

Consequences of the new competition rules for the high jump at the European Team Championships

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ABSTRACT

In 2009 European Athletics replaced the European Cup with the European Team Championships. The new event featured innovative technical rule changes in many events including the pole vault and high jump, where each competitor was entitled to a maximum of four aggregate fouls throughout the competition. The purpose of this study was to examine the effects of the new rules on performance in the high jump. Data on performances in the top leagues (n=48; 24 males and 24 females) were obtained from both the 2008 European Cup and the 2009 European Team Championships. Nine dependent variables were examined using a statistical analysis package. The authors found the new rules had not affected the results but, in the case of male jumpers, several performance parameters including mean height and the number of successful attempts had improved. They suggest a psychological effect of the rules was to make the jumpers more focused on their technique. On the other hand, the overall performance of the women jumpers seems to have deteriorated. The number of attempts taken and the mean mark achieved were lower and there were more failed efforts in 2009 compared to 2008. A possible explanation is that the psychological effect led to the jumpers taking too few attempts and failing more often.

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Introduction

The European Team Championships, previously known as the European Cup and originally known as the Bruno Zauli Cup after its creator, the former Chairman of the European Committee of the International Association of Athletics Federations (known at that time as the International Amateur Athletics Federation), is meant to develop the sport by providing a team competition in the track & field events in which all the athletics federations of Europe take part. First staged in 1965, the event was held on a biennial basis (triennial once), but since 1993 it has been staged annually. Although Zauli died just a few months before its launch, the competition has developed into an important fixture on the athletics calendar, particularly for the smaller and medium size athletics nations.

In an effort to be more attractive to modern audiences, sponsors and the media, European Athletics made some significant changes to the format and re-launched the championships as new event in 2009. In addition to the new name, the changes included combining each country's men's and women's teams, which formerly competed in separate events, into a single national team, a reorganisation of the league system at the heart of the event, and the introduction of innovative technical rules in a number of disciplines.

The event comprises four meetings, or leagues, which take place over the same weekend. At each of the meetings there are 20 track & field disciplines for men and women respectively. Team scores are calculated by combining the points scored by the men and women in all the disciplines and the teams are classified into the leagues according to their scores. The top league consists of the 12 best teams from the previous year and is named the SPAR European Team Championships. The next 12 teams (13-24) make up the First League, the following eight teams (25-32) form the Second League and the remaining teams form the Third League. The system produces in a 1 – 50 ranking and creates a number of battles for promotion and relegation between the leagues¹.

The technical rule changes for the vertical jumps, the high jump and pole vault, are of particular interest. According to the current IAAF general competition rules: "An athlete may commence jumping / vaulting at any height previously announced by the Chief Judge and may jump / vault at his own discretion at any subsequent height. Three consecutive failures, regardless of the height at which any of such failures occur, disqualify from further jumping / vaulting except in the case of a tie for first place"². Although the IAAF rules undergo continuous refinements in order to make the events' conduct fairer to athletes and more interesting for spectators, they stayed the same fundamentally for many decades until European Athletics decided to

apply drastic changes for the 2009 European Team Championships³.

According to the new regulations: "In the High Jump and Pole Vault each competitor shall be entitled to a maximum of 4 (four) aggregate fouls throughout the whole competition. All the other relevant IAAF Rules for the vertical jumps will apply. IAAF Rule 181.8 c) will apply for ties"⁴.

In a study based on a hypothetical scenario, THEODOROU et al. (2009) suggested that a generalisation of these new rules on the world level would result in a notable decline in high jump performance⁵. The purpose of the current study is to compare the data from the 2008 European Athletics Cup and the 2009 European Team Championships (conducted under old and new rules, respectively), and examine the consequences of the new rules for the men and women's high jump.

Methods

Considerations

The official results from the high jump at 2008 European Cup and 2009 European Team Championships were selected for analysis. In order to make a comparison between the two events, two factors had to be taken into consideration.

The first was the difference in the league structure of the two events. Forty-six teams (i.e. countries) participated in 2008 and were divided into five groups as follows:

- Super League (8 teams),
- First League Group A (8 teams),
- First League Group B (8 teams),
- Second League Group A (8 teams),
- Second League Group B (14 teams).

For the 2009 European Team Championships the structure changed and the 46 participating teams were divided as follows:

- Super League (12 teams),
- First League (12 teams),
- Second League (8 teams),
- Third League (14 teams).

The second factor was the performance level of the athletes participating on the respective leagues. As mentioned in the introduction, teams are classified into leagues according to their total scoring in the 20 men and women track and field events. This means that top-performing teams make it to the Super League and the quality of athlete can be expected to gradually decrease as we move down the leagues. In the lowest Leagues (second and third), it occurred that some teams were represented in the high jump by decathletes or heptathletes, due to lack of high jump specialists.

In order to make a sound comparison between the two competitions, we decided to use data from participating athletes' at the highest levels and thereby make it possible to draw useful conclusions regarding the new rules implementation. For this purpose, both the 2008 European Cup - Second League Groups A & B data and the 2009 European Team Championships Second & Third League data were excluded from the analysis.

Statistical analysis

The data of the 2008 European Cup Super League and First League Group A and First League Group B (24 teams; 24 male and 24 female athletes respectively, $n = 48$) and the 2009 European Team Championships Super League and First League (24 teams; 24 male and 24 female athletes respectively $n = 48$) were selected for analysis.

The dependent variables examined were the:

- athlete's season best performance (ASBP),
- athlete's personal best performance (APBP),
- athlete's starting height (ASH),
- athlete's final height (AFH),
- difference between athlete's starting height and final height (DASFH),
- number of attempts (NE),
- number of successful attempts (SE),
- number of failed attempts (FE),
- number of attempts passed following athlete's starting height (EF).

These variables were grouped together, according to their respective content, in the following three categories: a) athlete's season best performance & athlete's personal best performance, b) athlete's starting height, athlete's final height and difference between athlete's starting and final height and c) number of attempts, number of successful attempts, number of failed attempts and number of attempts following athlete's starting height.

The Statistical Package for the Social Sciences (SPSS)⁶, with MANOVA⁷, ANOVA⁸, discriminate function⁹, stepwise multiple regression and Pearson correlation coefficient⁸, was used for data analysis. Specifically, the Pearson r examined the inter-correlations among the separate dependent variables examined (e.g. athlete's final height, number of attempts, number of failed attempts and number of attempts following athlete's starting height, etc), separately for men and women. The stepwise multiple regression analysis was used to predict the athlete's final height (dependent variable) separated across gender and competitive year, from: the number of attempts, number of successful attempts, number of failed attempts and attempts passed following the athlete's starting height (independent variables).

The goal was to find which independent variables would significantly predict: a) final height and b) difference between start and finish height, for men and women competing at the 2008 European Cup and 2009 European Team Championships.

Further, the MANOVA⁹ examined the differences between the 2008 European Cup and 2009 European Team Championships. ANOVAs with Bonferroni adjustments were used as post hoc analysis to determine the origin of significance¹⁰. Further, discriminant function analysis¹¹ was utilised to determine the dependent variables significantly separating the 2008 and 2009 data. The .05 level of significance was selected to test the above statistical hypotheses.

Results

The differences between the 2008 European Cup and 2009 European Team Championships data were examined separately for men and women. In order to ensure that the athletes participating in 2008 and 2009 were of the same competitive level, the differences between the athlete's season best and athlete's personal best were examined. To that extent, the MANOVA revealed no significant differences between the 2008 and 2009 data ($\Lambda = .987$, $F = .305$, $p = .739$, $\eta^2 = .013$) for the men. Accordingly, the univariate post hoc analysis (ANOVAs), with Bonferroni adjustment (.05/ 2) revealed no significant differences separate the athlete's season best performance ($F = .220$, $p = .640$, $\eta^2 = .005$) and athlete's personal best performance ($F = .523$, $p = .473$, $\eta^2 = .011$) respectively. In turn, the multivariate analysis of variance (MANOVA) revealed no significant differences between the 2008 and 2009 data ($\Lambda = .955$, $F = 1.049$, $p = .359$, $\eta^2 = .045$), for the women. Accordingly, the univariate post hoc analysis (ANOVAs), with Bonferroni adjustment (.05/ 2) revealed no significant differences separate the athlete's season best performance ($F = 1.790$, $p = .188$, $\eta^2 = .037$) and athlete's personal best performance ($F = .924$, $p = .341$, $\eta^2 = .020$) variables examined (see Table 1).

Men's high jump

The MANOVA was not significant for the athlete's starting height, athlete's final height and difference between athlete's starting and final heights ($\Lambda = .925$, $F = 1.823$, $p = .173$, $\eta^2 = .075$). The univariate analysis, with Bonferroni adjustment (.05/ 3) revealed no significant differences between the 2008 and 2009 data for the athlete's starting height ($F = 1.189$, $p = .281$, $\eta^2 = .025$), athlete's final height ($F = 3.727$, $p = .060$, $\eta^2 = .075$) and difference between athlete's starting and final heights, respectively ($F = 1.088$, $p = .302$, $\eta^2 = .023$). Furthermore, the MANOVA was not significant for the number of attempts, successful attempts, failed attempts and number of

attempts passed following the athlete's starting height ($\xi = .928$, $F = .835$, $p = .511$, $\eta^2 = .072$) as well. The ANOVAs, with Bonferroni adjustment (.05/ 4) revealed no significant differences for the number of attempts ($F = .004$, $p = .947$, $\eta^2 = .000$), SE ($F = .398$, $p = .531$, $\xi^2 = .009$), FE ($F = 1.302$, $p = .260$, $\eta^2 = .028$) and number of attempts passed following the athlete's starting height ($F = .085$, $p = .772$, $\eta^2 = .002$).

The stepwise multiple regression for predicting final height (AFH) in 2008, had a significant multiple R^2 of .178 ($F = 4.755$, $p = .040$) comprising a single positive predictor of successful attempts (B weight = .422). The respective regression equation for 2008 was:

$$Y_{AFH} = 209.542 + 2.083 * X_{SE}$$

The prediction of athlete's final height in 2009 had a significant multiple R^2 of .640 ($F = 18.660$, $p = .003$) comprising: a) a negative predictor of number of attempts (B weight = -.423) and b) a positive predictor of successful attempts (B weight = 1.175), respectively. The regression equation for 2009 was as follows:

$$Y_{AFH} = 210.437 - 1.672 * X_{NE} + 6.154 * X_{SE}$$

Women's high jump

The MANOVA was not significant for the athlete's starting height, athlete's final height and difference between athlete's starting and final heights ($\Lambda = .996$, $F = .091$, $p = .913$, $\eta^2 = .004$). The univariate analysis, with Bonferroni adjustment (.05/ 3) revealed no significant differences between the 2008 and 2009 data for the athlete's starting height ($F = .168$, $p = .684$, $\eta^2 = .004$), athlete's final height ($F = .179$, $p = .674$, $\eta^2 = .004$) and difference between athlete's starting and final heights ($F = .079$, $p = .780$, $\eta^2 = .002$). The MANOVA was not significant for the number of attempts, successful attempts, failed attempts and number of attempts passed following the athlete's starting height ($\Lambda = .870$, $F = 1.600$, $p = .192$, $\eta^2 = .130$) as well. The

Table 1: Dependent variables analysed for the 2008 European Cup and 2009 European Team Championships Super League and First League (n = 48)

Dependent Variables	M + SD Men 2008 (N = 12)	M + SD Men 2009 (N = 12)	p value	M + SD Women 2008 (N = 12)	M + SD Women 2009 (N = 12)	p value
Athlete's season best performance (cm)	222.04 9.44	223.13 6.22	.641	189.67 6.19	187.00 7.55	.188
Athlete's personal best performance (cm)	225.33 8.90	226.96 6.47	.473	192.46 7.05	190.38 7.92	.341
Athlete's starting height (cm)	205.38 8.66	207.71 5.89	.281	174.25 4.99	173.58 6.21	.684
Athlete's final height (cm)	216.83 7.98	221.38 8.31	.060	187.63 8.74	186.58 8.30	.674
Difference between athlete's starting height and final height (cm)	11.46 7.05	13.67 7.59	.302	13.38 5.18	13.00 3.98	.780
Number of attempts	7.38 2.24	7.42 2.10	.947	8.38 1.97	7.17 1.43	.019
Number of successful attempts	3.50 1.61	3.79 1.58	.531	4.33 1.46	3.58 1.13	.054
Number of failed attempts	4.00 1.35	3.63 0.87	.260	4.04 0.99	3.63 0.77	.112
Number of passed attempts after the athlete's starting height	0.17 0.38	0.21 0.58	.772	0.29 0.80	0.13 0.44	.381

ANOVAs, with Bonferroni adjustment (.05/ 4) revealed significant differences for the number of attempts ($F = 5.885$, $p = .019$, $\eta^2 = .113$), and no significant differences for the successful attempts ($F = 3.922$, $p = .054$, $\eta^2 = .079$), failed attempts ($F = 2.620$, $p = .112$, $\eta^2 = .054$) and attempts passed following the athlete's starting height ($F = .783$, $p = .381$, $\eta^2 = .017$), respectively.

Since the univariate analysis was significant for the number of attempts and approached significance for the successful attempts, a discriminant function analysis was used to determine the variables that significantly separated performances in 2008 and 2009. The Wilks' Lambda value was significant for the number of attempts ($\Lambda = .887$, $p = .019$), and the canonical correlation coefficient (.337)

revealed that 11.36% of variability was explained from the differences between the two finals. Finally, the positive value of the standardised canonical function coefficient revealed that data from group one (2008) was higher than group two (2009), and the respective regression equation ($Y = -4.504 + .580 \cdot X_{NE}$) provided correct classification for 64.6% of cases.

The stepwise multiple regression for predicting athlete's final height in 2008, had a significant multiple R^2 of .840 ($F = 6.448$, $p = .020$) comprising three positive predictors of number of attempts (B weight = .092), successful attempts (B weight = .679) and attempts passed following the athlete's starting height (B weight = .263). The respective regression equation for 2008 was:

$$Y_{AFH} = 165.794 + .408 * X_{NE} + 4.057 * X_{SE} + 2.857 * X_{EF}.$$

The prediction of athlete's final height in 2009 had a significant multiple R^2 of .450 ($F = 6.520$, $p = .019$) comprising two positive predictors of number of attempts (B weight = .599) and failed attempts (B weight = .419). The regression equation for 2009 was:

$$Y_{AFH} = 160.769 + 3.466 * X_{NE} + 7.766 * X_{EF}.$$

Discussion

Men's high jump

The mean values for number of attempts, successful attempts and failed attempts reported (Table 1) in the present study for men participating in the high jump in the Super League and the First League of the 2008 European Cup and the 2009 European Team Championships are similar to those reported by THEODOROU et al. (2009) for jumpers in previous Olympic Games, IAAF World Championships in Athletics and European Athletics Championships. The values reported in that study were 7.28 ± 1.91 , 3.15 ± 1.40 and 4.10 ± 1.17 for number of attempts, successful attempts and failed attempts, respectively⁵.

The current study revealed no significant differences for any of the dependent variables examined in the men's high jump, when comparing the data from 2008 and 2009. However, the data showed that several performance parameters improved in 2009 compared to 2008. The mean final height of the 2009 competition increased by 4.55cm (2.09%) and the difference between the athletes' starting height and final height increased by 2.21cm (19%) compared to 2008 (see Table 1). Although the total number of attempts remained almost the same across time (+ 0.54%), this minimum increase in performance was accompanied by a concomitant 8.28% increase in successful attempts and a 9.25% decrease in failed attempts. Further, the percentile ratio successful attempts/failed attempts

changed favourably towards the successful in 2009 (47.43%/54.20% in 2008; 51.08%/48.92% in 2009).

The decrease observed in failed attempts in the present study could be partially attributed to the new regulations. Specifically, if the new regulations had not been applied, the athletes participating in 2009 would have taken at least 6.73% (mean NE = 0.5, SD= 0.78) more attempts following their fourth foul. Therefore, the present findings suggest that the implementation of the new regulations may have contributed to the 9.25% decrease in failed attempts. Similarly, THEODOROU et al. (2009) reported that, during a men's high jump final, 7.55% of the number of attempts (mean NE = 0.55, SD = 0.88) are performed after the athlete's fourth foul, with 94% of them (Mean NE = 0.52, SD=0.76) classified as failed⁵.

We can only speculate about the causes for the 8.28% increase in successful attempts. Since no significant differences existed on athletes' season's best and personal best performance between the two competitions studied, there may be two possible explanations. On the one hand, a change may have occurred in tactics in 2009. In the high jump, the athlete's only intervention parameter is the decision to pass an attempt, which is usually made based on information regarding the other competitors' performances as the competition progresses. However, no statistically significant differences were found between the two competitions in regard to passed attempts and no significant correlations were observed between passed attempts and any other parameter. Additionally, the percentile ratio of failed attempts remained almost the same in both competitions (2.30% for 2008 and 2.83% for 2009). A second possible explanation may be that the restriction in efforts imposed on the athletes may have had a beneficial psychological effect, forcing them to be more focused on their technique thus leading them to more successful efforts.

Women's high jump

The mean values of number of attempts, successful attempts and failed attempts reported (Table 1) in the present study for women participating in the high jump in the Super League and the First League of the 2008 European Cup and the 2009 European Team Championships are similar to those reported by THEODOROU et al. (2009) for jumpers in previous Olympic Games, IAAF World Championships in Athletics and European Athletics Championships. The respective values at that study were 8.21 ± 2.34 , 3.90 ± 1.76 and 4.30 ± 1.14 efforts number of attempts, successful attempts and failed attempts respectively.⁵

The current study revealed no significant differences for athlete's starting height, athlete's final height and difference between athlete's starting height and final height between 2008 and 2009. However, several parameters have shown differences. The mean final height (AFH) and the difference between the athletes' starting height and final height in 2009 were reduced by 0.55% and 2.84% respectively, compared to 2008 (see Table 1). Additionally, a statistically significant decrease was recorded for the total number of attempts (14.43%), probably associated to a 17.32% decrease in successful attempts and a 10.14% decrease in failed attempts compared to 2008. Furthermore, the percentile ratio successful attempts/failed attempts has changed favourably towards failed attempts (51.67%/48.21% for 2008 vs 49.93%/50.63% for 2009).

The decrease observed in total attempts may be attributed at the new regulations. Specifically, the current study data revealed that if the new regulations had not been applied the participating athletes would have taken at least 6.41% (Mean NE = 0.46, SD = 0.72) more attempts following their fourth foul. Similarly, THEODOROU et al. (2009) reported that during a women's high jump final, 7.91% of the number of attempts (mean NE = 0.65, SD = 1.09) are performed after the athlete's fourth foul. Although the findings

suggest that the implementation of the new regulations may have contributed to the 14.43% decrease in total attempts, a wide proportion of variability remains unexplained and the causes may only be hypothesised.

Since no significant differences existed between the athletes' season's best and personal best performance for both competitions, a possible explanation may be that the restriction in efforts imposed to athletes may have had a detrimental psychological effect on them leading them to failed rather than successful efforts. However, this parameter was not assessed and therefore we can only speculate.

Another possible explanation may be that the four aggregate foul restrictions may have had an effect on the competition tactics. Although no significant differences were recorded for the number of attempts passed following athlete's starting height when comparing the 2008 and 2009 data, it was observed that the percentile ratio (over number of attempts) of passed attempts has dropped by almost half, from 3.46% in 2008 to 1.81% in 2009. This could mean that the female jumpers have made attempts at heights that otherwise, for tactical or circumstantial reasons, they would have probably skipped, thus increasing the possibilities for failed attempts and a quick exit from the competition. The latter is also supported by the significant negative correlation of number of attempts passed following athlete's starting height with failed attempts -0.488 ($p < 0.016$) for 2009 and the multiple regression analysis, which demonstrated that the number of attempts passed following athlete's starting height and number of attempts were positive predictors of the female jumpers' final height. Once again, caution should be taken before drawing definite conclusions.

Conclusion

The purpose of the present study was to examine the data from the high jump in 2008 European Cup and the 2009 European Team

Championships and report possible consequences that implementation of new technical rules may have had on the event.

In terms of statistically significant difference, we can say that not much has changed after the implementation of the new rules. In absolute terms, however, several parameters associated with performance seem to have been affected. Performance in the men's event seems to have benefited from the new regulations. The mean performance was higher while more successful and less failed attempts were taken. A possible explanation for that could be a beneficial psychological effect forcing male jumpers to be more focused on their technique, leading them to more successful efforts.

On the other hand, performance of the women jumpers seems to have deteriorated. The mean mark achieved was lower, the total

number of attempts was significantly decreased and there were more failed attempts in 2009 compared to 2008. A possible explanation could be that a detrimental psychological effect that intervened in their tactics, leading to too few attempts, and led to more failed attempts.

Setting a different number of aggregate fouls for women jumpers may be a consideration for the rule makers in the future. However, before final conclusions can be drawn with respect to the implementation of the new rules upon athlete's performance in high jump, data from future events must be gathered and analysed.

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