

ICMJE authorship criteria are not met in a substantial proportion of manuscripts submitted to *Biochemia Medica*

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Abstract

Introduction: Our aim was to investigate if: (a) authors of *Biochemia Medica* meet authorship criteria given by International Committee of Medical Journal Editors (ICMJE), (b) authorship violations are more frequent in submissions containing some type of scientific misconduct.

Materials and methods: Self-reported authorship contributions regarding the three ICMJE criteria were analysed for all submissions to *Biochemia Medica* (February 2013–April 2015) which were forwarded to peer-review. To test the differences in frequencies we used Chi-squared test. $P < 0.05$ was considered statistically significant.

Results: 186 manuscripts were authored by 804 authors. All ICMJE criteria were met by 487/804 (61%) authors. The first and the last author met all the criteria more frequently than those authors in between ($P < 0.001$). The degree to which ICMJE criteria was met for the first author did not differ between manuscripts authored by only one author and those authored by >1 author ($P = 0.859$). In 9% of the manuscripts ICMJE criteria were not met by a single author. Authors of the 171/186 manuscripts declared that all persons qualify for authorship but only 49% of them satisfied all ICMJE criteria. Authors have failed to acknowledge contributors in 88/186 (47%) manuscripts; instead these contributors have been listed as authors without fulfilling ICMJE criteria. Authorship violation was not more common in 42 manuscripts with some type of scientific misconduct ($P = 0.135$).

Conclusion: Large proportion of authors of the manuscripts submitted to *Biochemia Medica* do not fulfil ICMJE criteria. Violation of authorship criteria is not more common for manuscripts with some type of scientific misconduct.

Key words: authorship; acknowledgement; research integrity; editorial practice

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Introduction

Authorship in research papers is a major requirement for advancement in an academic career and in applications for research funding. Besides being financially beneficial, authorship commonly corresponds to the impact of a certain laboratory/department and an overall researcher's reputation in the scientific community (1-5). Therefore, it is imperative that only researchers that fully meet authorship criteria are listed as authors. International Committee of Medical Journal Editors (ICMJE) has introduced updated authorship criteria that are

widely accepted and most commonly referred to by journal editors in journals' instructions for authors. According to ICMJE, in order to qualify as an author researcher has to contribute substantially in all aspects of the conducted study to be able to take responsibility and recognition for the work (6).

Biochemia Medica also embraces these recommendations. Starting from 2013 until May 2015 *Biochemia Medica* used disclosed *Author statement form* (Figure 1) (7). The form contained the short definition of authorship given by ICMJE. A descrip-

FIGURE 1. Author statement form used during manuscript submission process in *Biochemia Medica* in the period of February 2013 until May 2015.

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AUTHOR STATEMENT

Manuscript title:

Corresponding author (first name, last name):

**Please note that each contributing author must sign the *Author statement form*.
Otherwise, the manuscript will not be accepted for publication.**

Please fill in the table below with the following information:

- List the names of the authors in the order in which they appear in the manuscript. Thus, each author may be assigned a number for further identification (unique author's number).
- Each author should sign this form (in the table). By signing this form, authors take full responsibility for all statements made in the manuscript.

No.	Author's full name (in capital letters)	Author's signature
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		
9.		
10.		

AUTHORSHIP STATEMENT:

According to International Committee of Medical Journal Editors (ICMJE): "An author is considered to be someone who has made substantive intellectual contributions to a published study. An author must take responsibility for at least one component of the work, should be able to identify who is responsible for each other component, and should ideally be confident in their co-authors' ability and integrity." (available at: http://www.icmje.org/ethical_1author.html)

Please fill in the table with a unique author identification number for each author (from the previous table) to describe each author's contribution the work.

Contribution	Author number
substantial contribution to the conception and design	
substantial contribution to the acquisition of data	
substantial contribution to the analysis and interpretation of data	
drafting the article	
critically revising the article	
final approval of the version to be published	

Please tick the box if the statement applies:

- to the best of your knowledge, anyone who participated substantially in the study has not been omitted from the article
- to the best of your knowledge, all persons listed as authors qualify for authorship

All persons who have made substantial contribution to the work but do not meet the authorship criteria are listed in the Acknowledgment section (technical help, writing assistance, general support, financial and material support)

- Yes No Not applicable

All persons named in the Acknowledgment section of the manuscript have given their permission to be named

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Editorial board of Biochemia Medica strongly promotes research integrity and aims to prevent any type of scientific misconduct according to Committee on Publication Ethics (COPE) flowcharts. (available at: <http://publicationethics.org/resources/flowcharts>)

Please tick the box if, to the best of your knowledge, the following statements apply:

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RESEARCH ETHICS:

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An appropriate informed consent was obtained from each research participant:

- Yes
 No
 Not applicable

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tion of ICMJE criteria for authorship that were recommended at the time as well as the Editorial board's commitment to those recommendations were given in the journal's *Instructions for authors* as follows:

„*Biochemia Medica* adheres to guidelines for authorship set forth by the International Committee of Medical Journal Editors (ICMJE) (available at: <http://www.icmje.org/recommendations/browse/roles-and-responsibilities/defining-the-role-of-authors-and-contributors.html>). According to ICMJE: “An author is considered to be someone who has made substantive intellectual contributions to a published study. An author must take responsibility for at least one component of the work, should be able to identify who is responsible for each other component, and should ideally be confident in their co-authors' ability and integrity.”

Each author should meet all three criteria as follows:

1. substantial contributions to conception and design, acquisition of data, or analysis and interpretation of data;
2. drafting the article or revising it critically for important intellectual content;
3. final approval of the version to be published.

All persons who have made substantial contributions to the work but do not meet the criteria for authorship should be listed in the *Acknowledgments* section (technical help, writing assistance, general support, financial and material support). All persons named in the *Acknowledgments* section of the manuscript must give their permission to be named. Statement for such permission is included in *Author statement form*.”

In this “publish or perish” era when researchers are under pressure to publish frequently and preferably in high-impact journals, violations of authorship criteria are not uncommon (1,4,5). Examples of gift or honorary authorship such as inclusion of a well-respected scientist in a related field only to bring more merit to the paper or inclusion of the head of the department/laboratory as a courtesy have been reported many times (8,9). These misconducts result in the dilution of

responsibility and accountability of authors and diminish the credit of true authors (10,11). Ghost authorship, either as deliberate omission of an industry sponsored writer (11), not acknowledging a professional writer (12) or omission of a researcher because of research group disagreements (13), constitutes an authorship violation that misleads the readers. The position of the authors in the by-line can imply different contribution to the manuscript content between the first, second and the last author (11,14). Moreover, an influential name in the by-line can affect an article's success e.g. publication in a higher impact journal or greater number of citations (15).

Although every violation of authorship criteria could be classified as scientific misconduct it should be noted that sometimes the authors themselves negate their own authorship. So, it should be taken under a consideration that some researchers are not substantially familiar with authorship criteria or they just lack understanding (16).

Since authorship criteria violations, whether as a form of scientific misconduct or simple lack of knowledge, are present in biomedical literature and so far have been described in several studies (1,8,9,16-18) we hypothesized that a certain proportion of the manuscripts submitted to *Biochemia Medica* could also be associated with varying degrees of violations of the criteria for authorship. Therefore our aims were to: (a) make a descriptive analysis of the data on authorship, (b) investigate whether ICMJE authorship criteria were met by all authors of manuscripts submitted to *Biochemia Medica* and if fulfilment of those criteria varies if the first author is the only author or a part of a group of authors, (c) analyse the level of understanding of the difference between author and contributor and (d) to examine if violations were more prevalent in submissions suffering from some other type of scientific misconduct. This data is a valuable insight in the overall authorship of the manuscripts submitted to *Biochemia Medica* and can be used to improve Journal's policy on authorship.

Materials and methods

Data collection

Each author of the manuscripts submitted to *Biochemia Medica* has to sign the *Author statement form* (one form for all authors) and fill in the statements regarding his/her contributions to the presented study. The form is designed in such way to assure agreement of all authors with the stated order of authors and self-reported contributions provided in the *Author statement form* (figure 1). At the time ICMJE stated only three criteria for authorship which we did not change when the ICMJE issued an updated forth authorship criteria later that year (2013). Each manuscript submitted to *Biochemia Medica* was screened by the Editor-in-Chief. From February 2013 until April 2015 a total of 346 manuscripts were submitted to *Biochemia Medica*. Those manuscripts that met the general criteria listed in the *Instructions to authors* and were within journal's scope were assigned to the Research Integrity Editor (RIE) for further analysis. Out of the 346 initially submitted manuscripts, the Editor-in-Chief forwarded 192 (55%) manuscripts for analysis to the Research Integrity Editor (RIE) of *Biochemia Medica*. The RIE evaluated the manuscript texts similarity, the *Conflict of interest form* and the *Author statement form* which contain information on authorship, originality of submitted work, research ethics, privacy and confidentiality. All data collected during RIE's analysis were summarized and saved in a Microsoft Office Excel worksheet for further editorial research. For each manuscript the following data was collected: total number of authors, number of authors according to ICMJE (all 3 criteria), corresponding author, by-line, manuscript type, type of text similarity (if present), and statement for non-contributors (*Acknowledgments*). For each author the following data was collected: agreement with each ICMJE criteria, author's country, and position on the by-line. Manuscripts were classified by the following types: Original article, Review, Editorial, Short communication, Case report, Research integrity corner article, and Lesson in biostatistics. Text similarities were recorded in the following categories: plagiarism, patchwork plagiarism, self-plagiarism, techni-

cal plagiarism, salami publication and duplicate publication. For the purpose of statistical analysis we combined all types of observed text similarities in one category of general misconduct.

Out of 192 manuscripts, 6 forms were not appropriate (4 not provided and 2 not signed) even after sending requests to the authors. Therefore the total number of analysed manuscripts was 186. Data on all authors were included in this analysis regardless of total number of authors per manuscript or manuscript type, since all authors had to sign the same *Author statement form*. Manuscripts authored by only one author were processed the same way as other manuscripts. Those authors were considered as first and corresponding authors.

Statistical analysis

All descriptive statistics were done in Microsoft Office Excel worksheet (Microsoft, USA). Normality was tested using Kolmogorov-Smirnov test. Data deviated from normality and therefore were presented as median and interquartile ranges. For testing the differences in frequencies we used the Chi-squared test available in MedCalc Statistical Software version 13.0.6 (MedCalc Software, Ostend, Belgium). The level of statistical significance was set to $P < 0.05$.

Results

The total number of authors from 186 analysed manuscripts was 804, the median (interquartile range) number of authors *per* manuscript was 4 (2–6).

The distribution of authors by country and article type is presented in Figure 2 and Figure 3.

Out of 804 authors, all three ICMJE criteria for authorship were met by only 487 (61%) authors. Frequencies of different criteria for authorship among all authors are shown in Table 1.

Figure 4 shows the distribution of authors' self-reported contributions compared to their position in the by-line.

In 78% of the manuscripts submitted to *Biochemia Medica* the corresponding author is also the first

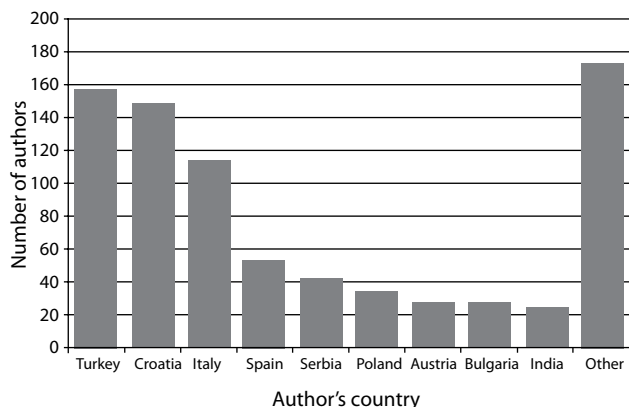


FIGURE 2. Distribution of authors of 186 manuscripts submitted to *Biochemia Medica* (in the period of February 2013 until April 2015) and forwarded to Research Integrity Editor according to country (Turkey (157), Croatia (149), Italy (114), Spain (54), Serbia (42), Poland (34), Austria (28), Bulgaria (28), India (25), Other (Australia, Czech Republic, Denmark, Russia, Macedonia, Greece, Egypt, Congo, Romania, Ireland, China, Pakistan, Colombia, Norway, UK, Portugal, Germany, Belgium, Brazil, France, Slovenia, Bosnia and Herzegovina, USA, Thailand) (173)).

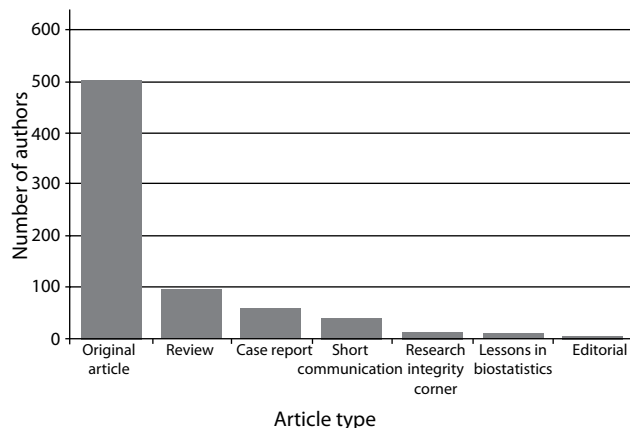


FIGURE 3. Distribution of authors of 186 manuscripts submitted to *Biochemia Medica* (in the period of February 2013 until April 2015) and forwarded to Research Integrity Editor according to the article type: Original article (590), Review (95), Case report (58), Short communication (39), Research integrity corner (11), Lessons in biostatistics (9), Editorial (2).

author and in 14% of manuscripts the corresponding author is the only author.

There was a statistically significant difference in meeting ICMJE criteria for authorship when comparing first author, last author and all authors in between (Chi-square = 47.560, $P < 0.001$). 21% of all

TABLE 1. Number of authors of 186 manuscripts submitted to *Biochemia Medica* (in the period of February 2013 until April 2015) and forwarded to Research Integrity Editor according to the type and number of fulfilled ICMJE authorship criteria.

Number of ICMJE criteria for authorship	Number of authors that satisfied criteria (%) (N = 804)
None	7 (1%)
Only first	105 (13%)
Only second	19 (2%)
Only third	11 (1%)
First and second	83 (10%)
First and third	65 (8%)
Second and third	27 (3%)
All three (true authors)	487 (61%)

First criteria: substantial contributions to conception and design, acquisition of data, or analysis and interpretation of data; Second criteria: drafting the article or revising it critically for important intellectual content; Third criteria: final approval of the version to be published.

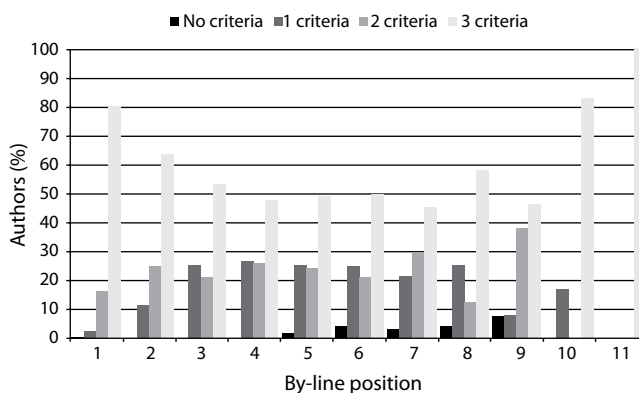


FIGURE 4. Distribution of authors' self-reported contributions regarding their position on the by-line. 804 authors of the 186 manuscripts submitted to *Biochemia Medica* (in the period of February 2013 until April 2015) and forwarded to Research Integrity Editor were analysed. For each by-line position we calculated a percentage of authors that meet one, two or all ICMJE criteria as well as for those who do not meet single criteria.

first authors and 34% of all last authors did not meet ICMJE criteria for authorship, whereas, 50% of the authors in between on the by-line did not meet the criteria for authorship. We also wanted to see whether there was a difference in meeting the criteria for authorship if the first author was the

only author or one in a group of authors. There was no statistically significant difference in frequency of meeting the authorship criteria (Chi-square = 0.032, $P = 0.859$).

Out of 186 analysed manuscripts 16 (9%) of them had no true author. In other words, for 16 (9%) manuscripts none of the listed authors fulfilled all 3 ICMJE criteria for authorship. On the other hand for 90 (48%) manuscripts all authors meet all three authorship criteria according to self-reported data.

For 171/186 (92%) manuscripts the corresponding authors declared in the *Author statement form* that to the best of their knowledge, all persons listed as authors qualify for authorship. However, for 88 manuscripts of those 171 this was not the case, because authorship criteria revealed that the authors did not satisfy ICMJE criteria after all. In 2 of 186 cases the corresponding authors stated that all authors do not meet criteria for authorship (which was true for one case and false for the other), whereas 13/186 corresponding authors did not answer that question.

When asked whether all persons who have made substantial contribution to the work but did not meet the authorship criteria were listed in the Acknowledgment section (technical help, writing assistance, general support, financial and material support), 73/186 (39%) of the corresponding authors stated "yes" but in 36 of those cases authors of the manuscript should have been listed in the acknowledgement section since they did not meet the criteria for authorship. 101/186 (54%) of the corresponding authors said that this statement was not applicable to their manuscript even though in 52 cases the authors of those manuscripts should have been listed in acknowledgements as they did not meet authorship criteria. 12 corresponding authors did not answer this question about acknowledging other persons support.

In order to see whether researchers that did not fulfil authorship criteria are more prone to commit other types of scientific misconduct, we compared the frequency of scientific misconduct (this general category was the sum of all detected text similarity frauds) with fulfilment of authorship criteria. Out of 186 analysed manuscripts, 42 manuscript

authored by 195 authors contained some other form of scientific misconduct. There was no statistically significant difference in the frequency of scientific misconduct relative to the authorship criteria (Chi-square = 2.232, $P = 0.135$). In other words, researchers that violate authorship criteria do not tend to commit scientific misconduct more often than those authors that meet all authorship criteria.

Discussion

The analysis revealed that 61% of all authors that submit their manuscripts to *Biochemia Medica* are true authors. Those 39% of authors who do not meet the authorship criteria could be regarded as honorary authors. The degree of compliance to the ICMJE criteria for authorship has been studied by a number of authors and for different journals. Marušić *et al.* found that 40% of 475 authors fulfilled ICMJE authorship criteria in manuscripts submitted to the *Croatian Medical Journal* (16), Hwang *et al.* reported 68% fulfilment rate of authorship criteria for researchers who published in *Radiology* (18). Investigations done by Bates *et al.* revealed a variable rate of honorary authorship i.e. those did not meet 3 ICMJE criteria; *Annals of Internal Medicine* 21.5%, *BMJ* 9.5% and *JAMA* 0.5% (17). Wislar *et al.* analysed six general medical journals with high impact factor in 2008 and found on average 21% of honorary authorship (8). Literature data implies that the issue of authorship is readily investigated among journal editors but regardless of the rules set by ICMJE, authorship violations do occur.

We found that 79% of the first authors and 66% of the last authors matched ICMJE criteria for authorship, while 50% of all authors in between in the by-line did not meet the criteria for authorship. Authorship criteria regarding the position in the by-line were also investigated by others. Bates *et al.* found that those who did not comply with all 3 ICMJE criteria were positioned closer to the end of the by-line (17). Hwang *et al.* report ICMJE criteria fulfilment rate regarding the by-line position similar to ours; 99% for the first author, 85.3% for the second, 66.5% for the last and 52.8% for the mid-

dle authors (18). It can be concluded that the authors in general recognize the difference among the positions in the by-line and that the middle authors most often comply with "more flexible" criteria than do the first and the last authors.

Authors of the manuscripts submitted to *Biochemia Medica* often do not recognize the difference between authors and contributors. For 88 manuscripts of 171 for which corresponding authors declared that all authors qualified for authorship, analysis revealed that not all authors satisfied ICMJE criteria after all. Furthermore, 9 manuscripts of 171 had no true author based on self-reported claims which seems unlikely for a manuscript submitted for publishing. Malički *et al.* asked the authors who submitted their manuscripts to the *Croatian Medical Journal* to describe their contributions by posing an open-ended question "Why do you think you should be the author on this manuscript?", without proposing answers, the percentage of authors that fulfilled ICMJE criteria was 15.6% (20). Rajasekaran *et al.* conducted a survey where the first authors of three different journals were asked about authorship in their articles. The study reported that 18% of authors were perceived as honorary authorship and 55% were ICMJE-defined honorary authorship (9). Those studies imply that there is a lack of knowledge and understanding of current authorship criteria. Therefore we believe that our results do not present intentional scientific misconduct because authors themselves provide answers about their contributions which negate their authorship in the *Author statement form of Biochemia Medica*.

In our study we did not find that researchers who violate authorship criteria commit other types of scientific misconduct more often than those authors who met all authorship criteria. This can suggest that authors are better informed about other types of scientific misconduct which is generally held as a more serious offence than authorship criteria violation (13). Authorship criteria violation can be regarded as questionable research practice.

However, the significant number of authors calls in question the appropriateness of ICMJE authorship criteria with major criticism of the flexibility of their interpretation (21) or the strictness of their rules (3). Authors call for the revision and update of the ICMJE criteria in order to be more applicable (20,21) since the existence of the criteria has not lowered the rate of irresponsible authorship (1).

It is important to note that we assessed self-reported claims of the authors' contributions for which there are no established methods to verify their sincerity and therefore can be considered as the limitation of the study. The editors rely solely on authors' statements even though those claims can be under- or overestimated, in cases when authors do not provide sincere facts, do not fully understand or are not aware of the existing authorship criteria. In those cases, these claims can create undeserving authorships and thus compromise scientific integrity.

Conclusion

A substantial proportion of authors who submit their manuscripts to *Biochemia Medica* do not comply with ICMJE criteria. Violation of authorship criteria is equally prevalent in manuscripts with and without some other type of scientific misconduct. Editors of *Biochemia Medica*, as well as other scientific journals, need to continuously educate their authors and readers on the importance of declaring true authorship in order to ensure and constantly improve scientific integrity. In an attempt to reduce the rate of authorship criteria violation, *Biochemia Medica* has declared its editorial policy on authorship in Journal's Instructions for authors. Moreover, to further educate our readers and authors, the Editors of *Biochemia Medica* have decided to publish the Journal editorial policy on authorship in this issue, within the *Research Integrity Corner* (22).

Potential conflict of interest

None declared.

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