Physical Activity and Cardiovascular Risk: 10 Metabolic Equivalents or Bust

Lack of activity destroys the good condition of every human being, while movement and methodical physical exercise save it and preserve it.

Plato[1]

It is no coincidence that the increase in chronic disease in people corresponds with the rapid decline in physical activity. The dramatic shift in lifestyle and behavior during the past 50 years is creating substantial challenges for the medical community to keep patients healthy. This issue of *Mayo Clinic Proceedings* includes a collection of articles that address declining physical activity in the general population and the resulting cardiovascular risk and mortality. Collectively, these articles highlight the importance of accurately quantifying physical activity in populations,[2,3] determining the threshold metric for cardiovascular risk,[4,5] and systematically delivering preventive recommendations to patients.[6] Three major points from these articles deserve emphasis: (1) fitness, and not just fatness, is important for stratifying cardiovascular risk; (2) simple physiologic measures, such as resting heart rate (RHR) and routine exercise testing, can be highly predictive of risk; and (3) physical activity should be recommended by all physicians, regardless of whether an institutional protocol for exercise prescription is yet in place.

Fitness and Fatness

One recurring theme regarding the population risk assessment for cardiovascular disease is that declining daily physical activity and increasing adiposity usually occur simultaneously. This makes it difficult to accurately assess energy expenditure (because many algorithms are based on normal-weight individuals), determine whether obese patients are getting enough cardioprotective activity, and make recommendations. In the article by Archer et al[2] in the current issue of the *Proceedings*, the authors validate a method of quantifying physical activity at a population level. Their research reinforces the idea that individuals with higher adiposity typically get less daily physical activity.

Similarly, physical activity recommendations may need to be modified for those in higher body mass index (BMI) categories simply because current estimates of risk are so heavily influenced by body mass per se, to the relative exclusion of lack of fitness that accompanies increased BMI. Specifically, current guidelines may actually underestimate cardiovascular risk and mortality in larger individuals. Abudiab et al[2] measured functional aerobic capacity in normal-weight, overweight, and obese men (based on BMI measurements) and correlated these data with survival rates over a 14-year observation period. They discovered that in all 3 BMI categories there was a significant increase in mortality when functional aerobic capacity was less than 80% of predicted for the BMI category.

Taken together, these aforementioned studies emphasize that tackling the issue of physical inactivity, independent of body mass, will have a substantial effect on cardiovascular disease risk and mortality, and this approach, if applied broadly, can inexpensively improve population-wide health.

The importance of regular exercise as a disease-preventing therapy is documented in a recent meta-epidemiologic study that suggests that in the few randomized trials on exercise efficacy, exercise training is similar to pharmacological interventions in reducing mortality from cardiovascular disease.[7] In addition, physical activity has broad-based effects beyond simple cardiovascular conditioning and risk modulation, eg, improvements in mental health and diminution of risk of dementia and brain aging,[8] and should perhaps be seen as the real "polypill."[9]

Simple and Straightforward

From a physiologic perspective, some of the most interesting and striking evidence of benefit from exercise comes from the observation of Saxena et al[4] in this issue of the *Proceedings*. These authors report that simply assessing RHR, a measurement that is simple to perform and is recorded at most patient-physician visits, can provide insights into

See also pages 1398, 1408, 1420, 1427, 1446

Mayo Clin Proc. ■ December 2013;88(12):1353-1355 ■ http://dx.doi.org/10.1016/j.mayocp.2013.10.015
www.mayoclinicproceedings.org ■

cardiovascular risk.[4] High RHR is already associated with greater mortality, independent of other risk factors.[10,11] Saxena et al[4] examined data from more than 50,000 patients and determined that individuals with low RHR (ie, <60 beats/min compared with >80 beats/min) had a lower mortality risk. Such an observation causes us to reexamine, on a patient-by-patient basis, whether sinus bradycardia is an indicator of health or illness. The Saxena et al[4] observation also highlights the important, yet often disregarded, role of vagal tone in cardiovascular risk. Underlying cardiac abnormalities can cause "remodeling" of the cardiac autonomic nerves, yet exercise training enhances cardiac parasympathetic activity.[12] Thus, the disruption of sympathovagal balance may be an early alteration in the pathogenesis of cardiovascular disease and a key mechanism in fatal arrhythmias and sudden death.

Another basic approach to assessing risk and establishing clinical thresholds is the goal of achieving 10 metabolic equivalents (METs, where 1 MET = 3.5 mL of oxygen consumed per kg body mass per min) on an exercise test. In patients with suspected cardiovascular abnormalities, there is evidence that those who have 10 METs or greater exercise capacity have an extremely low risk of death from cardiovascular disease. This is true even in individuals with significant coexisting cardiovascular risk factors.[13] In this context, Fine et al,[5] in this issue of the *Proceedings*, reported that in more than 7500 patients reaching 10 METs, there is little prognostic value of additional cardiovascular testing. Specifically, they conclude that performing additional tests for myocardial ischemia may not be useful if a patient achieves high cardiorespiratory "work" during stress testing and that there is little incremental value of testing patients for ischemic echocardiographic abnormalities above 10 METs. However, some key questions remain. Is this independent of age? For example, a young individual achieving less than 10 METs may be indicative of some pathologic condition. In addition, many of these studies are conducted in men only, so is 8 METs the appropriate threshold for women (because women tend to have lesser maximum aerobic capacity than men)?[14] Perhaps most important, what activities are needed to help a patient best "train" to achieve 10 METs?

Propagating the Message to Patients and Physicians

With all the evidence on the importance of physical activity in reducing all-cause mortality and the relatively simple evaluation techniques that are available, not all physicians are emphasizing this importance with their patients. This is elegantly summarized in the article by Vouri et al,[6] also in this issue of the *Proceedings*, who review the challenges of physical activity promotion in the health care system, additional obstacles, and the importance of emphasizing a straightforward message. When will physical activity recommendations be a health system—based goal as opposed to a largely individual patient goal? How long will it be until exercise prescriptions will simply be transferred to an on-staff exercise physiologist? When will physical activity become an essential vital sign? How do physicians and other providers make physical activity a priority and model health behaviors accordingly? How can recommendations be simplified for the most sedentary patients? As physical activity continues to emerge as a risk factor for many chronic diseases, it will be necessary for the health care community to find solutions.

Ten Metabolic Equivalents or Bust?

Given the 10 METs data and other recommendations reviewed previously herein, one interesting question is who can achieve 10 METs of aerobic activity? The short answer is that most middle-aged people can achieve 10 METs with regular exercise training, and values nearly this high are possible in older people as well.[15] In fact, this level of fitness is possible even in middle-aged men with coronary artery disease who engage in supervised vigorous exercise training,[16] and this training program can be successfully maintained for years.[17] Importantly, training in most patient populations is incredibly safe, with adverse event rates lower than those for drug interventions and other therapies, and this remains true for higher-intensity exercise training.[18] Thus, although more and more evidence points to the value of physical activity in general, and higher-intensity exercise in particular, the struggles of the medical community to systematically promote physical activity and exercise continue. The 5 articles that we highlighted from the current issue of *Mayo Clinic Proceedings* provide more

Mayo Clin Proc. ■ December 2013;88(12):1353-1355 ■ http://dx.doi.org/10.1016/j.mayocp.2013.10.015
www.mayoclinicproceedings.org

evidence and useful recommendations to solve this ongoing problem.

Jill N. Barnes, PhD
Michael J. Joyner, MD
Department of Anesthesiology
Mayo Clinic
Rochester, MN

Correspondence: Address to Michael J. Joyner, MD, Department of Anesthesiology, Mayo Clinic, 200 First St SW, Rochester, MN 55905 (joyner.michael@mayo.edu).

REFERENCES

1. National Association for Sport and Physical Education. Physical activity and health quotes. http://www.aahperd.org/letsmoveinschool/events/upload/Physical_Activity_Health_Quotes.pdf. Accessed November 1, 2013.
2. Archer E, Hand G, Hébert J, et al. Validation of a novel protocol for calculating estimated energy requirements and average daily physical activity ratio for the US population: 2005-2006. *Mayo Clin Proc*. 2013;88(12):1398-1407.
3. Abudiab M, Bilal A, Konecny T, et al. Use of functional aerobic capacity based on stress testing to predict outcomes in normal, overweight, and obese patients. *Mayo Clin Proc*. 2013;88(12):1427-1434.
4. Saxena A, Minton D, Lee D-c, et al. Protective role of resting heart rate on all-cause and cardiovascular disease mortality. *Mayo Clin Proc*. 2013;88(12):1420-1426.
5. Fine NM, Pellikka PJ, Scott CG, et al. Characteristics and outcomes of patients who achieve high workload (≥10 metabolic equivalents) at the time of treadmill exercise echocardiography. *Mayo Clin Proc*. 2013;88(12):1408-1419.
6. Vouri IM, Lavie CJ, Blair SN. Physical activity promotion in the health care system. *Mayo Clin Proc*. 2013;88(12):1446-1461.
7. Naci H, Ioannidis JPA. Comparative effectiveness of exercise and drug interventions on mortality outcomes: metaepidemiological study. *BMJ*. 2013;347:f5577.
8. Ahlskog JE, Geda YE, Graff-Radford NR, Petersen RC. Physical exercise as a preventive or disease-modifying treatment of dementia and brain aging. *Mayo Clin Proc*. 2011;86(9):876-884.
9. Fiuza-Luces C, Garatachea N, Berger NA, Lucia A. Exercise is the real polypill. *Physiology (Bethesda)*. 2013;28(5):330-358.
10. Benetos A, Rudnichi A, Thomas F, Safar M, Guize L. Influence of heart rate on mortality in a French population: role of age, gender, and blood pressure. *Hypertension*. 1999;33(1):44-52.
11. Kristal-Boneh E, Silber H, Harari G, Froom P. The association of resting heart rate with cardiovascular, cancer and all-cause mortality: eight year follow-up of 3527 male Israeli employees (the CORDIS Study). *Eur Heart J*. 2000;21(2):116-124.
12. Billman GE. Cardiac autonomic neural remodeling and susceptibility to sudden cardiac death: effect of endurance exercise training. *Am J Physiol Heart Circ Physiol*. 2009;297(4):H1171-H1193.
13. Bourque JM, Holland BH, Watson DD, Beller GA. Achieving an exercise workload of > or = 10 metabolic equivalents predicts a very low risk of inducible ischemia: does myocardial perfusion imaging have a role? *J Am Coll Cardiol*. 2009;54(6):538-545.
14. Åstrand PO. Human physical fitness with special reference to sex and age. *Physiol Rev*. 1956;36(3):307-335.
15. Trappe S, Hayes E, Galpin A, et al. New records in aerobic power among octogenarian lifelong endurance athletes. *J Appl Physiol*. 2013;114(1):3-10.
16. Ehsani AA, Biello DR, Schultz J, Sobel BE, Holloszy JO. Improvement of left ventricular contractile function by exercise training in patients with coronary artery disease. *Circulation*. 1986;74(2):350-358.
17. Rogers MA, Yamamoto C, Hagberg JM, Holloszy JO, Ehsani AA. The effect of 7 years of intense exercise training on patients with coronary artery disease. *J Am Coll Cardiol*. 1987;10(2):321-326.
18. Rognmo O, Moholdt T, Bakken H, et al. Cardiovascular risk of high- versus moderate-intensity aerobic exercise in coronary heart disease patients. *Circulation*. 2012;126(12):1436-1440.