TRENDS IN DEVELOPMENT OF WOMEN'S TRIPLE JUMP DISCIPLINE

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Abstract: *This publication analyses the dynamics of results in the women's triple jump in world championships. Based on the results achieved in the last World Outdoor Championship, we analysed the anthropometric characteristics of the finalists, as well as the individual components of the technique and their correlations. This allowed us to determine the current development of the triple jump discipline for woman in the pre-Olympic year.*

Key words: *triple jump, women's, development, elite sport*

1. Introduction

This publication analyses the dynamics of results in the women's triple jump in world championships. Based on the results achieved in the last World Outdoor Championship, we analysed the anthropometric characteristics of the finalists, as well as the individual components of the technique and their correlations. This allowed us to determine the current development of the triple jump discipline for woman in the pre-Olympic year.

2. Objective and Tasks

2.1. Objective

The objective of this study is to analyse the results in the women's triple jump discipline achieved during the final of the outdoor World Athletics Championships,

Doha 2019, which will allow us to determine the current evolution of the discipline.

2.2. Tasks

Follow up the development of results in women's triple jump at world championships;

Measure the final result and its constituent elements: the speed and length of the individual parts of the jump;

Determine their structural correlation.

3. Methods of Study

For the purpose of the study, we used the following methods: videometry and statistical analysis (variation, correlation analysis, and Shapiro-Wilk test of normal distribution). We received information on the measurement values obtained from the official website of the World Athletics

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Championships, Doha 2019. The approach they used was based on a VDM video system.

Two Stereoscopic cameras are installed in the stadium stands to record the results achieved. They capture HD-quality photos at 7 3D shots per second. These photos have a resolution of 15,824,256 pixels. In general, the entire system is calibrated depending on the distance of the cameras to the sand pit. Also, there are markers around it to facilitate the measurement. After receiving the photos at the stadium measurement centre via computer, the length of the jump is calculated.

For the sake of higher reliability of the results obtained, we used only the best attempts of each competitor who participated and registered a result in the final competition, i.e. 12 attempts.

4. Analysis of Results

The progress of the triple jump discipline can be followed on Figure 1. The main trend that has been noticed is the lower score for winning the world title in the last 10 years. Meanwhile, the qualifying result between the first three is relatively constant, between 14.60 and 14.80 m. The qualifying result for the top eight shows a great variability over the years, in the range between 13.80 – 14.39 m, stabilizing at 14.20 m during the last 5

championships. The result for entering the final of the World Championships is 14.10 m with a few exceptions.

From the output data of Doha 2019 women's triple jump finalists shown in Table 1, we have made the following analyses of the current evolution of the women's triple jump discipline. In support of previous studies, we can see that the champion has the highest bounce speed [2], [6].

As we can see from the table, the height of the competitors is between 166 and 192 cm. The average value of the studied characteristic is 174.5 cm, with the athletes showing great uniformity in this indicator. However, compared to previous studies on this indicator, the height of competitors has increased [7]. The weight of the study athletes is the indicator with the highest variability (V%=10%). The average weight of the athletes increased slightly compared to other similar studies [7]. The only exception for both indicators is the champion (Rojas).

The final results have a normal distribution for this kind of competitions, ranging from 13.99 to 15.37 m for the 12th and the 1st place, respectively. Medals are awarded with a score above 14.73 m [6]. The average length of the three parts of the jump (hop; step; jump) is: 5.28 m, 4.11 m, and 5.08 m.
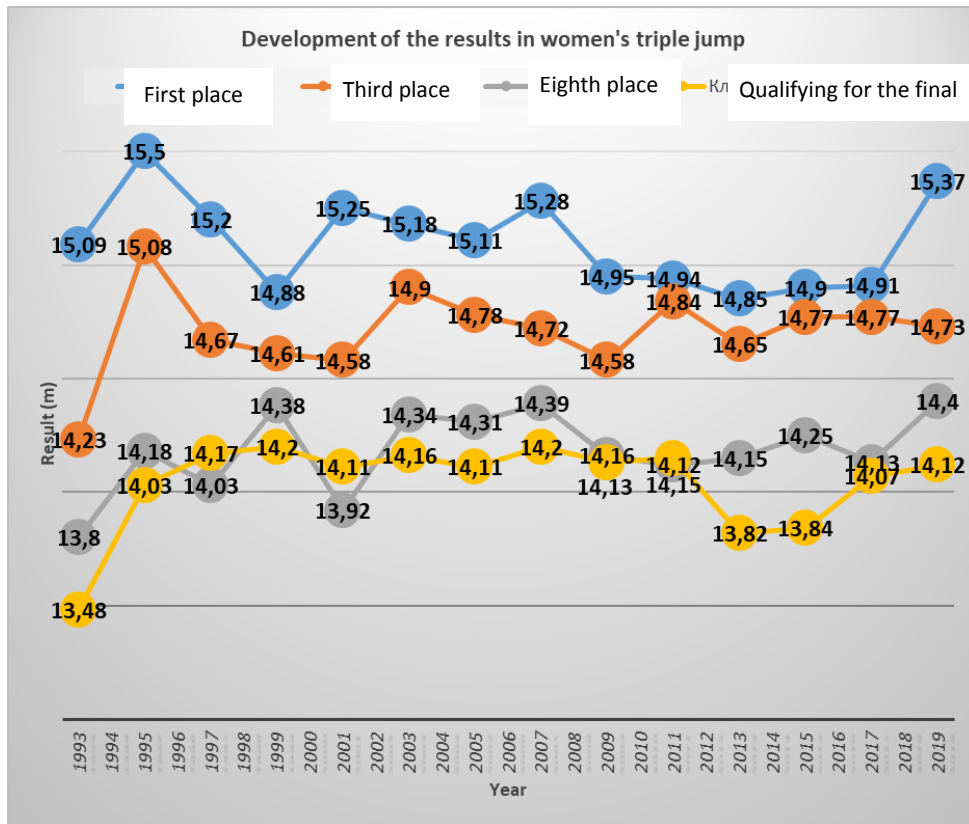
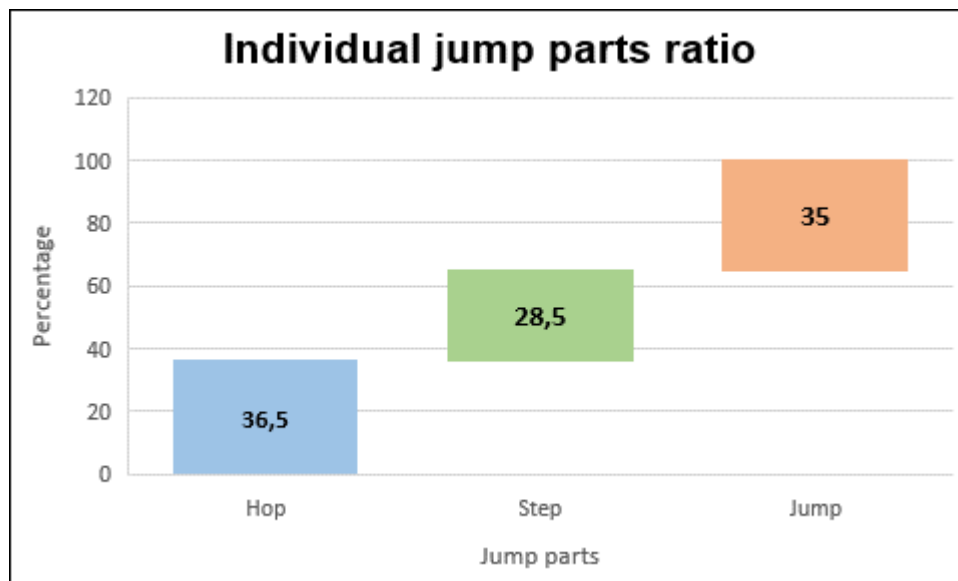Fig. 1. *Development of the results in women's triple jump at world championships*

Fig. 2. *Ratio of the individual parts of women's triple jump, Doha 2019*

Table 1

Doha 2019 women's triple jump finalists

Position	Name	Height	Weight	Total Length	Bounce	Step	Jump	Bounce speed	Step Speed	Jump Speed	Bounce Ratio	Speed Ratio	Jump Ratio
1	Poxac	192	72	15.37	5.71	4.03	5.63	9.1	8.1	5.8	37.2	26.2	36,6
2	Ricketts	180	64	14.92	5.44	4.21	5.27	8.6	7.6	5.9	36.5	28.2	35,3
3	Ibarguen	180	70	14.73	5.2	4.27	5.26	8.7	7.9	6.2	35.3	29.0	35,7
4	Williams	170	61	14.64	5.45	4.05	5.14	8.5	7.8	6.1	37.2	27.7	35,1
5	Saladukha	176	58	14.52	5.47	4.17	4.88	8.2	7.4	5.8	37.7	28.7	33,6
6	Peleteiro	171	52	14.47	5.37	4.14	4.96	8.4	8.0	6.4	37.1	28.6	34,3
7	Orji	166	61	14.45	5.46	3.62	5.37	8.4	7.0	6.3	37.8	25.1	37,2
8	Mamona	166	61	14.34	5.1	4.27	4.97	8.4	6.7	5.8	35.6	29.8	34,7
9	Franklim	170	61	14.08	5.1	4.08	4.9	8.5	7.6	5.5	36.2	29.0	34,8
10	Diallo	168	53	14.08	5.18	4.26	4.64	8.3	7.6	5.9	36.8	30.3	33,0
11	Panturoiu	170	57	14.07	5.03	4.34	4.7	8.0	7.4	5.9	35.7	30.8	33,4
12	Mäkelä	185	67	13.99	4.84	3.93	5.22	8.4	7.9	7.0	34.6	28.1	37,3
Average value		174.5	61.4	14.47	5.28	4.11	5.08	8.5	7.6	6.0	36.5	28.5	35,1

Matrix of correlations   Table 2

Statistical indicator	Position	Height	Weight	Total length	Hop length	Step length	Jump length	Bounce speed	Step speed
Position									
Height	-0.440								
Weight	-0.450	0.756*							
Total length	-0.952*	0.580*	0.555*						
Bounce length	-0.836*	0.234	0.138	0.840*					
Step length	-0.004	-0.038	-0.212	-0.064	-0.251				
Jump length	-0.634*	0.647*	0.811*	0.745*	0.512*	-0.559*			
Hop speed	-0.724*	0.628*	0.717*	0.798*	0.550*	-0.232	0.819*		
Step speed	-0.306	0.672*	0.318	0.322	0.141	0.057	0.297	0.476	
Jump speed	0.232	0.250	0.138	-0.177	-0.287	-0.420	0.279	-0.062	0.345

These lengths of the individual elements of the technique are distributed as shown in Figure 2. This in turn shows a balanced type of jumping from a larger number of athletes (8) with an equal length of the first and third steps [6]. An exception to this trend is only the twelfth athlete (Mäkelä), who has the longest third step (Table 1). Three of the participants in the finals have predominantly larger first step.

Studies in this direction have been carried out by a number of authors and their common opinion is that the individual model of jumping is determined based on the speed and power of the athlete and their technical training [1], [3], [4], [5], [8], [9], [10].

In terms of the speed of the three parts of the jump, there is no difference from previous similar studies. The speed gradually decreases with each part of the jump by an average of 0.7 m/s for the hop, 0.9 m/s for the step, and 1.5 m/s for the jump. A smaller decrease in the horizontal take-off speed is a sign of elite athlete status [2].

Data presented in Table 1 was subject to a test of normal distribution using the Shapiro-Wilk indicator. Based on the results of this analysis ($α>0.05$), all variables are normally distributed and may be correlated.

From the correlation matrix (Table 2) we may see that the Final ranking in the discipline depends on the total length of the jump ($r=-0.952$). In addition, the ranking has a high and inverse correlation with the length of the first step ($r=-0.836$) and with its speed ($r=-0.724$), as well as a significant inverse correlation with the length of the jump ($r=-0.634$). On the other hand, the total distance covered in the triple jump has a significant proportional correlation with the anthropometric characteristics of the competitors (respectively height – $r=0.580$ and weight – $r=0.555$), as well as a high proportional correlation with the individual parts of the jump (length of the first step $r=0.840$; length of the third step $r=0.7450$), and first step take-off speed $r=0.798$.

The length of the hop, i.e. the first step has a high proportional correlation with the speed of the hop $r=0.836$ and the length of the third step (jump) ($r=0.840$). The length of the jump, in turn, has a significant proportional correlation with the anthropometric indicators ($r=0.647$; $r=-0.811$). In addition, it has a significant proportional correlation with the initial velocity of the jump ($r=0.819$) and the preceding two parts of the triple jump, i.e. the hop and step ($r=0.512$; $r=0.559$, respectively).

There are no significant correlations in terms of the take-off speed of the step and jump, which is determined by the fact that the technique of execution is of great importance, i.e. maintaining the horizontal speed. In other words, due to the lack of any correlation dependence, we may say that the athletes have a certain reserve regarding this component of the technique.

In confirmation of previous studies, the main indicator of the end result is the first take-off speed indicator, which has an effect on the total length of the jump, as well as the length of the hop and jump. They, in turn, have a correlation that is conditioned by the retention of take-off speed.

From the correlations thus obtained, it may be concluded that taller and heavier athletes who are able to fully realize their speed and power during the jump are predisposed to achieve higher results in its individual parts and, as a consequence, higher ranking.

5. Conclusions

From the result achieved for the first place, we may say that the discipline is coming out of its temporary stagnation;

From the ratios found in the length of the individual parts of the jump, we may

conclude that the balanced type of triple jump athletes prevail;

In reaffirmation of previous regularities, the take-off speed of the Hop is found once again the main indicator.

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