

# Physical Activity, Fitness, Screen Time, and Healthy Brain Functions in Adolescents

av

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Akademisk avhandling

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**Abstract:**

There is public health concern regarding physical activity levels and sedentary behavior among adolescents. Only a small proportion meet the daily physical activity recommendations, while most spend most of their time being sedentary. There is a lack of studies examining the associations between physical activity, fitness, sedentary behaviors, and healthy brain functions, particularly in adolescents while using robust measures. The aim of this thesis was, therefore, to investigate how accelerometer-measured physical activity, sedentary time, sports participation, fitness, and screen time were associated with healthy brain functions (mental health, cognitive, and academic performance), in a cohort of Swedish adolescents. Further, to examine how physiological factors underpinning healthy brain functions change acutely when prolonged sitting is interrupted with physical activity breaks.

Paper I had a cross-sectional design and examined how accelerometer-measured physical activity and sedentary time, sports participation, and screen time were associated with mental health (anxiety and health-related quality of life) in 1139 Swedish adolescents (mean age 13.4). The results showed that adolescents who engaged in high levels of moderate-to-vigorous physical activity, particularly during leisure time, reported better mental health. In contrast, those with high levels of sedentary time or screen time during leisure time reported poor mental health.

In Paper II, cross-sectional associations between device-measured physical activity, fitness, and cognitive or academic performance were studied in the same cohort (n=1139, mean age 13.4). The results showed that adolescents with high fitness levels had better cognitive performance (in working memory and episodic memory tasks) and better academic performance (grades in math and Swedish). No significant association between accelerometer-measured physical activity and cognitive or academic performance was found.

Paper IV investigated longitudinal associations in the same cohort (n=1139). The aim was to study how accelerometer-measured physical activity, sports participation, fitness, and screen time at baseline (mean age 13.4) were associated with academic performance three years later (mean age 16.0). The results showed that higher fitness levels or low screen time on weekdays at age 13 were associated with higher school grades three years later. No significant associations between accelerometer-measured physical activity or sports participation at age 13 and academic performance three years later were found.

Paper III was based on an acute intervention study, the adolescents (n=17, mean age 13.6 years) performed three 80-minute lab sessions in randomized order. The sessions consisted of 80 minutes of prolonged sitting, with three-minute breaks every 17th minutes (either simple resistance activities, SRA, step-up exercise, STEP, or remain seated, SOCIAL). Changes in cerebral blood flow (oxygenated hemoglobin, Oxy-Hb, in the prefrontal cortex) were assessed before and after each session, using functional near-infrared spectroscopy during a working memory task. The results showed that following the physical activity breaks, cognitive performance improved during the most difficult cognitive task, these improvements were seen in parallel with an increase in Oxy-Hb in the prefrontal cortex. In contrast, no cognitive improvements were observed during the most difficult task after the prolonged sitting condition (SOCIAL), and Oxy-Hb levels significantly decreased.

In conclusion, device-measured physical activity was associated with some aspects of healthy brain function (mental health), but not all (cognitive and academic performance). However, incorporating physical activity breaks during prolonged periods of sitting seems to benefit cognitive performance, potentially through improved cerebral blood flow. The findings also suggest that adolescents with low levels of physical activity or high screen time were more likely to experience poor mental health. Furthermore, adolescents with high screen time at age 13 tended to have lower school grades three years later, at the end of compulsory school. These findings contribute to the current understanding of how physical activity, fitness, and sedentary behaviors relate to healthy brain function in adolescents and are of importance to researchers, parents, and professionals working with this age group.

Keywords: Exercise, Cardiorespiratory Fitness, Academic performance, Cognition, Adolescent, Mental health, Cerebrovascular circulation, Brain health.

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