

Why do 50% of studies find no connection between acute aerobic exercise and cognitive function?

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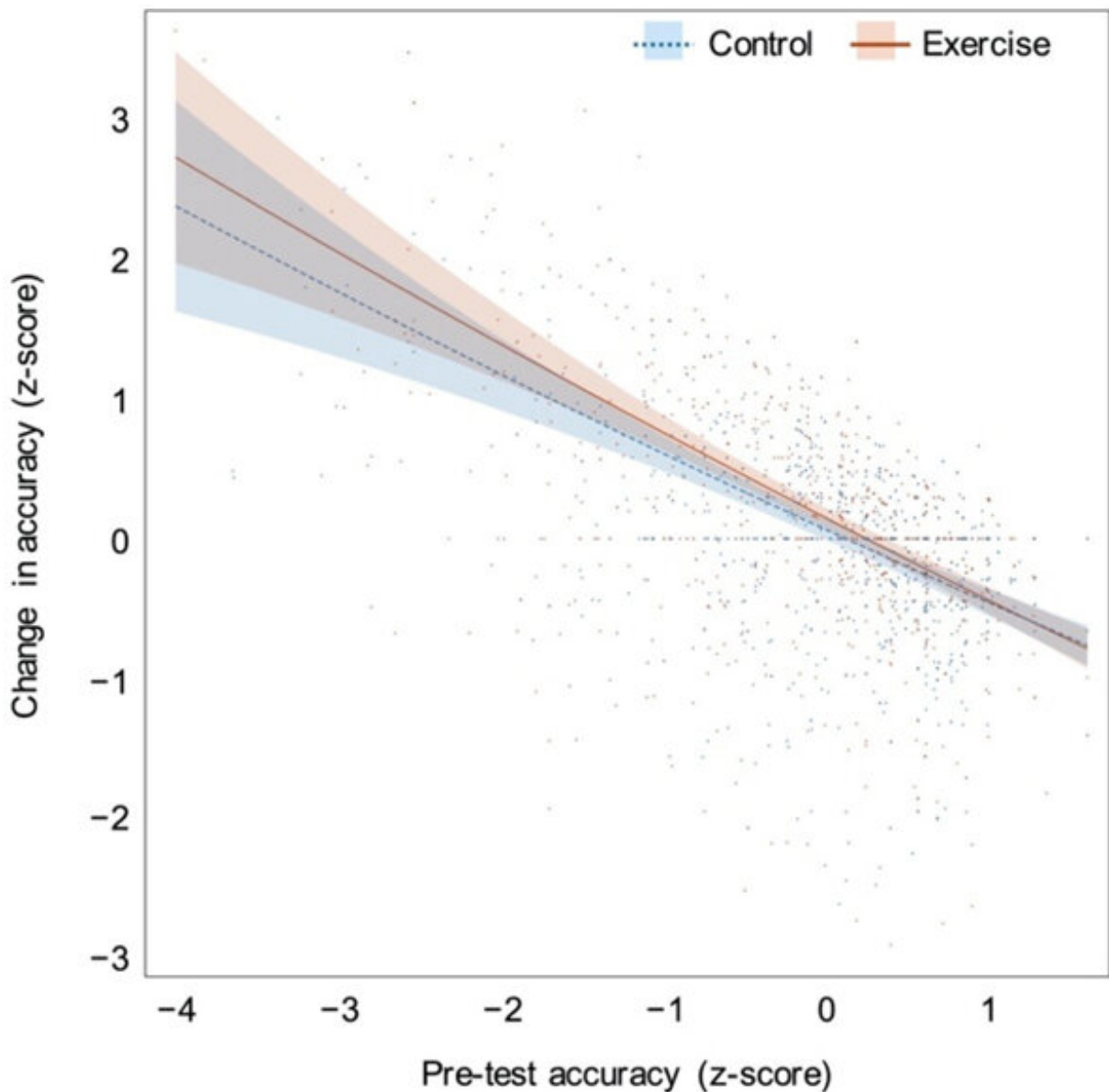


Figure 1: The relationship between initial cognitive function and post-exercise improvement. The x-axis shows the participants' baseline cognitive performance (response accuracy on the pre-test) and the y-axis shows improvement in cognitive performance (i.e. pre-post changes in response accuracy). Red and blue lines show the exercise condition and non-exercise control condition, respectively. It was understood that the benefit of aerobic exercise on cognitive performance (i.e., the difference between the red and blue bands) was greater in those who had lower pre-test scores. Credit: Kobe University

Over the past 20 years, many studies have investigated the effects of acute aerobic exercise on cognitive performance. In recent years, meta-analyses of data from these previous research studies have demonstrated that these a single bout of moderate aerobic exercise temporarily improves cognitive performance. However, close examination of the individual research studies on this topic revealed that in approximately 50% of studies, no beneficial link between acute aerobic exercise and cognitive function was found.

An international research collaboration, including Associate Professor Kamijo Keita (Faculty of Liberal Arts and Sciences, Chukyo University) and Assistant Professor Ishihara Toru (Graduate School of Human Development and Environment, Kobe University), conducted an IPD meta-analysis with the aim of resolving these discrepancies. They conducted this analysis from the perspectives of "What kind of people is this effective for?" and "Which cognitive functions does it benefit?"

Their results illuminated the following main points regarding the benefits of acute aerobic [exercise](#) on cognitive function: 1. The benefits were greater in those who originally had lower [cognitive performance](#) (i.e., those with lower scores on the pre-test) (Figure 1). 2. These results

show that acute aerobic exercise did not have greater beneficial effects specifically for prefrontal-dependent aspect of cognition but rather more generalized benefits across different types of cognitive performance.

These results were previously published in the online version of *Neuroscience and Biobehavioral Reviews* on June 18, 2021.

Main points

- Meta-analysis studies conducted in recent years have shown that a single bout of moderate aerobic exercise (acute aerobic exercise) temporarily improves cognitive performance. Furthermore, these analyses have demonstrated that this kind of exercise is disproportionately beneficial to cognitive functions that rely on the [prefrontal cortex](#) and associated networks.
- However, upon close examination, around half of these previous studies did not find any beneficial effects of acute aerobic exercise.
- The current research group conducted an IPD meta-analysis with the aim of resolving these discrepancies between the results of previous studies, by focusing on what kind of people benefitted and what kind of cognitive functions were affected.
- They revealed that acute aerobic exercise has a greater beneficial effect in people with lower cognitive performance.
- These findings show that acute aerobic exercise does not have greater beneficial effects specifically on the prefrontal-dependent aspect of cognition but rather more general benefits across different aspects of cognitive performance.

Research Significance

Many of the cognitive tests used in these previous research studies,

which assessed the prefrontal-dependent aspect of cognition, have a high difficulty level. Based on the present research results, on the surface, acute aerobic exercise might have had greater benefits on the prefrontal-dependent aspect of cognition if the cognitive tests were difficult, in other words, if participants had a low score on the pre-test. Many studies didn't take into account individual differences in cognitive function and did not alter test difficulty accordingly, and this is thought to be linked to the discrepancies between the results of the different studies. That is, it is possible to detect the benefits of acute aerobic exercise if cognitive tests are appropriately selected and controlled by the researchers.

This IPD meta-analysis revealed that taking into account individual differences in cognitive performance and test difficulty can contribute towards a reduction in discrepancies between research studies on this topic. In addition, most studies so far have focused on the prefrontal-dependent aspect of cognition, however, conducting studies focusing on other types of cognitive function as well will contribute towards the development of this research area.

More information: Toru Ishihara et al, The effects of acute aerobic exercise on executive function: A systematic review and meta-analysis of individual participant data, *Neuroscience & Biobehavioral Reviews* (2021). [DOI: 10.1016/j.neubiorev.2021.06.026](https://doi.org/10.1016/j.neubiorev.2021.06.026)

Glossary

*1 Meta-analysis

A statistical analysis of the results from multiple, independently conducted research studies. It is a method of analysis used to reveal what the combined results of previous research on a particular topic show.

*2 IPD Meta-analysis

A meta-analysis of Individual Participant Data (IPD).

*3 Prefrontal cortex

The front portion of the brain which is located directly behind the

forehead. It is thought to be like the brain's command center, governing higher mental functions.

Provided by Kobe University

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