CRF, MVPA, NEAT, PAEE, and Now Sedentary Time: Will the Pendulum Swing Back Again?

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Scientific knowledge is constantly progressing—today faster than ever before—and physical activity epidemiology research is no exception. Over the last 30 years this research area has expanded its focus beyond vigorous-intensity structured exercise to also incorporate moderate-to-vigorous intensity physical activity (MVPA). As a consequence, the public health goal slowly shifted from improving cardio-respiratory fitness (CRF) to include physical activity promotion.

This change was due to the convincing evidence that a significant proportion of physical activity-related health benefits occur when inactive individuals modestly increase their activity levels, mostly through moderate-intensity physical activity such as walking. Today, the scientific evidence for the beneficial effects of moderate-intensity physical activity on morbidity and mortality is no longer questioned. For example, in a landmark article, Lee and colleagues convincingly showed that the “no pain, no gain” concept was passé for preventing coronary heart disease among women.

However, when CRF is modeled simultaneously with physical activity, it usually presents stronger associations with all-cause mortality than physical activity. This may suggest that CRF is more important than physical activity in relation to health outcomes. It is however equally likely that the stronger association observed for CRF is due to differences in measurement error between the 2 exposure variables (ie, precisely measured CRF versus less precisely measured self-reported physical activity). Indeed, studies employing objective measures of physical activity energy expenditure (PAEE) have suggested that PAEE is associated with metabolic intermediate traits independent of CRF, and that CRF does not contribute to the explained variance once PAEE is included in the model.

Over the last few years, there has been widespread interest in the idea that non-exercise activity thermogenesis (NEAT; all activities of daily living, including occupation, fidgeting, transportation, and leisure), but not exercise, that increase energy expenditure above resting levels, may also be important for health. For example, it was shown that obese individuals sit, on average, 2 more hours per day compared with their lean counterparts. Posture allocation did not change following weight loss and weight gain in obese and lean individuals, respectively, suggesting that NEAT is biologically determined.

During the 3rd International Congress of Physical Activity and Public Health in May 2010, another (new) trend in physical activity epidemiology research has emerged. The focus is now on the hazardous health impact of prolonged sitting and sedentary behavior. Indeed, self-reported time spent watching TV appears to be associated with all-cause and cardiovascular disease mortality independent of physical activity. So the pendulum has swung from vigorous exercise to sedentary behavior and the question is whether or not it will swing back.

Most of the current evidence for the beneficial effects of physical activity (and the harmful effects of sedentary behavior) on health are based on self-reported physical activity, usually only considering leisure time physical activity. The current physical activity guidelines for health stating that all adults should be physically active at moderate intensity for at least 150 minutes per week in addition to their normal daily activity are predominantly based on this research. However, the field of physical activity epidemiology is fast approaching (or has already reached) its second era where technology development now makes it possible to include cheap, robust, and accurate objective methods into very large-scale epidemiological studies (eg, the UK Biobank) and population based interventions. This will generate new knowledge, challenge our current beliefs and change our way of thinking. Indeed, because most published research findings are “false” we have to be prepared to question old “truths”, for example, the current physical activity recommendations.

We need to incorporate more precise physical activity measurement methods to characterise the detailed dose-response associations between activity and health outcomes, to clarify which sub-dimension of physical activity is more important for a specific health outcome, and to estimate population levels of activity across the life-course in our epidemiological observational research.
We need additional large-scale lifestyle intervention studies, similar to the Diabetes Prevention Programme, where the separate effects of physical activity and its sub-components on the outcome of interest can be estimated precisely. Further, precise measurement methods are also needed to increase the statistical power and reduce sample size in studies of gene-physical activity interactions and for a thorough understanding of the biological and environmental determinants of physical activity.

So, will the pendulum swing back again and perhaps settle into an equilibrium where all aspects of physical activity and health are zealously pursued with equal attention? Only the future will tell, but one thing is for certain: we have only started to unravel the details of the importance of CRF, MVPA, PAEE, NEAT, and sedentary time for improving the health of individuals and populations.

References