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Mean speed in professional cycling: No evidence of decline

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ABSTRACT

The aim of this article was to evaluate the mean speed progression of the three major cycling stage races in order to empirically establish whether excellent in performance in professional cycling is to some extent correlated with the trend of blood doping and anti-doping throughout more than a century of official cycling competitions. We retrieved data about the mean speed of the winners of the Tour de France, Giro d'Italia and Vuelta a Espana, since their beginning. A linear correlation has then been calculated between the years and the mean speed in km/h for each single major cycling stage race, as well as for the mean speed of the winners of the three major cycling stage races in the same year. Although a highly significant correlation was found between years and mean speed of the winners of each single major cycling stage race during the same year ($r = 0.941$; $p < 0.001$), a number of differential trends were observed. More specifically, from 1903 to 1925 the association was inverse, between 1926 and 2000 the relationship was positive, whereas in the period 2001–2013 the relationship became virtually flat. This data suggests that a strengthened policy of anti-doping testing may have been effective in the past 15 years for curbing the use of performance-enhancing substances.

1. Introduction

El Helou et al. (2010) showed a speed progression of 6.38% in road cycling performance in the last 20 years, questioning the role of extra-physiological parameters in this progression. The fight against doping in the last decade has likely changed doping practices in high-level cycling. For that reason, anti-doping measures have not had the expected effects and the fight against doping in cycling is not over (Lentillon-Kaestner, 2013). Sport performance is strongly influenced by a variety of anthropometrical, physiological, psychological, environmental and technological factors (Lippi & Sanchis-Gomar, 2013). As regards endurance sports, which typically include long distance running, swimming and cycling, one of the leading determinants of optimal performance is represented by the aerobic capacity, which is in turn largely dependent upon the individual oxygen carrying capacity of blood (Lippi, Franchini, Salvagno, & Guidi, 2006).

Erythropoiesis, that is the production and release of erythrocytes from the bone marrow, is critically regulated by erythropoietin (Epo) (Palis, 2014). A decreased synthesis of this crucial hormone causes anaemia and decreased oxygen transport and delivery from the lungs to the peripheral tissues, whereas an abnormally high synthesis causes various degree of polycythemia. Due to the evidence that the administration of recombinant human Epo (rHuEpo) is effective to increase the red blood cell mass and the systemic muscular peak oxygen delivery (Lundby et al., 2008), the unfair use of blood doping through erythropoiesis stimulating agents (ESAs) administration and/or blood transfusions has been regarded as an attractive means by many athletes for enhancing their aerobic performance (Boning, Maassen, & Pries, 2011; Lippi & Banfi, 2006). This has led some to call the 1990–2010 period in professional cycling the "Epo epidemic" (Lodewijkx & Brouwer, 2011).

Although it is unquestionable that the use of ESAs has been practiced in past decades, the adoption of an increasing number of anti-doping tests for either direct detection of the doping agent/method or for providing indirect clues about the use of unfair practices (e.g., the biological passport) has likely contributed to limit the use of doping in official competitions (Lippi & Plebani, 2011; Sanchis-Gomar & Lippi, 2012). In effect, Emeritus Professor Arne Ljunqvist has declared that doping seems to be steadily on the decline (Renstrom, 2014). As such, in order to empirically assess whether excellence performance in professional cycling is to some extent correlated with the trend of blood doping and anti-doping

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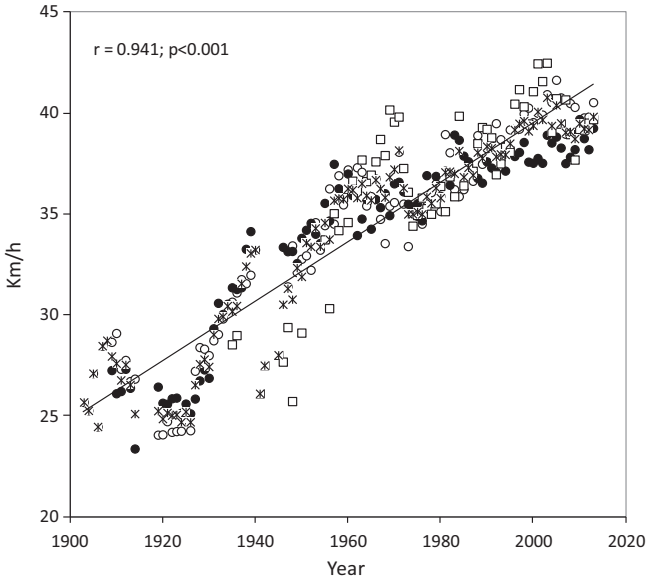

Fig. 1. Trend of average speed of the winners of Tour de France (○), Giro d'Italia (●), Vuelta a Espana (□), and average speed of the three races (*).

throughput years, we evaluated the mean speed progression of the three major cycling stage races (i.e., Tour de France, Giro d'Italia and Vuelta a Espana).

2. Methods

We retrieved data about the mean speed of the winners of the Tour de France, Giro d'Italia and Vuelta a España, since their beginning. A Spearman's correlation was then calculated between the years and the mean speed in km/h for each single major cycling stage race, as well as for the mean speed of the winners of the three major cycling stage races in the same year. Differential subanalyses were then performed according to the differential trends observed throughout the study period. This study agrees with the ethical standards set out by Harriss and Atkinson (2009).

3. Results

The results of this analysis are shown in Fig. 1. A highly significant correlation has been observed between years and mean speed of the winner of each single major cycling stage race (Tour de France, $r = 0.942$; $p < 0.001$; Giro d'Italia, $r = 0.919$; $p < 0.001$; Vuelta a Espana, $r = 0.823$; $p < 0.001$). A highly significant correlation was also found between years and mean speed of the winners of each single major cycling stage race during the same year ($r = 0.941$; $p < 0.001$). Since a number of differential trends were observed throughout the study period, we performed five additional subanalyses (Fig. 2). In the early period of official cycling competitions (i.e., from the 1903 to the 1925), no association was found between years and mean speed ($r = -0.52$; $p = 0.22$). In the following years, and more specifically in the periods 1926–1940 and 1941–1970, the relationship between year and mean speed was instead positive, displaying correlation coefficients of 0.975 and 0.918 (both $p < 0.001$) (Fig. 2). The significant, positive trend continued in the following period (i.e., between 1971 and 2000), with a gain of approximately 5 km/h of mean speed in 30 years compared to approximately 7 km/h in the previous 45 years. In the last period (years 2001–2013), the relationship between time and mean speed became virtually flat, with a non-significant trend for a decrease ($r = -0.50$; $p = 0.07$). When the standard error of the mean (i.e., the scatter around the regression line) was calculated, this was found to be significantly lower between the years 1980 and 2013 than in the previous period (Sy,x 0.67 versus 1.90 km/h).

4. Discussion

Doping in sports is regarded as an attractive method to improve performance by some athletes. It is undeniable that the administration of ergogenic aids can be effective to improve performance under optimal conditions, but this is not always what happens in the real world, where professional athletes systematically undergo a broad series of tests which limit their possibility (both in time and amount) to use banned substances or methods. There is still open debate around the cycling performance during the so-called "Epo epidemic". Lodewijkx and Brouwer performed a deep analysis of the time it took riders to win the race (Lodewijkx & Brouwer, 2011) and concluded that the effects of blood doping on professional cyclists' achievements may be largely overestimated. Conversely, Perneger calculated the average speeds of 5th place finishers of the three major cycling stage races in the period 1990–2009 (Perneger, 2010), and concluded that the fluctuation was highly correlated to the trend of use of banned substances.

According to our analysis, there is no correlation between year and speed in the early period of official cycling competitions, and this is probably attributable to stagnant technological development (i.e., bicycles were still very heavy and equipped with a single gear, since the two-speed derailleur only appeared in 1933, produced by Tullio Campagnolo). In the following years, and more specifically in the period 1926–1970, an impressive positive trend was observed, and this can be probably explained by major advances in technology of the racing bike, improvements in training and nutrition in the 1930s and 1940s, along with the introduction of the first forms of doping between the 1950s and 1970s (i.e., amphetamines and anabolic agents). That was incidentally the time when Tommy Simpson collapsed and died while climbing the Mont Ventoux during the 13th stage of the 1967 Tour de France, a death that has been attributed to the use of amphetamines (Lippi, Franchini, & Cesare Guidi, 2008). It was only in the past decade that this trend disappeared and the relationship became essentially flat (Fig. 2). This coincides with the inception of World Anti-Doping Agency and the beginning of the modern globalisation of anti-doping, which has probably led to substantial changes in doping practices.

As such, the results of our analysis do not confirm the hypothesis of Lodewijkx and Brouwer, wherein we find significant trends between mean speed of major cycling stage races from the early beginning (in 1903) to present time. In agreement with data reported by Perneger (2010), we also find a substantial increase of the mean speed between 1990 and 2000 (i.e., the period of the so-called "Epo epidemic"). Even more importantly, a substantial slowing down of professional cycling races could be recorded in the following years, with the average speeds of the three major stage races remaining fairly stable. This does not mean that doping practices have ceased, but they have been probably used to a lesser extent, and probably differently. A paradigmatic example is the misuse of erythropoietin and analogues, wherein the introduction of reliable protocols of direct and indirect athlete testing has probably contribute to favour the diffusion of well-planned schedules of intravenous mini-injections rather than the use of standard subcutaneous dosage (Lippi et al., 2006).

In conclusion, our analysis seems to confirm the existence of a potential effect of a strengthened policy of anti-doping testing in curbing the use of performance-enhancing substances, as suggested by Perneger. It is also noteworthy that the scatter around the regression line (i.e., the Sy,x) was lower in the past 34 years than in the previous period, thus indicating that the fluctuation of performance has remained much more stable in the more recent