



Editorial

Physical Activity, Fitness, and Cardiovascular Health Insights From Publications in *JAMA Network Open*

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*Victory! Victory! Rejoice, we conquer!***The last words of Pheidippides before his death, immediately after running the approximate distance of a marathon in 490 BC¹**

Some would believe the story of poor Pheidippides is a cautionary tale about the hazards of exercise. His battery was drained after running 25 miles to convey the outcome of the Battle of Marathon—his finite supply of energy was used up, and he died as a result. What's forgotten is that Pheidippides ran 300 miles in the days preceding his final marathon dash. Fear not the fate of Pheidippides! Yes, a sudden increase in vigorous exercise results in a small and transient increase in cardiovascular risk.² However, most individuals need to worry about exercising too little rather than too much. A mountain of scientific evidence has established that physical activity and fitness are both important for optimal cardiovascular health.^{3,4}

Despite this well-established evidence, opportunities remain to refine our understanding of the association of physical activity and fitness with cardiovascular health. Just how important is fitness, and just how fit is fit? How much activity is needed to see cardiovascular health benefits? How does fitness contribute to cardiovascular health? Is aerobic fitness or muscular strength more important for cardiovascular health? And how should we measure fitness and guide improvements in cardiovascular health? Six articles in *JAMA Network Open* have advanced our understanding and offered new insights on these questions (**Box**).⁵⁻¹⁰

Physical Activity, Exercise, and Fitness: Are They the Same?

Physical activity is any skeletal movement of the body resulting in energy expenditure. *Exercise* is a structured subset of physical activity, usually conducted with the intention of improving fitness.

Fitness is the ability to do moderate to vigorous activity without undue fatigue. While physical activity and fitness are moderately correlated, measured fitness may better reflect an individual's cardiometabolic risk profile.¹¹

Just How Important Is Fitness, and Just How Fit Is Fit?

When addressing patients' health behaviors, it can be helpful to emphasize behavior changes that offer the greatest health benefit. On the basis of prior epidemiologic studies, smoking is often emphasized as the strongest contributor to adverse health outcomes.¹² Increasingly, it is recognized that the association of aerobic fitness with health outcomes is just as strong, and potentially stronger, than smoking. In a study by Mandsager et al⁵ that included more than 120 000 individuals referred for routine exercise treadmill stress testing, greater cardiorespiratory fitness was inversely associated with long-term mortality. Compared with individuals who are the most aerobically fit, the risk of mortality was more than 5-fold higher in patients with the lowest aerobic fitness. In comparison, the risk of mortality was 41% higher among smokers compared with nonsmokers in the same study.⁵ These findings are consistent with prior studies that emphasize the importance of aerobic fitness as it is associated with health outcomes.¹³

+ Related article

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Box. *JAMA Network Open* Articles on Physical Activity, Fitness, and Cardiovascular Health

Association of Cardiorespiratory Fitness With Long-term Mortality Among Adults Undergoing Exercise Treadmill Testing⁵

Association of Light Physical Activity Measured by Accelerometry and Incidence of Coronary Heart Disease and Cardiovascular Disease in Older Women⁶

Association of Leisure-Time Physical Activity Across the Adult Life Course With All-Cause and Cause-Specific Mortality⁷

Associations of Aerobic Fitness and Maximal Muscular Strength With Metabolites in Young Men⁸

Association Between Push-up Exercise Capacity and Future Cardiovascular Events Among Active Adult Men⁹

Trends and Costs Associated With Suboptimal Physical Activity Among US Women With Cardiovascular Disease¹⁰

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The work by Mandsager et al⁵ also addresses concerns about a potential upper limit of fitness benefit. In a 2015 study,¹⁴ strenuous levels of self-reported activity were associated with increased mortality risk, raising concerns about a Pheidippides syndrome of harm associated with the extremes of exercise. However, no association of high levels of measured aerobic fitness with mortality was observed in the study by Mandsager et al,⁵ suggesting that no ceiling or untoward effects are associated with elite fitness. Indeed, another prospective cohort study¹⁵ also found no upper threshold of fitness and mortality risk. The differences in findings may be owing to differences in the exposure between studies, with objectively measured exercise tolerance showing no upper bounds, while self-reported activity may have a point of diminishing return.

How Much Activity Is Needed to See Cardiovascular Health Benefits?

Although no upper limit to the benefits of fitness was identified in the study by Mandsager et al,⁵ many individuals are far removed from elite levels of fitness. Exercise training can improve aerobic fitness, but for many, baseline exertional intolerance can become demotivating when the focus is on increasing moderate and vigorous exercise. However, the health benefits of fitness are not limited to moderate- and vigorous-intensity activities. In an article by LaCroix et al,⁶ the association of light physical activity with cardiovascular disease events was evaluated among participants in the Objectively Measured Physical Activity and Cardiovascular Health study,⁶ an ancillary study to the Women's Health Initiative that enrolled more than 7000 ambulatory community-dwelling women 63 years and older; notably, physical activity was objectively measured by accelerometers rather than self-report. LaCroix et al⁶ found that the amount of time older women spent doing light physical activity (defined as 1.6-2.9 metabolic equivalents, similar to leisurely walking) was independently associated with a lower likelihood of cardiovascular disease events, with each additional hour-per-day increment in light physical activity associated with a 10% lower risk of cardiovascular disease events. These findings are consistent with a 2011 meta-analysis of observational studies¹⁶ that found that individuals who were physically active at levels lower than the minimum recommended amount had significantly lower risk of coronary heart disease compared with those with no leisure-time physical activity. These findings are consistent with recently updated physical activity and prevention guidelines that emphasize the importance of moving more and sitting less.^{4,17} The findings from LaCroix et al⁶ and these guidelines can serve to encourage reductions in sedentary behavior, as strenuous exercise need not be the first objective for improving health. Once tolerance for light physical activity is developed, transitioning to increasing levels of moderate and vigorous physical activity can be encouraged. Together, these studies and guidelines suggest some activity is better than none—but more is better yet.

A frequent perception is that prior years of sedentary behavior cannot be overcome later in life. A study by Saint-Maurice et al⁷ overturns this perception. Using data from the National Institutes of Health-AARP (formerly American Association of Retired Persons) Diet and Health Study, the authors analyzed the association of leisure-time physical activity with mortality in more than 315 000 adults.⁷ Compared with adults who were consistently inactive, those who maintained the highest leisure-time physical activity were at the lowest mortality risk. But the benefits were not limited to those who were more active throughout their life. Adults who were inactive in early adulthood but increased physical activity in later adulthood had a 35% lower mortality risk compared with adults who remained inactive. In short, it's never too late to get active.

How Does Fitness Contribute to Cardiovascular Health? Is Aerobic Fitness or Muscular Strength More Important for Cardiovascular Health?

Physical activity and exercise capacity are associated with a large number of mediators of cardiovascular health, including blood pressure, blood glucose level, lipid profile, resting heart rate, endothelial function, parasympathetic tone, and tendency for thrombosis. Less clear is the degree to which aerobic fitness and muscular strength contribute to mediators of cardiovascular health. In a cross-sectional study of 580 Finnish men by Kujala et al,⁸ the associations of aerobic fitness and

muscular strength with measures of the cardiovascular metabolome were assessed. The authors observed associations of aerobic fitness with metabolome markers of cardiovascular health that were largely attenuated after accounting for body fat percentage. Similar associations of maximal muscular strength with metabolome markers of cardiovascular health were not observed. Activities to maintain muscular strength are important to maintain physical function, and prior studies of individuals with diabetes¹⁸ suggest resistance training in combination with aerobic training leads to greater improvements in blood glucose levels than either training alone. However, the study by Kujala et al⁸ suggests that aerobic fitness is the stronger contributor to markers of cardiovascular health for most individuals.

How Should We Measure Fitness and Guide Improvements in Cardiovascular Health?

Although the previously discussed studies used detailed assessments of activity and fitness, in clinical care it doesn't always need to be complicated. Prior studies have demonstrated associations of simple measures of fitness (eg, grip strength¹⁹ or 6-minute walk test²⁰) with patient outcomes. A nice addition to this literature comes from a study of more than 1000 male firefighters by Yang et al⁹ that assessed the association of push-up capacity with cardiovascular outcomes. Compared with firefighters completing fewer than 10 push-ups, those able to complete more than 40 push-ups had a lower risk of cardiovascular events. Although the generalizability of push-up capacity remains a question, the study by Yang et al⁹ is a good reminder of the simple assessments that can lead to a better understanding of exercise tolerance and associated health outcomes.

While the epidemiologic evidence demonstrating the importance of exercise and fitness for cardiovascular health is sound, more research is needed to inform the interventions that will help patients achieve the health benefits associated with activity and fitness. Trials of exercise type, dosage (including frequency, duration, and intensity), and mechanisms to maintain exercise adherence in healthy populations and those with existing cardiovascular disease¹⁰ will provide evidence to guide patients and health care professionals.³ Until then, for nearly all patients, the mantra for exercise and fitness is some is better than none—and more is better yet.

ARTICLE INFORMATION

Published: August 23, 2019. doi:10.1001/jamanetworkopen.2019.8343

Correction: This article was corrected on October 9, 2019, to fix a wording error in the eighth paragraph.

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Conflict of Interest Disclosures: None reported.

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