	142 (55%)	63 (25%)	38 (15%)	41 (16%)
Member of AJPP				
Yes (n=35)	22 (63%)	12 (34%)	6 (17%)	4 (11%)
No (n=460)	291 (63%)	122(27%)	90 (20%)	79 (17%)
Plagiarism policy available				

Yes (n=127)	69 (54%)	31 (24%)	21 (17%)	17 (13%)
No (n=368)	244 (66%)	103 (28%)	75 (20%)	66 (18%)
Reference to text-matching software				
Yes (n=80)	34 (43%)	18 (23%)	11 (14%)	5 (6%)
No (n=415)	279 (67%)	116 (28%)	85 (20%)	78 (19%)
Commercial publisher				
Yes (n=205)	112 (55%)	51 (25%)	33 (16%)	28 (14%)
No (n=290)	201 (69%)	83 (29%)	63 (22%)	55 (19%)
Country of corresponding author				
Nigeria (n=250)	175 (70%)	63 (25%)	63 (25%)	49 (20%)
South Africa (n=83)	32 (39%)	19 (23%)	6 (7%)	7 (8%)
Other African country (n=99)	67 (68%)	33 (33%)	17 (17%)	17 (17%)
Non-African country (n=63)	39 (62%)	19 (30%)	10 (16%)	10 (16%)
Type of study				
Cross-sectional study (n=247)	164 (66%)	78 (32%)	50 (20%)	36 (15%)
Retrospective study (n=65)	40 (62%)	22 (34%)	10 (15%)	8 (12%)
Case report (n=42)	27 (62%)	10 (24%)	9 (21%)	8 (19%)
Trial (n=36)	23 (64%)	6 (17%)	10 (28%)	7 (19%)
Cohort study (n=22)	9 (41%)	1 (5%)	4 (18%)	4 (18%)
Review, (n=21)	14 (67%)	4 (19%)	0	10 (48%)
Case-control study (n=12)	8 (67%)	0	5 (42%)	3 (25%)
Case series (n=12)	5 (42%)	3 (25%)	0	2 (17%)
Qualitative study (n=9)	6 (67%)	3 (33%)	3 (33%)	0
Laboratory study (n=8)	6 (75%)	2 (25%)	2 (25%)	2 (25%)
Mixed-methods (n=7)	2 (29%)	1 (14%)	0	1 (14%)
Before-after (n=7)	3 (43%)	2 (29%)	1 (14%)	0
Controlled before-after (n=7)	6 (86%)	2 (29%)	2 (29%)	2 (29%)

Redundancy was less common than plagiarism. Overall, 11% of articles had any level of redundancy, comprising 4% of articles with some redundancy, 4% with moderate redundancy and 2% with extensive redundancy (Table 7).

Table 7: Overall redundancy (n=495)

Redundancy score	Definition	n	% (95 CI)
Any level of redundancy	At least one or more sections with redundancy of one to two sentences; or level 2 redundancy in the methods section	54	11% (8 to 15%)
Some redundancy (Level 1)	One or more sections with redundancy of one to two sentences; or level 2 redundancy in the methods section	21	4% (3 to 7%)
Moderate redundancy (Level 2)	One or more sections with redundancy of three to six sentences; or level 3 redundancy in the methods section	22	4% (3 to 7%)
Extensive redundancy (Level 3)	One or more sections with redundancy of four or more linked sentences, or redundancy of more than six sentences	11	2% (1 to 4%)

Accuracy of various OSI thresholds

We explored the accuracy of various thresholds of OSIs according to our plagiarism framework (Table 8). With an OSI threshold of 5%, sensitivity was high, meaning that 97% of articles with any level of plagiarism were correctly identified as such and only 3% of articles with any level of plagiarism were missed. However, specificity was low, meaning only 17% of articles without any plagiarism were correctly identified as such and the rate of false positives was high (83%). Increasing the threshold led to a decreased sensitivity and increased specificity.

Table 8: Sensitivity and specificity of various OSI thresholds

OSI threshold	Sensitivity	Specificity
OSI >5%	97%	17%
OSI >10%	84%	51%
OSI >15%	66%	83%

Discussion

Our study is the first to explore actual levels of plagiarism in biomedical journals from Africa. We proposed a framework to measure plagiarism, as an OSI generated by text-matching software on its own is not sufficient to describe the presence and extent of copied text. Indeed, the OSI is only an indication of the proportion (%) of copied text[1] and there is no consensus of an acceptable threshold. Indeed, the reported sensitivity of OSI thresholds varies across studies. In our sample, the sensitivity for an OSI threshold of 10% was 84%, compared to 97% for a threshold of 5%. Taylor and colleagues found an even lower sensitivity of 67% for an OSI threshold of 11.5%, excluding citations and references,[21] while Higgins and colleagues (2016) found that an OSI threshold of 10% yielded a sensitivity of 95.5%.[13] Zhang (2010) used text-matching software to screen manuscripts submitted to a Chinese journal for plagiarism[14] and found that 23% contained plagiarism or redundancy, of which a quarter contained high levels of plagiarism. However, it is not clear how plagiarism was defined. A study from Pakistan that assessed plagiarism of submitted manuscripts[15] found that 39% of papers contained plagiarised text, using a strict definition of the presence of one or more copied sentences. They reported similar results for papers from Turkey and China. A study assessing plagiarism in manuscripts submitted to the Croatian Medical Journal[12] identified plagiarism, defined as an OSI of more than 10% in any section of the manuscript, in 11% (85/754) of manuscripts, of which 8% (63/754) were classified as plagiarism of others, while 3% (22/754) was self-plagiarism (i.e. redundancy). In a sample of 400 manuscripts submitted to an American speciality journal, 17% were found to have at least one copied sentence. Half of these (53%) were regarded as being self-plagiarism.[13] Our study assessed plagiarism in published articles and found a much higher rate of plagiarism than other studies. In our sample, 72% of articles had an OSI above 10%, and 63% (95% CI 58 to 68%) had any level of plagiarism, while 11% (95%CI 8 to 15%) had any level of redundancy. It is possible that the rate of plagiarism in manuscripts submitted to these journals (but not published) is even higher.

In line with recommendations for best practices,[6 7 22] increasing numbers of journal editors and publishers, especially the large publishing houses, make use of text-matching software to screen submitted manuscripts for copied text.[23] But, software licences are expensive and some smaller journals, especially institutional journals and those with non-commercial publishers, may not be able to afford them.[24] Indeed, we found that of the 26% of journals that had a policy of plagiarism, most were from commercial publishers. In addition, only 16% of journals in our sample mentioned the use of text-matching software.

Our framework is limited in that is only measures plagiarism in terms of the number of copied sentences, although it does take into account where in the article the copied text was found. We considered plagiarism in the methods section to be less serious than plagiarism in other sections of the articles, as it is sometime difficult to avoid repeating standard descriptions of methods. [5 25] Our

framework does not, however, consider other aspects of plagiarism, such as how the text was referenced, whether the copied text referred to a standard phrase or common knowledge and whether plagiarism was intentional or not,[4] which are important aspects to consider when making judgements about plagiarism. The framework is also limited to plagiarism of text and does not take into account plagiarism of data or images (which is also a limitation of text-matching software). To test our framework, one author (AR) checked all the articles, and another author (EW) checked a random sample of 10% of articles. While our scores for overall plagiarism were mostly consistent we found that variations depended on how we scored borderline cases in terms of what was considered a completely copied sentence. The framework therefore may lack precision in terms of interrater reliability and test-retest reliability and needs further testing. However, we found that the framework was still a useful tool which facilitated assessment across articles and represented the extent of plagiarism well.

We were interested in regional journals and wanted to examine smaller and non-mainstream journals based in Africa. We considered various sampling frames, but few met our requirements. We chose AJOL to sample journals, as it hosts over 500 journals, including 179 biomedical journals, from over 30 African countries. In addition, journals indexed on AJOL need to meet certain criteria linked to good publishing practices. These include, inter alia, a functioning editorial board, peer-review of content and availability of content in electronic format.[16] In light of the known challenges in identifying and accessing African biomedical journals,[26 27] we thus considered AJOL to be a comprehensive and pragmatic sampling frame, although it does not represent all African biomedical journals.

The recently established African Network for Research Integrity (ANRI) has recognised the need to raise widespread awareness about research integrity among African researchers to prevent poor practices related to plagiarism, redundant publication, authorship and conflicts of interest.[28] Furthermore, the need to build capacity of African journals to improve the quality and visibility of African research has previously been recognised. In an attempt to address this need, the AJPP was initiated in 2004.[8 27] In addition to building capacity of specific member journals, the project has also envisaged that the African members become “regional leaders and share their acquired knowledge and experience with other editors and journals on the continent”.[27] Although only seven of our included journals were members of AJJP, the proportion of articles with any level of plagiarism was the same for member and non-member journals. Only one of the seven AJJP member journals mentioned a policy on plagiarism. It is possible that journals had plagiarism policies but did not mention them on their online information; however, given the actual amount of plagiarism we found, we think this is unlikely, and since one purpose of such policies is to act as a deterrent we believe they should be clearly publicised by journals.

The level of plagiarism in African biomedical journals is concerning. African journals should aim to meet global expectations and follow best practices with regards to their policies and guidelines on plagiarism. This includes using text-matching software to detect plagiarism and redundancy in submitted manuscripts. Not only will this help to verify the originality of submitted work, but it also has the potential to deter poor practices. However, although text-matching software is a useful screening tool, editors should not rely on the OSI on its own. A high similarity score should trigger detailed assessment by a knowledgeable editor, but the possibility of false positives and false negatives should always be borne in mind and was clearly shown in our study. Our plagiarism framework provides an approach to classify the extent of plagiarism. Further testing of the tool is necessary to determine validity and reliability.

This paper has uncovered a major problem with writing and publishing in medical science in Africa needing attention both through institutional development of expectations and good practice in

academic institutions, and development of journal editorial procedures to detect and respond to the problem.

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Contributions of authors

All authors contributed to the design of the study and the development of the plagiarism framework. AR collected and analysed data from journals and articles with input from TY, PG, and EW. AR reviewed all manuscripts using the plagiarism framework and EW independently reviewed 10% of included articles. AR drafted the manuscript. TY, PG and EW critically engaged with the manuscript and provided input. All authors approved the final version of the manuscript.

Competing interests

Paul Garner is part of Cochrane, an organization that routinely uses Turnitin. Elizabeth Wager has given workshops on plagiarism and spoken at a conference funded by Turnitin. Anke Rohwer and Taryn Young do not have any known conflicts of interest.

Data sharing

Unpublished data from the study is available upon request from AR.

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Figures

Figure 1: Flow diagram of included journals and research articles

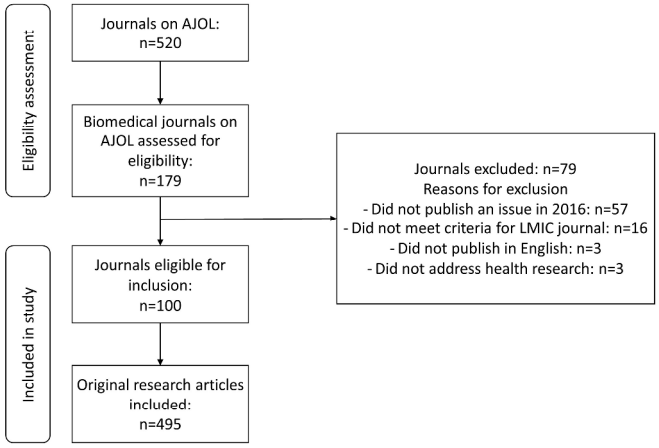

Figure 1: Flow diagram of included journals and research articles

338x190mm (300 x 300 DPI)

Supplementary file 1: Data extraction forms

1.1 Data extraction form for journal policies and guidelines

General information		
Journal name		
Website		
Scope		
Publisher		
Country where publisher is based		
Country where editor in chief is based		
LMIC journal?	Yes	
	No	
Impact factor	Yes	
	No	
Publication frequency		
Open access	Yes	
	No	
Scope general?	Yes	
	No	
Plagiarism		
Policy available	Yes	
	No	
Description on what constitutes plagiarism?	Yes	Describe:
	No	
Reference to plagiarism software?	Yes	
	No	
Consequences of plagiarism described?	Yes	Describe:
	No	
Reference to COPE flow-diagram?	Yes	
	No	
Authorship		
Guideline available	Yes	Describe:
	No	
Guideline in line with updated ICMJE crietira (i.e. 4 criteria)?	Yes	
	No	
Guideline in line with old ICMJE crietira (i.e. 3 criteria)?	Yes	
	No	
Contributorship policy	Yes	Describe:
	No	
Information on acknoweldgement practices	Yes	Describe
	No	
Conflict of interest		
Guideline available	Yes	
	No	

Definition of a conflict of interest	Yes	Describe
	No	
Guidance on what to declare	Yes	
	No	
Funding sources		
Guideline available	Yes	
	No	
Information on what to declare	Yes	Describe
	No	
Guidance on how to declare funding	Yes	Describe
	No	
Funding statement in publication	Yes	
	No	
ICMJE		
Do they mention ICMJE recommendations?	Yes	
	No	
Is there a link to the ICMJE website?	Yes	
	No	
Is there a link to the ICMJE document?	Yes	
	No	
Notes		

1.2 Data extraction form for all research articles

General information		
Study ID		
Type of study		
Number of authors		
Country of contact author		
Authorship		
Did authors disclose contributions of authors?	Yes	Describe
	No	
For each author: Which ICMJE criteria are met?	Yes	
	No	
Are any other contributors listed in the acknowledgement section?	Yes	Describe
	No	
Conflicts of interest		
Did authors declare conflicts of interest	Yes	None known
		Financial conflicts of interest
		Non-financial conflicts of interest
	No	
Funding sources		
Did authors disclose funding sources?	Yes	Commercial funding
		Non-commercial external funding e.g. grants, NPOs, private funders
		No external funding
	No	
Plagiarism		
Turnitin similarity score		

Score >10%?	Yes	
	No	
No plagiarism	Yes	
	No	
Abstract	Plagiarism	Level 1
		Level 2
		Level3
	Redundancy	Level 1
		Level 2
		Level3
Introduction	Plagiarism	Level 1
		Level 2
		Level3
	Redundancy	Level 1
		Level 2
		Level3
Methods	Plagiarism	Level 1
		Level 2
		Level3
	Redundancy	Level 1
		Level 2
		Level3
Results	Plagiarism	Level 1
		Level 2
		Level3
	Redundancy	Level 1
		Level 2
		Level3
Discussion	Plagiarism	Level 1
		Level 2
		Level3
	Redundancy	Level 1
		Level 2
		Level3
Overall	Plagiarism	Mild
		Moderate
		Severe
	Redundancy	Mild
		Moderate
		Severe
Notes		

Supplementary file 2: Dummy OSI report generated by Turnitin

We submitted a dummy text linked to our own work to Turnitin, that generated an OSI report. In this hypothetical example, we demonstrate how we counted copied sentences.

There are few empirical studies on irresponsible research practices from low-and middle income countries (LMICs). Only one of the systematic reviews mentioned above [8] included studies conducted in LMICs – three of the 14 studies that contributed data to the meta-analysis. Published literature focuses on high-income countries and research misconduct in terms of data falsification, data fabrication and plagiarism [6, 9]. In LMICs research outputs are increasing (both locally and with international collaborations), national policies on research integrity are lacking [10] and the pressure to perform and live up to global standards is rising. In this context, adequate systems, processes and guidelines are needed to ensure ethical behaviour, address poor research reporting practices and promote research integrity [11]. Understanding researchers' perceptions of and experiences with good and poor reporting practices is key to inform activities that promote research integrity and further research in this field.

We counted 4 linked copied sentences in this paragraph

We developed and piloted an online questionnaire (Supplementary file 1). We created nine hypothetical scenarios related to guest authorship, ghost authorship, plagiarism, redundant publication and declaration of conflicts of interest. After each scenario, we asked participants to answer three questions in order to elicit responses on participants' understanding and occurrence of acceptable and unacceptable reporting practices. Questions followed a similar pattern for all scenarios. In addition, there was an opportunity to add free-text comments or clarifications after each scenario.

We did not count this sentence as being plagiarised

Results from the survey indicated that guest authorship is a common occurrence. Participants commented extensively on these scenarios, alluding to the relevance and complexity of the problem and providing some reasons for engaging in this practice. Results from the interviews mirrored those of the survey and provided further insight into the magnitude of the problem. Interviewees told many stories describing what happened at institutions and elaborated on the reasons already provided in the survey. Survey respondents thought that omitting an author who had made substantial contributions was unacceptable – yet, they indicated that this did occur at their institutions. Free-text comments on this practice showed that respondents had strong feelings about this, especially where they themselves had experienced omission from publications in the past. These feelings were echoed in the interviews and participants elaborated on the power play between junior and senior researchers. Indeed, this was one of the main themes that emerged from the data.

Survey respondents thought that plagiarism was unacceptable. Quantitative responses were underlined by free-text comments and respondents seemed to be very clear about this form of misconduct. Interviewees reiterated these views. They were very aware of the consequences of plagiarism, one interviewee appropriately saying: *"it's like doping in sports"*.

Of all the irresponsible practices explored, perceptions and occurrence of guest authorship stood out. In light of the availability of international guidelines [20] and journal requirements on contributions of authors, this result is striking although not unexpected when considering results of other studies. A meta-analysis on the misuse of authorship [8] found a self-reported prevalence of 55% (95%CI 45% to 64%) amongst health researchers from countries outside of the USA and UK, including South Africa, India and Bangladesh. A survey conducted amongst medical professionals in India [21] found a high prevalence of guest authorship (65%; 101/155), while in a study conducted in Nigeria, 36% (47/133) of participating health professionals indicated that they had encountered disagreements about authorship [22]. In our survey, 77% (153/198) of respondents indicated that guest authorship occurred at their institutions.

We counted 6 linked copied sentences in this paragraph

Supplementary file 3: Characteristics of included journals

Journal ID	Journal Name	Publisher	Type of publisher	Country		Scope	Open access	First online issue	Impact Factor	Issues/ year	AJPP member	Member of COPE	
				Publisher	Editor-in-Chief							Journal	Publisher
AJOL_1	African Health Sciences	Faculty of Medicine, Makerere University	Non-commercial	Uganda	Uganda	General	Yes	2001	0.642	4	yes	no	no
AJOL_2	African Journal for Physical Activity and Health Sciences	LAM publications Limited	Commercial	South Africa	South Africa	General	No	2002	no	4	no	no	no
AJOL_3	African Journal of Anaesthesia and Intensive Care	Mirral Printing Press	Non-commercial	Nigeria	Nigeria	Specialised	No	2008	no	2	no	no	no
AJOL_4	African Journal of Biomedical Research	Biomedical Communications Group	Non-commercial	Nigeria	Nigeria	General	Yes	1999	no	3	no	no	no
AJOL_5	African Journal of Clinical and Experimental Microbiology	AJCEM Life line publishers	Non-commercial	Nigeria	Nigeria	General	Yes	2002	no	3	no	no	no
AJOL_6	African Journal of Drug and	African Centre for Research and Information	Non-commercial	Nigeria	Nigeria	Specialised	Yes	2008	no	not reported	no	no	no

	Alcohol Studies	on Substance Abuse (CRISA)											
AJOL_7	African Journal of Health Professions Education	Health and medical publishing group	Commercial	South Africa	South Africa	Specialised	Yes	2009	no	2	no	no	no
AJOL_8	African Journal of Health Sciences	Kenya Medical Research Institute and African Forum for Health Sciences	Non-commercial	Kenya	Kenya	General	No	2002	no	4	no	no	no
AJOL_9	African Journal of Infectious Disease	Obafemi Awolowo University	Non-commercial	Nigeria	Nigeria	Specialised	Yes	2007	no	2	no	no	no
AJOL_10	African Journal of Paediatric Nephrology	African Paediatric Nephrology Association (AFPNA)	Non-commercial	Nigeria	Nigeria	Specialised	No	2014	no	2	no	no	no
AJOL_11	African Journal of Paediatric Surgery	Medknow Publications	Commercial	India	Nigeria	Specialised	Yes	2004	no	2	No	No	yes
AJOL_12	African Journal of Reproductive Health	Women's Health and Action Research Centre (WHARC)	Non-commercial	Nigeria	Nigeria	Specialised	No	1999	no	4	no	no	no
AJOL_13	African Journal of Rheumatology	African League of Associations for	Non-commercial	Africa (regional offices in Africa)	South Africa	Specialised	No	2013	no	2	no	no	no

		Rheumatology (AFLAR)											
AJOL_14	African Journal of Traditional, Complementary and Alternative Medicines	African Networks Ethnomedicines	Non-commercial	Nigeria	Nigeria	Specialised	No	2004	0.553	3	no	no	no
AJOL_15	Anatomy Journal of Africa	Association of Anatomical Societies of Africa	Non-commercial	Kenya	Kenya	Specialised	Yes	2012	no	2	no	no	no
AJOL_16	Annals of African Medicine	Medknow Publications	Commercial	India	Nigeria	General	Yes	2002	no	2	no	no	yes
AJOL_17	Annals of African Surgery	The Surgical Society of Kenya/Medics Management services	Non-commercial	Kenya	Kenya	Specialised	Yes	2007	no	2	yes	no	no
AJOL_18	Annals of Ibadan Postgraduate Medicine	Bookbuilders Africa	Commercial	Nigeria	Nigeria	General	Yes	2003	no	2	no	no	no
AJOL_19	Annals of Medical and Health Sciences Research	Medknow Publications	Commercial	India	Nigeria	General	Yes	2011	no	not specified	no	no	yes
AJOL_20	Annals of Nigerian Medicine	Medknow Publications	Commercial	India	Nigeria	General	Yes	2005	no	2	no	no	yes
AJOL_21	Central African	University of Zimbabwe	Non-commercial	Zimbabwe	Zimbabwe	General	No	1999	no	not specified	no	no	no

	Journal of Medicine												
AJOL_22	East African Medical Journal	Kenya Medical Association	Non-commercial	Kenya	Kenya	General	No	1999	no	12	no	no	no
AJOL_23	East African Orthopaedic Journal	Kenya Orthopaedic Association	Non-commercial	Kenya	Kenya	Specialised	Yes	2007	no	2	no	no	no
AJOL_24	East and Central African Journal of Surgery	Association of Surgeons of East Africa/College of surgeons of East Africa (COSECSA)	Non-commercial	Tanzania	Uganda	Specialised	Yes	1996	no	2	no	no	no
AJOL_25	Egyptian Journal of Pediatric Allergy and Immunology (The)	The Egyptian Society of Pediatric Allergy and Immunology	Non-commercial	Egypt	Egypt	Specialised	Yes	2003	no	2	no	no	no
AJOL_26	Ergonomics SA	Ergonomics Society of South Africa	Non-commercial	South Africa	South Africa	Specialised	No	2008	no	2	no	no	no
AJOL_27	Ethiopian Journal of Health Development	Ethiopian Public Health Society	Non-commercial	Ethiopia	Ethiopia	General	Yes	2000	no	3	no	no	no
AJOL_28	Ethiopian Journal of Health Sciences	Jimma University	Non-commercial	Ethiopia	Ethiopia	General	Yes	1999	no	6	yes	yes	no
AJOL_29	Ghana Medical Journal	Ghana Medical Association	Non-commercial	Ghana	Ghana	General	Yes	2004	no	4	yes	yes	no

AJOL_31	Highland Medical Research Journal	Highland Medical Research Limited	Non-commercial	Nigeria	Nigeria	General	No	2002	no	2	no	no	no
AJOL_32	IFE PsychologIA	The Ife Center for Psychological Studie	Non-commercial	Nigeria	Nigeria	Specialised	No	1998	no	2	no	no	no
AJOL_33	International Journal of Basic, Applied and Innovative Research	Anthonio Research publications	Non-commercial	Nigeria	Nigeria	General	Yes	2012	no	4	no	no	no
AJOL_34	International Journal of Herbs and Pharmacological Research	Anthonio Research publications	Non-commercial	Nigeria	Nigeria	Specialised	Yes	2012	no	4	no	no	no
AJOL_35	International Journal of Medicine and Biomedical Research	Michael Joanna Publications	Commercial	Nigeria	Nigeria	General	Yes	2012	no	3	no	yes	no
AJOL_36	Internet Journal of Medical Update - EJOURNAL	AKS publication	Commercial	Mauritius	Mauritius	General	Yes	2006	no	2	no	no	no
AJOL_37	Jos Journal of Medicine	Association of Resident Doctors of Jos University Teaching Hospital	Non-commercial	Nigeria	Nigeria	General	Yes	2009	no	3	no	no	no

AJOL_38	Journal of Basic and Clinical Reproductive Sciences	Nigerian Medical Association	Non-commercial	Nigeria	Nigeria	Specialised	Yes	2012	no	2	no	no	no
AJOL_40	Journal of Community Medicine and Primary Health Care	Association of Community Physicians of Nigeria	Non-commercial	Nigeria	Nigeria	Specialised	Yes	2004	no	2	no	no	no
AJOL_41	Journal of Endocrinology, Metabolism and Diabetes of South Africa	Medpharm Publications	Commercial	South Africa	South Africa	Specialised	Yes	2004	no	3	no	no	no
AJOL_42	Journal of Experimental and Clinical Anatomy	Medknow Publications	Commercial	India	Nigeria	Specialised	Yes	2003	no	2	no	no	yes
AJOL_43	Journal of Medical and Biomedical Sciences	School of Medicine and Health Science, University for Devel-opment Studies	Non-commercial	Ghana	Ghana	General	Yes	2012	no	not specifie d	no	no	no
AJOL_44	Journal of Medicine and Biomedical Research	Fine Print and Manufacturer Ltd	Commercial	Nigeria	Nigeria	General	Yes	2002	no	2	no	no	no
AJOL_45	Journal of Medicine in the Tropics	Medknow Publications	Commercial	India	Nigeria		Yes	2002	no	2	no	no	yes
AJOL_46	Journal of Obstetrics and	Kenya Obstetrical	Non-commercial	Kenya	Kenya	Specialised	No	2011	no	4	no	no	no

	Gynaecology of Eastern and Central Africa	and Gynaecological Society (KOGS)											
AJOL_47	Journal of Pharmaceutical and Allied Sciences	Department of Pharmaceutics University of Nigeria	Non-commercial	Nigeria	Nigeria	General	No	2004	no	2	no	yes	no
AJOL_48	Malawi Medical Journal	College of Medicine, University of Malawi and Medical Association of Malawi.	Non-commercial	Malawi	Malawi	General	Yes	1986	0.837	4	yes	yes	no
AJOL_49	Medical Journal of Zambia	Zambia Medical Association	Non-commercial	Zambia	Zambia	General	Yes	2008	no	3	no	yes	no
AJOL_50	Nigerian Health Journal	Nigerian Medical Association	Non-commercial	Nigeria	Nigeria	General	Yes	2008	no	4	no	no	no
AJOL_51	Nigerian Hospital Practice	CME Ventures	Commercial	Nigeria	Nigeria	General	No	2007	no	24	no	no	no
AJOL_52	Nigerian Journal of Clinical Medicine	Association of Resident Doctors of the Lagos State University Teaching Hospital Ikeja	Non-commercial	Nigeria	Nigeria	General	No	2008	no	2	no	no	no
AJOL_53	Nigerian Journal of Clinical Practice	Medknow Publications	Commercial	India	Nigeria	General	Yes	2001	0.524	6	no	no	yes

AJOL_54	Nigerian Journal of Family Practice	Society of Family Physicians of Nigeria. (SOFPON).	Non-commercial	Nigeria	Nigeria	Specialised	No	2012	no	2	no	no	no
AJOL_55	Nigerian Journal of Gastroenterology and Hepatology	Society for Gastroenterology & Hepathology	Non-commercial	Nigeria	Nigeria	Specialised	No	2009	no	4	no	no	no
AJOL_56	Nigerian Journal of General Practice	Medknow Publications	Commercial	India	Nigeria	General	Yes	2011	no	2	no	no	yes
AJOL_57	Nigerian Journal of Guidance and Counselling	Department of Counsellor Education, University of Ilorin, Ilorin, Nigeri	Non-commercial	Nigeria	Nigeria	Specialised	No	1998	no	1	no	no	no
AJOL_58	Nigerian Journal of Medicine	University of Nigeria	Non-commercial	Nigeria	Nigeria	General	No	2005	no	4	no	no	no
AJOL_59	Nigerian Journal of Natural Products and Medicine	Nigerian Society of Pharmacognosy	Non-commercial	Nigeria	Nigeria	Specialised	No	1997	no	1	no	no	no
AJOL_60	Nigerian Journal of Ophthalmology	Medknow Publications	Commercial	India	Nigeria	Specialised	Yes	2000	no	2	no	no	yes
AJOL_61	Nigerian Journal of Paediatrics	Paediatric Association of Nigeria	Non-commercial	Nigeria	Nigeria	Specialised	Yes	2001	no	4	no	yes	no

AJOL_62	Nigerian Journal of Parasitology	Parasitology and Public Health Society of Nigeria	Non-commercial	Nigeria	Nigeria	Specialised	No	2000	no	2	no	no	no
AJOL_63	Nigerian Journal of Physiological Sciences	Physiological Society of Nigeria	Non-commercial	Nigeria	Nigeria	Specialised	Yes	2003	no	2	no	no	no
AJOL_64	Nigerian Journal of Plastic Surgery	Medknow Publications	Commercial	India	Nigeria	Specialised	Yes	2006	no	2	no	no	yes
AJOL_65	Nigerian Journal of Psychiatry	Associations of Psychiatrists in Nigeria	Non-commercial	Nigeria	Nigeria	Specialised	No	2005	no	3	no	no	no
AJOL_66	Nigerian Journal of Surgery	Medknow Publications	Commercial	India	Nigeria	Specialised	Yes	2009	no	2	no	no	yes
AJOL_67	Nigerian Journal of Surgical Research	Medknow Publications	Commercial	India	Nigeria	Specialised	Yes	2000	no	4	no	no	yes
AJOL_68	Nigerian Journal of Surgical Sciences	Medknow Publications	Commercial	India	Nigeria	Specialised	Yes	2005	no	2	no	no	yes
AJOL_69	Nigerian Medical Journal	Medknow Publications	Commercial	India	Nigeria	General	Yes	2005	no	4	no	no	yes
AJOL_70	Nigerian Medical Practitioner	SAME ventures	Commercial	Nigeria	Nigeria	General	No	2003	no	12	no	no	no
AJOL_71	Nigerian Quarterly Journal of	Lagos University Medical Society	Non-commercial	Nigeria	Nigeria	General	No	2003	no	4	no	no	no

	Hospital Medicine												
AJOL_72	Obstetrics and Gynaecology Forum	In House Publications	Commercial	South Africa	South Africa	Specialised	No	2002	no	4	no	no	no
AJOL_73	Orient Journal of Medicine	Nigerian Medical Association of South-East Nigeria	Non-commercial	Nigeria	Nigeria	General	Yes	2003	no	4	no	no	no
AJOL_74	Pan African Medical Journal	PAMJ-Center for Public Health Research and Information African Field Epidemiology Network	Non-commercial	Kenya	Kenya	General	Yes	2008	no	not specified	no	yes	no
AJOL_75	Port Harcourt Medical Journal	Medknow Publications	Commercial	India	Nigeria	General	Yes	2006	no	3	no	no	yes
AJOL_76	Research Journal of Health Sciences	Osun State University	Non-commercial	Nigeria	Nigeria	General	Yes	2013	no	4	no	no	no
AJOL_77	Rwanda Journal	University of Rwanda	Non-commercial	Rwanda	Rwanda	General	Yes	2013	no	4	yes	no	no
AJOL_78	SA Journal of Radiology	AOSIS publishing	Commercial	South Africa	South Africa	Specialised	Yes	2004	no	4	no	no	yes
AJOL_79	Sahel Medical Journal	Medknow Publications	Commercial	India	Nigeria	General	Yes	2002	no	4	no	no	yes
AJOL_80	Savannah Journal of Medical Research and Practice	University of Ilorin Teaching Hospital	Non-commercial	Nigeria	Nigeria	General	No	2012	no	2	no	no	no

AJOL_81	Sierra Leone Journal of Biomedical Research	College of Medicine and Allied Health Sciences, University of Sierra Leone	Non-commercial	Sierra Leone	Sierra Leone	General	Yes	2009	no	3	yes	yes	no
AJOL_82	South African Family Practice	Medpharm Publications	Commercial	South Africa	South Africa	Specialised	Yes	2002	no	12	no	no	no
AJOL_83	South African Gastroenterology Review	In House Publications	Commercial	South Africa	South Africa	Specialised	No	2003	no	4	no	no	no
AJOL_84	South African Journal for Research in Sport, Physical Education and Recreation	Stellenbosch University	Non-commercial	South Africa	South Africa	Specialised	No	2001	no	2	no	no	no
AJOL_85	South African Journal of Child Health	Health & Medical Publishing Group	Commercial	South Africa	South Africa	Specialised	Yes	2008	no	4	no	no	no
AJOL_86	South African Journal of Clinical Nutrition	Medpharm Publications	Commercial	South Africa	South Africa	Specialised	Yes	2004	no	4	no	no	no
AJOL_87	South African Journal of Obstetrics and Gynaecology	Health & Medical Publishing Group	Commercial	South Africa	South Africa	Specialised	Yes	2005	no	3	no	no	no
AJOL_88	South African Journal of Psychiatry	AOSIS publishing	Commercial	South Africa	South Africa	Specialised	Yes	2002	0.193	1	no	yes	yes
AJOL_89	South African Journal of	South African Sports	Non-commercial	South Africa	South Africa	Specialised	Yes	2003	no	3	no	no	no

	Sports Medicine	Medicine Association											
AJOL_90	South African Journal of Surgery	Health & Medical Publishing Group	Commercial	South Africa	South Africa	Specialised	Yes	2004	0.462	4	no	no	no
AJOL_91	South African Medical Journal	Health & Medical Publishing Group	Commercial	South Africa	South Africa	General	Yes	1983	1.5	12	no	no	no
AJOL_92	South Sudan Medical Journal	South Sudan Doctors' Association	Non-commercial	South Sudan	South Sudan	General	Yes	2008	no	4	no	no	no
AJOL_93	Southern African Journal of Anaesthesia and Analgesia	Medpharm publications	Commercial	South Africa	South Africa	Specialised	Yes	2002	no	6	no	no	no
AJOL_94	Southern African Journal of Critical Care	Health & Medical Publishing Group	Commercial	South Africa	South Africa	Specialised	Yes	2004	no	2	no	no	no
AJOL_95	Southern African Journal of HIV Medicine	AOSIS publishing	Commercial	South Africa	South Africa	Specialised	Yes	2000	0.529	1	no	yes	yes
AJOL_96	Sudan Journal of Medical Sciences	Omdurman Islamic University	Non-commercial	Sudan	Sudan	General	Yes	2006	no	3	no	no	no
AJOL_97	Tanzania Journal of Health Research	National Institute for Medical Research	Non-commercial	Tanzania	Tanzania	General	Yes	2001	no	4	no	no	no
AJOL_98	Tropical Journal of	College of Medicine,	Non-commercial	Nigeria	Nigeria	General	No	2005	no	2	no	no	no

	Health Sciences	University of Ilorin											
AJOL_99	Tropical Journal of Medical Research	Medknow Publications	Commercial	India	Nigeria	General	Yes	2004	no	2	no	no	yes
AJOL_100	Tropical Journal of Obstetrics and Gynaecology	Medknow Publications	Commercial	India	Nigeria	Specialised	Yes	2001	no	2	no	no	yes
AJOL_101	Tropical Journal of Pharmaceutical Research	Pharmacotherapy Group	Non-commercial	Nigeria	Nigeria	Specialised	Yes	2002	0.543	24	no	no	no
AJOL_102	West African Journal of Radiology	Medknow Publications	Commercial	India	Nigeria	Specialised	No	2000	no	1	no	no	yes

Supplementary file 4: Table of excluded journals

Journal Name	Reason
1. Abia State University Medical Students' Association Journal	Last issue in 2015
2. Africa Sanguine	Last issue in 2015
3. African Journal for the Psychological Study of Social Issues	Not health research
4. African Journal of AIDS Research	Not LMIC journal – Editor in chief not in LMIC
5. African Journal of Cross-Cultural Psychology and Sport Facilitation	Last issue 2008
6. African Journal of Environmental Science and Technology	Not LMIC journal – Editor in chief not in LMIC
7. African Journal of Neurological Science	Not LMIC journal – Editor in chief not in LMIC
8. African Journal of Oral Health	Last issue in 2006
9. African Journal of Oral Health Sciences	Last issue in 2008
10. African Journal of Physiotherapy and Rehabilitation Science	Last issue in 2015
11. African Journal of Urology	Not LMIC journal – Publisher not in LMIC
12. Afrimedic Journal	No issue in 2016
13. Alexandria Journal of Medicine	Not LMIC journal – Publisher not in LMIC
14. Annals of Pediatric Surgery	Not LMIC journal – Publisher not in LMIC
15. Arab Journal of Nephrology and Transplantation	Last issue in 2014
16. Archives of Ibadan Medicine	Last issue in 2006
17. Archives of Medical and Biomedical Research	Not LMIC journal – Editor in chief not in LMIC
18. Benin Journal of Postgraduate Medicine	Last issue in 2010
19. Clinics in Mother and Child Health	Not LMIC journal – Editor in chief and publisher not LMIC
20. Continuing Medical Education	Not LMIC journal – Publisher not in LMIC
21. Counsellor (The)	Last issue in 2014
22. Dar Es Salaam Medical Students' Journal	Last issue in 2012
23. East African Journal of Public Health	Last issue in 2015
24. East and Central African Journal of Pharmaceutical Sciences	Last issue in 2013
25. Ebonyi Medical Journal	Last issue in 2012
26. Edo Journal of Counselling	Last issue in 2011
27. Edo Journal of Counselling	Last issue 2011
28. Egyptian Journal of Medical Human Genetics	Not LMIC journal – Publisher not in LMIC
29. Egyptian Journal of Medical Laboratory Sciences	Last issue in 2001
30. Ethiopian Pharmaceutical Journal	Last issue in 2015
31. Gender and Behaviour	Not health research
32. Global Journal of Community Medicine	Last issue in 2009
33. Global Journal of Medical Sciences	Last issue in 2011
34. Health SA Gesondheid	Not LMIC journal – Publisher not in LMIC
35. IMTU Medical Journal	Last issue in 2015
36. Indo-Pacific Journal of Phenomenology	Not LMIC journal – Publisher not in LMIC

37. International Journal of Emotional Psychology and Sport Ethics	Last issue 2008
38. International Journal of Health Research	Last issue in 2012
39. International Journal of Malaria and Tropical Diseases (IJMTD)	Last issue in 2005
40. International Journal of Medicine and Health Development	Last issue in 2014
41. Journal of Biomedical Investigation	Last issue 2009
42. Journal of Child and Adolescent Mental Health	Not LMIC journal – Publisher not in LMIC
43. Journal of Ethiopian Medical Practice	Last issue in 2002
44. Journal of Health and Visual Sciences	Last issue in 2015
45. Journal of Medical Investigation and Practice	Last issue 2015
46. Journal of Medical Laboratory Science	Last issue 2012
47. Journal of Medicine and Medical Science	Last issue in 1999
48. Journal of Phytomedicine and Therapeutics	Last issue 2015
49. Journal of Psychology in Africa	Not a LMIC journal – Publisher not in LMIC
50. Journal of Surgical Technique and Case Report	Last issue 2015
51. Journal of the Eritrean Medical Association	Last issues 2009
52. Journal of the Nigerian Infection Control Association	Last issue 2001
53. Journal of the Nigerian Optometric Associatio	Last issue in 2010
54. Journal of the Obafemi Awolowo University Medical Student's Association (IFEMED)	Last issue in 2014
55. Journal Tunisien d'ORL et de Chirurgie Cervico-Faciale	Publishes in French.
56. Libyan Journal of Medicine	Not LMIC journal – Editor in chief and publisher not in LMIC
57. Mary Slessor Journal of Medicine	Last issue 2013
58. Nigerian Dental Journal	Last issue 2014
59. Nigerian Endocrine Practice	Last issue 2013
60. Nigerian Journal of Clinical and Counselling Psychology	Last issue 2002
61. Nigerian Journal of Health and Biomedical Sciences	Last issue 2010
62. Nigerian Journal of Nutritional Sciences	Last issue 2012
63. Nigerian Journal of Orthopaedics and Trauma	Last issue in 2013
64. Nigerian Journal of Otorhinolaryngology	Last issue in 2006
65. Nigerian Journal of Pharmaceutical Research	Last issue 2011
66. Nigerian Journal of Postgraduate Medicine	Last issue 2010
67. Revue Africaine de Chirurgie et Spécialités	Publishes in French
68. Revue de Médecine et de Pharmacie	Publishes in French
69. Rwanda Journal of Health Sciences	Last issue 2013
70. SAHARA-J: Journal of Social Aspects of HIV/AIDS	Not LMIC journal – Publisher not in LMIC
71. Science et Technique, Sciences de la Santé	Last issue in 2015.
72. Scientific Medical Journal	Last issue 2001
73. Sokoto Journal of Veterinary Sciences	Veterinary Medicine
74. Sudanese Journal of Dermatology	Last issue 2010
75. Tanzania Dental Journal	Last issue 2014
76. Tanzania Medical Journal	Last issue 2015

77. West African Journal of Medicine	Last issue in 2013
78. West African Journal of Pharmacology and Drug Research	Last issue in 2015
79. Zagazig Journal of Occupational Health and Safety	Last issue 2010

Supplementary file 5: Levels of plagiarism and redundancy per section

Total n=495	Any	Level 1: 1-2 sentences copied	Level 2: 3-6 separate sentences copied	Level 3: 4+ linked or 6+ separate sentences copied
Plagiarism				
Abstract	49 (10%)	42 (8%)	6 (1%)	1 (0.2%)
Introduction	232 (47%)	113 (23%)	67 (14%)	52 (11%)
Methods	148 (30%)	86 (17%)	53 (11%)	9 (2%)
Results	15 (3%)	8 (2%)	6 (1%)	1 (0.2%)
Discussion	195 (39%)	89 (18%)	64 (13%)	42 (9%)
Redundancy				
Abstract	16 (3%)	9 (2%)	5 (1%)	2 (0.4%)
Introduction	16 (3%)	7 (1%)	4 (1%)	5 (1%)
Methods	52 (11%)	16 (3%)	20 (4%)	16 (3%)
Results	13 (3%)	5 (1%)	7 (1%)	1 (0.2%)
Discussion	13 (3%)	6 (1%)	6 (1%)	1 (0.2%)