

Peer Review File

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Reviewer A

The purpose of the submitted paper is to determine and clarify whether wearing a medical or conventional mask during exercise adversely affects peripheral oxygen saturation and other physiological markers and subjective factors.

However, I consider that major improvements in the current state of the manuscript are necessary to be published, as described below.

General comment:

It would be desirable to explain the results more carefully, discuss them in more detail, and state the author's point of view clearly.

We added more detail to the Results (see Pages 9-12, lines 188-290) and the Discussion has undergone a rewrite (see Pages 12-14, lines 292-382).

Major Remarks

#1. The results of the Friedman's test are shown in supplementary, but it is better to include it in the text of "Results", and to explain clearly. Moreover, the description of the results of Friedman's test on the SPO₂ cannot be found.

We removed the supplementary and included all the results of the Friedman's tests in the text. We also added Friedman's test results for SPO₂ (see Pages 9-12, lines 188-290).

#2. Line 190 to 191 (Table2): Authors state that the subjective effects of buffs were worse than surgical masks, as shown in Table 2. I suggest to describe the properties of the buff compared to surgical masks, and explain how this finding came to be.

We described the properties of the masks (buff and surgical mask) in the Measurements section (see Page 6, lines 122-125). We added the symptomology questions to Table 3 (previously Table 2), and the scale of rating in the table footnote to explain how we arrived at this finding (see Table 3).

#3. Line 196 to 197, and 220 to 221: It is difficult to understand the explanation for the relationship between slight increase in metabolic load and the higher expiratory temperature. Also, in relation to dyspnea. A clear explanation is needed.

We added detail to clarify the relationship between increased metabolic load and higher expiratory temperature (a common physiological response during exercise), including the addition of new

references. We also added further information regarding what the temperature results might mean, as we concede the possibility that air accumulation was measured (see Pages 13, lines 311-323)

In relation to dyspnea (RPB), we highlighted that this was a subjective sensation, and is related to the physical barrier of the mask, rather than any change in metabolism. (see Pages 12/13, lines 304-305). These changes were made as part of larger changes to the discussion, as suggested by reviewers.

#4. line 211 to 212: Authors describe the strengths of this study to the use of an appropriate and sufficient sample size to measure and to evaluate over time during exercise load. However, a relatively large number of studies similar to this one have been conducted and published, as evidenced by other papers cited in the references cited in reference 19 of your paper. Please clearly indicate how you differ from these papers to make such an assertion.

We highlighted and referenced the studies closest to ours, and indicated how our study adds to their findings. (see page 13-14, lines 331-349) Furthermore, we removed the mention of our study being “larger” than others but still maintained we adequately powered the study (see page 15, lines 369-377)

#5. Figure 1A: In Figure 1A, only buff shows a significantly lower SPO2 value. I suggest including and discussing this finding in the text.

We highlighted this finding in the discussion, as part of an overall rewrite of the opening paragraphs of the discussion, suggested by other reviewers (see Page 12, lines 295-298).

Minor remarks

#1. Please add units to the measurement items on the vertical axis of graphs other than Figure 1A.

Thank you. We added units on the vertical axis of all figures, excluding Figure 1A (see Figures document Page 1-4).

#2. The figure legend shows uppercase 1A and 2B, etc., but the actual graph uses lowercase a, b, etc. Please unify.

We unified the figure legends as per your suggestion (see Figures document Pages 1-4).

#3. I suggest to correct the figure legend for Figure 4A and 4B.

We corrected the figure legends for Figures 4A and 4B (see Figures document Page 4).

Reviewer B

1. It is recommended with the manuscript regulations to be submitted, write following the format.

Thank you, we followed the format to fit the journal regulations. We changed all 'p-values' to 'P-values', and rounded all p-values to three decimal places.

2. Title: Please change the title to the formal title such as “Effects of no mask, a surgical mask and a fabric buff at moderate intensity exercise on peripheral oxygenation saturation”

We changed the title to “Effects of no mask, a surgical mask and a fabric buff on peripheral oxygenation saturation during moderate intensity exercise”. (see Page 1, line 1-2).

3. The authors should provide information about key findings.

We added our key findings as per the Journal's requirements. We also more detail to the Results (see Pages 9-12, lines 188-290) and the Discussion has undergone a rewrite (see Pages 12-14, lines 292-382).

4. As COVID-19 moves from epidemic to endemic, it's hard for me to understand what these researchers are trying to say. The authors need to clarify this manuscript's main aim and conclusion.

COVID-19 did not form part of our study's aims or objectives, however, it did spark our interest. Many countries are still using masks during moderate intensity exercise and activities of daily living for example walking around office spaces, and climbing stairs. We wanted to observe the effect of no mask vs. mask-wearing on peripheral oxygenation saturation during moderate intensity exercise. We added detail to clarify the main aim and conclusion of our manuscript (see Page 15, line 397-368).

5. What is the hypothesis of this study?

The study's hypothesis is “Peripheral oxygen saturation will be impaired by wearing a surgical mask and a buff mask during moderate intensity exercise as opposed to not wearing a mask.” (see Page 6, line 98-100).

6. Effect of masks on respiratory rate, heart rate, expiratory air temperature (line 160).

“At T1, there were no significant differences in RR between the masked and control group. At T2, the Friedman test indicated significant differences between the groups ($p=0.045$). However, the post-hoc tests did not identify any significant pairwise differences but rather a trend toward a higher RR whilst wearing the surgical mask compared to the control group ($p=0.053$).” Why RR did not have differences? Please describe this point.

Whilst uncommon, this statistical anomaly can occur due to the reduction in power that occurs when undertaking pairwise analyses. This has been acknowledged in the results (see Page 10, lines 242-244).

7. Discussion: It seems the author's written results repeat. The authors should provide information and discuss physiological responses at each point.

In line with comments from other reviewers, the discussion has been rewritten. This includes not repeating the results, as well as discussing the results in relation to other physiological findings (see Pages 12-14, lines 292-382)

8. Please check line 207.

Given the changes to the discussion, this spelling error is no longer present.

Reviewer C

General Review Summary: In my evaluation, this study is of high quality and provides valuable insights, effectively supported by well-presented graphical data. However, certain changes are warranted prior to publication.

Detailed Revision Suggestions:

1. Abstract: The abstract is comprehensive and aptly summarizes the content. However, the key findings should be explicitly stated.

Thank you. We highlighted the key findings in the abstract (page 3, lines 52-54)

2. Introduction: The introduction effectively contextualizes the study and elaborates on crucial parameters. In line 76, the description of fabric mask (B) prompts the question of possible variations in its construction and design, which could be explored further.

Thank you. We added details on possible variations in the construction and design of a buff mask (previously called a fabric mask) (Page 6, lines 124-125). We described the 3 mask conditions in the 'Methods section'. (see Page 6, lines 122-125).

3. Methods: Some minor adjustments are recommended:

Line 83: I suggest removing "of all genders" since this is addressed later.

We removed "of all genders".

Line 83: It is mentioned that participants engaged in at least three times a week of sufficient physical activity. Were details available about whether this pertained to aerobic or strength exercises? This could impact results and might be worth mentioning in limitations if not available.

We added information on the physical activity and sports the participants participated in into the text (see Page 9, lines 193-194) and in Supplementary Table S1.

Line 84: Participants were publicly invited to partake in the study. Could you provide more details about this process?

We added more detail on the recruitment process (see Page 6, line 107).

Line 86: Could you specify a defined period rather than the term "recent" concerning how long ago COVID-19 infection should have occurred?

We added a defined period and deleted "recent" (see Page 6, lines 111-112).

Lines 90-92: As BMI results are discussed, how were participants' height measurements taken? Please include this in the methods.

We added detail on measuring weight and height (see Page 6, lines 117-118).

Line 94 and overall: Referring to the "unmasked" group as the "control group" throughout the report might confuse readers, given that the same participants were in groups (B) and (M). Consider replacing "control group" with a more appropriate term (e.g., "unmasked"). Additionally, in line 132, replacing "group" with a suitable alternative could enhance clarity.

Apart from these points, the methodological description is well-presented.

Thank you. We replaced the "control group" with no mask (NM) throughout the manuscript, tables and figures.

4. Results: Point 3.1: Consider using a table to present the data instead of the text, along with a sentence summarizing it, potentially broken down by gender. We added detail to section 3.1 and inserted Table 1 (see Page 9, lines 191-192). Point 3.2: The p-values for (C) could be included in a table, possibly in supplementary material, for better clarity. We included Supplementary Tables S2, S3 and S4 to show the p-values. Overall, the results section is well-explained, except for the "control group" terminology.

Thank you.

5. Discussion: Omit the first sentences in lines 188 and 193, as they have been previously addressed in the report, thus avoiding redundancy.

The discussion has changed, and no longer has any redundancies (see Pages 12-14, lines 292-382).

Additionally, consider discussing:

- The implications of the results suggesting that moderate exercise, even while wearing a mask, is feasible without adverse health effects. This could extend to everyday activities such as commuting.

Agreed. We added more detail to the discussion (see Page 14, lines 356-358, and Page 15, line 382).

- The feasibility of engaging in a 30-minute workout while wearing a mask, especially when outdoor exercise is prioritized.

Thank you, we added thoughts (see Page 14, lines 356-358).

- Public acceptance of mask-wearing and strategies to enhance it. The study focuses on adults; however, the impact on children, who were greatly affected by the pandemic, deserves attention.

We agree that the pandemic greatly affected children. However, as our study focused on adults we preferred to not discuss studies on children, but added text to the limitation section (see Page 15, line 373).

- Further exploration of child-related studies in this context.

Given the potential policy implications, particularly in future pandemic situations, a more extensive discussion could provide valuable evidence-based insights for decision-makers.

Please refer to the above response.

Reviewer D

Clarifying the influence of wearing either a medical grade, or a fabric ('buff') face mask of under moderate exercise is an interesting topic, and it would be helpful to get further insights on this topic.

I thank the authors for their interesting study. However, I would like to raise a few points for discussion, which may help to improve the quality of paper.

Major points:

The discussion is very short and too superficial. The results of the study are shortly described but not compared with the current literature, so that the impression is given that these are entirely new findings. I therefore strongly recommend that the discussion should be fundamentally revised and the following points should be included.

The Discussion has undergone a rewrite to include more information (see Pages 12-14, lines 292-382).

1. The fabric mask used (Buff) is not fundamentally different in construction to other fabric masks, so that the results of this study should be discussed with studies that have tested the influence of fabric masks.

Detail added to the Discussion section (see Page 13-14, lines 325-349).

2. there are studies that have performed a similar exercise (Lässig J, Falz R, Pökel C, et al. Effects of surgical face masks on cardiopulmonary parameters during steady state exercise. Sci Rep. 2020;10(1):22363. doi: 10.1038/s41598-020-78643-1). This should be included in the discussion.

The suggested study, along with others, has been included in the discussion (see Pages 13-14, lines 325-349).

3. The key parameters of the present work (SpO₂, EtCO₂ect.) should be compared with results from other studies as they are standard parameters. In particular, please explain why SpO₂ is higher under resting conditions (T₀) under the mask than without and why there is a decrease under exercising conditions (Figure 1A). The same is shown for EtCO₂ (Figure 1A). Is there an explanation for this especially for T₀

In line with suggested changes to the discussion by other reviewers, we discussed the findings in line with other studies (see Pages 12-14, lines 325-349).

4. The temperature under the mask also depends on the ambient conditions. The temperatures under the mask (Figure 3) seem very low to me because the exhaled air has a higher temperature. Do you have ambient temperature data? Please discuss your temperature results with other studies.

We thank the reviewer for this comment. We undertook a post-priori analysis examining expired breath temperature after accounting for ambient temperature. These results made us question whether we had measured expired breath temperature or air accumulation behind the mask. Given the uncertainty, and

the difficulty measuring expired breath temperature with facemasks, we discussed, with reference to other studies, that the expired breath temperature shown in this study could suggest either increased metabolism, or air accumulation which in turn could explain the reduction in SpO₂%. (see Pages 11, lines 259-263, and Pages 13, lines 314-325)

5. As mask wearing could not be performed blinded, the subjective parameters should be considered more critically in the discussion (this is already known from other studies). This point should also be listed in point 4.3.

We acknowledged that the lack of blinding could have potentially led to bias in the RPB responses, however, given the study design, this was unavoidable (see Pages 13-14, lines 299-309).

Minor points:

Line 12: Please write out the 2nd forename. The abbreviation is not necessary.

Thank you, we removed the abbreviation and wrote out the 2nd forename (see Page 1, line 15).

Line 19: Word counts are missing

Added, thank you (see Page 1, line 22).

Line 21: No number of figures etc.

Added, thank you (see Page 1, line 24).

Line 36ff: For the whole manuscript, it should be considered that numbers can be subscripted if appropriate. Example: SpO₂

Corrected throughout the manuscript, thank you

Line 50: The comma at the end should be deleted

Deleted, thank you (see Page 3, line 57).

Line 55: The literature citation should be corrected so that you don't start with 4.

Corrected, thank you (see Page 4, line 65).

Line 207: unclear what (REFS[DS1]) means

Corrected, thank you. This is reference 30 (see Page 14, line 362).

Line 251-252, 272ff: Please check the reference list, because there are different styles of writing

Corrected, thank you. Vancouver reference style corrected (see Page 16).

Table 1: Please add the units of the parameters in the 1st column.

Units added, thank you. See Table 2 (previously Table 1).