

# Analysis of competitive shooting of the world top female biathletes and female biathletes of the national team of Ukraine

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**Purpose:** optimization of preparation of highly skilled female biathletes on the basis of determining the required number of shots that provides optimum prerequisites for stable performance at the season major competition.

**Material & Methods:** analysis of scientific-methodical literature; theoretical methods of scientific cognition; methods of mathematical statistics.

**Results:** average percentage of hits of the World and Olympic champions and prizewinners (2006–2015) has been calculated. It constitutes 84,47% during 420 shots performed per season. It has been revealed that in 86,42% of cases the high quality of shooting is provided by 340–500 shots performed per season.

**Conclusions:** in order to medal at the season major competition one should have the level of shooting preparation equal to 84–85% hits per season, minimum possible quality of shooting along with excellent racing preparation – 79,5%. 160–280 competitive shots performed per season could provide stable performance at the major competition.

**Keywords:** biathlon, number of shots, competitive shooting.

## Introduction

A wide use of competitive practice, not only in the form of shows, but also as an effective remedy of training of sportsmen is a distinctive feature of modern sport [9; 17; 18]. It led to the increase in the international competitive program, the creation of the international competitive structure with the rigid quota system and admissions which isn't allowing to come for starts of large international competitions to poorly trained sportsmen in biathlon [13; 23] that in total «was reflected in the increase of influence of the system of competitions at strategy of training of biathlons» [5].

According to a number of experts [13; 15; 20], the World Cup (WC) in biathlon is one of the rigid international competitive calendars which creation of trimesters doesn't consider the number of the days which are necessary for adaptation of an organism to geographical factors of venues of competitions. The accepted system of calculation of general and national offsets [23] in biathlon forces sportsmen to participate in all stages of WC and to start constantly in an emergency and wasteful phase of adaptation of an organism to mountain or hour conditions that considerably emasculates their organism and leads to the decrease in the level of sportswear [5; 15].

Competitions are used as an effective remedy of training of the separate parties of preparedness which aren't often solved by means of usual trainings in the modern system of training of sportsmen. At the same time experts recommend to use competitions only in that volume which will provide optimum preparedness of sportsmen for the main start of a season as an insufficient competitive practice leads to decrease in ef-

iciency of the competitive activity [9; 10; 17; 18; 20]. In total these two factors (the optimum competitive practice and the international competitive calendar which isn't providing an effective management of a condition of a sportswear) put forward the expediency of creation of individual competitive calendars at admission to the main start of a season (MSS) [16; 19].

As biathlon combines two sports: ability to move quickly on skis on a distance and hold high-quality and fast shooting, and a contribution of the last indicator to sports result increased significantly for the last decades [6–8; 12] – it is possible to ask a question – if the level of sports skill of biathlons directly depends on quality of shooting, [2; 7; 8] what kind of parameters of competitive shooting preparation need to achieve to come to the level, allowing to fight for a gain of medals on MSS and what number of competitive starts provides stability of this indicator.

Recommendations weren't revealed by the authors in scientific and methodical literature on biathlon concerning the optimum competitive practice providing an effective performance in the main start of a season [3; 4; 7; 8; 11; 14; 21; 22]. This work is a continuation lifted by authors before a subject on optimization of training of highly skilled biathlons taking into account the international system of competitions [5; 7; 13; 15; 16].

## Communication of the research with scientific programs, plans, subjects

The area of the work corresponds to a scientific subject 2.5.

«The improvement of the training process in winter sports» on the specialty 24.00.01. – Olympic and professional sport of the Consolidating plan of the research works in the sphere of physical culture and sport for 2011-2015.

## The purpose of the research

To optimize training of biathlons of high qualification on the basis of definition of necessary quantity of the competitive shots providing optimum prerequisites for a stable performance in MSS.

### Research problems:

1. To carry out the analysis of scientific and methodical literature regarding influence of quality of shooting on result in biathlon and optimum competitive practice on result of performance in the main start of a season.
2. To determine the level of shooting preparedness of the leading biathlons of the world ascending to the podium at the winter Olympic Games (WOG) and the World Cups (WC) in individual types of the competitive program.
3. To define the optimum quantity and quality of the competitive shots providing a possibility of a gain of medals in MSS (WC, WOG).
4. To define the quality of competitive shooting training of sportswomen of a national team of Ukraine for the purpose of further recommendations about the creation of individual competitive calendars.

## Material & Methods

The following methods of the research were used in the work:

1. Analysis of scientific and methodical literature.
2. Theoretical methods of scientific knowledge, such as supervision, generalization, analysis and synthesis.
3. Methods of mathematical statistics.

More than 3300 protocols of competitions of stages of WC among women, WC and WOG from 2005/2006 till 2014/2015 sports seasons were undergone to the analysis.

## Results and discussion

It is the most convenient to estimate professional shooting skill of biathlons by means of an integrated indicator – the «percent of hits» characterizing reliability of his shooting both at concrete competitions, and during the season in general [2; 7]. In use the quantity of shots which were made by a sportsman at competitions, are called «a competitive shot». Sportswomen-biathlons who are ascending to the podium at WC and WOG from 2006 till 2015 in individual disciplines of the competitive program on average for a sports season, have a «competitive shot» 420 shots at 84,47% of hits (tab. 1).

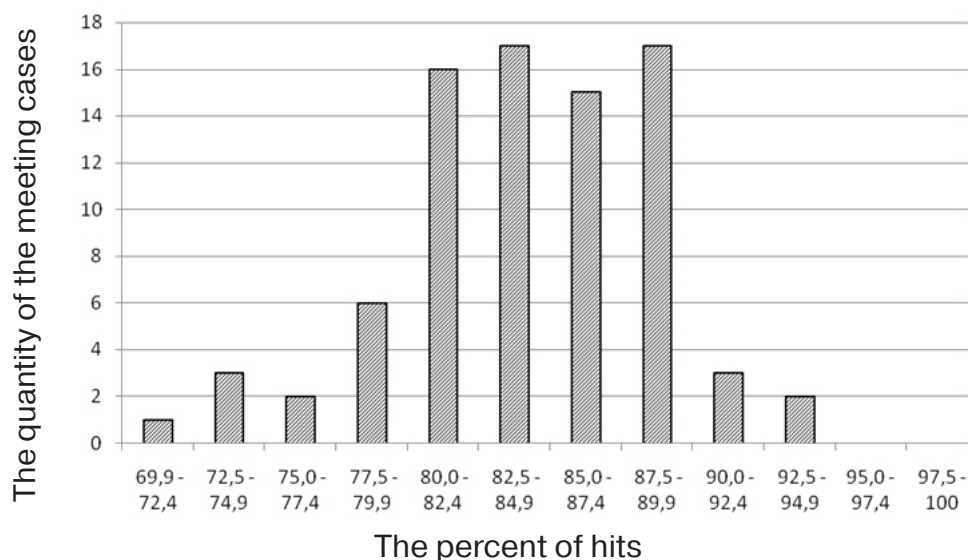
In total the competitive activity of 82 sportswomen was investigated. The number of sportswomen doesn't coincide with quantity of the held medals as one sportswoman could win several medals in a season. The quality of shooting of 79,27% of the leading sportswomen is in the range from 80,1 till 90,0% of hits (pic. 1). Only 6,1% of shoot better than 90,0%. A low interest of hits is a criterion which cuts sportsmen from a fight for medals. It is seldom who shoots worse than 80,0% at the quantity of shots in competitions for 400. It is possible to compensate a low interest of hits only by high speed of movement (Lilia Efremova, Uschi Disl, Magdalena Neuner). Just these sportswomen, who are performing several years, enter the remained 14,63% of the prize-winners who are having the worse quality of shooting 80,0% (pic. 1).

Distinctions as firing at sportswomen before MSS (at various quantity of stages of WC before MSS) and during the season in general are statistically doubtful and aren't defined by the number of starts (tab. 1). The coefficient of correlation of this indicator makes 0,927 that speak about high interrelation of these indicators. A distinctive feature of this selection is improvement of quality of shooting on MSS. So, before MSS the percent of hits on group averaged 84,07%±4,94 (84,16% at 6 stages of WC and 83,85% at 8 stages of WC) (tab. 1). On MSS – 86,27%±5,75, what is better on 2,20%. And on the start which has brought to sportswomen of medals – 93,45%±5,56 that is on 9,38% better, than before MSS. And distinctions as shooting are reliable (compare pic. 1 and 2).

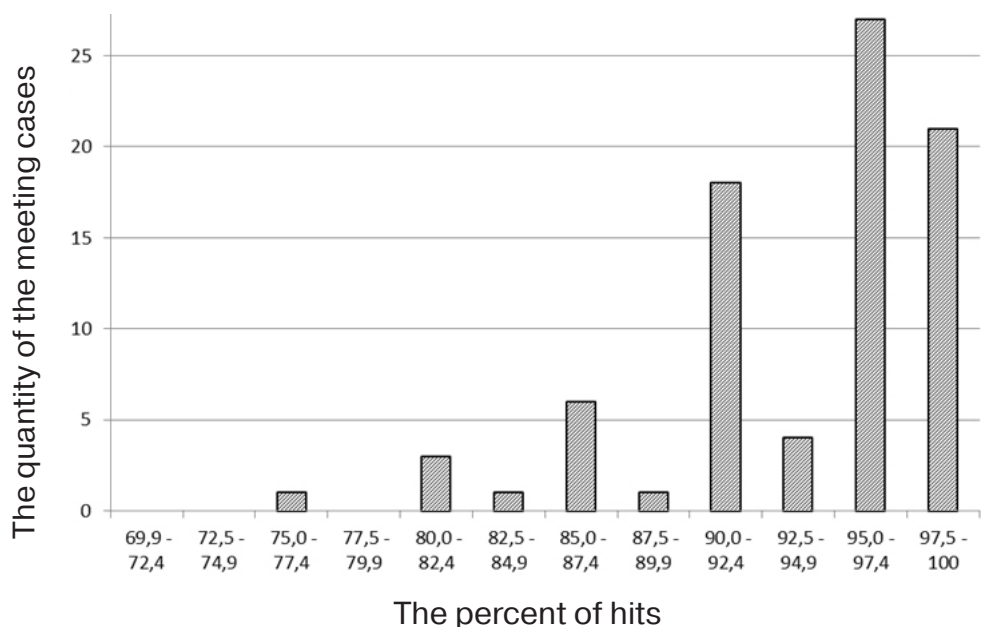
On the start which has brought medals, 98,78% of sportswomen have the quality of shooting higher than 80,0% of hits, 93,9% shoot better than 85,0% of hits, 85,37% of sportswomen have the percent of hits higher than 90,0 (pic. 2). The biathlons having the highest ski-racing preparedness

**Table 1**  
**Statistical data of a competitive shooting of biathlons who won prizes at WC and WOG from 2006 till 2015 (n=82)**

№	Indicator	Total of a season		Before the main start of a season				On MSS (WC, WOG)		On the start of MSS, winning of a medal	
				At 6 stages of WC till MSS		At 6 stages of WC till MSS					
		% hits	Shots	% hits	Shots	% hits	Shots	% hits	Shots	% hits	Shots
1	Average	84,47	420,26	84,16	214,96	83,85	306,84	86,27	82,74	93,45	
2	$\sigma$	4,50	62,99	5,12	39,61	4,58	49,58	5,75	11,39	5,56	
3	Maximum	94,2	508	94,4	272	94,1	355	95,1	110	100,0	70
4	Minimum	71,8	240	70,7	106	71,1	165	74,0	51	76,6	10
5	Cases (n)	82		57		25		82		82	



**Pic. 1. The chart of distribution of the quality of shooting during the season at champions and prize-winners of WC and WOG from 2006 till 2015 among women (n=82)**



**Pic. 2. The chart of distribution of the quality of shooting on the start which has brought medals at champions and prize-winners of WC and WOG from 2006 till 2015 among women (n=82)**

(14,63%) have the percent of hits lower than 80,0 % during the season, they mobilize and shoot better 80,0% on MSS. At the distance which has brought them medals, the quality of their shooting averages 90,83% (tab. 2).

Thus, the level of sports skill directly depends on the quality of shooting, and the quality of shooting directly depends on the quantity of the made shots at competitions that in turn depends on the number of starts in which a sportsman took part [1; 6].

Such quality of shooting 340x500 with competitive shots for a sports season – 86,42% of cases is provided (pic. 3). Less than 340 and more than 500 competitive shots are done only by certain biathlonists. It is necessary from 160 till 280 competitive shots before MSS at 6 stages of WC before MSS. The

executed less than 160 shots by certain sportswomen can be counted up before MSS, most likely, the exception connected with the postponed illness in a season, but not regularity or the tactical decision. Sportswomen manage to make bigger quantity of competitive shots (from 260 to 360) at 8 stages of WC before MSS.

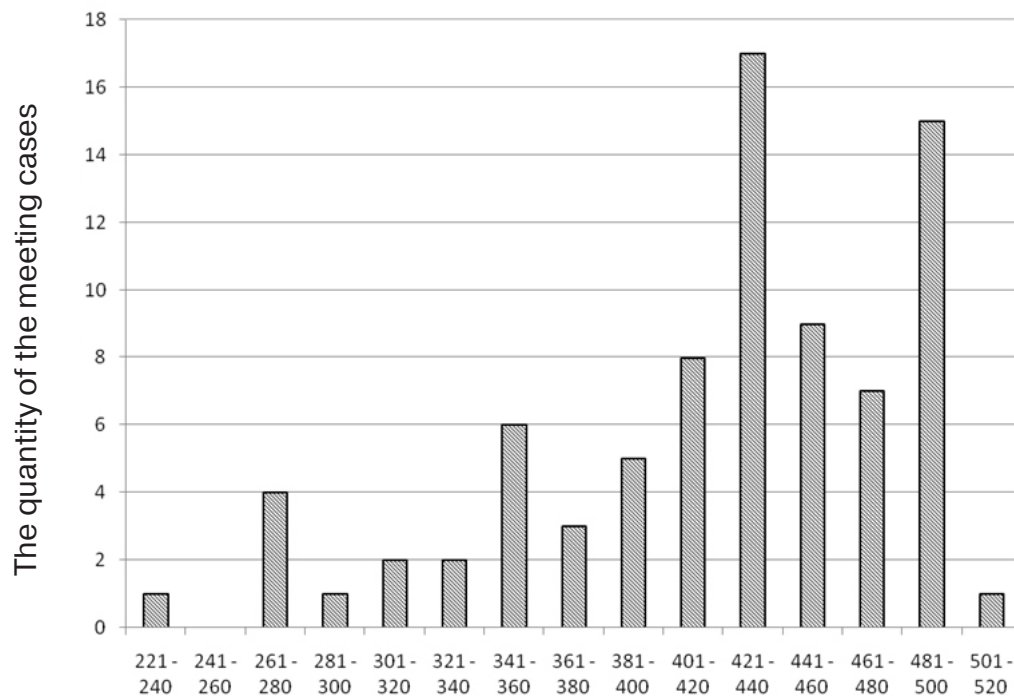
The quality of competitive shooting of leaders of a national team of Ukraine (tab. 3) is above the shown average indicators of prize-winners of WC and WOG in a season what allows them to ascend to the podium of these competitions periodically.

The long-term analysis of THE competitive activity of sportswomen of a national team of Ukraine (tab. 3) allows making several conclusions. High-quality shooting is possible at small

Table 2

Statistical data of the competitive shooting of the biathlonsists who took prizes at the WC and WOG from 2006 till 2015, who are having the worse quality of shooting in a season 80,0% (n=8)

№	Surname, Name	Year	% of hits			
			At a season	Before MSS	On MSS	On a distance, having taken medals
1	Disl Uschi	2006	75,1	79,1	78,6	85,0
2	Efremova Lilia	2006	71,8	71,9	75,6	100,0
3	Neuner Magdalena	2007	74,6	70,7	74,6	80,0
4	Neuner Magdalena	2008	73,5	74,3	74,0	80,0
5	Hauswald Simone	2009	79,5	76,0	74,6	100,0
6	Kuzmina Anastasiya	2009	76,5	73,6	80,0	90,0
7	Domracheva Darya	2011	79,9	80,9	76,1	85,0
8	Bachmann Tina	2011	72,5	71,1	79,6	90,0
9	Kuzmina Anastasiya	2011	79,7	80,6	78,9	90,0
10	Neuner Magdalena	2012	79,5	81,8	74,7	90,0
11	Kuzmina Anastasiya	2014	79,7	79,0	84,0	100,0
12	Gasparin Selina	2014	79,9	80,9	88,5	100,0
Average			76,85	76,66	78,28	90,83
$\sigma$			3,19	4,20	4,41	7,64
Maximum			79,9	81,8	88,5	100,0
Minimum			71,8	70,7	74,0	80,0



The quantity of the executed competitive shots for a sports season

**Pic. 3.** The chart of distribution of the quantity of the competitive shots executed for a sports season at champions and prize-winners of WC and WOG from 2006 till 2015 among women (n=82)

**Table 3**

**Dynamics of the quality of competitive shooting (% of hits) and the quantity of competitive shots in the competitive period at the sportswomen of a national team of Ukraine who were taking part in WC or WOG**

№	S.N.	Indicator	Sports seasons								
			2006-2007	2007-2008	2008-2009	2009-2010	2010-2011	2011-2012	2012-2013	2013-2014	2014-2015
1.	Pidgrushna Ye.	% of hits	78,9	81,2	84,7	86,3	86,3	81,9	88,3	89,5	
		Shots	361	202	313	437	400	343	478	256	
2.	Semerenko V.	% of hits	78,0	84,0	84,2	85,2	84,6	84,0	86,9	88,4	
		Shots	459	356	481	472	469	450	459	294	
3.	Semerenko V.	% of hits	84,5	82,8	77,0	85,3	81,6	76,9	79,9	84,7	86,4
		Shots	343	377	473	422	463	411	427	438	566
4.	Khvostenko O.	% of hits	91,1	87,1	90,9	91,1	87,6				
		Shots	448	395	330	338	201				
5.	Dzhima Yu.	% of hits		79,5	77,6	82,0	83,5	83,1	85,2	85,3	86,7
		Shots		210	232	161	315	225	371	374	414
6.	Burdyga N.	% of hits					88,3	81,5	77,8	82,2	79,6
		Shots					180	428	221	314	314
7.	Suprun I.	% of hits	73,3	75,8	71,9	78,0	81,4	71,9	79,7	74,4	
		Shots	150	289	231	91	291	221	227	203	
8.	Abramova O.	% of hits								69,0	73,3
		Shots								216	371
9.	Bondar Ya.	% of hits						74,7	68,4	69,0	
		Shots						225	187	252	
10	Panfilova M.	% of hits						72,6	69,0		
		Shots						135	252		
11	Varvinets I.	% of hits						82,3	77,3	83,7	
		Shots						124	229	326	
12	Zhuravok Yu.	% of hits							84,9	94,6	
		Shots							146	260	

«shot» as there is a high probability to make it in optimum conditions (a calm, an approach to a boundary at speed, a lack of a strong emotional background), but it doesn't possess a competitive reliability [2; 7]. The continuous practice is necessary for high-quality conducting shooting at the most responsible competitions that is expressed in participation in a large number of starts and it is reflected in competitive «shot». So, the average percent of hits top-10 WC at women made 85,6% at 416 shots in 2009/2010 sports season [7]. Falling of the quality of shooting at poorly trained sportsmen with increase in the quantity of shots is natural as the various unforeseen and not met earlier situations begin to meet (shooting ranges with a different wind rose, unusual lighting, inconvenient approach, big desire to make firing good, a high emotional background of a fight, etc.), with which a sportsman doesn't cope, and it is negatively reflected in result of his firing. However the general fitness increases that is reflected in stabilization and improvement of the quality of shooting as time goes by with the increase in the quantity of shots.

The decrease in number of starts before the main start of four years till 9-12, with the purpose to come «fresher» to the most necessary distances, can be considered expedient. Such actions lead to decrease in a competitive shot and improvement of quality of shooting, but then the basic work has to precede it for about five and more years (tab. 3). From the table it is visible that the decrease in the quantity of competitive loading (as the indicator – quantity of the made shots at competitions) promoted at several sportswomen in a season of 2014 to shooting improvement of quality. The decrease of «shot» was preceded by a long basic work for several years. The

decrease in competitive loading without a good basic work doesn't bring a result (tab. 4).

**Table 4**

**The characteristic of competitive shooting of Yelena Petrova (all official competitions are considered)**

Sports seasons	% of hits			Total	
	Total	Lie	Stay	Shots	Miss
2000/01	85,6	86,4	84,8	354	51
2001/02	86,3	83,3	89,4	174	24
2002/03	84,1	88,2	80,0	220	35
2003/04	82,5	86,9	78,0	120	21
2004/05	86,4	90,0	82,9	140	19
2005/06	81,1	90,3	71,5	264	50

The decrease in competitive shooting practice for the highly experienced sportswoman Yelena Petrova before the World Cup 2004 have led to good result (bronze in an individual race) (tab. 4). However four sports seasons without a break, especially two the last, the previous WOG-2006 (on 120 and 140 shots for a sports season), – have led to loss of self-confidence, deterioration in rate of fire and quality of firing at competitions of MSS. The quantity of shots in competitions at Yelena Petrova in two Pre-Olympic seasons are 3,5 times less, than at leaders of the world biathlon. Our researches show that decrease in the level of competitive practice is justified for one season, and that by good long-term basic shooting preparation. The decrease in competitive practice leads more than two years to deterioration of competitive shooting and,

as a result, is negatively reflected in sports result.

The decrease at some sportswomen of competitive «shot» in a season, as well as the number of starts, can be connected both with the tactical decision, and with temporary circumstances ( illness, disqualification, missing in the main structure of the national team, desire to finish an unfortunate sports season or sports career in the middle of a season). Therefore the main criterion at an individual competitive calendar is density of competitive starts before MSS, but not during the season in general.

## Conclusions

1. The number of the starts falling on each sportsman in a season (that influences the level of a competitive shot) has to be optimum and accurately dosed for the achievement of the best sports result on the most responsible starts of a season or four years.

2. It is necessary to have the level of shooting preparedness not lower than 80,0% of hits during the season (85,37% of all prize-winners) to apply for a gain of medals on MSS. The average percent of hit of champions and prize-winners of WC and WOG for the last 10 sports seasons from 2006 till 2015 makes 84,47% at 420 shots.

3. 93,9% of sportswomen in MSS won medals with the quality of shooting in the range of 85,0-100% in individual disciplines from 2006 till 2015 seasons. And 85,37% with the quality of shooting in the range of 90,0-100%.

4. A low interest of hits is a criterion which cuts sportsmen from fight for medals. On a share of the sportswomen who are shooting worse in a season 80,0%, 14,63% of medals are necessary, therefore it is necessary to achieve the quality of shooting higher than 90,83% of hits for a gain of medals.

5. High quality of shooting is provided with 340-500 competitive shots for a sports season at hits – 86,42% of cases. At the same time a stable performance on MSS requires from 160 till 280 competitive shots executed before MSS. Distinctions as shooting at sportswomen before MSS and during the season in general are statistically not reliable and aren't defined by the number of starts.

6. The decrease in number of starts before the main start of four years till 9-12 can be considered expedient at long-term basic sports preparation, with the purpose to come «fresher» to the most necessary distances. Such actions though lead to the decrease in a competitive shot, but, as a rule, increase the quality of shooting.

7. The main criterion for drawing up an individual competitive calendar is a performance of a necessary competitive shot before MSS, but not during the season in general.

## Prospects of further researches

Provide a creation of optimum individual competitive calendars taking into account the necessary quantity of competitive shots before MSS.

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