

# Sedentary Behaviors, Physical Inactivity, and Cardiovascular Health: We Better Start Moving!

In the past few decades, the pharmacological management of cardiovascular diseases (CVD) has improved dramatically.<sup>1</sup> With the exception of promoting smoking cessation, little progress has been made to promote and achieve a healthy lifestyle to prevent CVD. Physical inactivity and reduced cardiorespiratory fitness (CRF) are major contributors to CVD. However, a new CVD and all-cause mortality risk factor has emerged in recent years: sedentary behavior (SB),<sup>2-4</sup> which is defined as engaging in activities requiring 1.5 or less metabolic equivalents, while in a seated, reclined, or lying posture during waking hours.<sup>5</sup>

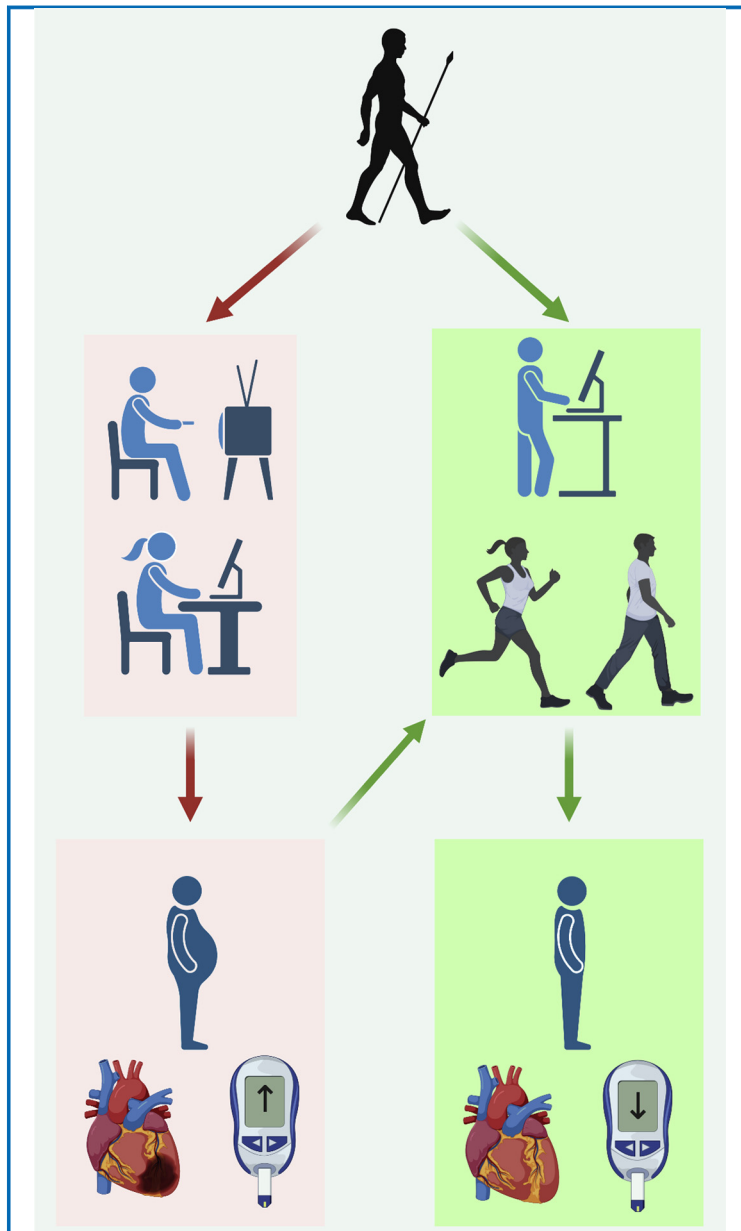
There has been a dramatic shift from times in which hunting represented the major activity to provide food to the current era in which grocery stores and, more recently, food delivery systems dramatically reduced the amount of physical activity (PA). Interestingly, 2 separate ways of thinking have hypothesized that (1) relying on moderate to vigorous PA for hunting and agriculture activities prior to industrialization may explain why achieving the recommended level of PA is protective against chronic diseases as the result of evolutionary history, independent of how the rest of the day is spent (ie, sitting vs standing) and (2) that even in the setting of adequate levels of PA, there are negative cardiometabolic effects of SB that may counteract, if not even abolish, the benefits of PA.

The latter hypothesis proposes SB as a potential therapeutic target to improve cardiometabolic health, but very little is known in this regard. Moreover, whether substituting SB in the form of sitting with standing may even be necessary or whether increased PA may be sufficient to overcome the issues associated with SB is largely unknown. Of note, increased SB is an example of the innate sedentary nature of humans, which can be deleterious when coupled with our ingenuity to find ways of performing “work” as efficiently as possible. Importantly, a

large proportion of Americans as well as many across the globe have sedentary jobs, rely heavily on passive modes of transportation, and spend long hours in front of screens.

A recent study provided interesting data characterizing sedentary time of a Tanzanian hunter-gatherer tribe as similar to that of individuals living in industrialized cities.<sup>6</sup> The tribe, however, spent a greater amount of time in moderate to vigorous PA and squatted when sedentary (ie, active rest), which expended more energy with greater skeletal muscle activity than a chair-sitting sedentary posture.<sup>6</sup> This finding suggests that even during non-ambulatory time, much can be done to counteract the detrimental effects of sitting. Of note, recent evidence also suggests that short bouts of exercise preceding prolonged times of sitting can attenuate the detrimental effects of sitting itself, namely, vascular dysfunction, at least in young individuals.<sup>7</sup>

With regard to nonambulatory time, however, do strategies aimed at reducing sitting time reduce CVD and all-cause mortality risks? In this issue of *Mayo Clinic Proceedings: Innovations, Quality & Outcomes*, Saeidifard et al<sup>8</sup> report an interesting review and meta-analysis to determine whether replacing nonambulatory sitting time with nonambulatory standing time improves CVD risk factors. They included 877 adults (64% female) previously enrolled in 9 clinical trials in which participants were assigned (randomly and nonrandomly) to replacing sitting time with standing for at least 30 minutes per day and were followed up for a relatively short time of 3.8 months. On average, the participants replaced sitting with standing for 1.33 h/d. Moreover, the authors found that replacing sitting time with standing was associated with statistically significant improvements in fasting glycemia (glucose level,  $-2.53$  mg/dL) and body fat ( $-0.75$  kg).<sup>8</sup> The other risk factors investigated—body weight, fasting insulin,



**FIGURE.** Illustration of the evolution of humans from hunter-gatherers to more sedentary beings as a result of industrialization. Currently, individuals who increase their sedentary behaviors (SB) and reduce their level of physical activity (PA) have a greater risk for cardiovascular diseases, including coronary heart disease, heart failure, and hypertension but also metabolic diseases, such as obesity and type 2 diabetes mellitus. Conversely, those who remain or become physically active and minimize SB, for instance by using standing desks and/or performing quick exercise “snacks,” can reduce the risk for development of cardiovascular and metabolic abnormalities. Moreover, such strategies (ie, increased PA and reduced SB) can also be implemented to improve cardiovascular disease and metabolic risk factors in individuals with established diseases. Of note, the effects of replacing SB with PA are of a greater magnitude than replacing them with standing.

systolic and diastolic blood pressure, waist circumference and waist to hip ratio, total, low-density, and high-density lipoprotein cholesterol, and triglycerides, however, were not significantly affected by the intervention.<sup>8</sup>

The benefits described by Saeidifard et al<sup>8</sup> appear to be small, yet clinically significant, particularly considering the relatively short follow-up and the little time participants spent in the sitting position replaced with standing. The short follow-up might have minimized the potential beneficial effects of the intervention. Of note, the authors did not investigate whether their findings were consistent throughout the diverse level of participants’ PA, which is clearly a limitation of the study. A prior analysis of 149,077 individuals followed up for 8.9 years has revealed that reducing SB, even in “high sitters” (ie, individuals sitting for more than 6 h/d), does not improve survival in those individuals who already meet the recommended level of weekly aerobic PA currently recommended by the Physical Activity Guidelines (150 minutes of moderate to vigorous PA or 75 minutes of vigorous PA).<sup>9,10</sup> However, this analysis also found that when the recommended level of PA is not met, then reducing SB with standing may exert a small, yet statistically and clinically significant, beneficial effect by 3% relative risk reduction of all-cause mortality.<sup>9</sup> Moreover, in high-sitters, replacing 1 hour of sitting time with walking was associated with a 22% relative risk reduction for all-cause mortality, a much stronger effect than that reported with replacement of sitting time with standing alone.<sup>9</sup>

Although the evidence supports the concept that reducing SB by either standing and possibly even replacing with PA exert beneficial effects, numerous barriers limiting the adherence to those strategies exist. To overcome such problems, time-efficient measures of incorporating PA throughout the day have been explored. Most recently, the effects of exercise “snacks” of short bursts of PA (ie, stair climbing) have been found to be effective strategies to improve CRF, perhaps the strongest CVD as well as all-cause mortality risk factor.<sup>11</sup> This hypothesis proposes exercise “snacks,” in addition to a standing desk, as realistic approaches to incorporate activities that improve CRF as areas worth exploring in work places.

In conclusion, Saeidifard et al<sup>8</sup> are to be congratulated for providing important evidence that may not result in a clear “standing ovation” yet suggest improvements in some important risk factors for CVD (ie, fasting glycemia and body fat) when replacing sitting time with standing. Finally, additional evidence suggests that reducing SB with standing provides a small, yet clinically significant, benefit on health, which is further augmented when replaced with PA.<sup>2,3</sup> In fact, clinicians should still consider PA as a major strategy to improve CVD risk, especially considering that the potential benefits of this intervention are of a greater magnitude.<sup>2,12</sup> When meeting the PA recommendation is not a feasible option, replacing sitting time with standing, ultimately resulting in reduced SB, may also be an appropriate strategy for improving cardiovascular health (Figure).

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