nature portfolio

Peer Review File

Physical activity for public health in the 21st Century

Corresponding Author: Dr Deborah Salvo

This file contains all reviewer reports in order by version, followed by all author rebuttals in order by version.

Version 0:

Reviewer comments:

Reviewer #1

(Remarks to the Author)
Thank you for the opportunity to review this manuscript which explores the role of physical activity for public health through a global equity and social justice lens.

I will caveat my review with the acknowledgement that I am not a global public health researcher. I am based in the UK and have only explored public health within the UK and compared to other high income countries. My research has largely focused on the social determinants of health and health inequalities. I do however raise some concerns that the authors may wish to address to help the reader understand the research and facilitate the connections between the work that has been submitted.

1. My primary concern is the scale of work undertaken being synthesised into one paper. There are 4 aims of the work and a wide variety of analysis/review that spans different time periods - At the moment I feel this paper is trying to embed potentially 4 papers into one and I do not think this works - if the article can demonstrate how each component of the aims and related method speaks to an overarching aim (which may be reconceptualising physical activity in the 21st century) then this may be more plausible but as it stands I am confused and this remains unclear.

2. In the figures it should be clear what time period the data describes. It should be clear that this spans from around 2008 to 2019 and what the implications of condensing and comparing over a decade will have within and between your LIC, LMIC, UMIC and HIC categories.

3. I am interested to understand how teethe above analysis links with the COVID-19 work - how relevant/connected can these two pieces of work be?

3. In your background it would be good to include a definition of what the WHO physical activity guidelines are and what percentage is considered a good benchmark to meeting them, this should include a description early on defining the domains for those less familiar.

4. In Aim 1/inequality analysis - how did the three key theoretical frameworks or concepts (this should be clear) inform the analysis - in what way? At the moment I can see that it potentially led to the type of analysis you have undertaken but this isn't clear.

5. Can the harmonisation process of variable categories in the online methods section be expanded upon?

6. I am not convinced that the model presented in Figure 5 is a true representation of current public health relevance of physical activity - I think about the social determinants of health and the diderichsen framework for health inequalities - both understand the bidirectional and inter related nature of social structures/systems and how these may impact health and health outcomes and inequalities, and the role of physical activity in this.

7. Figure 6 needs more contextual information to evidence A as safe and B as unsafe.

8. Table 1's reconceptualisation of physical activity - it would be helpful to add a column highlighting what part of he work led to these reconceptualisation/recommendation

Reviewer #2

(Remarks to the Author)
A. Summary of the key results
The key results of this paper show: that there are substantial intersectionality effects on physical activity, whereby gender, country income level, and individual education levels interact to influence physical activity in different ways; that physical activity has a key role in infectious disease prevention/outcomes; and that physical activity has an important role in prevention and management of mental health conditions.

B. Originality and significance: if not novel, please include reference
Individually, the three focus areas are not new – as acknowledged by the authors who point to many existing studies, syntheses and meta-analyses of the accumulated evidence. What is novel in this study is that the bringing together of these concepts and integration with our current NCD-focused approach to physical activity promotion.

C. Data & methodology: validity of approach, quality of data, quality of presentation
The data sources, methodological approaches and presentation are all of a high standard. See my comment under F below in relation to acknowledging self-report measures of physical activity.

D. Appropriate use of statistics and treatment of uncertainties
On face value, the statistics appear appropriate (with the caveat that I am not a statistician).

E. Conclusions: robustness, validity, reliability
The conclusions drawn are appropriate for the data presented.

F. Suggested improvements: experiments, data for possible revision
- Page 3, lines 88-102: The framing of physical activity as 'necessity vs choice' (often called 'discretionary versus non-discretionary' or 'utilitarian vs non-utilitarian') is not a new concept but the language is likely more easily understood, particularly by those outside of academia and hence a useful addition. Given the interplay with socioeconomic factors, it may be worth acknowledging the well-documented occupational physical activity paradox– that when examining work-related physical activity, health outcomes (particularly cardiovascular and mental health) are often in the opposite direction to expected. See for example:
https://bjsm.bmj.com/content/52/3/149
https://pubmed.ncbi.nlm.nih.gov/19062235/

- The other concept not clearly mentioned (although alluded to) is transport disadvantage – it would be good to see explicit acknowledgement of this literature or at least the concept in the manuscript.

- The WHO data for the intersectionality analysis was self-reported. Could the authors comment on any limitations related to this measurement approach, and any potential implications for the interpretation of the findings?

- Table 1 – point 1. While I agree with the principle, given that the term 'health enhancing physical activity' is currently widely applied in the literature as a capture-all term for physical activity (what the authors propose to call 'overall physical activity') – would it be less confusing to use a different term for 'health enhancing physical activity'? The major distinction here seems to be necessity vs choice. Are the implications also here that activity done for work or for travel to and from places when there is no other choice bad for health?

- Table 2 – point 2. I wonder if it is worth a point here about working towards developing objective measures of domain-specific PA – we currently rely on self-report PA to distinguish domains, with all of its inherent biases. Perhaps this is worth a recommendation to progress the field with the highest methodological rigour?

- I wondered if the authors might comment on how this reconceptualization might fit in with existing frameworks – e.g. the Global Action Plan for Physical Activity. What would be the implications of this reconceptualization for existing frameworks and approaches? I would like to have seen the 'what next?' given some attention.

G. References: appropriate credit to previous work?
Yes, the authors give due to credit to previous work.

H. Clarity and context: lucidity of abstract/summary, appropriateness of abstract, introduction and conclusions
The manuscript is clear, provides ample context.

Version 1:

Reviewer comments:

Reviewer #1

(Remarks to the Author)

Reviewer #2

(Remarks to the Author)
Thank you for the opportunity to re-review this thought-provoking and comprehensive work.
The authors have put a lot of careful consideration and effort into responding to the reviewers' comments and revising their manuscript accordingly. I believe this has strengthened the manuscript further including in its clarity, focus, and implications. I now just have a few relatively minor suggestions for the authors to consider, listed below.

P16, paragraph 2:
'With respect to muscle-strengthening physical activity, a 2021 review by Nascimento and colleagues reports evidence of a significant association between high (vs. low) levels of muscle-strengthening activity with 26% lower risk of renal cancer (HR= 0.74; 95% CI= 0.56 to 0.98).57 However, this evidence was drawn from only two studies. More work is needed assessing the possible contributions of muscle-strengthening activity to cancer prevention.'

The authors should consider adding something to the last sentence about exploring possible contributions of muscle strengthening activity to cancer prevention, independent of aerobic physical activity and/or whether effects are cumulative.

P16, paragraph 2:
'This could suggest that the benefits of post-diagnosis physical activity for cancer survival are limited to early or mid-stage cancer patients, but more research is needed in this population.'

Perhaps worth a comment here about terminal/non-terminal cancer diagnoses – I don't know this literature well but is seems intuitive that those with a terminal prognosis wouldn't benefit as much from physical activity. I know that is somewhat alluded to in talking about early or mid-stage but many mid-stage cancers can result in recovery.

Table 1:
Strange punctuation surrounding 'overall physical activity' and 'physical activity for health and wellbeing'?

Figure 6 footnote:
Check typo – community I think should be commuting

General:
The additions and re-read has prompted me to think about what we do in the future when measuring and analysing self-reported physical activity for health and wellbeing data. I think it could be useful to give researchers (and those working in public health surveillance and monitoring) some guidance as to what this means for their work going forward, if they choose to use this framework (which I hope they will). Does the reconceptualisation suggest we ignore occupational/non-discretionary/unsafe PA? Or adjust for it in analyses? Or maybe assess interactions? This is something I think could be added to Table 1.

Dear Editor,

Thank you for the opportunity to submit a revised version of our manuscript and to address the reviewers' comments. We thank the reviewers for their helpful feedback that helped us produce a more cohesive, stronger manuscript. Please find the point-by-point response to reviewers in the table below.

Editors	We would ask the narrative portion of the paper is extended to cover the impact that exercise has on other disease, specifically we think it would be beneficial to discuss the impact exercise can have on cancer. Especially given the recent clinical trial - https://www.nejm.org/doi/full /10.1056/NEJMoa2502760	We thank the editors for this suggestion. We agree that the cancer-related benefits of physical activity remain less visible to the medical and public health fields, and to the public at large, than it's cardiometabolic health benefits. As such, we agree that it is a valuable addition to include a narrative section summarizing the evidence of the associations of physical activity with cancer outcomes. This new section has now been added, with extended information on the evidence supporting these associations included in the Online Supplement. The recent clinical trial in NEJM provided is now also referenced in the new section of the paper focused on cancer. We have also re-framed the paper to discuss physical activity's benefits beyond cardiometabolic health, instead of "beyond NCDs" at large, given that as you well point out, the cancer-related benefits of physical activity remain under-acknowledged/promoted.
Editors	We recommend the narrative is given a peg other than COVID-19, not that we think this is unimportant only that it does not appear as timely as we would like for such a piece. And we are concerned that it might limit the works impact.	Thank you for this suggestion. We agree that given the timing of this publication it is best to not ground the narrative of the manuscript on the COVID-19 pandemic. As such, we have made substantial edits throughout the paper to adjust accordingly. This includes fully removing a section in the narrative focused on "lessons from the COVID-19 pandemic", which is now only included in the Online Supplement. The narrative of the main paper now exclusively focuses on two key elements: (1) physical activity is more complex than it seems, and the way in which people across the world are active have important health, equity, and social justice implications; and (2) there are other critical health benefits from physical activity than those associated to cardiometabolic health, and these have been mostly underexploited in physical activity promotion efforts. This said, there are still some sections of the paper

		including information pursuant to COVID-19. Specifically, the infectious disease section relies on epidemiological evidence made possible by the “natural experiment” of the COVID-19 pandemic, which allowed to confirm the benefits of physical activity for infectious disease prevention and control that decades-old mechanistic studies had alluded to. In summary, as requested, the overall narrative of the paper is not COVID-19 centric, and we agree that this change has strengthened the timeliness of our paper.
Editors	The data collected from the WHO surveys is an incredible resource and we would appreciate more analysis of this dataset.	Thank you very much for this request. We agree that the WHO STEPS dataset is a highly valuable resource. We had originally limited the analyses presented in the main paper mainly due to space concerns. However, given the suggestion to expand on the analysis, we have now included two new elements that we believe strengthen the paper and maximise our use of the data: (1) New Figure 2 now examines the relative contribution of each of the three examined domains to total/overall physical activity across country income levels. This analysis allowed us to confirm the heavy reliance on necessity-driven physical activity among people living in low- and middle-income country. This finding has critical implications given recent findings by others (e.g., physical activity paradox research) on the null or potentially detrimental effects of occupational physical activity for physical health; and of the necessity versus choice physical activity framework which brings into question the contributions of active transport that occurs in unsafe or suboptimal conditions to complete health (i.e., considering road safety concerns, mental health, transport disadvantage, and the perpetuation of social inequities). (2) New Extended Data Table 1 provides country-level estimates for gender- and socioeconomic-based inequalities. We believe

		these country level data will be helpful for readers from across the world to work within their local settings in benchmarking towards improvements in reductions of physical activity inequalities within their countries.
Reviewer 1	Thank you for the opportunity to review this manuscript which explores the role of physical activity for public health through a global equity and social justice lens. I will caveat my review with the acknowledgement that I am not a global public health researcher. I am based in the UK and have only explored public health within the UK and compared to other high income countries. My research has largely focused on the social determinants of health and health inequalities. I do however raise some concerns that the authors may wish to address to help the reader understand the research and facilitate the connections between the work that has been submitted.	We thank the reviewer for their time and insightful comments, which we believe have helped us clarify multiple elements of our manuscript, and altogether, produce a much improved version of the paper.
Reviewer 1	My primary concern is the scale of work undertaken being synthesised into one paper. There are 4 aims of the work and a wide variety of analysis/review that spans different time periods - At the moment I feel this paper is trying to embed potentially 4 papers into one and I do not think this works - if the article can demonstrate how each component of the aims and related method speaks to an overarching aim (which may be reconceptualising physical activity in the 21st century) then this may be more plausible but as it stands I am confused and this remains unclear.	Thank you for this comment. In an attempt to make the overarching goal of the paper explicit and to clearly show how each component of the paper supports the overarching goal, we have rephrased the last paragraph of the introduction, as follows: "The overarching goal of this paper is to reconceptualise global physical activity research and promotion efforts to better respond to the public health and societal complexities of the 21st Century, including syndemics, persistent inequalities, and climate change. Specifically, through this paper, we underscore the need to recognise the role that physical activity can play in supporting or hindering social and health equity, and highlight physical activity's importance for the prevention and control of often overlooked health outcomes beyond cardiometabolic diseases. To attain this goal, we: (1) use a health equity lens to describe global domain-specific physical activity inequalities; (2) summarise the evidence on the links of physical activity with key health outcomes beyond cardiometabolic diseases:

		immunity and infectious diseases, depression, and cancer; and draw lessons from these first two exercises and from Paper 2 of this Series (on physical activity and climate change) to (3) introduce a new model to help guide global physical activity measurement, surveillance, research, and promotion efforts, centred in a “physical activity for health and wellbeing” approach.” Importantly, per another helpful suggestion by this reviewer, the model for the reconceptualisation of physical activity for public health has been re-worked, and now clearly demonstrates the links between the topics of part 1 of the paper (physical activity inequalities and implications for health inequities and social justice) and part 2 of the paper (broader range of benefits of physical activity beyond cardiometabolic health). The Discussion of the paper has also been enhanced to better integrate the findings of both sides of the paper to inform a reconceptualsation of physical activity for public health. Finally, per editorial request, we are no longer highlighting the lessons from the COVID-19 pandemic as a central element of this paper. This, in our view, helped produce a much more cohesive piece.
Reviewer 1	In the figures it should be clear what time period the data describes. It should be clear that this spans from around 2008 to 2019 and what the implications of condensing and comparing over a decade will have within and between your LIC, LMIC, UMIC and HIC categories.	Thank you for this comment. We agree that this is a limitation of the available international data. All figures now acknowledge the date range. Further, the Discussion section of the paper, specifically, the limitations paragraph, now highlights this issue.
Reviewer 1	I am interested to understand how the physical activity inequalities analysis links with the COVID-19 work - how relevant/connected can these two pieces of work be?	Thank you for this comment. As noted above, per editorial request, we have refocused the paper to no longer peg the narrative to the COVID-19 pandemic. We believe that this has helped more clearly integrate the two first components of the paper (global physical activity inequalities analysis and review of some of the major yet less recognised benefits of physical activity), which in turn inform the third and final section: a new model that reconceptualises physical activity for

		public health in the 21st Century, acknowledging both the fact that the way in which people across the world are active can contribute to health (in)equity; and, that physical activity has multiple benefits which are currently not fully acknowledged nor exploited in its promotion.
Reviewer 1	In your background it would be good to include a definition of what the WHO physical activity guidelines are and what percentage is considered a good benchmark to meeting them, this should include a description early on defining the domains for those less familiar.	Thank you, these definitions/cut-points have been added to the introduction section of the paper.
Reviewer 1	In Aim 1/inequality analysis - how did the three key theoretical frameworks or concepts (this should be clear) inform the analysis - in what way? At the moment I can see that it potentially led to the type of analysis you have undertaken but this isn't clear.	Thank you for this request. In re-reading our draft, we agree in that we were not being explicit as to how these concepts and frameworks informed the analysis. We have added a paragraph to clarify this, which reads as follows: "Together, these theoretical concepts and frameworks motivated our examination of the relative contribution to overall physical activity across domains: active leisure, which is primarily associated with choice-based physical activity; active labour, which is primarily associated with economic necessity; and active transport, which, depending on its environmental and societal context, can be the result of either free, noncoercive choices or of economic necessity. These frameworks and concepts also informed our hypotheses. Specifically, we hypothesized that more socially advantaged individuals based on status-conferring characteristics (i.e., men, people of high socioeconomic status, residents of high-income countries) would have higher access to choice-based physical activity. Further, we hypothesized that the intersection of multiple social status-conferring elements (gender, socioeconomic status, country of residence) could lead to magnified inequalities in domain-specific physical activity."
Reviewer 1	Can the harmonisation process of variable categories in the online methods section be expanded upon?	The Online Methods section now includes an expanded description of the process via which the socioeconomic status

		variable (with education as proxy) was harmonized across countries.
Reviewer 1	I am not convinced that the model presented in Figure 5 is a true representation of current public health relevance of physical activity - I think about the social determinants of health and the diderichsen framework for health inequalities - both understand the bidirectional and inter related nature of social structures/systems and how these may impact health and health outcomes and inequalities, and the role of physical activity in this.	Thank you very much for this comment. Our team took this suggestion to heart and after extensive brainstorming and review of the two models/frameworks you referenced, produced what we believe is a much improved version of a model for reconceptualising physical activity for public health in the 21st Century. As is now described in our text: "The new model explicitly recognises the influences of social status-conferring identities, broad societal context (including physical activity policy and political economies, which are addressed in detail in Paper 3 of this Series63), and of planetary level factors (see Paper 2 of this Series23) on the circumstances in which activity occurs; and ultimately, on individual and population patterns of physical activity (Figure 6, panel B). The top part of the model is informed by the Dahlgren-Whitehead Social Determinants of Health model,64,65 and by the findings of our global inequalities/intersectionality analysis. The bottom part of the model is informed by our review of the lesser recognised benefits of physical activity for health and wellbeing. The model highlights the bidirectional relationship between the health status of populations and their physical activity patterns, and of broader contextual elements. Finally, informed by our global and analysis of intersectional physical activity inequalities and its theoretical precursors (physical activity security, the necessity versus choice physical activity framework, and intersectionality theory), the proposed reconceptualisation posits centring public health research and promotion on the concept of "physical activity for health and wellbeing"." Please note that the model now centres on "physical activity for health and wellbeing", per the recommendation by Reviewer 2 to use a different term than "health-enhancing physical activity", to avoid confusion with prior work utilising the other term in a different way. We believe the term "physical activity for health and wellbeing" adequately

		captures the notion that not all types of physical activity fully support health and wellbeing (physical, mental, and societal wellbeing).
Reviewer 1	Figure 6 needs more contextual information to evidence A as safe and B as unsafe.	Thank you. Additional detail has been added to the legend in this Figure (which is now labeled as Figure 7, given the addition of another figure in the inequalities analysis section, per editorial request). The new information included reads as follows: “The photograph in panel A shows key features that make active transport supportive of complete health, including: high-quality pedestrian and cycling infrastructure with full separation from motorised traffic, climate-resilient features (e.g., shade), and a high density of readily accessible destinations by active transport. In contrast, the photograph in panel B exemplifies the conditions in which many people globally, but especially in LMICs, experience on a daily basis when community by foot out of economic necessity, including children. Key features denoting unsupportive conditions for physical activity for complete health are the lack of safe pedestrian infrastructure, exposing pedestrians to traffic injury and death risk, as well as lack of protection from the elements.”
Reviewer 1	Table 1's reconceptualisation of physical activity - it would be helpful to add a column highlighting what part of he work led to these reconceptualisation/recommendations	Thank you for this suggestion. We have now included information on which component of the paper informs each element/recommendation of the reconceptualization, we decided to add this information in the same column as the description of each element, to avoid unnecessary blank space by adding a full new column for this. We agree that this information is helpful for readers to clearly see how our work informs the different elements of the reconceptualization.
Reviewer 2	The key results of this paper show: that there are substantial intersectionality effects on physical activity, whereby gender, country income level, and individual education levels interact to influence physical activity in different ways; that physical activity has a key role	We thank the reviewer for their time and helpful insights. The suggestions provided have helped us produce what we believe is a much improved version of the manuscript. We especially appreciated the suggestion to re-think the term “health-enhancing physical activity”

	in infectious disease prevention/outcomes; and that physical activity has an important role in prevention and management of mental health conditions. Individually, the three focus areas are not new – as acknowledged by the authors who point to many existing studies, syntheses and meta-analyses of the accumulated evidence. What is novel in this study is that the bringing together of these concepts and integration with our current NCD-focused approach to physical activity promotion. The data sources, methodological approaches and presentation are all of a high standard. On face value, the statistics appear appropriate (with the caveat that I am not a statistician). The conclusions drawn are appropriate for the data presented.	and to propose a different term to avoid confusion in our field.
Reviewer 2	Page 3, lines 88-102: The framing of physical activity as 'necessity vs choice' (often called 'discretionary versus non-discretionary' or 'utilitarian vs non-utilitarian') is not a new concept but the language is likely more easily understood, particularly by those outside of academia and hence a useful addition. Given the interplay with socioeconomic factors, it may be worth acknowledging the well-documented occupational physical activity paradox– that when examining work-related physical activity, health outcomes (particularly cardiovascular and mental health) are often in the opposite direction to expected. See for example: https://bjsm.bmj.com/content/52/3/149 https://pubmed.ncbi.nlm.nih.gov/19062235/	Thank you for this recommendation. We agree on the importance of explicitly referencing the occupational physical activity paradox. We have added this and have used the reference provided by the reviewer. We opted to add this information in the Discussion section of the paper, as we felt this better fits the overall narrative of the paper.
Reviewer 2	The other concept not clearly mentioned (although alluded to) is transport disadvantage – it would be good to see explicit acknowledgement of this literature or at least the concept in the manuscript.	Thank you very much for this suggestion. We have now explicitly alluded to this concept in the Discussion section of our paper, and have cited corresponding literature.
Reviewer 2	The WHO data for the intersectionality analysis was self-reported. Could the	Thank you for this suggestion. The limitations paragraph within the

	authors comment on any limitations related to this measurement approach, and any potential implications for the interpretation of the findings?	Discussion section of the paper now highlights this issue, and discusses the implications (possible overreporting), but also the need to rely on self-report to distinguish between domains of physical activity.
Reviewer 2	Table 1 – point 1. While I agree with the principle, given that the term 'health enhancing physical activity' is currently widely applied in the literature as a capture-all term for physical activity (what the authors propose to call 'overall physical activity') – would it be less confusing to use a different term for 'health enhancing physical activity'? The major distinction here seems to be necessity vs choice. Are the implications also here that activity done for work or for travel to and from places when there is no other choice bad for health?	Thank you very much for this suggestion, which helped us carefully re-think our terminology for this paper. In hindsight, we agree that using the same term that has become a "catch-all" way to refer to physical activity across all domains (health-enhancing physical activity) could lead to unnecessary confusion in our field. Indeed, the implications of the necessity vs. choice framework are that not only occupational physical activity may not always be health-promotive (as supported by the PA paradox), but that taking into account the full definition of health per WHO, which talks about a complete state of physical, mental, and societal wellbeing, perhaps also not all active transport is supportive of complete health. This notion has been further clarified in multiple sections of the manuscript. Further, in support of this notion and to respond to this excellent point about terminology by the reviewer, we have changed the term used in our reconceptualization to "physical activity for health and wellbeing".
Reviewer 2	Table 2 – point 2. I wonder if it is worth a point here about working towards developing objective measures of domain-specific PA – we currently rely on self-report PA to distinguish domains, with all of its inherent biases. Perhaps this is worth a recommendation to progress the field with the highest methodological rigour?	Thank you for raising this point. We have expanded point 2 in the table to recommend the development of more accurate measures of domain-specific physical activity.
Reviewer 2	I wondered if the authors might comment on how this reconceptualization might fit in with existing frameworks – e.g. the Global Action Plan for Physical Activity. What would be the implications of this reconceptualization for existing frameworks and approaches? I would like to have seen the 'what next?' given some attention.	Thank you for this helpful suggestion. We have added the following section to the closing of the Discussion paper: "Significantly, this proposed reconceptualisation aligns with other recent calls to move away from purely physiological definitions of physical activity, towards more holistic approaches, and to conceptualise health within its biosocial context. Although this reconceptualisation diverts from WHO's

		Global Action Plan for Activity (GAPPA) message that “every move counts” for better health, there are multiple aligned elements which can support the development of an updated global action plan for physical activity promotion. These points of convergence include GAPPA’s emphasis on: (1) increasing awareness and appreciation for the multiple health benefits of physical activity; (2) the importance of providing people with opportunities for enjoyable physical activity; (2) the need to increase access to environments that facilitate healthy choices through active leisure and transport; and (3) the importance of safe, inclusive, and contextually appropriate physical activity opportunities for all.”

Reviewer	Reviewer Comment	Author team response
Reviewer 2	Thank you for the opportunity to re-review this thought-provoking and comprehensive work. The authors have put a lot of careful consideration and effort into responding to the reviewers' comments and revising their manuscript accordingly. I believe this has strengthened the manuscript further including in its clarity, focus, and implications. I now just have a few relatively minor suggestions for the authors to consider, listed below.	We thank the reviewer for their time and helpful comments which have helped strengthen our manuscript.
Reviewer 2	P16, paragraph 2: 'With respect to muscle-strengthening physical activity, a 2021 review by Nascimento and colleagues reports evidence of a significant association between high (vs. low) levels of muscle-strengthening activity with 26% lower risk of renal cancer (HR= 0.74; 95% CI= 0.56 to 0.98).57 However, this evidence was drawn from only two studies. More work is needed assessing the possible contributions of muscle-strengthening activity to cancer prevention.' The authors should consider adding something to the last sentence about exploring possible contributions of muscle strengthening activity to cancer prevention, independent of aerobic physical activity and/or whether effects are cumulative.	Thank you for this suggestion. We have edited the final sentences of that paragraph, to now read as follows: "More work is needed assessing the possible independent or cumulative contributions of muscle-strengthening activity to cancer prevention, beyond or compounded with those of aerobic physical activity."
Reviewer 2	P16, paragraph 2: 'This could suggest that the benefits of post-diagnosis physical activity for cancer survival are limited to early or mid-stage cancer patients, but more research is needed in this population.' Perhaps worth a comment here about terminal/non-terminal cancer diagnoses – I don't know this literature well but is seems intuitive that those with a terminal prognosis wouldn't benefit as much from physical activity. I know that is somewhat alluded to in talking about	Thank you for this insightful comment. The evidence remains fairly limited with regards to studies assessing potential benefits of physical activity among advanced patients, and lacks differentiation between those with a terminal vs. non-terminal diagnosis. We have edited the final phrase of this paragraph as followed: "This could suggest that the benefits of post-diagnosis physical activity for cancer survival are limited to early or mid-stage

	early or mid-stage but many mid-stage cancers can result in recovery.	cancer patients, but more research is needed that differentiates the effects of physical activity among advanced cancer patients with a terminal versus a non-terminal diagnosis."
Reviewer 2	Table 1: Strange punctuation surrounding 'overall physical activity' and 'physical activity for health and wellbeing'?	Thank you for pointing this out. This has been fixed.
Reviewer 2	Figure 6 footnote: Check typo – community I think should be commuting	This figure has now been removed from the manuscript given the journal's formatting requirements, with no figures allowed in the Discussion section and our count of Tables and Figures being too high. However, we thank you for your attention to detail and helpful notes.
Reviewer 2	The additions and re-read has prompted me to think about what we do in the future when measuring and analysing self-reported physical activity for health and wellbeing data. I think it could be useful to give researchers (and those working in public health surveillance and monitoring) some guidance as to what this means for their work going forward, if they choose to use this framework (which I hope they will). Does the reconceptualisation suggest we ignore occupational/non-discretionary/unsafe PA? Or adjust for it in analyses? Or maybe assess interactions? This is something I think could be added to Table 1.	Thank you very much for the helpful suggestions to provide more guidance for researchers and those involved in physical activity surveillance to (hopefully) use our proposed framework. We have expanded our recommendations in Table 1 to speak to the point you rise. Namely, the following bullet points have been added or expanded to cover this matter: 1. In Reconceptualisation Element 1 (Physical Activity for Health and Wellbeing): - "Overall physical activity" and "physical activity for health and wellbeing" should be differentiated when measuring, tracking population levels (i.e., surveillance), and conducting physical activity studies. Researchers should work to develop self-reported measures or statistical approaches that allow for this differentiation.

		2. In Reconceptualisation Element 2 (Physical activity goals and benchmarking): - Assess the extent to which active transport occurs in safe, and dignified conditions. This will require developing measures to determine the environmental and sociocultural conditions where active transport takes place, and including them as part of physical activity surveillance systems. - Develop measures to assess and track choice- versus necessity-based physical activity in populations, and set benchmarking goals aiming to maximise choice-based physical activity.