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RESEARCH ARTICLE

THE EFFECT OF LIFE KINETIC TRAINING ON REACTION TIME AND ANAEROBIC POWER IN TAEKWONDO ATHLETES

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ABSTRACT

Purpose: The purpose of this study was to investigate the effects of life kinetic training (LKT) program on reaction time and anaerobic power in taekwondo athletes.
Material and Methods: This study was designed using a single-group pre-posttest quasi-experimental design to determine the effect of the LKT on the performance of taekwondo athletes. Athletes applied the LKT twice a week for 8 weeks, in addition to their regular sport-specific training sessions. The measurements were conducted at 30-minute intervals, in the following order: reaction time, standing long jump, and agility test.
Results: There was a significant increase in standing long jump distances between the pre-test (147±21 cm) and post-test (160±18 cm) values (p<.001). However, there was no significant change in participants' reaction times and agility test performance (p>.05).
Conclusion: In conclusion, although the LKT significantly increased the explosive power of taekwondo athletes, no statistically significant improvement was observed in reaction time or agility performance.

Keywords: Taekwondo, life kinetic, reaction, agility, standing long jump

INTRODUCTION

Taekwondo is a high-intensity combat sport that requires a complex integration of physical, technical, and cognitive skills (1). Competitive success depends on the athlete's ability to perform explosive movements, such as quick kicks and strikes, as well as their ability to synchronously process environmental information to anticipate their competitors' moves (2, 3). In this context, anaerobic power and neuromuscular coordination are considered the main factors underlying taekwondo performance, particularly during high-speed movements. In recent years, traditional methods have increasingly been supported by neuro-cognitive training methods to improve athletic performance (4, 5). One of these methods, life kinetic training (LKT), combines unfamiliar motor tasks with cognitive challenges to improve brain-body coordination (6). Contrary to traditional methods, LKT focuses on creating new neural pathways by challenging the brain through unfamiliar movement patterns, dual-task exercises, and visual-spatial exercises (7). Although the benefits of this method have been studied in various team sports, its specific effects on combat sports-where reaction time and anaerobic power are both critical-have not yet been sufficiently investigated.

Although the physiological demands of taekwondo have been extensively discussed in the literature, there is no consensus regarding the effect of cognitive-based motor training on these athletes' anaerobic power and reaction time (8). Many of the existing studies focus on isolated physical interventions, often ignoring the potential synergy between cognitive load and motor output (9, 10). This gap in the literature requires research into whether a structured LKT can yield meaningful improvements in both physical (anaerobic power) and cognitive (reaction time) abilities in the context of taekwondo.
Accordingly, the primary aim of this study is to examine the effects of LKT on reaction time and anaerobic power in taekwondo athletes. The study hypothesis is that the program may provide significant improvements in the athletes' performance parameters.

MATERIALS AND METHODS

Experimental Design

This study was designed using a single-group pre-post-test quasi-experimental design to determine the effect of the LKT protocol on the performance of taekwondo athletes. Athletes applied the life kinetic program twice a week for 8 weeks, in addition to their regular sport-specific training sessions. Measurements were conducted at 30-minute intervals in the following order: reaction time, standing long jump, and agility test. All procedures were coordinated in a standardized form before and after the eight-week intervention.

Subjects

The study included 14 male taekwondo athletes (age: 12.36±1.00 years, training age: 3.14±1.35 years, height: 158±5.86 cm, weight:50.60±10.46 kg, BMI: 21.17±3.92, fat mass: 13.90±6.55 kg, muscle mass: 19.71±3.45 kg). In order to be accepted into the study, athletes had to be free from any illnesses or injuries, regularly participate in competitions, and engage in at least three training sessions each week. Before all tests, the researchers obtained an informed consent form from the athletes, which included information about potential risks related to the study and experimental designs. The study protocol is based on the latest version of the Declaration of Helsinki. The study was approved by Non-Interventional Research Ethics Committee of Dokuz Eylül University (Date: 18.01.2019, Number: 2019/01-118).

Anthropometric Data Collection

Athletes' heights were measured when they were wearing shorts and a t-shirt and without shoes. A manual stadiometer was used to measure height by measuring the separation between the sole of the foot and the top of the head. The data obtained were recorded in centimeters (cm). Body weight (kg), BMI (kg/m²), muscle mass (kg), and fat mass (kg) data were evaluated using bio-impedance Tanita (Tanita MC-980MA, Tokyo, Japan).

Life Kinetic Training Program

LKT programs (Table 1) are designed based on the requirements of the taekwondo branch. The exercise program was conducted twice a week for 8 weeks. Each exercise was performed for 3 repetitions with a 2-minute rest period. The exercises were designed to gradually increase in terms of their coordinative complexity and cognitive load. In this context, the program initially focused on basic jumping and technical striking combinations; subsequently, object control tasks and rapid decision-making tasks based on external stimuli that trigger the dual-task mechanism were integrated.

Table 1. Life kinetic training programs

Over the line on the ground: ▪ Following an explosive start, participants performed three single-leg lateral hops to each side (right and left). This was followed by four straight punches (ap jirugi). The sequence was then repeated, beginning with another explosive start and single-leg hops. ▪ Following an explosive start, participants performed three double-leg lateral jumps to each side (right and left). This was followed by four straight punches (ap jirugi) and two sidekicks (yop chagi). The sequence was then repeated, beginning with another explosive start and double-leg jumps.
On the ground, within numbered circles, in accordance with verbal commands: ▪ In the single-numbered circles, double-leg jumps were performed, while in the two-numbered circles, single-leg jumps were performed. ▪ While hopping with a single foot within the circles, stand with both feet on the target circle by command.
Without touching the lines within the squares drawn on the ground: ▪ The athletes hold the tennis balls in both hands, throw them up and catch them with the other hand. ▪ The athletes run sideways in time with the rhythm while changing the ball in their hands.
Verbal commands: Red: lateral running; Blue: crossover running; Green: backward running ▪ The athletes began shadow boxing at the starting line and then, following verbal commands, made explosive moves in different directions. They continued using boxing techniques once they reached the target point.

Reaction Time Measurement

A simple reaction time test (Davis TL, Frang JY, 1990) was used to measure reaction time. An HP 530 Intel Pentium notebook was used in the study. The study measured athletes' visual reaction times. During the test, athletes were required to keep their eyes focused on the screen and their heads positioned 40 cm behind the screen. Athletes were instructed to use the fingers of their dominant hand to press the A key in response to random stimuli displayed on the computer, positioning their finger approximately 1 cm above the key before stimulus presentation. The reaction times of the participants to the stimuli were recorded by the computer, and the mean simple reaction times were determined (11).

Agility Test

A 4x10 m agility test was used to assess the athlete's agility performance. The test was conducted in a 4x10 m area with cones placed at specific points. A Newtest Powertimer 300 (Finland OY) photocell system was used to measure the time taken to complete the test. Athletes performed two maximum effort trials with a 5-minute passive rest period between trials. The best completion time was used for statistical analysis. Verbal encouragement was provided throughout the trials (12).

Standing Long Jump

Standing long jump performance was measured using a measuring tape. The athletes performed a forward jumping movement on two feet from a designated starting point. The jump distance was recorded as the distance between the jump line and the point where the feet last touch the ground. Athletes performed two maximum effort trials with a 5-minute passive rest period between trials. The best performance was used for statistical analysis (13).

Statistical Analyses

JASP software was used for all statistical analyses (0.19.1.0). The Shapiro-Wilk test was used to determine whether the data were normally distributed. For each variable, descriptive statistics (mean ± standard deviation) were calculated for pre-test and post-test conditions. Agility, reaction time, and standing long jump values were compared between the pre-test and post-test conditions using paired samples t-tests. Statistical significance was set at $p < .05$. An additional Bonferroni correction was applied to control for Type I errors across multiple comparisons. The adjusted significance threshold was set at $\alpha = 0.016$ (0.05 / 3 tests) (14). For clarity, p-values are presented together with their Bonferroni status in parentheses (e.g., "Bonferroni-s." for significant after correction).

RESULTS

In Table 2, descriptive statistics and p values of reaction time, agility test, standing long jump variables at pre-test and post-test conditions are presented.

Table 2. Descriptive statistics (Mean±SD) and p values of reaction time, agility test, standing long jump variables at pre-test and post-test conditions

	Reaction Time (sec)	Agility Test (sec)	Standing Long Jump (cm)
Pre (Mean±SD)	0.292±0.01	11.57±0.78	147±21
Post (Mean±SD)	0.298±0.02	11.46±0.49	160±18
***p* value**	0.413	0.272	0.001*** **(Bonferroni-s.)**

Note. $p < 0.001$ (***)

DISCUSSION

The main aim of this study was to examine the effects of the LKT on reaction time, agility, and standing long jump performance in taekwondo athletes. The findings indicate that the applied protocol resulted in a statistically significant increase in standing long jump performance; however, it did not lead to improvements in reaction time and agility performance. These findings raise questions about the selective effects of motor training involving cognitive load on physical performance and sport-specific adaptation processes.

The improvement in standing long jump performance observed in this study can be attributed to the indirect effects of LKT on the neuromuscular system (increased motor unit synchronization and neural adaptations). Although the LKT program does not primarily aim to develop strength, it is known to improve movement efficiency by stimulating the neuromuscular control mechanisms through coordinative challenges (15, 16). In sports that require explosive power, the development of neural pathways and the more efficient integration of proprioceptive input with motor output are associated with muscle strength development and speed (17).

Similar studies in the literature indicate that balance and coordination exercises combined with cognitive challenges improve anaerobic power (18-20). In this context, the improvement observed at the end of the 8-week period can be attributed not to an increase in muscle mass but to the central nervous system's ability to stimulate muscle fibers in a more synchronized manner.

Contrary to our hypothesis, the non-significant difference in reaction time and agility scores may be associated with the developmental characteristics of the athletes and the nature of the training stimulus. The main reason for this may be the athletes' mean age (12.36 ± 1.00 years), because their motor development is still continuing. In athletes during the pre-adolescent and early adolescent periods, factors such as neuromuscular coordination and reaction speed are strongly influenced by both biological maturation and regular sports training (21-23). Although athletes in this age group compete at a competitive level, their technical skills may not yet be fully developed. This may have limited the effectiveness of training sessions with a high cognitive load, such as LKT, on physical performance.

Another possible factor is the intensity and duration of the training protocol used. Although the 8-week LKT may have improved the standing long jump, it may not have reached the threshold of long-term adaptation required for changes in neuromotor skills such as agility, requiring rapid decision-making. We believe that, for such cognitive-based motor skills to become permanent in young athletes and be reflected in test scores, training frequency or total duration must be increased.

The present findings differ from the results of other studies reporting that LKT enhances agility in team sports such as soccer (24, 25). This situation may stem from the differences in the training structure and biomechanical demands of these branches. The neural preparation effect provided by LKT, which is seen in standing long jump performance, shows that this method could be an effective aid for lower-body explosive strength. However, the observation of no similar improvement in agility can be explained by the term "transfer deficit" found in the literature, which refers to the limited ability to transfer cognitive gains to performance (26).

Limitation

This study has some limitations. First, the low mean age (12.36 ± 1.00 years) of the participant group, who are in early adolescence, may make it difficult to generalize the results to adult or elite-level athletes. Additionally, the small sample size may limit the statistical power and generalizability of the findings, particularly for detecting small-to-moderate effects. Second, the absence of a control group in the study prevents a definitive conclusion regarding whether the observed increase in standing long jump was due solely to the LKT or to the athletes' routine training programs. Finally, since the reaction time and agility measurements were conducted using general laboratory tests, they may not fully reflect the dynamic responses specific to taekwondo.

CONCLUSION

In conclusion, the 8-week LKT appears to be a potentially effective method for improving lower-body explosive power (standing long jump) in taekwondo athletes in early adolescence. However, no statistically significant improvement in reaction time and agility performance was observed among athletes in this age group. These findings suggest that athletes in this age group may require longer-term neuro-motor protocols or programs that are more closely integrated with sport-specific techniques for cognitive-based motor skills to become permanent. Coaches are recommended to incorporate LKT into training programs, particularly to enhance neuromuscular readiness and diversify the physical capacities of young athletes. In future studies, there is a need for long-term research that includes control groups and sport-specific field tests in order to better understand the effects of LKT in this age group.

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