# PEER REVIEW HISTORY

BMJ Open publishes all reviews undertaken for accepted manuscripts. Reviewers are asked to complete a checklist review form (http://bmjopen.bmj.com/site/about/resources/checklist.pdf) and are provided with free text boxes to elaborate on their assessment. These free text comments are reproduced below.

## **ARTICLE DETAILS**

| TITLE (PROVISIONAL) | Analysis of wheelchair falls in team sports at the Paralympic   |
|---------------------|---|
|                     | Games: Video-based descriptive comparison between the Rio   |
|                     | 2016 and Tokyo 2020 games   |
| AUTHORS             | Fukui, Kazuki; Maeda, Noriaki; Sasadai, Junpei; Shimizu, Reia;<br>Tsutsumi, Shogo; Arima, Satoshi; Tashiro, Tsubasa; Kaneda,<br>Kazuki; Yoshimi, Mitsuhiro; Mizuta, Rami; Abekura, Takeru; Esaki,<br>Hinata; Terada, Tomoki; Komiya, Makoto; Suzuki, Akira; Urabe,<br>Yukio |

| REVIEWER         | Grimshaw, Paul   |
|------------------|--|
|                  | The University of Adelaide   |
| REVIEW RETURNED  | 05-Mar-2022  |
|                  |  |
| GENERAL COMMENTS | Line 32 – how can you have a decimal place of a fall. This data is<br>nominal and is not discrete. You cannot have 5.8 falls? Either it<br>was a fall, or it was not a fall. |
|                  | Lines 24-25 personally I do not like the excessive use of these abbreviations  |
|                  | Line 31 – I think there should be a space between – attention[5, 6]<br>– please check all these  |
|                  | Line 36 – are we sure it is video? These days it is probably digital footage.  |
|                  | Line 57 – there seem to be a lot of space missing issues, unless this is formatting but please check all these as I am not checking anymore i.e. 3.5(highest                 |
|                  | Putting separate line numbers per page DOES NOT HELP<br>REVIEWING you will need to work this out when I change<br>numbers as I am not doing this for you                     |
|                  | Line 18 – I would not use "we"   |
|                  | Line 8 – have you defined IPC?   |
|                  | Line 10 – these numbers do not seem to match the abstract  |
|                  | Line 22 – use of "we" again  |
|                  | Line 45 – how can you use a one-way ANOVA on this data?<br>ANOVA requires normal distribution, homogeneity of variance and   |

## **VERSION 1 – REVIEW**

| a random sample on PARAMETRIC data. This nominal or<br>categorical data is NOT PARAMETRIC.<br>You cannot take a categorical variable and then simply get the<br>mean and then assume this is parametric data. How is it possible<br>to have 0.8 of a fall?        |
|---|
| I should stop reviewing this paper now and return it for correction.  |
| Line 7 but you had permission to use the videos I presume.  |
| Results   |
| Line 10 – as before – how can you take a categorical variable like<br>it is or it isn't a fall and then do parametric statistical techniques on<br>the data – it is meaningless, they are not scores they are<br>categories and counts.                           |
| Based on this I would question the validity of all these results  |
| Discussion  |
| Line 46 space issue again – i.e. findingsis   |
| There is some merit in some of these findings but the statistical<br>analysis that you have conducted cannot be used to support the<br>results or discussion. I suggest that you re-examine the statistical<br>methods that you have used in this work carefully. |

| REVIEWER        | Musselman, Kristin<br>University of Toronto, Physical Therapy |
|-----------------|---|
| REVIEW RETURNED | 04-Apr-2022   |

| GENERAL COMMENTS  | Thank you for the opportunity to review the manuscript "Analysis        |
|-------------------|---|
| CEREIX E COMMENTO | of wheelchair falls in team sports at the Paralympic Games: Video-      |
|                   | based comparison between the Pie 2016 and Tekve 2020 games"             |
|                   | Mile this research is interesting and well mativated there are          |
|                   | vvnile this research is interesting and well-motivated, there are       |
|                   | some methodological and reporting issues that if addressed,             |
|                   | would improve the manuscript.   |
|                   | 1. Title: The title suggests that a video-based comparison of the       |
|                   | 2016 and 2020 games was completed. Yet, in the Methods and              |
|                   | Results it seems that there wasn't a statistical comparison made        |
|                   | between data extracted from the 2016 and 2020 games, but                |
|                   | instead a descriptive comparison. Further, it's not clear whether       |
|                   | the 2016 data were obtained from a video-based analysis? The            |
|                   | title should be edited to reflect what was done in the study. For       |
|                   | example "Video-based descriptive comparison" would be more              |
|                   | example, video-based, descriptive comparison would be more              |
|                   | accurate, assuming the 2010 data were pulled from video, and the        |
|                   | authors opt not to complete a statistical companison between the        |
|                   | 2016 and 2020 games (see below).  |
|                   | 2. Abstract: The objective states "and compare those of the Rio         |
|                   | 2016" As per comment #1, I'd be clear that a descriptive                |
|                   | comparison was completed.   |
|                   | 3. Introduction: The authors provide good motivation for this study.    |
|                   | Characterizing falls is an important step toward fall and injury        |
|                   | prevention. The objective at the end of the Introduction states that    |
|                   | the number of falls, occurrence of falls and characteristics of falls   |
|                   | were studied. What prevented the authors from extracting data on        |
|                   | injuries from falls? I realize all injuries would not be evident in the |
|                   | video, but whether falls resulted in the player coming off the court    |
|                   | video, but whether rais resulted in the player conning on the court,    |

| or receiving immediate medical attention, would have been evident  |
|--|
| 4. Methods: Data from the 2016 games are stated to have come from the IPC official website and a prior study. Was the data from  |
| the 2016 games collected and analyzed in the same way as the 2020 games? The analysis of the 2020 data is well described (i.e.   |
| be beneficial for the 2016 games (or stating the similarities and  |
| differences between the analyses, and providing more detail in the case of differences). If there are differences in the analyses of the 2016 and 2020 games, how might these differences impact the |
| findings of the current study?<br>5. Statistical comparison: Please clearly state what variables are   |
| compared. For example, it is not clear if this section applies to the comparison of data from the 2016 and 2020 games. The reader  |
| 4) that statistical comparisons were not completed between these   |
| two datasets. Why weren't these two datasets compared with statistics? It also came as a surprise to see that falls with and   |
| without foul play at the 2020 games were statistically compared (i.e. Table 3).  |
| 6. Patient and public involvement: The lack of involvement of athletes in the study should be acknowledged as a limitation.  |
| suspect they would have provided good insight into what  |
| parameters to extract from the videos and could have provided helpful interpretation of the findings.  |
| 7. Results: It doesn't appear that post-hoc tests were applied? For example, a "significant difference in the number of falls was  |
| observed among the three sports"; yet, between which specific  |
| other statistically significant findings reported in Tables 2-4.   |
| 8. Results: The average number of falls per game is reported in the first sentence of the Results. Please add the standard   |
| deviation to the mean values.  |
| 9. Table 2: Clarify in the Table that the values in the cells represent: number of falls (% of total falls). 'Unidentified' could be removed under 'Plaving phase (%)'                               |
| 10. Table 3: The title could better represent the data provided in   |
| judgement". Clarify in the Table that the values in the cells  |
| represent: number of falls (% of total falls).   |
| reporting as number of falls (% of total falls) to be consistent with  |
| the other tables.<br>12. Discussion: As per comments 1 and 2 above. I'd specify  |
| "and to descriptively compare them between Rio 2016 and  |
| Tokyo 2020" (final sentence in first paragraph of Discussion, lines 55-56).  |
| 13. Discussion: Second paragraph, beginning line 59 page 13 – I  |
| think this sentence is referring to falls. For example, "tended to<br>have a high percentage of falls among high pointers while MWB<br>(54.3%) conversely tended to have a high percentage of falls  |
| among low pointers."   |
| la. Discussion: Can the statement about low pointers having a lower risk of falling than high pointers (page 14, line 10) be backed  |
| up with one or more references? It is not clear why low pointers<br>would have a lower fall risk. Wouldn't low pointers be less likely to<br>prevent a fall through corrective motor strategies?     |

#### **VERSION 1 – AUTHOR RESPONSE**

Comments from Reviewer 1,

1. Line 32 – how can you have a decimal place of a fall. This data is nominal and is not discrete. You cannot have 5.8 falls? Either it was a fall, or it was not a fall.

Response: Thank you for your valuable input. As you pointed out, a fall is either a fall or it is not. However, in this case, after calculating the number of falls for each team by event, we have also calculated the frequency of falls for each event. This was done to make the difference in frequency easier to understand, therefore, we purposely displayed the average number of falls.

2. Lines 24-25 personally I do not like the excessive use of these abbreviations Response: Thank you for pointing this out. In this case, we are using the same abbreviations as in previous studies, WR and WB. We have decided that this is easier for readers to understand.

3. Line 31 – I think there should be a space between – attention[5, 6] – please check all these Response: Thank you for pointing this out to us. We have corrected this.

4. Line 36 – are we sure it is video? These days it is probably digital footage. Response: Thank you for pointing this out. We have used the term "video" in our previous study, so we have decided to use the same term in this study as well.

5. Line 57 – there seem to be a lot of space missing issues, unless this is formatting but please check all these as I am not checking anymore i.e. 3.5(highest .... Response: Thank you for pointing this out. We have checked everything and fixed all issues of a similar nature.

6. Putting separate line numbers per page DOES NOT HELP REVIEWING you will need to work this out when I change numbers as I am not doing this for you Response: We apologize very much for the inconvenience. We have added continuous line numbering.

7. Line 18 – I would not use "we" Response: Thank you for pointing this out. We have corrected it.

8. Line 8 - have you defined IPC?

Response: Thank you for pointing this out. It was not previously defined, however, we have included the definition now.

9. Line 10 – these numbers do not seem to match the abstract Response: We deeply apologize, but we have rechecked the numbers in the abstract and could not find the discrepancy. Would you mind pointing out the precise lines?

10. Line 22 – use of "we" again

Response: Thank you for pointing this out. We have corrected it.

11. Line 45 – how can you use a one-way ANOVA on this data? ANOVA requires normal distribution, homogeneity of variance and a random sample on PARAMETRIC data. This nominal or categorical data is NOT PARAMETRIC.

Response: Thank you for your question. In this case, we are counting the number of fall occurrences per match, not the presence or absence of falls. Therefore, since the total number of falls for each match is calculated for each competition, we believe that this could be viewed as a continuous

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indicator. Additionally. we have decided to use a one-way analysis of variance in this study, since previous studies had used similar methods.

12. You cannot take a categorical variable and then simply get the mean and then assume this is parametric data. How is it possible to have 0.8 of a fall?

Response: The Kappa coefficient is considered reliable for data at 0.8 or higher. Therefore, in this case we assumed that at 0.8 or above, the data is reliable with no variation in the results of the three analyses.

13. I should stop reviewing this paper now and return it for correction. Response: Thank you for using your valuable time to review our paper.

14. Line 7 but you had permission to use the videos I presume. Response: Yes, we obtained permission from IPC before analyzing the video.

#### Results

15. Line 10 - as before – how can you take a categorical variable like it is or it isn't a fall and then do parametric statistical techniques on the data – it is meaningless, they are not scores they are categories and counts.

Response: Thank you for your valuable comment. We would indeed have a nominal measure if we had been measuring the presence or absence of falls. However, in this case, we counted the number of falls for each match and calculated the total number of falls. Therefore, we have adopted this statistical method because we believe that the reader will better understand the results if they are calculated and compared as averages per match.

16. Based on this I would question the validity of all these results

Response: Thank you for your comments. In addition to our answer above, in the previous study, we have made a descriptive comparison with our previous study, Rio 2016. For this comparison, we have used the same statistical methods in both studies.

Discussion

17. Line 46 space issue again – i.e. findingsis

Response: Thank you for your repeated corrections. We have corrected this as well.

18. There is some merit in some of these findings but the statistical analysis that you have conducted cannot be used to support the results or discussion. I suggest that you re-examine the statistical methods that you have used in this work carefully.

Response: Thank you for your valuable input. As we have responded above, we have used the same statistical methods in this study as in previous studies in order to compare our results with Rio 2016. Also, we counted the number of falls, not the presence or absence of falls, and we believe that the results can be better understood by the readers when comparing mean values. We hope you understand.

## Comments from Reviewer 2,

1. Title: The title suggests that a video-based comparison of the 2016 and 2020 games was completed. Yet, in the Methods and Results it seems that there wasn't a statistical comparison made between data extracted from the 2016 and 2020 games, but instead a descriptive comparison. Further, it's not clear whether the 2016 data were obtained from a video-based analysis? The title should be edited to reflect what was done in the study. For example, "Video-based, descriptive comparison" would be more accurate, assuming the 2016 data were pulled from video, and the authors opt not to complete a statistical comparison between the 2016 and 2020 games (see below).

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Response: Thank you for pointing this out. We have revised the title to "video-based, descriptive comparison".

2. Abstract: The objective states "and compare those of the Rio 2016..." As per comment #1, I'd be clear that a descriptive comparison was completed.

Response: Thank you for pointing this out. We have corrected it to match the title.

3. Introduction: The authors provide good motivation for this study. Characterizing falls is an important step toward fall and injury prevention. The objective at the end of the Introduction states that the number of falls, occurrence of falls and characteristics of falls were studied. What prevented the authors from extracting data on injuries from falls? I realize all injuries would not be evident in the video, but whether falls resulted in the player coming off the court, or receiving immediate medical attention, would have been evident in the video?

Response: Thank you for your valuable question. As you mentioned, the videos we used to analyze the falls were recorded during matches and followed the game, so they did not follow the player who fell. Consequently, we could not extract additional specific data from the video, such as whether the player had left the court injured, or received medical attention. Therefore, we were unable to investigate the relationship between the injury data in this study. This has been described as a limitation of our study. (p14, L:311-316)

4. Methods: Data from the 2016 games are stated to have come from the IPC official website and a prior study. Was the data from the 2016 games collected and analyzed in the same way as the 2020 games? The analysis of the 2020 data is well described (i.e. first paragraph of the Methods). A similar level of description would be beneficial for the 2016 games (or stating the similarities and differences between the analyses, and providing more detail in the case of differences). If there are differences in the analyses of the 2016 and 2020 games, how might these differences impact the findings of the current study?

Response: Thank you for your valuable question. We have used similar data collection and analysis methods in our previous studies. Since our analysis methods are also similar, we believe that the results of the current study are purely indicative of the characteristics of falls per convention. We have added details regarding the analysis of the 2016 convention. We thank you in advance for your confirmation. (p6, L151-152)

5. Statistical comparison: Please clearly state what variables are compared. For example, it is not clear if this section applies to the comparison of data from the 2016 and 2020 games. The reader doesn't realize until later in the Results (i.e. when reviewing Table 4) that statistical comparisons were not completed between these two datasets. Why weren't these two datasets compared with statistics? It also came as a surprise to see that falls with and without foul play at the 2020 games were statistically compared (i.e. Table 3).

Response: Thank you for your valuable suggestions. We have calculated the characteristics of falls in 2020 in the same way as in 2016. We have conducted this statistical analysis because we believe that a descriptive comparison of the current results with the 2016 results calculated in previous studies will provide a more detailed picture of the fall characteristics in wheelchair competitions at the 2020 Olympic games. We have added a more detailed description in the statistics section. (p6, L166-173)

In addition, since the data for the presence of foul play was unique to this year's results, we have statistically compared the results and included them in the results section as well.

6. Patient and public involvement: The lack of involvement of athletes in the study should be acknowledged as a limitation. I suspect they would have provided good insight into what parameters to extract from the videos and could have provided helpful interpretation of the findings.

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Response: Thank you for your valuable suggestions. As you pointed out, we were only able to analyze the video in this study, and we believe we would have obtained better data if we had been able to survey the athletes who fell. We have added this to our limitations. Please check it. (p14, L307-312)

7. Results: It doesn't appear that post-hoc tests were applied? For example, a "significant difference in the number of falls was observed among the three sports"; yet, between which specific sports did those differences lie? This comment also applies to other statistically significant findings reported in Tables 2-4.

Response: Thank you for your question. As you pointed out, we did not specify the results of the posthoc tests. The difference in the number of falls has been corrected in the text to highlight the areas where there was a significant difference with respect to Table 2-4. Please check it.

8. Results: The average number of falls per game is reported in the first sentence of the Results. Please add the standard deviation to the mean values.

Response: Thank you for pointing this out. We have added the standard deviation to the mean. Please check it. (p8, L182-184)

9. Table 2: Clarify in the Table that the values in the cells represent: number of falls (% of total falls). 'Unidentified' could be removed under 'Playing phase (%)'.

Response: Thank you for pointing this out. We have revised the table to show the number of falls (% of total falls) (Table 2). Also, "Unconfirmed" has been entered to match the number to 100%.

10. Table 3: The title could better represent the data provided in the table; for example, "Fall characteristics according to foul judgement". Clarify in the Table that the values in the cells represent: number of falls (% of total falls).

Response: Thank you for your valuable advice. We have revised the title to "Fall characteristics according to foul judgement" (Table 3). We have also added a note to show the number of falls (% of total falls).

11. Table 4: It looks like the number of falls is reported. I suggest reporting as number of falls (% of total falls) to be consistent with the other tables.

Response: Thank you for pointing this out. We have revised the number of falls (as a percentage of total falls) to be consistent with the other tables (Table 4).

12. Discussion: As per comments 1 and 2 above, I'd specify "...and to descriptively compare them between Rio 2016 and Tokyo 2020" (final sentence in first paragraph of Discussion, lines 55-56). Response: Thank you for pointing this out. Per your previous comments, this sentence has been corrected to: "...and to descriptively compare them between Rio 2016 and Tokyo 2020" (p12, L:219-220)

13. Discussion: Second paragraph, beginning line 59 page 13 – I think this sentence is referring to falls. For example, "...tended to have a high percentage of falls among high pointers while MWB (54.3%) conversely tended to have a high percentage of falls among low pointers. Response: Thank you for pointing this out. As you pointed out, we are referring to falls. We have revised the wording as you suggested. (p12, L212)

14. Discussion: Can the statement about low pointers having a lower risk of falling than high pointers (page 14, line 10) be backed up with one or more references? It is not clear why low pointers would have a lower fall risk. Wouldn't low pointers be less likely to prevent a fall through corrective motor strategies?

Response: Thank you for your valuable question. Certainly, we believe that low pointers are more likely to fall because they are unable to balance properly after losing their balance due to diminished trunk function. However, based on the results of both Rio 2016 and Tokyo 2020, WR and WWB have experienced more falls in high pointers. We speculate that this is because high pointers are more aggressive in dynamic and contact play without the fear of falling. Since there is no literature on falls, we are unable to provide details using precise literature, therefore, we have revised the wording of the text to "speculate". (p13, L259)

| REVIEWER         | Musselman, Kristin   |
|------------------|--|
|                  | University of Toronto, Physical Therapy  |
| REVIEW RETURNED  | 02-Jun-2022  |
|                  |  |
| GENERAL COMMENTS | I thank the authors for addressing the reviewers' comments<br>thoroughly and professionally. The description of the study,<br>presentation of the results in the tables and the statistical analyses<br>are all improved. I have two minor comments on the revised<br>manuscript:<br>1. The standard deviations are missing for the reporting of mean<br>values in the first sentence of the Results ("with the average<br>number of falls per game being 5.8, 23.0, and 9.6, respectively").<br>2. The reporting of the results of the post-hoc analysis in table 4 is<br>a bit hard to follow. If I understand correctly, the symbols are used<br>to indicate if a value is statistically higher or lower than the other<br>two values. For example, for the variable 'Contact with another<br>player', the number of falls for WR is "significantly lower among the<br>3 events". Does this mean that in the pair-wise post0hoc<br>comparisons that is was significantly lower than the values for<br>MWB and WWB? If yes, this is a bit surprising looking at the<br>values in Table 4 since the values for WR and WWB are very<br>similar. Is there a way to more clearly report the findings from the<br>post-hoc comparisons? |

### **VERSION 2 – REVIEW**

## **VERSION 2 – AUTHOR RESPONSE**

Comments from Reviewer 1,

1. The standard deviations are missing for the reporting of mean values in the first sentence of the Results ("with the average number of falls per game being 5.8, 23.0, and 9.6, respectively").

Response: Thank you for pointing this out. We have added the standard deviations (p2 L54, p8 L184-185).

2. The reporting of the results of the post-hoc analysis in table 4 is a bit hard to follow. If I understand correctly, the symbols are used to indicate if a value is statistically higher or lower than the other two values. For example, for the variable 'Contact with another player', the number of falls for WR is "significantly lower among the 3 events". Does this mean that in the pair-wise post0hoc comparisons that is was significantly lower than the values for MWB and WWB? If yes, this is a bit surprising

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looking at the values in Table 4 since the values for WR and WWB are very similar. Is there a way to more clearly report the findings from the post-hoc comparisons?

Response: Thank you for your most valuable suggestions. Table 4 ("Contact with another player") examines whether there is a difference in the percentage of falls between the three groups with and without contact. Therefore, the difference between the WR and WWB values was small, but the difference was statistically significant. Since the table was in a vertical format, it may have been difficult to understand. We have arranged the results horizontally to make it easier to see the results of the post-test (Table 4).

## **VERSION 3 – REVIEW**

| REVIEWER         | Musselman, Kristin  |
|------------------|---|
|                  | University of Toronto, Physical Therapy   |
| REVIEW RETURNED  | 12-Jul-2022   |
|                  |   |
| GENERAL COMMENTS | Thank you for attending to my suggestions. Table 4 is indeed easier to follow in the revised format |