Can light under-desk cycling enhance cognitive performance during prolonged sedentary work?

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1. Prolonged sedentary behaviour and negative health and performance consequences

It has been well established that there is substantial negative health risk from prolonged sedentary time, potentially even in individuals who otherwise meet health guidelines for moderate to vigorous activity¹. Excessive occupational sitting² is a substantial component of a sedentary lifestyle for many which has been associated with increased risk of cardiovascular disease³ and musculoskeletal discomfort⁴, and may be related to reduced cognitive performance⁵.

In the workplace, active workstations, such as sit/stand desks and treadmills, have been promoted as countermeasures to sedentary behaviour. However prolonged use of sit/stand workstations may not be sustainable due to musculoskeletal discomfort, in particular low back pain⁶. The use of treadmill workstations has had barriers to wide scale acceptance due to concerns with noise, safety and a larger workstation footprint. The potential negative performance impact of active workstations is also seen as a major barrier to implementation. Use of an under-desk cycle at a standard work station may allow easier implementation of a lower cost alternative, however little is known about the potential performance impact.

Light cycling activity promotes circulation and muscle activity through rhythmic contractions of the large muscles in the legs, and also potential for activation of trunk muscles for stabilising posture⁷. Light cycling may thus mitigate some of the health risks associated with prolonged sitting⁸. Cycling can increase cerebral blood flow⁹ and may thus also be able to promote enhanced cognitive performance. However, active workstations require dual task performance, which can result in physical and/or cognitive performance decrement in one or both tasks. Cycling has been found to result in less performance decrement than walking during computer based work activities, with this being suggested to be related to lesser balance attentional requirements and greater torso stability¹⁰.

Recent evidence indicates an indirect association between increasing sedentary time and reductions in cognitive performance¹¹ that might be alleviated by light physical activity. Past performance testing of cognition, whilst undertaking light activity, has included short term memory, attention reaction time¹² and transcription typing tests¹³. Assessments of sustained alertness and vigilance and higher order cognitive functions including problem solving, imperative in sedentary occupations such as radiographer, control room operator and air traffic controller, requires further research – as does the potential impact of light activity.

1.1 Study aim

Given the implications of sedentary behaviour on health and cognitive performance, this study aimed to compare the impact of performing a prolonged sedentary task with and without light activity (under-desk cycling) on cognitive performance.

2. Methods

2.1 Design and participants

The study was a within-subject experimental design laboratory study approved by Curtin University Human Research Ethics Committee. Participants completed two conditions; sustained sitting for 2 hours and sustained sitting with continuous light under-desk cycling for 2 hours. Condition order was randomised and balanced. Participants were adults recruited from the researchers’ networks. Exclusion criteria included those for whom workstation set up was anthropometrically unsuited due to height or girth and who had known pain in response to activity (pre-existing condition). Participants required English and computer literacy. Participants brought their own computer based reading material/tasks to undertake throughout the two hour duration, except for completing the computerised assessments.
2.2 Dependent variables

Dependent variables included a subjective rating of mental alertness (visual analogue scale), vigilance (Sustained Attention to Response Test) and creative problem solving (Ruff Figural Fluency Test). Five serial measures were taken for each variable, at the start of the two hour period and every ~30 minutes.

3. Results

Preliminary analysis was conducted for the first 13 participants. Electromyography confirmed light activity was performed during the under-desk cycling condition compared with the non cycling condition (see example from one participant in Figure 1 a and b). End of condition group means (standard deviation) suggested no difference between non cycling and cycling for subjective alertness (non cycling 21 (8.6); cycling 20 (7.0)) and Ruff Figural Fluency unique designs (non cycling 37.5 (5.9); cycling 41.6 (11.1), however Sustained Attention to Response Test appeared better during cycling (non cycling 49.8 (25.5); cycling 63.0 (22.5) (see example from one participant in Figure 2 a and b).

4. Conclusion

Under-desk cycling provides light activity during prolonged sitting but appeared to have minimal impact on subjective alertness or objectively measured creative problem solving. Objectively measured sustained attention may have had less decrement over time and will be evaluated with further analysis of more participants.
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References