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Research Article

Effects Of Life Kinetic Exercises On Dynamic Balance İn Taekwondo Athletes

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ABSTRACT

Objective: The aim of this study was to investigate the effects of 8-week Life Kinetic exercises on dynamic balance in red belt and above taekwondo players aged 11-14 ($\bar{x}$=12.67±1.01) years.
Method: This research is an experimental study with pretest-posttest control group. Thirty red belt and above taekwondo athletes with an average age of 12.67±1.01 were randomly divided into two groups as experimental and control groups. The experimental group athletes (n=15) practiced Life Kinetic (LK) exercises for 45 minutes two days a week for 8 weeks in addition to taekwondo training. Balance ability was assessed using the Performanz balance device and Y Balance test before and after the LK exercise program. Data were analyzed by two-factor mixed design ANOVA with repeated measures. The difference between variables was considered significant when the *P* value was less than 0.05.
Results: According to the results of the Performance Balance test, when the biped, right foot and left foot measurements were analyzed, the interaction of group and measurement factors made a significant difference on the measured values ($P<0.05$). According to the results of the Y Balance test, the interaction of group and measurement factor created a significant difference in the right and left foot Y Balance scores ($P<0.05$).
Conclusion: Based on these results, LK exercises may contribute to the development of dynamic balance skills of athletes. It was also concluded that the improvement seen in the experimental group was superior to the control group practicing traditional taekwondo training.

Keywords: Taekwondo, Life Kinetic, Dynamic Balance, Y Balance Test.

INTRODUCTION

Taekwondo is a sport branch that requires motoric and cognitive characteristics such as strength, strength endurance, endurance, speed, agility, quickness, flexibility, dexterity, coordination and attentiveness (Ramazanoğlu, 2000). Performance in taekwondo can be determined according to the technical, tactical, psychological, physical and physiological characteristics of a competitor. In taekwondo, it is necessary to create a perfect technique in training and to use these techniques in the best way with tactical skills in the competition. Taekwondo training is therefore structured to target these specific performance instruments (Pieter, 2009). In taekwondo, various movement combinations were performed during the fight. Cognitive and motor skills need to work in harmony in order to demonstrate this performance and to make correct defense and attack while maintaining body stability. For this reason, Life Kinetic (LK) exercises developed by Horst Lutz, a football coach in Germany, are currently used in many countries around the world as a training program to promote neuronal learning, create new brain networks and reduce neural symptoms, as well as improve the concentration and performance of the visual system (Lutz, 2016; Peker, 2014).
Life Kinetik is a modern technical action training program based on the formation of nervous system habits specifically associated with the intense activity of the athlete's intelligence. The essence of this training method is in the combination of different motor activities (often disrupting basic movement techniques) that activate and shape integrative cortical areas and at the same time increase the efficiency of an athlete's thought processes (Demirakca, Cardinale, Dehn, Ruf, & Ende, 2016; Duda, 2015; Pietsch, Böttcher, & Jansen, 2017).

Life Kinetik exercise is a combination of three component exercises that include motor activity exercises, cognitive challenges and peripheral visual perception exercises (Lutz, 2011). The application of movement in Life Kinetic training has a wide variety of variations and the basic movements in Life Kinetic training are catching, throwing and catching objects, eye and limb coordination (Henryk, 2015). The Life Kinetic training method is based on three basic systems: flexible body control, optimized perception and cognitive abilities. The first one is flexible body control, which is a state of readiness and appropriate response to stimuli from the outside world. Since the situations that may be encountered during the competition are not repeated, these situations encountered for the first time during the competition cause an increase in the stress levels of the athletes and limit the application of the correct technique (Faigenbaum, Kraemer, Blimkie, Jeffreys, Micheli, Nitka, & Rowland, 2009). However, as the experience and variety of training increases, the ability to adapt to new situations can also increase. As a result, it becomes possible for the brain and body to apply these techniques more flexibly. Second, optimized perception is an extremely important cornerstone alongside physical performance. Visual perception is certainly dominant, but other senses also play an important role, although with different weights. The visual system needs body coordination cognitive skills to process as much information as possible quickly (Peker, 2014; Canbulat, 2011). The aim of Life Kinetic exercises is to activate the visual system as much as possible, working on factors such as depth, speed, distance and focus to ensure fluid movement of the eye. Flexible body control and perception are highly functional areas, but they become dysfunctional without cognitive skills, which are very important in providing them. Therefore, cognitive skills, which are essential for effective and rational thinking and mind-body coordination, are a significant component aimed to be developed through Life Kinetic exercises (Lutz, 2017).

Balance or postural oscillation is the process of maintaining the position of the body's center of gravity vertically on the base of support by executing smooth and coordinated neuromuscular activities with rapid, continuous feedback from visual, vestibular and somatosensory structures (Nashner, 2014). In athletes and sedentary subjects, a rapid adaptation occurs by the neuromuscular system to changes in the center of gravity during rest or movement (Akyüz, Çoban, Dilber, Ergün, Taş, Işık, Akyüz, 2016). Although it is often thought of as a static process, balance is a complex and dynamic process that involves coordinated activities of sensory, motor and biomechanical components with neurological connections (Erkmen, Suveren, Göktepe, Yazıcıoğlu, 2007). Dynamic balance includes the different movement states of daily life activities such as walking, weight transfer activities, climbing up and down stairs, sitting and rising from a chair, and the integrity between these states (Chaudhari & Andriacchi, 2006). In combat sports, each athlete must learn to use the stimulation of muscle, joint and skin mechanoreceptors to adapt to constant changes in posture, support, ground and opponent contact in order to turn variable dynamic situations to their advantage (Perrin, Deviterne, Hugel, & Perrot, 2002; Perrot, Deviterne, Perrin, 1998). When balance and mobility skills are trained correctly, it has been shown to improve the body's movement awareness in all ranges of motion (Clark, Lucett, Corn, 2008). A study conducted by the University of Aalen in 2008 with more than 3,000 children between the ages of 5 and 18 showed that 62% of children had mild to severe balance problems (Hoffmann, 2008). These children scored on average 0.6 points lower in German, math and sports lessons than students without balance problems. This suggests that improving vestibular perception and thus balance may also have an impact on cognitive skills. Life Kinetic training aims to develop the ability of balance as it involves practicing many different exercises and their various variations at the same time.

In the light of the studies, Life Kinetic exercises were adapted to taekwondo branch and the effect of LK exercises on balance, which is an important skill for athletes interested in this sport, was tried to be examined.

MATERİAL AND METHOD

The present investigation employed a pretest-posttest control group design. In the study, athletes who voluntarily accepted to participate in the study were randomly assigned to the experimental and control groups. Then, measurements of the dependent variable were taken before the training practices of the subjects in the groups. In this research process, the experimental group practiced the 45-minute Life Kinetic training program for two days a week in addition to their taekwondo training four days a week. The Life Kinetic program was developed and administered by the researcher, who received formal training in this methodology. The control group continued taekwondo training only four days a week for eight weeks. Upon completion of the 8-week period, all participants underwent post-intervention assessments using the same measurement protocols as the baseline testing.

Research Group

The sample of the study consisted of 30 (15 girls, 15 boys) healthy volunteer participants aged 11-14 years who practiced taekwondo in Mersin province. Ethics committee approval numbered 08/08/2022-011 was obtained from the Sports Sciences Ethics Committee before the study was initiated.

Among the participants who agreed to participate in the study, 15 athletes (7 boys, 8 girls) were selected as the Life Kinetic training group and 15 athletes (8 boys, 7 girls) were selected as the control group by random sampling method. In experimental studies, attention was paid to randomization assignment to reveal the effect of the treatment and to purify the group from possible confounding variables. In addition, measures such as balancing, equalization and stabilization were taken to ensure balance in the groups. Participants were athletes who have been practicing taekwondo for at least two years, red belt and above.

Data Collection

Information Form: Before the research, a measurement form was developed to record the measurement results and the measurement results were recorded on this form. The measurements of the study were made in Mersin gymnasium with a capacity of 500 people. The participants' height, weight, age, belt and training year information were obtained and recorded.

Y Balance test

The Y Balance Test is a dynamic stability test that is considered to be effective and clinically applicable to provide an accurate assessment of lower limb neuromuscular control (Thorpe and Ebersole, 2008). The Y Test kit consists of a position platform to which three wooden blocks are attached, marked in centimeters, forming the anterior posteromedial and posterolateral reach directions. The participant stands on the sole of the foot with the distal side of the right foot on the baseline and the hands in a fixed position at the waist. While maintaining a one-foot stance on the right leg, the subject pushes the wooden block as far as possible with the free limb (left leg) and reaches in the anterior (ANT), posteromedial (PM) and posterolateral (PL) directions relative to the standing foot. The tape measure was fixed to the wooden bars and the maximal reach was recorded in cm as the point reached by the most distal part of the foot. Participants completed 3 consecutive trials for each reach direction and subjects switched limbs between each direction to reduce fatigue (Plisky, 2009; Shaffer, Teyhen, Lorenson, Warren, Koreerat, Straseske, & Childs, 2013). In order to eliminate leg length advantage,

Normalized reach (%)=(absolute reach)/(limb length)*100

The scores obtained by using the formula were normalized. The total score value was calculated by taking the average of the normalized ANT, PL and PM scores.

Performanz Balance Test

Another balance measurement in our study was performed with the "Performanz Balance Device". Performanz balance device is used in dynamic balance measurement in the "Turkey Sportive Talent Identification and Sports Orientation" project implemented by the Ministry of Youth and Sports. This is an electronic device designed to determine the balance ability, also referred to as postural oscillation, and the stability or mobility of the center of gravity on the balance leg. In the test phase, the athlete is first asked to stand on the device with both feet with support from the table. For 10 seconds, the athlete is asked to remain as still as possible without touching, holding, bending and crouching. At the end of the test, the athlete gets off the device and rests for ten seconds. After repeating the same steps for the right and left foot, the balance test is completed. At the end of each test, the balance application represents the athlete's balance value as a score out of 100. The balance score is based on the percentage of the athlete's presence in the swing zones, which are divided into eight sections. Staying stable in and around the center zone brings the balance score closer to 100.

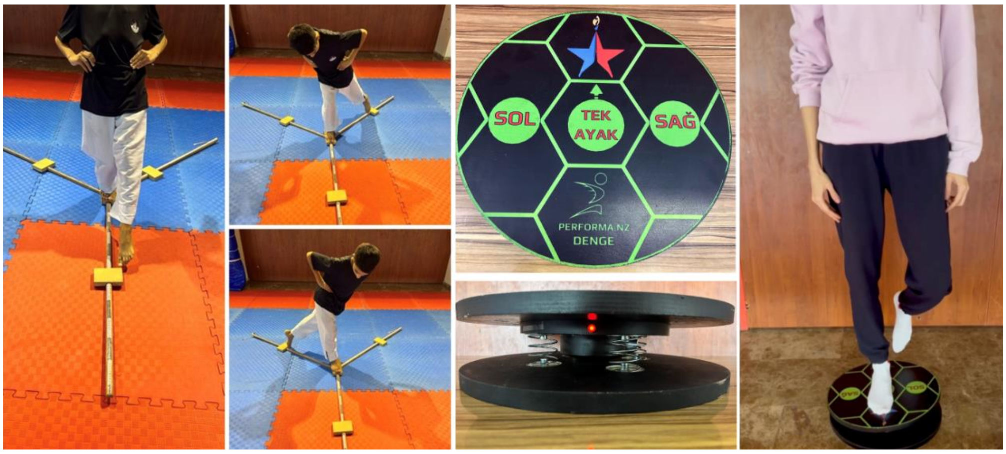

Figure 1. Y Balance Test and Performanz Balance Test

Data Analysis

In this study, a two-factor mixed design ANOVA analysis with repeated measures was conducted to test the effects of Life Kinetic training on balance. Dependent variables were examined whether they showed normal distribution on independent variables by calculating the Shapiro-Wilk test and the standard value of skewness from normality tests. In this context, the data were found to be normally distributed. The homogeneity tests of variances were checked with Levene's test and Pillai's Trace test results were given in mixed design ANOVA models in cases where variance homogeneity could not be achieved in the measurements. When the P value is less than 0.05, the difference between the variables is considered significant.

RESULTS

Age, years of training, height and body weight information of the athletes are shown in Table 1 according to group and gender variables.

Table 1. Descriptive data of the experimental and control groups

Groups	Gender	n	Age		Years of Training		Height (cm)		Weight (kg)	
			Mean	SD	Mean	SD	Mean	SD	Mean	SD
Experiment	Female	8	12.75	1.28	4.13	1.8	159.87	6.51	46.01	5.9
	Male	7	13.29	0.75	4.86	1.77	161.85	7.49	47.27	6.09
Control	Female	7	12.29	0.95	3.29	1.38	154.85	7.9	41.82	6.25
	Male	8	12.38	1.06	3.25	1.03	155.5	10.95	48	12.23

As mentioned in the data collection tools section, two different balance measurements were made in the study. First, the results of the measurements made with the performance balance device and then the results of the Y Balance measurements are given.

Table 2. Descriptive statistics of the pair, right and left foot balance test scores of the groups

Subtests			Pair Foot Balance		Right Foot Balance		Left Foot Balance	
Test	Group	n	Mean	SD	Mean	SD	Mean	SD
Pre-test	Experiment	15	64.33	7.5	69.13	8.77	63.4	9.59
	Control	15	63.46	9.56	64.33	11.67	60.86	8.58
	Total	30	63.9	8.46	66.73	10.43	62.13	9.03
Post-test	Experiment	15	74.8	7.6	77.06	7.38	77.33	7.01
	Control	15	68.26	10.13	67.2	11.35	63.6	8.31
	Total	30	71.53	9.41	72.13	10.66	70.46	10.29

According to Table 2, when the mean scores of the double foot balance test are examined, it is seen that the double foot balance test scores of the experimental and control groups are very close to each other. After the Life Kinetic exercises applied to the experimental group, there was a 16% increase in double foot balance skills. In the control group, there was a 7% increase in balance skills, although less than the experimental group. When the right foot balance scores were examined, an increase of approximately 11% was observed in the balance scores after the Life Kinetic exercises applied to the experimental group. In the control group, this increase was approximately 5%. When the left foot balance scores were examined, a high rate (22%) of improvement in balance skills was observed after the Life Kinetic exercises applied to the experimental group. In the control group, the positive change was approximately 5%. In order to determine the significance of these changes seen in the pre-test and post-test averages of the groups, the mixed measures ANOVA results of the three subtests are given in the table below.

Table 3. Mixed design ANOVA results for the difference in performanz balance test scores of experimental and control groups

Balance Tests	Pair Foot Balance			Right Foot Balance			Left Foot Balance		
Factors	F	*P*	Eta square	F	*P*	Eta square	F	*P*	Eta square
Group (Experimental/control)	1.519	.228	.051	4.471	.044*	.138	8.711	.006*	.237
Measurement (pretest/posttest)	45.823	.000*	.621	24.478	.000*	.466	36.970	.000*	.569
Group*Measurement	6.313	.018*	.184	5.387	.028*	.161	16.695	.000*	.374

P<0.05; two-factor mixed *ANOVA Test*

According to Table 3, a statistically significant difference was observed in the double leg balance scores of the participants in the experimental and control groups before and after the procedure ($F(1,28) = 6.313$, $p<.05$, $\eta2=0.184$). When the eta squared value was examined; 0.18 indicates that the effectiveness of the Life Kinetic exercises on the pair foot balance scores is at a moderate level. When the main effect of the measurement factor was analyzed, the difference between the test scores of the individuals was significant ($F(1,28) = 45,828$ $p<.05$, $\eta2=0,621$). In this case, the Life Kinetic exercises were effective in increasing the pair foot balance score. When the effect of the group variable on the double leg balance score was analyzed without considering the measurement factor, it was seen that there was no significant difference ($F(1,28) = 1,519$, $p>.05$). Although there was no significant difference between the groups, it was found that the scores of the experimental group in which Life Kinetic exercises were applied were higher on average than the control group. Based on the ANOVA results related to the difference in biped balance scores, the group variable explains 5% of the change in performance, the measurement factor explains 62%, and the group-measurement interaction explains approximately 18%.

Results of the right foot balance test showed a significant difference in the pre-test and post-test measurements of the participants in the experimental and control groups ($F(1,28)=5.387$ $p<.05$, $\eta 2=0.161$). With an eta squared value of 0.161, it is seen that the effectiveness of Life Kinetic exercises on right foot balance scores is moderate. According to the ANOVA results regarding the difference in right foot balance scores, the group variable explains approximately 14% of the change in performance, the measurement factor explains 46%, and the group-measurement interaction explains approximately 16%.

In the left foot balance test results, a significant difference was observed as a result of the pre-test and post-test measurements of the participants in the experimental and control groups ($F(1,28) =16,695$ $p<.05$, $\eta 2=0,374$). With an eta squared value of 0.374, it was found that the Life Kinetic exercises were highly effective on the left foot balance scores. Based on the ANOVA results regarding the difference in left foot balance scores, the group variable explains approximately 24% of the change in performance, the measurement factor explains 57%, and the group-measurement interaction explains approximately 37%.

Table 4. Descriptive statistics of right and left foot Y Balance scores of the groups

Y Balance			**Right foot Y balance**		**Left foot Y balance**	
Test	**Group**	n	Mean	SD	Mean	SD
Pre-test	Experiment	15	230.42	10.56	230.11	14.78
	Control	15	220.26	9.86	220.93	14.23
	Total	30	225.34	11.29	225.52	15
Post-test	Experiment	15	243.41	12.32	241.88	13.38
	Control	15	221.99	9.62	223.73	13.81
	Total	30	232.70	15.38	232.80	16.24

When the right foot Y Balance test descriptive statistics of the groups are analyzed in Table 4, an increase of 5.65% is observed between the pre-test and post-test measurements of the experimental group. However, there was no remarkable increase between the pre-test and post-test values of the control group (0.8%). When the pre-test, post-test and group averages of the left foot Y Balance values are analyzed, an increase of approximately 5% is observed in the experimental group averages. In the control group, an increase of approximately 1.36% units was observed. ANOVA results regarding the difference between pre-test and post-test measurements are given below.

Table 5. Mixed design ANOVA results for the difference between the right and left foot Y Balance scores of the experimental and control groups

Y Balance	**Right Foot Y Balance**			**Left Foot Y Balance**		
Factors	F	*P*	Eta square	F	*P*	Eta square
Group (Experimental/control)	19.003	.000*	.404	7.558	.010*	.213
Measurement (pretest/posttest)	27.255	.000*	.493	31.359	.000*	.528
Group*Measurement	15.926	.000*	.363	11.889	.002*	.298

P <0.05; two-factor mixed *ANOVA Test*

When Table 5 is examined, a significant difference was observed in the right foot Y Balance scores of the participants in the experimental and control groups as a result of the measurements before and after the procedure ($F(1,28) =15,926$ $p<.05$, $\eta 2=0,363$). Life Kinetic exercises were found to be highly effective in improving right foot Y Balance scores ($\eta 2=0.363$). When the measurement factor was analyzed, the difference between the pre-test and post-test values was significant ($F(1,28) =27,255$ $p<.05$, $\eta 2=0,493$).

According to the results of the left foot Y balance test analysis, a significant difference was observed in the first and last measurements of the experimental and control groups ($F(1,28) =11,889$ $p<.05$, $\eta 2=0,298$). The eta squared value shows that the effect of Life Kinetic exercises on left foot balance scores is high. When only the measurement factor was analyzed, there was a significant difference ($F(1,28) =31,359$ $p<.05$, $\eta 2=0,528$). The difference was also significant when the effect of the group variable was analyzed without considering the measurement factor ($F(1,28) =7,558$ $p<.05$, $\eta 2=0,213$).

DISCUSSION AND CONCLUSION

The statistically significant interactions described in the previous section reveal that the improvements in dynamic balance skills in the pretest and posttest findings showed significant differences between the Life Kinetic training group and the control group. Specifically, while modest improvements were observed in the control group over the 8-week period, the experimental group receiving additional Life Kinetic exercises showed significantly greater gains in dynamic balance performance. Interaction effect sizes ranged from moderate to large, highlighting the substantial influence of the Life Kinetic intervention. Since our study was conducted in children aged 11-14 years and for two months, motor skills are affected by the growth factor. In addition, the improvement seen in the control group is thought to be due to the continuity of taekwondo training and getting used to the measurement device. In addition, there are studies in the literature showing that taekwondo sport can cause improvements in balance performance (Pons Van Dijk, Lenssen, Leffers, Kingma, & Lodder, 2013; Matthews, Matthews, Yusuf, & Doyle, 2016).

From the literature, in a study conducted on tennis players aged 11-12 years, the effect of 8-week Life Kinetic training on balance ability was measured with the Y Balance test and it was found that it contributed positively to the balance skills of the athletes (Tekdemir, 2022). In another study conducted with tennis athletes, the balance ability of athletes between the ages of 10-14 was measured with the Y Balance test and it was stated that the experimental group athletes improved their motor and cognitive skills (Büyüktaş, 2021). These findings are similar to our study and suggest that Life Kinetic training improves balance skills.

In a study conducted in football, one of the team sports, the effects of 10-week Life Kinetic brain exercises on balance parameters were examined and it was determined that Life Kinetic training positively affected balance skills (Korkmaz & Karabulak, 2023). According to a study examining the effect of Life Kinetic training program on balance skills of basketball players between the ages of 15-18, it was concluded that LK training had a positive effect on the development of motoric skills and dynamic balance (Yılmaz, 2022). In a study aiming to examine the acute and chronic effects of Life Kinetic exercises on motor coordination, the Child Body Coordination Test showed a statistically significant improvement according to the pretest, posttest and retention test results of the experimental group (Çimen, 2021). Another study shows that Life Kinetic training is effective on balance ability as a result of an 8-week study on 24 students with no sports history in the same age group as our study (Peker & Taşkın, 2014). The findings that 6 weeks of football training combined with Life Kinetic exercises and football training alone significantly improved the balance ability of preadolescent boys measured with the Y Balance test in both groups. These results revealed that adding cognitive motor coordination exercise to regular soccer training may be important, but there was no significant difference between both groups (Cakir, Turkkan, & Ozer, 2020).

As a result of a study conducted on middle school students aged 10-14 years with mild intellectual disabilities, it was observed that Life Kinetic exercises applied regularly for 10 weeks contributed positively to balance development (Özşengezer & Top, 2022). These studies support the findings of our study. In the literature, contrary to our study, a study was found in which Life Kinetic training did not have a positive effect on balance ability. In a study examining the effect of Life Kinetic training on some coordinative abilities in elite badminton players, dynamic balance skills were measured with the flamingo balance test and as a result, it was determined that Life Kinetic training combined with badminton training did not significantly contribute to the development of coordinative abilities (Kurt & Çolak, 2022). It is thought that the fact that the study group consisted of elite athletes and the measurement method was different from the measurement method used in our study may have caused the results not to be similar.

According to the findings obtained, it can be said that Life Kinetic exercises can be effective in balance development. However, it should be kept in mind that in experimental studies, confounding variables such as the background of the athletes and the effect of the measurement may also affect the results of the procedure.

Conflicts of Interest: The authors declare no conflicts of interest.

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