Effects of prolonged sitting and physical activity on markers of cardiometabolic risk in healthy children and youth: A pilot study

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Introduction: It has recently been reported that a single day of uninterrupted sitting may result in deleterious changes in markers of cardiometabolic risk among adults. The purpose of the present randomized crossover study was to determine whether a single day of sitting (with or without short walk breaks or structured physical activity) would result in increased levels of insulin, glucose or lipids among healthy children and youth aged 10–14 years.

Methods: Participants included 2 males and 5 females who experienced 3 conditions in random order on separate days, with at least 7 days between each session. The Sedentary (SED) condition consisted of 8 hours of uninterrupted sitting. The Sedentary With Breaks (SWB) condition was similar to the SED condition, but participants performed a 2 minute walk-break at 30% of VO2 peak every 20 minutes throughout the day. The Sedentary With Breaks and Physical Activity (SWBPA) condition was similar to the SWB condition, but in addition to walk-breaks participants also performed 2 separate 20 minute bouts of structured physical activity at 60% of VO2 peak. Participants were provided with identical standardized meals at all three visits, which were based on each individual’s resting metabolic rate and directly measured physical activity, with breakfast and lunch providing 25% and 40% of estimated daily needs, respectively. Blood samples were taken in the fasted state before breakfast, and every 90 minutes throughout each experimental condition. Incremental area-under-the-curve (iAUC) for insulin, glucose, triglycerides, HDL- and LDL-cholesterol was compared across the three conditions using a mixed effect model with random intercept.

Results: Participants had an average age of 12 ± 1 years, body mass index of 18.7 ± 5.3 kg/m² and HOMA-Insulin Resistance score of 0.85 ± 0.35 at baseline. We observed no significant differences in the iAUCs between the three conditions for insulin (p = 0.43), glucose (p = 0.95), triglycerides (p = 0.31), LDL- (p = 0.55) or HDL-cholesterol (p = 0.84).

Discussion: Results from this pilot study suggest that uninterrupted sitting may not result in significant increments in markers of cardiometabolic risk in healthy children and youth or that these markers are not sensitive to acute changes in this age group. Future studies employing larger samples or individuals at increased risk for metabolic disturbances are needed to more fully investigate the relationship between acute bouts of sedentary behaviour and markers of cardiometabolic risk in the pediatric population.

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Estimated replacement effects of accelerometer-derived physical activity and self-reported sleep duration on chronic disease biomarkers

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Introduction: Across a 24-hour day, time is disproportionately distributed between sleep, sedentary time (sitting or lying with low energy expenditure), light-intensity activity, and moderate-vigorous intensity activity (MVPA). Individually, physical activity and healthful sleep (~8 hr/night) are beneficially associated, while sedentary time is detrimentally associated, with health outcomes. The relationship between these behaviors may also be important, with preliminary evidence suggesting physical activity and healthful sleep are related. However, the magnitude and direction of these relationships, and their impact on health outcomes, are unclear. This study explored the impact of alternating the time spent in these different behaviors (sleep, sedentary time, light-intensity time, MVPA time) on chronic disease biomarkers.

Methods: Data from the cross-sectional, 2005–2006 US National Health and Nutritional Examination Survey (NHANES) were analyzed, adjusting for the complex sampling design. Adults aged 30 to 74 years with 4+ days of accelerometer data and self-reported sleep duration were included in analyses (N = 3,238). Adults with sleep disorders and pregnant/lactating women were excluded. Cardiovascular (Framingham Risk Score and homocysteine levels), adiposity (body mass index and waist circumference), inflammatory (C-reactive protein), insulin resistance (HOMA-IR and HOMA-B), and hyperinsulinemia biomarkers were examined. Isotemporal substitution methods were used to estimate replacement effects for accelerometer-derived activity (MVPA: > 1951 cpm; light-intensity: 100–1951 cpm; sedentary: < 100 cpm) and reported sleep time (duration, sleep onset latency) variables on selected biomarkers.

Results: After adjustment for study covariates (age, gender, ethnicity, income, smoking, depression, and energy intake) and time spent in other activities, replacing 30 min/day of sedentary time with 30 min/day of MVPA was associated with improved levels for all biomarkers (p < 0.02 to 0.0001) with the exception of homocysteine. Replacing 30 min/day of sedentary time with 30 min/day of extended sleep duration was associated with improved cardiovascular (p < 0.04 to 0.01), insulin resistance (p < 0.05 to 0.0004), and hyperinsulinemia (p = 0.03) biomarkers, but not adiposity or inflammatory biomarkers. Light intensity activity and sleep onset latency replacement effects were equivocal across biomarkers.

Discussion: On average, replacing sedentary time with accelerometer-derived MVPA or self-reported sleep duration, even after controlling for other activities, was associated with improvements in a range of important biomarkers associated with cardiovascular disease and diabetes. Future research should explore these replacement associations longitudinally using objective methods to assess sleep parameters.

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