

The evolution of world records at 100 meter dash and the dynamics of the factors that influenced the sprinters performance capacity

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Abstract

The first 100 m men's world's unmatched record but published by the IAAF was held by William MacLaren, a British athlete who ran in 1867 at Haslingden (a small town in the Rossendale Valley in Lancashire), 110 yards (100.58m) in 11,0 seconds with manual timing.

The first IAAF official world record was obtained by the American athlete Donald Lippincott, in Stockholm (Sweden), during the 1912 Olympic Games, when he won 100m with 10.6 seconds.

The total number of world records at 100 m recorded by the IAAF since 1867 to date amounts to 206 new records and equal records. Of these, 23 records were set before the IAAF set the conditions for the approval of a world record to be officially registered (1912), and 188 records are official. 150 official world records were manually timed and 33 records were automatically timed.

What are the factors that have determined over time this dynamic of world records, implicitly the performance capacity of sprint athletes? In this study we will try to identify the main factors and how they influenced athletic performance.

Keywords: word records, 100m, sprint athletes, factors, performance capacity.

1. Introduction

2. A brief history of 100m dash

Track and field is a sport that consist of various athletic contests involving running races, and jumping and throwing events. Track and field was known simply as “athletics” in the 19th century, as events like the 100-meter dash, marathon run, long jump, and shot put were regarded as ultimate test of athletics skill.

Track and field’s program of events is largely derived from ancient athletic festivals held by Greece and the British Isles. Both the original Olympiad in ancient Greece and the Celtic Tailteann Games date from around the 9th century BC. These pageants played host to the best athletes throughout the land, who contested running, jumping, and throwing events in addition to wrestling, “feats of strength”, archery, and in the case of the Greeks, swimming. (Crego R, 2003)

The first Greek Olympics took place in 776 BC. It lasted for one day and featured sacrifices in honor of the Greek gods, especially Zeus. The only athletic event was a sprint from one end of the race course to the other. It was called a “stadion”, or “stade”, and its distance was about 192 meters. From 776 to 724 BC, the stadion was the only event at the Olympic Games; the victor gave his name to the entire four-year Olympiad. The winner of the stadion at the first Olympic Games was Koroibos of Elis, the subsequent four-years was called the Olympiad of Koroibos.

Eventually the Olympics became a five-day event and included other contests, such as boxing and the pentathlon. In the pentathlon, the athlete participated in five events, including a sprint. However, the original stade continued to be the chief event, and its popularity continued until Emperor Theodosius I, who abolished the games in 394 AD.

The Tailteann Games were funeral games associated with the semi-legendary history of Pre-Christian Ireland. Some historical sources place the beginnings of these games around 1600 BC, others in 632 BC. These were celebrated until

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the year 1169-1171 AD when they died out after the Norman invasion. Games included the long jump, high jump, running, hurling, spear throwing, boxing, contests in sword fighting, archery, wrestling, swimming, and chariot and horse racing.

Though cultural and religious trends in Europe tended to downplay athletics throughout medieval times, the sport of pedestrianism began to gain popularity in Britain and Western Europe beginning in the late of 17th century. While most pedestrians engaged in long walks runs for distance, some enjoyed short-course competition and sprinting, typically between either two or several competitors and usually linked to gambling.

The French tried to revive the Olympics during the French Revolution. Contests were held three years in a row from 1796 to 1798. The French had recently invented the metric system, so for the first time, Olympic athletes competed on race tracks measured in meters.

Track and field grew out of pedestrianism in 19th century England and took two distinct forms, one professional and one amateur. Professional track and field had no regulation, with many athletes making a living on cunning and skill. There are numerous accounts of sprinters who would travel from town to town in disguise, pretending to have little skill or knowledge of racing until they had convinced several local competitors to run against them and even more spectators to place bets against them.

As so many organized sports in Victorian England, track and field was a product of the public schools and universities. The first intramural competition was held at Eaton College in 1837. In Britain and USA, the 100 yards dash or “century” as it was called, came to be standard by which men of speed were measured. To run “even time” was to break 10 seconds in the 100 meters yards.

Running races were also included in other attempts to revive the Olympics, such as the Grand Olympic Festival, which took place in Liverpool during the 1860s. Greece also attempted to revive the Olympics at about the same time. This revival, called the Olympia of Zappas, featured a re-enactment of the ancient stade sprint.

In 1864 the initial Oxford versus Cambridge intercollegiate athletics meet was staged – an event generally regarded as the “foundation meeting” of modern athletics. In the latter quarter of the 19th century, track and field gained popularity throughout colleges and clubs in England and along the northeastern seaboard of USA.

When the modern Olympic Games began in 1896, sprinters ran a 100-meter dash and a 400-meter dash. A 200-meter dash was added in the 1900 Olympics, and teams of four sprinters began to run relay races in the 1912 Olympics. Women’s sprint events were added in the 1928 Olympics. The format of the races changed. Ropes, which originally separated the sprinting lanes, were eventually discarded.

According to the IAAF, the first unofficial 100-yard dash record for a professional athlete was obtained in London, in 1850 by George Seward (GBI), with a performance of 10.0 seconds, and the first unofficial record of an amateur athlete was obtained at Cambridge by Thomas Bury (GBI), in 1855, with a performance of 10.0 seconds. The last official record of this distance was obtained by Johnny Jones (USA) in 1977 with a performance of 9.21 seconds, at the College Triangular Meeting in Texas, USA.

The first 100 m men's world's unmatched record but published by the IAAF was held by William MacLaren, a British athlete who ran in 1867 at Haslingden (a small town in the Rossendale Valley in Lancashire), 110 yards (100.58m) in 11,0 seconds with manual timing.

The first IAAF official world record was obtained by the American athlete Donald Lippincott, in Stockholm (Sweden), during the 1912 Olympic Games, when he won 100m dash with 10.6 seconds.

The first unofficial record of a woman, obtained at a distance of 110 yards dash, was made by Mamie Hubbard (USA) in New York in 1890. The last official record recorded at this distance was obtained by the athlete Chi Cheng (TPE) in the year 1970 with a performance of 10.0 seconds.

The first unofficial record obtained by a woman on the 100 meters dash is held by Aino Rannanpaa (FIN), when in 1902, in Helsinki he traveled this distance with a performance of 17.4 seconds. The first official record in this distance belongs to the athlete Marie Mejzlicova II (TCH), when in a contest in Prague, in 1922, she traveled the distance of 100 meters dash in 13.6 seconds.

Since the beginning of the athletic events, the short distance races have been an attraction for athletes and spectators. On the other hand, speed runs represented one of the most historical races along with the marathon.

3. Analysis of the evolution of world records at 100 meters dash

The first 100 m men's world's unmatched record but published by the IAAF was held by William MacLaren, a British athlete who ran in 1867 at Haslingden (a small town in the Rossendale Valley in Lancashire), 110 yards (100.58m) in 11,0 seconds with manual timing (see Fig.1). During this period, the veracity of the times is under many question marks, there being reports that in many situations the times were approximate, there were no specific timing tools, at other times the running surface was not perfectly flat, the wind was not taken into consideration and the situations where the start was stolen was not regulated by regulation. Between 1867 and 1912, Britain awarded 4 world records, the United States 3 records, Belgium one record, Sweden 7 records, Upper Africa one record and Germany 6 world records. As can be seen in the figure below, in 45 years the world record has improved by 0.5 seconds, the longest period in which the world record has not changed was for 14 years (10.80 seconds) between 1892 and 1906.

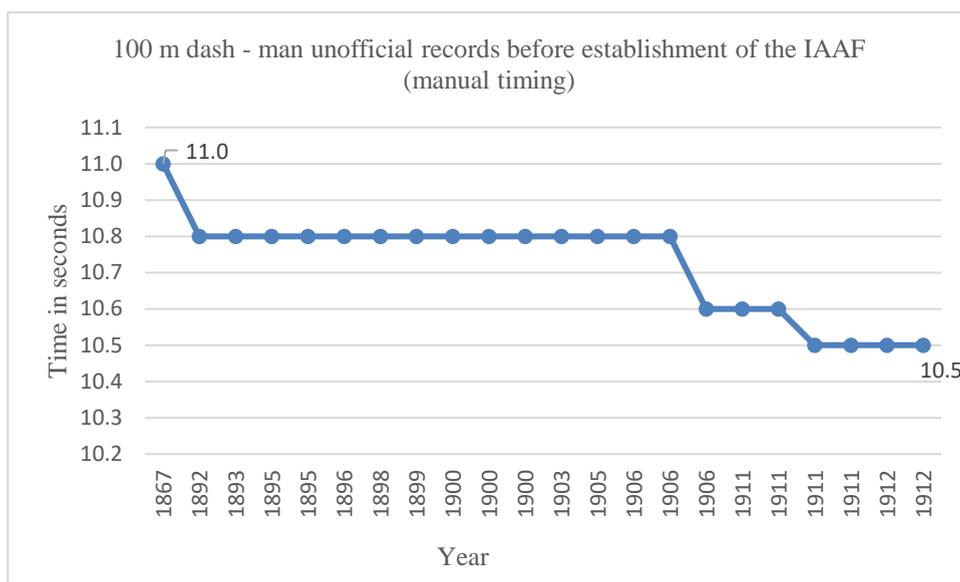


Fig.1

The first official world records were manually recorded and recognized by the IAAF, with the establishment of this international forum. The first IAAF official world record was obtained by the American athlete Donald Lippincott, in Stockholm (Sweden), during the 1912 Olympic Games, when he won 100m with 10.6 seconds. Thus, between 1912 and 1977 there were 108 world records and equal world records, of which 8 world record improvements (see Fig.2). Of these, 7 record enhancements and another 51 matched world records were obtained by US athletes. Another 25 records were matched by athletes from Germany, then the Federal Republic of Germany.

As can be seen in the figure below, in 74 years the world record has improved by 0.8 seconds, the longest period when the world record has not changed was for 20 years (10.20 seconds), between 1936 and 1956.

The last IAAF official world record, manual timing, was obtained by the Nigerian athlete Chidi Imo, in Berlin (Democratic Republic of Germany), in 1986, when he won 100m with 9,80 seconds.

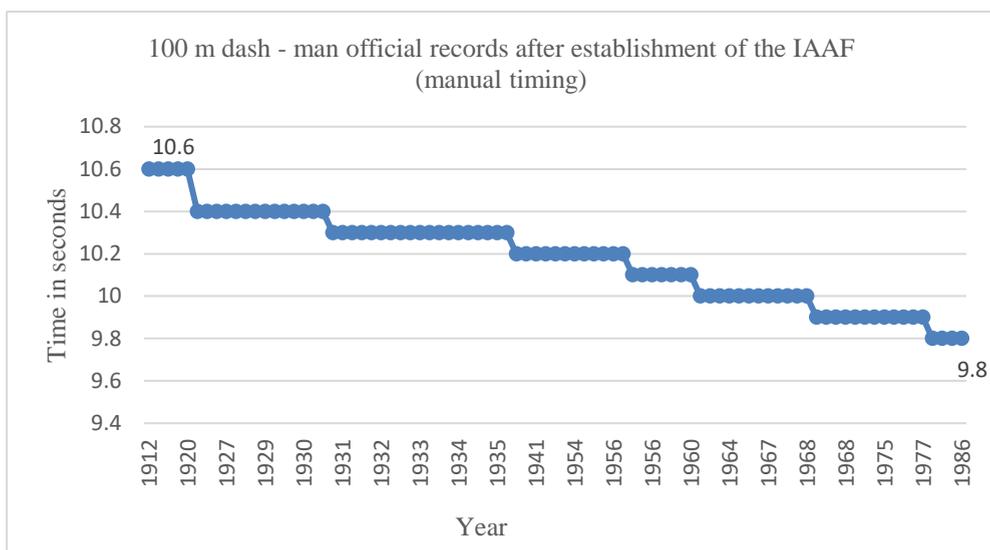


Fig.2

The world records as they are known today are those recorded with automatic timing, and in order to be approved they must comply with the IAAF athletic regulations. Automatic timing started in 1932, since then, the world record being improved or equaled 33 times. The times obtained by the runners being recorded at the level of hundreds of seconds, caused the world record to be improved 27 times and equaled only 6 times. Athletes in the United States have managed to improve or equal the world record 18 times. Their supremacy has been overthrown since 2005 by two Jamaican athletes, Asafa Powell and Usain Bolt, who have achieved 5 world record improvements and two draws. In 87 years of automatic timing, the world record improved by 1.06 seconds, the most spectacular leap in the world record taking place during the Jamaican rule. The current world record is 9.58 seconds, obtained by Jamaican athlete Usain Bolt in 2009, in Berlin (Germany), in the final of the World Championships (see Fig.3). The longest period when the world record has not changed was for 16 years (10.38 seconds), between 1932 and 1948. The second longest period when the world record has not changed was for 15 years (9.95 seconds), between 1968 and 1983.

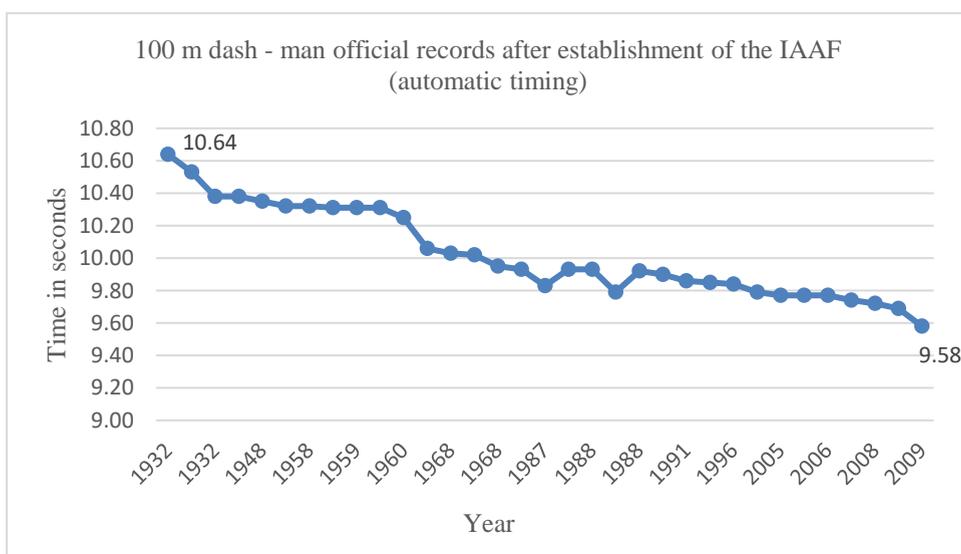


Fig.3

As shown in Table 1, the last 10 records at 100 meters dash have managed to descend below the ten second barrier, the performance achieved since 1968. Of these, seven are athletes from the United States two are from Jamaica and one from Canada. The extraordinary performance of 9.58 seconds per 100 meters dash of Jamaican athlete Usain Bolt, is already 10 years the most valuable result in this distance, announcing a record that many years will not be broken.

Table 1. Top 10 men world record holders at 100 meters dash

Mark	Wind	Competitor	DOB	Country	Venue	Date
9.58	0.9	Usain BOLT	21-Aug-86	JAM	Olympiastadion, Berlin (GER)	16-Aug-09
9.74	1.7	Asafa POWELL	23-Nov-82	JAM	Guidobaldi, Rieti (ITA)	9-Sep-07
9.79	0.1	Maurice GREENE	23-Jul-74	USA	Athina (GRE)	16-Jun-99
9.84	0.7	Donovan BAILEY	16-Dec-67	CAN	Olympic Stadium, Atlanta, GA (USA)	27-Jul-96
9.85	1.2	Leroy BURRELL	21-Feb-67	USA	Pontaise, Lausanne (SUI)	6-Jul-94
9.86	1.2	Carl LEWIS	1-Jul-61	USA	Olympic Stadium, Tokyo (JPN)	25-Aug-91
9.93	1.4	Calvin SMITH	8-Jan-61	USA	Air Force Academy (USA)	3-Jul-83
9.95	0.3	Jim HINES	10-Sep-46	USA	Estadio Olímpico, Ciudad de México (MEX)	14-Oct-68
9.9h	0.9	Charlie GREENE	21-Mar-45	USA	Sacramento, CA (USA)	20-Jun-68
9.9h	0.8	Ronnie Ray SMITH	28-Mar-49	USA	Sacramento, CA (USA)	20-Jun-68

The first unofficial record obtained by a woman on the 100 meters dash is held by Aino Rannanpaa (FIN), when in 1902, in Helsinki he traveled this distance with a performance of 17.4 seconds. (see Fig.4). Between 1902 and 1919, the world record has improved by 13 times with a total of 4.60 seconds, the longest period in which the world record has not changed for 6 years (between 1913-1919). The beginning of women sprint obviously was the dominated by Finland who awarded 11 out of 13 world records.

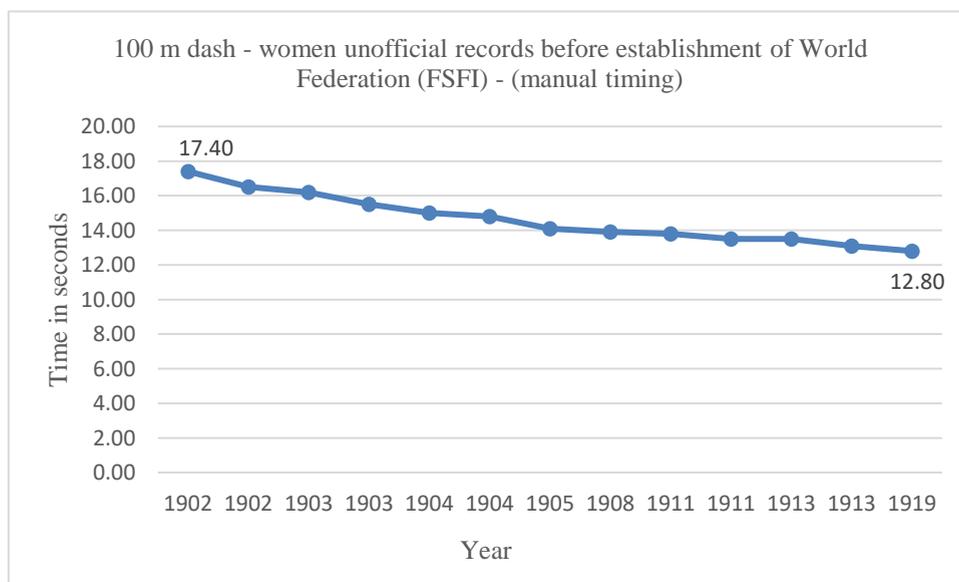


Fig.4

4. Factors that throughout time influenced the sprinters performance capacity

This last part of the research, concentrates on the analysis of some important key factors that influence sprinters' performance. In general, the main factors that determine the performance of an athlete at the 100m race are the following:

- **Wind:** In track and field, wind assistance is the benefit that an athlete receives during a race or event as registered by a wind gauge. Wind is one of many forms of weather which can affect sport. In these events, the maximum legal wind assistance is 2.0 meters per second. If the runners of a race receive more wind assistance than this, their times will not be eligible as collegiate, national, or world records. On May 31, 2008, Usain Bolt ran a 100m time of 9.72 seconds with a +1.7m/s wind, officially breaking the 100 meter world record. On June 29, 2008, Tyson Gay ran a 100m time of 9.68 seconds with +4.1m/s wind. Despite having a faster absolute time, he does not receive the world record.

- **Altitude:** The physics of high altitude sports performance and the advantages derived by the competitors in such venues are as varied as they are emphatic. Intense research conducted in the wake of the world record onslaught at Mexico City confirmed that the reduced wind resistance and drag upon the competitors' bodies in the thin air permitted the athletes to move with greater efficiency. So long as the event did not involve prolonged duress to the aerobic energy system and its dependency upon maximal amounts of oxygen, an athlete could expect better performances in higher altitude. The 1968 Olympics held in Mexico City were the first games staged at a high altitude 2,300 m, and the number of world records set was indicative of the impact of the thinner air on performance. Records fell in almost every track event from the 100 m dash to the 1.500m.

- **Reaction Time:** In the world of track and field, reaction time is known to be a pivotal aspect of a top-level athlete's technical arsenal, separating the gifted from the elite. Reaction time is defined as the interval of time between the onset of a stimulus, and the initiation of a response. Brain electrophysiological studies have confirmed that cerebral potential amplitude increases during the acquisition of a new skill, specifically premotor potential, which is the "decision-to-act" portion of reaction time; this potential was predictably higher in the expert sprinters (Collet, 1999). This revelation in neuroscience provides proof that reaction time does have an environmental basis, in other words, it is both learned and trainable. The reaction time is the time it takes for the runner to respond to the start signal and begin leaving the starting blocks. IAAF policies consider that there is a limit to how fast a human can react to a start signal. As of 2002, if an athlete left the blocks sooner than 100 mSec after the start signal, he was deemed to have false-started. Some fans think this is wrong and that any reaction after the gun should be allowed. The best athletes reaction times are usually in the range of 120 mSec (0.12 sec) to 160 mSec. Tim Montgomery improved that to a near perfect 104 mSec - and came very very close to being false-started. The only sprinter to get closer to perfection was Surin Bruny - who managed a 101 mSec in the 1999 WC 2nd semi-final.

- **Temperature and Humidity:** At fixed pressure and temperature, the range of realistic humidity variations shows little influence on 100 meter race times, yielding corrections of under 0.01 s for the range considered. Since race times are measured to this precision, the effects would be no doubt negligible. Similarly, if temperature is allowed to vary at a fixed humidity level, the corrections grow in magnitude but are still relatively small 0,023 s.(Mureika J R, 2006)

- **Track Surface:** At the beginning of modern athletics, in the 19th century, the running surfaces were totally different from those of today. The athletes ran on the streets, on the grass, on battered soil. Only at the end of the century the surfaces began to be beaten, and covered with slag. Unlike modern times, in the 19th century were only four to five to six lanes in the stadium of those days. That meant athletes had to run more qualifying races, sometimes on the same day. Starting in the late 1950s, artificial surfaces using a combination of rubber and asphalt began to appear. An artificial warm-up track was constructed for the 1956 Summer Olympics in Melbourne, Australia. During the 1960s many of these tracks were constructed; examples still exist today. In the mid-1960s Tartan tracks were developed, surfaced with a product by 3M. The name Tartan is a trademark, but it is sometimes used as a genericized trademark[citation needed]. This process was the first to commercialize a polyurethane surface for running tracks, though it was originally conceived for horse racing. Since the early 1980s, the manufacturer of the surfaces selected for most championship meets has been the Italian company, Mondo, again the trademarked brand name becoming used as a genericized trademark. Mondo's track surface is called Mondotrack. This form of construction gives a more

consistent bounce (or energy return) and traction. As an example of Mondo-track, this surface were used even in 2016 Summer Olympics in Rio de Janeiro, Brazil. (https://en.wikipedia.org/wiki/All-weather_running_track)

- **Spikes:** The first track spikes date back to the 1850's. They were made by runners looking to increase traction on dirt tracks. The first 'spikes' consisted of little more than nails driven through the sole of the shoe. Kangaroo leather, touted for its strength and low weight, found its way into the uppers of early spikes. This leather would continue to see widespread use in the uppers of competition shoes until the 1970's. In 1900's. in a rural Bavarian town called Herzogenaurach a cobbler by the name of Adi Dassler begins handcrafting sports shoes, including track spikes. His shoes become known for their build quality, and with the money he earns he goes on to found Adidas, today one of the largest sportswear companies in the world. In 1936, Adi Dassler took note of the Olympic Trials performances of an American by the name of Jesse Owens. Despite the risk of being caught by the Nazi regime, Dassler contacted Owens and convinced him to use his spikes during the upcoming Games in Berlin. Owens won four gold medals. Fast forward to 1960, when American sprinter Wilma Rudolph, heralded as the fastest woman in the world, wore spikes featuring a midfoot shank and a nylon spike plate. Structure was provided by a heel cup and adidas' iconic 3-stripes logo purchased from Finnish brand Karhu Sports. Though removable spikes were first developed around the 1930's, fixed spikes remained in favor due to their strength and weight for several decades. The spikes worn by Alberto Juantorena in the 1976 Olympic Games were among the first to feature a modern removable spike system, allowing for the customization of the spike configuration for track surface and personal preference. Take another leap 20 years and you have Michael Johnson's iconic gold Nikes. These shoes caught the world's collective eye during the 1996 Olympics in Atlanta. Made of Zytel – a lightweight combination of nylon and fiberglass, these spikes tipped the scale at a meager 90g and were designed to last through a single use. (<http://blog.runningwarehouse.com>)

- **Clothing:** For the first time a mandatory clothing was imposed at a major athletics competition by the organizers, at the 1912 Stockholm Olympic Games. The official 1912 Olympic Report outlined that “each competitor shall wear a jersey with short sleeves and drawers to the knees, and shall also have on back and front during competition a distinctive number corresponding to the number in the programme assigned to him by ballot.” Over the years, shoes got lighter and the clothing tighter. In the 1970s, synthetic materials began to make their way into running uniforms and the differences between attire for short- and long-distance runners began to grow. With an eye on aerodynamics, sprinters opted for closer-fitting speed suits while marathoners focused on light material that would not get weighed down by mile after mile of sweat. The 1984 U.S. Olympic uniforms in were designed with the consultation of NASA scientist Lawrence Kuznetz. Applying technology used in space suits for American astronauts, Kuznetz and Kappa Sport created a double-knit, aluminum-coated fabric aimed at deflecting the sun's rays and pulling perspiration from the body. In 1988 Seoul Olympic Games the biggest uniform story of the Summer Games centered around Florence Griffith Joyner. In the Olympic Trials, Flo Jo wore an iconic brightly colored one-legged body suit (right), a get-up that was not allowed in Seoul. By the early '90s, sprinters had opted for tight, synthetic uniforms. By 1996, midriff clothing were a frequent sight on the Olympic track. By the 2008 Olympics in Beijing, computer modeling had been widely incorporated into athletic uniform design, with aerodynamic tweaks aimed at reducing wind resistance. The idea that technology could—and should—shave time off sprinters' races was becoming standardized.

- **Training, Recovery:** Sprint training were present since the 19th century. The training philosophy has undergone changes due, in particular, to the experiences of athletes and coaches, and later in the 20th century, due to the multidisciplinary approach to training athletes. Broadly speaking, the sprinters' training takes into consideration, depending on the ontogenetic development of the athlete, several methodical aspects that ultimately converge to the improvement of the performance capacity. These consider both the improvement of the starting and running technique and the development of specific physical qualities. Thus the sprinters training follows the development of general and specific endurance, development of speed under all its forms of manifestation, development of general and specific strength of the muscle groups involved in the effort, education and the development of power, improvement of the starting and running technique through specific and aiding exercises, a careful and correct periodization of sports training, a proper use of the effort parameters within each training session and assuming tangible intermediate and final goals and not least mental and mental training. On the other side in today's competitive sport environment, discovering effective methods of facilitating optimal athletic performance is paramount to success. The recovery period is essential in maintaining athletes physical and psychological well-being and crucial in the pursuit of intense physical training and satisfying performances. General a scientific base of recovery has in consideration the

physiology of optimal training how to prevent overtraining, how to peak for optimal performance, recovery at the muscular level, nutrition strategies, electrostimulation, compression, massage, and immersion procedures, among others.

- **Doping in sport:** The use of drugs in sports goes back centuries, about all the way back to the very invention of the concept of sports to help increase performance capacity. According to a study commissioned by the World Anti-Doping Agency (WADA), actually 44% of athletes had used banned substances during their careers. Nevertheless, only 0.5% of those tested were caught. The World Anti-Doping Agency is a foundation created through a collective initiative led by the International Olympic Committee (IOC). It was set up on 10 November 1999 in Lausanne, Switzerland, as a result of what was called the "Declaration of Lausanne", to promote, coordinate and monitor the fight against drugs in sports. (https://en.wikipedia.org/wiki/Doping_in_sport)

5. Conclusions

In conclusion, this study aimed to evoke the best world performances of male and female sprint over two centuries, in the context of the factors that influenced the value of these performances.

As you can see, the men's sprint began its journey of world records with a performance of 11.0 seconds in 1867. At 152 years distance the phenomenal record held by Usain Bolt, 9.58 seconds promises to remain long unbeatable. So the male sprint took a century and a half to improve his performance on the 100 meter dash with 1.42 seconds.

As the modal records showed, they were for a long time estimated and approximated, the subjectivity of the human factor being largely present. Once the introduction of automatic timing and rules regarding the approval of world records, these results have become indisputable.

Studying the graphs of the evolution of world records for both men and women, it can be seen that world records have stagnated, especially in the 20th century, during critical historical periods, characterized by instability and changes in political regimes, wars, etc.

On the other hand, in the period after World War II, an unprecedented revival of sport and results in the communist countries is observed.

The male sprint began to be dominated by color athletes starting in the second half of the 20th century, while the female sprint was dominated by Caucasian athletes until the end of the last century when color athletes from United States gained their supremacy.

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