Sports Coaching

Impact of increasing age on high-performance Olympic triathletes in male and female: a case report

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Abstract - Aim: Increasing age is associated with significant changes in athletes' performance; however, it is not yet known how increasing age could influence the performance of triathletes. In this sense, the present study aimed to investigate how the performance of two elite triathletes (HCK and AD), who participated and finished the Olympic Games in Sydney, Athens, Beijing, and London, could change over the years. **Methods:** This study reports two cases (male and female) with cross-sectional and retrospective characteristics that describe how the increasing age changes the performance of two elite triathletes who participated in four consecutive Olympics (2000, 2004, 2008, and 2012). Pearson correlation test was used to verify the correlation between the performance and age of the triathletes. A value of $p < 0.05$ was assumed to show statistical significance. **Results:** The results suggest that both triathletes showed impaired performance at the Summer Games in Athens in 2004. When the two athletes were analyzed together, positive correlations were observed between age and transition 1 (T1; swim-to-cycle) and transition 2 (T2; cycle-to-run). Also, a high correlation was found between T2 and age for HCK but not for AD. The results showed a significant correlation between increasing age and a reduction in running performance for HCK. **Conclusion:** Although the two triathletes improved overall time throughout the Olympic Games, this improvement did not correlate with age. Thus, the increasing age does not seem to impact these two athletes during the four Olympic events.

Keywords: triathlon, age, performance.

Introduction

Triathlon is an individual endurance sport that combines three stages (swimming, cycling, and running)[1]. This sport features a variety of events with different distances (e.g., ultra-triathlon, Ironman, off-road, and Olympics)[2]. The official distance for the Olympic games triathlon, officially accepted at the 2000 Sydney Games, was set at 1500 m swimming, 40 km cycling, and 10 km running[1]. Also, between stages, there is transition 1 (T1; swim-to-cycle) and transition 2 (T2; cycle-to-run)[1]. In some events of this modality, athletes are grouped by age category (i., e. South Americas Championships, Pan American Triathlon, and World Triathlon Championship)[3]. The Olympic triathlon does not adopt this method of category by age group (https://www.olympic.org); nevertheless, athletes' age might range, on average, from 19 to 38 years for women and 22 to 36 for men[4].

In triathlon, increasing age seems to influence performance according to the event's distance[5]. The authors of this study[5] proposed that in the swimming stage, the magnitude of effect resulting from the increased age in athletes' performance is similar among competitors of short and long-distance events (Olympic and Ironman, respectively)[5]. However, in the cycling and running stages, the decline in performance is greater in Ironman triathletes than in subjects competing in Olympic Games triathlon[5].

The literature has investigated the effect of age on performance in triathletes who participated in Olympic distance triathlons[6]. The results of this study[6] showed that the overall time of the triathletes was constant when the subjects were between 18 and 34 years old. However, the performance decline was higher in women than in men and started after 50 years of age (in swimming) and after 40 years of age (for cycling and running)[6]. Nevertheless, the body of literature has not yet analyzed how increasing age could alter the individual performance of triathletes in Olympic events over twelve years.

Although increasing age is a factor associated with performance[5], other strategies (e.g., technological advan-

ces and pre-competition energetics factors) have been considered by researchers and coaches as essential factors to improve athletes' performance over the years[7]. In this context, it is necessary to investigate how the performance of triathletes could be impacted over the years during the Olympic Games.

Indeed, case studies that analyze changes in performance over the years in ultra-triathlon athletes have already been reported[8]; nevertheless, no study spanning longitudinal data from two triathletes who participated in four consecutive Olympic Games events. Thus, it is important to understand how the increasing age could influence the performance of triathletes over a long period and then provide more participation in events and better performance. So, the present study aimed to investigate and describe how the aging process would alter the performance of two elite triathletes who participated and finished the Olympic Games in Sydney, Athens, Beijing, and London.

Case report o clinical series

This study reports two cases with cross-sectional and retrospective characteristics that describe how the increasing age changes the performance of two elite triathletes who participated in four consecutive Olympic Games (2000, 2004, 2008, and 2012).

Subjects

Subject 1 (HCK) is male and was born on May 4, 1976, in the United States. The American was the only man in the world to qualify and complete all Olympic triathlon events (https://www.olympic.org). The AD (subject 2) is a woman triathlete born on September 22, 1975, in Germany. She was also the only one to participate in four Olympic Games [4] consecutively.

It is noteworthy that, like other case report studies[9], triathletes were called by abbreviations (HCK e AD) to maintain the identity of the participants. Approval by the local Ethics and Research Committee is unwarranted because the names of the individuals are preserved, and all information was collected through a website (https://www.olympic.org). This study followed all the guidelines of the National Health Council regarding resolution 510/16.

Data collection and procedures

Cross-sectional data on the two triathletes' performance were obtained through the official World Triathlon website on the Internet (https://www.triathlon.org/results). The information collected was: the name of the participants, date of birth, position, overall performance, and time separately for each discipline (i.e., 1.5 km swim, 40 km cycle, and 10 km run) and transitions (T1 and T2). Finally, the age was calculated from the date of birth and the dates of the Olympic Games.

Statistical analysis

Descriptive statistics presented data analysis, and the data used for performance were analyzed by means. The Shapiro-Wilk test verified data normality. Subsequently, Pearson's correlation test was used to verify the correlation between the performance and age of the triathletes. A value of $p < 0.05$ was assumed to show statistical significance. The SPSS 26.0 program was used to obtain data.

Results

Table 1 shows descriptive data on the performance of the two triathletes at the 2000 (Sydney), 2004 (Athens), 2008 (Beijing), and 2012 (London) Olympic Games. The descriptive results show that both athletes reduced performance at the Athens Olympics, specifically on the cycling stage. However, it was observed that after 2004 the athletes reduced the final time over the years.

Unlike Table 1, Table 2 shows the percentage of change of HCK and AD concerning the winners of the

Table 1 - Descriptive data of the two triathletes separately by Olympic Games.

Athlete	Olympics	Age	Position		Performance					
					Swimming	T1	Cycling	T2	Running	Final time
HCK	2000	24	17		00:17:48	00:00:22	00:58:57	00:00:17	00:32:37	01:50:04
	2004	28	9		00:18:11	00:00:19	01:02:23	00:00:22	00:31:51	01:52:46
	2008	32	7		00:18:03	00:00:29	00:59:05	00:00:27	00:31:40	01:49:48
	2012	36	14		00:17:25	00:00:44	00:58:44	00:00:33	00:31:20	01:48:46
				CV	2%	3.9%	3%	2.8%	2%	2%
AD	2000	25	18		00:20:01	00:00:26	01:06:35	00:00:20	00:37:07	02:04:36
	2004	29	11		00:19:40	00:00:24	01:09:56	00:00:24	00:36:34	02:07:24
	2008	33	33		00:20:15	00:00:29	01:06:08	00:00:32	00:38:18	02:05:45
	2012	37	12		00:19:24	00:00:44	01:05:27	00:00:29	00:35:32	02:01:38
				CV	2%	2.9%	3%	2%	3%	2%

Legend: T1: Transition 1 (swim-to-cycle); T2: Transition 2 (cycle-to-run); CV: coefficient of variation.

Olympic Games from 2000 to 2012. For HCK, it is noted that his performance in the race is inferior to the winner in the Olympics 2000, 2008, and especially in 2012. When we analyzed the percentage of change in the performance of athlete AD, a greater variation was observed in the 2008 Olympic Games. This negative change in performance was mainly observed at the race stage (−15.15%).

Table 3 shows the data of correlations between the age and performance of the triathletes. Large and significant correlations between age and performance were observed only in transition two and in the running stage for HCK. However, no correlation was shown in the AD. Also, when the two athletes were analyzed together, the results showed that increasing age is associated with increased transition time (T1 and T2).

Discussion

This case study aimed to analyze how increasing age alters the performance of the only two elite triathletes (female and male) who participated in and completed four Olympic Games. First, impaired performance in both athletes at the Athens Olympics was observed compared to the other summer games. At 2000, 2008, and 2012 Olympics, the profile of elevation in cycling was lower than in Athens. Thus, it is suggested that this decrease in performance, specifically in cycling, is related to the high elevation profile (i.e., 80 m) during the course (www.olympicchannel.com).

The transition 1 (swim-to-cycle) of both athletes correlated with increased age. These findings are similar to studies conducted with elite Ironman triathletes competing in 'Ironman Hawaii'[10]. In this study, the authors found that increasing age was associated with increased transition time for men and women[10]. Other authors suggest that swimming at high intensity would influence cycling performance due to an increase in VO_2 early in the cycling stage[11]. Other findings also propose that endurance performance decreases with increasing age due to reductions in VO_2 max and a decline in lactate threshold[12]. Therefore, the impaired performance in transition 1 could be explained by changes resulting from the increasing age of triathletes.

Our results also showed a significant correlation between increasing age and impaired performance in T2 (cycle-to-run). Contraction patterns are different between cycling (concentric contractions) and running (eccentric contractions); in this sense, the change of activity could negatively influence neuromuscular performance during transition 2[13,14]. Also, it is noteworthy that fast skeletal muscle fibers atrophy is more than slow skeletal muscle fibers with increasing age[13,14].

Indeed, after the Athens Olympics, both HCK and AD decreased the total time over the years; however, the results showed a slight variation (2%) in the triathletes' time, which is not correlated with the increase in age. Previously, findings showed that the peak performance of ultra-triathletes is achieved between the ages of 25 and 44 years[13]. Also, in a more recent study[11] proposed that athletes achieve peak performance in endurance events soon after the age of 25 due to adaptations to training.

In this context, the age group that the subjects reach the peak in triathlon performance may vary according to

Table 3 - Correlation between athletes' age and Olympics performance.

	HCK		AD		HCK and AD	
	age		age		age	
	r	p	r	p	r	p
Swimming	−0.49	0.50	−0.44	0.56	−0.03	0.94
T1	0.88	0.12	0.84	0.16	**0.86**	**0.006**
Cycling	−0.25	0.74	−0.36	0.64	−0.29	0.94
T2	**0.99**	**0.001**	0.85	0.15	**0.93**	**0.001**
Running	**-0.96**	**0.04**	−0.34	0.66	−0.04	0.91
Final time	−0.52	0.48	0.56	0.44	−0.02	0.95

Legend: T1: Transition 1 (swim-to-cycle); T2: Transition 2 (cycle-to-run). Significant correlations are in bold.

Table 2 - Percentage of time variation concerning Olympic Games winners.

Athlete	Olympics	Age	Percentage of performance change					
			Swimming	T1	Cycling	T2	Running	Final time
Simon	2000	25	+0.72%	+0.28%	−0.08%	0%	−5.67%	−1.53%
Hamish	2004	33	+0.70%.	0%	−3,27%	−2.94%	+0.65%	−1.47%
Jan	2008	27	+0.87%	−1.16%	−0.11%	−0.38%	−2.95%	−0.86%
Alistair	2012	24	−2.05%	−1.28%	−0.67%	−2.22%	−7.62%	−2.20%
Brigitte	2000	33	−3.89%	0%	−2.06%	+2.24%	−5.39%	−3.27%
Kate	2004	34	+4.70%	−2.90%	−1.01%	0%	−8.22%	−2.15%
Emma	2008	27	−2.11%	−0.74%	−2.79%	−2.06%	−15.15%	−6.18%
Nicola	2012	30	−0.10%	−1.28%	+0.15%	0.32%	−5.49%	−1.52%

Legend: T1: Transition 1 (swim-to-cycle); T2: Transition 2 (cycle-to-run); +: refers to an improvement in the percentage of performance concerning the time of the first place; -: refers to a decrease in the percentage of performance concerning the time of the first place.

the type of event[13], stage (swimming, cycling, and running), and gender[15]. Therefore, since HCK and AD started to improve performance only after their 28 and 29 years, respectively, it is suggested that in Triathlon in Olympic Games distance, peak performance seems to be reached between 28 and 37 years.

Our study has some limitations. First, the researchers did not follow the training routine and competitions of the two athletes, which could be essential to explain physiological changes and performance. Also, knowing that technological advances are an important factor for performance improvement[7], the present study did not analyze the type of equipment used by athletes in each Olympic Games. External factors are also a limitation of this study, as climate change can influence performance. This cross-sectional and retrospective study described the individual changes resulting from the increasing age of two triathletes who participated in four consecutive Olympic Games. Physiological and psychological aspects were not evaluated over the years; therefore, it would be interesting for future studies to evaluate the relationship between age and performance of triathletes and understand how physiological and psychological factors could alter the performance of athletes during a period under the analysis of sports performance.

Conclusions

In conclusion, it was seen that both HCK and AD had a particularly affected performance in the cycling stage at the Athens Olympics compared to the other Olympic Games due to the elevation profile of the course. Regarding transitions, we observed that the athletes' performance reduced with aging. Although HCK and AD improved the total race time over the years of each Olympic event, this improvement did not correlate with the age of the athletes. In summary, the findings showed that there was a high correlation between transitions and increasing age; however, age does not seem to be associated with overall performance.

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