



***Psychosomatic Medicine***

Author's Accepted Manuscript

**Article Title:** Effect of Leisure-time physical activity on psychological distress and well-being and its mediators – Authors' reply

[Letter to the Editor – Authors' Reply]

**Authors:** André O. Werneck, Brendon Stubbs, Aaron Kandola, Adewale L. Oyeyemi, Felipe B. Schuch, Mark Hamer, Davy Vancampfort, and Danilo R. Silva

**DOI:** 10.1097/PSY.0000000000001139

This manuscript has been accepted by the editors of *Psychosomatic Medicine*, but it has not yet been copy-edited; information within these pages is therefore subject to change. During the copy-editing and production phases, language usage and any textual errors will be corrected, and pages will be composed into their final format.

Please visit the journal's website ([www.psychosomaticmedicine.org](http://www.psychosomaticmedicine.org)) to check for a final version of the article.

When citing this article, please use the following: *Psychosomatic Medicine* (in press) and include the article's digital object identifier (DOI).

## **Effect of Leisure-time physical activity on psychological distress and well-being and its mediators – Authors’ reply**

André O. Werneck, MSc<sup>1</sup>, Brendon Stubbs, PhD<sup>2,3</sup>, Aaron Kandola, MSc<sup>4</sup>,  
Adewale L. Oyeyemi, PhD<sup>5,6</sup>, Felipe B. Schuch, PhD<sup>7</sup>, Mark Hamer, PhD<sup>8</sup>,  
Davy Vancampfort, PhD<sup>9</sup>, Danilo R. Silva, PhD<sup>10</sup>

<sup>1</sup>Department of Nutrition, School of Public Health, University of São Paulo (USP), São Paulo;  
Brazil.

<sup>2</sup>Department of Psychological Medicine, Institute of Psychiatry, Psychology and Neuroscience,  
King's College London, De Crespigny Park, London, Box SE5 8AF, United Kingdom.

<sup>3</sup>South London Maudsley NHS Foundation Trust, London, UK.

<sup>4</sup>Division of Psychiatry, University College London, London, UK

<sup>5</sup>Department of Physiotherapy, College of Medical Sciences, University of Maiduguri, Borno  
State, Nigeria.

<sup>6</sup>Department of Physiotherapy, Faculty of Basic Medical Sciences, Redeemer’s University, Ede,  
Nigeria

<sup>7</sup>Department of Sports Methods and Techniques, Federal University of Santa Maria, Santa  
Maria, Brazil

<sup>8</sup>Institute Sport Exercise & Health, Division Surgery Interventional Science, University College  
London, London, UK.

<sup>9</sup>Department of Rehabilitation Sciences, KU Leuven – University of Leuven, Leuven, Belgium.

<sup>10</sup>Postgraduate Program in Physical Education, Federal University of Sergipe - UFS, São  
Cristóvão, Brazil.

**Corresponding author:** André O. Werneck, MSc, Department of Nutrition, School of Public Health, University of São Paulo (USP). Av. Dr. Arnaldo, 715 - Cerqueira César, São Paulo - SP, 01246-904, São Paulo, Brazil. E-mail: andrewerneck@usp.br.

ACCEPTED

We would like to thank Prajapati and Swami (1) for their letter commenting on our recent manuscript, in which we investigated the association between leisure-time physical activity and future psychological distress and well-being, as well as potential mediators of these associations (2).

We agree with the authors that the lack of adjustment for important confounding factors is a limitation of the study, which was also presented in the discussion of the manuscript (2). Moreover, we highlighted in our discussion that some unexamined variables such as self-esteem, social relationships, emotional support and self-perceived skills (3) may not act as confounding factors in the association of leisure-time physical activity with future well-being and psychological distress, but rather as mediators (3). In this case, future studies with data in multiple waves should analyze the mediating role of the aforementioned variables.

We highlighted that there is consistent evidence of a causal association linking physical activity and the included mediators (4–9), as well as linking the mediators with future well-being and psychological distress (10–13). However, we also agree that a reverse causality is possible, considering the potential bidirectional relationships.

Prajapati and Swami (1) requested to adjust for other potential mediators such as cognition, body mass index (BMI), disability, and pain during the first (2004) wave (at 34 years). Although of relevance, it was unfortunately not possible to adjust for cognition, disability, and pain given that these were not measured during this first wave. Body mass index (BMI) was assessed. However, one should acknowledge that BMI at 34y is highly correlated with BMI at 42

years, presenting a multicollinearity problem for the models. Even though the temporal time sequence is lost when using BMI at 34y as the mediator, we repeated the mediation models now considering BMI at age 34, in order to address the comment of Prajapati and Swami (1). We found that BMI at 34y indeed mediated the association between leisure-time physical activity and subsequent well-being both considering frequency (pure indirect effect: 0.015; 95%CI: 0.007; 0.025) and total leisure-time physical activity (pure indirect effect: 0.004; 95%CI: 0.001; 0.007). These findings indicate a possibility of bidirectionality.

Prajapati and Swami requested clarity for choosing specific waves to include. The reason is that these waves were chosen as they were simply the three most recent subsequent waves with relevant data for our research aims. We did not include the 38 years' wave because it did not include physical activity nor cognition.

Prajapati and Swami suggest reporting consistency of LTPA over different time points would have substantiated the findings. The assessment methods were not consistent across data sweeps, thus direct comparison of physical activity levels is problematic. We consider that our analysis is more suitable for the research question because physical activity has a latency period for association with most health outcomes, and measures at the same wave of the outcome would increase the risk of reverse-causality. We also disagree that the inclusion of some modeling such as longitudinal latent growth analysis would be sufficient to the determination of any causality in our theoretical model, considering that we are using observational data, and its limitations regarding causality would persist regardless of the statistical approach. We do agree that the

verbal recall test is a memory test and does not reflect global cognition, requiring more tests, such as executive function and this should have been reported as a limitation of our manuscript.

Finally, we again thank Prajapati and Swami (1) for the opportunity to clarify some points on our study and to raise the discussion on methodological issues that still need to be addressed for a better understanding of the causality between physical activity, well-being and psychological distress.

## References

1. Prajapati N, Swami MK. Effect of Leisure-time physical activity on psychological distress and well-being and its mediators. *Psychosomatic Medicine*. 2022;
2. Werneck AO, Stubbs B, Kandola A, Oyeyemi AL, Schuch FB, Hamer M, Vancampfort D, Silva DR. Prospective Associations of Leisure-Time Physical Activity With Psychological Distress and Well-Being: A 12-Year Cohort Study. *Psychosomatic Medicine*. 2022;84:116–22.
3. Kandola A, Ashdown-Franks G, Hendrikse J, Sabiston CM, Stubbs B. Physical activity and depression: Towards understanding the antidepressant mechanisms of physical activity. *Neuroscience & Biobehavioral Reviews*. 2019;107:525–39.
4. Blondell SJ, Hammersley-Mather R, Veerman JL. Does physical activity prevent cognitive decline and dementia?: A systematic review and meta-analysis of longitudinal studies. *BMC Public Health*. 2014;14:510.
5. Chin S-H, Kahathuduwa CN, Binks M. Physical activity and obesity: what we know and what we need to know\*: Physical activity and obesity. *Obesity Reviews*. 2016;17:1226–44.
6. Mänty M, Møller A, Nilsson C, Lund R, Christensen U, Avlund K. Association of physical workload and leisure time physical activity with incident mobility limitations: a follow-up study. *Occupational and Environmental Medicine*. 2014;71:543–48.
7. Paterson DH, Warburton DE. Physical activity and functional limitations in older adults: a systematic review related to Canada's Physical Activity Guidelines. *International Journal of Behavioral Medicine*. 2010;7:38.

8. Shiri R, Lallukka T, Rahkonen O, Leino-Arjas P. Excess Body Mass and Leisure Time Physical Activity in the Incidence and Persistence of Chronic Pain. *Pain Medicine*. 2020;21:3094–3101.
9. Shiri R, Falah-Hassani K. Does leisure time physical activity protect against low back pain? Systematic review and meta-analysis of 36 prospective cohort studies. *British Journal of Sports Medicine*. 2017;51:1410–18.
10. Chan LLY, Okubo Y, Brodie MA, Lord SR. Mobility performance predicts incident depression: A systematic review and meta-analysis. *Experimental Gerontology*. 2020;142:111116.
11. Faith MS, Butryn M, Wadden TA, Fabricatore A, Nguyen AM, Heymsfield SB. Evidence for prospective associations among depression and obesity in population-based studies: Prospective obesity-depression associations. *Obesity Reviews*. 2011;12:e438–53.
12. Ma Y, Xiang Q, Yan C, Liao H, Wang J. Relationship between chronic diseases and depression: the mediating effect of pain. *BMC Psychiatry*. 2021;21:436.
13. Snowden MB, Atkins DC, Steinman LE, Bell JF, Bryant LL, Copeland C, Fitzpatrick AL. Longitudinal Association of Dementia and Depression. *The American Journal of Geriatric Psychiatry*. 2015;23:897–905.