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Long-distance, short-distance: triathlon. One name: two ways.

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Abstract

Triathlon is a relatively new sport. It is a multidisciplinary sport, which comprises three disciplines: swim, bike and run, as well as the two transition times between the swim and bike sections, and the bike and run sections. There are four common triathlon disciplines: Sprint-Distance, Olympic-Distance, considered Short-Distance (SD), Half Ironman and Ironman, Long-Distance (LD). The aim of this paper is to analyze whether there is a great difference in the way of winning a triathlon in both cases, SD and LD competitions. This paper will also analyze whether the winner of a triathlon is usually the best of one of the three disciplines and which discipline that is (swim, bike or run); the paper also examines the effect of the three disciplines on the overall result of the triathlon and which of the three disciplines is key to win the competition. This data is based on two events: the Volcano Triathlon (SD) and the Ironman Lanzarote (LD). Method: time records for each discipline (swim, bike and run) for the top-ten triathletes (male, female and overall) of two triathlons, the Volcano Triathlon (SD), and the Ironman Lanzarote Triathlon (LD) from 2007 to 2013 were analyzed. The partial times of each discipline for the first triathlete were studied in order to establish which discipline was its best one (with respect to the top-ten): one discipline, two disciplines or three disciplines, and which one in particular: swim, bike or run. Results: Analysis of the results show that for (SD) the bike segment (71,43% male, 85,71% female) is a determining factor vs. the swim and run segments. While in (LD) the swim segment (57,14%) is key for men athletes, vs. women where the run (85,71%) is the most important discipline. Comparing overall results for SD and LD, the swim section shares similar values (42%-50%) in Olympic and Ironman races. The bike segment (78,57%) is a determining factor in Olympic triathlon (SD) vs. (28.57%) for Ironman (LD). Conclusions: winners of the races tend to be the best in one, two or three disciplines in SD vs. only two or three disciplines in LD.

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1. Introduction

Triathlon started around the decade of the 70's. It is a sport which combines three different sport disciplines: swimming, cycling and running, including the transitions between the three disciplines: Transition one is the section of the race between the swim and the bike, and transition two, between the bike and the run. At present there are a variety of distances in triathlon; the most common ones are: Sprint triathlon (750m swim, 20km bike, 5km run); Olympic triathlon (1500m swim, 40km bike, 10km run), Half Ironman (1900m swim, 90km bike, 21km run) and Ironman (3800m swim, 180km bike, 42km run).

The Sprint triathlon is popular in amateur level. The Olympic triathlon (which has been renamed "Standard Triathlon" in 2015), is the most popular event with elite athletes competing in a series of races held worldwide to establish the International Triathlon Union (ITU) World Champion [1].

In 1978, several competitors began the world's first Ironman triathlon event off the beach of Waikiki, Hawaii. Ironman is included in the chart of ultra-endurance, which is defined as moderate to high-intensity (threshold intensity, e2-e3) exercise performed for a duration longer than 4 hours [2,3]. During the last century, there has been a continuous decrease in performance times in different sports disciplines such as athletics (track and field) and swimming [4].

Triathlon can be classified into two varieties: Short-Distance (SD), and Long-Distance (LD) triathlon. The SD includes the Sprint and Olympic-distances. The LD includes the Half Ironman and Ironman distances. As it can be observed there is a great difference in distance between SD and LD. From the (750/1500m 20/40km 10/21km) of the Sprints and Olympics to the (1900/3800m 90/180km 21/42km) of the Half and Ironman distances.

This paper compares two very different triathlons: the Olympic-distance triathlon (SD), and the Ironman-distance triathlon (LD). The analysis focuses on the following questions:

- Is the winner of a triathlon usually the best in all disciplines?
- How many disciplines does the best athlete win in order to be the winner of the competition: one, two or three?
- Which ones and how many times?
- Are there any differences in gender?
- Are there any differences in SD and LD races?

All these questions are analyzed in order to achieve some answers based on objective data for a better understanding of these two different races: the behavior of themselves and between themselves and whether there is a great difference in the way of winning a triathlon race in both cases.

1.1. Limitation of the study. Value Added.

Very few studies have analyzed the external factors (positions and times), that affect performance and evolution over the years [5,6]. There is one study that analyses these variables over the time although over the Ironman Distance [7].

The Olympic-distance triathlon has different demands that distinguish this event both from longer or non elite triathlons [8]. The main difference of the Olympic triathlon (SD) with the long-distance (LD) triathlons is the use of drafting, something that makes the execution of these events completely different [9,10]. Drafting is mainly used in sport physiology and biomechanics to describe the tactic of performing a mode of activity in a sheltered position [11]. Triathletes who draft behind other competitors can substantially reduce their energy expenditure during the bike segment [11,12,13] and increase their performance (go behind a bike using aerodynamic advantage). In Olympic-distance triathlons (SD), drafting on the bike segment is allowed, whereas drafting is not allowed in Ironman-distance triathlons. It is considered that there is a handicap in the study due to the great difference in the performance of the athletes if drafting in Olympic is allowed while it is not allowed in Ironman races. In this study case, in the Olympic triathlon Volcano (SD) drafting is not allowed, like in the Ironman Lanzarote Triathlon (LD). This way, the results obtained are more accurate.

Triathlon is a sport which is determined by various external factors such as climate factors, the weather conditions, humidity, temperature, geographic and distance profiles, whether the bike section is on a hilly or a flat

course, etc. Results obtained from the comparison of two different triathlons could not have a great significance if the external differences between them are extremely big. For the purpose of this study case the Olympic Volcano Triathlon and the Ironman Lanzarote have been chosen, as they share similar features. Both events take place in the island of Lanzarote and share the same external factors; they both take place on a similar date during the month of May, sharing similar weather conditions, temperature, humidity, and warm conditions. The swim, bike, and run features, profiles and conditions are also shared in both events.

2. Method

Fourteen triathlon competitions held between the years 2007 and 2013 have been studied (male, female and overall winners): 7 Olympic Triathlons (Volcano Triathlon) and 7 Ironman (Lanzarote Ironman Triathlon). The top-ten triathletes of the triathlon were considered for the analysis. The organizers of both races have been informed and given their consent in taking part in this study, maintaining the anonymity of the participants.

Data of both events has been collected in collaboration with the organizers. The times for all competitions (Volcano Triathlon and Ironman Lanzarote) in all of the editions were acquired with the same timing system. The chip was used by all the athletes during the races on their ankles. Reading mats were located at the entrance and exit of the transition area and at the finish line. The overall result of a triathlon race consists of the sum of the times needed for each segment, swim (S), bike (B) and run (R), and the transition times between swim and bike (T1), and the transition time between bike and run (T2). Triathlon Total Time is the overall time $(S)+(T1)+(B)+(T2)+(R)$. Times were recorded when the triathletes crossed the timing mats.

A seven-year period was selected (2007-2013), two triathlons per year, the Volcano and the Ironman Lanzarote triathlons. Both genders were analyzed. The data analysis was based on the list of results offered by the organizers of both events. The competitions which took place before 2007 were not analyzed, due to the transition times (T1) and (T2) not being listed separate, incomplete data, or because T1 had been added to the swim time, and T2 has been added to the bike time. Results after 2013 could not be added to this paper.

2.1. Data Processing

Overall times and times for each one of the three disciplines and transition times of the top-ten triathletes were analyzed. Five different times were collected for each athlete: Swim (S), transition1 (T1), bike (B), transition 2 (T2), and run (R). Transition times T1 and T2, were considered as part of the total time, but are not relevant for this study. Only the time of the three main disciplines (S, B, R) were analyzed. Data was obtained from pdf file data-sheets, provided by the organizers: Club La Santa (<http://www.clublasanta.com>). Data files show registration number, names of the competitors, overall position and gender position, BIB number, position and times for each discipline and transition times. The times were shown in hour, minutes, and seconds.

C++ program was developed for cleaning not useful registers, and non-desirable information. Times were cleaned of punctuation marks and copied in plain text. Mathematical Excel sheets were created. Disciplines, transitions and total times were converted from hours and minutes into seconds, for a better use.

2.2. Data Analysis

An Excel sheet was developed to organize data and carry out calculations. Each discipline and the transitions times for the top-ten athletes were listed. For each discipline, the best time was analyzed and selected. The best time out of the three disciplines, swim, bike or run was studied to determine whether it belonged to the winner of that event. The best time of the swim for the top-ten athletes, the best time of the bike for the top-ten athletes, the best time of the run for the top-ten athletes was also analyzed; and how many of these best times and in what discipline (swim, bike, run) had the winner of that event obtained.

A table has been created to represent the amount of disciplines in which the winner of a particular event had had the best performance and to determine whether the winner of the triathlon had had the best performance in one, two or the three disciplines, that year.

Standard statistical methods were used to calculate percentages. Number of disciplines won and number of editions were used. Analyses for male, female and overall were taken into consideration.

3. Results

Results correspond to the top-ten triathletes, male and female gender, and overall winner, for Lanzarote Volcano Triathlon (Olympic: Short-Distance) and Ironman Lanzarote (Ironman: Long-Distance:), during the period (2007-2013).

Olympic-Distance Triathlon: Volcano Triathlon (Short-Distance (SD)): Chronological Analysis:

Male Gender: In 2007, the male gender winner had the best time in one of the disciplines: the bike section. In 2008, the winner had the best time in the three disciplines: swim, bike and run, which is the only time that this happens in the period of time analyzed (2007-20013). In the years 2009, 2010, the winner had the best time in one discipline, bike (the same as 2007). In 2011, the winner had the best time in two of the disciplines: swim and bike. The winners of 2012 and 2013 had the best time in one discipline, 2012 (swim), 2013 (bike).

Table.1, shows the number of times in which the winner of the triathlon achieved the best time in three, two and one discipline respectively, and the percentages which it represents.

Table 1. Number of times that the winner of the triathlon was the partial winner in three, two and one of the disciplines (Olympic-distance Volcano Triathlon (SD), Overall)

Volcano Triathlon “% Success”	#3 Disciplines	#2 Disciplines	#1 Discipline
14,29%	1 (time.)	-	-
14,29%	-	1 (time.)	-
71,43%	-	-	5 (times.)

From the results above, it is observed that in the period between 2007 to 2013, in (14,29%) of the editions the winners had achieved the best time only in three or two disciplines respectively. And in (71.43%) of the editions, the winner of the triathlon won being the best only in one discipline.

Female Gender: Regarding female gender, results show that, in 2007 the winner had achieved the best time in two of the disciplines: bike and run. The 2008 winner had achieved the best time in one discipline, the bike section. The 2009 winner had achieved the best time in two of the disciplines: the bike and the run (the same as in 2007). In the year 2010, the winner had achieved the best time in one discipline, bike (the same as in 2008). In 2011, the winner had achieved the best time in one discipline, the swim. In 2012, the winner had achieved the best time in the three disciplines: swim, bike and run, which is the only time this happened in the period of study between the years 2007 and 2013. At last, the 2013 winner had achieved the best time in two disciplines: swim and bike.

Table.2, shows the number of (times) that the female winner of the triathlon had achieved the best time in three, two and one discipline respectively, and the percentages which it represents.

Table 2. Number of times that the winner of the triathlon was the partial winner in three, two and one of the disciplines (Olympic-distance Volcano Triathlon (SD), Overall)

Volcano Triathlon “% Success”	#3 Disciplines	#2 Disciplines	#1 Discipline
14,29%	1 (time.)	-	-
42,86%	-	3 (times.)	-
42,86%	-	-	3 (times.)

It can be observed that for the editions between 2007-2013, the winner of the Volcano Triathlon won being the best in the three disciplines (14,29%). On the other hand, in 42.86% of the cases, the winners achieved the best time in two or three disciplines respectively.

Ironman Distance Triathlon: Ironman Triathlon (Long-Distance (LD)): Chronological Analysis:

Male Gender: Male gender from 2007 to 2011 in the Ironman Lanzarote, winner had obtained the best time in one discipline: 2007 (bike), 2008, 2009, 2010 (swim), 2011 (bike). 2012 and 2013 winners had obtained the best time in two disciplines, 2012 (bike, run), 2013 (swim, bike).

Table.3, Shows information of victories for each discipline as described above.

Table 3. Number of times that the winner of the triathlon was the partial winner in three, two and one of the disciplines (Ironman-distance Ironman Lanzarote (LD), Male)

Ironman Triathlon “% Success”	#3 Disciplines	#2 Disciplines	#1 Discipline
0,0 %	0 (times.)	-	-
28,57 %	-	2 (times.)	-
71,43 %	-	-	5 (times.)

Results above show that in male gender, in any of the events (0,0%) a winner of the Ironman Lanzarote had the best time in the three disciplines altogether. In two occasions (28,57%) the winner obtained the best time in two disciplines. In five occasions (71,43%) the winners of the Ironman Lanzarote won having obtained the best time in only one of out of the three disciplines.

Female Gender: In 2007, the winner had obtained the best time in two disciplines: swim and bike. In 2008, 2009, 2010, the winner had achieved the best time in one discipline: the swim. In 2011, like in 2007, the winner obtained the best time in two disciplines: swim and run. In 2012, the winner achieved the best time in one discipline: the swim. At last, in the year 2013, the winner obtained the best time in two disciplines: bike and run.

Table.4, Shows information of victories for each discipline as described above.

Table 4. Number of times that the winner of the triathlon was the partial winner in three, two and one of the disciplines (Ironman-distance Ironman Lanzarote (LD), Female)

Ironman Triathlon “% Success”	#3 Disciplines	#2 Disciplines	#1 Discipline
0,0 %	0 (times.)	-	-
42,86 %	-	3 (times.)	-
57,14 %	-	-	4 (times.)

As in male gender, none of the events (0,0%) of the female Ironman Lanzarote was won by a triathlete who obtained the best time in the three disciplines. In three occasions (42.86%) the winners won two of the disciplines. (57,14%) represents the editions in which the winners won with only one best discipline.

4. Discussion and Conclusion

For the Olympic Volcano Triathlon (SD), results show that the second discipline (the bike section) was determinant for men (71.43%), women (85.71%), and overall (78.57%). The first discipline, the swim (42.86%) shares the same value for men and women. While the third discipline, the run is a more decisive segment for women (42.86%) vs. men (28.57%).

In the case of the Ironman Lanzarote Triathlon, in male gender, the swim is determinant (57,14%) much more than the bike (42,86%) second place, and run (28,57%) last place. For women the results are the opposite: the determinant discipline is the third segment, then run (85,71%), the swim segment (42,86%) is the second more important, and the bike segment (14,29%) is the less relevant. Overall male and female, both, the swim (50%) and the run (57,14%) have similar relevance, which is just the double of the bike segment with (28,57%).

If we compare results from the Olympic Volcano Triathlon (SD) with the Ironman Lanzarote Triathlon (LD), in terms of discipline relevance, we can deduce significant differences between the two events. Even though the swim is similar in both distances, the Volcano Triathlon (SD) and the Ironman Lanzarote (LD), it can be observed that the bike discipline is completely different in both races, (78,57%) Volcano Triathlon (SD) vs. (28.57%) Ironman

Lanzarote (LD); which is even more decisive in Short-Distance competitions (with a small deviation in women). The third discipline of the triathlon, the run segment, is more relevant in Long-Distance (57,14%) vs. Short-Distance (35,71%), with a slight difference in women.

Considering all these aspects, it can be concluded that the role of each discipline in both races, Short-Distance and Long-Distance, is substantially different although they share similarities. The swim discipline must be considered for the Ironman preparation, and not the bike segment, as this is essential for winning an Ironman event. On the other hand, the run segment is important for winning both, an Olympic-distance triathlon and an Ironman Triathlon.

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References

- [1] VLECK VE, BÜRGI A, BENTLEY DJ. The consequences of swim, cycle, and run performance on overall result in elite Olympic distance triathlon. *Int J Sports Med.* 2006; 27:43-48. doi:10.1055/s-2005-837502 [Back to text]
- [2] KREIDER RB. Physiological considerations of ultraendurance performance. *Int J Sport Nutr.* 1991; 1(1):3-27.
- [3] HAWLEY JA, HOPKINS WG. Aerobic glycolytic and aerobic lipolytic power systems. A new paradigm with implications for endurance and ultraendurance events. *Sports Med.* 1995; 19(4):240-50.
- [4] Berthelot G, et. al JF (2010) Athlete atypicity on the edge of human achievement: performances stagnate after the lastpeak, in 1988. *PLoS One* 5:e8800
- [5] LANDERS GJ. Anatomical, biomechanical and physiological loading during human endurance performance at selected limb cadences via triathlon. Doctoral Thesis: Department of Human Movement and Exercise Science. The University of Western Australia; 2002.
- [6] PATON CD, HOPKINS WG. Competitive performance of elite Olympic-distance triathletes: reliability and smallest worthwhile enhancement. *Sport science.* 2005; 9:1-5.
- [7] LEPERS R. Analysis of Hawaii ironman performances in elite triathletes from 1981 to 2007. *Med. Sci. Sports Exerc.* 2008; 40(10):1828-1834. doi:10.1249/MSS.0b013e31817e91a4
- [8] BENTLEY DJ, MILLET GP, VLECK VE, MCNAUGHTON LR. Specific aspects of contemporary triathlon: implications for physiological analysis and performance. *Sports Med.* 2002; 32:345-359. doi:10.2165/00007256-200232060-00001
- [9] CHATARD JC, CHOLLET D, MILLET G. Performance and drag during drafting swimming in highly trained Triathletes. *Med Sci Sport Exerc.* 1998; 30:276-1280. doi:10.1097/00005768-199808000-00015
- [10] MILLET GP, VLECK VE, BENTLEY DJ. Physiological requirements in triathlon. *J Hum Sport Exerc.* 2011; 6(2):184-204. doi:10.4100/jhse.2011.62.01
- [11] J. BRISSWALTER, C. HAUSSWIRTH. Consequences of drafting on human locomotion: benefits on sports performance. *International Journal of Sports Physiology and Performance.* 2008, 3(1): 3-15.
- [12] J.C. CHATARD, B. WILSON. Drafting distance in swimming. *Medicine and Science and Sports and Exercise.* 2003, 35(7): 1176-1181.
- [13] G.P. MILLET, D.J. BENTLEY. The physiological responses to running after cycling in elite junior and senior triathletes. *International Journal of Sports Medicine.* 2004, 25: 191-197.