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Does COVID-19 facilitate gender inequality in article submission behavior? To what extent is article submission behavior influenced by career status? An exploration using the German Journal of Exercise and Sport Research as an example

Gender differences in academia, captured by disparities in the number of publications, citations, funding, recognition, and salary are well documented (Huang, Gates, Sinatra, & Barabási, 2020; Madera, Hebl, Dial, Martin, & Valian, 2019) across disciplines and countries (e.g., Goastellec & Pekari, 2013; Ginther, 2006). Although there are more female than male undergraduate and graduate students in most western countries, studies show that women are underrepresented in full professor and leadership positions (e.g., Statistisches Bundesamt, 2021a, b, c; Best, Sanwald, Ihsen, & Ittel, 2013; Shinozaki, 2017). This underrepresentation might be attributable to the gender gap in research productivity (D'Amico, Vermigli, & Canetto, 2011), which is captured by several factors, e.g., the amount of research funding and academic networks. One of the most important indicators and commonly

used measures of research productivity is the publication output. Studies show that men publish significant more articles than woman (Beaudry & Larivière, 2016; König, Fell, Kellnhofer, & Schui, 2015). Reasons for this gender differences in publication output are not entirely clear and multifaceted. Among others, studies emphasize individual factors (e.g., self-efficacy), social factors (e.g., care duties due to traditional role models), and systemic factors (e.g., masculine culture of the field, career preferences, lack of female mentors) as influencing factors (Stack, 2004; Larivière, Ni, Gingras, Cronin, & Sugimoto, 2013; Wang & Degol, 2017; Cheryan, Ziegler, Montoya, & Jiang, 2017; Gabster, van Daalen, Dhatt, & Barry, 2020). However, as stated by Engeli and Mügge in 2020, “there is room for optimism” (2020, p. 179). Universities and professional associations had become more and more sensitive to gender gaps and clearly promote gender equality as top priority. Specific measures (e.g., mentoring, scholarships, and fundings to promote female researchers’ research productivity) are taken to further narrow gender gaps.

Does COVID-19 reinforce inequality?

The COVID-19 lockdowns, starting in Europe in mid-March 2020 (e.g., BMG, 2023), caused severe changes in all aspects of daily life, including the work of female and male scientists. Researchers had to stay at home and for many researchers, the workload increased, as, e.g., lectures and meetings had to be converted into an online format, and students and colleagues had to be informed about rules and procedures regularly (Jackman et al., 2022; Pokhrel & Chhetri, 2021). Especially female scientists stated that while the workload increased the research productivity decreased (Myers et al., 2020). A few women started publishing their experience on social media (e.g., Twitter) and blogs already in April 2020 under #coronapublication-gap. Editors of international journals (e.g., *International Studies Quarterly*, *International Political Sociology*) reported that during the first two months of the COVID-19 pandemic submissions by female scientists decreased compared to prior to the pandemic (Fazackerley, 2020; Flaherty, 2020; Fuchs-Schündeln,

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Availability of data and material
not applicable

Code availability
the code will be updated in OSF

2020; Wiegand, Lisle, Murdie, & Scott, 2020). Women post fewer preprints than men and analyses of registered report repositories reveal that women start fewer new projects compared to men (Viglione, 2020). Studies show that the number of submissions by women has fallen dramatically, but submissions by men have remained constant. Some journals even recorded an increase in submissions from male authors of around 50% (e.g., Fazackerley, 2020; Shurchkov, Deryugina, & Stearns, 2020).

The reasons, why COVID-19 affected the research productivity of female and male researchers differently are not clearly understood. One potential factor might be additional household and childcare duties. Even before COVID-19, women covered significantly more household and childcare responsibilities compared to men (Griefß, 2014). A recent study found that the pandemic tends to revive those traditional roles (Kohlrausch & Zucco, 2020), as mainly mothers reduced working hours and increased the time spent on childcare and household duties, even in dual-career academic couples (Andersen, Nielsen, Simone, Lewiss, & Jagsi, 2020; Johnston, Mohammed, & Van Der Linden, 2020). Another factor that might lead to differences in research productivity might be that COVID-19 had a higher impact on mental health in female vs. in male researchers. Lambrechts and Smith (2020) stated that female doctoral students reported a significantly higher impact on their well-being than their male counterparts and that the difference is not underpinned by variance in caring responsibilities. Finally, another aspect pointed out by Górska, Kulicka, Staniszewska, and Dobija (2021) is that there may be certain highly gendered forms of academic work. Female researchers would provide more emotional and psychological support to students, for which there was an increased demand during the pandemic. This type of work is less visible and does not directly result in research output.

Reports and individual studies also suggest that the influence of COVID-19 on productivity of female and male researchers differs depending on the dis-

cipline. It can be assumed that, e.g., in educational and laboratory sciences it is more dramatic, since data collection is sometimes not possible or only with an even greater organizational effort (Cui, Ding, & Zhu, 2022; Myers et al., 2020). The latter might no longer be compensable for groups that are already burdened. To what extent these findings are generalizable from these respective disciplines to sport and exercise science is yet unclear. From our point of view, the development of gender-specific publication behavior and sustainable effects should be monitored in a regular manner to investigate whether differences stagnate or become larger.

Therefore, the aim of the current study was to investigate whether the decrease in submissions by women also applies for the field of sport and exercise sciences. We used the German Journal of Sport and Exercise Science as an example to compare article submissions before and during the COVID-19 pandemic. We consider in the analysis the first author, because this is usually the person with the largest share of work (Deutscher Hochschulverband, 2011). In addition, first authorship is of particular importance in, e.g., doctoral studies and appointment procedures. There are exceptions to this principle (e.g., alphabetical sorting, first and second author are equal), but these can only be researched to a limited extent. A consideration of all authors was also too complex against this background. We hypothesized that women submitted fewer papers to the journal during the COVID-19 pandemic compared to prior to the pandemic. Second, we examined to what extent the career status (doctoral student, senior researcher, professor) influenced the submission behavior during COVID-19. The career status was considered, as senior researchers are most likely to have care responsibilities in contrast to mostly younger doctoral students or older professors.

Method

The analyses focused on article submissions to the German Journal of Exercise and Sport Research from April 1st, 2019

to March 31st, 2021. Anonymized data was provided by the editor-in-chief of the journal. For the authors, only information about the date of submission, gender of the authors, country, and career status was accessible¹. Submissions, which were rejected by the editors because of incompleteness or retracted by the authors were removed prior to the analyses. In addition, only article submissions by authors from Europe were included. Submissions by authors from Asia, North and South America, Australia, New Zealand, and Africa were not considered, as lockdown periods differed to those in Europe. Article submissions were grouped per month. In order to analyze whether the COVID-19-pandemic influenced gender-specific publication behavior, the following time periods were compared: (1) article submission behavior in the year before the corona pandemic (April 2019 to March 2020), (2) article submission behavior during the first year of the corona pandemic (April 2020 to March 2021). The career status was operationalized through the title of the first author and categorized as either PhD student (no title), senior researcher (Dr./PhD), or professor. A log-linear analysis of the categorical variables gender, time, and career status ($2 \times 2 \times 3$ design) was calculated to test whether the submission behavior depends on these variables or their interactions. Log-linear analyses are expansions of the chi-square test and can be used to analyze the relationship between more than two categorical variables.

The study was preregistered on the online pre-registration platform aspredicted.org (#50972).

Results

In total, 198 articles were submitted from April 2019 to March 2021 ($n = 114$ submissions by authors from German universities). 64 articles were submitted by female first authors (32.3%), 123 by male first authors (62.1%). In 11 cases, the gender could not be identified (5.6%).

¹ The former editor in chief provided the data in an anonymized way. Data analyses and the manuscript were not influenced by the editor-in-chief.

■ **Figure 1** shows the proportion of article submissions from female first authors from April 2019 to March 2021, grouped for the time periods pre and during COVID-19. Overall, the number of article submissions varies between zero (e.g., August 2019 and 2021) and ten (April 2021). Across 2019, 2020, and 2021, no specific period can be identified in which a particularly large number of articles were submitted by female authors. However, it is noticeable that in July, August, and September 2020 more articles were submitted compared to 2019 and 2021.

■ **Table 1** shows the article submissions by male and female authors in months before COVID-19 (April 2019–March 2020) and comparable months during COVID-19 (April 2020–March 2021). Male authors submitted significantly more articles to the German Journal of Exercise and Sport Research than female authors in both periods (before COVID-19 pandemic: $n_{\text{men}} = 60$; $n_{\text{women}} = 27$; during COVID-19 pandemic: $n_{\text{men}} = 63$; $n_{\text{women}} = 37$). Contrary to our assumption, the total number of submissions slightly increased during the pandemic.

Furthermore, ■ **Table 1** shows the proportion of article submissions by the first author's gender, time period, and career status. In each group (without PhD, PhD, professors), the portion of submissions by men and women was either equally high (only in the group of PhDs during the COVID-19 pandemic) or the portion of article submissions by men were higher than submissions by female authors (in all other groups). The difference of submissions between female and male first authors was smallest in the group without PhD and highest in the group of professors. In addition, findings indicate that the number of article submissions decreased during the COVID-19 pandemic only in male researchers with PhD (with the biggest gap of $\Delta 8$). Unexpectedly, in all other groups, the number of submissions increased during the COVID-19 pandemic compared to prior to the pandemic. Results of a log-linear analysis including gender, time period, and career status as factors ($2 \times 2 \times 3$ design) show that effects

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Abstract

During the COVID-19 pandemic, many governments closed schools and imposed social distancing requirements, limiting childcare options and requiring researchers to stay at home. Recent studies indicated that women are particularly negatively affected by the pandemic containment measures. Depending on discipline and type of publication, it is stated that the number of submissions by women has fallen dramatically, but submissions by men have remained constant or even increased. The aim of this study is to examine whether a decrease in article submissions during the COVID-19 pandemic by women also applies to the field of sport and exercise sciences using the German Journal of Exercise and Sport Research as an example. Furthermore, this study aimed to investigate to what extent career status has an influence on submission behavior during COVID-19. The current analysis focuses on 198 submissions to the German Journal of

Exercise and Sport Research, which were systematically examined with regard to the first authorship of articles submitted from April 1st, 2019 to March 31st, 2021. Results of a log-linear analysis show that men submitted significantly more articles. The gap between women and men is greatest in the position of professors, which reflects the distribution of women and men in scientific employees. However, no significant differences in submission behavior are found before vs. during the pandemic. This study functions as a starting point for the discipline of sport and exercise science from which submission behavior should be further monitored taking into account individual and social factors which might influence submission behavior.

Keywords

Gender inequality/differences · Sport and exercise science · Academia · Corona pandemic · Women · Men

of gender on submissions ($X(1) = 17.18$, $p < 0.001$) and the gender \times career status interaction ($X(2) = 20.05$, $p < 0.001$) were significant. However, the effect of gender \times time period interaction on the number of submissions was not significant.

Discussion

The first aim of this study was to examine whether a decrease in article submissions during COVID-19 pandemic by women also applies for the field of sport and exercise sciences. The second aim was to investigate to what extent the career status (PhD student, senior researcher, professor) had an influence on article submission behavior within COVID-19 times. Results of a log-linear analysis including gender, time period, and career status as factors showed that men submitted significantly more articles to the German Journal of Exercise and Sport Research before and during the COVID-19 pandemic compared to women, ap-

proximately twice as many. This is not surprising, since the percentage of men in positions in which scientific publications are produced is higher than the percentage of women (e.g., Statistisches Bundesamt, 2021c; Best et al., 2013; Shinozaki, 2017). Thus, the gender difference is not necessarily attributable to a different submission behavior in general but may be due to the higher number of male scientists working in the field of sports sciences. Results further showed a significant interaction effect gender \times career on submissions, suggesting that the number of submissions by men and women differed by status group. The difference of submissions between female and male first authors was smallest in the group without PhD and highest in the group of professors. This might be attributable to the fact that the gap between women and men is greatest in the position of professors in sports sciences, at least in Germany. This becomes visible in numbers collected by the Federal Statistical

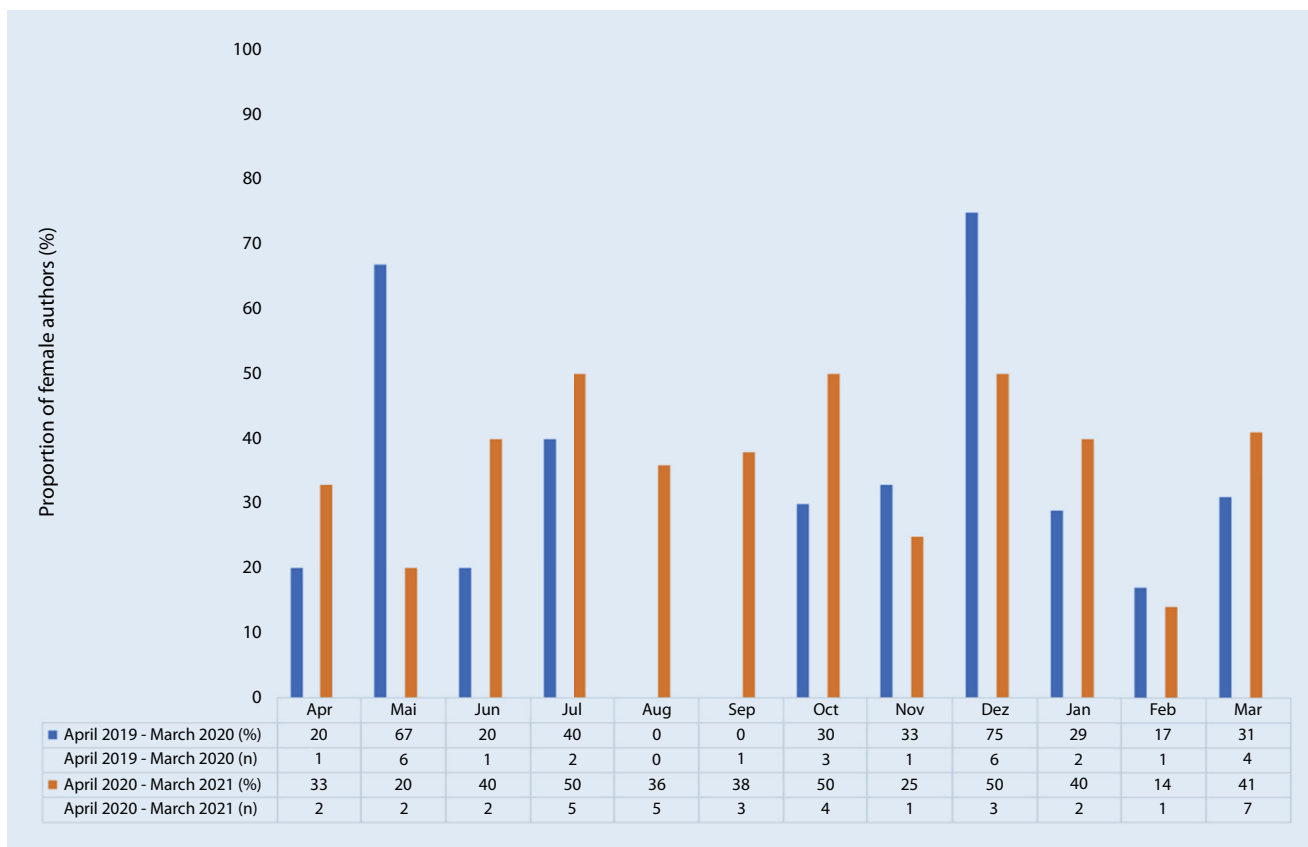


Fig. 1 ▲ Proportion of article submissions by female authors in the period Apr. 2019 to Mar. 2020 (pre COVID-19) and Apr. 2020 to Mar. 2021 (during COVID-19) per month. In total, 198 articles were submitted from April 2019 to March 2021. 64 articles were submitted by female authors. Due to the small sample, the percentages are very high in some months

Office in 2020. They show that of 287 professors in sport science at German universities, 81 are female, which is 28% (Statistisches Bundesamt, 2021c).

Contrary to our hypothesis the descriptive results of submissions by women during the COVID-19 pandemic showed a slight increase of submissions by women and no decrease. However, the effect of time period on article submissions remained non-significant. A similar trend is visible for male researchers, with the only exception for male senior researchers. Unfortunately, an interpretation is limited due to our study design, however some possible explanations are offered. As this is the first study taking into account article submissions behavior in sport and exercise sciences using one journal as an example, we only had access to the number of article submissions differentiated by gender and career status, but had no further information on factors that might influence the article submission behavior. Additionally, the

number of submissions is quite low in general.

Possibly the slight increase in article submission is attributable to either that researcher might still had sufficient data on studies conducted or data collection was possible during the pandemic (e.g., via online questionnaires). Staying at home might have been beneficial, as it allowed them to work more efficiently. Heo et al. (2022), for example, emphasized positive experiences of scientists in STEM (science, technology, engineering, mathematics) and medicine fields during the pandemic with regard to their productivity. Participants in their study described working at home as “more comfortable”, “efficient”, “more balanced”, and “fluid”. Additionally, many activities that typically compete with work time, e.g., commuting or traveling for in-person conferences, were eliminated. Furthermore, a lack of social and recreational opportunities might lead researchers to invest more time in their work (Kruger, Matu-

rana, & Nickerson, 2022). Finally, an increase in article submission might also be a result of increasing research on COVID-19-related topics, faster reviews, and increased funding opportunities related to COVID-19 which as a result might led to publication output (Gao, Yin, Myers, Lakhani, & Wang, 2021; Heo et al., 2022; Zyoud & Al-Jabi, 2020). Results showed that in July, August, and September 2020 more papers were submitted compared to 2019. We assume that significantly fewer people have gone on vacation due to strict social distancing requirements.

The fact that we were not able to replicate the effects shown in recent studies, i.e., increased gender inequality in publication output during COVID-19, could also be attributable to the discipline. While for example in neuroimmune and psychiatric fields, scientists are forced to work with data collected in laboratories (Myers et al., 2020), researchers in sport and exercise science might have worked to a greater extent with existing

Table 1 Distribution of the submissions before and during COVID-19 by time period, gender, and career status

| | April 2019–March 2020 | | | | | April 2020–March 2021 | | | | |
|-------|-----------------------|-----------|-----------|----------|-----------|-----------------------|-----------|-----------|-----------|------------|
| | Without PhD | PhD | Prof | NI | Total | Without PhD | PhD | Prof | NI | Total |
| Women | 12 (46%) | 13 (36%) | 2 (9%) | 0 (0%) | 27 (29%) | 16 (46%) | 15 (50%) | 4 (13%) | 2 (18%) | 37 (35%) |
| Men | 14 (54%) | 23 (64%) | 20 (91%) | 3 (38%) | 60 (65%) | 19 (54%) | 15 (50%) | 26 (87%) | 3 (27%) | 63 (59%) |
| NI | 0 (0%) | 0 (0%) | 0 (0%) | 5 (63%) | 5 (5%) | 0 (0%) | 0 (0%) | 0 (0%) | 6 (55%) | 6 (6%) |
| Total | 26 (100%) | 36 (100%) | 22 (100%) | 8 (100%) | 92 (100%) | 35 (100%) | 30 (100%) | 30 (100%) | 11 (100%) | 106 (100%) |

NI not identified

data or data from, e.g., online surveys. Thus, effects caused by the corona virus might become visible later.

Interestingly, the results of this study showed that the only group in which submissions decreased during COVID-19 was the group of male researchers with PhD. Additionally, the gap between submissions before vs. during COVID-19 was highest in this group (Δ 8). However, in total, the numbers per subgroup were very low (0–23 in one year), which should be considered when interpreting the results. The number of submissions by female researchers with PhD increased by two in one year. Researchers with PhD might be a group that is particularly affected by COVID-19 with regards to research productivity. They tend to have a smaller scientific network and fewer job securities than, e.g., full professors (Böhm & Liu, 2022). Additionally, they might be parents of younger children, who needed time for homeschooling. Likewise, some might be responsible for the care of their parents. Care duties for the older generation increased, as older people were most vulnerable to the coronavirus and daily routines such as shopping groceries became a risk factor. The additional workload due to care responsibilities might also affect the productivity of younger professors or older doctoral students.

Taking to account that researchers with PhD usually put a lot of time and effort in writing articles, as they often face more pressure than, e.g., senior professors to publish papers in order to obtain an unlimited position, it is not surprising that the submission gap (before vs. during the pandemic) is likely to be most pronounced for this group (cf. Cui et al., 2022).

The findings need to be validated within a larger study taking individual

differences, such as an assessment of care duties and research time in different stages of scientific career phases, into account as well. Also, in this study, we investigated averaged relations between gender, career status, time periods, and submission behavior. Specific subgroups that were additionally burdened by COVID-19 may not have been identified (e.g., scholarship holders, researchers with limited contracts). The investigation of the development of submissions during COVID-19 from a person-centered approach might help to identify subgroups in need for special support. Future studies should also pay particular attention on the first months of the lockdown. We decided to include the months April and May in our analyses, as we assumed that researchers were particularly affected from the lockdown in the early months. We argued that the workload of researchers increased, as, e.g., teaching had to be converted into an online format and students had to be informed regularly about changes with regard to teaching and exams. In addition, work from home had to be organized (e.g., equipment such as computers, working places). Possibly, child care and homeschooling had to be managed. Thus, we have chosen to also consider the early months of the lockdown. However, one can also assume that most of the work was already done before the lockdown started and staying at home might have been beneficial for some researchers, as it allowed them to work more efficiently in the early months. Thus, results of analyses could differ depending on chosen time periods. Therefore, we exploratorily inspected the submission behavior from June to May (pre and during Covid-19). In line with the original results, we found an increased number of submitted

articles during the Covid-19 pandemic. Also, the number of submissions by male researchers with PhDs decreased during Covid-19 with Δ 11, being the highest gap between pre and during Covid-19. These results also fit the findings considering the April to March time period. However, we found that female authors even tended to submit more articles during the Covid-19 pandemic than before (June–May: $n_{pre} = 24$, $n_{during} = 44$; April–March: $n_{pre} = 27$, $n_{during} = 37$) compared to the change in submission behavior by male authors. The gender \times time period interaction is, however, again not significant ($X^2 = 3.51$, $p = 0.06$). The increase in submissions by female authors is especially manifested by an increased number of submissions by female authors without a PhD and female professors. Finally, also the consideration of future time periods seems to be promising, as it could be studied how article submission behavior changes during and after the pandemic.

Summarizing, the hypothesized effect of COVID-19 on article submissions to the German Journal of Exercise and Sport Research could not be found. Does this mean that we can sit back against the background of science policy considerations? The authors believe not. On the one hand, significant differences of article submissions with respect to gender could be found, which reflect actual ratios of men and women in scientific research positions. On the other hand, having only limited information this article can only be a starting point, from which submission behavior should be further monitored paying attention to a possible negative impact of individual and social factors which might influence submission behavior and productivity. Although no COVID-19 related effects could be found, we would like to

raise awareness that institutions and supervisors should pay attention to possible negative impact of COVID-19 pandemic in some individuals or subgroups. From our perspective, efforts are to be made to identify possible negative influences, and measures should be developed to support researchers during and after the COVID-19 pandemic. Measures can be taken at various levels. In terms of university policy, e.g., how are care periods taken into account in application processes and how is this monitored? What institutional offers are made to support care tasks? How will excessive demands during the pandemic be monitored and taken into account in the future? According to which criteria are administrative, teaching, and research tasks distributed within a working group? Within sports science, it also makes sense to use these as an occasion for broader discussion and exchange in the context of conferences. In this way, barriers and spaces for development can be identified, made visible, and conclusions can be drawn from them.

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Declarations

Conflict of interest. L. Henning, C. Raue-Behlau, B. Halberschmidt, J. Peikenkamp and M. Tietjens declare that they have no competing interests.

For this article no studies with human participants or animals were performed by any of the authors. All studies mentioned were in accordance with the ethical standards indicated in each case.

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