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How sickening is sitting?

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Summary



Physical activity is an established and important contributor to optimal health and development in youth. On the other hand, excessive sedentary behaviour has been proposed as a contributor to poor health. In today's society few children meet the physical activity guideline of daily 60 minutes moderate-to-vigorous-intensity physical activity (MVPA). Besides, it is easy for young people to engage in a lot of sedentary behaviour, for example while sitting at school, watching TV, playing video games, using the computer and making homework. Sedentary behaviour is defined as 'any waking behaviour characterized by an energy expenditure ≤ 1.5 metabolic equivalents, while in a sitting, reclining or lying posture'. Young people who meet the guidelines for physical activity can still have a high level of sedentary time. To date, still little is known about young people's sedentary behaviour and the potential adverse health consequences.

This thesis aimed to extend the knowledge on sedentary behaviour among young people by: (1) summarizing the evidence on the prospective relationship between young people's sedentary behaviour and indicators for biomedical health; (2) describing differences in body movement across various sedentary activities, as measured by accelerometer counts, muscle activity and heart rate; (3) examining tracking of total sedentary time, prolonged sedentary time and their day-to-day variation during childhood; (4) examining child- and parent-related correlates of total and prolonged sedentary time in 5- to 6-year-old children; and (5) exploring child- and parent-perceived determinants of children's sedentary behaviour, using concept mapping with 11- to 13-year-old children and their parents.

Prospective relationship between young people's sedentary behaviour and indicators for biomedical health

The systematic literature research described in *chapter 2*, summarizes the evidence on the prospective relationship between childhood sedentary behaviour and biomedical health indicators overall and stratified by type of sedentary behaviour (TV viewing, computer use/games, screen time and objective sedentary time). A total of 109 studies were included of which 19 were regarded as of high methodological quality. The evidence varied by type of sedentary behaviour. For TV viewing, we found moderate-to-strong evidence for a relationship with increased risk for overweight/obesity, increased incidence of overweight/obesity and decreased fitness. For screen time we found moderate-to-strong evidence for a relationship with increased BMI and increased risk for overweight/obesity. For computer use/games and objective sedentary time we found insufficient evidence or no evidence for a relationship with biomedical health indicators, depending on the outcome. The meta-analysis indicated that TV viewing or computer use was not significantly related with BMI at follow-up. In

conclusion, the evidence for a prospective relationship between childhood sedentary behaviour and biomedical health is unconvincing.

Differences in body movement across various sedentary activities in youth

Variations in body movement across sedentary activities are currently unknown, as are age differences in such variations. The controlled laboratory study described in *chapter 3* examines body movement differences across various sedentary activities in children and adolescents, assessed by acceleration of the hip-, thigh- and wrist, muscle activity and heart rate. Body movement differences between sedentary activities and standing were also examined. Fifty-three children (aged 10–12 years) and 37 adolescents (aged 16–18 years) performed seven different sedentary activities, a standing activity and a dancing activity in a controlled setting. Each activity lasted 10 minutes. Participants wore an Actigraph on their hip and both wrists, an activPAL on their thigh and a heart rate monitor. The muscle activity of weight-bearing leg muscles was measured in a subgroup ($n = 38$) by surface electromyography. Children showed significantly more body movement during sedentary activities and standing than adolescents. In both age groups, screen-based sedentary activities involved less body movement than non-screen-based sedentary activities. Differences in body movement during standing and sedentary activities were relatively small. Muscle activity of leg muscles was not consistently significantly higher during standing than during sedentary activities. The magnitude of differences was dependent on device and position. For example, body movement differences between screen-based and non-screen-based sedentary activities were most pronounced for heart rate and acceleration of the thigh. Future research is needed to confirm these body movement differences in a free-living setting and to examine the relevance for health of the small body movement differences between screen-based versus non-screen based and standing versus sedentary activities.

Tracking of total sedentary time, prolonged sedentary time and their day-to-day variation during childhood.

To gain more understanding of the potential health effects of sedentary time, knowledge is required about the accumulation and longitudinal development of young people's sedentary time. *Chapter 4* describes tracking of young peoples' total and prolonged sedentary time as well as their day-to-day variation using the International Children's Accelerometry Database (ICAD). Moderating effects of gender and age group on tracking coefficients were also examined. Longitudinal accelerometer data of 5,991 children (aged 4-17 years) were used from eight studies in five countries (average follow-up: 2.7 year; range: 0.7-8.2). Average total sedentary time at study level ranged from 246-387 minutes/day at baseline and increased annually by 21 minutes/day. This increase consisted almost entirely of

prolonged sedentary time, defined as sedentary time accumulated in bouts of at least 10 minutes. Total and prolonged sedentary time tracked moderately. Tracking of day-to-day variation in total and prolonged sedentary time was low. Tracking of total sedentary time was higher during childhood than during the transition from childhood to adolescence. Tracking of total and prolonged sedentary time was slightly higher for boys than for girls, while tracking of day-to-day variation was similar for boys and girls. The results suggest that young people with high levels of sedentary time are likely to remain among the people with highest sedentary time as they grow older. Day-to-day variation in total and prolonged sedentary time, however, was rather variable over time.

Child- and parent-related correlates of total and prolonged sedentary time

Little is known about factors influencing young people's sedentary time. One gap in the current knowledge exists around parental influences on children's sedentary time. Parent-related correlates may be of importance for young children's sedentary time, as young children have little autonomy and parents play an essential role in shaping and enabling their children's health behaviours. *Chapter 5* describes child- and parent-related correlates of overall total and prolonged sedentary time in 5- to 6-year-old children. Also, child- and parent-related correlates of total and prolonged sedentary time during different time periods, i.e. weekend days and the after-school period, are described. Sedentary time and MVPA were assessed by ActiGraph accelerometers in children (n = 836) and one of their parents/carers. Parents completed a questionnaire examining potential parent-related correlates. Only a few of the examined potential child- and parent-related correlates were associated with young children's total or prolonged sedentary time and most associations differed by time period. Higher child MVPA was the only correlate that was consistently associated with lower total and prolonged sedentary time across all time periods. Qualitative studies exploring children's and parents' motives for children to engage in sedentary time may provide new insights into potential important correlates.

Child- and parent-perceived potential determinants of children's sedentary behaviour

Chapter 6 explores potential determinants of children's sedentary behaviour from the perspective of children and parents. Qualitative data were collected during concept mapping sessions with four groups of 11- to 13-year-old children (n = 38) and two online sessions with parents (n = 21).

Children and parents generated sedentary behaviour motives, sorted related motives, and rated their importance in influencing children's sedentary behaviour. Next, multidimensional scaling and hierarchical cluster analyses were performed to create clusters of motives resulting in concept maps. Concept maps of children yielded eight to ten perceived determinants and concept maps of parents yielded six to seven perceived determinants. Parents' and children's perspectives differed with regard

to both type and importance of potential determinants. Children and parents identified six similar potential determinants. The potential determinants: “sitting because it is the norm (I have to)” and “sitting because I can work/play better that way”, were identified and rated as important by both children and parents. In addition, children rated “there is nobody to play with” as an important potential determinant for engaging in sedentary behaviour. Parents rated “My child sits because he/she is tired, wants to relax, wants to rest”, as an additional important potential determinant. Future observational and intervention studies are needed to confirm the importance of these potential determinants.

Conclusion

Since the health effects of sedentary behaviour are not well understood at this moment and it is uncertain if health effects of sedentary behaviour are truly independent of physical activity, public health initiatives are advised to focus on increasing children’s MVPA instead of reducing sedentary time. In order to better understand the potential adverse health effects of sedentary behaviour, improvements in the measurement and analysis of sedentary behaviour are needed as well as insight in underlying physiological mechanisms. Future research should move beyond analyses of total volumes of either sedentary time or physical activity, while adjusting for each other, and move towards studying 24-hour patterns taking into account the accumulation and alternation of sedentary behaviour, physical activity at various intensities and sleep.