Increased Average Longevity among the "Tour de France" Cyclists

Authors
F. Sanchis-Gomar[1], G. Olaso-Gonzalez[1], D. Corella[2], M. C. Gomez-Cabrera[1], J. Vina[1]

Affiliations
[1] Department of Physiology, Faculty of Medicine, University of Valencia, Spain
[2] Department of Preventive Medicine and Public Health and CIBER Fisiopatología de la Obesidad y Nutrición, Faculty of Medicine, University of Valencia, Spain

Key words
- life expectancy
- mortality
- physical activity
- endurance
- lifestyle

Abstract

It is widely held among the general population and even among health professionals that moderate exercise is a healthy practice but long term high intensity exercise is not. The specific amount of physical activity necessary for good health remains unclear. To date, longevity studies of elite athletes have been relatively sparse and the results are somewhat conflicting. The Tour de France is among the most gruelling sport events in the world, during which highly trained professional cyclists undertake high intensity exercise for a full 3 weeks. Consequently we set out to determine the longevity of the participants in the Tour de France, compared with that of the general population. We studied the longevity of 834 cyclists from France (n = 465), Italy (n = 196) and Belgium (n = 173) who rode the Tour de France between the years 1930 and 1964. Dates of birth and death of the cyclists were obtained on December 31st 2007. We calculated the percentage of survivors for each age and compared them with the values for the pooled general population of France, Italy and Belgium for the appropriate age cohorts. We found a very significant increase in average longevity (17 %) of the cyclists when compared with the general population. The age at which 50 % of the general population died was 73.5 vs. 81.5 years in Tour de France participants. Our major finding is that repeated very intense exercise prolongs life span in well trained practitioners. Our findings underpin the importance of exercising without the fear that becoming exhausted might be bad for one's health.

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Correspondence
Dr. Mari Carmen Gomez-Cabrera, PhD
Department of Physiology
Faculty of Medicine
University of Valencia
Avda. Blasco Ibañez 15
46013 Valencia
Spain
Tel.: + 34/963/864 646
Fax: + 34/963/864 642
carmen.gomez@uv.es

Introduction

A consensus is growing on the importance of the relationship between physical activity and health and wellness, but the specific amount of physical activity necessary for good health remains unclear [8]. Continued debate as to how much, what type, how often, what intensity, and how long the physical activity should be performed, has led to the promulgation of numerous different public health and clinical recommendations [1]. Public health recommendations for physical activity are 30 min of moderate-intensity activity per day, which provides substantial benefits for sedentary adults. However this amount of exercise may be insufficient to prevent unhealthy weight gain. Blair et al. recommend, for persons exercising 30 min per day, that they try to build up to 60 min per day. It is considered that this may provide additional health benefits [1]. It is widely held among the general population and even among health professionals that although moderate exercise is a healthy practice, vigorous competitive exercise is not [17].

It is now clear that persons (healthy or unhealthy) who undergo regular exercise show a reduction in their risk of mortality [15, 21], but the effects of competitive sports on health are uncertain [6, 22]. In fact it has been hypothesized that the increased risk of cardiovascular disease observed in very highly trained athletes might be related to the frequent exposure to oxidative stress associated with strenuous exercise [9]. In a previous work we showed that Tour de France participants display mild muscle damage as evidenced by an increase in plasma activity of cytosolic enzymes such as creatine kinase or aspartate aminotransferase [5].

To date, longevity studies of elite athletes have been relatively sparse and the results are somewhat conflicting [19, 20]. In one report coming out of a single country (Finland), athletes participating in multiple sports were tracked for longevity, and it was reported that long-distance

runners and cross-country skiers live significantly longer than the general population [10,11]. In contrast, a second study showed that individuals whose energy expenditure is in the range of 3500 kcal per week exhibit a mortality rate higher than that of the sedentary population [16].

Professional road cycling is an extreme endurance sport. Approximately 30000–35000 km are ridden each year in training and competition. Some races, such as the Tour de France (TdF) last 21 days (~100 h of competition) during which professional cyclists cover > 3500 km (see **Table 1**). In some phases of such a demanding sport, exercise intensity is surprisingly high, since professional cyclists must complete prolonged periods of exercise at high percentages (~90%) of their maximal oxygen uptake (VO_{2max}) [14]. Therefore, the TdF is among the most gruelling sport events in the world, during which highly trained professional cyclists undertake long-term high intensity exercise for a full 3 weeks period.

Based on these observations, we decided to test the hypothesis that the exercise regimen to which elite cyclists are subjected does indeed have a life shortening effect relative to the general population. Consequently we set out to determine the longevity of the participants of the TdF and compared it with that of the general population born between 1892 and 1942 (i.e., the years in which the cyclists studied were born).

Methods

Study population

Of the 1318 participants, who have cycled the TdF between the years 1930 and 1964, only 1229 riders are considered for which there is proof of their date of birth and death. Cyclists who did not complete all stages of the TdF were excluded. Other exclusion criteria for this study were: cycling before 1930 or after 1964 and being born in a country that has contributed less than 100 participants during this period. Of these 1229 cyclists, all men, 834 came from France (n = 465), Italy (n = 196) and Belgium (n = 173), representing the 68% of participants in the TdF in the years studied. The remainder came from 21 different countries (see **Fig. 1**), each represented by only a small number of cyclists. To simplify matters, we focused on the 3 countries with the largest contingent of the TdF participants and compared the longevity of their cyclists with that of the average population in their respective countries. Furthermore, these countries have a demographic record of the population since the nineteenth century, allowing comparison of the survival rates of the riders of the TdF with the general population. Only very scattered data can be obtained in the literature on cyclists who rode the TdF before 1930. Of course, of those who rode after 1964, many are still alive and the rate of survival cannot be calculated. This leaves us with a broad sample of 834 cyclists (of a possible total of 1318), which constitute a representative population of the TdF participants. Survival rates for riders of the TdF between 1930 and 1964 correspond to years of birth between 1892 and 1942. This was compared with that of the general population, i.e., men born between 1892 and 1942 (the years in which the cyclists studied were born). Our data come from 3 official electronic websites (www.letour.fr, www.cyclingarchives.com, www.memoire-du-cyclisme.net) which contain detailed information about every cyclist who has ever taken part in the TdF, including dates of birth and death. The average age of death of the male general population in the countries of origin was calculated from data obtained from the human mortality database (www.mortality.org).

Dates of birth and death and the percentage of survivors for each age, on December 31st 2007, were recorded to calculate the curve both for general population and for cyclists. The percentage of survival of cyclists born in each year (from 1930 to 1964) was plotted and compared with the calculated values for the pooled general population of France, Italy and Belgium for the appropriate age cohorts.

The variable named "percentage of survivors" was defined as follows: number of persons born in a given year who were alive on December 31st 2007 divided by number of persons born in that given year. The variable "age" was calculated as: 2007 – year of birth. The same applies for the TdF participants. This study meets the required ethical standards of this journal [7].

Statistical analysis

This was a case-control study. Statistical analysis was performed with SPSS (Chicago, IL, USA) software for Windows (version 17.0). Polynomial regression curves for each population were adjusted and areas under each curve were measured. Statistical significance of the difference in areas was calculated by the z- statistic. The non parametric Mann-Whitney U test was applied for the comparison of the mean of the percent survival for each population. The alpha level for statistical significance was set at $p < 0.05$.

Table 1 Some features of the Tour de France concluded between 1930 and 1964.

	TOURS 1930–1964
average of total kilometres performed per tour	4537.7 ± 238.5 (km)
average total time employed per tour	138.0 ± 16.2 (h)
average of completed tours per cyclist	2.4 ± 2.0 (times)
average age of cyclists who competed in the tours	27.3 ± 3.6 (years)
average speed (all tours)	33.1 ± 2.7 (km/h)

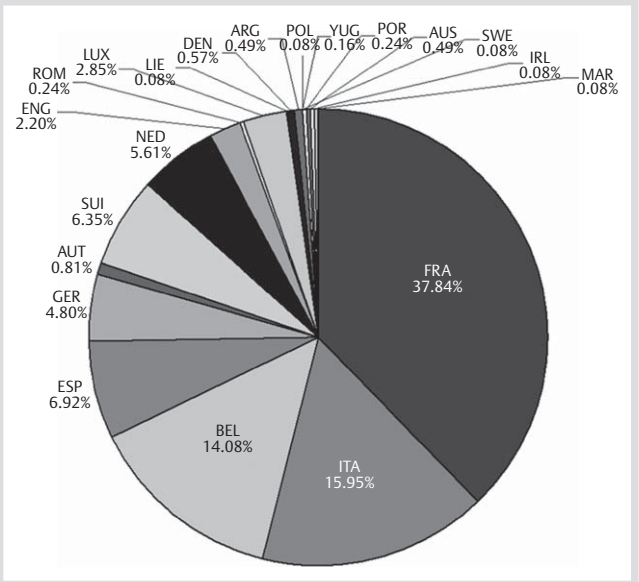

Fig. 1 Distribution by countries of the cyclists who participated in the TdF between 1930 and 1964. ARG: Argentina; AUS: Australia; AUT: Austria; BEL: Belgium; DEN: Denmark; ENG: England; ESP: Spain; FRA: France; GER: Germany; ITA: Italy; IRL: Ireland; LIE: Liechtenstein; LUX: Luxembourg; MAR: Morocco; NED: Netherlands; POL: Poland; POR: Portugal; ROM: Romania; SWE: Sweden; SUI: Switzerland; YUG: Yugoslavia. Algeria is not represented because it has only one rider representative.

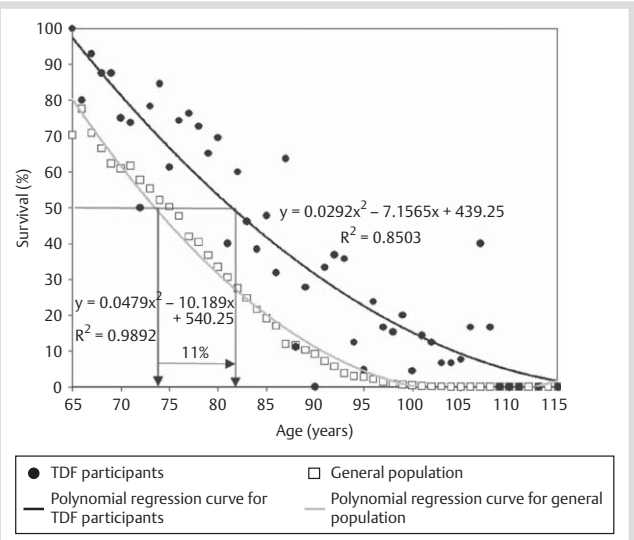

Fig. 2 Percentage of survival related to age in TdF participants and in the general population. Persons born between 1892 and 1942 have been studied. Average life span of TdF participants is higher ($p = 0.004$; 17.5%) than the general population of the same country in which the cyclists were born. The age at which 50% of the general population died was 73.5 vs. 81.5 years in TdF participants, i.e., 11% increase.

Results

Fig. 2 shows that longevity of the TdF participants is significantly higher than that of the general population (when comparing the area under the curve corresponding to the TdF participants with that of the general population $p < 0.05$). The average of survival between 65 and 115 years was 39.1% in the participants of the Tour, while for the general population it was 21.5%. The age at which 50% of the general population died was 73.5 vs. 81.5 years in the TdF participants, i.e., 11% increase (see **Fig. 2**). Note that the values in ordinates are percentage of participants alive. For instance, of the 5 persons who were born in 1900 and who rode the TdF between 1930 and 1964, 2 were still alive on December 31st 2007, i.e., 40%. Considering all the ages studied, the average percentage of survival of the TdF participants (area under the curve) was 17% higher than that of the general population.

Discussion

Low levels of physical activity (2.5 h/week of moderate intensity) reduce mortality by 19% [23]. Increasing this to a 1 h session 7 days a week (7 h/week) could increase the benefit to 24% [23]. Professional cyclists' levels of activity are ~30 h/week of moderate-high intensity activity [14]. The effect of this level of exercise on mortality has been studied very scarcely. In our study we show that professional cyclists' exhibit increased life span.

In our opinion, physicians, health professionals and general population should not hold the impression that strenuous exercise and/or high-level aerobic competitive sports have deleterious effects, are bad for one's health, and shorten life. Recently, it has been shown that non-vigorous physical activity reduces the risk of all-cause mortality [23]. In another study, Chakravarty et al. have concluded that vigorous exercise at middle and older ages is associated with reduced disability in later life and a notable survival advantage [2]. This study demonstrates that even higher levels of activity also increase longevity. We have to keep in mind that our data are limited to 1964 which is perhaps before the time some of today's most dangerous drugs were used, e.g. anabolic steroids, blood doping, etc. Moreover, endurance cyclists are a select group and may be a selected population because people in poor health are less likely to become cyclists and thus they are likely to have healthier habits than the general population [11]. However, while this work was in process, a study published by Ruiz et al. showed that the association between strenuous aerobic exercise, undertaken by elite athletes, and increased life expectancy is not biased by a genetic selection [17]. Their results indicated that top level athletes have similar disease-trait-related genotype scores to those observed in non-athletes [17]. However other lifestyle factors could also contribute to the increased average longevity among the Tour de France participants. Former athletes seem to smoke less, consume less alcohol and have a healthier diet than the general population [4]. Our results are in accordance with previous studies in which it has been demonstrated that an improvement in cardiorespiratory fitness are associated with a lower risk of mortality from all-causes [12]. In our opinion, the critical beneficial factor is also being physically fit. Many patients and clinicians are confused about what amount of exercise is needed for health [3].

We are aware of some unavoidable limitations of our study. For instance we do not have information on co-morbidities or causes of death of the population studied. Likewise, the more conventional longevity analysis to estimate a population survival curve from a sample, the Kaplan-Meier curve, could not be used because the control population is not closed, for instance human migrations cannot be excluded from our analysis. Moreover, we know that the cyclists undertook strenuous bouts of exercise in their early life, but we do not have data about their physical activity in subsequent years. Former athletes are physically more active as they age than the age-matched general population [18]. There is a possibility that these exercise habits are likely to explain the 17% increase in average longevity in the cyclists when compared with the general population.

In spite of these limitations, we conclude that long-term repetitive strenuous exercise does not increase mortality or shorten life span. On the contrary, this type of exercise lengthens life span (see **Fig. 2**). The general recommendation should be to train and perform exercise frequently. The most recent recommendation regarding exercise was: "Even a little is good; more may be better!" [13]. In view of our results, perhaps it would be better to say: "Even a little is good; a lot is better if you are well trained".

However it should be noted that this level of physical activity is not a plausible and reasonable goal for most people, especially for unfit, middle-aged and older people, or unhealthy persons (diabetics or obese patients). We do not claim that one should subject himself to a lifelong regimen of strenuous exercise but rather that, contrary to previous beliefs, professional competitive exercise, if the subject is previously trained, is a healthy practice that may prolong life span.

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