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Original article

Determinants of journal impact factors in 'Nutrition and Dietetics'

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SUMMARY

Background and aim: The aim of this cross-sectional study was to analyse determinants of the 2023 impact factors (IFs) of journals within the field of 'Nutrition and Dietetics'.
Methods: The Clarivate™ Journal Citation Reports™ website (https://jcr.clarivate.com/jcr/home) was searched on 9 January 2025 for journals with a 2023 IF (published in June 2024) ≥ 6.0 in the field of 'Nutrition and Dietetics'. Analysis was performed using GraphPad Prism software.
Results: There were there were 84,040 citations in 2023 to 10,719 works published in 2021 and 2022 in the 12 journals with an IF ≥ 6.0. Median numbers of citations per output were lower than mean citations in all journals. This difference ranged from 0.55 to 3.97. Most outputs (47.5%–79.1 %) had 1–10 citations. The 1538 open access outputs were cited less frequently [mean (95 % CI) 6.98 (6.55–7.40)] than the 9181 subscription outputs [7.99 (7.81–8.16), $P < 0.0001$]. The 2063 reviews were cited more frequently [8.94 (8.45–9.43)] than the 8656 original articles [7.58 (7.42–7.74), $P < 0.0001$]. When the highest cited outputs from each journal were excluded, the fall in IFs ranged from 0 to 2.4. The was also the case when the two highest cited outputs were excluded (fall ranged from 0 to 2.7).
Conclusion: This comprehensive analysis of journal IFs has shown that although review articles increase IFs of journals, open access outputs do not. IFs can be distorted by 1 or 2 highly cited outputs and may not reflect the impact of the majority of outputs.

1. Introduction

Citation indices for scientific publications were first proposed in 1955 by Eugene Garfield who desired a "bibliographic system for science literature that can eliminate the uncritical citation of fraudulent, incomplete, or obsolete data by making it possible for the conscientious scholar to be aware of criticisms of earlier papers." [1]. The Science Citation Index was developed by Garfield in collaboration with Irving Sher in 1961, and they defined it as "a directory of cited references where each reference is accompanied by a list of source documents which cite it. The most characteristic feature of the citation index is that the user begins a search with a specific known paper and from there is brought forward in time to subsequent papers related to the earlier paper." [2]. This subsequently led to the development of a ranking system for journals by impact factor (IF), divided by categories of journals in the same field, in 1969 [3].

Journal IFs are published in the year following the period of impact (e.g., 2023 IFs are published in 2024) and are derived from the Clarivate™ Journal Citation Reports™ (JCR) (https://jcr.clarivate.com/jcr/home) according to the following formula [4]:

Abbreviations: AAS, Altmetric Attention Scores; CI, confidence intervals; IF, impact factor; IQR, interquartile range; JCR, Journal Citation Reports™; SD, standard deviation; SNIP, Source normalized impact per paper.

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$$\textit{Impact Factor (for 2023)} = \frac{\text{Citations in 2023 to items published in 2021 + 2022}}{\text{Number of citable items in 2021 + 2022}}$$

For example, if a journal has an IF of 14.0 in 2023, then the mean number of citations in 2023 per eligible output in 2021 and 2022 from that journal was 14.0 [5,6].

IFs are a journal level metric and are not indicative of the quality of individual outputs. They signify the relative importance of a journal within the specified category or field, and journals with higher IFs are perceived to be more prestigious than those with lower IFs [6]. While originally invented as a tool to help librarians decide which journals to purchase, IFs soon became used as a measure for judging academic success of both journals and authors [6]. Despite the availability of other measures to quantify publication quality and journal rankings [6–9], and the inherent criticism of IFs [6,10–20], they are still the most frequently used tool to rank journal quality. The IF is also a serious consideration for where a paper is submitted for publication and career progression.

In this cross-sectional study we aimed to analyse determinants of the 2023 IFs of journals with an IF ≥ 6.0 in the JCR subcategory of ‘Nutrition and Dietetics’ within the category of ‘Clinical Medicine’.

2. Methods

The methodology for this study was similar to that we have used previously [20].

$$\frac{\textit{Citations in 2023 to items published in 2021 } (\mathbf{4255}) + 2022\ (\mathbf{2033})}{\textit{Number of citable items published in 2021 } (\mathbf{633}) + 2022\ (\mathbf{313})} = \frac{6288}{946} = 6.6$$

2.1. Search strategy

We searched the Clarivate™ JCR website on 9 January 2025 for journals with a 2023 IF (published in June 2024) ≥ 6.0 in the subcategory of ‘Nutrition and Dietetics’ through a licence provided to the University of Nottingham.

2.2. Data extraction

We exported the ‘Journal Impact Factor contributing items’ for each of the selected journals from JCR to a Microsoft® Excel 365 (Microsoft® Corporation, Redmond, WA, USA) spreadsheet along with the following information: authors, item (output) title, source (journal) title, citation details, type of document (review or original article), number of citations, and whether open access (gold or gold hybrid) or subscription. IFs were retrieved from the data provided on JCR (published IFs) and also derived from the citation exports for each journal from JCR to check for any discrepancies in the retrieved and recalculated IFs (calculated IFs) [20].

2.3. Outcomes

Our primary aim was to produce descriptive statistics for IFs for the journals with an IF ≥ 6.0. Our secondary aim was to use these data to identify if there were any differences between impact factors quoted on JCR and those calculated from outputs derived from JCR exports along with the proportion of total outputs for each journal that were used for calculation of IF. The impact of type of publication (review or original article) and mode of publication (open access or subscription) on citation counts was also determined along with whether exclusion of the top one, or top two cited outputs from each journal influenced IF.

2.4. JCR published calculation vs. JCR export calculation

The differences between the IF published on JCR and that calculated by us from the spreadsheets for each journal exported from JCR were determined as follows:

For example, for *Clinical Nutrition* the calculation of IF published on the JCR website was:

Whereas, the calculated IF from the exported spreadsheet from JCR was:

$$\frac{\textit{Citations in 2023 to items published in } 2021 + 2022\ (\mathbf{6187})}{\textit{Number of citable items published in } 2021 + 2022\ (\mathbf{946})} = 6.5$$

2.5. Recalculation of IF after the single highest and two highest cited outputs in each journal were excluded

The change in IFs after excluding the highest and two highest cited outputs from each journal was calculated as follows:

$$\textit{Impact Factor (2023)} = \frac{[\text{Citations in 2023 to items published in 2021 + 2022}] - \text{Citations to highest (or two highest) cited outputs}}{[\text{Number of citable items in 2021 + 2022}] - 1\ (\textit{or } 2)}$$

This was done twice, once for number of citations as published on JCR and then for number of citations as calculated from exported JCR spreadsheets.

2.6. Statistical analysis

Data were analysed and graphs created using GraphPad Prism version 10.0.0 for Mac (GraphPad Software, Boston, MA, USA, www.graphpad.com). All calculations were based on data exported for each individual journal from JCR. Descriptive statistics are presented as n (%), proportions, mean (standard deviation – SD or 95 % confidence intervals – CI), median (interquartile range – IQR) and range. Statistical significance for differences was calculated using the Mann–Whitney U-test or the unpaired Student *t*-test. Differences were considered significant at $P < 0.05$.

2.7. Ethics statement

This cross-sectional study precluded participation of human subjects and did not meet the criteria for "research" according to the UK Health Research Authority decision tool (https://www.hra-decisiontools.org.uk/ethics/). Therefore, ethical approval was not necessary.

3. Results

In 2023, there were 84,040 citations to the 10,719 works published in 2021 and 2022 from the 12 journals with an IF ≥ 6.0 in the category of 'Nutrition and Dietetics' (Table 1). The number of eligible outputs in the calculation period ranged widely from 40 (*Annual Review of Nutrition*) to 6911 (*Food Chemistry*) and the number of citations ranged even more widely from 226 (*Journal of the American Nutrition Association*) to 58,565 (*Food Chemistry*). The percentage of open access outputs in the 12 journals ranged from 5.0 % (*Annual Review of Nutrition*) to 100.0 % (*Hepatobiliary Surgery and Nutrition*) and that of review articles ranged from 2.1 % (*Food Policy*) to 100.0 % (*Progress in Lipid Research*, *Annual Review of Nutrition*, and *Critical Reviews in Food Science and Nutrition*). Fig. 1 demonstrates the number of citations to each output in the 12 journals.

3.1. Median vs. mean citation counts

Median number of citations per output were lower than mean citations in all the 12 journals (Table 1). This difference ranged from 0.55 (*Journal of the American Nutrition Association*) to 3.97 (*Progress in Lipid Research*). The frequency of number of citations per eligible output from each journal is shown in Table 2. The vast majority of outputs in all journals had 1-10 citations and the proportion ranged from 47.5 % (*Annual Review of Nutrition*) to 79.1 % (*Clinical Nutrition*). Only 5 of the 10,719 outputs had >100 citations.

3.2. Open access vs. subscription access

Of the 10,719 eligible outputs there were 1538 (14.3 %) open access and 9181 (85.7 %) subscription outputs. The median (IQR) number of citations per output for open access outputs was 5 (2.0–8.0) and that for subscription outputs was 6 (3.0–10.0), $P < 0.0001$ (Mann–Whitney U-test). The mean (95 % CI) number of citations per output for open access and subscription outputs was also higher for subscription than open access outputs ($P < 0.0001$) (Table 3). The only journal (*Hepatobiliary Surgery and Nutrition*) that published all outputs as open access was ranked 12th by IF.

3.3. Reviews vs. original articles

There were 2063 (19.2 %) reviews and 8656 (80.8 %) original articles, with the median (IQR) number of citations per output for reviews [6.0 (3.0–11.0)] being similar to that for original articles [6 (3.0–10.0) (Table 3). However, this difference between the two was statistically significant [$P = 0.0004$ (Mann–Whitney U-test)], indicating that reviews were more likely to be cited than original articles. The mean (95 % CI) number of citations per output for reviews was significantly greater than that for original articles (Table 3). This is also borne out by the fact that the 1st (*Progress in Lipid Research*), 2nd (*Annual Review of Nutrition*) and 7th (*Critical Reviews in Food Science and Nutrition*) ranked journals by IF published exclusively review articles. The proportion of reviews published in the 5th ranked journal (*Advances in Nutrition*) was 79.7 %. *Food Policy*, the journal with the lowest proportion of reviews (2.1 %) was ranked 8th.

3.4. Discrepancies between published and calculated impact factors

There was a discrepancy between published and calculated IFs (Table 1, Fig. 2). Although the number of outputs used to calculate IFs was identical between the two for all journals, the number of citations was less for the exported data than those used by JCR. Journals with the highest reduction in citation counts between the JCR and the JCR exported outputs data were the *Journal of the American Nutrition Association* (77.4 % reduction) and *Hepatobiliary Surgery and Nutrition* (40.7 %). The journals with the lowest reduction in citation counts between the JCR and the JCR exported outputs data were *Progress in Lipid Research* and *Current Obesity Reports* (both 0.5 %) (Table 1). Except for *Progress in Lipid Research* (IF 14.0 by both calculations), IFs calculated by us were uniformly lower than those published on JCR. This decrease in IF ranged from as low as 0.1 for *Current Obesity Reports* (1.1%), *Food Chemistry* (1.2 %) and *Clinical Nutrition* (1.5%) to as high as 5.3 (77.9 %) for the *Journal of the American Nutrition Association* (Table 1, Fig. 2).

3.5. Effect of exclusion of the highest and two highest cited outputs

When the highest and two highest cited outputs from each journal were excluded, IFs fell for all journals except the *Journal of the American Nutrition Association* (Table 4, Fig. 3). The fall in IFs after exclusion of the highest cited outputs ranged from 0 (*Journal of the American Nutrition Association*) to 2.4 (31.2 %) (*Proceedings of the Nutrition Society*) and after exclusion of two highest cited outputs ranged from 0 (*Journal of the American Nutrition Association*) to 2.7 (35.1 %) (*Proceedings of the Nutrition Society*).

4. Discussion

4.1. Main findings

This large cross-sectional study across 12 journals with an IF ≥ 6.0 in the field of "Nutrition and Dietetics" has shown that median citation counts per output were uniformly lower than mean citation counts per output, emphasising the fallacy of using means to calculate IFs for skewed data. For all journals most outputs had between 1 and 10 citations per output, with only 5 outputs being cited ≥100 times.

Importantly, there was a discrepancy between IFs published by JCR and those calculated by us using spreadsheets exported from JCR, with the former being uniformly higher than the latter. This finding is consistent with previous work done on journals in the JCR subcategories of 'General and Internal Medicine', 'Surgery' and 'Anesthesiology' [20], but the underlying reason for this discrepancy is not clear. While the underlying mathematical model to calculate IFs is publicly known, the dataset which is used to calculate IFs is not publicly available and, hence, it has been alleged that results may be based on hidden data [15]. Journals are known

Table 1
Included journals, impact factors, citable outputs and citations.

Journal	Published impact factor[a]	Citations in 2023 to items published in 2021 + 2022 (as used in JCI calculation)[a]	Citations in 2023 to items published in 2021 + 2022 (as derived from exported JCI spreadsheets)[b] (% reduction)	Citable items in 2021 + 2022[a]	IF (as calculated from data available from JCR)[b]	Fall in IF (%)	No. of open access outputs:subscription outputs[b] (Proportion of open access outputs in %)	No. of reviews:original articles[b] (Proportion of reviews in %)	Mean ± SD (95 % CI) citations/output[b]	Median (IQR) citations/output[b]	Range[b]
Progress in Lipid Research	14.0	968	964 (0.4)	69	14.0	0	22:47 (31.9)	69:0 (100.0)	13.97 ± 14.50 (10.49–17.45)	10.0 (5.0–18.0)	1–90
Annual Review of Nutrition	12.6	503	495 (1.6)	40	12.4	1.6	2:38 (5.0)	40:0 (100.0)	12.38 ± 10.74 (8.94–15.81)	9.0 (4.25–16.75)	0–37
Current Obesity Reports	9.5	653	650 (0.5)	69	9.4	1.1	25:44 (36.2)	14:55 (20.3)	9.42 ± 11.15 (6.74–12.10)	6.0 (2.0–13.0)	0–63
Food Chemistry	8.5	58,565	57,971 (1.0)	6911	8.4	1.2	468:6443 (6.8)	274:6637 (3.6)	8.39 ± 8.31 (8.19–8.58)	6.0 (3.0–11.0)	0–284
Advances in Nutrition	8.0	2532	2467 (2.6)	316	7.8	2.5	171:145 (54.1)	252:64 (79.7)	7.81 ± 7.73 (6.95–8.66)	5.0 (3.0–10.0)	0–49
Proceedings of the Nutrition Society	7.7	720	638 (11.4)	94	6.8	11.7	50:44 (53.2)	7:87 (7.4)	6.79 ± 23.97 (1.88–11.70)	3.0 (1.0–7.0)	0–231
Critical Reviews in Food Science and Nutrition	7.3	8851	8572 (3.2)	1219	7.0	4.3	91:1128 (7.5)	1219:0 (100.0)	7.03 ± 6.63 (6.66–7.40)	5.0 (3.0–9.0)	0–58
Food Policy	6.8	1901	1830 (3.7)	281	6.5	4.4	105:176 (37.4)	6:275 (2.1)	6.51 ± 7.70 (5.61–7.42)	4.0 (2.0–8.0)	0–58
Journal of the American Nutrition Association[c]	6.8	226	51 (77.4)	33	1.5	77.9	3:30 (9.1)	7:26 (21.2)	1.55 ± 2.05 (0.82–2.27)	1.0 (0.0–2.0)	0–10
Clinical Nutrition	6.6	6288	6187 (1.6)	946	6.5	1.5	237:709 (25.1)	115:831 (12.2)	6.54 ± 9.87 (5.91–7.17)	4.0 (2.0–8.0)	0–169
American Journal of Clinical Nutrition	6.5	4191	3874 (7.6)	647	6.0	7.7	272:375 (42.0)	40:607 (6.2)	5.99 ± 7.07 (5.44–6.53)	4.0 (2.0–8.0)	0–63
Hepatobiliary Surgery and Nutrition	6.1	575	341 (40.7)	94	3.6	41.0	90:0 (100.0)	20:74 (21.3)	3.63 ± 4.89 (2.63–4.63)	2.0 (1.0–5.0)	0–34

[a] Data from that published on Clarivate™ Journal Citation Reports™ (https://jcr.clarivate.com/jcr/home).
[b] Calculated by us from data exported from spreadsheets available on Clarivate™ Journal Citation Reports™.
[c] New journal – no citable outputs in 2021.

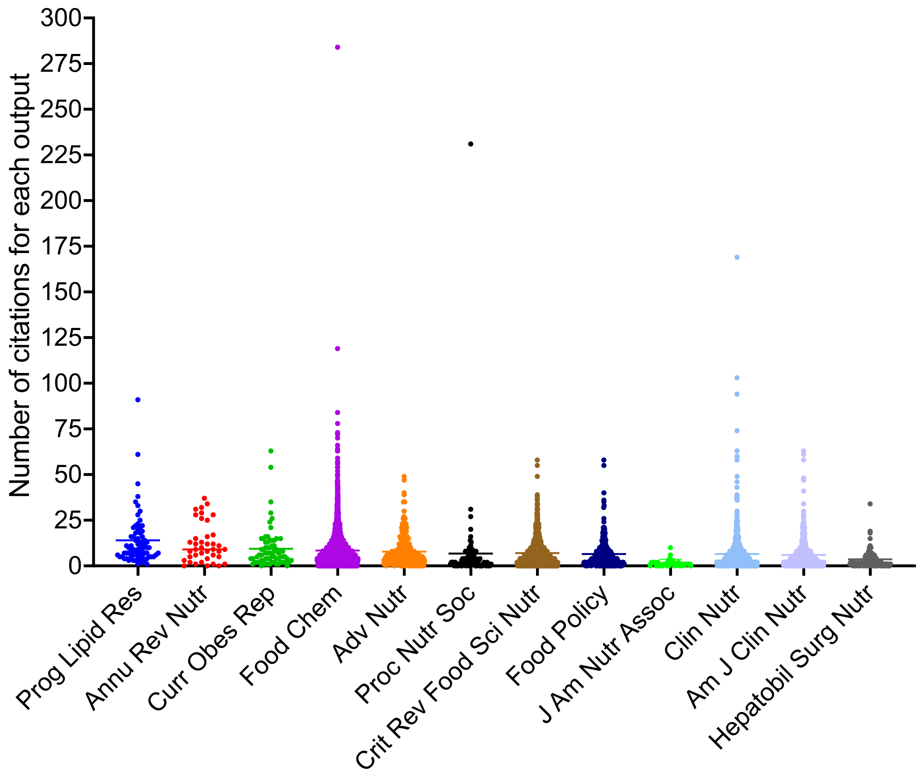

Fig. 1. Individual values plots for citation counts for each of the 12 journals. Horizontal bars represent medians. Data from spreadsheets exported from Journal Citation Reports™.

to negotiate with JCR on items that are 'citable', and consequently variations of more than 300 % in IF have been observed [13]. In addition, Clarivate™ states "No single feature defines a 'citable' item – but consideration of all of these (abstract, descriptive article titles, named author with author addresses, article length, cited references and data content) across many examples of the items in each section results in a strongly consistent association between items identified as 'citable' (articles and reviews) and items whose citations create the Journal Impact Factor." [4,21].

As expected, reviews were cited to a greater extent than original articles, but open access outputs were cited less frequently than subscription outputs, thus showing that open access publication did not have a role in increasing IFs. When the highest and two highest cited outputs from each journal were excluded, the IFs fell. However, this reduction was not as pronounced as in a study where a few very highly cited papers in high impact factor journals contributed to IFs by a much greater extent [20].

4.2. Interpretation of results considering the current literature

IF calculations are based not only on the number of citations to outputs from a journal, but also on immediacy of the citations. Hence, outputs that might eventually be highly cited could have a

Table 2
Number of outputs in each citation count category for each journal.

Journals → / Citation count range[a] ↓	Prog Lipid Res (n = 69)	Annu Rev Nutr (n = 40)	Curr Obes Rep (n = 69)	Food Chem (n = 6911)	Adv Nutr (n = 316)	Proc Nutr Soc (n = 94)	Crit Rev Food Sci Nutr (n = 1219)	Food Policy (n = 281)	J Am Nutr Assoc (n = 33)	Clin Nutr (n = 946)	Am J Clin Nutr (n = 647)	Hepatobil Surg Nutr (n = 94)
0	–	3 (7.5 %)	2 (2.9 %)	203 (2.9 %)	19 (6.0 %)	17 (18.1 %)	76 (10.3 %)	29 (10.3 %)	11 (33.3 %)	57 (6.0 %)	60 (9.3 %)	21 (22.3 %)
1–10	38 (55.1 %)	19 (47.5 %)	47 (68.1 %)	4865 (70.6 %)	223 (70.6 %)	69 (73.4 %)	895 (73.4 %)	205 (73.0 %)	22 (66.7 %)	748 (79.1 %)	494 (76.3 %)	68 (72.3 %)
11–20	17 (24.6 %)	9 (22.5 %)	13 (18.8 %)	1412 (20.4 %)	52 (16.5 %)	5 (5.3 %)	191 (15.7 %)	35 (12.5 %)	–	105 (11.1 %)	68 (10.5 %)	4 (4.3 %)
21–30	8 (11.6 %)	5 (12.5 %)	4 (5.8 %)	303 (4.4 %)	15 (4.7 %)	1 (1.1 %)	41 (3.4 %)	5 (1.8 %)	–	19 (2.0 %)	18 (2.8 %)	–
31–40	3 (4.3 %)	4 (10.0 %)	1 (1.4 %)	80 (1.2 %)	5 (1.6 %)	1 (1.1 %)	13 (1.1 %)	5 (1.8 %)	–	7 (0.7 %)	1 (0.2 %)	1 (1.1 %)
41–50	1 (1.4 %)	–	–	28 (0.4 %)	2 (0.6 %)	–	1 (0.1 %)	2 (0.7 %)	–	3 (0.3 %)	3 (0.5 %)	–
51–60	–	–	1 (1.4 %)	9 (0.1 %)	–	–	2 (0.2 %)	–	–	2 (0.2 %)	1 (0.2 %)	–
61–70	1 (1.4 %)	–	1 (1.4 %)	5 (0.07 %)	–	–	–	–	–	1 (0.1 %)	2 (0.3 %)	–
71–80	–	–	–	3 (0.04 %)	–	–	–	–	–	1 (0.1 %)	–	–
81–90	–	–	–	1 (0.01 %)	–	–	–	–	–	–	–	–
91–100	1 (1.4 %)	–	–	–	–	–	–	–	–	1 (0.1 %)	–	–
101–150	–	–	–	1 (0.01 %)	–	–	–	–	–	1 (0.1 %)	–	–
151–200	–	–	–	–	–	–	–	–	–	1 (0.1 %)	–	–
201–300	–	–	–	1 (0.01 %)	–	1 (1.1 %)	–	–	–	–	–	–

[a] Calculated from spreadsheets exported from Clarivate Journal Citation Reports™ (https://jcr.clarivate.com/jcr/home).

Table 3
Citations for open access *vs.* subscription outputs and review articles *vs.* original articles.

	n (%)	Median (IQR) citations/output	Range	*P* value[a]	Mean (95 % CI) citations/output	*P* value[b]
Publication model						
Open access	1538 (14.3)	5.0 (2.0–8.0)	0–119	<0.0001	6.98 (6.55–7.40)	<0.0001
Subscription	9181 (85.7)	6.0 (3.0–10.0)	0–284		7.99 (7.81–8.16)	
Type of article						
Review article	2063 (19.2)	6.0 (3.0–11.0)	0–284	0.0004	8.94 (8.45–9.43)	<0.0001
Original article	8656 (80.8)	6.0 (3.0–10.0)	0–231		7.58 (7.42–7.74)	

[a] Mann–Whitney *U*-test.
[b] Unpaired Student *t*-test.

low citation count during the two years encompassing the calculation of IF [5].

Citing articles must be published in journals selected by Clarivate™ for inclusion in Web of Science databases [22]. There are several criteria for selection of journals to be included Web of Science. Some of these are:

- the content should be considered useful,
- the journals should have international content and interest,
- publication standards should be high and include factors like clarity of peer review, timeliness, and adherence to ethical principles, and
- an analysis of citations (e.g., level of self-citation) [22].

Besides the factors mentioned, there are several other limitations associated with the calculation and interpretation of IFs [6,10–20]. These include the fact that only 20 % of outputs account for 80 % of citations, the inclination of authors to cite papers from high rather than low impact factor journals, reviewers and editors coercing authors to cite certain articles, inaccurate citations, and a language bias that may reduce citations to articles published in languages other than English. Comparisons of IFs across disciplines and within different fields of research of a particular discipline are of limited validity and outputs generated by "paper mills" may falsely increase IFs. In addition, retracted outputs may still be cited and, therefore, contribute to IFs.

Most journals cannot be ranked with precision by using IFs and only the top and bottom few journals could place any confidence in their rank position, with intervals being wider and overlapping for most journals [14]. Moreover, a few highly cited outputs can have a major impact on IFs. A study on 3,088,511 papers published in 11,639 journals in the 2017 JCR suggested that one in ten journals had their IF boosted by more than 50 % by their top three cited papers [23].

As outliers for the number of citations are known to affect IFs, in 2016 the Nature Publishing Group calculated the two-year median IF which is the median number of citations that articles published in 2013 and 2014 received in 2015 [24]. As the median is not distortion by outliers, the two-year median IF for *Nature* in that year was 24, when compared with the Clarivate™ reported IF of 38 [24].

Weak to moderate correlations have been shown between Altmetric Attention Scores (AAS) and citations [25,26], underscoring the fact that social media attention may help increase citations and, hence, IFs. Nevertheless, while AAS are more immediate and plateau after a short while, citations increase at a variable rate and some increases in citations may be outside the period of IF calculation.

4.3. Strengths and limitations of the study

This is the largest study of its kind to provide a detailed analysis of the factors affecting IFs across 12 journals in field of 'Nutrition and Dietetics'. It has shown discrepancies in the way IFs are

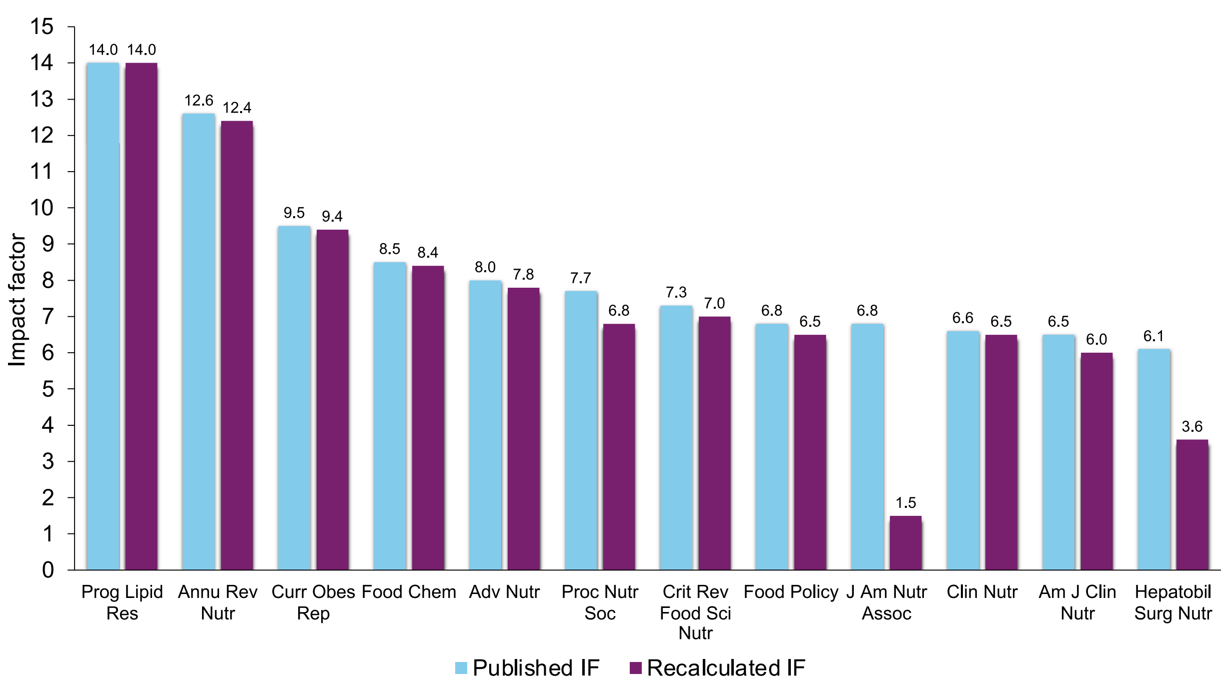

Fig. 2. Published impact factors on Journal Citation Reports™ and impact factors recalculated from spreadsheets exported from Journal Citation Reports™.

Table 4
Recalculation of IF after the highest and two highest cited outputs in each journal were excluded.

Journals →	Prog Lipid Res	Annu Rev Nutr	Curr Obes Rep	Food Chem	Adv Nutr	Proc Nutr Soc	Crit Rev Food Sci Nutr	Food Policy	J Am Nutr Assoc	Clin Nutr	Am J Clin Nutr	Hepatobil Surg Nutr
Original IF (JCR)[a]	14.0	12.6	9.5	8.5	8.0	7.7	7.3	6.8	6.8	6.6	6.5	6.1
Recalculated IF (from data exported from JCR)[b]	14.0	12.4	9.4	8.4	7.8	6.8	7.0	6.5	1.5	6.5	6.0	3.6
No. of citations to the highest cited paper	91	37	63	284	49	231	58	58	10	169	63	34
Recalculated IF after deleting the highest cited paper (JCR)[c]	12.9	11.9	8.7	8.4	7.9	5.3	7.2	6.6	6.8	6.5	6.4	5.8
Fall in IF (a-c)	7.9 %	5.6 %	8.4 %	1.2 %	1.3 %	31.2 %	1.4 %	2.9 %	0 %	1.5 %	1.5 %	4.9 %
Recalculated IF after deleting the highest cited paper (from data exported from JCR)[d]	12.8	11.7	8.6	8.3	7.7	4.4	7.0	6.3	1.3	6.4	5.9	3.3
Fall in IF (b-d)	8.6 %	5.6 %	8.5 %	1.2 %	1.3 %	35.3 %	0 %	3.1 %	13.3 %	1.5 %	1.7 %	8.3 %
No. of citations to the two highest cited papers	152	71	117	403	96	262	113	113	16	272	124	53
Recalculated IF after deleting the two highest cited papers (JCR)[e]	12.2	11.4	7.8	8.4	7.8	5.0	7.2	6.4	6.8	6.4	6.3	5.7
Fall in IF (a-e)	12.9 %	9.5 %	17.9 %	1.2 %	2.5 %	35.1 %	1.4 %	5.9 %	0 %	3.0 %	3.1 %	6.6 %
Recalculated IF after deleting the two highest cited papers (from data exported from JCR)[f]	12.1	11.2	7.7	8.3	7.6	4.1	6.9	6.2	1.1	6.3	5.8	3.1
Fall in IF (b-f)	13.6 %	9.7 %	18.1 %	1.2 %	2.6 %	39.7 %	1.4 %	4.6 %	26.7 %	3.1 %	3.3 %	13.9 %

IF= Impact Factor.
JCR = Journal Citation Reports™.
a–f are indicators of the calculations for "Fall in IF".

calculated and how a few highly cited outputs may boost IFs. It included the latest data from 2023 IF calculations and, hence, provides the most up to date analysis. It has also provided further evidence for some of the criticisms regarding IFs.

Limitations of the study include the fact that as it only analysed 2023 IF data, trends over the years could not be commented on. In addition, outputs from only 12 journals with an IF ≥ 6.0 were analysed and results from other fields or journals with lower IFs

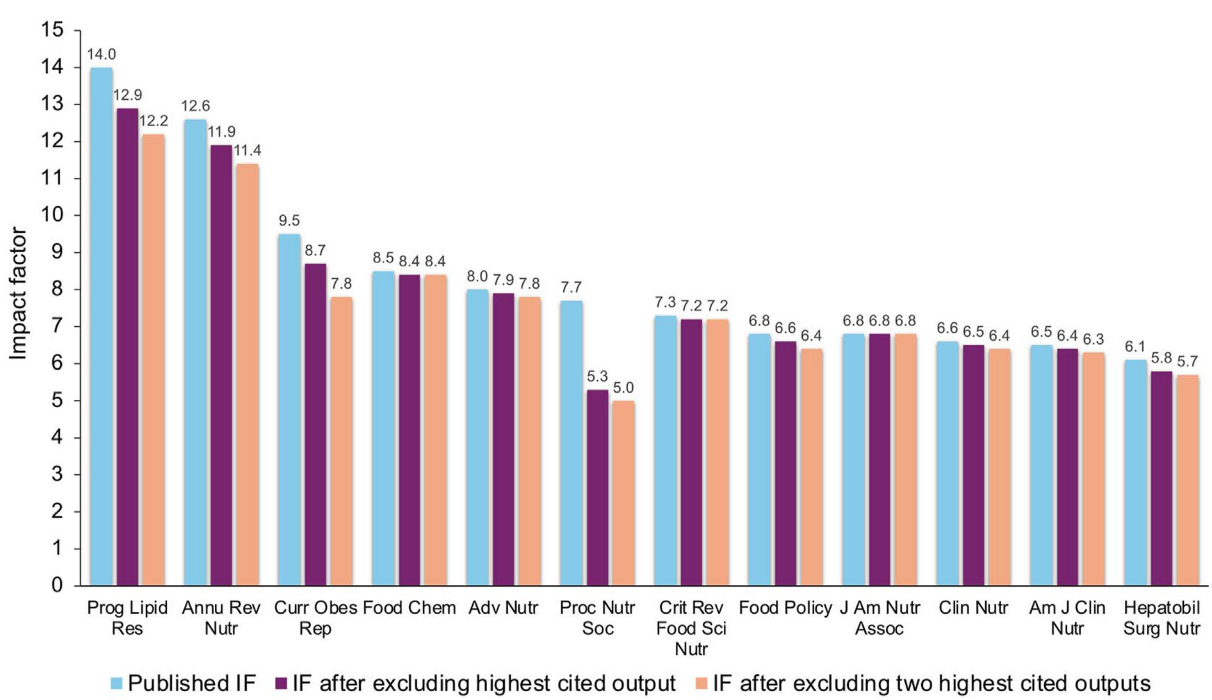

Fig. 3. Change in published impact factors after exclusion of the highest and two highest cited outputs from each journal (based on Journal Citation Reports™ published calculations).

could be different. Only Clarivate™ JCR data were used as at present Clarivate™ is the only organisation that provides officially accepted IFs. Analysis of other databases such as Scopus, GoogleScholar and Dimensions that also provide citation counts could have yielded different results, especially as the number of journals included in these databases differs from those included in JCR. In addition, analysis of other measures of impact such as AAS, PlumX Metrics, CiteScores, SCImago Journal Rank, Source normalized impact per paper (SNIP), relative citation ratio and Eigenfactor scores [7,9] was not performed. However, these are emerging metrics and have not yet replaced IFs, but could have an impact in the future. In addition, each new metric has its own limitations [27] with, for example, PlumX Metrics and Cite Scores being mainly for journals published by Elsevier [28].

5. Conclusions

This comprehensive analysis of journal IFs has shown that although review articles increase IFs, open access outputs do not. IFs can be distorted by 1 or 2 highly cited outputs and may not reflect the impact of the majority of outputs. However, despite the several limitations, IFs continue to be an important parameter used to assess academic outputs.

Author contributions

Both authors made substantial contribution to conception and design, acquisition of data, or analysis and interpretation of data; drafted the article and revised it critically for important intellectual content; gave final approval of the version to be published; *and* agree to be accountable for all aspects of the work thereby ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

Data sharing

Data will be available upon reasonable request from the corresponding author.

Ethics statement

This cross-sectional study precluded participation of human subjects and does not meet the criteria for "research" according to the HRA decision tool (https://www.hra-decisiontools.org.uk/ethics/), therefore ethical approval was not necessary.

Declaration of Generative AI and AI-assisted technologies in the writing process

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Conflict of interest

DNL is Co-Editor-in-Chief and KRN is an Associate Editor of *Clinical* Nutrition. No other disclosures to report.

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