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THE COMPETITION STRATEGY IN HIGH JUMP AND POLE VAULT: HOW MANY TRIALS?

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Abstract: The pole vault and high jump are events named vertical jumps within track and fields. The aim of the vertical jump events is that the athlete runs on the approach way with proper speed, then jumps upwards and passes over the bar where height is previously determined by the athlete, without dropping the bar to the ground. In the vertical jump events, the competition variables which the starting height, the final height, the difference between the starting and final height, the total number of attempting, the amount of valid and invalid jumps were examined measured within the scope of competition tactics. The aim of this study is to show coaches and athletes how to plan the competition variables in order to achieve the aimed performance by putting forth their competition strategy features. In addition, the study is going to determine the similarities and differences between podium athletes and other finalist athletes through the example of European championship finals where elite athletes compete. The research group consisted of 223 high jumpers (male: 105, female: 118) and 216 pole vaulters (male: 109, female: 107) competing in the European Championships (6 indoor and 5 outdoor) between 2009 and 2019. Statistical comparison of the podium athletes and remaining finalist athletes' groups was carried out using Independent Samples t-Test. Pearson correlation coefficients (r) were used to express the relationships between parameters. Linear regression analysis was used to find coefficients of determination (r^2) for the relationships. Significant differences were found in podium athletes in terms of initial height, final height, difference between them, total number of trials and number of successful trials in both events and both genders. Male and female athletes who have won medals in both high jump and pole vaults have performed a total of 4-8 trials. The difference between the initial height and the final height was 12 ± 4 cm in male high jump podium athletes and 14 ± 3 cm in female high jump athletes; It was found that the male pole vaulters were 34 ± 12 cm and the mean 29 ± 8 cm in females. It is clear that the average of the total number of trials in both events and genders has declined significantly in the last 10 years. The total number of trials was found to be higher in high performing athletes. As a result, it was seen that the medallist athletes had higher initial heights than the other finalists, they reached the final heights with more differences after the initial heights, and the total number of trials and successful trials were higher. In the light of these data, it is recommended that the performance components that are examined and found to be important in this study for vertical jumps be examined in detail by the coaches, and that a strategy for competition management is developed according to the current situation of the athletes.

Key Words: High Jump, Pole Vault, Attempt, Podium, Athlete

YÜKSEK ATLAMA VE SIRIKLA ATLAMADA YARIŞMA STRATEJİSİ: KAÇ DENEME?

Öz: Yüksek atlama ve sırıkla atlama branşları atletizm içinde dikey atlamalar olarak adlandırılır. Dikey atlama branşlarında amaç, sporcunun yaklaşma koşu yolunda uygun hızda koşması, daha sonra yukarı doğru sıçraması ve yüksekliği sporcu tarafından önceden belirlenen çıtayı yere düşürmeden geçmektir. Dikey atlamalarda yarışma başlangıç yüksekliği, final yüksekliği, başlama ve final yüksekliği arasındaki fark, toplam deneme sayısı, başarılı ve hatalı deneme sayısı yarışma değişkenleri yarışma taktik anlayışları kapsamında incelenir. Bu araştırmanın da amacı, dikey atlama branşlarında elit sporcuların yarışma yönetim özelliklerini ortaya koyarak hedeflenen performansa ulaşmak için yarışma değişkenlerinin planlanmasında antrenör ve sporculara yol göstermektir. Ayrıca elit sporcuların yarıştığı Avrupa şampiyonaları finalleri örneği üzerinden podyum sporcuları ile diğer finalist sporcular arasındaki benzerlik ve farklılıkları belirlemektir. Araştırma grubunu 2009 ve 2019 yılları arasında Avrupa Şampiyonaları'nda (6 salon and 5 açık saha) final yarışan 223 yüksek atlama sporcusu (erkek:105, kadın:118) ile 216 sırıkla atlama sporcusu (erkek:109, kadın:107) oluşturmuştur. Podyum sporcularının ve diğer finalist sporcu gruplarının istatistiksel karşılaştırması bağımsız örneklem t-Testi kullanılarak yapıldı. Parametreler arasındaki ilişkileri ifade etmek için pearson korelasyon (r) testi yapılmıştır. Tespit edilen ilişkileri açıklamak için de lineer regresyon analizi (r^2) kullanılmıştır. Her iki branşta ve her iki cinsiyette de başlangıç yüksekliği, final yüksekliği, bunlar arasındaki fark, toplam deneme sayısı ve başarılı deneme sayıları yönünden podyum sporcuları yönünde anlamlı farklar tespit edilmiştir. Hem yüksek atlama hem de sırıkla atlama branşlarında madalya alan

erkek ve kadın sporcuların 4-8 arasında toplam deneme gerçekleştirdikleri görülmüştür. Başlangıç yüksekliği ile final yüksekliği arasındaki farkın, erkek yüksek atlama podyum sporcularında 12±4 cm, kadın yüksek atlama sporcularında ise ortalama 14±3 cm; erkek sırıkçılarda 34±12 cm, kadınlarda ise ortalama 29±8 cm olduğu hesaplanmıştır. Her iki branşta ve cinsiyette toplam deneme sayıları ortalamalarının son 10 yılda belirgin bir şekilde düşmüş olduğu açıkça görülmektedir. Toplam deneme sayısının, yüksek performans sergileyen sporcularda daha fazla değerlerde olduğu tespit edilmiştir. Sonuç olarak, madalya alan sporcuların diğer finalistlerden daha yüksek başlangıç yükseklikleri olduğu, başlangıç yüksekliklerinden sonra daha fazla fark ile final yüksekliklerine eriştikleri, toplam deneme ve başarılı deneme sayılarının daha fazla olduğu görülmüştür. Bu veriler ışığında dikey atlamalar için bu çalışmada incelenen ve önemli olduğu tespit edilen performans bileşenlerinin antrenörler tarafından detaylı incelenmesi, sporcularının mevcut durumuna göre müsabaka yönetiminde strateji geliştirilmesi önerilir.

Anahtar Kelimeler: Yüksek Atlama, Sırıkla Atlama, Deneme, Podyum, Atlet

INTRODUCTION

As it is well known, athletics is divided into track events and field events. Jumping events take place within field events like throwing events. Jumps also compose horizontal and vertical jumping events. Pole vault and high jump events belong to vertical jumps. The aim of the vertical jumps that athletes run on the approach way as proper speed then jump upwards, and to pass over the bar where height is previously determined by the athlete, without dropping the bar to the ground. The main difference between the events that any auxiliary equipment is not used in the high jump by the athlete. In contrast, the athlete jumps with the pole as an assisting equipment in the pole vault to pass over the bar.

All athletes have three attempts per height during the competition. The athletes who are clear the bar any height can continue next height. The heights of attempts are selected by athletes, which according to announcement by the technical delegate of the competition. The athlete may continue to jump until he/she has lost his/her right to compete after all other athletes have failed. The athletes should begin the trial between 30 second and 2 minutes for the high jump competition depending on the number of athletes. To the pole vault, time allowed for the trial between 1 minute and 3 minutes. Furthermore, at the end of the competition, the athletes are ranked according to the height at which they were last successful. In case of equality between the athletes, the procedure is applied according to the lowest total of failures. The all detailed rules of all athletics events are determined and administered by the International Association of Athletics Federations (IAAF, 2017).

Apart from the level and technical capacity of the athlete's bio-motor abilities in vertical jumps, tactical approaches to be determined during the competition are also an effective performance component in many competitions. Tactical decisions are often determined by the competition ranking, the colour of the medal, the winner and the loser. For instance, the starting height of the competition, total number of attempts, number of failures, number of successful attempts. At this point, the coach will have to predict the target performance level before the competition and determine the starting height of the competition. The difference between the starting height and the target competition height should be planned by how many trials, by trying which intermediate heights. In other words, competition management, competition strategy should be determined.

There are few studies examining different dimensions of competition variables in high and pole vaults (Böheim and Lackner, 2013; Ladany, 1975; Theodorou and Skordilis, 2009; Theodorou et al. 2009b, 2009a, 2010). In these studies, competition variables such as starting height, final

height, the difference between starting and final height, total number of trials, number of successful and unsuccessful trials were examined.

Ladany (1975) argues that determining the optimal starting height in pole vaults is also the determinant of the maximal height targeted in the competition. Theodorou and Skordilis (2009) examined the high jump competitions in 2008 (European Cup) and 2009 (European Team CH) competitions in terms of competition variables.

In the studies examining the competition variables in the pole vault and high jump events in the Olympic Games (OG), World (WCH) and European Championships (EACH) between 2000 and 2009 (Theodorou et al., 2009a, 2009b), the number of mean trials for male athletes was seven attempts, eight attempts for female athletes. (both high jump and pole vault is the same). On the other hand, Böheim and Lackner (2013) have examined competition strategies according to gender by the competition variables in the high jump and pole vault events. They have concluded that men use more risky competition strategies.

As can be seen, the issue of competition management, which includes competition strategies in vertical jumps, questioned by scientists interested in athletics, albeit to a limited number, remains an important factor affecting success. Nevertheless, there is no study comparing the athletes who won medals in vertical jumps and other athletes in terms of the variables that determine the competition strategies.

The aim of this research is to show the management characteristics of the elite athletes in vertical jump events and to guide the coaches and athletes in the planning of the competition variables such as determining the initial height to reach the targeted performance and total number of trials. It also shows the similarities and differences between podium athletes and other finalist athletes through the example of European championship finals where elite athletes compete.

METHOD

The research group consisted of 223 high jumpers (male: 105, female: 118) and 216 pole vaulters (male: 109, female: 107) competing in the European Championships (6 indoor and 5 outdoor) between 2009 and 2019. The demographic information of the athletes was obtained from different athletes' databases (European Athletics, 2019a; IAAF, 2019; Tilastopaja, 2019). Competition results are taken from the high jump and pole vault competition technical sheets of the relevant championships in the European Athletics official competition webpage (European Athletics, 2019b).

The age, height, body weight, body mass index (BMI) of the athlete as of the date of the competition, the starting height, the last height at which he successfully jumped (final height), the difference between the starting height and the final height, total number of trials, number of failures and the number of successful trials were determined as competition variables. The unsuccessful attempts after the best performance in the competition were not examined among the competition variables.

General characteristics of the participants were presented as means and standard deviations (±SD). Statistical comparison of the podium athletes and remaining finalist athletes' groups was carried out using Independent Samples t-Test. Pearson correlation coefficients (r) were used to express the relationships between parameters. Interpretation of correlation coefficients

was as follows: r≤ 0.49 weak relationship; 0.50 ≤ r ≤ 0.74 moderate relationship; and r≥ 0.75 strong relationship (Portney and Watkins, 2015). Linear regression analysis was used to find coefficients of determination (r^2) for the relationships. For the statistical procedure, IBM-SPSS 20.0 software was applied and statistical significance was set at $p<0.05$.

RESULTS

The similarities and differences between the high jump podium athletes and other finalists are given in Table 1 and Table 2.

Table 1. Comparison of male high jump podium athletes (n = 34) and other finalists (71) in terms of age, anthropometric characteristics and competition variables

Variables	Podium / Remaining	min.	max.	Mean	SD	p
Age (year)	Podium	20,5	34,0	26,2	2,9	0,44
	Remaining	17,9	38,0	25,6	3,9	
Body Height (m)	Podium	1,83	2,02	1,93	0,04	0,51
	Remaining	1,73	2,02	1,93	0,05	
Body Weight (kg)	Podium	65,0	87,0	78,8	5,9	0,03*
	Remaining	60,0	87,0	76,2	5,4	
BMI (Kg/m^2)	Podium	17,3	23,6	21,2	1,7	0,01*
	Remaining	17,3	23,6	20,4	1,3	
Starting height (m)	Podium	2,15	2,30	2,19	0,03	0,02*
	Remaining	2,15	2,21	2,18	0,02	
Final height (m)	Podium	2,26	2,38	2,31	0,03	0,00*
	Remaining	2,15	2,32	2,24	0,04	
Difference (m)	Podium	0,04	0,19	0,12	0,04	0,00*
	Remaining	0,00	0,17	0,06	0,04	
Trials	Podium	2	9	5,9	2,0	0,00*
	Remaining	1	8	3,6	1,7	
X	Podium	0	4	1,7	1,5	0,06
	Remaining	0	4	1,3	1,0	
O	Podium	2	7	4,1	1,3	0,00*
	Remaining	1	6	2,4	1,1	

O= successful trial, X= unsuccessful trial, *p<0.05

Male high jumpers competing in the European Championships were average 26 years old and 1.93 m tall. Similarity was found between the medallists and other finalist athletes in terms of age, body height and number of failures. Statistically significant differences were found on the podium athletes' side about other variables. The podium athletes who started the competition at an average of 2.19 ± 0.03 meters reached a mean performance of 2.31 ± 0.03 m (Difference = 12 ± 4 cm) with a total of six trials (O = 4, X = 2).

Table 2. Comparison of female high jump podium athletes (n = 35) and other finalists (n = 83) with respect to age, anthropometric characteristics and competition variables

Variables	Podium / Remaining	min.	max.	Mean	SD	p
Age (year)	Podium	19,3	38,0	27,4	4,5	0,07
	Remaining	17,0	40,8	25,7	4,8	
Body Height (m)	Podium	1,69	1,92	1,84	0,06	0,04*
	Remaining	1,68	1,92	1,81	0,05	
Body Weight (kg)	Podium	50,0	75,0	62,6	6,2	0,61
	Remaining	49,0	75,0	62,0	5,4	
BMI (Kg/m^2)	Podium	15,0	21,0	18,5	1,2	0,28
	Remaining	15,1	21,2	18,8	1,2	
Starting height (m)	Podium	1,79	1,92	1,84	0,03	0,00*
	Remaining	1,79	1,87	1,82	0,02	
Final height (m)	Podium	1,92	2,03	1,98	0,03	0,00*

	Podium / Remaining	min.	max.	Mean	SD	p
	Remaining	1,80	1,99	1,91	0,04	
Difference (m)	Podium	0,07	0,21	0,14	0,03	0,00*
	Remaining	0,00	0,17	0,08	0,04	
Trials	Podium	3,0	11,0	5,9	2,1	0,00*
	Remaining	1,0	10,0	4,0	1,9	
X	Podium	0,0	5,0	1,2	1,2	0,75
	Remaining	0,0	4,0	1,1	1,1	
O	Podium	3,0	7,0	4,7	1,2	0,00*
	Remaining	1,0	6,0	2,9	1,1	

*O= successful trial, X= unsuccessful trial, *p<0.05*

In female high jumpers, similarities were found in terms of age, body weight, body mass index and number of unsuccessful trials between podium athletes and other finalists. The medallists (1.84m) were taller than the other finalists (1.81m).

It was seen that podium athletes showed higher values in terms of starting height, total number of trials, number of successful trials and difference between starting height and final performance. The podium athletes who started the competition at an average of 1.84 ± 0.03 meters reached a performance of 1.98 ± 0.03 m (Difference $= 14 \pm 3$ cm) with a total of 6 trials (O = 5, X = 1).

The similarities and differences between pole vault athletes and other finalists are given in Table 3 and Table 4.

Table 3. Comparison of male pole vault athletes (n = 34) and other finalists (75) in terms of age, anthropometric characteristics and competition variables

Variables	Podium / Remaining	min.	max.	Mean	SD	p
Age (year)	Podium	18,8	35,4	26,4	3,5	0,24
	Remaining	17,4	38,5	25,5	3,8	
Body Height (m)	Podium	1,70	1,94	1,85	0,07	0,16
	Remaining	1,70	1,95	1,87	0,05	
Body Weight (kg)	Podium	66,0	85,0	76,2	6,0	0,10
	Remaining	65,0	90,0	78,1	5,3	
BMI (Kg/m^2)	Podium	20,2	23,9	22,3	0,9	0,48
	Remaining	19,5	24,9	22,4	1,3	
Starting height (m)	Podium	5,30	5,75	5,49	0,12	0,01*
	Remaining	5,30	5,61	5,43	0,10	
Final height (m)	Podium	5,50	6,05	5,82	0,13	0,00*
	Remaining	5,30	5,90	5,58	0,15	
Difference (m)	Podium	0,15	0,60	0,34	0,12	0,00*
	Remaining	0,00	0,50	0,16	0,13	
Trials	Podium	2	12	5,8	2,4	0,00*
	Remaining	1	8	3,5	1,7	
X	Podium	0	5	1,7	1,4	0,11
	Remaining	0	4	1,3	1,0	
O	Podium	2	8	4,2	1,6	0,00*
	Remaining	1	6	2,2	1,1	

*O= successful trial, X= unsuccessful trial, *p<0.05*

Male pole vaulters competing in the European Championships were 26 years old on average. It was seen similarity between the groups in terms of age, height, body weight, BMI and the number of failures. Statistically significant differences were found on the podium athletes' side about other variables. The podium athletes who started the competition at an average of 5.49 ± 0.12 meters reached a final height performance of 5.82 ± 0.13 m (Difference $= 0.34 \pm 0.12$ m) with a total of 6 trials (O = 4, X = 2).

Table 4. Comparison of female pole vault athletes (n = 34) and other finalists (n = 73) with respect to age, anthropometric characteristics and competition variables

Variables	Podium / Remaining	min.	max.	Mean	SD	p
Age (year)	Podium	21,3	33,0	26,0	3,3	0,44
	Remaining	17,6	37,9	25,4	4,1	
Body Height (m)	Podium	1,60	1,79	1,71	0,05	0,88
	Remaining	1,60	1,82	1,71	0,05	
Body Weight (kg)	Podium	50,0	69,0	58,5	5,9	0,68
	Remaining	51,0	69,0	59,0	5,1	
BMI (Kg/m^2)	Podium	17,6	22,5	20,0	1,6	0,46
	Remaining	17,6	23,0	20,3	1,3	
Starting height (m)	Podium	4,22	4,65	4,41	0,10	0,00*
	Remaining	4,10	4,65	4,31	0,10	
Final height (m)	Podium	4,55	4,85	4,70	0,09	0,00*
	Remaining	4,10	4,70	4,46	0,12	
Difference (m)	Podium	0,15	0,50	0,29	0,08	0,00*
	Remaining	0,00	0,40	0,14	0,12	
Trials	Podium	3	10	5,5	1,8	0,00*
	Remaining	1	8	3,6	1,7	
X	Podium	0	5	1,6	1,3	0,52
	Remaining	0	5	1,4	1,2	
O	Podium	2	6	3,9	1,0	0,00*
	Remaining	1	5	2,2	0,9	

*O= successful trial, X= unsuccessful trial, *p<0.05*

In female pole vaulters, similarities were found in terms of age, body height, body weight, BMI and unseccesful trial between the podium athletes and other finalists. It was seen that podium athletes showed higher values in terms of starting height, total number of trials, number of successful trials and difference between starting height and final height. The podium athletes who started the competition at an average of 4.41 ± 0.10 meters reached a performance of 4.70 ± 0.09 m (Difference = 0.29 ± 0.08 m) with a total of 6 trials (O = 4, X = 2).

Table 5. Relationships between male high jumpers performances and competition variables (r)

	Podium / Remaining	n	Starting height	Trials	X	O	Difference
Final height	Podium	34	0.12	0.44*	0.00	0.69*	0.61*
	Remaining	71	-0.05	0.79*	0.42*	0.83*	0.87*
	All	105	0.17	0.76*	0.31*	0.86*	0.87*

p<0.05

When the performances of male high jumpers and total number of trials were examined, it was found that there was a statistically significant, positive and high correlation (r = 0.76). In the regression analysis, it was seen that the total number of trials in men could explain 58% of the performance ($r^2 = 0.58$). Likewise, it was found a positive and high relationship between actual performance and the difference which is between the starting height and final height (r = 0.87).

Table 6. Relationships between female high jumpers' performances and competition variables

	Podium / Remaining	n	Starting height	Trials	X	O	Difference
Final height	Podium	35	0.45*	0.62*	0.47*	0.59*	0.46*
	Remaining	83	0.20	0.68*	0.35*	0.83*	0.86*
	All	118	0.40*	0.72*	0.30*	0.85*	0.85*

p<0.05

When the performances of female high jumpers and the total number of trials were examined, it was seen that there are a statistically significant, positive and moderate correlation was found

(r = 0.72). In the regression analysis, it was found that the total number of trials in women could explain 51% of the performance ($r^2 = 0.51$). Likewise, it was found a positive and high relationship between actual performance and the difference which is between the starting height and final height (r = 0.85).

The relationship between the final height reached at the end of the competition and other competition variables is given in the tables below.

Table 7. Relationship between male pole vaulters' performances and competition variables (r)

	Podium / Remaining	n	Starting height	Trials	X	O	Difference
	Podium	34	0.55*	0.58*	0.28	0.63*	0.57*
Final height	Remaining	75	0.51*	0.66*	0.34*	0.71*	0.78*
	All	109	0.55*	0.72*	0.34*	0.78*	0.81*

*p<0.05

When the performance of male pole vaulters and the total number of trials were examined, a statistically significant, positive and high-level relationship was found (r = 0.72). In the regression analysis, it was seen that the total number of trials in men could explain 52% of the performance ($r^2 = 0.52$). Likewise, it was found a positive and high relationship between actual performance and the difference which is between the starting height and final height (r = 0.81).

Table 8. Relations between female pole vault performers and competition variables (r)

	Podium / Remaining	n	Starting height	Trials	X	O	Difference
	Podium	34	0.69*	0.34	0.05	0.52*	0.22
Final height	Remaining	73	0.47*	0.54*	0.29*	0.63*	0.63*
	All	107	0.63*	0.62*	0.20*	0.77*	0.71*

*p<0.05

When the performances of female pole vaults and the total number of trials were examined, it was found that there was a statistically significant, positive and moderate relationship (r = 0.62). In the regression analysis, it was seen that the total number of trials in women could explain 39% of the performance ($r^2 = 0.39$). Likewise, it was found a positive and moderate relationship between actual performance and the difference which is between the starting height and final height (r = 0.71).

In both events and gender, the relationship between competition performance and number of trials was determined. Likewise, high and moderate level relationships were found between the difference variable and the final height variable. In other words, it can be said that total number of trials and difference between starting height and final height are important variables in high jump competition performance.

DISCUSSION

The starting height, final height, the difference between them, the total number of trials, the number of successful and unsuccessful trials between the podium athletes and the other finalist athletes examined as competition variables, and the relationship between these variables and the final height are discussed below to according the events and genders.

High Jump
In the high jump, significant differences were found between medallist athletes and other finalist athletes in terms of initial height, final height, difference between them, total number of

trials and number of successful trials. It was found similarity between the groups in terms of mean number of fail trials. It was calculated that medallist male athletes performed between 4-8 trials (5.9 ± 2.0 attempts) and the other finalists performed between 2-6 (3.6 ± 1.7 attempts) trials. In females, medallists (5.9 ± 2.1 attempts) and other finalist athletes (4.0 ± 1.9 attempts) showed mean trials like men. In a study examining the finals of major competitions (OG, WCH, EACH) between 2000 and 2009, it was reported that males performed 5-9 trials (7.3 ± 1.9 attempts) and females performed 6-10 trials (8.2 ± 2.3 attempts) (Theodorou et al. (2009a). In another study examining the 2008 European Cup, the mean number of trials was reported to be between 5-9 trials in men (7.4 ± 2.2 attempts) and 6-10 trials in women (8.4 ± 2.0 attempts) (Theodorou and Skordilis, 2009).

The difference between the initial heights and final heights examined in this study was found to be 12 ± 4 cm for male podium athletes and 6 ± 4 cm for other male finalists. In female high jump, average difference was calculated as 14 ± 3 cm for podium athletes and 8 ± 4 cm for other finalists. The difference between starting height and final height was found as 9.4 ± 4.8 cm for men and 10.9 ± 5.0 cm for women by Theodorou et al. (2009a). In another study involving the European Cup, the mean difference was 11.5 ± 7.1 cm in males and 13.4 ± 5.2 cm in females (Theodorou and Skordilis, 2009). The findings obtained from the podium athletes of the current study support the data in the literature.

The positive correlations were found between the final height values reached by the athletes and the total number of trials for both gender (male r = 0.76, r^2 = 0.58 / women r= 0.72, r^2 = 0.51). In other words, as the final height values of the high performing athletes increased, the total number of trials increases, too. It was calculated in the high jump that the total number of trials as the performance component explained the final height by 51% in women and 58% in men.

Pole Vault
Significant differences were found in the pole vault event in terms of the starting height, the final height, the difference between them, the total number of trials and the number of successful trials. Similarities were determined between the groups in terms of age, anthropometric characteristics and mean number of unsuccessful trials. It was calculated that the male medallist athletes performed between 4-8 trials (5.8 ± 2.4 attempts) and the other finalists performed 2-6 (3.5 ± 1.7 attempts) trials. In females, the medallist athletes (5.5 ± 1.8 attempts) and the other finalist athletes (3.6 ± 1.7 attempts) showed similarity for mean trials like the men. In a study examining the finals of major competitions (OG, WCH, EACH) between 2000 and 2009, it was reported that males performed between 5-9 trials (6.9 ± 2.2 attempts) and females performed between 5-11 trials (8.0 ± 2.5 attempts) in the pole vault event (Theodorou et al. (2009b).

In another study examining the 2008 European Cup, the mean number of trials was reported to be between 5-9 trials (6.7 ± 2.1 attempts) in men and between 5-11 trials (7.9 ± 2.6 attempts) in women (Theodorou et al., 2010). In this study, the difference height between the initial heights and final heights was found 34 ± 12 cm for male podium athletes and 16 ± 13 cm for other male finalists. The average of the difference height for female pole vaulters was 29 ± 8 cm for podium athletes and 14 ± 12 cm for other finalists. In another study involving the European Cup, the mean difference height was 28.5 ± 18.1 cm for males and 34.1 ± 18.2 cm for females (Theodorou et al., 2010). According to the literature and current study values, it can be said that European elite pole vaulters (in both genders) have chosen the initial height approximately 30 cm below the final height.

The moderate positive relationships were found between the final height values reached by the athletes and the total number of attempts in men ($r = 0.72$, $r^2 = 0.52$) and in women ($r = 0.62$, $r^2 = 0.39$). In other words, as the final height values of the high performing athletes increased, the total number of trials increased too. It was calculated in the pole vault that the total number of trials as the performance component can explain to the final height by 52% in men and 39% in women.

CONLUSION

It is clear that the mean of the total number attempts has declined significantly in both events and genders during the last 10 years. What has changed in the training after 2009? The reason of this decline may be the subject of another research. The difference between the initial height and the final height was approximately 10 cm in the high jump and 30 cm in the pole jump. It was found that the total number of trials as the performance component was higher for podium athletes. As a result, it was seen that the medallists had higher initial heights than the other finalists, they reached the final heights with more differences after the initial heights. The total number of trials and the successful trials were higher for medallist athletes, too. In the light of these finding, it is recommended that the performance components for vertical jumps be examined in detail and a competition strategy is developed by coaches.

Practical Application:

1. *To all the vertical events athletes in both genders, coaches can be planned total number of trials between 4-8 attempts for the competition.*

2. *The following ranges can be used to determine the initial height of the competition according to the events and genders.*
   a. *To male high jumpers: between 8-16 cm below the aimed final height*
   b. *To female high jumpers: between 11-17 cm below the aimed final height*
   c. *To male pole vaulters: between 22-46 cm below the aimed final height*
   d. *To female pole vaulters: between 21-37 cm below the aimed final height*

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