

Effect of different stages on match outcomes during high level judo competitions

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Abstract

This study aimed to demonstrate the effect of successive stages of high-level judo competitions on match outcome and the factors effecting it. A total of 4550 official matches in both men and women were included in the analysis. Frequencies and percentages were used for descriptive statistics. Mean and standard deviations with 95% confidence intervals were also presented. The difference in the variables investigated for each stage of judo competitions was analysed with the Chi-square test. Continuous variables were analysed with the Kruskal-Wallis test. The way competitors won a match differed in elimination, final stages, and medal matches ($p=.02$). When the difficulty of the matches increased, the percentage of the matches ended with *ippon* decreased and the percentage of the matches resulted with *waza-ari* increased. The percentage of the matches without any *shido* decreased from the elimination to the finals while there was a significant increase in the percentage of the matches with *shido* ($p=.01$). The match duration was found to increase from eliminations to the finals ($p=.00$). The efficiency index of the winner athletes during the first stage was higher than the other stages ($p<.05$). In conclusion, high-level judo athletes won a match with different scores at different stages during high-level judo competitions. Moreover, athletes were awarded with penalties more during the finals compared to eliminations, and match duration incrementally increased from the eliminations to the finals.

Keywords: Combat sports; martial arts; judo; performance analysis; match analysis, event phase; efficiency index.

Efecto de las diferentes rondas de competición en los resultados del combate en competiciones de judo de alto nivel

Resumen

El objetivo de este estudio fue demostrar el efecto de las sucesivas rondas de competición de judo de alto nivel en el resultado del combate y en diversos factores que afectan al mismo. Se analizaron 4550 combates oficiales, tanto masculinos como femeninos. Se utilizaron frecuencias y porcentajes en la estadística descriptiva, así como medias y desviaciones estándar con intervalos de confianza del 95%. La diferencia entre las variables investigadas para cada ronda de las competiciones de judo se analizó con la prueba de Chi-cuadrado. Las variables continuas se analizaron con la prueba de Kruskal-Wallis. La forma en que se consiguió la victoria fue diferente en rondas de eliminación, rondas finales y rondas de lucha por medallas ($p=.02$). Al progresar en las rondas, el porcentaje de enfrentamientos que terminaron con *ippon* disminuyó y el porcentaje de los que terminaron con *waza-ari* aumentó. El porcentaje de combates sin *shido* disminuyó desde las eliminatorias hasta la final, mientras que hubo un aumento significativo en el porcentaje de combates con *shido* ($p=.01$). Se encontró que la duración de los combates aumentaba desde las rondas eliminatorias hasta la final ($p=.00$). El índice de eficiencia de los atletas ganadores

O efeito das diferentes rondas de competição nos resultados de combate em competições de judô de alto nível

Resumo

Este estudo tem como objetivo demonstrar o efeito das sucessivas fases de competição no judô de alto nível nos resultados do combate e em diversos fatores que afetam o mesmo. Incluiu-se na análise um total de 4550 combates oficiais, tanto masculinos, como femininos. Utilizaram-se frequências e percentagens na estatística descritiva, assim como médias e desvio-padrão com intervalos de confiança de 95%. A diferença entre as variáveis investigadas para cada ronda das competições de judô analisou-se com o teste do Qui-Quadrado. As variáveis contínuas analisaram-se com o teste de Kruskal-Wallis. A forma como se conseguiu a vitória foi diferente nas rondas de eliminação, nas rondas finais e nas rondas de luta por medalhas ($p=.02$). No decurso das rondas, a percentagem de confrontos que terminaram com *ippon* diminuiu e a percentagem dos que terminaram com *waza-ari* aumentaram. A percentagem dos combates sem *shido* diminuíram das eliminatórias até à final. Houve um aumento significativo das percentagens de combates com *shido* ($p=.01$). Verificou-se ainda que a duração dos combates aumentou desde as rondas eliminatórias até à final ($p=.00$). O índice de eficiência dos atletas vencedores

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durante la primera fase fue más alto que en el resto ($p<.05$). En conclusión, en competiciones de judo de alto nivel los atletas de judo ganaron sus combates con diferentes puntuaciones según las rondas. Además, recibieron más penalizaciones durante las finales en comparación con las rondas eliminatorias, y la duración de los combates aumentó gradualmente desde las rondas eliminatorias hasta las finales.

Palabras clave: Deportes de combate; artes marciales; judo; análisis del rendimiento; análisis de combates; ronda de competición, índice de eficiencia.

durante a primeira fase foi mais alto do que o restante ($p<.05$). Em conclusão, nas competições de judô de alto nível os atletas de judô ganharam os seus combates com diferentes pontuações segundo as rondas. Por outro lado, receberam mais penalizações durante as finais, em comparação com as rondas eliminatórias, e a duração dos combates aumentou gradualmente desde as rondas eliminatórias até às finais.

Palavras-chave: Desportos de combate; artes marciais; análise do rendimento; análise de combates; ronda de competição índice de eficiência.

1. Introduction

The competition system of the International Judo Federation (IJF) suggested a short *repêchage* since 2009, where only athletes who reached at least the quarter-finals have a chance for a medal. During the successive preliminary rounds, athletes try to have a place among the last eight athletes, called quarter-final, to have a chance for a medal. If an athlete loses the quarter-final, they have to win the *repêchage* to fight for the bronze medal. Athletes should win all successive matches to fight for a gold medal. In this system, the athletes who lose before the quarter-finals are eliminated and have no chance for a place at the podium. Especially after the regulation about the competitions in 2009 (IJF, 2020), the World Ranking List was introduced, and the World Judo Tour events were the main pathway to qualify to the Olympic Games.

A judo match lasts four minutes for both men and women athletes and ends before the determined time with the execution of a technique scored with an *ippon*, double *waza-ari* or *hansoku-make* (disqualification). In case of a tie, the match continues till one of the opponents scores or gets disqualified during the golden score. In contrast to previous refereeing rules, now athletes are warned with the first two *shidos*, and the third *shido* disqualifies the athlete, that is to say, a penalty or two penalties do not decide the winner except for *hansoku-make* or correspond to a score. Moreover, athletes can be disqualified with a direct *hansoku-make* due to the acts against the spirit of judo (IJF, 2018 edition).

Rule changes in the last decade have been conducted to promote more positive judo where athletes always search for *ippon* instead of negative actions (Boguzewski, 2011; Ito et al., 2013). There are many studies related to judo match analysis where scores, penalties, match duration and effect of rule changes on scores, penalties, and match duration have been investigated (Calmet et al., 2017a,b; Ceylan & Balci, 2017; Franchini et al., 2013; Ito et al., 2013; Katicips, Silva, Kons & Detanico, 2018; Miyake et al., 2014; Suganami et al., 2005). Despite the abovementioned aim of the rule changes, many authors presented no change or even decrease in the number of scores (Adam, Smaruj & Tyszkowski, 2011; Calmet et al. 2017a,b; Ceylan & Balci, 2017; Franchini et al., 2013). All these studies have provided detailed information about judo match content in terms of score, penalties and match duration. However, World Ranking List and especially draw and seeding have gained a lot of importance for the Olympic Games as Guilherme and Franchini (2017) noted that the probability of seeded athletes for an Olympic medal was around 41.1% while it was 31.0% for number one ranked athletes to become Olympic champions. Still, there is no current study which demonstrates the effect of match rounds on match outcome, penalties, match efficiency index and match duration. The only study related to this issue (Adam, Wolska, & Tabakov 2018) investigated 845 male competitors during the 2014 and 2015 World Championships to resolve judo matches at successive stages.

Nevertheless, many important changes have been made in terms of refereeing rules and thus causing changes in technical and tactical components (Calmet et al., 2017a, b; Ceylan & Balci, 2017) of a judo match as well as physical capacities of the athletes despite not fully confirmed (Sterkowicz-Przybycień & Fukuda 2016). Therefore, analysing judo matches at successive stages in terms of match outcome, penalties, match efficiency index and match duration provides important information for coaches, researchers and high-level judo athletes who must change their technical and tactical preparations for each opponent. Thus, the aim of this study was to investigate the effect of successive stages of high-level judo competitions on match outcome and the factors affecting it.



We hypothesized that match duration would be shorter, the percentage of *ippon* score would be higher while the percentage of penalties would be less at the preliminary rounds, while match duration would increase, the percentage of *ippon* would decrease and the percentage of penalties would increase towards the finals.

2. Methods

2.1. Procedures and data collection

An observational descriptive design was used to examine the study's hypotheses. The hypotheses were investigated through comparing the way an athlete won a match, penalties, match duration and match efficiency index during different stages of the matches during 2018 and 2019 World Championships and 2019 Grand Prix in Zagreb, Budapest, Antalya, Tbilisi, Marrakech and Tel Aviv. The data were obtained from the official website of the IJF in a secondary form and not generated by experimentation. Besides, personal identification or countries of the athletes whose matches were analysed were not reported. Therefore, there is no ethical issue to use or interpret the data (Calmet et al., 2017a; Ceylan & Balci, 2017). The matches with *fusen* and *kiken geschi* were excluded from the study and 4550 official matches in both men and women were included in the analysis.

According to refereeing rules of IJF, competitions comprises of two main event stages: preliminaries and finals. Some sub-stages under these stages are defined as different event stages at the World Championships and the Grand Prix. Nevertheless, sub-stages are classified as elimination round of 128, elimination round of 64, elimination round of 32, elimination round of 16, quarter-finals, *repêchage*, semi-finals, contests for bronze medal and final –gold medal (IJF 2019). Because the number of heavyweight athletes is less, official classification of IJF was applied during the analysis. The stages following each other at sport competitions were classified according to Adam et al. (2018) as follows: 1st stage: matches during first and second rounds for positions up to 64 and 32; 2nd stage: preliminary stage, matches for positions from 32 to 16; if a competitor loses it means they were eliminated from the competition; 3rd stage: matches in "the medal zone", in case of victory the competitor has a chance to direct fight for a medal and a failure means the chance for *repêchage*; 4th stage: a direct match for medals.

Match outcomes were classified as *ippon*, *waza-ari-awasete-ippon*, score superiority with *waza-ari* and *hansoku-make* by either following three *shidos* or directly awarded according to current IJF refereeing rules (IJF 2019). The difference in match efficiency scores that were calculated with match outcomes, numbers of *ippon* and *waza-ari*, number of *shido* and match duration per athlete per match were investigated for abovementioned stages. Match efficiency score for each athlete per match was calculated as follows:

$$\text{Judo Match Efficiency} = (((\text{Ippon} * 20) + (\text{Wazari number} * 10)) * \text{Match duration factor}) - (\text{Shido number} * 3) - (\text{Hansoku-make} * 20) + 26 * \text{Match result factor}$$

- Match duration factor: 5 for 1-60 second, 4 for 61-120 second, 3 for 121-180 second, 2 for 181-240 second, 1 for 241 second and above
- *Hansoku-make*: yes=1, no=0.
- Match result factor: 2 for the winner, 1 for the defeated.

2.2. Statistical Analysis

Frequencies and percentages were used for descriptive statistics, also mean and standard deviations with 95% confidence intervals were presented. The normality of the data was examined with Shapiro-Wilk test. The difference in the categorical variables investigated for each stage of judo competitions was analysed with Chi-square test, and effect size was determined with Cramer's-V and classified with degrees of freedom (.10 ≤ Small effect; .11 to .30 = Medium effect; .50 ≥ Large effect) (Kim, 2017). Continuous variables were analysed with Kruskal-Wallis test. Statistical analysis was carried out with Statistical Package for the Social Sciences (SPSS) 22.0 (Chicago, the USA). P-value was set at $p < .05$.

3. Results

Figure 1 presents frequencies and percentages related to match outcomes during successive eliminations, quarter-finals, semi-finals and medal matches. According to Chi-square Independence test results, the way competitors won a match differed in elimination, final stages and medal matches ($\chi^2_{(9, n=4550)}=20.2, p=.02$; Cramer's $V=.04$ [small effect]). When the competitions became harder from eliminations towards the finals, the percentage of the matches ending with *ippon* and *waza-ari-awasete-ippon* decreased except for 2nd and 3rd stages while the percentage of the matches ending only with *waza-ari* increased except for 2nd and 3rd stages. When changes in scores during each stage of competitions were separately evaluated, the percentage of *ippon* ($\chi^2_{(3, n=4550)}=2.76, p=.43$) and *waza-ari-awasete-ippon* ($\chi^2_{(3, n=4550)}=3.6; p=.31$) decreased towards the finals, but these changes were not statistically significant. The percentage of the matches without any *waza-ari* or with two *waza-aris* decreased from the elimination to the finals but the number of matches ending with a single *waza-ari* increased ($\chi^2_{(6, n=4550)}=13.06, p=.03$; Cramer's $V=.04$ [small effect]). There were no significant changes in the percentage of matches ending with *hansoku-make* ($\chi^2_{(3, n=4550)}=1.08; p=.78$).

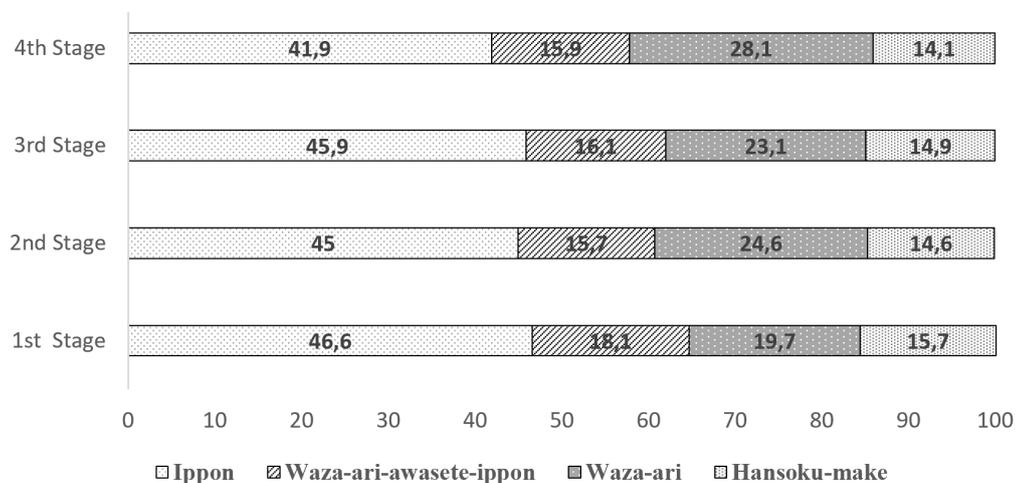


Figure 1. Percentage changes of match outcomes in the elimination and final stages of judo competitions.

Figure 2 presents percentages of matches with or without a *shido* during successive eliminations, quarter-final, semi-final, *repêchage* and medal matches. The percentage of the matches without any *shido* at the 1st stage was higher than the rest. At the same time, there was a significant increase in the percentage of the matches with *shido* after the 1st stage ($\chi^2_{(3, n=4550)}=11.85, p=.01$, Cramer's $V=.05$ [small effect])

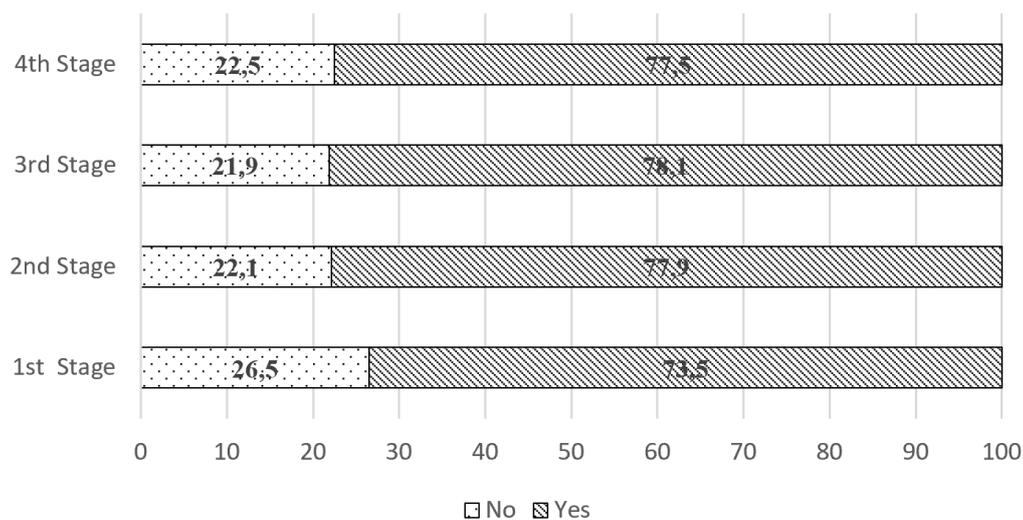


Figure 2. Percentages of the matches with or without *shido* during elimination and final stages of judo competitions.

Table 1 presents the changes in match durations during successive eliminations, quarter-final, semi-final, *repêchage* and medal matches. According to Kruskal-Wallis test results, the match duration changed at successive stages ($\chi^2_{(3, n=4550)}=77.63, p=.00$). The match duration at the finals was significantly higher than 1st stage ($p<.05$).

Table 1. The changes in match durations (second) during eliminations and finals of judo competitions.

Stages	M	±	SD	(CI 95%)
1. Elimination	177.4	±	100.5a	(173.5-181.4)
2. Elimination	199.4	±	102.8bc	(191.8-207.1)
3. Repêchage, quarter and semi-finals	204.1	±	108.6cb	(197.2-211.0)
4. Finals	217.9	±	114.6d	(206.6-229.2)

a,b,c,d Significant difference among means with different letter in the same column $p<.05$

When efficiency indexes of the athletes that were calculated with scores, penalties and match durations were compared for each successive stage, the efficiency index of the winner athletes significantly differed among the stages ($\chi^2_{(3, n=4550)}=35.75, p=.00$). The efficiency index of the winner athletes during the first stage was significantly higher than the rest ($p<.05$), while there was no significant difference among the rest stages ($p>.05$). The efficiency index of the defeated athletes were the same during all stages ($\chi^2_{(3, n=4550)}=2.20, p=.53$) (Table 2).

Table 2. The match efficiency indexes for winner and defeated athletes during eliminations and finals of judo competitions

Stages	Winner				Defeated			
	M	±	SD	(CI 95%)	M	±	SD	(CI 95%)
1 st	146.8	±	75.2 ^a	(143.9-149.6)	20.4	±	9.2	(20.1-20.8)
2 nd	134.4	±	71.8 ^{bcd}	(129.1-139.7)	20.5	±	8.9	(19.8-21.2)
3 rd	133.6	±	70.9 ^{cbd}	(128.9-138.4)	20.7	±	9.1	(20.1-21.3)
4 th	128.9	±	70.0 ^{dbc}	(121.2-136.6)	21.1	±	9.0	(20.1-22.1)

a,b,c,d Significant difference among means with different letter in the same column $p<.05$

3. Discussion

The analysis of match stages during judo competitions should be of importance for technical and tactical training plans of the judo athletes. The results of such studies can be used by coaches and athletes when planning technical and tactical training and match strategies concerning potential opponents. This study investigated the effects of successive stages during high-level judo competitions on match outcome and the factors effecting how the matches ended. The main findings of the study can be summarized as: 1) the percentages of the scores *ippon* and *waza-ari-awasete-ippon* were higher during eliminations while they were lower during the finals with a percentage increase of only *waza-ari* except for 2nd and 3rd stages, 2) the percentage of the matches with *shido* during eliminations was the lowest compared to the rest, 3) there was a continuous increase in the match duration from eliminations to the finals, 4) the efficiency index of the winner athletes was higher during the eliminations and differed among stages while the efficiency index of the defeated was the same during all stages.

When match outcomes during the different stages of judo competitions were investigated, they changed among the stages. In other words, the percentage of the matches won by *ippon* was higher during the eliminations than the finals. In contrast, the percentage of the matches won by *waza-ari* was higher during the finals. These findings confirmed our hypothesis. The findings of Adam, Wolska and Tabakov (2018) were in accordance with our study. They noted a higher percentage of *ippon* and *waza-ari-awasete-ippon* during preliminary stages while indicating a decrease towards the finals. They also indicated a lower percentage for technical advantage during preliminary stages, and it increased from preliminary stages to the finals. In contrast, Boguzewski (2011) investigated only the final stages of the Olympic Games 2008, World Championships 2005-2009, and Grand Slam Paris 2010 and stated that more than 50% of the matches ended by *ippon*

during the final stages. The percentages related to *hansoku-make* in Adam et al.'s (2018) study significantly decreased from preliminaries to finals. However, in our study, the difference was not significant. This situation may have resulted from the number of matches investigated in this study or can be related to the effects of rule changes.

During the analysed competitions, the percentage of the matches without any *shido* was the highest during the eliminations. There was a significant increase in the percentage of the matches with *shido* during the next two stages, it may have stemmed from tactical awareness of top-level athletes who compete each other frequently and know each other's strengths. These findings partially confirmed our hypothesis because we expected the percentage of penalties increased towards the finals but it decreased in the finals. Likewise, Adam, Wolska and Tabakov (2018) presented an increase in the percentages of penalties among different stages during World Championships 2014-2015. Although IJF has implemented many rule changes to promote active judo for spectators with minimizing the effect of *shido* on match outcome, the number of matches with a *shido* and even *hansoku-make* as a result of successive penalties increased (Balafoutas, Lindner & Sutter, 2012; Franchini et al., 2013; Calmet et al., 2017a, b). Moreover, it was stated that *shido* has indirect and significant effects on the judo match results (Balci & Ceylan, 2020), the tactical awareness of the coaches and athletes seem to be more important than ever to determine the result of a judo match. The reasons why athletes were penalised with a *shido* were non-combativity, false attack and outside-contest-area (Adam et al., 2018). This can explain the efforts of IJF for more active judo as athletes who were not eager to present any technique and thus a score were penalised with a *shido* for non-combativity. The explanation of Balafoutas, Lindner & Sutter (2012) for the increase in *shido* was that athletes resorted to *shido* instead of risking score when they felt in a difficult situation during the match as the first *shido* did not correspond to any score after the rule change in 2009.

The duration of a judo match has changed since judo was accepted as an Olympic sport. At present, it is limited to 4 minutes for both men and women athletes with the unlimited golden score in case of a tie (IJF, 2017 edition). In the current study, the stages significantly affected the match duration that increased towards the final though the difference between 2nd and 3rd stages were not significant that totally confirmed our hypothesis. It incrementally increased from the eliminations to the finals. Some studies noted that the matches ended before the determined time during high-level judo competitions and the percentage of the matches that ended in golden score was really low (approximately (2-7%)) (Balafoutas et al., 2012; Segedi et al., 2014; Witkowski et al., 2012). However, with the recent rule changes, the percentages of the matches ended in golden score were reported to increase from 4.71% (2015 World Championship) to 24.09% (2017 World Championship) (Calmet et al., 2017b). As there is no study with which we can compare our findings, we can suggest that the difference related to the match durations during different stages may have resulted from the fact that high-ranked athletes had the possibility compete during the next stages (Courel-Ibanez, Escobar-Molina, & Franchini, 2018) and the competitions became harder as they know each other better.

The match efficiency index has been calculated differently by different researchers (Adam et al., 2011; Adam & Sterkowicz-Przybycień, 2018; Kons et al., 2019). In this study, scores, penalties, match outcome and total durations of the matches were used to calculate the efficiency index. The efficiency index of the winner athletes decreased from the eliminations to the finals while no difference was found in defeated athletes. The higher efficiency index during the eliminations means that winner athletes presented more scores, finished the match in a shorter duration and was awarded fewer penalties. However, when they competed at the finals their efficiency index decreased, which can be explained with difficulties of the matches against strong opponents.

This study had some limitations. Firstly, the data were directly taken from the official website of the IJF and only the scores or penalties on the scoreboard were included in the analysis. More detailed analysis could have been provided in terms of technical-tactical aspects with video analysis as indicated by the literature (Miarka et al., 2016; Sterkowicz-Przybycień et al., 2017). Secondly, some Grand Prix where the number of the heavyweight athletes was low were excluded from the study for the accuracy of the data at the eliminations. Lastly, the results of the winner and defeated athletes were evaluated together, it can be advised to investigate winner and defeated



athletes separately in order to make detailed analysis of the results especially related to *waza-ari* and *shido*.

5. Conclusions

Our study found that high-level judo athletes won a match with different scores at different stages during high-level judo competitions. Moreover, athletes were awarded with penalties more during the finals compared to eliminations, and match duration incrementally increased from the eliminations to the finals. Another point was that the winner athletes presented a higher efficiency index during first elimination stage while it decreased towards the finals. Match duration, distribution of the scores, penalties and match efficiency index of the winner athletes differed between eliminations and finals during high level judo competitions. The results of the study show that coaches and athletes are required to prepare differently in terms of technical and tactical aspects for different stages at the competitions in their training plans.

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