



## Commentary

## Cardiorespiratory Fitness and Physical Activity: Two Important but Distinct Clinical Measures with Different Degrees of Precision - A Commentary



Cardiorespiratory fitness (CRF) greatly refines risk prediction in apparently healthy individuals as well as those at varying risk for or already diagnosed with one or more chronic conditions.<sup>1–6</sup> The overwhelming evidence in support of the prognostic strength of CRF, most often obtained from maximal exercise testing, led to a 2016 American Heart Association Scientific Statement which afforded this measure vital sign status.<sup>7</sup> Simply stated, the higher your CRF, with an ideal level often defined as a peak metabolic equivalent (MET) >10, the better your health trajectory, irrespective of your other health characteristics (e.g., hypertensive, elevated blood sugar, obesity). Conversely, a peak MET level <5 METs is regarded as particularly ominous to one's health. This relationship even holds true for individuals with varying degrees of genetic risk for cardiovascular disease (CVD); individuals with high genetic risk have a significantly lower CVD event rate if they have a higher CRF.<sup>8</sup> It is important to note that, while both age and sex significantly impact CRF, clinical application of the aforementioned peak MET levels (i.e., <5 and >10) is commonly done without consideration of natural changes across the lifespan or differences between men and women. As such, there is an opportunity to enhance the precision by which we analyze CRF in a given individual and more accurately assess the risk for future untoward events.

We read the recent article by Mandsager et al.<sup>9</sup> with great interest and congratulate the authors on an outstanding analysis. This publication contributes to the body of evidence demonstrating the prognostic value of CRF.<sup>7</sup> In fact, the present study demonstrated the ability of a low CRF to predict an increased risk in all-cause mortality was greater than or equal to the prognostic strength of other well-known risk factors such as CVD, smoking or diabetes. With a dataset of >120,000 patients and >13,000 all-cause deaths, the authors were able to perform highly powered prognostic analyses across a wide age range (i.e., 18 to ≥80 years) in both men and women. Moreover, the phenotyping of CRF across five categories (low, below average, above average, high and elite) allowed for assessment of the prognostic significance of CRF with greater precision. Notably, all levels above a low CRF portended a survival benefit, including below average CRF. As such, viewing improvements in CRF (represented in this study as peak METs) on a continual scale is highlighted in the current findings; when low fitness is identified, intensive efforts should be made to improve CRF as much as possible, recognizing increases as small as 1 MET can improve survival.<sup>7,10</sup> In fact, in a CVD cohort undergoing cardiac rehabilitation, our group demonstrated the greatest reductions in mortality were achieved in individuals who present with a low CRF at baseline (e.g., <5 METs) and improve following an exercise training intervention

(i.e., 30% reduction per 1 MET increase).<sup>11</sup> As mentioned previously, a CRF <5 METs has been traditionally been viewed as a *universal threshold* for defining low fitness and a significant health risk. The current study demonstrates that this low CRF threshold is only appropriate with advanced age and much higher peak MET thresholds should be viewed as disconcerting in younger and middle-aged individuals (i.e., 7–10 peak METs, depending on exact age). Moreover, low CRF thresholds vary by sex. Therefore, both age and sex must be considered when using peak METs to assess health risk in a more individualized and precise manner.

The current study has drawn considerable attention from the lay media, which on the surface should be viewed as positive. Press coverage of this kind can certainly raise public awareness and hopefully encourage individuals to view CRF as a vital sign that is important to measure and improve upon to optimize health. Unfortunately, the lay media has not accurately reported on the methodology or key findings of the study by Mandsager et al.<sup>9</sup> For example, the Time article summarizing this study incorrectly interpreted the results, implying not exercising was synonymous with low CRF and was the reason for the reported poor health outcomes; “researchers found a clear connection between a longer, healthier life and high levels of exercise”<sup>12</sup>; this may be partly due to the authors themselves in their introduction alluding to the fact that some have suggested the potential toxicity of high amounts of exercise. The study by Mandsager et al.<sup>9</sup>, however, assessed CRF estimated from clinical treadmill testing as opposed to time spent performing moderate to vigorous physical activity (PA). Reported or measured PA is certainly not interchangeable with CRF.<sup>6</sup> In fact, approximately half of the variability in CRF is considered to be related to heritable factors.<sup>13</sup> Additionally, inherited factors influence the CRF response to exercise training by ≈50%.<sup>7</sup> Compared to self-reported PA habits, CRF measured through clinical exercise testing has clearly been shown to be a superior prognostic marker.<sup>13–15</sup> As such, clinicians should not assume that a patient reporting high levels of PA enjoys the health protections found in the current study; measurement of CRF provides the most accurate assessment of risk. In addition, we are starting to appreciate that not all individuals *respond* (i.e., the non-responder phenomenon) to exercise training with a significant increase in CRF and that individuals who do not respond have poorer health outcomes compared to those who do increase CRF through exercise training.<sup>16,17</sup> The lay media interpretation of this article went on to conclude that no level of PA was detrimental, implying that exercising at extremely high volumes produced even greater health benefits. However, there is evidence to indicate that extremely high levels of exercise

training over the long term is physiologically detrimental and may increase the risk for adverse events; a high CRF and high exercise volumes, while related, are truly independent phenomena and should be analyzed as such.<sup>18,19</sup> Moreover, lay media representation of this study did not report on the vital importance of improving low CRF, even if just to a below average CRF level. Such small CRF improvements can lead to significant reductions in risk for adverse events and moving from a sedentary lifestyle to a level of PA well below an elite training level can elicit such CRF improvements.<sup>20,21</sup> This is a critically important message to send to those who lead a predominantly sedentary lifestyle (a considerable proportion of the population<sup>22</sup>) and are likely to perceive participation in high exercise volumes as unrealistic. There is evidence to indicate sedentary individuals incorrectly perceive only exercise at high volumes provide a health benefit and that adopting such exercise habits are unattainable.<sup>23</sup> As healthcare professionals, we need to encourage those who lead a sedentary lifestyle to move more throughout their day with the goal of improving their CRF to any level; even 1 MET increases in CRF matter greatly to one's health outlook.<sup>24</sup>

In conclusion, CRF is clearly a vital sign, a designation further supported by the findings reported by Mandsager et al.<sup>9</sup> Reported exercise training habits are not synonymous with CRF, with the latter being a superior measure of health and prognosis. To provide the greatest precision in health assessments and individualize care plans that are optimally effective at improving outcomes, measurement of CRF is the preferred approach.

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