

# ALTERNATION OF PHYSICAL AND FUNCTIONAL POWERS OF HIGH PERFORMANCE FEMALE BMX CYCLIST DURING YEARLY TRAINING CYCLE

Kazys Milašius, Rūta Dadelienė, Linas Tubelis, Juozas Skernevičius  
*Lithuanian University of Educational Sciences, Vilnius, Lithuania*

## ABSTRACT

*Research background and hypothesis.* There is a lack of information on BMX cyclists' training. Information about athletes' of this cycling event training and their organism adaptation to physical loads practically does not exist in Lithuania. Consequently, it is relevant to reveal the main characteristics of alternation of Lithuanian high performance international class female cyclists' physical and functional powers. The hypothesis that physical and functional power indices between BMX cyclist and track cyclist differ is being tested.

*Research aim* was to reveal characteristics of Lithuanian high performance female BMX cyclist's physical and functional power indices and their alteration during yearly training cycle; to compare them to analogical data of other cycling event athletes.

*Research methods.* Research of a Lithuanian BMX female cyclist (A) was organized in VPU Sport Science Institute in 2010–2011. Research was carried out during these yearly cycle periods: preparatory (I), competition (II), and transitional (III).

*Research results.* Physical development indices were established and muscular power in various energy producing zones was analyzed. Maximal anaerobic alactate glycolytic capacity (MAAGC) with applied 30-s test was established as well. Functional capacity of blood circulation and respiratory system was evaluated under resting heart rate, its rate alteration after standard physical load, and after one minute recovery; under these data Roufier index was calculated. Indices of female BMX cyclist's physical and functional powers were compared to analogical results of female sprint track cyclist – 200 m event World champion (B), and female track cyclist – 3 km pursuit event World championship bronze winner (C).

*Discussion and conclusions.* Our analyzed BMX cyclist's SMCP is very high and exceeds the same index of cyclists in other various specializations analyzed. However, AAMP and mixed anaerobic alactate glycolytic muscular power indices are insignificantly lower than analogical indices of one of the best World track sprinters. Elite cyclist's (C), whose part of energy, during competition period, is produced in aerobic way, functional capacity of blood circulation system is the highest and these indices of the investigated BMX cyclist are lower than aerobic capacity of cyclist C.

**Keywords:** bicycle motocross, physical development, muscular power, functional capacity.

## INTRODUCTION

Bicycle motocross (BMX) event in cycling sport is rather recent; International Olympic Committee included it into the list of Olympic sports in 2003, and in 2008 this event was on cycling events program of Beijing Olympic Games. BMX track is ragged 380–400 m length route with up-hills, slopes, sharp-turns, springboards, and straight distances (Politi, Heazlewood, 1996). The best World's BMX female cyclists ride this

distance in 40–45 s; thus specific abilities are needed in such format competitions (Campillo et al., 2007; Herman et al., 2009). J. Cowell et al. (2011) indicate high muscular power in short-term work to be essential for athletes of this cycling event, which is only lower than analogical power of 200 m sprint event track cyclists. Anaerobic-glycolytic energy producing way is also highly significant because of its considerable input to energetics during such

short-term work (Hodgins et al., 2001; Herman et al., 2009). For such reason training of BMX female cyclists has to be purposefully directed to developing characteristics specifically needed for this sport (Bertucci, Hourde, 2001; Mateo et al., 2011).

High performance female bicycle motocross athlete, who successfully participates in most international competitions, has been recently trained in Lithuania. Road and track cyclists' training and main characteristics of their body adaptation to physical loads do not lack researchers' attention in foreign as well as in Lithuanian scientific publications (Mujika, Padilla, 2001; Atkinson et al., 2003; Faria et al., 2005; Tubelis et al., 2007, 2009; Dadelienė et al., 2008; Buividas, Milašius, 2011), but yet there is a shortage of information on BMX cyclists' training. Information about athletes of this cycling event training and their body adaptation to physical loads practically does not exist in Lithuania. Consequently, it is relevant to reveal the main characteristics of Lithuanian high performance international class female cyclist's physical and functional powers alternation during yearly cycle, which would further lead to the improvement of female cyclists' training process for this event.

**Research aim** was to reveal characteristics of Lithuanian high performance female BMX cyclist's physical and functional power indices and their alteration during yearly training cycle; to compare them to analogical data of other athletes in cycling events.

## RESEARCH METHODS

Research of Lithuanian BMX female cyclist (A) was organized in VPU Sport Science Institute in 2010–2011. Research was carried out during these yearly cycle periods: preparatory (I), competition (II), and transitional (III). Physical development indices of body mass, muscle and fat mass and their correlation (MFMI), body mass index (Norton et al., 1996), and the power of both hands was established. Muscular power in various energy producing zones was analyzed as well. Efficiency of alactate anaerobic energy producing mechanisms was measured after establishing single muscular contraction power (SMCP) (Bosco et al., 1982) with ergometer step test and alactate anaerobic muscular power (AAMP) (Margarita et al., 1966) with 10-s test on veloergometer. Maximal anaerobic alactic glycolytic capacity (MAAGC) with applied

30-s test on veloergometer (*Wingate test*) (Bar-Or, 1987) and blood lactate (La) concentration were also established. Functional capacity of blood circulation and respiratory system was evaluated under resting heart rate (HR), its rate alteration after standard physical load, and after one minute recovery; under these data Roufier index was calculated. Methods of this research have been described by J. Skernevičius et al. (2004).

Indices of female BMX cyclist's physical and functional powers were compared to analogical results of female sprint track cyclist – 200 m event World champion (B), and female track cyclist – 3 km pursuit event World championship bronze winner (C).

## RESEARCH RESULTS

Our investigated athlete's body mass, muscle and fat mass were the highest during preparatory stage (Table 1). During competition stage athlete's body mass, muscle and fat mass diminished and during transitional stage they were even lower. Athlete's SMCP and AAMP had the highest values during competition period: they were respectively 32.2 and 16.8 W/kg (Table 2). When analyzing BMX cyclist's specific working efficiency indices alteration during yearly cycle, it can be indicated that absolute as well as relative maximal instantaneous, anaerobic alactate muscular power in 10-s work test and anaerobic alactate glycolytic power in 30-s work test were the highest during competition period testing (Table 3). Lactate concentration after 30-s physical load test, which absolute average power reached 732 W, on maximal exertion was up to 16.2 mmol/l. Although functional capacity indices of blood circulation system fluctuated a little during yearly cycle, the requirements for athlete's aerobic capacity were fully answered. During yearly cycle the heart rate of the investigated athlete fluctuated from 40 to 48 b/min, Roufier index – from 2.0 to 0.8 (Table 4).

## DISCUSSION

When analyzing physical development data (Figure 1), it is apparent that female BMX cyclist is considerably heavier than track sprinter (B) and pursuit athlete (C). M. Slyter et al. (2001) indicate optimal female BMX cyclists' body mass to be 70–74 kg. Our analyzed female BMX cyclist's body mass fluctuated between 75 and 78 kg during yearly cycle. Cyclist's muscle and fat mass is higher than

Table 1. Alternation of female BMX cyclist's physical development and muscle-fat mass correlation indices during yearly training cycle

No.	Periods	Body mass, kg	BMI, kg/m <sup>2</sup>	Hands power, kg		Muscle mass, kg	Fat mass, kg	Muscle fat mass index
				Right	Left			
1	Preparatory	78.0	28.0	42	40	43.2	10.5	4.09
2	Competition	76.5	26.3	45	40	40.3	9.5	4.24
3	Transitional	75.5	26.4	46	42	40.3	8.2	4.91

Table 2. Alternation of female BMX cyclist single muscular contraction power (SMCP) and anaerobic alactate muscular power (AAMP) indices during yearly training cycle

No.	Periods	SMCP		AAMP	
		W	W/kg	W	W/kg
1	Preparatory	2309	30.6	1200	15.7
2	Competition	2460	32.2	1266	16.8
3	Transitional	2176	28.8	1125	14.9

Table 3. Alternation of female BMX cyclist's physical powers during yearly training cycle

No.	Periods	Power W						La, mmol/l
		10 s				30 s		
		max	W/kg	av.	W/kg	av.	W/kg	
1	Preparatory	1470	19.3	1030	13.6	705	9.3	14.4
2	Competition	1614	21.2	1059	13.9	732	9.6	16.2
3	Transitional	1426	19.0	1032	13.8	669	8.3	13.7

Table 4. Alternation of female BMX cyclist's functional capacity of blood circulation system indices during yearly training cycle

No.	Periods	Roufier index	HR at rest, b/min	HR after load, b/min	
				Straight after	after 60 s
1	Preparatory	0.8	40	100	68
2	Competition	2.0	44	104	72
3	Transitional	1.6	48	104	64

of other researched cyclists. BMX cyclist's muscle mass was 43.2 kg during preparatory stage and we assume that this led her to developing higher SMCP than that of contestants' of other cycling events. Other authors (Tubelis et al., 2007, 2009; Dadelienė et al., 2008; Mateo et al., 2011) also state that muscle mass of cyclists, where in the anaerobic alactate or mixed anaerobic alactate glycolytic reactions dominate competition period, correlate with SMCP, AAMP, and MAAGC. Reduction of BMX cyclist's body mass and fat mass indices during transitional stage can be related to reduction of specific strength exercises during training sessions.

SMCP of the investigated female BMX cyclist increased from 25.5 to 32.2 W/kg since testing in 2008 (Dadelienė et al., 2008) and exceeded SMCP of sprint and pursuit athletes, whose indices were

respectively 27.4 and 28.7 W/kg. The highest AAMP was in sprint cyclist (B) – 18,0 W/kg, though, and it was identical – 16.8 W/kg – in BMX cyclist and pursuit cyclist (Figure 2). T. Hodgkins et al. (2001) suggest that success in sprint cycling and BMX cross-country racing depends on muscle quality to develop high power during short-term work.

Maximal and average anaerobic alactate muscular power on 10-s veloergometer test is the highest in athlete B and reaches respectively 23.8 and 15.0 W/kg, and in BMX cyclist it is marginally lower and reaches respectively 21.2 and 13.9 W/kg (Figure 3).

Being of high athletic fitness level, all three athletes represented sufficiently high anaerobic alactate muscular power. Index of 30-s work power on maximal exertion test was 9.6 W/kg in female

BMX cyclist and in track cyclist it was 10.3 W/kg and so in pursuit athlete it was even higher and reached 11.0 W/kg. Similar anaerobic alactate power indices were estimated by Bertucci and Ch. Hourde (2011), who researched France national BMX team female cyclists' physical powers. They estimated that when performing anaerobic alactic glycolytic power test (*Wingate*) French cyclists reached average 10.6 W/kg power, which was higher by 28% than regional cyclists' level, as it was established by W. Bertucci et al. in 2007.

Blood circulation system representing indices of our investigated cyclists A and B, whose

competition period is short, were of sufficient level. However, Roufrier index of cyclist C, who trains for pursuit event, was even higher (-1.2). Research results have revealed that cyclists' A and B functional capacity of blood circulation system is high despite the fact that in preparatory period considerable part of the load is performed in training zones of anaerobic alactate and glycolytic energy producing muscles. Functional indices of blood circulation system of cyclist C, where considerable part of energy is produced in aerobic reactions in competition period, were particularly high and corresponded to the level of World elite athletes (Lucia et al., 2002).

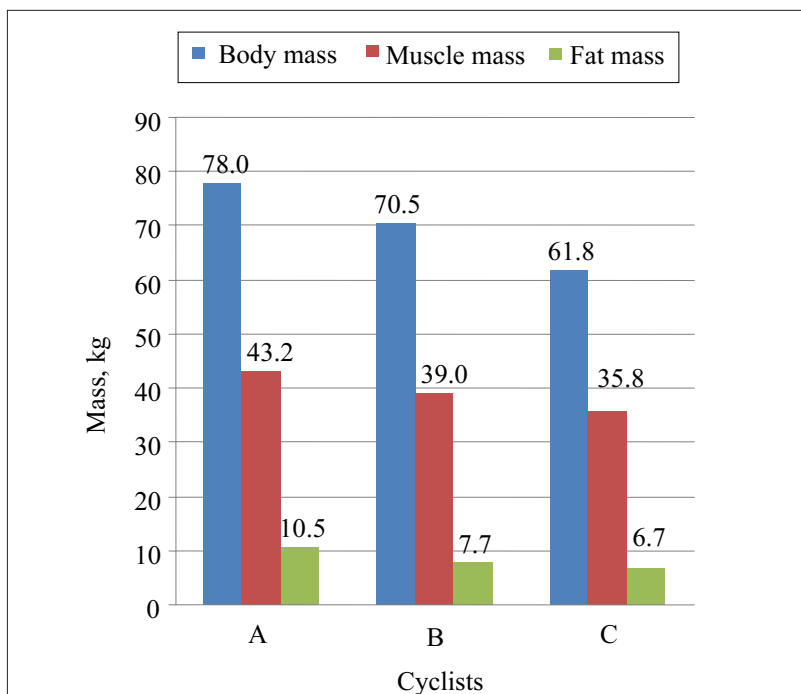


Figure 1. Comparative characteristics of different specialization female cyclists' physical development indices

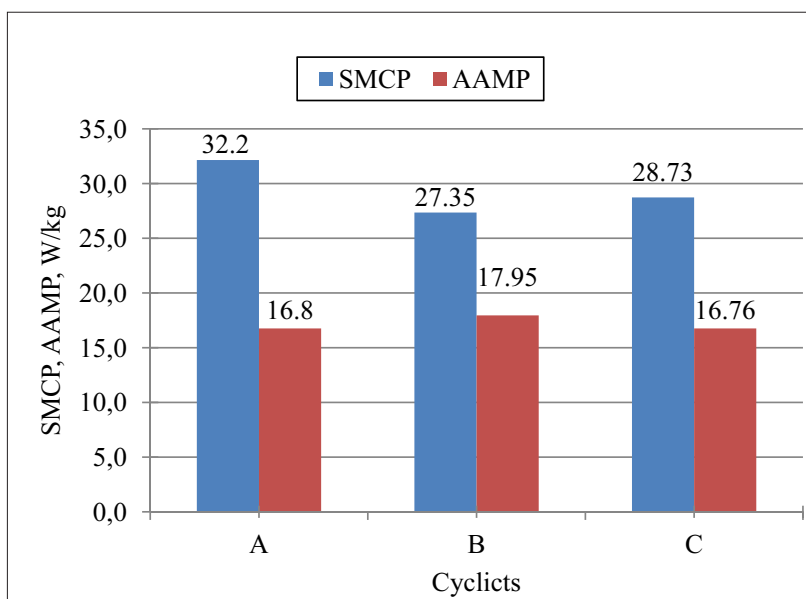
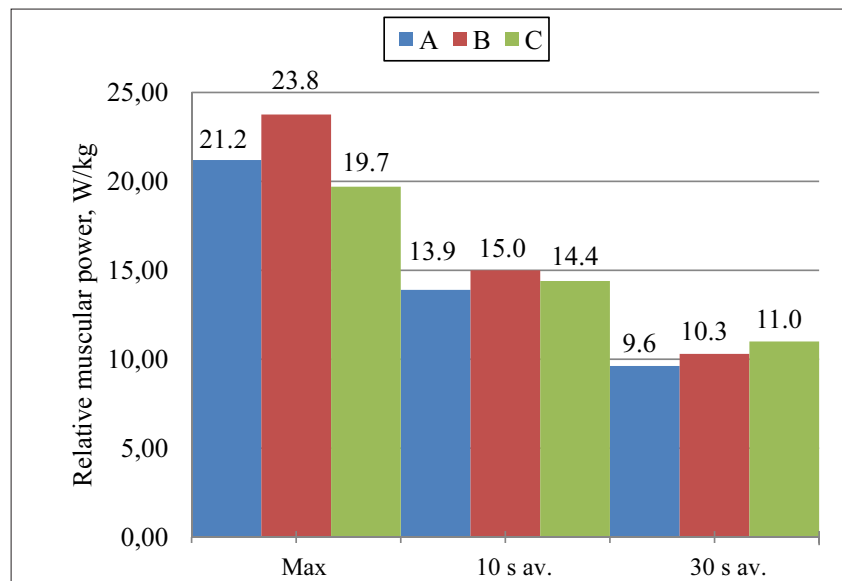


Figure 2. Comparative characteristics of different specialization female cyclists' SMCP and AAMP indices

Figure 3. Comparative characteristics of different specialization female cyclists' indices of relative muscular power at various energy producing zones



## CONCLUSIONS AND PERSPECTIVES

1. Female BMX cyclist's body mass, muscle and fat mass fluctuated in descending order from preparedness to competition period during yearly cycle. This athlete weighed more than cyclists of track sprint and pursuit.

2. Our investigated BMX cyclist's SMCP is very high and exceeds the same index of other cyclists in various specialization analyzed, however,

AAMP and mixed anaerobic alactate glycolytic muscular power indices are insignificantly lower than analogical indices of one of the best World track sprinters and glycolytic capacity is lower than that track of track sprinter and pursuit cyclist.

3. Functional capacity of blood circulation system of elite cyclist (C), whose part of energy during competition period is produced in aerobic way, is the highest and these indices of our investigated BMX cyclist are slightly lower than aerobic capacity of cyclist C.

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## DIDELIO MEISTRIŠKUMO BMX DVIRATININKĖS FIZINIŲ IR FUNKCINIŲ GALIŲ KAITA METINIŲ TRENIRUOČIŲ CIKLU

Kazys Milašius, Rūta Dadelienė, Linas Tubelis, Juozas Skernevičius

*Lietuvos edukologijos universitetas, Vilnius, Lietuva*

### SANTRAUKA

*Tyrimo pagrindimas ir hipotezė.* Apie BMX dviratininkų rengimą informacijos dar nepakanka. Lietuvoje šios dviračių rungties sportininkų rengimo, jų organizmo adaptacijos prie fizinių krūvių klausimais duomenų beveik nėra. Todėl svarbu nustatyti tarptautinės klasės BMX dviratininkės fizinių ir funkcinių galių svarbiausius bruožus. Tyrimu tikrinama hipotezė, kad BMX dviratininkų parengtumo rodikliai skiriasi nuo treko dviratininkų.

*Tikslas* – atskleisti Lietuvos didelio meistriškumo BMX dviratininkės fizinių galių ir funkcinių rodiklių ypatumus bei kaitą metinių treniruotės ciklu ir palyginti juos su kitų rungties dviratininkų analogiškais duomenimis.

*Metodai.* 2010–2011 metais buvo organizuotas Lietuvos BMX dviratininkės (A) tyrimas. Tyrimai atlikti parengiamuoju (I), varžybų (II) ir pereinamuoju (III) metinio ciklo laikotarpiais. Nustatyti fizinio išsivystymo rodikliai. Tirtas raumenų galingumas įvairiose energijos gamybos zonose. Nustatytas maksimalus ir anaerobinis alaktatinis-glikolitinis pajėgumas (MAAGP) atliekant 30 s trukmės testą. Kraujotakos ir kvėpavimo sistemos funkcinis pajėgumas vertintas pagal ramybės pulsą, jo dažnį po standartinio fizinio krūvio, po vienos minutės atsigavimo ir iš šių duomenų paskaičiuotą Ruffjė indeksą.

*Rezultatai.* BMX dviratininkės fizinių ir funkcinių galių rodikliai palyginti su treko dviratininkės sprinterės 200 m rungties pasaulio čempionės (B), treko dviratininkės ir 3 km persekiojimo pasaulio čempionato bronzos medalio laimėtojos (C) analogiškais rezultatais.

*Aptarimas ir išvados.* Mažųjų dviračių kroso tiriamosios VRSG yra labai didelis ir pralenkia šį kitų specializacijų dviratininkų rodiklį, tačiau AARG, mišraus anaerobinio alaktatinio-glikolitinio raumenų galingumo rodikliai nedaug nusileidžia vienos iš pajėgiausių pasaulio treko sprinterės analogiškiems rodikliams. Elito dviratininkės (C), kurios varžybinės veiklos metu dalis energijos pagaminama aerobiniu būdu, kraujotakos sistemos funkcinis pajėgumas yra didžiausias, o BMX dviratininkės šie rodikliai mažai nusileidžia jos aerobiniam pajėgumui.

**Raktažodžiai:** mažųjų dviračių krosas, fizinis išsivystymas, raumenų galingumas, funkcinis pajėgumas.

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Corresponding author **Kazys Milašius**  
Lithuanian University of Educational Sciences  
Studentų str. 39, LT-08106 Vilnius  
Lithuania  
Tel +370 5 2751748; +370 5 2734858  
E-mail kazys.milasius@vpu.lt