



Sedentary behavior and not physical activity predicts study progress in distance education



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ABSTRACT

Previous research has shown that physical activity and sedentary behavior are related to learning performance in traditional education. In distance education (DE), however, students are characterized by different features (e.g., age and responsibilities). As a result, DE students often have full schedules and must make choices that traditional students do not. Advice on behavior change is low-cost and easy to implement. Therefore, it is of interest to investigate whether physical activity and sedentary behavior are related to learning performance in DE. In an observational longitudinal study, physical activity and sedentary behavior of 1100 adult DE students were analyzed using multiple regression analysis. Students provided information on physical activity, sedentary behavior and important covariates at the start of their study. Learning performance, measured as study progress, was evaluated after 14 months (i.e., the number of successfully completed modules). Analyses revealed that only sedentary behavior was a significant predictor for study progress. More sedentary behavior was predictive for more learning performance in adults participating in DE. Despite these findings, it is not recommended that students should be more sedentary as health/cognitive benefits following from more physical activity and less sedentary behavior are proven. Instead, future research should focus on which specific sedentary behaviors are responsible for this relation as sedentary behaviors may be differentially associated with learning performance.

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1. Introduction

While physical activity has been shown to have a positive effect on academic achievement in children (Fedewa & Ahn, 2011), sedentary behavior has been shown to have a negative effect (Tremblay et al., 2011). These findings account for children in traditional education. However, to our knowledge, there is no research that deals with the relation between physical activity/sedentary behavior and learning performance in adult students participating in distance education (DE).

This population is important as life expectancies keep rising and the fastest growing population group in most countries is that of older adults (The Netherlands: Centraal Bureau voor de Statistiek, 2014; Worldwide: United Nations, 2012). As a result of both changing policies with respect to retirement age and a rapidly changing knowledge-based economy, people also have to work and learn longer. Although certificates and diplomas usually remain valid for the entire duration of a person's life, the knowledge, skills and competencies needed in one's

work change. Thus, there is an increasing need for people to develop their professional knowledge and experience far into adult age (Eurydice, 2011), often through participation in continuing formal education. An increasingly preferred form of education (both formal and informal) is DE, which allows for the liberty of studying at one's own pace and schedule. Information and Communication Technologies (ICT) and especially the Internet provide useful solutions to reach students that are not able to attend meetings during regular times or are not able to travel for the education they want. DE combines education with ICT and allows students to study at their own pace and schedule.

This study was executed among students of this type of DE, characterized by mainly online learning. The goal of this study was to evaluate whether their physical activity and/or sedentary behavior were related with their learning performance.

1.1. Mechanisms

Different mechanisms may be responsible for the positive effects of physical activity on learning (for a detailed overview see: Barenberg, Berse, & Dutke, 2011). Physical activity increases cerebral blood flow, the blood flowing to and through the brain. This, in turn, heightens

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blood supply, delivering more nutrients (e.g., glucose and oxygen) to the neurons, what may increase their function and as a result possibly enhances learning (Timinkul et al., 2008). The release and production of neurotransmitters and neurotrophins (i.e., proteins that promote development, function and survival of neurons) is also a result of physical activity (Winter et al., 2007). According to van Praag (2009), this release leads to:

- elevated levels of neurogenesis, the process of neuron creation
- higher synaptic plasticity, the process of strengthening or weakening synaptic bonds
- higher spine density, the increase in the occurrence of possible synaptic locations
- angiogenesis, the process of creating new blood vessels from other vessels
- elevated levels of vascular growth factors, increase in factors that enhance blood vessel growth.

These neurophysiological changes are often caused by epigenetic changes (i.e., changes in the accessibility of the DNA enabling or blocking transcription) following physical activity, which lead to a higher transcription and as a result a higher release of these growth factors, neurotransmitters and neurotropic factors. The ultimate result is an increase in brain plasticity (Kaliman et al., 2011), a benefit for learning.

1.2. Distance education versus traditional education

Participants in this study are students of the Open University of the Netherlands (OUNL). The majority of these students have ages between 25 and 45, which are congruent with the typical characteristics of a DE student (Latanich, Nonis, & Hudson, 2001). These students often have a full-time employment, a partner and children, which is logical as these characteristics are positively associated with age. This also means that their time to study is limited. This is in sharp contrast with traditional education, which is characterized by children and young adolescents, without any of these 'adult' responsibilities and constraints. This means that comparing findings on the relation between physical activity and sedentary behavior on the one hand, and learning performance between traditional and DE on the other is difficult because of differences not only in the educational setting (i.e., face-to-face vs. distance), but also differences in characteristics of the students.

1.3. Physical activity

There has been no research carried out dealing with the relation between physical activity and learning performance in DE. Therefore, the literature present on this relation in traditional, face-to-face education is shortly reviewed. Burkhalter and Hillman (2011) state in their review that there is no clear consensus with respect to the relation between physical activity and academic achievement in children noting that the research carried out indicates either a positive relation between physical activity and academic achievement or no relation at all. Thus, research results have been inconclusive. Despite this, physical activity is still regarded as beneficial since time spent on physical activity does not impair academic achievement (Spitzer & Hollmann, 2013), while it improves health and physical function (Keeley & Fox, 2009). Other research suggests that there are possible benefits of physical activity on academic achievement, but this cannot as of yet be firmly concluded (see: Shephard, 1996; Taras, 2005; Tomporowski, Davis, Miller, & Naglieri, 2008). A more recent, and more comprehensive meta-analysis, executed over 59 studies of which 39 were carried out with an experimental design, revealed a significant and positive effect of physical activity on academic achievement in children, with an effect size of 0.28 ($SE = 0.03$) which can be considered to be a small to medium effect

(Fedewa & Ahn, 2011). In other words, despite a lack of clear consensus it is safe to state that physical activity appears to have a beneficial effect on academic performance in children (see recent reviews of Hillman, Kamijo, & Scudder, 2011; Singh, Uijtdewilligen, Twisk, van Mechelen, & Chinapaw, 2012).

1.4. Sedentary behavior

The flip-side of physical activity is sedentary behavior. Sedentary behavior can actually be seen as not being physically active. However, recently it is more and more viewed as an independent construct as sedentary behavior is associated with health and demographic variables, independent of physical activity (Rhodes, Mark, & Temmel, 2012). As was the case earlier, here too, no research has been found concerning the relation between sedentary behavior and learning performance in DE. Analog to the previous section, the available literature on this relation in traditional education is shortly reviewed. A large review study found that there is a negative relation present; the more sedentary behavior exhibited by children, the lower their academic achievement (Tremblay et al., 2011). In the narrative review of 35 studies, no effect size was reported and no meta-analysis was performed. The majority (i.e., 75%) of the studies reviewed, report that academic achievement may be hampered by what they call more screen time (i.e., watching television, playing video games, and using the computer for non-academic purposes). In interpreting these results, however, it is important to note that 32 of the 35 studies were cross-sectional in nature and academic achievement was measured in different ways (i.e., IQ, school grades, grade point average, performance on standardized tests, and self-report questionnaires) (Tremblay et al., 2011). The research in this field is in its infancy.

1.5. The present study

The present study evaluated the relation between physical activity and sedentary behavior on the one hand, and learning performance on the other, in students of the OUNL, offering formal university-level DE. Study at the OUNL is open to anyone over the age of 18. This study is the first in which the relation between physical activity/sedentary behavior and learning performance – measured as study progress – is investigated in DE. Based on the literature, we propose two hypotheses:

- Physical activity is positively associated with study progress: more time spent being physically active, or, more intense physical activity leads to better study progress.
- Sedentary behavior is negatively associated with study progress: more time spent not physically active (e.g., sitting) leads to lower study progress.

2. Methods

2.1. Design

Data from this observational study come from the Adult Learning Open University Determinants (ALoud) study, an investigation of different psychological and biological factors possibly affecting study progress in DE students (Neroni, Gijsselaers, Kirschner, & de Groot, 2015). Data from the biological part of this project are available and stored permanently on DANS EASY, a sustainable platform for archiving research data (Gijsselaers, 2015). Other measures collected in the ALoud study but not included in this article were biological factors (e.g., sleep, nutrition), cognition, and psychological factors. Physical activity, sedentary behavior and covariates were reported via an online digital survey conducted after registration at the university. Study progress was measured objectively using data from the exam registration office.

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