Targeting sedentary behaviour

Appendices

Summary

During the last decades, Western societies live in an environment that is characterized by passive forms of transportation, sedentary jobs and modern communication techniques. These changes have contributed to a predominantly physically inactive lifestyle in which a vast majority of our waking hours is spent in a seated position. Insufficient physical activity, defined as not meeting the minimum international recommendations for regular physical activity (>150 of moderate-to-vigorous intensity physical activity [MVPA] min/week), is a major contributor to the development of non-communicable diseases (NCDs), such as chronic respiratory diseases, type 2 diabetes mellitus, cardiovascular diseases and cancer. Despite the significant health benefits of MVPA, adherence to these physical activity guidelines is poor. In addition, it appears that even the recommended levels of MVPA do not always fully protect against cardiometabolic risk factors and the development of NCDs. As such, next to the time spend in MVPA, an additional factor that also appears to determine cardiometabolic health and NCD development is sedentary behaviour. In fact, during the past decade, emerging evidence clearly disclosed that, even in the presence of regular MVPA, prolonged sedentary behaviour is an independent contributor to cardiometabolic health. In keeping with this line of reasoning, it has been suggested that both physical inactivity and a sedentary lifestyle should be targeted as they independently affect cardiometabolic health.

Although MVPA has recognized as an important factor to improve cardiometabolic health, it is less clear whether high amounts of MVPA are able to combat the detrimental effects on cardiometabolic health due to spending in high volumes of sedentary time. Therefore, it could be questioned if the inverse association between sedentary time and cardiometabolic health could be attenuated or even eliminated in individuals engaging in high amounts of MVPA. In this respect, in **Chapter 3**, we investigated the modifying effects of MVPA on the association between sedentary behaviour and cardiometabolic health using objective accelerometer-derived measures within highly active adults. Here, associations between various movement behaviours (i.e. sleeping, standing, light intensity physical activity [LPA] and MVPA) and biomarkers of glucose tolerance and lipid metabolism were analysed using a compositional data analyses approach to account for all behaviours. In this study, we observed that, despite spending in

high levels of sedentary behaviour (7−13 hours/day), high levels of MVPA were able to mitigate the inverse association between sedentary behaviour and cardiometabolic health. These results suggest that engaging in at least 60 minutes of MVPA may be viable to protect the potential harms of prolonged sitting. In addition, the cardiorespiratory fitness (CRF) was significantly correlated with both sedentary time and MVPA. From this, it could be suggested that people with a high CRF may provide favourable effects against the deleterious consequences of prolonged sitting.

Although we proposed a minimum of one hour of MVPA per day to counteract the detrimental effects of sedentary behaviour on cardiometabolic health, the majority of the population is not able to reach these high levels of MVPA and spend the largest part of the day in sedentary behaviours. Unfortunately, no pragmatic/realistic strategies involving a more holistic 24-hour approach targeting both interacting behaviours have been proposed so far. Therefore, interventions to reduce sedentary behaviour and increase physical activity levels are necessary to combat the increased risk of NCD development in the general population.
It has already been shown that consumer wearable activity tracker (CWAT)-based multicomponent interventions are able to improve physical activity within healthy adults and positively affects the risk of NCD development. Next to the decreased risk, physical activity plays also an important role in the progression and management of NCDs. Therefore, in **Chapter 4** we systematically reviewed the effects of CWAT-based interventions on physical activity and cardiometabolic health in populations with NCDs. In this study, we observed that populations with chronic diseases significantly increased their daily step count using CWATs only, or as part of a multi-component intervention. This increase in physical activity resulted in significant improvements in cardiometabolic health such as a reduced waist circumference, systolic blood pressure and low-density lipoprotein cholesterol concentration.

Given the fact that both physical activity and sedentary behaviour should be targeted, we subsequently investigated in **Chapter 5** and **Chapter 6** the efficacy of CWATs, as self-monitoring (CWAT-only) and as part of a multicomponent behaviour change strategy (CWAT + motivational counselling), to reduce

sedentary time, increase physical activity and improve cardiometabolic health in healthy sedentary adults.

In **Chapter 5**, we investigated the effectiveness of CWAT-based efficacy of a single component CWAT-only intervention and the added value of a multicomponent (CWATs + motivational interviewing) behaviour change intervention to reduce sedentary behaviour, increase physical activity and improve anthropometrics, body composition, glucose tolerance and lipid metabolism within sedentary adults. This study showed that the multicomponent intervention (CWAT-use + motivational interviewing) significantly reduced sedentary behaviour and increased physical activity, whereas the single component (CWAT-only) intervention did not. Moreover, the reduction of sedentary behaviour was accompanied by an improvement in body weight, waist circumference, fat mass, triglyceride concentration and enhanced insulin sensitivity. In addition, most favourable effects were found when LPA was increased instead of standing or MVPA. These results are promising for people who fail to reach the recommended levels of MVPA to improve cardiometabolic health and a delayed onset of chronic diseases.

In **Chapter 6**, we investigated the efficacy of self-monitoring (CWAT-only) and multiple behaviour change techniques (self-monitoring + motivational counselling) to reduce sedentary behaviour and improve cardiometabolic health and vascular function in sedentary adults. Health outcomes measures included anthropometrics, body composition, lipid metabolism, heart rate variability (cardiac autonomic function), vascular endothelial function and markers of systemic low-grade inflammation and microvascular endothelial function. Self-monitoring in combination with motivational interviewing effectively reduced sedentary time, increased physical activity and improved serum lipids (triglyceride concentration) and heart rate variability, whereas self-monitoring on its own did not. Moreover, regression analyses showed that MVPA was significantly associated with cardiac autonomic function, which indicates that MVPA is more important for cardiovascular health.

Overall, the studies described in this dissertation were designed to investigate the modifying effects of MVPA on the association between sedentary behaviour and cardiometabolic health, and to study novel approaches to improve sedentary behaviour, physical activity, cardiometabolic health and vascular function. Taken together, high amounts of MVPA can eliminate the association between sedentary behaviour and cardiometabolic health. For people who are not able to reach these high amounts of MVPA, a multicomponent behaviour change intervention, consisted of a CWAT and motivational interviewing, seems a promising way to effectively reduce sedentary behaviour and increase the amount of both standing time, light-intensity physical activity and MVPA. These effects lead to improvements of both metabolic and cardiovascular health.