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Chapter 1

General introduction



Physical activity

Physical activity is an established and important contributor to health and development in youth (1,2). Physical activity is defined as ‘any bodily movement produced by skeletal muscles that requires energy expenditure’ (3). Therefore, physical activity does not only include exercise but also daily activities that involve bodily movement such as playing, active transport and household chores. Physical activity is often subdivided into light, moderate and vigorous intensity physical activity, based on Metabolic Equivalents (METs) of activities. METs are a measure of energy expenditure, whereby 1 MET refers to the basal metabolic rate i.e. the amount of energy expended while at rest. Light intensity physical activity includes activities of 1.5-2.9 METs (e.g. slow walking, playing an instrument); moderate intensity physical activity of 3.0-5.9 METs (e.g. playing in the playground, cycling, walking to school, skateboarding); and vigorous intensity physical activity of 6.0 METs or higher (e.g. running, most competitive sports) (4). Especially moderate-to-vigorous intensity physical activity (MVPA) is associated with a wide range of health benefits such as lower body mass index (BMI), lower percentage of body fat, increased cardiovascular health, increased bone mineral density and better mental health (1, 5-7). Dutch guidelines for healthy physical activity recommend that children and adolescents should engage in MVPA for at least 60 minutes per day. Besides, children and adolescents should perform activities that strengthen their muscles and bones at least three times a week (7). Muscle strengthening activities are aimed at improving power and endurance of skeletal muscles and to increase their size, examples are abdominal exercises, cycling and skating. Bone strengthening activities are activities in which the body carries its own weight, like jumping, running, dancing and climbing stairs (7). In the Netherlands, the percentage of children that adheres to the guideline of daily 60 minutes MVPA has declined over the last years with currently only 20% of children and 15% of adolescents meeting the guideline (8). Also internationally, the number of children and adolescents who meet physical activity guidelines is low (9). Young people who have an insufficient physical activity level to meet the guidelines are referred to as being physically inactive (10).

Sedentary behaviour

Being physically inactive is not the same as being sedentary. Sedentary behaviour is defined as ‘any waking behaviour characterized by an energy expenditure ≤ 1.5 METs, while in a sitting, reclining or lying posture’ (10). Young people who meet the guidelines for physical activity can still be highly sedentary. For example, a child who engages in 80 minutes of MVPA per day may be sedentary for the rest of the day. In adults, time spent sedentary has been related to all-cause mortality, cardiovascular disease mortality, cancer mortality and type 2 diabetes (11, 12). However, it is doubted whether detrimental health effects of sedentary behaviour are truly independent of physical activity as a meta-

analysis of Ekelund *et al.* (12) found that associations were attenuated or even eliminated in the most active adults. To date, little is known about the potential adverse health consequences of young people's sedentary behaviour. Recent experimental (13) and epidemiological studies (14-16) in young people suggest that not only total sedentary time but also the extent to which sedentary time is accumulated in prolonged bouts (i.e. prolonged sedentary time) might be important for health.

Health effects of young people's sedentary behaviour

Nowadays, there are plenty of opportunities for young people to engage in sedentary behaviour. For example, sitting at school, watching TV, playing video games, using the computer and making homework. Estimates suggest that young people living in Europe spend up to 9 hours per day sedentary (17). Young people's sedentary time is consistently found to increase with age (18, 19). For example, a cross-sectional study of Cooper *et al.* (20) reported a 25% higher daily sedentary time in adolescents aged 17-18 year old compared to children aged 5-6 year old.

There is some evidence for an association between young people's sedentary time with obesity, increased blood pressure and increased cholesterol levels (11). However, this evidence has four important limitations to consider. First, it is predominately based on cross-sectional studies (11), which gives no indication for causality of the association. Second, most studies examining health effects of sedentary behaviour in young people focused on self- or parent-reported TV viewing time. Verloigne *et al.* (17) found that TV and screen time are not representative for total sedentary time in children. TV viewing time or screen time can therefore not be used as a proxy for total sedentary time in children. Nevertheless, most systematic reviews summarized the evidence for health effects for sedentary behaviour overall, regardless of type of sedentary behaviour (e.g. TV viewing, screen time, computer time, total sedentary time) (11). Third, a lot of studies did not adjust their analyses for physical activity.

A fourth limitation of previous evidence for health effects of sedentary behaviour is that there are some important limitations in the measurement of sedentary behaviour which may influence associations with health outcomes. Sedentary behaviour is frequently assessed using questionnaires filled in by parents or children themselves. These questionnaires often recall time spent in specific sedentary activities, of which TV viewing time, computer time and total screen time are most often inquired. As with all self-report methods, sedentary behaviour questionnaires may suffer from recall bias and social desirability bias. Besides, the validity and reliability of these questionnaires are low. Hidding *et al.* (21) systematically reviewed the validity and reliability of sedentary behaviour questionnaires and concluded that no questionnaire existed with both an acceptable validity and

reliability. These measurement limitations of sedentary behaviour questionnaires increase the likelihood of misclassification, which subsequently bias relationships with health outcomes. Accelerometers are increasingly used as an objective measure of sedentary time. Although objective measurement with accelerometers may be a step forward compared to self-reported methods, accelerometers have some limitations as well. First, accelerometers provide an estimate of sedentary time but cannot provide information about time spent in specific sedentary activities. Second, total sedentary time assessed by accelerometers may incorporate time spent standing, because standing still will not result in acceleration. This potentially weakens associations of sedentary time with health outcomes. Third, accelerometry is not completely objective because a number of subjective decisions (e.g. used cut-points, criteria for non-wear time) are made in the data reduction process. There is no consensus yet about optimal data reduction criteria (22) while these data reduction criteria may influence associations with health outcomes (23).

In summary, more knowledge is needed on the health effects of young people's sedentary behaviour based on prospective studies of high methodological quality, taken type of sedentary behaviour into account. Chapter 2 summarizes the evidence on the prospective relationship between young people's sedentary behaviour and biomedical health indicators, for sedentary behaviour overall and stratified by type of sedentary behaviour (i.e. TV viewing, computer use/games, screen time and objectively assessed total sedentary time). Moreover, when possible, the results are quantitatively synthesized in meta-analyses.

Overall, stronger evidence has been found for an adverse association between TV viewing time and health outcomes, than for other sedentary activities and (objectively measured) total sedentary time (24). One explanation could be that especially TV viewing is associated with unhealthy eating behaviour (25). Another explanation may be that TV viewing involves less body movement than other sedentary activities. Variations in body movement across sedentary activities are currently unknown. Chapter 3 examines variations in body movement across a wide range of sedentary activities.

Tracking of young people's sedentary time

Little is known about the stability of total and prolonged sedentary time and their day-to-day variation during childhood. Tracking of sedentary time refers to the degree in which current time spent sedentary can predict time spent sedentary at a later time point. Chapter 4 examines tracking of young peoples' total sedentary time, prolonged sedentary time and their day-to-day variation using the International Children's Accelerometry Database (ICAD). The ICAD is a pooled dataset and contains

data from studies conducted around the world that used the Actigraph accelerometer to objectively measure young people's sedentary time and physical activity (26). The full database contains data of approximately 37,000 children (aged 3-18 years) from twenty studies in ten countries. Within the ICAD, longitudinal data from eight studies (total N=14,098 participants) is available to examine tracking of sedentary time during childhood.

Factors associated with young people's sedentary behaviour

Development of effective and tailored interventions targeting sedentary behaviour requires knowledge of behavioural correlates and determinants. Altenburg et al. (27) systematically reviewed the evidence for effectiveness of interventions to reduce children's sedentary time and concluded that there is no convincing evidence for effectiveness (27). This may be explained by lack of knowledge regarding the most important correlates and determinants (28). One gap in the current knowledge exists around parental influences on children's sedentary time. Parent-related correlates may be important 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 (29). Chapter 5 examines associations of child- and parent-related correlates with objectively measured total and prolonged sedentary time in 5- to 6-year-old children. Another major gap in the current knowledge of correlates and determinants is the perspective of children themselves on why they engage in sedentary behaviour. Children's perspectives could bring new insights into potential determinants of their sedentary behaviour. Also, parents' perspectives on potential determinants of their children's sedentary behaviour could provide new meaningful insights. Chapter 6 explores child- and parent-perceived determinants of children's sedentary behaviour.

Aim and outline of this thesis

This thesis aims to extend the knowledge on sedentary behaviour among young people. *Chapter 2* describes a systematic review and meta-analysis summarizing the evidence on the prospective relationship between young people's sedentary behaviour and indicators for biomedical health. *Chapter 3* describes differences in body movement across various sedentary activities, as measured by accelerometer counts, muscle activity and heart rate. *Chapter 4* examines tracking of total sedentary time, prolonged sedentary time and their day-to-day variation during childhood. *Chapter 5* examines child- and parent-related correlates of total and prolonged sedentary time in 5- to 6-year-old children. *Chapter 6* explores child- and parent-perceived determinants of children's sedentary behaviour, using concept mapping with 11- to 13-year-old children and their parents. Finally, *chapter 7* summarizes and

Chapter 1

critically discusses the main findings described in earlier chapters. Moreover, it describes implications for practice, directions for future research and provides an overall conclusion.

References

1. Janssen I, LeBlanc AG. Systematic review of the health benefits of physical activity and fitness in school-aged children and youth. *Int J Behav Nutr Phys Act* 2010; 7: 40.
2. Strong WB, Malina RM, Blimkie CJ et al. Evidence based physical activity for school-age youth. *Journal Pediatr* 2005; 146: 732-7.
3. Caspersen CJ, Powell KE, Christenson GM. Physical activity, exercise, and physical fitness: definitions and distinctions for health-related research. *Public Health Rep* 1985; 100: 126.
4. Haskell WL, Lee I-M, Pate RR, et al. Physical activity and public health: updated recommendation for adults from the American College of Sports Medicine and the American Heart Association. *Circulation* 2007; 116: 1081.
5. Biddle SJ, Asare M. Physical activity and mental health in children and adolescents: a review of reviews. *Br J Sports Med* 2011; 45: 886-895.
6. Jiménez-Pavón D, Kelly J, Reilly JJ. Associations between objectively measured habitual physical activity and adiposity in children and adolescents: Systematic review. *Int J Pediatr Obes* 2010; 5: 3-18.
7. Weggemans RM, Backx FJ, Borghouts L, et al. The 2017 Dutch Physical Activity Guidelines. *Int J Behav Nutr Phys Act* 2018; 15: 58.
8. Hildebrandt VH BC, Hofstetter H. Trendrapport bewegen en gezondheid. Leiden: TNO; 2015.
9. Booth VM, Rowlands AV, Dollman J. Physical activity temporal trends among children and adolescents. *J Sci Med Sport* 2015; 18: 418-425.
10. Tremblay MS, Aubert S, Barnes JD, et al. Sedentary behavior research network (SBRN)—terminology consensus project process and outcome. *Int J Behav Nutr Phys Act* 2017; 14: 75.
11. de Rezende LFM, Lopes MR, Rey-López JP, Matsudo VKR, do Carmo Luiz O. Sedentary behavior and health outcomes: an overview of systematic reviews. *PLoS One* 2014; 9: e105620.
12. Ekelund U, Brown WJ, Steene-Johannessen J, et al. Do the associations of sedentary behaviour with cardiovascular disease mortality and cancer mortality differ by physical activity level? A systematic review and harmonised meta-analysis of data from 850 060 participants. *Br J Sport Med* 2018: doi: 10.1136/bjsports-2017-098963.
13. Belcher BR, Berrigan D, Papachristopoulou A, et al. Effects of interrupting children's sedentary behaviors with activity on metabolic function: a randomized trial. *J Clin Endocrinol Metab* 2015; 100: 3735-3743.
14. Carson V, Stone M, Faulkner G. Patterns of sedentary behavior and weight status among children. *Pediatr Exerc Sci* 2014; 26: 95-102.

15. Gabel L, Ridgers ND, Della Gatta P, et al. Associations of sedentary time patterns and TV viewing time with inflammatory and endothelial function biomarkers in children. *Pediatr Obes* 2016; 11: 194-201.
16. Saunders TJ, Tremblay MS, Mathieu MÈ, et al. Associations of sedentary behavior, sedentary bouts and breaks in sedentary time with cardiometabolic risk in children with a family history of obesity. *PLoS One* 2013; 8: e79143.
17. Verloigne M, Loyen A, Van Hecke L, et al. Variation in population levels of sedentary time in European children and adolescents according to cross-European studies: a systematic literature review within DEDIPAC. *Int J Behav Nutr Phys Act* 2016; 13: 69.
18. Janssen X, Mann KD, Basterfield L, et al. Development of sedentary behavior across childhood and adolescence: longitudinal analysis of the Gateshead Millennium Study. *Int J Behav Nutr Phys Act* 2016; 13: 88.
19. Tanaka C, Reilly J, Huang W. Longitudinal changes in objectively measured sedentary behaviour and their relationship with adiposity in children and adolescents: systematic review and evidence appraisal. *Obes Rev* 2014; 15: 791-803.
20. Cooper AR, Goodman A, Page AS, et al. Objectively measured physical activity and sedentary time in youth: the International children's accelerometry database (ICAD). *Int J Behav Nutr Phys Act*. 2015; 12: 113.
21. Hidding LM, Altenburg TM, Mokkink LB, Terwee CB, Chinapaw MJ. Systematic review of childhood sedentary behavior questionnaires: What do we know and what is next? *Sports Med* 2017; 47: 677-699.
22. Chinapaw MJ, de Niet M, Verloigne M, De Bourdeaudhuij I, Brug J, Altenburg TM. From sedentary time to sedentary patterns: accelerometer data reduction decisions in youth. *PLoS One* 2014; 9: e111205.
23. Atkin AJ, Ekelund U, Møller NC, et al. Sedentary time in children: influence of accelerometer processing on health relations. *Med Sci Sports Exer* 2013; 45: 1097-1104
24. Van Ekris E, Altenburg T, Singh A, Proper K, Heymans M, Chinapaw M. An evidence-update on the prospective relationship between childhood sedentary behaviour and biomedical health indicators: a systematic review and meta-analysis. *Obes Rev* 2016; 17: 833-849.
25. Hobbs M, Pearson N, Foster PJ, Biddle SJ. Sedentary behaviour and diet across the lifespan: an updated systematic review. *Br J Sports Med* 2014; 49: 1179-1188.
26. Sherar LB, Griew P, Esliger DW, et al. International children's accelerometry database (ICAD): design and methods. *BMC Public Health* 2011; 11: 485.

27. Altenburg TM, Kist-van Holthe J, Chinapaw MJ. Effectiveness of intervention strategies exclusively targeting reductions in children's sedentary time: a systematic review of the literature. *Int J Behav Nutr Phys Act* 2016; 13: 65.
28. Uijtdewilligen L, Nauta J, Singh AS, et al. Determinants of physical activity and sedentary behaviour in young people: a review and quality synthesis of prospective studies. *Br J Sports Med* 2011; 45: 896-905.
29. Patrick H, Hennessy E, McSpadden K, Oh A. Parenting styles and practices in children's obesogenic behaviors: scientific gaps and future research directions. *Child Obes* 2013; 9: S73-S86.