"Blacklists" and "whitelists" to tackle predatory publishing: A cross-sectional comparison and thematic analysis

Michaela Strinzel[1], Anna Severin[1,2], Kathrin Milzow[1], Matthias Egger[1,2]

[1] Swiss National Science Foundation, Bern, Switzerland

[2] Institute of Social and Preventive Medicine (ISPM), University of Bern, Switzerland

Corresponding Author:

Michaela Strinzel[1]

Wildhainweg 3, CH-3001 Bern

Email address: michaela.strinzel@snf.ch

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Abstract

Background. Despite growing awareness of predatory publishing and research on its market characteristics, the defining attributes of fraudulent journals remain controversial. We aimed to develop a better understanding of quality criteria for scholarly journals by analysing journals and publishers indexed in blacklists of predatory journals and whitelists of legitimate journals and the lists' inclusion criteria.

Methods. We searched for blacklists and whitelists in early 2018. Lists that included journals across disciplines were eligible. We used a mixed methods approach, combining quantitative and qualitative analyses. To quantify overlaps between lists in terms of indexed journals and publishers we employed the Jaro-Winkler string metric and Venn diagrams. To identify topics addressed by the lists' inclusion criteria and to derive their broader conceptual categories, we used a qualitative coding approach.

Results. Two blacklists (Beall's and Cabell's) and two whitelists (DOAJ and Cabell's) were eligible. The number of journals per list ranged from 1404 to 12357 and the number of publishers from 473 to 5638. Seventy-three journals and 42 publishers were included both in a blacklist and whitelist. A total of 198 inclusion criteria were examined. Seven thematic themes were identified: (i) peer review, (ii) editorial services, (iii) policy, (iv) business practices, (v) publishing, archiving and access, (vi) website and (vii) indexing and metrics. Business practices accounted for almost half of blacklists' criteria, whereas whitelists gave more emphasis to criteria related to policy and guidelines. Criteria were grouped into four broad concepts: (i) transparency, (ii) ethics, (iii) professional standards and (iv) peer review and other services. Whitelists gave more weight to transparency whereas blacklists focused on ethics and professional standards. The criteria included in whitelists were easier to verify than those used in blacklists. Both types of list gave relatively little emphasis to the quality of peer review.

Conclusions. There is overlap between journals and publishers included in blacklists and whitelists. Blacklists and whitelists differ in their criteria for quality and the weight given to different dimensions of quality. Aspects that are central but difficult to verify receive insufficient attention.

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Introduction

There is increasing concern in the scientific community and society about “predatory” journals, also called fake, pseudo or fraudulent journals. These allegedly scholarly open access (OA) publishing outlets employ a range of unethical publishing practices: despite claiming otherwise and charging for it, they do not provide editorial services and scientific quality control. There is widespread agreement that fraudulent journals pose a threat to the integrity of scholarly publishing and the credibility of academic research [1–7].

There have been various attempts to derive criteria to characterize and identify predatory journals, in order to support researchers in avoiding respective research outlets. These attempts include the compilation of lists of fraudulent journals (“blacklists”) or trustworthy journals (“whitelists”). The best-known list is the blacklist of "potential, possible, or probable predatory scholarly open-access journals" (further referred to as Beall’s list) by Jeffrey Beall, a librarian based at University of Colorado Denver who coined the term “predatory” journal in 2015 [8]. Beall took his list down in 2017, probably due to an increasing number of lawsuits from the publishers included in the list [7]. At present, the list is maintained and updated by an anonymous scholar at a different site [9]. While blacklists aim to expose and thus warn against presumed fraudulent journals, whitelists take the inverse approach by providing an index of vetted, presumed legitimate publishing outlets. The selection of journals considered for inclusion in such lists is based on a set of criteria, which a journal has to comply with in order to be included. Predominantly, whitelist criteria refer to proficiency and adherence to best practices to confirm the legitimacy of a journal. In the case of blacklists, these criteria describe undesirable, unethical and deceptive practices that are believed to characterize fraudulent journals. [10]. As such, the two types of lists present different perspectives on the same challenge: assuring quality and legitimacy of academic publishing practices. Approaches other than blacklists and whitelists include decision trees or checklists to help authors distinguish between fraudulent and legitimate journals, for example *Think. Check. Submit.* [1, 11, 12].

Despite the ongoing discussions on fraudulent publishing and the growing body of research on its market characteristics and prevalence, the defining attributes of fraudulent, illegitimate journals remain controversial [13, 14]. Given that the prevalence of “predatory journals” can only be

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assessed based on a clear definition of fraudulent publishing, systematic studies on the understanding of quality and legitimacy in academic publishing are needed. This study aims to contribute to a better understanding of prevalent notions of good and poor quality in academic publishing by analyzing the inclusion criteria and journals and publishers included in blacklists of fraudulent journals and whitelists of legitimate journals.

Methods

We used a mixed methods approach, combining quantitative and qualitative methods. Using record linkage methods, we compared blacklists and whitelists in terms of overlap, i.e. with regard to the journals and publishers they indexed. We then qualitatively examined and interpreted inclusion criteria of blacklists and whitelists.

Selection of blacklists and whitelists

We searched for blacklists and whitelists in February 2018 using Google and Google Scholar. The search was pre-planned and comprehensive, aiming to identify all eligible blacklists and whitelists. We used the search terms “blacklist”, “whitelist”, “predatory journal” and “predatory publisher”. We selected lists that were multidisciplinary, that is, they included journals from different academic disciplines, were commonly used in studies on predatory publishing, and were accessible either free of charge or for a fee. Two independent reviewers (MS and AS) screened selected lists for suitability. We excluded lists that did not meet our inclusion requirements. The sets of blacklist and whitelist inclusion criteria were obtained from the respective websites in February and March 2018, the journals and publishers indexed in these lists were downloaded in December 2018.

Quantitative analysis of contents

In the first part of the study, we compared contents of lists quantitatively in terms of the journals and publishers they include. Where possible, we compared lists based on the unique journal identifier ISSN or its electronic version (e-ISSN). Since Beall’s list and Cabell’s blacklist did not include an ISSN or e-ISSN for every journal, comparisons had to be based on the names of journals. Due to potential typographical errors and other orthographic differences between the lists under investigation, we matched strings based on their similarity, using the Jaro-Winkler algorithm in R package *RecordLinkage* [15]. The algorithm involves computing string lengths, the number of

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common characters in the two strings, and the number of transpositions [16]. The Jaro-Winkler metric generally is scaled between 0 (no similarity) and 1 (exact match). The metric was calculated for all possible pairs of journals. We chose the cut-off metric individually for each pair of lists, depending on the similarity of lists (e.g. the more orthographically similar, the higher the cut-off metric).We then inspected the pairs above the cut-off score to determine whether journal names matched. For matching journal names of a blacklist and a whitelist we further compared the journals' publishers and websites to exclude cases where two journals were merely named the same, but from different outlets. We used Venn diagrams to illustrate the overlap between different lists. See Figure 1 for a schematic representation of the procedure of quantitative comparison. The procedure was repeated for publishers indexed in the four lists.

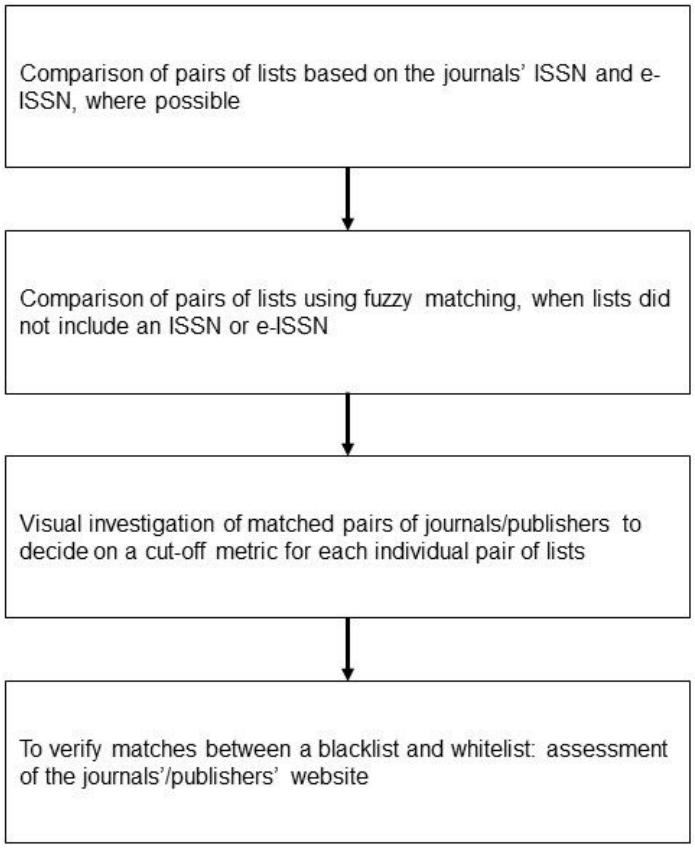

Figure 1. *Procedure of the quantitative comparison of blacklists and whitelists.*

Qualitative analysis of inclusion criteria

In the second part of the study, we conducted the qualitative analysis of inclusion criteria of blacklists and whitelists. Aiming to generate a more holistic and explicit understanding of quality criteria for scholarly journals employed by these lists, we conducted a thematic analysis. As a technique for analysing qualitative data, thematic analysis involves the organisation and rich

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description of data by examining themes within that data, thereby enabling the identification of implicit and explicit ideas [17]. We conducted the analysis in three steps: first, we read and reread the sets of inclusion criteria and repeatedly coded their topic, that is, the aspect of a journal or publishing practice each criterion referred to, until saturation across topics was reached [18, 19]. Second, we identified and analysed broader concepts addressed by the inclusion criteria. Aiming to facilitate a holistic understanding of the topics addressed by the inclusion criteria, we adopted a more abstract level of analysis and assessed to which dimensions of quality the inclusion related. This involved an in-depth interpretation of inclusion criteria and their topics, followed by comparisons of topic frequencies across lists.

In a third step, we assessed the ease of verifying criteria. Criteria were assessed with regard to the degree of subjective judgment that was required to verify whether a criterion was met, as well as to the number of sources that had to be consulted. The verifiability of inclusion criteria was categorized as follows: (1) Easy verifiability where a criterion could be verified based on an easily accessible source and without involving individual judgement; (2) Intermediate verifiability where the consultation of several sources or contact with the journal (but without the need of subjective judgement) was required; (3) Difficult verifiability where the verification of a criterion would require subjective judgment. Table 1 illustrates the classification of verifiability.

The analysis was conducted by two assessors (MS and AS), who independently repeated the steps, revised concepts and subsequently finalized them by consensus. One of the assessors (AS) was blinded to which lists the criteria originated from.

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143 ***Table 1.*** *Verifiability of criteria.*

Verifiability	Description	Examples of criteria
Easy	Only one source has to be consulted in order to verify the criterion, no subjective judgement required.	*ISSNs should be clearly displayed*.(DOAJ) *The publisher displays prominent statements that promise rapid publication and/or unusually quick peer review*.(Cabell's blacklist)
Intermediate	Several sources have to be consulted or contact with the journal/publisher is required in order to verify the criterion, no subjective judgement required.	*The publisher makes unauthorized use of licensed images on their website, without permission or licensing from the copyright owners.(Beall's list)* *The journal does not indicate that there are any fees associated with publication, review, submission, etc. but the author is charged a fee after submitting a manuscript*.(Cabell's blacklist)
Difficult	Subjective judgement is required in order to verify the criterion	*Articles published in the journal must be relevant to current priorities in its field and be of interest to the academic community*.(Cabell's whitelist) *The publisher dedicates insufficient resources to preventing and eliminating author misconduct*.(Beall's list)

144

145 # Results

146 Two blacklists, the updated Beall's list [9] and Cabell's International blacklist [20], and two
147 whitelists, DOAJ [21] and Cabell's International whitelist [20], met our inclusion criteria. A
148 subscription to the lists of Cabell's International was purchased for this study whereas access to
149 the DOAJ and the updated Beall's list was free of charge. While Beall's list and the DOAJ are
150 limited to OA journals and publishers, Cabell's lists cover both OA and closed access journals and
151 publishers with a ratio of 1:4 (OA : closed/other access) in the whitelist and 3:1 (OA : closed/other
152 access) in the blacklist. Beall's list included the fewest journals, but unlike the other three lists,

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Beall's list contains two separate lists of journals and publishers, which are independent of one another. This means, that journals included in Beall's list of "standalone journals" do not belong to any of the publishers listed in Beall's list of publishers. For this reason, we conducted the quantitative analysis of the lists' contents separately for journals and publishers. Table 2 summarizes the features of the included lists.

Table 2. *Characteristics of blacklists and whitelists included in the study.*

List	Maintenance	Access	Type of Journals and Publishers	Number of Journals	Number of Publishers	Inclusion Criteria used in analysis	Date accessed	Notes
Blacklists								
Beall's List	Formerly an individual scholarly librarian, now an academic wishing to remain anonymous	Free	Standalone OA journals and OA publishers	1404	1205	54 criteria developed by Jeffrey Beall, based on COPE [30] and WAME [31] statements	13.12.18	Unlike the other lists, journals and publishers included in the two Beall's list are independent of each other
Cabell's Blacklist	Employees of for-profit company	Subscription	OA and subscription-based journals and publishers (ratio 3:1)	10671	473	63 criteria	13.12.18	
Whitelists								
Cabell's Whitelist	Employees of for-profit company	Subscription	OA and hybrid or subscription-based journals and publishers (ratio 1:4)	11057	2446	38 criteria, not including criteria defining which disciplines are allowed in the list	13.12.18	
DOAJ	Community of OA publishers and voluntary editorial staff	Free	OA journals and publishers	12357	5638	10 basic inclusion criteria, 14 principles of transparency, 15 additional recommendations, not including OA specific criteria	13.12.18	

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Quantitative analysis of contents

Table 3 shows the number of journals and publishers included in each list. For each pair of lists the number of matching journals and publishers, including percentage overlap is provided. Overall, there is considerable overlap between blacklists and blacklists and between whitelists and whitelists, and some overlap between whitelists and blacklists (see Figures 2 and 3).

Table 3. *Cross-comparison of overlaps between blacklists and whitelists in this study.*

		Overlap No. of journals / publishers (%)			
		Beall's List	**Cabell's Blacklist**	**DOAJ**	**Cabell's Whitelist**
Beall's List	Journals	**1404**	234 (16.7%)	41 (2.9%)	1 (0.07%)
	Publisher	**1205**	296 (24.6%)	29 (2.4%)	0 (0%)
Cabell's Blacklist	Journals	234 (2.2%)	**10671**	38 (0.4%)	0 (0%)
	Publishers	296 (62.5%)	**473**	22 (4.7%)	1 (0.2%)
DOAJ	Journals	41 (0.3%)	38 (0.3%)	**12357**	980 (8%)
	Publishers	29 (0.5%)	22 (0.4%)	**5638**	407 (7.2%)
Cabell's Whitelist	Journals	1 (0%)	0 (0%)	980 (9%)	**11057**
	Publishers	0 (0%)	1 (0.04%)	407 (16.6%)	**2446**

Note: Numbers in bold indicate the number of journals/ publishers included in one list. Percentages refer to the lists on the left side of the table and indicate the proportion of journals/publishers, for which the overlap with another journal accounts for.

Overlap between blacklists was greater for publishers than for journals. Of all journals included in Beall's list and Cabell's blacklist (n = 12075), 234 journals were identical (1.9%), of all publishers appearing in the lists (n =1678) the share in overlap was 17.6%. While the overlap of publishers only accounted for 16.6% in Beall's list, it accounted for more than half of the publishers blacklisted by Cabell's (62.5%), indicating that Cabell's may use Beall's list as a source of predatory publishers. Looking at the overlaps between the two whitelists, we see that the share in

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journals and publishers that appeared on both the DOAJ and Cabell's whitelist were in total 4.2% (n = 980) and 5.0% (n = 407), respectively. The relatively small overlap is probably explained by the fact that the DOAJ is limited to OA journals and publishers while Cabell's whitelist includes all types of journals.

Overlaps between Cabell's whitelist and the two blacklists were small: only one journal was found that matched with Beall's list and one publisher that matched with Cabell's blacklist. In contrast, we identified some overlap between the DOAJ and the two blacklists. There were 41 journals (0.3% of 13779 journals) and 29 publishers (0.4% of 6843 publishers) that appeared on both the DOAJ and Beall's list, and 38 journals (0.2% of 23046 journals) and 22 publishers (0.4% of 6111 publishers) that were indexed in both the DOAJ and Cabell's blacklist. Names of journals and publishers included in both types of lists are given in the table in supplementary file 1.

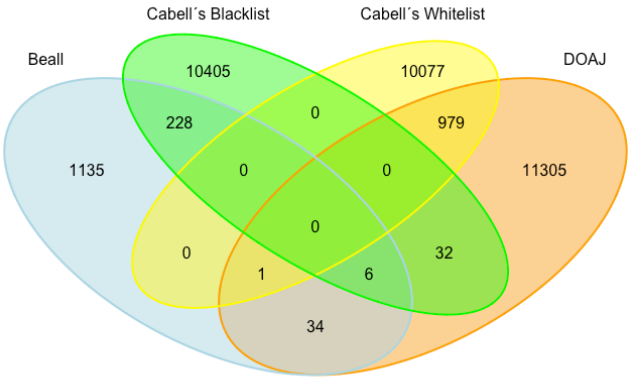

***Figure 2**. Venn diagram of journal overlaps between Beall's list, Cabell's blacklist, the DOAJ and Cabell's whitelist.*

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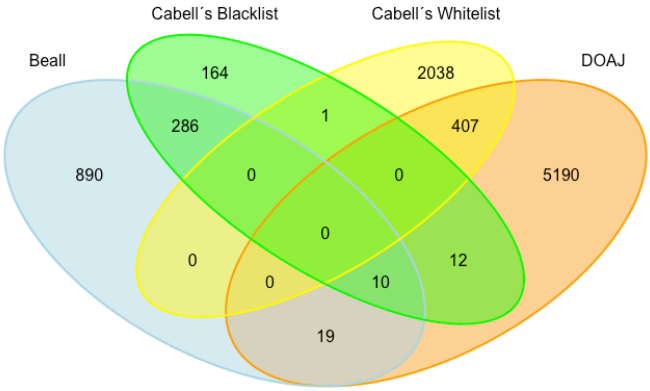

Figure 3. Venn diagram of publisher overlap between Beall's list, Cabell's blacklist, the DOAJ and Cabell's whitelist.

Qualitative analysis of inclusion criteria

Thematic analysis

The analysis of inclusion criteria showed that some statements, principles or recommendations covered more than one criterion and we therefore deconstructed them into separate criteria. A total of 198 criteria were finally included in the qualitative analysis, 120 from blacklists and 78 from whitelists (see list of criteria in supplementary file 2). The iterative thematic analysis of the 198 criteria identified seven topics: (i) peer review, (ii) editorial services, (iii) policy, (iv) business practices, (v) publishing, archiving and access, (vi) website and (vii) indexing and metrics. The topics and the distribution of criteria across topics are summarized in Figure 4 and Table 4, and discussed in detail below. Blacklists gave most emphasis to business practices, followed by editorial services and publishing practices, archiving and access. In whitelists, policy was most extensively covered, followed by business practices and editorial services.

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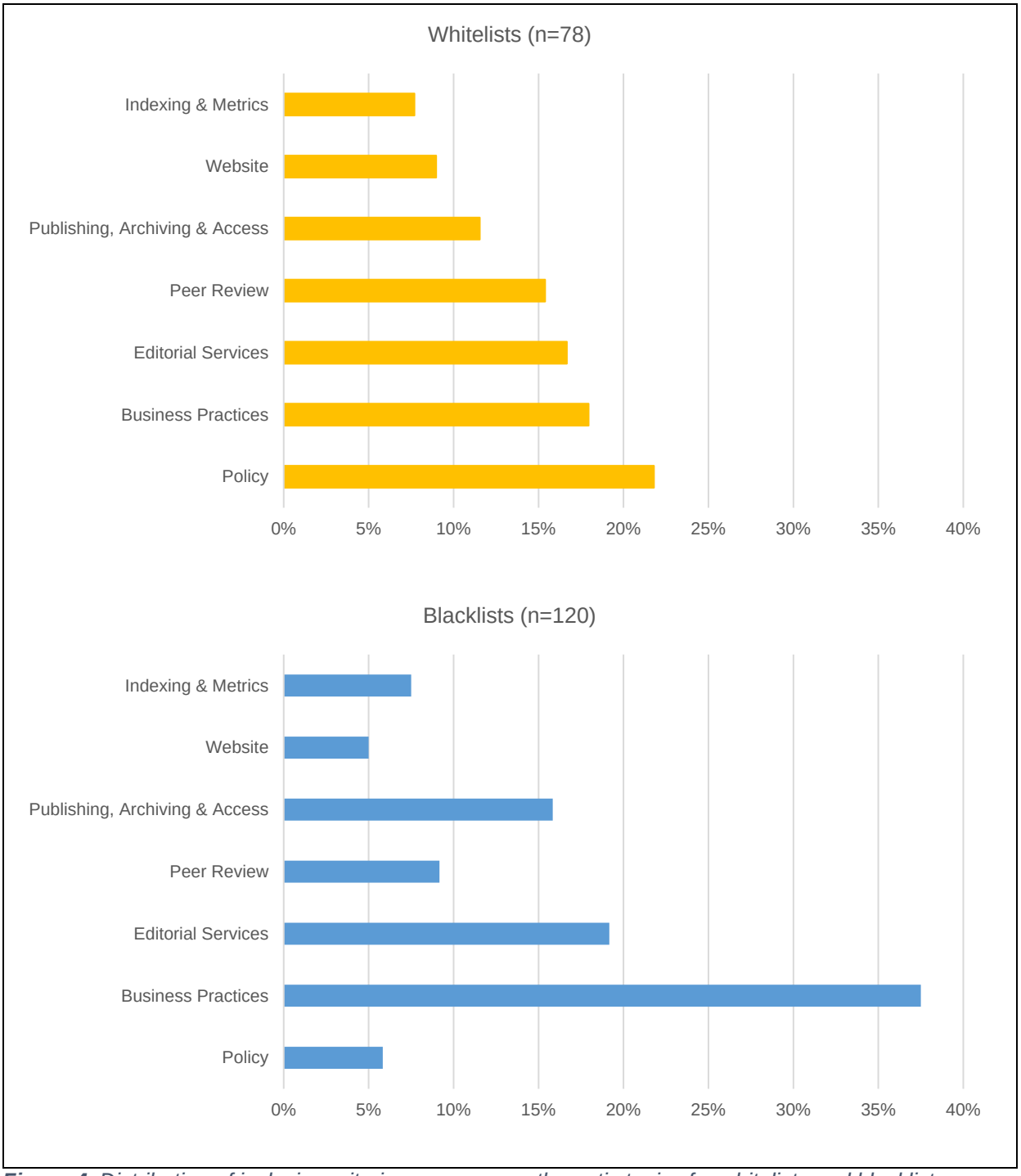

Figure 4. *Distribution of inclusion criteria across seven thematic topics for whitelists and blacklists.*

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213 ***Table 4.*** *Consolidated list of topics addressed by inclusion criteria for blacklists and whitelists.*

		No. of criteria (column %)			
Topic	**Includes criteria that refer to:**	**Blacklists**		**Whitelists**	
		Beall	**Cabell**	**DOAJ**	**Cabell**
Peer Review n=23	- the presence/absence of peer-review - The type and quality of peer review - The qualification of peer reviewers	6 (10.5%)	5 (7.9%)	4 (10.0%)	8 (21.1%)
Policy n=24	- the presence/absence of author guidelines - the presence/absence of policies regarding retraction, copyright/ licensing, editorial services, peer-review etc.	4 (7.0%	3 (4.8%)	9 (22.5%)	8 (21.1%)
Business Practices n=59	- the type of marketing activities - the presence/absence of contact information - the type of or the presence/ absence of information on the business model and legal status - the aspects of a journal's self-representation, such as its name, mission etc.	19 (33.3%)	26 (41.3%)	5 (12.5%)	9 (23.7%)
Publishing, Archiving & Access n=28	- publishing practices, such as the main author and target group, the type of publication model, the type of literature published - access to the articles and information on access - the presence/ absence of digital archives	7 (12.3%)	12 (19.0%)	4 (10.0%)	5 (13.2%)
Website n=13	- the structure, functionality, grammar/ spelling, advertisement etc. of the website	3 (5.3%)	3 (4.8%)	6 (15.0%)	1 (2.6%)
Indexing & Metrics n=15	- the presence/absence, respective authenticity of permanent journal identifiers (such as ISSN, DOI) - the presence/absence or type of journal metrics	5 (8.8%)	4 (6.3%)	4 (10.0%)	2 (5.3%)
Editorial Services n=36	- the presence/absence of, composition of or information on the editorial board and editorial practices	13 (22.8%)	10 (15.9%)	8 (20.0%)	5 (13.2%)
n=198		**n=57**	**n=63**	**n=40**	**n=38**

214

215 ## Peer review

216 Both blacklists and whitelists include criteria stating that a journal needs to have a "rigorous" peer
217 review system in place (see list of criteria in supplementary file 2). Both whitelists do not define
218 "rigorous", however, Cabell's whitelist implies that peer review should be anonymous and

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conducted by at least two reviewers. The whitelists appear to rely on the information provided by the journal. Cabell's whitelist also takes acceptance rates of journal into account as a measure of selectivity. The criteria included in blacklists describe the peer review process as "insufficient", "inadequate" or "not bona fide" (see list of criteria in supplementary file 2). To judge the adequacy of peer review, blacklists make use of several indicators: the promise of fast publication, the acceptance of fake papers and obvious pseudoscience, publication of conference contributions without review or the poor qualification of reviewers. Beall considers reviewers unqualified if they lack expertise in the field the journal covers, for instance when the journal solicits reviewers who are no experts or when the journal does not vet reviewers suggested by the author. With the exception of Cabell's whitelist, the lists do not include a large proportion of criteria referring to peer review. The figures in supplementary file 3 show the distribution of topics for the individual four lists.

Editorial services

Regarding editorial services, both types of lists require an editorial board with qualified members, where "qualified" is defined as academic expertise in the journal's field (see list of criteria in supplementary file 2). The lists require information on the board members' names, their academic affiliations and contact details. DOAJ particularly stresses this aspect (see supplementary file 3). In addition, blacklists consider the truthfulness of details about board members. Beall takes into account the number of board members (at least four, see supplementary file 2). Other criteria of both Beall's list and Cabell's blacklist refer to diversity of the editorial board in term of geographical origin, gender or ethnicity. In addition to criteria regarding the editorial board, both blacklists address the lack of editorial services such as copyediting and proofreading. They also take into account whether the resources a journal spends on preventing author misconduct are "sufficient", as assessed by cases of plagiarism. In this context, the whitelists value the use of plagiarism screening tools. Criteria referring to the editorial services of a journal account for relatively large proportions of the DOAJ and Beall's list (see figures in supplementary file 3).

Policy

Both blacklists and whitelists state that comprehensive policies should be in place. Doing so, blacklists and whitelists focus on different kinds of policies. Whitelists address various aspects such as the presence of detailed author guidelines, information on the type of licensing, peer review

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and editorial services, handling of retractions etc. In contrast, blacklists address the lack of policies on archiving, originality licensing, peer review and author guidelines. Blacklists, moreover, focus on how author guidelines are worded, i.e. whether they are original or copied from another journal, or of poor orthography. As shown in the figures in supplementary file 3 the topic "Policy" constitutes the greatest proportion of criteria in the DOAJ, and accounts for a large number of criteria in Cabell's whitelist. The two blacklists, by contrast, only contain few criteria addressing policy and guidelines.

Business practices

There is common understanding amongst blacklists and whitelists with respect to business practices. All lists address similar aspects, but do so to different degrees of detail. Blacklist criteria refer to the business model of a journal, its marketing activities (e.g. spam emails) and the way a journal promotes itself (e.g. boastful language). They also address the correctness of information on the location of the editorial office, legal status, management and mission. The lack of membership in learned societies, the focus on profit (e.g. by offering pre-pay options) or the non-disclosure of the APC charged are considered fraudulent. Whitelists require unobtrusive marketing practices, contact details, and pricing transparency. Cabell's whitelist, like the blacklists, considers membership in organizations like COPE, WAME and others. Both blacklists and Cabell's whitelist put most weight on the business practices of a journal. For the DOAJ, this topic plays a less important role (see figures in supplementary file 3).

Publishing practices, archiving and access

Blacklists assess the range of topics a journal covers, whether its articles appear in more than one journal and how easily articles can be accessed. In addition, authorship criteria address the publication of many papers by the same authors within one journal. Beall's criteria also refer to publications by the editor or lack of publications by members of the editorial board, both of which indicate bad publishing practices. Whitelist criteria are less specific, and do not address authorship explicitly. Both types of lists state that articles should be permanently archived and easily accessible, irrespective of the type of access.

Whereas access to articles and publishing and archiving practices appear subordinate in Beall's list, the DOAJ and Cabell's whitelist, Cabell's blacklist includes a high proportion of criteria addressing these topics (see figures in supplementary file 3).

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Website

Both blacklists and whitelists are concerned with appearance and functionality of a journal's website. Blacklists are more detailed and mention dead links, orthography (poor grammar and spelling), language (directed at authors), pictures (illegal use of copyrighted material) and advertising (cluttered and obtrusive). Generally, aspects regarding the website of a journal are addressed by only a few criteria in both blacklists and whitelists. In relative terms, the DOAJ includes the highest number of criteria of this topic (see figures in supplementary file 3).

Indexing and metrics

There is general agreement that a journal should have a permanent, verifiable identifier such as the ISSN. Moreover, being indexed in bibliographic databases is perceived as an indicator of a journal's trustworthiness by both blacklists and Cabell's whitelist. Whitelists, in particular the DOAJ, stress that identifiers should be transparently displayed on a journal's website. Regarding metrics, the DOAJ states that the prominent display of impact factors is considered unethical practice. Blacklists, in contrast, check whether the information on metrics is correct and mention the use of fake metrics. If a JIF is mentioned it should be the Thompson Reuters JIF (now Clarivate). The aspect of indexing and metrics constitutes a small proportion of the inclusion criteria for both blacklists and whitelists (see figures in supplementary file 3).

Conceptual analysis

The analysis of criteria produced four concepts: (i) transparency, (ii) ethics, (iii) professional standards and (iv) peer review and other services. Figure 5 shows the percentage of criteria of blacklists and whitelists that inform the different concepts. Compared to blacklists, whitelists gave more emphasis to transparency and less emphasis to professional standards and ethics. There was similar emphasis on peer review and other services.

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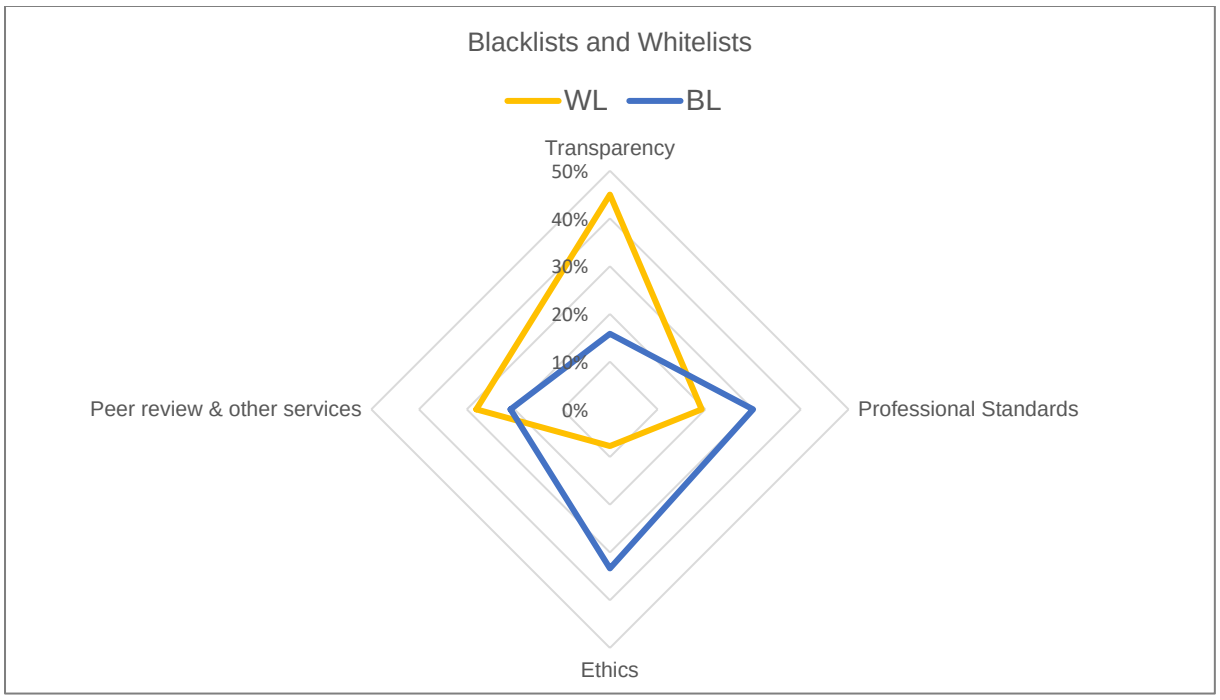

Figure 5. *Distribution of inclusion criteria across four concepts for blacklists and whitelists.*

Transparency

Criteria relating to transparency include the presence of guidelines and policies and transparent business and publishing practices. Whitelists address a broader range of topics than blacklists. For instance, both whitelists include a high number of criteria referring to the transparency of editorial practices, including for example the provision of names, affiliations and contact details of the editorial board members (see list of criteria in supplementary file 2). In comparison to the other lists, the DOAJ includes the highest proportion of criteria related to transparency, whereas Beall's list uses least criteria informing on this concept (see figures in supplementary file 4).

Ethics

Criteria informing on business and publication ethics occupy much space in both blacklists. These criteria describe a range of unethical practices ranging from the provision of false or misleading information (regarding name, legal status, location, editorial board) and the use of fake metrics to unethical publishing practices (such as plagiarism). Cabell's blacklist includes more criteria relating to ethics than Beall's list (see figures in supplementary file 4). Whitelists include only few criteria on business ethics, most of which are general in nature. For example, the journal should not provide information that might mislead readers or authors (see list of criteria in supplementary

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file 2). The DOAJ includes the criterion that the prominent display of the impact factor is inappropriate.

Professional Standards

This concept refers to a journal's professional appearance and demeanor, as reflected by external features of a journal such as its website and business practices (marketing activities and pricing). Professional standards are of central importance for blacklists, and in particular Beall's list, but are less so for whitelists (least important in the DOAJ, see supplementary file 4). Criteria related to the journal's standing, such as whether it is indexed in a database or member of an association, are covered by both blacklists and Cabell's whitelist.

Peer review and other services

This concept comprises criteria related to the provision of specific services including peer review and editorial services and the quality of these services. A small number of criteria also addresses services such as the indexing of a journal in bibliographic databases, the long-term archiving of articles and the protection against misconduct. The concept peer review and other services plays a varying role for the four lists. Beall's list and Cabell's whitelist include more criteria related to the concept than the DOAJ and Cabell's blacklist (see figures in supplementary file 4). Criteria addressing editorial services, mostly focus on the existence of an editorial board with a sufficient number of qualified editors. Both blacklists and whitelists address peer review and the quality of this service. Doing so, the quality of a journal's articles and the type of peer review (in terms of the duration of the review process or the number and qualification of reviewers) are used as proxies for quality in peer review (Cabell's whitelist, Beall's list and Cabell's blacklist). A journal guaranteeing acceptance or "rapid publication" is considered negatively by the DOAJ and regarded a sign for poor peer review by both blacklists.

Verifiability

The verifiability of blacklist and whitelist criteria differed. The verifiability of inclusion criteria was easiest for the DOAJ and equally difficult for the three other lists (Table 5). In particular, the proportion of criteria categorized as easily verifiable through a single source was considerably greater for the DOAJ (77%) than for Beall's list (31%) and both Cabell's lists (whitelist 47% and blacklist 35%). The DOAJ includes a high number of criteria related to transparency, which are

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easier to assess than the other three concepts (Table 5). Besides a high number of easily verifiable criteria, Cabell's whitelist contains a large proportion of criteria that require individual judgment. These criteria often address peer review and editorial services. Items that require several sources for verification or prior contact with the journal are more common in blacklists and predominantly address professional standards as well as business and publishing ethics.

Table 5. *Distribution of inclusion criteria across three levels of verifiability.*

	Verifiability		
	Easy (one source required)	**Intermediate** (several sources required)	**Difficult** (subjective judgment required)
Lists			
DOAJ n=40	31 (77%)	4 (10%)	5 (13%)
Cabell white n=38	18 (47%)	8 (21%)	12 (31%)
Beall n=57	18 (31%)	25 (43%)	14 (24%)
Cabell black n=63	22 (35%)	30 (48%)	11 (17%)
n=198	**n=89 (45%)**	**n=67 (34%)**	**n=42 (21%)**
Topics			
Peer Review n=23	7 (30%)	3 (13%)	13 (57%)
Editorial services n=36	14 (39%)	10 (28%)	12 (33%)
Business Practices n=59	23 (39%)	27 (46%)	9 (15%)
Policy n=24	21 (88%)	3 (14%)	-
Publishing, Archiving & Access	9 (32%)	12 (43%)	7 (14%)

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n=28			
Indexing & Metrics n=15	4 (15%)	11 (73%)	-
Website n=13	11 (84%)	1 (8%)	1 (8%)
Concepts			
Transparency n=54	48 (88%)	4 (8%)	2 (4%)
Professional Standards n=51	24 (47%)	23(43%)	5 (10%)
Ethic n=46	7 (15%)	31 (67%)	8 (18%)
Peer review and other services n=47	10 (21%)	10 (21%)	27 (48%)

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Discussion

The qualitative analysis elucidated the multidimensional understanding of quality in academic publishing that underpins blacklists and whitelists. This multidimensionality is reflected on both the level of the specific topics addressed by criteria and the more abstract level of concepts. The thematic analysis of topics and concepts covered by the 198 inclusion criteria for the different lists resulted in seven topics and four broader concepts. It showed important differences between lists in the emphasis given to these topics: blacklists gave much emphasis to business practices, editorial services and publishing practices. In contrast, whitelists covered policy most extensively, followed by business practices, editorial services and peer review. Regarding the broader concepts, whitelists gave more emphasis to transparency and less emphasis to professional standards and ethics than blacklists. The two types of list thus complement each other and contribute to a broader understanding of quality. Of note, the whitelist criteria were easier to verify than the criteria used by blacklists. Overall, blacklists and whitelists appear to prioritize easily verifiable dimensions of a journal's quality over the quality of scientific evaluation.

In the DOAJ, more criteria relate to transparency of business and publishing practices rather than to the quality of peer review. This indicates a risk of falsely endorsing the legitimacy of a journal based on its transparent nature, while at the same time ignoring journals' lack of best practices in peer review. Similarly, blacklist criteria predominantly relate to ethical issues and professional standards and not to the quality of the scientific evaluation of article submissions. Only Cabell's whitelist appears more balanced in valuing different dimensions of journal quality, including peer review. The quality of peer review is difficult to evaluate, although standardized instruments have been used previously, for example in the context of assessing the impact of open peer review [22, 23]. Interestingly, publishers who were criticized for poor peer review and included in Beall's list, such as MDPI or Frontiers, are planning to make peer review reports openly accessible along with the article, so that readers can judge the thoroughness of its scientific evaluation.

The quantitative analysis investigated overlaps in contents between blacklists and whitelists. The overlaps in journals and publishers we found between blacklists and whitelists may be interpreted in several, non-mutually exclusive ways. First, these journals may be "false positives" on the

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blacklists, i.e. wrongly classified as fraudulent. Indeed, Beall's list has been criticized for not distinguishing fraudulent from low-quality journals, or from emerging journals, for example journals from the Global South. The latter may not be able to afford membership of associations, or not yet have been accepted as members and thus be misclassified by blacklists [24–26]. Others have argued that even if describing undesirable practices, some of the criteria Beall used to characterize fraudulent journals are also applicable to established, presumed legitimate journals [27, 28]. Second, these journals might be "false negatives" on the whitelists, i.e. wrongly classified as being legitimate, based on criteria that are easily verified and easily met, but which do not allow identification of other, fraudulent practices, for example the lack of adequate peer review. Clearly, the status of a journal may change over time, as publishers and editors abandon questionable practices, or good practices. Lists therefore need to be kept up to date, and journals should be periodically re-assessed. Third, some journals may operate in a grey zone for extended periods, meeting some blacklist and some whitelist criteria. Fourth, beside their "common" goal to identify legitimate or illegitimate journals and publishers, the lists follow additional, different agendas, which might require a different weighing of inclusion criteria or could affect the inclusion or exclusion of certain journals and publishers. Although the overlap was small, the criteria in use for the different lists are unlikely to fully capture quality and legitimacy in academic publishing. In other words, these lists can be useful, but they do not provide a completely accurate delimitation between legitimate and illegitimate journals. In a further analysis, we will examine the characteristics of journals that ended up both on blacklists and whitelists in detail.

To our knowledge, this is the first systematic, comparative analysis of blacklists of predatory journals and whitelists of legitimate journals. A recent scoping review by Cobey and colleagues identified 109 characteristics of predatory journals, which were extracted from 38 empirical studies including a definition of predatory journals [29]. In line with what we found for blacklist criteria, Cobey et al. report that most characteristics used to define predatory journals do not relate to the quality of the scientific evaluation of article submissions, but to the journal's business operations and revolve around the lack of transparency, integrity and quality.

Our study has several limitations. As fuzzy matching allows to compare strings on the basis of similarity rather than on a precise match, it is possible that we missed journals and publishers contained in both a blacklist and a whitelist due to orthographic differences of their titles. Further

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limitations concern the qualitative analysis. First, qualitative analysis always entails a certain degree of subjectivity as the assessor's knowledge, background and judgement influences data interpretation. As such, results are inevitably tentative and represent just one possible conceptualization of the data. To mitigate the subjective nature of data interpretation, two assessors analyzed the inclusion criteria. Second, in interpreting the criteria, we did not take into account potential list-specific weighting of criteria (the DOAJ has a hierarchy of criteria), but weighted every criterion equally for the sake of cross-list comparability. Another limitation arises from our inclusion requirements, which restricted eligible blacklists and whitelists to interdisciplinary and internationally available lists. We thus did not consider country- or discipline-specific lists, which might differ in their understanding of quality, transparency and legitimacy in academic publishing.

Conclusions

The lack of a clear conceptual foundation of predatory journals limits the meaning and applicability of current research on predatory journals. Our study indicates that the blacklists and whitelists examined are helpful to inform researchers about journals that are likely fraudulent or likely legitimate. Nevertheless, the lists tend to emphasize easily verifiable criteria, which are easier for journals to meet, whereas dimensions that are more difficult to assess, such as peer review, are less well covered. Finally, our study illustrates the overlap between blacklists and whitelists, indicating that some journals are misclassified and that others operate in a grey zone between fraud and legitimacy. Future research should aim at better defining this grey zone. We also encourage future research to further investigate the concepts of quality, transparency and legitimacy as well as best practices in academic publishing, specifically with regard to peer review.

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Abbreviations

APC: Article Processing Charge
OA: Open Access
COPE: Committee on Publication Ethics
DOAJ: Directory of Open Access Journals
JIF: Journal Impact Factor
WAME: World Association of Medical Editors
ISSN: International Standard Serial Number
e-ISSN: Electronic International Standard Serial Number

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