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Özgün Araştırma / Research Article

A STUDY ON THE RELATIONSHIP BETWEEN CADENCE AND PERFORMANCE OF PROFESSIONAL ROAD CYCLISTS: THE EXAMPLE OF THE TOUR DE FRANCE 2021

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ABSTRACT

The aim of this research is to investigate the effects of low and high cadence data of the riders on performance and success ranking in the Tour de France 2021, one of the most important and difficult bicycle races in the world.

In this research, the cadence data obtained during the 21 stages of the riders who could complete the Tour de France 2021 were obtained from the Strava program, and the general classification rankings were obtained from the official website of the Tour de France 2021. The riders included in the study were determined according to their general classification. The data of six riders in the first twenty and the last twenty of the general classification were analyzed. Descriptive statistics and independent sample t-test applied in the study were performed with SPSS 22.0 statistical package program. Literature data of the study were obtained by using content analysis method with academic publications that can shed light on the subject.

The findings we obtained the analysis of the data show that high cadence brings better performance and success. It is seen that new studies to be carried out in this direction are valuable in terms of the importance and clarification of the subject.

Keywords: Cycling, performance, cadence

PROFESYONEL YOL BİSİKLETÇİLERİNİN KADANS VE PERFORMANS İLİŞKİSİ ÜZERİNE BİR ÇALIŞMA: 2021 FRANSA BİSİKLET TURU ÖRNEĞİ

ÖZET

Bu araştırmanın amacı, Dünya'nın en önemli ve zor bisiklet yarışlarından biri olan 2021 Fransa Bisiklet Turu'nda, sporcuların düşük ve yüksek kadans verilerinin performans ve başarı sıralamasına etkilerini araştırmaktır.

Bu araştırmada, 2021 Fransa Bisiklet turunu tamamlayabilen sporcuların 21 etap boyunca elde ettikleri kadans verileri Strava programından, genel klasman sıralamaları ise Tour de France resmi internet sitesinden elde edilmiştir. Araştırmaya dahil edilen sporcular genel klasman sıralamalarına göre belirlenmiştir. Genel klasmanın ilk yirmi ve son yirmisinde bulunan altışar sporcunun verileri analiz edilmiştir. Araştırmada uygulanan tanımlayıcı istatistik ve bağımsız örneklem T testi SPSS 22.0 istatistik

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paket programı ile yapılmıştır. Çalışmaya ait literatür veriler konuya ışık tutabilecek akademik yayınlar ile içerik analizi yöntemi kullanılarak elde edilmiştir.

Verilerin analizi sonucunda elde ettiğimiz bulgular yüksek kadansın daha iyi performans ve buna paralel başarı getirdiğini göstermektedir. Kadans ve performans üzerine yapılan çalışmaların sınırlı sayıda, laboratuvar ortamında ve gerçek yarış ortamından uzak olmaları sebebiyle yapmış olduğumuz araştırma ile direkt ilişkilendirilememiştir. Bu doğrultuda yapılacak yeni çalışmaların konunun önemi ve netleştirilmesi açısından değerli olduğu görülmektedir.

Anahtar Kelimeler: Bisiklet, performans, kadans

1. INTRODUCTION

Understanding the factors that affect cycling performance is of interest to scientists, trainers, and cyclists. Accordingly, many literatures have examined how some environmental, physiological, and biomechanical factors affect cycling performance. Cycling performance appears to be largely determined by the cyclist's ability to produce high power outputs with minimal metabolic cost. Since pedaling speed (cadence) can affect both the power generation ability and the rate of energy consumption, it is thought that the choice of cadence may have a significant impact on cycling performance (Faria et al., 2005).

In the research, the performance related to the professional road bike; It is believed to be related to maximum oxygen consumption (Max Vo2), cycling efficiency (Maximum efficiency with low metabolic load) and lactate threshold. Together, these factors have been shown to enable elite cyclists to establish and maintain high workloads and relatively fast cadence (Majerczac et al., 2006; Faria et al., 2005).

Interestingly, there is little available literature examining the extent to which cadence (rpm) affects cycling performance directly or indirectly (with its effect on related variables such as efficiency). Therefore, although MaxVo2, lactate threshold and maximum power output explain most of the performance-related details in road cycling, the effect of cadence frequency is uncertain in professional male cyclists and almost unexplored in female cyclists (Graham et al., 2018; Nielsen et al., 2004; Foss et al., 2005).

Measuring physiological responses to exercise is a valid and reliable method for predicting performance. The most measured responses include heart rate (HR), perceived exertion (RPE), oxygen uptake (VO2), Lactate Threshold (LT), and blood lactate (BLa) ratings. The effectiveness of cadence selection has been shown to play a role in metabolic responses by influencing the onset of fatigue and sustained maximum strength (Faria et al., 2005; Brisswalter et al., 2000).

Formenti et al. (2019) stated that high cadence may cause an increase in metabolic demand on the skeletal muscle system. It has been stated here that the increase in respiratory functions may be particularly evident, while low pedaling speed increases intramuscular pressure.

Studies have not been able to determine exactly how many RPM the pedaling speed should be associated with delaying the onset of fatigue (Rodriguez et al., 2006). While several studies have shown that lower cycling rates are advantageous, some studies have reported increased lactate production and accelerated fatigue. Data on high cadence are also controversial (Lucia et al., 2004; Faria et al., 2005).

The relationship between cadence, performance and success is a subject that has not been agreed upon with the research done so far. Most of the studies have been done on the recreational riders and in a laboratory environment. It is thought that the professional riders should be evaluated separately due to their physical and performance differences. In this direction, the aim of the research is to investigate the effects of low and high cadence data of the riders on performance and success ranking in the Tour de France 2021, one of the most important and difficult bicycle races in the world.

2. METHODS

Twelve healthy and competitive professional road cyclists were included in the study. The cadence data obtained during the 21 stages of the riders who could complete the 2021 French Cycling Tour were obtained from the Strava program, and the general classification rankings and degrees were obtained from the official website of the Tour de France 2021.

The riders included in the study were determined according to their general classification. The data of six riders in the first twenty and the last twenty of the general classification were analyzed. Since all the data could not be accessed due to reasons such as not all the riders using the Strava program or some of them hiding their data, the riders in the first twenty and the last twenty with open data were determined by simple random sampling method.

Descriptive statistics and independent sample t-test analyzes were performed with SPSS 22 statistical package program.

Ethics committee approval is not required for the study due to the method of data collection.

3. RESULTS

The cadence data and averages of the professional road cyclists included in the study in all race stages are presented in Table.1.

Table 1. Cadence data and averages

Riders	1	2	3	4	5	6		7	8	9	10	11	12
Stage 1	90	88	88	86	86	92		87	86	83	83	85	80
Stage 2	90	85	86	85	93	90		86	84	84	83	88	79
Stage 3	92	87	86	89	92	91		87	87	90	85	83	90
Stage 4	88	87	84	85	94	89		87	86	86	84	84	81
Stage 5	97	103	99	95	101	100		96	92	94	91	96	89
Stage 6	88	88	86	88	98	90		92	89	90	86	85	86
Stage 7	92	88	88	88	96	94		85	86	85	83	87	80
Stage 8	90	88	90	87	91	90		80	83	77	79	80	88
Stage 9	86	80	87	83	85	84		80	81	76	77	78	76
Stage 10	89	84	84	85	93	90		89	87	86	84	83	79
Stage 11	91	84	88	89	90	93		85	84	81	77	80	76
Stage 12	88	85	86	86	92	90		84	86	81	82	84	78
Stage 13	87	82	85	86	92	90		87	87	82	84	84	77
Stage 14	91	82	87	88	90	90		83	83	79	81	83	77
Stage 15	89	83	87	86	91	90		80	81	75	77	81	75
Stage 16	90	85	86	87	87	88		85	85	78	80	82	75
Stage 17	90	83	88	85	90	87		81	81	75	78	81	75
Stage 18	91	85	89	86	89	90		82	82	74	77	83	74
Stage 19	89	82	84	84	89	91		85	85	80	80	84	78
Stage 20	96	78	99	94	97	101		96	93	89	91	92	87
Stage 21	82	82	79	81	83	85		78	83	78	79	70	74
Averages	89,8	85,19	87,42	86,8	91,38	90,71		85,47	85,28	82,04	81,95	83,47	79,71

The riders included in the study were divided into groups of six according to their rank in the first twenty and the last twenty, and the group averages obtained are presented in Table 2.

Table 2. Group Averages

	Mean	SD	N
Group 1 (6 riders from the top 20)	88,5500	2.44401	6
Group 2 (6 riders from the last 20)	82,9867	2.20759	6

According to the group averages, the twenty-one stage cadence averages of the six professional road cyclists in the top twenty were found to be better than the averages of the six riders in the last twenty.

The results of the Independent Sample T-test conducted in line with the data obtained according to the group averages are presented in Table 3.

Table 3. Comparison of group Averages with T-test

	N	Mean	SD	t	p
Group 1	6	88,5500	2.44401	4.138	0.002
Group 2	6	82,9867	2.20759		

It was found that there was a statistically significant difference of 0.002 ($p<0.05$) in the means between the two groups.

4. DISCUSSION

Our findings show statistically that high cadence brings high performance and success. Although these data in the road bike race, which is very important like the Tour de France, show parallelism with some of the studies in the field, some studies claim the opposite. The most important problem in this subject is that the studies are not in a real racing environment and are mostly in laboratory environments. For this reason, the data we obtained were evaluated by studies carried out in the laboratory environment.

Lucia et al. (2004) found that pedaling at low cadences (50-60 rpm) in laboratory tests resulted in lower oxygen uptake, lactate, ventilation, heart rate and perceived effort compared to high cadences (90-100 rpm), but that riders with high cadence (90-90 rpm) 100) stated that they are trying to adapt. However, it was stated in the study that low cadence increases power output, accelerates fatigue, and high cadence and speed are directly proportional.

Abbiss et al. (2009) also stated in their studies that high cadences reduce the force used per pedal stroke, thus reducing, or delaying muscle fatigue (especially type 2 muscle fibers).

Choosing slow pedaling ratios will mean using excessively high gears for extended periods of time and increase the risk of muscle injuries for the riders who want to reach high speeds (Marsh and Martin, 1998).

Gothsal et al. (1998) analyzed the seven cyclists riding at 200 watts at pedal cadences of 70, 90, and 110 rpm (random order). Oxygen uptake, heart rate, stroke volume, cardiac output, blood pressure and vascular resistance were determined. Like previous studies, oxygen uptake increased with increasing cadence (70, 90, 110 rpm) at this workload. Heart rate, stroke volume, cardiac output and blood pressure increased with increasing cadence. Even when the workload was constant, the increase in pedal cadence resulted in increased muscle blood flow and venous return. They reported that they thought higher cadences could still be chosen by cyclists, despite the reduction in economics.

In their study investigating the effects of low and high cadences on the cardiovascular system, Canivel and Wyatt (2016) reported that high cadence conversion creates significant differences on the cardiovascular system compared to low cadence, after applying 150-watt and 20-minute tests with 9 cyclists at 50 and 100 rpm cadence. However, it has been stated that low cadence creates less body

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stress. Despite this, they added to their studies that important riders and coaches adopt and defend the high cadence / low strength technique.

Stebbins et al. (2014) conducted tests on 8 elite cyclists with 80 and 100 rpm cadence for 180 minutes and 50-65-80% Vo2max intensity. The data showed that higher cadences (100 vs 80 rpm) were less efficient, resulting in greater energy consumption and lower power output during peak performance.

Formenti et al. (2015) performed a test on 16 recreational participants with a cadence speed of 50-70-90-110 rpm and a workload of 50-100-150 w in their study on the use of oxygen by cadence. He noted that using a high cadence style for everyone, but the elite riders can waste 60% of your energy stores, and while a high cadence style may be beneficial in some situations, it is not for everyone.

Studies generally indicate the negative effects of high cadence for the recreational riders. It is expressed by studies that with high cadence, there will be more load on the cardiovascular system and the athlete can get tired more easily. In addition, studies indicate that the professional riders prefer high cadence, and the riders with high cardiovascular capacity can avoid the negative effects of high cadence. In this direction, the relationship between high cadence and success that we have obtained in our study is also supported by studies. The most obvious difference between cadence speeds can be considered as the increase in the intensity of the load on the muscles at low cadence, the formation of easier lactic acid accumulation and the early exhaustion of the athlete. It is observed that with high cadence, the force per pedal stroke decreases and the chance to maintain the similar performance for a longer period occurs.

5. CONCLUSION

Although the data in our study show that cadence is directly related to high performance and success, it is clear that high cadence brings higher metabolic load to the body as the common point of the studies. Although high cadence has negative effects on some performance-related data, its significant positive effects can change the perspectives of the riders on this issue.

While laboratory studies on cadence and performance seem valid for the recreational riders, the situation is different for the performance riders. It is also supported by the results of our analysis that the preferences of the successful riders are high cadence due to the high goals. In line with the data obtained, it can be thought that high-level riders plan their training in this direction to get rid of the negative effects of high cadence. Factors such as suitability of muscle type, aerobic capacity, and correct technique can help reduce the negative effects of high cadence.

It is important for the professional riders in this field to carry out new studies in the laboratory and in the real environment in terms of clarifying the subject.

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