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EDITORIAL

Reduced mortality in former Tour de France participants: the benefits from intensive exercise or a select genetic tour de force?

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This editorial refers to 'Mortality in French participants in the Tour de France (1947–2012)', by E. Marijon et al. doi:10.1093/eurheartj/eht347

During the 13th stage of the 1967 Tour de France, near the summit of Mount Ventoux, race leader Tom Simpson fell dramatically from his cycle. Legend dictates that Simpson demanded in whispered gasps 'Put me back on my bike!' just moments before succumbing to a fatal cardiac arrest. Although post-mortem examination revealed amphetamines in Simpson's body, the story bears testament not only to the fanatical devotion of many endurance athletes, but also to the gruelling nature of this 3500 km event. Riders completing the Tour are estimated to have scaled the combined equivalent of Ben Nevis, Scafell Pike, Snowdon, Mont Blanc, Kilimanjaro, and Everest within 21 days. In 2013, the year that has witnessed the 100th excursion of the Tour, the risk-benefit ratio of such extreme exercise continues to provoke fierce controversy amongst the scientific community.

Evidence for the health benefits of physical activity is incontrovertible. Individuals engaging in habitual exercise exhibit reduced levels of cardiovascular disease, obesity, hypertension, cancers, and depression, and live ~6 years longer than their sedentary counterparts.^{1,2} These data are derived largely from analyses of modest exercise 'doses'. A recent study of Danish joggers indicated that running at modest pace for 1–2.5 h/week yielded the greatest increase in life expectancy, above which the benefits plateaued.³ Meta-analyses reveal reduced cardiovascular mortality and morbidity at 30–50 METS (metabolic equivalents)/week, reflected in the European Society of Cardiology recommendation for 2.5–5 h of moderate (or 1–1.5 h intense) activity per week for the prevention of generalized atherosclerosis.^{1,4}

In contrast, professional athletes may habitually expend 200-300 METS/week, whilst participation rates amongst the general population in endurance events such as marathons and the ironman have risen exponentially. Although recognized that individuals harbouring cardiac diseases risk fatal arrhythmias during exercise,⁵ the concept

that repetitive, intense exercise might increase mortality and cardiac morbidity in previously healthy individuals is relatively novel. Acute elevations in markers of myocardial damage, coupled with transient ventricular dysfunction, have been documented in several studies of endurance athletes.⁶ Veteran athletes exhibit increased rates of atrial fibrillation and heart block,⁷ whilst a burgeoning body of literature has raised the possibility of irreversible cardiac remodelling, myocardial fibrosis, ventricular arrhythmias, and even sudden death in a minority of cases.⁸

A number of studies have thus attempted to evaluate the riskbenefit ratio of intense exercise by assessing mortality in elite athletes, with somewhat conflicting results. In 1939, Hartley observed a 15% mortality reduction amongst previous Oxford-Cambridge boat race participants compared with the general population,⁹ whilst Rook found no mortality difference between former Cambridge University athletes and non-athletic 'intellectuals'.¹⁰ Prout observed a longevity increase of 6.3 years amongst former Harvard and Yale oarsmen compared with non-athletic classmates,¹¹ whilst Sarna demonstrated a 6 year increase in longevity in elite Finnish endurance athletes compared with non-athletes matched for area of residence.² In a seminal study of former Danish champions from 19 sporting disciplines, Schnor observed a 39% mortality reduction in those < 50 years of age compared with the general population, although this advantage did not persist into later life.¹² To date there have been few data on longevity in endurance cyclists, a group that are arguably subject to the most profound physiological stresses, in addition to potential adverse effects from reportedly widespread use of performance-enhancing drugs (doping).

In the study by Marijon, mortality amongst 786 French male participants in the Tour de France was assessed between 1947 and 2012.¹³ Mortality data gathered from websites was used to calculate standardized mortality ratios for Tour participants, using male, age-matched members of the French population as referents. The study demonstrated a 41% mortality reduction amongst cyclists, consistent across different historical time periods, almost every age category, and for cardiovascular, respiratory, gastrointestinal, and cancer-

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related deaths. A non-significant mortality increase was observed in cyclists aged <30 years, attributable to traumatic and cardiovascular causes. The authors conclude that endurance exercise is associated with reduced mortality, apparently outweighing any deleterious effects of exercise or doping.

The authors should be commended on a methodically researched report, with complete mortality data for every French Tour participant during the study period. Although similar to the work of Sanchis-Gomar,¹⁴ the study provides additional information on causes of death, and adds to the sparse literature on mortality in athletes habitually exceeding exercise recommendations. The study is, however, restricted by several important methodological limitations. The veracity of data derived from websites is difficult to guarantee. Precise causes of death cannot be ascertained in the absence of routine autopsy in France; for example, how many cardiovascular deaths were sudden, due perhaps to exercise-induced cardiomyopathy? Such data would have been particularly enlightening for the youngest cyclists who demonstrated unexpectedly high cardiac mortality. Importantly, there is no information on morbidity, particularly relating to the prevalence of premature sinus node disease or atrial fibrillation in the sixth decade amongst the cyclists. Attempts to correlate distinct periods of race participation with prevailing doping agents are speculative and distracting, since corroborative data on individual drug histories are lacking. However, the most imperative limitation lies in the very inclusion of the study and control groups. Some of the most elite former athletes in the world were compared with the general population; the latter including individuals with preexisting chronic diseases or life habits which would have precluded participation in high level sports. Indeed the ability to compete in the most arduous endurance sports may in itself indicate a superior genetic composition with lower disease susceptibility. Furthermore,

since it is recognized that former athletes continue to lead a healthier lifestyle and smoke less than the general population, reduced mortality in later life cannot be attributed simply to the effects of a decade of intense sport.²

Therefore, due to a multitude of confounding factors, it is difficult to draw concrete and meaningful conclusions regarding the effects of endurance exercise itself on mortality from the data presented (*Figure 1*). In the earlier study by Hartley, the authors warned 'We have been obliged to compare oarsmen with men living at the same time. The ideal would be to compare with fellow graduates. . . under similar conditions except that they did not participate in such strenuous exercise'.⁹ It is unfortunate that three-quarters of a century later, the present study is unable to redress this imbalance. Although providing food for thought, the study by Marijon ultimately leaves key questions on the optimal exercise dose and risk-benefit ratio of endurance sport unanswered. Perhaps the writer Mark Twain had foreseen this debate when he advised; 'Get a bicycle. You will not regret it, if you live'. More than a century onward, we remain a long way from knowing how insightful these words may have been.

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