

# SHOOTING PARAMETERS OF BIATHLETES IN VARIOUS AGE GROUPS IN 2011–2012 WORLD CHAMPIONSHIPS

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## ABSTRACT

*Research background and hypothesis.* Physical fitness problems in biathlon are quite extensively discussed, but biathlon shooting in Lithuania is not analyzed enough. The special literature lacks information about the shooting parameters that leaders demonstrate in the world biathlon championships. Moreover, shooting parameters in different age and gender groups have not been analyzed enough. The hypothesis that shooting parameters in adult, youth and junior age group biathletes would differ was tested.

*Research aim.* The aim of our study was to analyze shooting parameters of biathletes in various age groups in 2011–2012 world championships and reveal fundamental differences in the aspects of age and gender.

*Research methods.* Research participants were youths (age: 17–18 years), juniors (age: 19–20 years) and adults (age: 21–41 years), male and female biathletes. The number of subjects was 2175. Descriptive statistical methods were used for data analysis.

*Research results.* Data analysis revealed the main differences in shooting parameters between adult, junior and youth groups, male and female biathletes. Also, comparison of shooting parameters between biathletes in various age groups and leaders in the same group was carried out.

*Discussion and conclusions.* Our research revealed that the highest shooting accuracy was observed in adult male and female biathlete groups ( $p < 0.025$ ). The shooting accuracy of junior and youth female biathletes was higher than that in the junior and youth male groups ( $p < 0.05$ ). The longest average shooting time was in youth group ( $p < 0.001$ ). The shooting time of biathletes in adult group was the shortest. We found that male biathletes in various age groups performed shots in less time compared to female biathletes ( $p < 0.05$ ). Research results revealed that shooting parameters among leaders statistically significantly differed comparing them with the average shooting parameters in the group ( $p < 0.05$ ).

**Keywords:** biathlon, shooting accuracy, shooting time.

## INTRODUCTION

Biathlon is complex winter sport which combines cross-country skiing with rifle marksmanship. Cyclical cross-country load in biathlon combines with acyclic actions in the fire range which requires complicated movement coordination (Pöhlmann, 1986). It is known that skiing time has bigger influence on final result in comparison with shooting efficiency in biathlon (Cholewa et al., 2005). However, final competition results and success in biathlon are decided not only upon the ability to ski fast but also the ability to shoot accurately (Skernevičius et al., 2005). Also, a

biathlete makes big difference being able to change in competition in skiing – shooting activities and control psychological tension, especially in a shooting range (Сорокина, 2010).

Shooting in biathlon is a complicated motor activity which requires position stability, high concentration and psychomotor skill levels with preliminary rapid preparation actions to assure fast and accurate shooting in both positions. Moreover, shooting in biathlon is highly influenced by various internal and external factors. The main internal factors are psychophysical, technical, tactical and

psychological. The main external factors are social, climatic and factors which are related to sports equipment (Hofman et al., 1992; Nitzsche, 1998; Grebot et al., 2003; Sattlecker et al., 2006; Grebot, Burtheret, 2007). Only a few studies have been directed towards shooting tasks in biathlon which mainly are concerned with physiological factors. From a scientific point of view it is important to analyse statistically the results of shooting obtained during recent world biathlon championships.

## RESEARCH METHODS

Research was carried out by analysing official protocols of youth, junior and adult biathletes' shooting parameters in 2011–2012 world biathlon championships. The shooting parameters analysed were shooting accuracy (%) and shooting time (s).

For data analysis we chose biathletes who were participating in youth (age: 17–18 years) 691, junior (age: 19–20 years) 545 and adult (age: 21–41 years) 939 groups, men and women. They were named as subjects. The overall number of subjects in our study was 2175.

The study was accomplished by analysing official protocols of youth, junior and adult biathlon

world championships in 2011–2012 year ([www.biathlonworld.com](http://www.biathlonworld.com), [www.Hora2000.com](http://www.Hora2000.com)).

**Statistical analysis.** All the data were expressed as average ( $\bar{x}$ ), standard error (Sx), standard deviation (S) and variance (V) of the mean. Hypothesis concerning the difference between means was verified using Student  $t$  test for independent and dependent variables. The difference between the means was regarded as statistically significant when error probably with respect to criteria was  $p < 0.05$ .

## RESEARCH RESULTS

Data analysis revealed that overall shooting accuracy of adult female group amounted to 76.8%. The shooting accuracy of biathletes in junior female group was 71.8%, while for woman in the youth group – 70.6%. Testing shooting accuracy in various age male groups educed that adult biathletes reached 77.4% shooting accuracy. Also, shooting accuracy of junior male biathletes was 70.4%. Biathletes in youth male group reached 67.3% of the shooting accuracy level (Table 1).

The analyses of the results of shooting time revealed that adult women biathletes spent on

Table 1. Shooting accuracy of various age groups, men (M) and women (W), in prone and stand positions

Age group	Youth		Junior		Adult	
	M	W	M	W	M	W
Average of leaders' accuracy (%)	87.5	88.8*	91.7	93.3	92.2*	95.8
Sx	1.3	1.0	2.1	1.5	1.1	1.0
S	2.2	2.8	3.6	2.6	3.2	3.1
V	2.5	3.2	3.9	2.8	3.5	3.2
Average of group accuracy (%)	67.3	70.6	70.4	71.8	77.4	76.8
Sx	1.4	1.5	1.4	1.4	1.2	1.2
S	22.5	22.1	19.6	20.2	17.9	18.8
V	33.4	31.2	28.4	28.5	23.2	24.8

**Note.** Sx – standard error, S – standard deviation, V – variance of the mean; \* – Biathletes who achieved 1<sup>st</sup>–8<sup>th</sup> places in youth women and adult men groups were considered as leaders. In other groups leaders' results calculation was based on data from biathletes who took 1<sup>st</sup>–3<sup>rd</sup> places.

Table 2. Shooting time of various age groups, men (M) and women (W), in prone and stand positions

Age group	Youth		Junior		Adult	
	M	W	M	W	M	W
Shooting time in prone position (s)	42.4	45.5	39.8	41.8	34.7	37.9
Sx	0.8	0.9	0.7	0.7	0.4	0.4
S	7.7	7.6	6.1	5.4	4.9	4.7
V	18.2	16.7	15.4	13.1	14.1	12.5
Shooting time in stand position (s)	37.2	41.3	34.7	39.9	31.4	34.9
Sx	0.6	0.8	0.5	0.7	0.4	0.4
S	6.3	6.8	4.9	5.5	4.7	3.9
V	16.9	16.3	14.1	13.9	14.9	11.3

**Note.** Sx – standard error, S – standard deviation, V – variance of the mean.

average 36.4 s for a shot. Average shooting time of junior women biathletes was 40.8 s. Also, youth women group reached the average shooting time of 43.4 s. The data analysis of men group biathletes' shooting time showed that adult biathletes spent 33.1 s on shooting. Also, the analysis revealed that biathletes in junior male group demonstrated the shooting time of 37.3 s and youth male biathletes performed shots in 39.8 s (Table 2).

## DISCUSSION

Scientists M. D. Hoffman et al. (1992), M. D. Hofman and G. M. Street (1992), K. Rundell and D. Bacharach (1995), B. Paugsachova (2000), F. Manfredini et al. (2002), J. Cholewa et al. (2005), B. Paugsachova et al. (2010) claim that the final result of the competition mostly depends on  $\text{VO}_2\text{max}$  and upper body muscle power of biathlete in skiing event, also shooting accuracy and time in shooting event. The study of J. Cholewa et al. (2004) obtained results which clearly indicated a decrease in the level of efficiency in shooting parameters in biathlon in the seasons of 1997–2003. However, K. Nitzsche's (1998) research on the shooting parameters in 1969–1996 seasons determined that the shooting parameters had a tendency to increase. Our study agrees with the previously mentioned thesis that success in shooting event is highly influenced by shooting accuracy and time because our data analysis revealed that biathletes who occupied leader positions demonstrated significantly higher shooting accuracy levels and shorter shooting time than their group on average ( $p < 0.05$ ) (Table 1, Figure 4).

The analysis of the research results showed that shooting parameters between various age group

biathletes had statistically significant differences. Research revealed that the shooting accuracy in prone position was significantly higher than that in stand position among various age group women biathletes ( $p < 0.01$ ). Biathletes in adult women group showed a significantly better average shooting accuracy than junior ( $p < 0.025$ ) and youth group women ( $p < 0.005$ ), in both prone and stand shooting positions. Moreover, the shooting accuracy in stand position of junior women group biathletes was significantly higher than that of youth biathletes ( $p < 0.05$ ) (Figure 1).

The results obtained during the study showed that shooting accuracy in prone position was significantly higher than that in stand position among various age group men biathletes. Average shooting accuracy of adult men biathletes was significantly higher than that of junior ( $p < 0.005$ ) and youth men biathletes ( $p < 0.001$ ). Also, the analysis revealed that junior men group biathletes demonstrated higher average shooting accuracy than youth biathletes ( $p < 0.05$ ) (Figure 2).

Results of A. Kryl (1987) and M. I. Shygunov (Шикунов, 1987) research revealed that average shooting time of adult group biathletes was  $32.5 \text{ s} \pm 0.36$  in prone and  $30.2 \text{ s} \pm 0.24$  in stand position. The analysis of our study established that the average time spent in shooting of biathletes in adult group was  $36.3 \text{ s} \pm 0.4$  was in prone and  $33.2 \text{ s} \pm 0.4$  in stand position (Figure 3). Although our data analysis revealed that shooting time was insignificantly longer than that in previous research of A. Kryl (1987) and M. I. Shygunov (Шикунов, 1987) it showed that shooting time was important for success in shooting event.

Our study showed that the longest shooting time was determined in youth group, while adult group

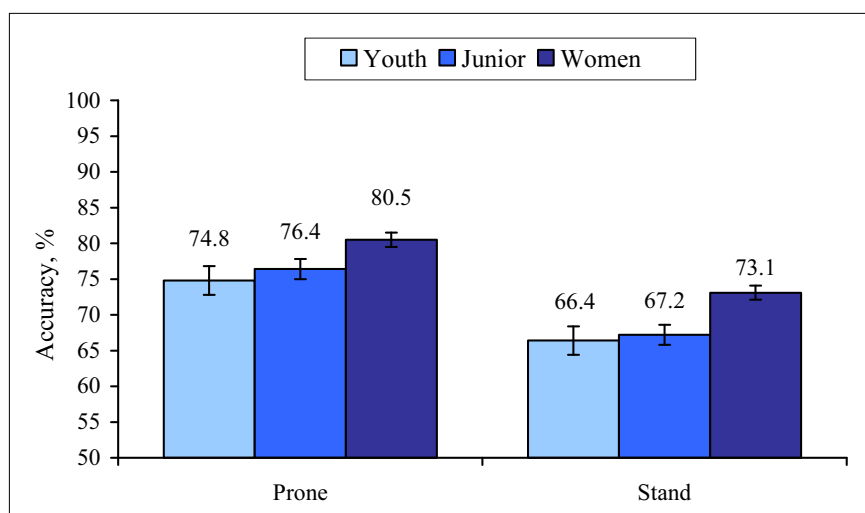


Figure 1. Shooting accuracy of various age group women biathletes, in prone and stand positions ( $\bar{X} \pm S_x$ )

Figure 2. Shooting accuracy of various age group men biathletes, in prone and stand positions ( $X \pm Sx$ )

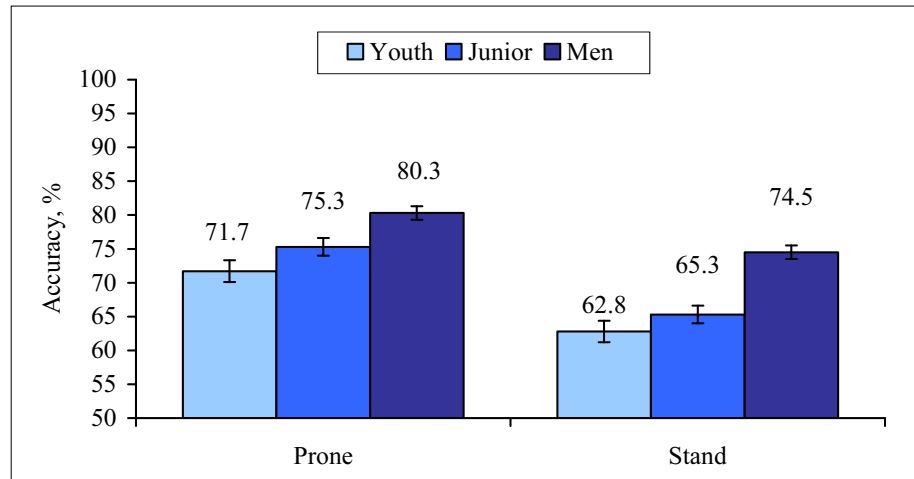


Figure 3. Average shooting time of various age groups, men and women ( $X \pm Sx$ )

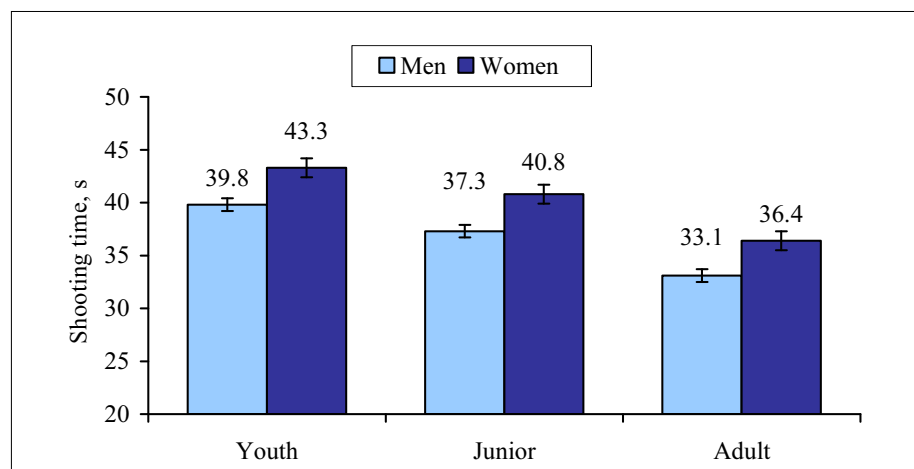
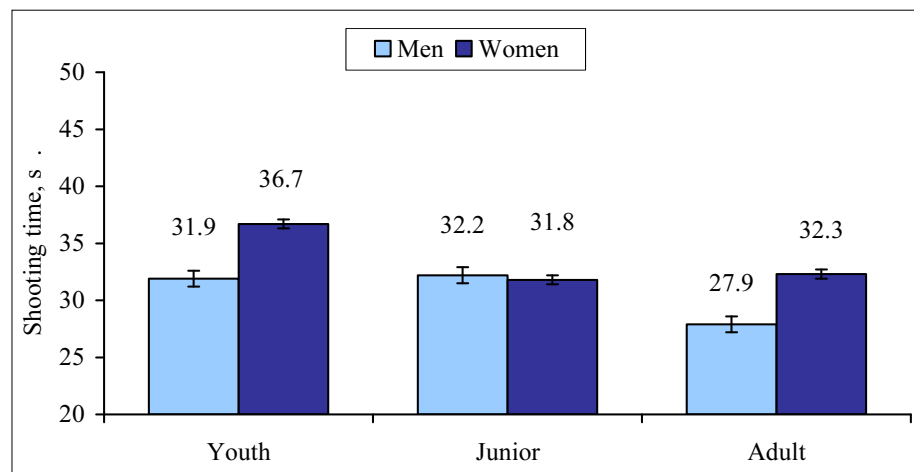


Figure 4. Average shooting time of leaders in various age groups, men and women ( $X \pm Sx$ )



biathletes demonstrated the shortest shooting time ( $p < 0.001$ ). Adult male group showed the shortest average shooting time in both stand (31.4 s) and prone (34.7 s) positions. We found that male biathletes in various age group showed shorter shooting time than women biathletes in various age groups ( $p < 0.005$ ) (Figure 3). We observed a tendency that shooting time in prone position was longer than that in stand position ( $p < 0.05$ ).

We compared the shooting time results in various age groups with the shooting time of leaders in the same groups. We found that biathletes who took award winning places demonstrated significantly shorter shooting time than of the biathletes in their groups ( $p < 0.05$ ). Average shooting time of leaders in adult men and women group were  $30.9 \text{ s} \pm 1.1$  in prone and  $29.3 \text{ s} \pm 0.9$  in stand positions (Figure 4).

Some scientists (Pustovrh et al., 1995; Cholewa et al., 2004; Cholewa et al., 2005; Sattlecker et al., 2006) found no shooting significance to final competition results. However, our research revealed the tendency that the shooting time of biathletes who took leader places had significantly differed from the average shooting time of their group. This difference was most distinct in junior and youth groups.

Our research results suggest that shooting parameters in modern biathlon are becoming increasingly important. However, there is no information how to evaluate shooting parameters. For this reason, further studies should be carried out to construct reference assessment scales for shooting parameters.

## CONCLUSIONS AND PERSPECTIVES

1 The highest shooting accuracy was determinate in adult male and female groups of biathletes. The average shooting accuracy level between youth and junior groups did not differ statistically significantly.

2. The longest average shooting time was in youth group. The shortest time of shooting was observed in adult group of biathletes. The shooting time of men in various age groups was shorter than that of women in the same group.

3. Shooting parameters of leaders in various groups were significantly better than the group average.

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# SKIRTINGŲ AMŽIAUS GRUPIŲ BIATLONININKŲ 2011–2012 METŲ PASAULIO BIATLONO ČEMPIONATŲ ŠAUDYMO RODIKLIAI

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## SANTRAUKA

*Tyrimo pagrindimas ir hipotezė.* Biatlonininkų fizinio parengtumo problemos yra gana plačiai išnagrinėtos, tačiau biatlono šaudymo klausimai Lietuvoje nėra analizuoti. Specialiojoje pasaulinėje literatūroje trūksta informacijos apie tai, kokių šaudymo rodiklių pasiekia pasaulio biatlono čempionatuose lyderių pozicijas užimantys biatlonininkai. Šaudymo rodikliai neišanalizuoti ir skirtingų amžiaus grupių bei lyčių požiūriu. Tyrimu tikrinama hipotezė, kad suaugusiųjų biatlonininkų šaudymo rodikliai skiriasi nuo jaunimo ir jaunių amžiaus grupių biatlonininkų.

*Tikslas* – išanalizuoti suaugusiųjų, jaunimo ir jaunių biatlonininkų 2011–2012 metų pasaulio čempionatų šaudymo rodiklius ir juos palyginti lyties bei amžiaus požiūriu.

*Metodai.* Duomenų analizei pasirinkti jaunių (amžius: 17–18 m.), jaunimo (amžius: 19–20 m.) ir suaugusiųjų (amžius: 21–41 m.) grupių biatlonininkų šaudymo rodikliai. Analizuoti tokie šaudymo rodikliai: laikas ir taiklumas. Stebėjimo vienetų kiekis 2011–2012 m. –  $n = 2175$ . Duomenų analizei atlikti taikyti matematinės statistikos metodai.

*Rezultatai.* Nustatyti suaugusiųjų, jaunimo ir jaunių amžiaus grupių biatlonininkų šaudymo rodikliai buvo palyginti lyčių bei amžiaus požiūriu. Taip pat palyginti skirtingo amžiaus biatlonininkų šaudymo rodikliai su atitinkamoje grupėje lyderių pozicijas užėmusių biatlonininkų šaudymo rodikliais.

*Aptarimas ir išvados.* Nustatyta, kad biatlonininkų moterų šaudymo taiklumas jaunių ir jaunuolių amžiaus grupėse yra didesnis nei atitinkamos grupės biatlonininkų vyrų ( $p < 0,05$ ). Suaugusiųjų grupių biatlonininkų taiklumas didesnis nei jaunimo ir jaunių ( $p < 0,025$ ). Šaudymo laiko vidurkis ilgiausias jaunių amžiaus grupėje. Suaugusiųjų grupės biatlonininkai šūvius atlieka per trumpiausią laiko tarpą ( $p < 0,001$ ). Jaunių, jaunimo ir suaugusiųjų vyrų grupių biatlonininkų šaudymo laiko vidurkis yra trumpesnis nei moterų atitinkamai ( $p < 0,05$ ). Lyderių pozicijas iškovojusių biatlonininkų šaudymo parametrai reikšmingai skyrėsi nuo atitinkamos grupės vidurkio ( $p < 0,05$ ).

**Raktažodžiai:** biatlonas, šaudymo taiklumas, šaudymo laikas.

Gauta 2012 m. balandžio 11 d.  
Received on April 11, 2012

Priimta 2012 m. birželio 8 d.  
Accepted on June 8, 2012

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