

Summary

The high prevalence of overweight and obesity among children in most parts of the world is a well-documented fact. In parallel with this “obesity epidemic”, increasing numbers of children now show features of metabolic syndrome. Several movement behaviors involving various aspects of physical activity, sedentary behavior, and lack of good-quality sleep have all been linked to this recent development of obesity and cardio-metabolic risk among children. Early puberty is a period characterized by rapid changes in body composition and movement behaviors. As movement behaviors, obesity, and cardio-metabolic risk appear to track from childhood to adulthood, this may be a critical period for implementing preventive strategies aimed at reducing obesity and its associated metabolic complications in adulthood.

The overall objective of this thesis was to assess objectively measured movement behaviors in 8- to 11-year-old Danish children and relate these movement behaviors to indicators of adverse health (dietary intake, adiposity, and cardio-metabolic risk markers). The specific objectives were:

1. To evaluate the concordance between wrist- and waist-worn accelerometers for sleep scoring.
2. To examine objectively measured movement behaviors between seasons and within a week.
3. To examine the relation between sleep and dietary risk factors for overweight and obesity.
4. To investigate the direction of causality between movement behaviors and adiposity.
5. To examine associations between movement behaviors and the metabolic syndrome score.

In **Paper 1**, data from the OPUS School Meal Pilot Study was used to evaluate the concordance between wrist- and waist-worn accelerometers for sleep scoring. We concluded that the two attachment sites cannot be used interchangeably for the measurement of sleep indicators in children using the existing algorithms. However, waist-worn devices could be used to obtain a proxy measure of sleep duration for ranking purposes in epidemiological studies. Therefore, monitoring of sleep and physical activity could be done by a single accelerometer worn on the waist for 24-hours a day, which was then done for the main study (**Papers 2-5**).

In **Paper 2**, we found autumn to be the most accurate and unbiased estimate of habitual physical activity, although the considerable intra-individual variation across seasons suggested that a single period of measurement may not provide an accurate estimate of habitual behavior. Given that sedentary time was higher and physical activity was lower during winter and

during weekends (as was sleep duration during weekends), these periods might serve as key intervention periods to promote a healthy lifestyle. As most children in this group did not meet screen time, physical activity, and sleep recommendations, we investigated whether differences and changes in movement behaviors were associated with different indicators of adverse health (**Papers 3-5**).

In **Paper 3**, we found that short sleep duration and a high variability in sleep duration, as well as sleep problems, were associated with an obesity-promoting diet, suggesting that sleep influences diet or that both a poor diet and poor sleep are part of a cluster that characterizes certain children.

In **Paper 4**, low physical activity and short sleep duration were independently associated with a higher fat mass index, and combined associations of movement behaviors suggested a synergistic effect. Furthermore, baseline fat mass index predicted decreased physical activity and increased sedentary time over a 200-day follow-up period. These results suggest that movement behaviors are related to fat mass index, possibly with low physical activity and high sedentary time being the result of fatness rather than its cause.

In **Paper 5**, decreasing moderate-to-vigorous physical activity and sleep duration were associated with an increased cardio-metabolic risk profile over a 200-day follow-up period although it was attenuating when adjusted for adiposity. Furthermore, negative changes in moderate-to-vigorous physical activity, sedentary time, and sleep duration all at the same time synergistically increased the cardio-metabolic risk profile of children. These results suggest that multiple movement behaviors should be targeted to improve cardio-metabolic risk markers in childhood and that this is possibly mediated or confounded by adiposity.