

# Is physical activity always good for you? The physical activity paradox

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## KEYWORDS

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Regular physical activity is a known protective factor for the prevention of non-communicable diseases such as cardiovascular disease, type 2 diabetes, breast, and colon cancer. Physical activity also has benefits for mental health, delays the onset of dementia, contributes to the maintenance of an adequate body weight and to general well-being. Research on physical activity has mainly focused on leisure and total time, and less on the activity in the workplace. The current guidelines actually recommend physical activity in any form and do not distinguish between the different areas, e.g. physical activity carried out during leisure time, at home or at work. However, new evidence suggests a contrast between the health effects of physical activity in leisure time vs. that in the workplace. In particular, while physical activity, even of high intensity in leisure time, has been associated with positive health outcomes, adverse consequences have been documented for physical activity in the workplace, both in terms of cardiovascular diseases, work absences due to illness and mortality from all causes. These contrasting effects of physical activity in leisure time compared to that in the workplace constitute the so-called 'physical activity paradox'.

## Every move counts

### World Health Organization 2020

The 'Global action plan on physical activity 2018-2030' set the goal of reducing physical inactivity by 15% by 2030 and outlined 20 actions and interventions, including political ones, considered necessary to achieve this goal.<sup>1</sup> Physical activity is defined as any body movement produced by skeletal muscles that requires energy expenditure and can be performed in a wide range of intensities: as part of work, housework, during transport or during leisure time, or when practicing sporting activities.<sup>2</sup> Regular physical activity is a known protective factor for the prevention of non-communicable diseases such as cardiovascular disease, type 2 diabetes, breast, and colon cancer.<sup>2-5</sup> Physical activity also has mental health benefits, delays the onset of dementia and can contribute to maintaining an adequate

body weight and general well-being. Conversely, compelling evidence indicates that a sedentary lifestyle is associated with cardiovascular disease and type 2 diabetes, as well as cancer and all-cause mortality. Physical inactivity is in fact one of the main causes of global mortality.<sup>6</sup> It is estimated that between 4 and 5 million deaths per year could be avoided if the world population were more active.<sup>1,2</sup> Global estimates of physical inactivity indicate that in 2016 27.5% of adults<sup>7</sup> and 81% of adolescents<sup>8</sup> did not meet the 2010 World Health Organization recommendations and the trend in subsequent years showed a limited overall improvement. The data also highlights that women are less active than men in most countries and that there are significant differences in physical activity levels both within and between countries and regions. There are currently no global estimates of sedentary lifestyle, but technological innovation and the transition to more sedentary occupations and recreation and the increasing use of motorized transport are contributing to changing physical activity patterns and increasing sedentary behaviour throughout the world.

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## The 'sustainable lightness' of physical activity for cardiovascular health (and more)

The beneficial effects of physical activity had already been remarked over 2000 years ago by Hippocrates who, in his 'Regime', recommended physical activity with foresight: '... You cannot keep yourself healthy based only on the type of diet, but this must also be accompanied by physical exercises'. Thereafter, and until recently, the health effects associated with different areas of physical activity were considered similar and beneficial, as reported by a meta-analysis of cohort studies published up to 2010.<sup>9</sup> Clear evidence for the health benefits of physical activity began to emerge in the 1950s, with pioneering studies showing that physically active workers (in the London public transport system and among San Francisco dockers) had a lower risk of coronary heart disease and mortality compared to colleagues engaged in sedentary jobs.<sup>10,11</sup> Subsequently, research on physical activity has focused mainly on leisure and total activity, and less on that in the workplace.<sup>12</sup> As is well known, countless confirmations from large populations on different continents have consistently shown that regular physical activity has beneficial effects on cardiovascular health and premature mortality, a scientific evidence that has been widely implemented in the recommendations of the World Health Organization and in all international guidelines, not only purely cardiac oriented. The current guidelines actually recommend physical activity in any form and do not distinguish between the different areas, e.g. physical activity carried out during leisure time, at home or at work. This evidence is supported by cohort analyzes from different countries with a wide range of socioeconomic differences as demonstrated in the recent Prospective Urban Rural Epidemiology (PURE) study which enrolled over 130 000 participants without pre-existing cardiovascular disease from 17 high-, middle-, and low-income countries. By administering questionnaires it has been shown that compared to mild physical activity [i.e. <600 metabolic equivalent task (MET) min/week or <150 min/week of moderate intensity physical activity], moderate physical activity (600-3000 MET min/week or 150-750 min/week), and high physical activity (>3000 MET min/week or >750 min/week) were associated with a gradual reduction in total mortality (hazard ratio 0.80 and 0.65;  $P < 0.0001$ ) and cardiovascular diseases (0.86 and 0.75;  $P < 0.001$ ) regardless of socioeconomic status.<sup>13</sup>

## So is physical activity always and only good?

That regular physical activity has a favourable impact on health would seem to be limited to that of leisure time (e.g. sport, recreation, transport). In fact, new evidence suggests a contrast between the health effects of physical activity in leisure time compared to that in the workplace. In particular, while physical activity, even of high intensity in leisure time, has been associated with positive health outcomes, adverse consequences have been documented for physical activity in the workplace, both with regard to cardiovascular diseases and mortality from all causes. These contrasting effects of physical activity in leisure

time compared to that in the workplace constitute the so-called 'physical activity paradox'.<sup>14,15</sup> For a considerable portion of the adult population, work is the main environment in which to carry out physical activity. Workers in construction, agriculture and industrial production companies are physically active for most of their working day, for most of the year. Despite this intense physical activity during work, these and other manual workers are often not in good health. Therefore, it has been hypothesized that intense physical activity at work could be harmful: a problem of no small importance given that, despite a decreasing trend in physical intensity at work in the last decades, a significant portion of the workforce is engaged in challenging physical activities.

## The paradox of physical activity

Until a few years ago, the possible existence of the 'physical activity paradox' was only marginally considered. Recently, however, a large meta-analysis of 193 696 participants showed that males involved in physically intense work have, compared to those less physically engaged, an 18% increase in the risk of mortality from all causes, even after adjustment for most important confounding factors, including physical activity in leisure time.<sup>16</sup> These findings suggest that there may indeed be a paradox of physical activity in male workers, with high levels of physical activity in the workplace associated with adverse health consequences in contrast to the existing evidence of beneficial health effects of the intense activity in free time. The authors concluded that if the observed association were causal, the guidelines on physical activity should distinguish between work and leisure because meeting current recommendations in the workplace may not provide the expected benefits or even constitute a risk.

A confirmation later came from another Scandinavian cohort study that evaluated 17 697 men and women with a mean age of 47.2 years examined in 1987-1988 and followed up for 26 years.<sup>17</sup> In fact, a U-shaped relationship has been demonstrated between physical work activity and mortality. Compared to the moderately active group, a 16% higher all-cause mortality was observed in sedentary patients and 13% higher in those with heavy manual labour. In the same population, however, an inverse correlation between recreational physical activity and mortality from all causes was confirmed, thus reiterating the possible existence of a paradoxical effect of physical activity.

Even more recently, the risk of major adverse cardiovascular events (MACE) and all-cause mortality related to physical activity at work or in leisure time was investigated in the Copenhagen General Population Study, a large contemporary study of 104 046 males and females with baseline assessment in 2003-2004 and subsequent mean follow-up of 10 years.<sup>18</sup> While an inverse relationship with MACE and all-cause mortality was confirmed for physical activity in leisure time, an increase in MACE and mortality was instead found in relation to the increasing level of physical activity in the workplace from mild to moderate to intense (hazard ratio 1.04, 1.15, and 1.35, respectively for MACE and 1.06, 1.13, and 1.27 for all-cause mortality).

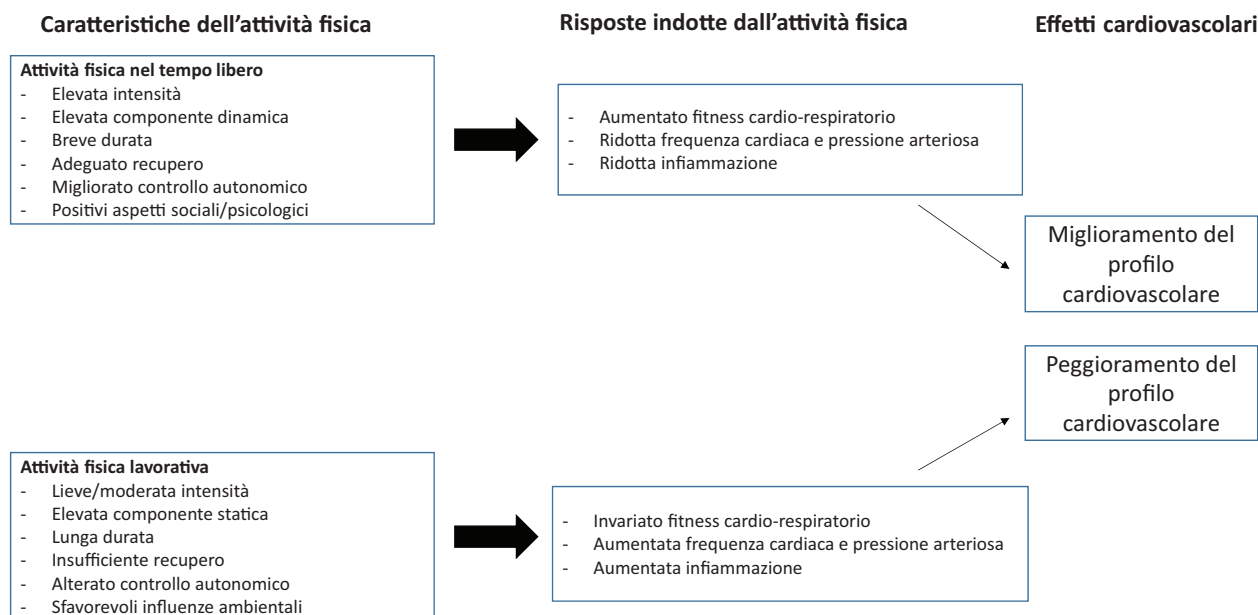


Figure 1 Type of physical activity, and cardiovascular effects.

However, the heterogeneity of the evidence available on the subject should also be noted, as remarked by a recent and extensive review.<sup>19</sup> This general review of 158 observational studies found favourable but also unfavourable associations between high levels of physical activity and a wide range of both cardiac and non-cardiac outcomes, and concluded by hoping for better quality evidence to provide unambiguous evidence of the health effects of physical activity at work. Importantly, the evidence for most physical activity data was generated from observation of cohort studies. Such studies are limited by unknown confounding factors, selection bias and therefore do not allow to exclude inverse causality.

### The possible reasons for the physical activity paradox

Recent epidemiological studies would therefore document that intense physical activity at work increases the risk of cardiovascular disease and mortality, even after adjustments for other confounding factors including socioeconomic status, recreational physical activity, and a healthy lifestyle. In order to develop effective interventions, it is necessary to establish the mechanisms underlying the physical activity paradox. Among the hypotheses formulated<sup>15,20</sup> (Figure 1), first and foremost physical activity at work is often made up of repetitive endurance efforts of short periods while that during leisure time is usually aerobic, more suitable for improving physical fitness and cardiovascular health. Consequently, work activity increases and does not reduce heart rate and elevated heart rate is a known cardiovascular risk factor. Blood pressure can also be increased by continuous efforts such as weight lifting or static postures, with consequent unfavourable repercussions. In addition, the work activity, compared to the recreational one, is performed with shorter recovery periods

and often without adequate control of working conditions. It should be remembered that globally about 50% of the workforce works outdoors without sufficient attention to climatic conditions, hydration, restorative breaks resulting in caloric stress, which does not happen during recreational physical activity. Night shifts and environmental factors such as noise and air pollution could also produce their effect. Last but not least, intense work activity increases the levels of inflammation (e.g. C-reactive protein) which remain high without adequate rest times, and for which the body has no time to recover.

### Conclusions and implications

High levels of physical activity during free time are associated with a reduction in the risk of cardiovascular events and mortality from all causes, while high physical activity at work would seem to be associated with an increased risk, configuring the 'physical activity paradox'. This data should be taken into consideration by those who write guidelines on cardiovascular prevention regarding the levels of physical activity to be recommended. At the same time, health professionals should evaluate and take into account the particularly high risk of physically strenuous work and recommend a healthy lifestyle in these high-risk individuals in their youth. Furthermore, although difficult to transfer in reality, companies should ensure adequate recovery times at work and recreational forms in particular for workers who perform heavy manual work.

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