

TECHNICAL AND TACTICAL ANALYSIS OF YOUTH TAEKWONDO PERFORMANCE

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ABSTRACT

Casolino, E, Lupo, C, Cortis, C, Chiodo, S, Minganti, C, Capranica, L, and Tessitore, A. Technical and tactical analysis of youth taekwondo performance. *J Strength Cond Res* 26(6): 1489–1495, 2012—This study aimed to analyze the technical and tactical aspects of young athletes during official taekwondo competitions. Fifty-nine youth taekwondo athletes (43 boys and 16 girls; age range: 10–12 years; weight category range: <24 to >59 kg) with at least 2 years of taekwondo training consisting of three 90-minute training sessions for 3 d·wk⁻¹ participated in this study. Thirty-seven matches (three 1-minute rounds, with 1-minute rest in between) were analyzed to verify the differences ($p \leq 0.05$) in offensive and defensive actions in relation to gender (male, female), match outcome (winners, nonwinners), kicking leg (front, rear), and round (first, second, third). No difference emerged for gender and match outcome. With respect to defensive actions (8.4 ± 12.0%), youth athletes engaged more frequently ($p < 0.0001$) in offensive actions (91.6 ± 12.0%), which showed a significant decrease ($p < 0.016$) from the first round (42.3 ± 21.8%) to the second (33.1 ± 14.8%) and third (24.5 ± 16.0%) ones. Kicks performed with the rear leg (94.4 ± 7.8%) occurred more frequently ($p < 0.0001$) than those performed with the front leg (5.6 ± 7.8%). In considering that a high level of coordination is required to perform front-leg kicks and defensive actions necessitate a high level of tactical skills, these findings might indicate a not-yet complete attainment of fundamental coordinative capabilities in 10- to 12-year-old athletes, independently of match outcome. To enhance coordination capabilities in youth athletes, coaches are recommended to structure their training including skill-ability and sport-ability drills.

KEY WORDS match analysis, technical indicators, youth taekwondo athletes

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INTRODUCTION

Originating in Korea as a martial art during the VI century B.C., taekwondo became an official Olympic sport in the Sydney 2000 Games and was included in the first edition of the Youth Olympic Games (23). At present, it is one of the most popular martial arts with 192 nations associated with the World Taekwondo Federation (40), and competitions are regularly organized at regional, national, and international levels according to the athlete's age, gender, skill level (i.e., belt color), and weight category to control for major differences between athletes. Official competitions include qualifying, semifinal and final phases organized during the same day with a variable time schedule (i.e., 30–120 minutes between competitions). Therefore, successful athletes might engage in several matches before their final one. In particular, matches comprise three 2-minute rounds with a 1-minute rest in between, and points are scored when an athlete produces a displacement of his or her opponent's body segment punching his or her torso or kicking his or her torso and head (39).

Because taekwondo athletes start training and competing around 10 years of age, youth matches should be based on a progression to meet the physiological characteristics of the children, to preserve them from an excessive physiological strain, and to facilitate the development of their technical-tactical skills (2). For this reason, the Italian Taekwondo Federation establishes the proficiency level of youth athletes taking into account their training experience (i.e., from 1 to 3 years) and technical capabilities. Furthermore, coaches of youth taekwondo athletes have to be black belt holders with at least a 1-year experience as assistant coaches, have participated in regional and national coaching courses, and passed a national coaching examination (18). Finally, the Italian Taekwondo Federation has differentiated the rules of youth competitions by reducing the duration of the rounds (range: 60–90 seconds), applying more stringent rules for scoring area (i.e., only torso), and requiring also foot-gear and mouth-guard protectors (18).

Because of the strict competitions constraints, taekwondo matches take place under a high situational unpredictability because of the interaction of the players with their opponents.

During matches, physiological, technical, tactical, biomechanical, cognitive, and psychological stressors determine several activity profiles in relation to the proficiency and the age of the athletes (4). Despite the physiological demands and technical-tactical aspects of elite taekwondo, competitions have been studied extensively (1,3-7,14,24-30,37), it is not possible to generalize information gathered on elite to young athletes because of age-related differences (8). At present, few studies have focused on the physiological and psychological responses of young athletes during simulated (34) and official matches (9,12,13), whereas there is a need for studies on the technical-tactical capabilities of young taekwondo athletes to plan effective youth programs for taekwondo academies. Unfortunately, the lack of scientific data on prepubescent athletes may have impact on our understanding of the requirements of youth taekwondo and hence our ability to develop strategies aimed to promote the potential of children. In considering that information on the athlete's responses during competition is important for optimizing training programs (9), monitoring technical and tactical parameters could represent a useful model for coaches to generate proper strategies to facilitate the learning process of the young athletes, prioritizing not only the development of basic motor abilities but also the improvement of sport-specific skills of the youth performance (2,8).

In sport sciences, athletic performance is investigated by means of notational and match analyses, which code relevant technical and tactical behaviors of athletes (21,22).

Analyzing international taekwondo competitions, Bridge et al. (5) reported the turning kick as the most used technique. Unfortunately, no information is available regarding the leg (i.e., rear or front) used to kick. Although it is possible to speculate that in a challenging competitive situation experienced athletes might rely on their ability to perform both the more natural rear-leg kicks and the more difficult front-leg kicks, young athletes might encounter difficulties in performing more demanding kicks during sparring. In considering that prepuberty represents the most important phase for the development of coordination (2), a thorough investigation of technical aspects of youth official matches is strongly needed to develop strategies for promoting the potential of children.

In the literature (5,25,26), the occurrence of offensive and defensive techniques and the incidence of scoring during the 3 rounds have been used as indexes of tactical aspects in elite competitors. Analyzing the incidence of offensive and defensive techniques in relation to gender, round, and match outcome, Kazemi et al. (24,26) reported in successful elite taekwondo athletes the main use of offensive techniques during the Sydney and Athens Olympic Games, whereas an opposite trend has been observed during the 2008 Olympics (25). Because the capability to score using a defensive technique requires athletes to find the proper timing to counteract the opponents effectively (26), this trend might indicate a more cautious approach during sparring (25). Furthermore, the analysis of score distribution during a match

TABLE 1. Techniques description.

Technique	Description
Backward slide turning kick	It is a defensive technique to avoid the attack of the opponent. It is performed with both the rear and the front leg, depending on the distance in-between the opponents.
Anticipated turning kick	It is a defensive technique performed with the front leg at a close distance to the opponent with the aim to anticipate his or her attack.
Direct turning kick	It is the most used technique performed with both front and rear legs. It is considered an offensive technique when performed with the rear leg. When performed with the front leg, it is considered a defensive technique after avoiding an attack at a close distance in-between opponents or an offensive technique to carry out a quick attack when the 2 opponents are at a close distance.
Switched feet turning kick	It is a defensive technique. To avoid the attack of the opponent, the athlete switches feet and directly kicks by using his or her rear leg.
Back kick (180°)	It is a defensive technique. To anticipate or to block the opponent's attack, the defender spins quickly looking over his or her shoulder, raises his or her rear leg to kick and the foot is thrust out to drive the heel into the target.
Shuffled kick	It is an offensive technique used to close the fighting distance by moving quickly forward and kicking without changing step. Starting from the guard position, the back foot moves first and stops before passing the front foot that moves to perform the kick.
Jumping fake turning kick	It is an offensive technique performed with both the front and the rear leg. It includes a first fake jumping kick and a second turning kick.
360° Turning kick	It is an offensive technique performed with a turning action of the body to assist in developing power for a kick.

TABLE 2. Technical parameters.*

Defensive	Front leg	Backward slide turning kick
		Anticipated turning kick
		Direct turning kick
Rear leg	Rear leg	Switched feet turning kick
		Backward slide turning kick
		Back kick (180°)
Offensive	Front leg	Shuffled kick
		Jumping fake turning kick
		Direct turning kick
Rear leg	Rear leg	Jumping fake turning kick
		Direct turning kick
		360° Turning kick

*Defensive and offensive techniques classified in relation to the kicking leg (i.e., front and rear).

showed that successful athletes tend to use the first round to evaluate the opponents and to conserve energy for the final part of the match (5). In considering that the development of sport concept and match skills necessitates a high perceptual and cognitive expertise (19,31), there is a need for information regarding the tactical behaviors of young taekwondo athletes during official matches.

At present, scientific information on technical and tactical aspects of youth taekwondo competitions is practically non-existent. Thus, the aim of this study was to examine official competitions of prepubescent female and male athletes to define their activity profile in relation to typology of actions, kicking techniques, match periods, and match outcome. It has been hypothesized that athletes at the beginning of their competitive career might use few kicking techniques and demonstrate a limited tactical capability.

METHODS

Experimental Approach to the Problem

To test the hypothesis that athletes at the beginning of their competitive career might use few kicking techniques and demonstrate a limited tactical capability, in this study, a notational analysis was used to evaluate the teams for each round. Two expert members of the Italian Taekwondo Federation observed several matches from the Italian Youth Championship before selecting technical and tactical parameters for the classification system used in this study. Furthermore, according to the literature (5,24–26), information on the tactical aspects of the youth taekwondo competition has been provided considering the typology of actions (i.e., offensive and defensive techniques), match period (i.e., first, second, and third rounds), and match outcome (i.e., winner

TABLE 3. Mean ± SD of frequency of occurrence (%) of techniques in relation to the type of action, kicking leg, gender, and match outcome.

Type of action	Kicking leg	Techniques (%)	Men		Women		Total
			Winners	Nonwinners	Winners	Nonwinners	
Defensive	Front leg	Backward slide turning kick	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
		Anticipated turning kick	0.6 ± 2.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.3 ± 1.2
		Direct turning kick	0.8 ± 2.8	0.2 ± 0.9	0.8 ± 2.2	0.0 ± 0.0	0.5 ± 2.0
Rear leg	Rear leg	Switched feet turning kick	8.7 ± 11.8	4.4 ± 7.0	0.4 ± 1.1	6.2 ± 13.3	5.8 ± 9.8
		Backward slide turning kick	0.9 ± 3.9	1.2 ± 4.8	0.4 ± 1.1	0.7 ± 2.1	1.0 ± 3.9
		Back kick (180°)	1.4 ± 3.3	0.8 ± 3.2	1.3 ± 3.7	0.0 ± 0.0	1.0 ± 3.1
Offensive	Front leg	Shuffled kick	3.0 ± 4.8	3.6 ± 6.7	1.5 ± 2.9	3.1 ± 5.4	3.1 ± 5.5
		Jumping fake turning kick	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0
		Direct turning kick	3.3 ± 4.5	1.8 ± 3.9	0.0 ± 0.0	0.0 ± 0.0	2.0 ± 3.9
Rear leg	Rear leg	Jumping fake turning kick	2.5 ± 5.0	9.9 ± 20.9	0.0 ± 0.0	0.5 ± 1.3	5.0 ± 14.1
		Direct turning kick	78.6 ± 15.6	77.9 ± 24.8	95.7 ± 5.2	89.5 ± 12.9	80.6 ± 19.8
		360° Turning kick	0.3 ± 1.3	0.3 ± 1.7	0.0 ± 0.0	0.0 ± 0.0	0.2 ± 1.4

and nonwinner). The term “winner” is relative to athletes who won their matches. In particular, an offensive technique is defined as the onset of athlete’s planned action and a defensive technique as a situation in which the opponent has attacked first (32). Although a fourth round has to be performed to verdict a winner in case of a tie score after the completion of the third round, the present analysis considered only the techniques performed during the first 3 rounds.

Starting from the kicking stance (i.e., the athlete standing with feet approximately shoulder width apart), the kicks were classified also considering their preparatory action as follows (32): (a) backward slide turning kick; (b) anticipated turning kick; (c) direct turning kick; (d) switched feet turning kick; (e) back kick (180°); (f) shuffled kick; (g) jumping fake turning kick; and (h) 360° turning kick (Table 1). Each kick was recorded in relation to the type of action (i.e., defensive or offensive) and the kicking leg (i.e., front and rear) (Table 2). In particular, the analysis of the kicking leg was deemed relevant to indicate coordinative capabilities of the young athlete. In fact, kicks performed with the rear leg are more natural because they determine a transfer of the body weight along the posterior-anterior direction of the kicking movement. Conversely, kicks performed with the front leg necessitate a shift of the body weight backward, which is opposite to the direction of the kick.

To avoid interobserver variability, a single experienced observer scored all the matches. Before the study, the observer scored a single match twice, the 2 scores being performed 7 days apart. No difference was reported for the notational analysis of the competition. To establish the observer’s objectivity, a second experienced observer analyzed the same combat. The lack of difference between observers proved that different researchers could use this notational analysis to effectively record the movement profile of youth taekwondo athletes.

Subjects

The Institutional Review Board approved the study performed in accordance with the ethical standards in sport and exercise science research. Before the study, written informed consent was obtained from the children, their parents, and their coaches. The unique chance of cooperation with the Italian Taekwondo Federation presented us with an opportunity to have access to measurements on young athletes (10–11 years) during the Italian “Cadetti B” Taekwondo Championship. The youth matches included three 1-minute rounds with a 30-second break between each round.

Fifty-nine youth athletes (43 boys, 16 girls; age: 11 ± 1 years) were recruited for this study during the Italian “Cadetti

TABLE 4. Mean ± SD of frequency of occurrence (percentage) of offensive and defensive actions in relation to gender and match outcome.

Type of action	Women		Men		Total
	Winners	Nonwinners	Winners	Nonwinners	
Defensive	3.0 ± 5.6	7.0 ± 14.0	12.4 ± 13.5	6.5 ± 10.0	8.4 ± 12.0
Offensive	97.1 ± 5.3	93.1 ± 13.7	87.6 ± 13.5	93.5 ± 10.0	91.6 ± 12.0*

**p* < 0.0001 with respect to defensive actions.

B” Taekwondo Championship. The discrepancy in the gender representation of the sample (i.e., female: 27%, male: 73%) mirrors the Italian participation in competitive sports (10). Inclusion criterion for this study was the participation in taekwondo training programs consisting of three 90-minute training sessions for 3 d·wk⁻¹ for at least 2 years. According to the rules of the Italian Taekwondo Federation (18), the participating athletes were color belts, corresponding to 2-year (i.e., yellow) and 3-year (i.e., red) taekwondo experience.

Procedures

Thirty-seven matches (13 quarters, 13 semifinals, 11 finals) were recorded by means of a video camera (GR-DVL 107; JVC, Yokohama, Japan) positioned at a 5-m distance from the contest area. A Video Home System (SLV-E1000VC; Sony, Tokyo, Japan) was used to analyze recordings. The data inclusion criterion was the successful recording of both competitors throughout the entire 3 rounds of the match.

Statistical Analyses

Data are presented as mean values and SDs of frequency of occurrence (%). Statistical significance was set at *p* ≤ 0.05.

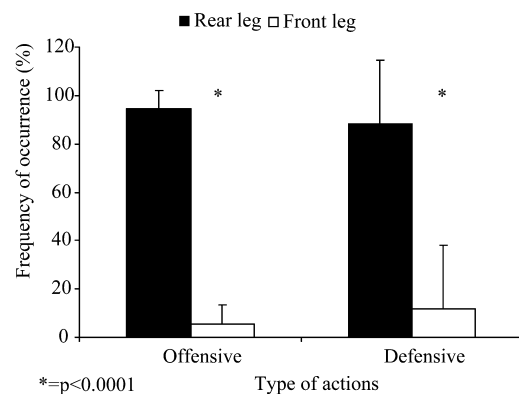


Figure 1. Mean and SDs of frequency of occurrence (percentage) of kicks performed with the rear and front legs in relation to offensive and defensive actions.

TABLE 5. Mean \pm SDs of frequency of occurrence (%) of offensive and defensive actions performed during first, second and third rounds in relation to gender and match outcome.

Round	Offensive actions						Defensive actions					
	Men			Women			Men			Women		
	Winners	Nonwinners	Total	Winners	Nonwinners	Total	Winners	Nonwinners	Total	Winners	Nonwinners	Total
First	40.8 \pm 21.1	43.9 \pm 24.1	47.1 \pm 24.0	37.7 \pm 14.8	42.3 \pm 21.8	45.0 \pm 37.7	28.8 \pm 39.5	37.5 \pm 17.6	33.3 \pm 0.1	38.8 \pm 36.3		
Second	34.0 \pm 14.2	33.2 \pm 14.3	29.9 \pm 18.1	32.8 \pm 18.4	33.1 \pm 14.8	30.2 \pm 32.7	47.0 \pm 45.2	37.5 \pm 17.6	16.6 \pm 23.5	35.1 \pm 36.2		
Third	25.3 \pm 17.0	22.9 \pm 17.1	23.0 \pm 12.0	29.5 \pm 12.8	24.5 \pm 16*†	24.7 \pm 33.3	24.2 \pm 39.7	25.0 \pm 35.3	50.0 \pm 23.5	26.1 \pm 34.2		

* $p < 0.0001$ with respect to the first round.† $p = 0.001$ with respect to the second round.

Before the study the Kolmogorov test was applied to test the normal distribution of the data. A within-subject repeated-measures analysis of variance (ANOVA) was used to test for differences for type of action (i.e., offensive vs. defensive) performed during the matches in relation to gender (female vs. male) and match outcome (i.e., winner vs. nonwinner). To verify differences for kicking leg (i.e., front vs. rear) in offensive and defensive actions, a multivariate ANOVA (MANOVA) for repeated-measures was applied, considering the kicking leg (i.e., front vs. rear) as within factor, and gender (female vs. male) and match outcome (i.e., winner vs. nonwinner) as between factors. Finally, a MANOVA was applied to test the differences among match periods (i.e., first, second, and third rounds) in offensive and defensive actions with respect to match outcome (i.e., winner vs. non-winner) and gender (i.e., male vs. female). Levene's test for homogeneity of variance and Mauchly's test for the sphericity were applied to control for statistical assumptions. To avoid type 1 errors, univariate effects within MANOVAs were examined only if the overall MANOVA was significant. When multiple comparisons were performed, post hoc Fisher protected least significant difference comparisons with Bonferroni corrections were used. To provide meaningful analysis for significant comparisons from small groups, Cohen's effect sizes (ESs) between groups were also calculated (16). An $ES < 0.2$ was considered trivial, from 0.3 to 0.6 small, < 1.2 moderate, and > 1.2 large.

RESULTS

Table 3 shows the percentage of occurrence of kicking techniques. In general, the direct kick was the most used during offensive actions and the switched kick during defensive ones. In particular, as the occurrence of the backward slide turning kick, jumping fake turning kick, anticipated turning kick, back kick (180°), and 360° turning kick ranged between 0 and 1%, data were pooled for type of actions and kicking leg. Independently from gender and match outcome, a higher ($p < 0.0001$, $ES = 6.93$) occurrence of offensive techniques emerged with respect to defensive ones (Table 4).

The MANOVA showed a main effect only for the kicking leg ($p < 0.0001$). For both offensive and defensive actions, the univariate test showed a prevalent ($p < 0.0001$) use of rear-leg kicks (Figure 1). A main effect ($p < 0.019$) emerged for round. The post hoc analysis maintained differences only between the third round with respect to the first ($p < 0.0001$, $ES = 0.55$) and second ($p = 0.001$, $ES = 0.93$) ones (Table 5).

DISCUSSION

To our knowledge, this is the first study evaluating the technical and tactical aspects of youth official taekwondo competitions. The main findings of this study are that kicking techniques were mainly limited to the direct turning kick during offensive actions and the switched feet turning kick during defensive ones; a major use of rear leg to perform

a kick; a predominant use of offensive techniques with respect to defensive ones; and a higher frequency of occurrence of offensive techniques during the first and second rounds. The lack of differences in the studied variables between winners and nonwinners indicated that at youth level the strict rules posed by the Italian Taekwondo Federation to control for coaching quality and athlete's proficiency (18) succeeded in providing fair match situations for children.

Although coaches suggest technical and tactical strategies, the main use of the most natural offensive (i.e., direct turning kick) and defensive (i.e., switched leg turning kick) techniques of the young athletes may indicate a limited technical capability in children. In fact, our classification did not include the most complex kicks (i.e., hook, spinning hook, side, push, and axe kicks), which have to be considered for elite athletes even though they were less used in a match (5). Furthermore, children almost exclusively performed rear-leg kicks, which are more natural than rear-leg ones. In fact, to execute front-leg kicks an athlete has to perform a sequence of preceding adjustments from the kicking stance to transfer the body weight on the rear leg. In considering that the capability of coupling movements is not completely mature by the end of the first decade of life (11,17) linking less natural movements together necessitates adequate opportunity to develop. Thus, few years of taekwondo academy might not be sufficient to allow 10-year-old children to master the high coordinative requirements to perform fast kicks using the front leg. Conversely, experienced athletes are able to make use of a broad technical capability to score points kicking with their front and rear legs.

Under stringent time constraints of sparring, the young athletes relied on easy and natural movements. Actually, chronic participation in open skill sports proved to help players overruling easy movement patterns spontaneously emerging under stressful temporal constraints and controlling for the negative influence of velocity of execution on coordinative tasks (17). Therefore, agility, reaction speed, dynamic balance, and proper timing are of primary importance in combat sports to coordinate different sequences of movements in relation to the opponent's behavior (35). Actually, coordination is best developed from 7 years of age till puberty (2,38) and the sensitive period for motor coordination occurs in prepubescent years (2,20). Thus, coaches are strongly encouraged to focus their training on the development of coordinative capabilities of children through dynamic situations. In fact, motor skills should be developed in the context of the match to avoid that children perceive isolated drills as tedious and irrelevant to their actual performance during sparring (36).

In young athletes, a limited technical capability could affect the tactical dimension of their match play. The low occurrence of defensive techniques observed in this study may indicate that children are not able to effectively avoid the attacks of the opponent. Although the excitement of the match comes from scoring from an offensive action, recently

the relevance of defense in taekwondo emerged in elite athletes (25). In fact, a prevalent use of offensive actions has been reported for successful athletes during the 2000 and 2004 Olympics (24,26), whereas during the last edition of the Games, an opposite trend has been observed (25). Because open skill sports strongly depend on the athlete's capability to react to his or her opponent, the frequent use of defensive techniques in successful athletes indicates that they tend to rely more on a conservative approach to the match (25). A method through which children can learn technical elements could be based on a tactical approach to the match by creating opportunities for athletes to develop anticipatory skills associated with attacks and defense, which stimulate the young athlete to articulate solutions to tactical problems (15).

Examination of the type of actions across the rounds highlights the athlete's tactical strategy in relation to the stage of combat. Differences between rounds were found only for offensive actions, probably because the defensive techniques occurred sporadically. Young taekwondo athletes attacked significantly more during the first 2 rounds with respect to the third one. An opposite trend has been reported for elite female (26) and male (5) athletes, who tend to use the first round to plan effective strategies for the match (26). Although the specific match strategies of elite and young athletes could be ascribed to the differences in tactical capability of novice and expert athletes, it could be also speculated that the peculiarities of elite and youth training could have an impact on their sparring behaviors. In particular, relying on a solid technical capability developed by means of extensive cumulated practice, elite athlete considerably train the tactical aspects of combat (33), whereas training programs for youth athletes have to focus first on the development of basic motor abilities of children before building up their technical and tactical skills (2). Finally, it is also important to consider that elite matches include 2-minute periods, whereas the corresponding picture for youth matches is 1 minute. Thus, the limited sparring time might enforce the young athletes to attack from the very beginning of the match. However, the impact that specific competition factors in taekwondo might have on the youth combat warrants further research.

PRACTICAL APPLICATIONS

The limited use of sport-specific techniques and front-leg kicks, and the large incidence of offensive actions suggest coaches to focus their youth taekwondo training programs on coordination-based exercises aimed to enhance the acquisition of various movements to be used under the time constraints of sparring. Because anthropometrical characteristics and general motor abilities change significantly in preadolescent athletes, coordination-based exercises must be reiterated during the developmental ages to support an athletic progress. To encourage the development of complex skills, it could be also advisable to introduce different rules

(i.e., more points attributed to difficult or front-leg kicks) for youth competitions.

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