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Investigation of FTP, VO_2max and Anaerobic Threshold Variables of Cyclists with Special Needs: A Case Study

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Abstract

The participation of individuals with special needs in performance sports has been increasing from past to present. As in athletes with normal development, stages are planned and implemented in accordance with the goals of high-level performance sports. This study aims to determine the functional threshold power (FTP), VO_2max and anaerobic threshold values of a cyclist with special needs to create performance prediction for athletes in similar disability groups. Fırat Uğur, a 26-year-old athlete with special needs who has been participating in cycling competitions for three years and has a body weight of 68 kg and a height of 180.5 cm, participated in the current study. In the findings obtained from the study, the normalized power value of the athlete was found as 204.3 watts, the FTP value as 204.3 watts and the relative power value as 3.00 watts / kg. The athlete's VO_2max value was 48.3 ml/kg/min; VO_2max load was 298 watts, and VO_2max heart rate was 175 beats/min, anaerobic threshold VO_2 value was 24.7 ml/kg/min, anaerobic threshold load was 103 watts and anaerobic threshold heart rate was 127 beats/min. When the research findings of the cyclists with special needs were compared with the results obtained from the current study, Fırat Uğur's findings were at lower levels. Considering that the athlete has only participated in competitions as a performance athlete for three years, it can be predicted that he will increase his performance level in the following years. It is recommended that the athlete's training be prepared according to the findings obtained and that the performance development be followed with measurements to be made at regular intervals.

Keywords: FTP, para cycling, Paralympic cyclist, special requirement, VO_2max

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Özel Gereksinimli Bisiklet Sporcusunun FTP, VO_2max ve Anaerobik Eşik Değişkenlerinin İncelenmesi: Vaka Çalışması

Özet

Özel gereksinimli bireylerin performans sporuna katılımı geçmişten günümüze giderek artış göstermektedir. Normal gelişim gösteren sporcularda olduğu gibi üst düzey performans sporu hedeflerine uygun aşamalar planlanıp uygulanmaktadır. Bu çalışmada, özel gereksinimli bir bisikletçinin fonksiyonel eşik gücü (FTP), VO_2max ve anaerobik eşik değerlerinin belirlenerek benzer engel gruplarındaki sporcular için performans öngörüsü oluşturmak amaçlanmıştır. Mevcut çalışmaya 26 yaşında, üç yıldır bisiklet yarışmalarına katılan, 68 kg vücut ağırlığı ve 180,5 cm boy uzunluğuna sahip özel gereksinimli bir sporcu olan Fırat Uğur katılmıştır. Çalışmadan elde edilen bulgularda sporcunun normalize edilmiş güç değeri 204,3 watt, FTP değeri 204,3 watt ve relatif güç değeri 3,00 watt/kg olarak bulunmuştur. Sporcunun VO_2max değeri 48,3 ml/kg/dk, VO_2max yükü 298 watt ve VO_2max kap atım hızı 175 atım/dk, anaerobik eşik VO_2 değeri 24,7 ml/kg/dk, anaerobik eşik yükü 103 watt ve anaerobik eşik kalp atım hızı 127 atım/dk olarak tespit edilmiştir. Özel gereksinimli bisikletçilerle yapılmış olan araştırma bulgularıyla mevcut çalışmadan elde edilen sonuçlar karşılaştırıldığında Fırat Uğur'un bulgularının daha düşük seviyelerde olduğu görülmüştür. Sporcunun sadece üç yıldır performans sporcusu olarak yarışmalara katıldığı düşünüldüğünde, ilerleyen yıllarda performans seviyesini yükselteceği öngörülebilir. Sporcunun antrenmanlarının elde edilen bulgulara göre hazırlanması ve düzenli aralıklarla yapılacak ölçümlerle performans gelişiminin takibi önerilir.

Anahtar Kelimeler: FTP, özel gereksinim, bisiklet, VO_2max

1. INTRODUCTION

Individuals with special needs are defined by the World Health Organization (WHO) as deficiencies or limitations in the performance of behaviors, duties and abilities that are considered normal by individuals or our body and expected to perform as a whole (WHO, 1980). Bicycle, a two-wheeled human-powered and non-motorized vehicle (Morpa, 1997) is defined as "para-cycling" for individuals with special needs (UCI, 2023). Para-cycling is divided into seven different events within the road and track branch. Road cycling events are defined as the road racing consisting of individual time trial, handcycling (bicycles ridden using the athlete's hand) team time trial. Track events are; on the other hand, considered as tandem sprint, team sprint, 500 m time trial, kilometer time trial, individual pursuit and stratch racing (UCI, 2023).

The way it is classified by the International Cycling Union (UCI) for individuals with special needs consists of three levels. These are the national classifier, the elite national classifier and the international classifier. National and elite national classifiers ensure that some or all characteristics of athletes with special needs are conducted at the national level. International classifiers, on the other hand, ensure that some or all components of athletes with special needs are carried out at the international level. Athletes are divided into appropriate categories according to the special needs situation (UCI, 2023).

The para-cycling branch is covered in four main sections. It is divided into groups according to the type of bicycles used by the UCI and the functional special requirements of the athlete. The first letter indicates the group of functional impairment, and the second digit indicates the level of special needs

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condition. The most severe special requirement case is expressed by one. People in the B1-B3 range refer to blind and special visual needs athletes who use tandem. The C1-C5 range includes some amputees riding a normal bicycle and athletes with cerebral palsy or traumatic brain injury. T1-T2 refers to athletes with certain cerebral palsy or brain injuries who use tricycles. H1-H4 identifies athletes with spinal cord injuries, amputees, and athletes with certain neurological special needs who use handcycles (Boucher et al., 2013).

As in performance athletes with normal development, FTP, maximum oxygen utilization amount (VO_2max) and anaerobic threshold values are accepted as performance determinants for cycling in individuals with special needs. FTP is defined as the highest power value that an athlete can complete in a semi-stable manner for an hour (Allen & Coggan, 2006). Tests can be performed for eight minutes or 20 minutes et al., 2007). In Anaerobic threshold the intersection point on the V slope where the athlete's pulmonary carbon dioxide excretion (VCO_2) increases more than the oxygen uptake (VO_2) and where the slope of VCO_2 / VO_2 is greater than one is indicated as the anaerobic threshold (Wasserman et al., 2011). VO_2max is defined as the maximum amount of oxygen our body can use during vigorous exercise (Rusdiana, 2020). Regular performance follow-up of athletes is significant in terms of determining their objective training load. When it comes to individuals with special needs, awareness raising should be followed by long-term athlete development stages for athletes with special needs after the first contact (Boucher et al., 2013).

In our Turkey, the participation of individuals with special needs in cycling competitions is increasing day by day. For example, three athletes participated in the Bodrum Granfondo race in 2021, 11 athletes in 2022 and 7 Paralympic athletes in the Bodrum Granfondo race in 2023 (Bilnet Okulları Bodrum Halikarnas Granfondo, 2021; Bodrum Granfondo, 2023; Uluslararası Corelli Bodrum Granfondo, 2022). The competitive environment created with the increase in the number of participants in the competitions has made it necessary to implement training plans and programs on scientific grounds. A search of the EBSCO SPORTDiscus with Full Text database with the keyword "para-cycling" showed a total of 14 studies. Four of the studies were related to competition speeds, three were survey studies, two were nutrition-related reviews, two were simulations, two were track competitions and one was a case study. In the "ISI-Web of Science" database, a total of 29 studies were found in the search with the same keyword. There is no study of Turkish authors among these studies. As a result of the screening, it was seen that studies were carried out on competition speeds of athletes (8), bicycle simulation (7), classification of athletes (4), case reports (4), bicycle performance components (VO_2max, speed, watt) (3), compilation (2), injury and integration questionnaires (2).

Due to the scarcity of studies based on the identification and follow-up of performance components related to individuals with special needs and the diversity of disability groups, more scientific research is needed in this context. The aim of this study is to examine the FTP, VO_2max and anaerobic threshold values of a cycling athlete who participates in competitions with special needs in our country. Thuswise, a performance prediction will be created for athletes in similar disability groups.

2. MATERIAL & METHOD

One cycling athlete with special needs participated in this study. In the study, FTP, VO_2max and anaerobic threshold values of special needs cyclists which are accepted as performance determinants for cycling were examined.

The height of the participant athlete was measured with a minimal clothing (wearing only a bicycle jersey) and with a 0.1 cm precision "SECA" brand while having a prosthesis on the foot (Gordon et al.,

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1988). Body weight was measured on the athlete with a minimal suit (only in a bicycle jersey) with a precision of 0.1 kg with a "Tanita BC-601" model device. Before the FTP test was applied, the athlete was asked to warm up for 10 minutes without causing fatigue. After the warm-up phase, the athlete was asked to rest for 2x20 seconds of maximal loading and three minutes in between. The athlete underwent five minutes of rest after two loads. When the rest period was completed, a 20-minute FTP test was applied and the athlete was asked to perform to the best of his ability during the test (Jeffries et al., 2021). The VO_2max test was performed on the bicycle ergometer with the athlete's own locking pedal shoe (SPD) in the form of a workload increase of 25 watts per minute. The test continued until the athlete voluntary exhaustion. The Cosmed Fitmade Pro test was carried out and the instrument was calibrated before measurement (Hill et al., 2002; Klika et al., 2007). After the VO2max test was performed on the athlete with the Cosmed Fitmate Pro device, the pulse and power values at the aerobic and anaerobic threshold points given by the device were taken as basis.

Data Analysis

The data obtained in the tests and measurements were transferred to the computer with Excel (Analyses Tool Pack) and the necessary descriptive analyzes were performed in SPSS 26.0 program.

Ethical Considerations

For this study, the ethics committee permission numbered E-33117789-604.01.01-103029 dated 28.03.2023 was obtained from the Bingöl University Rectorate Health Sciences Scientific Research and Publication Ethics Committee.

3. FINDINGS

Descriptive information about the cycling athlete with special needs within the scope of the study is given in Table 1. The findings of FTP values are presented in Table 2 and the findings of VO_2max value are presented in Table 3.

Table 1. Descriptive findings of study variables

n=1	
Age (year)	26
Sports age (year)	3
Height (cm)	180,5
Body weight (kg)	68

The age of the cycling athlete with special needs who participated in the study was 26, cycling sport year was 3, height was 180.5 cm, and body weight was 68 kg.

Table 2. Findings of FTP values

n=1	
Average power (watt)	202
Maximum power (watt)	403
Normalized power (watt)	215
Functional threshold power (watt)	204,3
Relative power (watt/kg)	3,0

The mean power value of the cyclist with special needs who participated in the study was found as 202, the maximum power value as 403, the normalized power value as 215, the functional threshold power as 204.3 watts and the relative power value as 3.0 watts/kg.

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Table 3. Findings of VO_2max values

n=1	
VO_2max (ml/kg/min)	48,3
VO_2max load (watt)	298
VO_2max heart rate (beats/min)	175
Anaerobic threshold VO_2 (ml/kg/min)	24,7
Anaerobic threshold load (watt)	103
Anaerobic threshold heart rate (beats/min)	127

The VO_2max value of the cycling athlete with special needs participating in the study was 48.3 ml/kg/min, VO_2max load was 298 watts, VO_2max heart rate was 175 beats/min, anaerobic threshold VO_2 value was 24.7 ml/kg/min, anaerobic threshold load was 103 watts, anaerobic threshold heart rate was 127 beats/min.

4. DISCUSSION & CONCLUSION

In the study conducted by Nimmerichter et al. (2010), 15 male cycling athletes with a VO_2max value of 67±5 ml/kg/min participated. Three road cyclists ranked in the top five in the general classification participated in Gallo et al.'s (2022) study in order to prepare a training strategy for the Giro d'Italia. VO_2max values of the athletes participating in the study were found to be 81, 82, 80 ml/kg/min and the minimum relative power outputs of 20 minutes between December and May were 6.6, 6.6 and 6.4 watts/kg, respectively. The VO_2max value of the cyclist who participated in the case study on the effects of ultra endurance exercise was determined as 70 ml/kg/min (Neumayr et al., 2002). In the study conducted to determine the strength outputs of the athletes who completed the race in the Women's World Cup, the data of 15 female cycling athletes were examined. The mean age of the athletes examined was 24.1±4.0 years, the mean body weight was 57.9±3.6 kg, the mean height was 168.7±5.6 cm, and the VO_2max value was 63.6±2.4 ml/kg/min (Ebert et al., 2005). 12 male cyclists participated in the study conducted to determine the relationship between CP (critical power) and power duration in the FTP and 16.1 km time trial (TT) test. According to the findings obtained from the results of the study, CP and FTP values were found to be 275±40 and 278±42 watts (Morgan et al., 2018). A total of 100 cyclists, including 25 mountain bike and 75 road bike athletes, participated in the study, which was conducted to determine the anthropometric characteristics of mountain and road bike athletes and to determine the somatic variables affecting aerobic capacity. As a result of the study, mountain bike athletes had less watts, body weight, height and absolute oxygen consumption than road cyclists (Zatoń et al., 2014). In order to determine the compatibility between CP and FTP, 17 trained cycling athletes and triathletes with a mean age of 31±9 years, body weight of 80±10 kg, VO_2max value of 51±10 ml/kg/min participated. The FTP values of the athletes participating in the study were determined as 249±44 watts (Karsten et al., 2021). Lucia et al. (2002) conducted a study on first class cyclists and 11 male cyclists with an average age of 26.1 years and a VO_2max value of 72.0±1.8 ml/kg/min participated. In the study conducted by Akbaş et al. (2023), the following result were obtained: height 166±10.0 cm, body weight 56.9±12.0 kg, FTP value 211±40.5 watts, VO_2max 62. 9±5,1 ml/kg/min, VO_2max load 299,4±66,8 watts, VO_2max pulse 193±7 beats/min, anaerobic threshold VO_2 31,0±6,6 ml/kg/min, anaerobic threshold load 106,5±27,0 watts, anaerobic threshold pulse 138±16 beats/min. Sitko et al. (2022) conducted a study on 46 road cycling athletes with different fitness conditions and found that the mean age of the athletes was 38 ± 9 years, height 177 ± 9 cm, body weight 71.4 ± 8.6 kg and VO_{2max} 61.1 ± 9.1 ml/kg/min. The study, which included five class H para cycling athletes aged 19-38 and 3-12 years of sports history and five athletes without special needs, found significant differences in performance values between the two groups (Russo et al., 2021). Twenty-three male cycling athletes with an average age of 24.25 years, a height of 1.69 m, a body weight of 62.5 kg and a minimum sports age of four years

participated in the study. According to the results obtained, the normalized power value of the athletes participating in the study was 276.65 watts, the FTP value was 262.85 watts, and the relative power value was 4.69 watts/kg (Ferney & Leguizamo, 2020). The cycling age of the athlete who participated in the current study was 3 years, the average power value was 202, the maximum power value was 403, the normalized power value was 215, the functional threshold power was 204.3 watts and the relative power value was 3.0 watts/kg. The results obtained from the current study are at a very low level than other studies.

As a result, the experience that the athlete will gain with the progression of cycling sports age will support his success. In addition, making training programs according to the training zones (based on measurements to be made at regular intervals) will ensure that the athlete's performance is increased to higher levels. The current study and future research on special needs will be important to create performance predictions for athletes with similar disabilities.

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Author Contributions
In this study, the contribution rate of the first author is 30%, the contribution rate of the second author is 25 and the contribution rate of the third, fourth and fifth authors is 15%.
Conflict of Interest
The author(s) did not state any conflict of interest regarding the study and publication.
Information related to Ethics Committee
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