Unravelling environmental influences on children's physical activity

VALORIZATION ADDENDUM

The current chapter describes the societal value and relevance of the work presented in this thesis. This will be described in terms of the relevance of study results for specific target groups. Also the dissemination of the results and products presented in this thesis will be described.

Relevance of the results presented in this thesis

The importance of regular Physical Activity (PA) for children's health and well-being is well understood, both worldwide and in the Netherlands (1). Increased PA is related to various benefits for children's general health and well-being. For example, several studies have indicated that inactivity is directly linked with various detrimental consequences for health and well-being, such as cardiovascular risk factors, bone health, general cognitive functioning, and social capabilities of children (2-5). In addition, PA may also be indirectly beneficial with respect to the primary prevention of overweight and obesity. As inactivity tends to track from childhood to adolescence and even to adulthood (6, 7), promoting PA is a major health promotion target in children.

Given the multi-dimensional short- and long term benefits of PA and the increased need for policies informed by evidence-based information, knowledge about how to effectively increase children's PA levels is of interest to multiple stakeholders such as researchers, policy makers at municipalities, health promotion professionals, school teachers, and parents. Accurate and reliable objective measurements of the frequency, intensity, and duration of PA over longer time periods (e.g. using accelerometers) is essential in identifying children that are insufficiently active and is an essential step in understanding how to increase these PA levels (8). In addition, effectively promoting children's PA levels also requires knowledge about determinants of PA. Several conceptual frameworks propose that besides individual-level factors (e.g. motivation, personality traits), PA is influenced by various layers of environmental factors (9). This may be especially relevant to municipalities and designers of public (urban) spaces. The relative influence of these factors however depend on the type of PA performed. For example, while some attributes of the physical environment may act as determinants of active transport, these attributes may be unsuccessful in influencing PA performed at school. This means that increased specificity of the type of PA (i.e. the PA context) is necessary to understand how PA can be influenced (10). The studies presented in this thesis provide indications for determinants of PA at both the individual and environmental level, which may in turn be used to successfully promote PA in various contexts (e.g. outside play, afterschool PA, sports participation, active transport).

The innovative techniques presented in chapters 6, 7, 8 and 9 are examples of the possibilities that arise when combining objective PA and environmental data from multiple sources or sensors. Namely, in these chapters, we have combined accelerometer data with registries of weather elements (chapter 6), school's time schedules (chapter 7) and combined GPS and GIS data (chapters 8 and 9). By doing so, relevant additional insights were obtained on determinants of PA in several social- and physical contexts, as

these methodologies enable researchers to investigate time-specific and location-specific analyses between the environment and PA behavior. Driven by fast-developing technological innovations and interest in the consumer market, collecting continuous streams of objective biometric data (e.g. activity and sleep patterns, blood glucose, blood pressure) becomes increasingly affordable. These technological innovations enlarge the possibilities to increase our understanding of specific relationships between PA and the environment, and enable us to combine data from multiple sensors to investigate under which circumstances the data from these sensors deviate or correlate. Most importantly however, these fast-developed biometric sensors should be extensively validated both in research-level as well as in consumer-level products, in order to avoid researchers as well as consumers to interpret these findings based on erroneous data.

Dissemination of results and products

The main innovative aspects of the results presented in this thesis are the investigation of PA within the specific social and organizational contexts, and the integration of objective measurements from multiple sources (i.e. accelerometers, registries of weather stations, global positioning systems and geographic information systems). In addition, the studies have additional innovative aspects in focusing for example on dynamics of PA in important phases in the development of childhood (i.e. the transition between primary and secondary school) and relationships with associated risk factors (i.e. the adiposity rebound period).

Empirical evidence is increasing regarding the influence of the publically accessible physical environment on for example children's leisure time PA and active transport. Therefore, results from studies using innovative methodology as presented in chapter 7, 8 and 9 may be of special interest to municipalities that attempt to create and facilitate supporting environments, incorporating multiple policy sectors such as urban design, transport, safety, and health. GPS and GIS methodologies are also suited to intuitively grasp and visually inspect mobility patterns of individual persons in their environment and observe trends across the day. Therefore these techniques can be integrated in innovation-platforms involving for example several municipality-sectors, universities, and commercial parties such as construction or transport companies. These innovation-platforms can systematically implement and analyze small-scaled natural experiments in publically accessible environments, targeting for example PA behaviors. Chapters 8 and 9 of this thesis have been made possible by continuous collaboration between the municipality of 's-Hertogenbosch and Maastricht University. Active collaboration with the municipality facilitated the recruitment of participants, data collection, and data analyses. We have planned additional meetings with various sectors of the municipality in the near future to further disseminate specific knowledge based on chapters 8 and 9, and to prioritize additional small-scaled analyses based on questions raised in interaction with the municipality. Another example of such collaboration between municipality-sectors, commercial parties and universities is the recently developed A2health study. This study evaluates an infrastructural change where main roads will be replaced by greenspaces and

cycling paths, involving the surrounding neighborhoods and its associated public health services. Also, Maastricht University, Utrecht University, the Fontys University of Applied Sciences Sport Eindhoven, and the Dutch ministry of infrastructure and environment were involved in this project. Relationships between the environment and PA will be studied in the A2Health study with techniques that are in line with the methodologies applied in chapters 7, 8 and 9.

However, the strength of the innovative methodology presented in this thesis is limited to the quality or precision of the GIS data at hand. As the quality of GIS data may differ between municipalities, standardization and national registries of highly specific Geospatial information is warranted. With this highly specific Geospatial information, results from studies as presented in 8 and 9 of this thesis may be easier generalized and disseminated to other municipalities. This also provides opportunities to combine accelerometer and GPS datasets across the Netherlands, or perhaps even internationally. By doing so, objective PA patterns can be studied in more diverse environmental, organizational, social, and socio-demographical contexts. An example of this combination of datasets is the international children's accelerometry database, which pooled accelerometer measurements from 20 countries worldwide (11).

Combined accelerometer and GPS methodologies only contain objective information on participant's movement or location. However, the integration of subjective data that relates to participant's perceptions of the built environment (e.g. perceptions of aesthetics, attractiveness, safety, functionality, or vicinity) provides important additional insights in environment-behavior relationships. The integration of these subjective measurements may be especially feasible when using ecological momentary assessment techniques, by which a respondent can report subjective information (e.g. perceptions or affect) repeatedly across the day at certain pre-defined time points (12). In this way, subjective information will be reported close in time to the actual experience, and can be subsequently aligned with objective information regarding children's activity and location. In terms of valorization, subjective data regarding perceptions of public spaces combined with objective data regarding the spatial location or travel patterns is highly relevant for municipalities, as these data can directly highlight where, when and in which domain (e.g. aesthetics, safety, functionality) important changes to the publically accessible physical or social environment can be made.

The outcomes of the work presented in this thesis have been disseminated through various channels. Results were disseminated through presentations, media, readings and publications in national and international journals. In addition, the methodological approach and accompanied results were presented at several national- and two international conferences (i.e. oral presentations during the 'International Conference of Diet and Activity Methods' and during the annual conference of the 'International Society of Behavioral Nutrition and Physical Activity'). Also, outcomes and techniques presented in this thesis have been used for educational purposes, for example in the Master of Sports and Physical Education at Fontys University of Applied Sport Sciences and in the

Bachelor Health Sciences at Maastricht University. The activities, products and innovations presented in this thesis led to further collaboration with national institutes (i.e. School of Sports Studies at Fontys University of Applied Sciences Sport Eindhoven, the Research group Healthy Lifestyle in a Supporting Environment at the Hague University of Applied Sciences, and the Department at Human Geography and Spatial Planning at Utrecht University) and international institutes (i.e. the Institute for Physical Activity and Nutrition at Deakin University, Melbourne, Australia).

References

1. Gezondheidsraad. Beweegrichtlijnen 2017. Den Haag: Gezondheidsraad 2017; publicatienr. 2017/08.
2. Janssen I, LeBlanc AG. Systematic review of the health benefits of physical activity and fitness in school-aged children and youth. International Journal of Behavioral Nutrition and Physical Activity. 2010;7(40):1-16.
3. Boreham CAG, McKay HA. Physical activity in childhood and bone health. British Journal of Sports Medicine. 2011;45.
4. Biddle SJ, Asare M. Physical activity and mental health in children and adolescents: a review of reviews. British Journal of Sports Medicine. 2011.
5. Sibley BA, Etnier JL. The relationship between physical activity and cognition in children: a meta-analysis. Pediatric Exercise Science. 2003;15(3):243-56.
6. Telama R. Tracking of physical activity from childhood to adulthood: a review. Obesity Facts. 2009;2(3):187-95 .
7. Kristensen PL, Møller N, Korsholm L, Wedderkopp N, Andersen LB, Froberg K. Tracking of objectively measured physical activity from childhood to adolescence: the European youth heart study. Scandinavian Journal of Medicine & Science in Sports. 2008;18(2):171-8.
8. Armstrong N, Welsman JR. The physical activity patterns of European youth with reference to methods of assessment. Sports Medicine. 2006;36(12):1067-86.
9. Kremers SP, De Bruijn GJ, Visscher TL, Van Mechelen W, De Vries NK, Brug J. Environmental influences on energy balance-related behaviors: a dual-process view. International Journal of Behavioral Nutrition and Physical Activity. 2006;3(1):9.
10. Giles-Corti B, Timperio A, Bull F, Pikora T. Understanding physical activity environmental correlates: increased specificity for ecological models. Exercise and Sport Sciences Reviews. 2005;33(4):175-81.
11. Sherar LB, Griew P, Esliger DW, Cooper AR, Ekelund U, Judge K, Riddoch C. International children's accelerometry database: design and methods. BMC Public Health. 2011;11:485.
12. Spook JE, Paulussen T, Kok G, van Empelen P. Monitoring dietary intake and physical activity electronically: feasibility, usability, and ecological validity of a mobile-based ecological momentary assessment tool. Journal of Medical Internet Research. 2013;15(9):214.