I am 80 going on 18: exercise and the fountain of youth

Michael J. Joyner and Jill N. Barnes
Department of Anesthesiology, Mayo Clinic, Rochester, Minnesota
Submitted 2 November 2012; accepted in final form 2 November 2012

AGING IS ASSOCIATED WITH PHYSIOLOGICAL decline. To slow or reverse this decline, humans have searched for various “fountains of youth” since the dawn of history (4). Most recently, aging has become medicalized and interventions, such as caloric restriction, stem cells, hormonal anti-aging therapy, antioxidants, and activation of specific biochemical pathways like the sirtuins have been seen as potential therapeutic interventions to slow the aging process. Frequently overlooked, ignored, or simply taken for granted are the powerful anti-aging effects of lifelong physical activity and exercise training. In this edition of the Journal of Applied Physiology, Trappe et al. (12) report remarkable results for maximal oxygen uptake in 80-yr-old former elite athletes, who have trained and remained physically active their entire lives. This is important because cardiorespiratory fitness is a strong independent risk factor for both all-cause and cardiovascular mortality (3). Additionally, VO2 max values in the 15–20 ml·kg−1·min−1 range are required for functional independence (12).

Highlights of this impressive data by Trappe et al. (12) include VO2 max values (38 ml·kg−1·min−1) that are almost twice as high as otherwise healthy sedentary 80-yr-olds and in the range seen for sedentary young adults. Data for maximum heart rate and ventilation and markers of skeletal muscle oxidative capacity were also much higher in the master athletes. Interestingly, lean body mass was similar, but the athletes had much less fat mass. What is especially interesting about these data is that the master athletes took almost twice as many steps per day as their sedentary counterparts, so that the time spent doing vigorous training did not simply replace daily living activities (12).

These data and the discussion in the article raise a number of interesting questions.

First, how much of the very high VO2 max values seen in the 80-yr-old athletes is due to the fact that they simply start with bigger “motors” early in life, meaning large compliant hearts with big stroke volumes (10)? In this context, a number of studies have shown that when elite athletes stop training in middle age their VO2 max values start to look more like their sedentary counterparts. However, it is reasonable to anticipate that perhaps 50% of the difference in VO2 max seen in the 80-yr-old athletes vs. controls might have been activated, reinforced, and remodeled. As they aged, daily exercise and their status as “super-fit” may have further reinforced their motivation and activated these reward pathways. However, we must also consider the differences in social norms for the athletes in Sweden compared to sedentary individuals in Muncie, IN. In Sweden, 32% of trips taken utilize walking or biking, compared to only 10% of trips in the United States (1). Could these environmental factors account for some of the differences in steps per day, VO2 max, and body mass between the two populations? Furthermore, in Sweden, neighborhoods with the highest degree of urbanization, aesthetically pleasing environment, and opportunities for physical activity were important determinants of walking minutes per week (2), highlighting the important role that urban planning and public space have in promoting physical activity.

Second, how did these individuals remain motivated to exercise and be so active as they got older? This is a complex topic with explanations that range from the sociological to central dopamine pathways in the reward centers of the brain. Perhaps the athletes enjoyed success as a result of superior “talent” when they were young. If they also enjoyed training and competing, then a number of central reward pathways might have been activated, reinforced, and remodeled. As they aged, daily exercise and their status as “super-fit” may have further reinforced their motivation and activated these reward pathways. However, we must also consider the differences in social norms for the athletes in Sweden compared to sedentary individuals in Muncie, IN. In Sweden, 32% of trips taken utilize walking or biking, compared to only 10% of trips in the United States (1). Could these environmental factors account for some of the differences in steps per day, VO2 max, and body mass between the two populations? Furthermore, in Sweden, neighborhoods with the highest degree of urbanization, aesthetically pleasing environment, and opportunities for physical activity were important determinants of walking minutes per week (2), highlighting the important role that urban planning and public space have in promoting physical activity.

Third, what other benefits are super-fit older people accruing? It is well documented now that overall fitness is associated with higher cognitive function and learning (9). Additionally, older adults with high aerobic fitness have higher hippocampal volumes and better spatial memory, providing additional protection from the age-related decline in brain volume (5). So not only are older athletes at lower risk of cardiovascular mortality, but they likely have lower risk for dementia and Alzheimer’s disease, increasing the likelihood of sustaining a high quality of life. Additionally, high levels of cardiorespiratory fitness seem to trump other risk factors for both all-cause mortality and cardiovascular disease (3).

Finally, what else do we need to know? The short answer is plenty, but there is little information about highly fit older women, and it will be interesting to see whether the benefits observed in older male athletes will also be seen when women exposed to increased sport and training opportunities starting in the 1970s “age-up.” Because a large portion of the age-related decrease in VO2 max is attributed to the loss of muscle mass (6), it will also be interesting to see what lifelong exercise training does to the “normal” sarcopenia and osteoporosis that accelerates after menopause in women. There are also persistent but unproven ideas about potential adverse effects of exercise on the cardiovascular system associated with lifelong intense training. Perhaps more detailed studies in subjects like those who participated in this study will help resolve this issue (11).

When all is said and done, it is critical to remember that in the United States, only 5% of adults are meeting what might be described as minimal physical activity guidelines and that the
obesity statistics continue to get worse. Similar trends are also emerging in the rest of the world, and if things do not change, health care systems will be overwhelmed by wave after wave of chronic lifestyle-related diseases and disability in aging societies. Trappe et al. (12) provide compelling evidence that this fate is not our physiological destiny, but a matter of the choices we make both individually and collectively. If you want to be a fit and healthy independent 80-yr-old, the key is to be fit and healthy throughout life. As Mark Twain pointed out: “life would be infinitely happier if we could only be born at the age of 80 and gradually approach 18.” Lifelong exercise may keep us part of the way there.

**DISCLOSURES**

No conflicts of interest, financial or otherwise, are declared by the authors.

**AUTHOR CONTRIBUTIONS**

Author contributions: M.J.J. and J.N.B. drafted manuscript; M.J.J. and J.N.B. edited and revised manuscript; M.J.J. and J.N.B. approved final version of manuscript.

**REFERENCES**


