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Editorial

Improving health by fighting the sedentary lifestyle

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There are many benefits of regular physical activity (PA) and a great deal of evidence to support them. As any active individual is aware, these benefits include improved cardiorespiratory fitness, muscular fitness, bone health, body composition, and cardiovascular and metabolic health biomarkers (19, 26). Recent developments have also shown the growing importance of genetics on several diseases such as obesity (16), but there is reason to believe that exercise might counteract this disposition (21). Indeed, for many metabolic diseases, exercise has been described as playing a valuable role, in some cases slowing down the progression of the disease, and for a few individuals, actually prolonging its onset. For instance, a recent study highlighted that living a physically active lifestyle is associated with a 40% reduction in the genetic predisposition to common obesity (15), whereas genetic influences on BMI are lower among those who report vigorous exercise (17). Similarly, structured exercise training that consists of aerobic exercise, resistance training, or both was associated with HbA1c reduction in patients with type 2 diabetes (25).

While biological parameters have long been associated with PA and exercise, their role in well-being and quality of life shouldn't be negligible. There is accumulating evidence suggesting that positive well-being is associated with healthy behaviours, lower delinquent activity, higher incomes, superior mental health, a higher education, a long life, better performance ratings at work, as well as an improved social and personal functioning (2). However, contemporary daily life is replete with a potential harmful effect in developed societies' quality of life and health outcomes due to the absence of physical activity. As a matter of fact, a sedentary lifestyle and a sedentary-promoting environment are features of our daily life that contribute tremendous impairment in peoples' quality of life and well-being. Indeed, humans have been increasingly spending more time in sedentary behaviours involving prolonged sitting (6) or no movement at all. However, while following physical activity guidelines is associated with lower risk of death, mortality benefit may also be achieved by engaging in physical activities at even less than recommended activity levels (11). For instance, sedentary women who started exercising said they had a lot more energy and were in better moods than when they were inactive. Thus, the more they exercised, the better they felt, but even 10 minutes more exercise a day gave them some quality-of-life benefits (1). Furthermore, even in limited/impaired exercise engagement there are findings showing that the use of alternative, relatively pain-free forms of exercise in the clinical management of patients with intermittent claudication improved their functional status and generic health-related quality of life (22).

In the last 5/6 years, a huge body of literature enhanced the negative effects, both acute and chronic, of sedentary behavior. Indeed different studies reported the importance of non-exercise activity termogenesis (NEAT) on total daily energy expenditure (TDEE), and data suggested that TDEE varies enormously even in industrialized countries, where, due to technology, sedentary-promoting activities have been developed. For instance, for two adults of similar size, TDEE can vary by as much as 1500 kcal/day (12). Furthermore, the role of NEAT in some diseases such as obesity was recently highlighted by the observation that lean sedentary people are standing and ambulatory for 152 min longer per day than obese participants (14). This is worth noting because an impressive 90% and more of the calories expended in all forms of physical activity were due to this pattern of standing and non-exercise ambulatory movements. Since the energy expenditure associated with NEAT while sitting was small (14), this pattern results in individuals not exercising enough. For instance, in a work-place environment findings showed that if time spent sitting at a computer were replaced by walking-and-working, energy expenditure could increase by 100kcal/h. Thus, if obese individuals were to replace computer-sitting time with walking computer time by 2–3 h/day, and if other components of energy balance were constant, significant weight loss of 20–30 kg/year could occur (13).

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Therefore, literature has clearly shown that sedentary behavior is a target within public health strategies comprising exercise promotion. However, a deeper understanding of the role of a sedentary life in people's well-being is needed (18). In fact, as noted previously, relatively little is known about the cellular signals, physiological responses, and disease outcomes caused by prolonged sitting and other sedentary behaviours (inactivity physiology) (7). Interestingly, some recent studies showed that: (a) independent from exercise, sedentary time predicts metabolic syndrome (4); (b) that recreational sitting, as reflected by television/screen viewing time, is related to raised mortality and CVD risk regardless of physical activity participation (24); (c) that the effect of low-intensity activity on postprandial glucose concentration was independent of moderate-vigorous activity (8). These data were followed by very recent longitudinal findings on Canadian population that have clearly demonstrated a dose-response association between sitting time and mortality from all causes and CVD, independent of leisure time physical activity (10). Further, it was also shown that even among those who achieved physical activity recommendations (30 minutes daily engaged in MVPA) those who had higher sitting time were twice as much at risk of getting an adverse cardiac event compared to their "less sitting" peers (10). Indeed, it is possible to achieve levels of MPVA consistent with health-related guidelines but spend most of the waking hours involved in sedentary behaviour (18). Some data also pointed out the importance of breaks on one's health outcomes. Recent studies show that independently of total sedentary time, MVPA and mean intensity of activity, having a higher number of breaks in sedentary time was beneficially associated with WC, BMI, TG and 2-h plasma glucose (9, 5).

All this information brings up new developments regarding the health-related PA relationship. However, physical activity/exercise promotion needs a more pronounced focus on peoples' expectations and motivations. Enjoyment and happiness are two main issues that programs of physical activity and exercise should address no matter the age group and setting (20). As a matter of fact, long-term engagement in exercise and/or behavioural change is meaningless without a consistent motivational environment focusing on creating *autonomy-supportive* interventions (23).

In summary, as suggested by others, health-related PA activity recommendations must also incorporate a statement focus on less time spent in sedentary behavior, not just the daily MVPA engagement (18, 7). Further, translational studies are needed at multiple levels, ranging from cellular research determining whether there are plausible mechanisms regulating risk factors, to more epidemiological research identifying clinical outcomes. These studies can be accomplished by integrating longitudinal study designs, considering the generalizability and diversity of the populations and contexts under study, exploring dose response relationships, integrating theory into studies, and fostering surveillance (3).

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