

English summary

Background: Increased physical activity (PA) is associated with decreased risk of a range of non-communicable diseases and with improved cognitive function, academic achievement, and mental health. Unfortunately, many children are inactive or spend only limited time engaged in PA. Schools have the potential to transform part of children's time from inactive to active. Curriculum-based classroom activities constitute a large proportion of school time, in which more teaching and learning activities involving PA could be implemented. Education outside the classroom (EOtC) is an example of an educational approach that could increase PA, as case studies have shown positive effects of EOtC on PA, academic learning motivation, well-being and social relations. National surveys in Denmark have shown substantial and increasing proportions of schools and teachers regularly practicing EOtC. When evaluating such interventions' effects on PA, it is crucial to obtain reliable and valid objective measurements of PA. PA is commonly measured using accelerometers and affected by the accelerometer attachment method, bodily placement, instructions for wear, and the chosen inclusion criteria. The accelerometer methodology commonly used to measure children's free-living PA would benefit, regarding the validity and reliability of measurements, from increasing wear time per day and number of valid days. This thesis investigates 1) compliance, predictors of compliance, and within-subject reliability of free-living PA measurements using skin-taped accelerometers; 2) effects of an EOtC intervention on children's weekly PA; and 3) differences in PA levels between domains and day types, primarily comparing EOtC time with classroom time.

Methods: Pairs of one EOtC and one comparison parallel class in grades three through six (18 schools, 46 classes and 1,013 pupils) were recruited to the Danish quasi-experimental TEACHOUT study, investigating how EOtC impacts PA, academic learning, motivation, well-being, and social relations. Children wore skin-taped accelerometers on the thigh and lower back. School activities (including EOtC practice) were monitored at the class level, and diaries were collected at the participant level (i.e., absence from school, reasons for accelerometer non-wear, and sleep times). For evaluation of the PA measurements conducted, predictors of accelerometer wear time and reliability of whole-day PA accelerometer data variability were investigated. The effects of EOtC on PA were compared between children in EOtC and comparison classes over a full week, and assessed at the participant level on specific day types and in specific domains.

Results: Of the children with thigh- ($n=903$) and lower-back-placed ($n=856$) accelerometers attached, 65.7% (thigh) and 59.5% (lower back) obtained seven days of uninterrupted 24h wear time. PA was negatively associated with wear time and the strongest of the tested predictors. Being a girl, younger (only for lower back), and having a lower BMI percentile were all associated with higher wear time. Also regarding wear time, 4.2 (thigh) and 3.1 (lower back) days of 24h wear time were needed to obtain 80% reliability due to whole-day PA variability. Sixteen class pairs with 663 children were eligible for the EOtC analyses, and 361

had valid PA data. Boys in EOtC classes spent more weekly time in moderate-to-vigorous physical activity (MVPA) compared to their comparison class counterparts, while no difference was found for girls. The accumulated time spent in MVPA on EOtC days was not different from school days without EOtC and physical education (PE), but lower than on PE days. EOtC days were associated with more light physical activity (LPA) than school days without EOtC and PE, and PE days. Boys spent a higher proportion of time in MVPA and girls in LPA in the EOtC domain compared to the classroom domain. Lower proportions of time were spent being inactive for children in general on EOtC days compared to all other day types.

Conclusions: The developed and evaluated methodology using skin-taped Axivity AX3 accelerometers in children to obtain valid and reliable PA data was successful, with high compliance rates for seven days of measurements, without non-wear. This creates a better and more detailed understanding of the PA effects of an intervention and better possibilities to compare PA outcomes across studies. The EOtC intervention's effects on weekly PA were sex-specific, increasing levels for boys, but with no difference observed for girls. Of the day types investigated, days with EOtC had the highest proportion of time spent in PA, and time in PA was higher in the EOtC domain compared to the classroom domain. Future studies should investigate the contexts within different domains in which high levels of PA are accumulated for boys and girls in order to gain a better understanding of the sex differences found and to increase PA for girls. EOtC was implemented over a full school year and practiced weekly by substituting activities in the classroom domain without adding external resources. This indicates that EOtC is a scalable way to increase PA for many boys during a school day without decreasing time for academic learning, although the effects on academic learning remain to be investigated. Teachers who participated in this study had little or no experience practicing EOtC, which indicates a greater potential for accumulating PA and further emphasizes the need to understand what constitutes good EOtC practice, the aim of which is to increase academic learning and PA simultaneously.