IMPACT OF THE SARS-COV-2 PANDEMIC ON ATHLETIC PERFORMANCE IN THE 100-METER RACE

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Abstract. *The COVID-19 virus has caused numerous deaths among the Romanian population and worldwide, which has entailed the restriction of certain rights regarding the training of elite athletes. Most sports competitions were cancelled all over the world, even the 2020 Olympic Games, thus jeopardising the athletes' performance. The purpose of this research is to make a comparison between the results of Romanian elite athletes in the sprint race (100 m) before and after the emergence of the SARS-CoV-2 virus and to identify certain parameters specific to these races: start reaction time, heart rate (during exercise and at rest) and stride frequency. In order to identify and monitor these parameters, we used the Polar Flow application, which is popular among both team and individual athletes. It was found that the average heart rate during competition had the value 175 beats per minute before the pandemic, while after the period of restrictions, it was 184 beats per minute; at rest, the average heart rate values were 66 beats per minute and 78 beats per minute, respectively. The average values recorded in the outdoor and indoor 100 m races are as follows: before the pandemic, 6.70 s and 10.66 s, respectively; after the period of restrictions, 6.88 s and 10.85 s, respectively. The enforcement of constraining conditions that affect the optimal development of training leads to changes in physiological parameters and significant differences between the results obtained.*

Keywords: *performance, 100 m sprint, COVID-19, athletics.*

Introduction

Athletics consists of a multitude of sporting events that include running, jumping, throwing as well as road, cross-country and walking events. The most common are cross-country races and road races (walking and marathon). Athletics is largely considered an individual sport, except for relay races (4 x 100 m and 4 x 400 m) and events involving the participation of a team (cross-country).

Athletics, but particularly the 100 m race, is one of the most watched competitions, which keeps the spectators speechless when seeing the competitors' constant attempts to overcome human limits and surpass themselves.

Reaching excellence in sprint races (100 m, 60 m) relies on athletes' ability to accelerate, which is a decisive factor in increasing performance. In the 100 m race, the athlete can best express the characteristics and nature of the skills acquired. Performance over this distance is based on "athletes' capability to accelerate their muscle mass and generate high amounts of running speed in the forward direction of motion" (Ghosh & Bhowmick, 2018, p. 144). Compared to other sprint events (200 m or 400 m), the simplicity of the 100 m race offers the possibility to clearly identify the key elements required for the ability to develop speed. In the other races mentioned above, where running into the turn must also be taken into account, we cannot talk about a concrete study on rectilinear movement, given that other forces and structures are involved in the running steps.

In order to accelerate, the neuromuscular system (especially of the trunk and lower limbs) must "generate force, and this force is in turn applied onto the supporting ground during the support phase of the running step cycle" (Ghosh & Bhowmick, 2018, p. 144).

The professionalism of athletes also consists in their ability to generate power, an indispensable feature for the production of running speed in sprinting events. The question is how much power an athlete can produce to be able to effectively push off the starting block, how capable an athlete is to maintain the optimal position and push forward when sprinting but also to maintain the maximum speed reached until the end of the race. Without this motor quality, the sprinter would not be able to produce force and speed, and without reaction speed, the race would be lost when leaving the starting block.

There are many factors that affect sports performance, from the athlete's training condition to psychological factors. Both physiological and psychological factors are important in athletics competitions. "The athlete who is sure to win enters the finish line by slowing down. This is not a physiological but a psychological phenomenon." (Turkeri & Ozturk, 2020, p. 26) Slowing down before the finish line includes physiological and psychological factors; this situation may play a role in winning the race, but it may also cause the athlete to lose the race. Therefore, athletes should focus on not slowing down until they reach the finish line.

The start of a 100 m race is initiated by a starter who uses two verbal commands and then the gunshot to indicate that athletes are allowed to leave the starting blocks and run at full speed to the finish line. An official competition includes certain systems that can detect wind speed, temperature and atmospheric pressure. The current use of electronic technology to measure athletic performance has a substantial contribution, given that such technology was not available in the competitions held before the 1900s. The operating standards of electronic devices measuring the start reaction speed stipulate that if it is below 0.100 s, the competitor will be disqualified. Reaction time when clearing the block is the only method of quantifying the start speed, which is measured from the moment the starter's gun is fired until the athlete pushes off the block, which triggers an attached sensor that measures the reaction rate.

Start reaction time is a main factor that influences the sprinters' performance. The research conducted by Helmick (2003) shows that reaction time has an input of about 1% to 2% in general and 5% in a 100 m race. Since scientific research results for training improvement are available, coaches and athletes should pay more attention to improving the start reaction time. Acceleration speed refers to stride frequency and length; their optimal ratio depends on the maximum speed reached. In order to develop a higher speed, it is necessary to increase stride frequency or length; ideally, both parameters should be increased, which is quite difficult because stride frequency depends on stride length (Ferro-Sánchez et al., 2001).

World-class athletes perform about 45 steps on average in a championship final (Smith, 2005). Given the number of steps performed within a short time, a sprinter goes through four phases: start reaction speed, acceleration, maximum speed, maintaining the acceleration speed reached in the previous phase (Saunders, 2004; Sugiyama et al., 2000).

It is not clearly established how these two kinematic parameters (stride frequency and length) interact with each other over the entire distance of 100 m; there are no data on the relationship between them and "on how world-class sprinters manipulate stride frequency and stride length in order to reach optimal efficiency of the sprint run" (Krzysztof & Mero, 2013, p. 150).

Although there are numerous studies conducted on world-class athletes, none has so far thoroughly examined the training components (duration, intensity, recovery, rest) or methods (Solli et al., 2017) used across an annual cycle.

Sports training and competitions during the pandemic

On 16 March 2020, the state of emergency was established throughout the Romanian territory for 30 days (Președintele României [President of Romania], 2020). This decree restricted physical activity in sports facilities. At that time, there were 158 coronavirus cases and 0 deaths in our country (World Health Organization, 2019a). Within less than 30 days, on April 15, the number of infections rose to 6,879 cases (with an increase of 97.71%), and the number of deaths rose to 344 cases. On the same date, there were 1,914,204 infections and 122,998 deaths caused by COVID-19 worldwide (World Health Organization, 2019b).

Sporting events were cancelled across the globe for both amateur and professional athletes, who had to give up the normal training process and perform it in unfavourable and inadequate conditions for the specifics of their activity. "The enforced isolation is expected to lead to cessation of organised training/competitive activity and prolonged periods of inactivity, broken up by rare practice sessions in suboptimal conditions." (Urbański et al., 2021, p. 2) Maintaining the training routine at an optimal level is essential in athletes' lives because it ensures their qualification for competitions and the achievement of good results.

In a project initiated by the Romanian Athletics Federation and entitled "Romania's Champions 2020", we identified several interviews that clearly highlighted that the most difficult period experienced by athletes in 2020, in terms of sporting life, was represented by the pandemic, more precisely the state of emergency period. During that time, athletes faced many barriers in the training process for domestic competitions held in September 2020. Unlike team sports where the result depends on collective work, in individual sports, the responsibility for success or failure belongs solely to the athlete, which involves paying more attention to the training process.

The economic impact of COVID-19 on sports clubs at local and national levels was severe, and many of them announced that they would not be able to cope with the crisis in the case of a second wave of the pandemic (Keshkar et al., 2021). From this point of view, the sports clubs providing funding for athletes faced financial difficulties, which had a negative impact on sports performance, given that their motivation and determination dropped.

Research purpose

The paper aims to identify the most important changes produced in the performance of 100-m sprint runners (competing in Romania) between the pre-pandemic period and the year when the SARS-CoV-2 virus emerged. The competitive year 2020 compared to 2019 was a challenge for each individual event because athletes had to use various methods to maintain an optimal physical shape and achieve the proposed goals. Online physical training or improvisation of training methods did not involve specific training, and the prerequisites for obtaining notable performance were far from an achievable dream.

Methodology

The six athletes analysed in this study are among the best rated in the last three years. They benefitted from a training plan designed by each coach, which was adapted to existing conditions. Through technology, we monitored and analysed several parameters such as heart rate (during exercise and at rest) and the number of steps performed in a 100 m race. The analysis was based on athletes' results before and after the lockdown period, which led us to conduct a comparative study.

"Heart rate monitoring is useful in wide areas including clinical medical care, pervasive health care, sports and well-being." (Parak & Korhonen, 2014, p. 3360) In 1982, Polar Electro produced the first wearable HR monitor for sport purposes, which was based on ECG monitoring (Laukkanen & Virtanen, 1998). Several studies on the assessment of differences in exercise intensity showed mixed results, depending on the device and the type of physical activity. Spierer et al. (2015) have concluded that the heart rate measurement error increases with exercise intensity for Omron HR500U and Mio Alpha devices when running and using the stationary bike. Stahl et al. (2016) examined exercise heart rate using Mio Alpha, Fitbit Charge, Basis Peak, Microsoft Band and TomTom Runner Cardio monitors and identified the highest percentage of error for treadmill running and the lowest for walking.

The Polar M430 watch, along with the Polar Flow application, tracks heart rate during both exercise and breaks between repetitions, thus providing accurate information that can contribute to a general picture of each athlete's level of training. This application can also provide data on the number of steps in a race to identify their frequency and regularity.

Results

We will present statistical data for the outdoor and indoor 100 m and 60 m races in order to make a comparison between the non-pandemic and pandemic periods.

Table 1. *Statistical data obtained with the t-test for the 100 m race*

No.	Results before and during the pandemic	Mean	Std. deviation	t-Test	t-Test for correlated means
1.	Best result	10.52	± 0.17		
2.	Non-pandemic result (2019)	10.66	± 0.16		
3.	**Best result - Non-pandemic result (2019)**	0.14	± 0.09	.01	.02
4.	Pandemic result (2020)	10.85	± 0.26		
5.	**Best result - Pandemic result (2020)**	0.33	± 0.11	.03	.66
6.	**Non-pandemic result (2019) - Pandemic result**	0.19	± 0.26	.12	.49
7.	Age	24.50	± 2.25		
8.	**Best result - Age**	-	-	-	.02
9.	**Non-pandemic result - Age**	-	-	-	.18
10.	**Pandemic result - Age**	-	-	-	.95

*($p < 0.05$)

The data in Table 1 show the outdoor results obtained in 2019 and 2020 as well as the best career results in the 100-m flat race, which is the topic of this paper. One can see an average

of the best results (10.52), an average of the 2019 results (10.66) and an average of the results in the pandemic year (10.85). Several correlations were made between the results achieved in different periods and between results and age. Thus, significant differences ($p < 0.05$) were identified between the best career results and those obtained in 2019. Differences were also identified between the best results and those obtained in 2020, but they were less significant. Another important aspect is the average t-value shown at item 3 of the correlation ($p < 0.05$).

The age of peak performance development for world-class sprinters is usually 25-26 years (Haugen et al., 2018; Hollings et al., 2014; Allen & Hopkins, 2015). Following the clarifications made by the above authors, we can say that the average age of the research athletes is that of peak performance development, considering the result obtained at item 7.

Table 2. *Statistical data obtained with the t-test for heart rate*

No.	Heart rate before and during the pandemic	Mean	Std. deviation	t-Test	t-Test for correlated means
1.	Exercise heart rate 2019	175.6	± 3.14		
2.	Exercise heart rate 2020	183.6	± 5.42		
3.	**Exercise heart rate 2019 - Exercise heart rate 2020**	5.17	± 8	.47	.01
4.	Exercise heart rate 2019	175.6	± 3.14		
5.	Non-pandemic result	10.66	± 0.16		
6.	Exercise heart rate 2019	66.5	± 3.08		
7.	Exercise heart rate 2020	76.1	± 2.85		
8.	**Exercise heart rate 2019 - Exercise heart rate 2020**	9.66	± 3.72	.68	.001
9.	**Exercise heart rate 2019 - Non-pandemic result**	-	-	.06	-
10.	Exercise heart rate 2020	183.6	± 5.42		
11.	Pandemic result	10.85	± 0.26		
12.	**Exercise heart rate 2020 - Pandemic result**	-	-	.04	-

*($p < 0.05$)

The data in Table 2 provide information on heart rate after a 100 m run and at rest, before starting an exercise. This indicator is important for athletic performance because it highlights values that can express the degree of fatigue or the level of physical training during both exercise and at rest. We made some correlations between the values of heart rate during exercise (2019-2020) and at rest, which were obtained before and during the pandemic. Differences between the correlations of average exercise heart rates obtained in 2019 compared to 2020 and resting heart rates obtained in 2019 compared to 2020 are significant ($p < 0.05$). As regards the correlation shown at item 12, we can identify a slightly significant difference between the values of heart rate during the pandemic and those obtained at the competition held the same year.

Table 3. *Statistical data obtained with the t-test for stride frequency and start reaction time*

No.	Parameters	Mean	Std. deviation	t-Test	t-Test for correlated means
1.	Stride frequency 2019	46.33	± 1.0		
2.	Stride frequency 2020	47.67	± 2.1		
3.	**Stride frequency 2019 - Stride frequency 2020**	1.33	± 1.96	.40	.15
4.	Start reaction time 2019	0.156	± 0.13		
5.	Start reaction time 2020	0.178	± 0.17		
6.	**Start reaction time 2019 - Start reaction time 2020**	0.021	± 0.020	.79	.049

*($p < 0.05$)

The correlation between the start reaction time and the power to push off the ground during the first 10-15 m with an optimal forward lean of the trunk is the key to success for elite sprinters. Sprinting technique and endurance considerably contribute to the 100 m performance. (Rumpf et al., 2016; Morin et al., 2011; Morin et al., 2012; Haugen, McGhie, & Ettema, 2019)

It is known that the lowest value allowed by the regulation for the start reaction speed is 0.100 s, and any value below this threshold is considered to be a false start, which will lead the athlete to disqualification. We believe that this reaction can be an important indicator for performance assessment, which is why we made some correlations between reaction times (2019-2020), and the obtained p-value was less than 0.05.

According to statistical studies on the number of steps in the 100 m race, beginner athletes perform 54-55 steps, average athletes, 50-52 steps, and elite athletes, 45-46 steps. Ursanu (2017) highlights that video analyses conducted on sprint runners have indicated that stride length is not equal for each pushing leg. Table 3 shows that the differences between the number of steps performed in the 100 m race before and during the pandemic are not significant, which is why we will not insist on this indicator.

Table 4. *Statistical data obtained with the t-test for indoor results*

No.	Results before and during the pandemic	Mean	Std. deviation	t-Test	t-Test for correlated means
1.	Result 60 m 2019	6.79	0.06		
2.	Result 60 m 2020	6.87	0.06		
3.	**Result 60 m 2019 - Result 60 m 2020**	0.08	0.08	.93	.06
4.	Best result 60 m	6.77	0.05		
5.	**Best result 60 m - Result 60 m 2019**	0.01	0.04	.11	.40
6.	**Best result 60 m - Result 60 m 2020**	0.1	0.07	.71	.01

*($p < 0.05$)

Table 4 shows the results obtained in the 60-m flat race during the competitive years 2019 and 2020, along with each athlete's best career results. In order to increase the credibility of this study, we decided to analyse both the indoor results achieved in 2019 and 2020 and the best results in the 60 m race. A comparison was made between the average results shown at items 5 and 6, and the obtained p-value was less than 0.05, which has a strong significance in

terms of the best results achieved in 2019 compared to 2020. This indicates that the results in 2020 are poorer than those in 2019 compared to the values of the best career results.

Discussion

Unlike the numerous descriptive studies on middle-distance and long-distance athletes worldwide, no studies have been conducted on world-class sprinters as regards the training components (modality, duration, intensity, frequency, rest periods, session rate, etc.) used across an annual cycle (Tonnessen et al., 2014; Tonnessen et al., 2015; Solli et al., 2017). "It is fair to say that positive developments in sprint training methods employed by world-class athletes have not been driven by sports scientists." (Haugen, Seiler et al., 2019, p. 2) It should be admitted that their successes and failures are largely due to the coach. However, during the periods of restrictions, athletes have the greatest responsibility for continuing their physical training in the best conditions. A recent study by Honceriu and Trofin (2020) examined the impact of the pandemic on professional football players, analysing the distance covered during the game, acceleration speed, the sprinting distance covered and the maximum speed reached. Following the analysis of physiological aspects, the above authors concluded that the anaerobic lactacid capacity of the players was affected by the pandemic period.

Conclusion

We believe that this period of restrictions (accompanied by numerous cases of infections and deaths, in addition to the shortcomings from the past) was the main cause for which athletes failed to fulfil the proposed goals. No one could have foreseen this period, which is why physical training resources were limited.

We are aware that physical training cannot take place in any conditions and in any space; an optimal climate and optimal parameters are needed to achieve the objectives proposed for the competitive season. We cannot claim for great objectives with currently questionable online training plans and in the absence of normal conditions for resuming sports activity.

As a final conclusion, we think that the negative results were influenced by some changes produced during the pandemic, but there were also indicators that remained unchanged, and others could be remedied or controlled using means identified by each athlete in the training process.

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