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Effect of Life Kinetic exercises on fundamental motor skills with the MOBAK-3 test battery

Efecto de los Life Kinetic Ejercicios Sobre las Habilidades Motrices Fundamentales con la Batería de Pruebas MOBAK-3

Berk Tuna, Mustafa Apak, Çiğdem Karagülmez Sağlam, Ezgi Sevilmiş
Girne American University (Cyprus)

Abstract. The aim of this study was to evaluate the effect of regular Life Kinetic (LK) exercises on the development of basic motor skills in 3rd grade primary school children (age group 8-9 years). . Randomly selected participants were divided into two groups as experimental group (n= 112) and control group (n= 106). In the pre-test day, object movements (throwing, throwing and catching, bouncing, dribbling) and self-movements (balancing, rolling, rope skipping, moving variably) of all participants were measured with MOBAK-3 test battery. Experimental group performed LK exercises for 12 weeks, while the control group did not participate in these exercises. At the end of 12-weeks programme, on the post-test day, the MOBAK-3 test battery was re-applied to all participants to measure changes in fundamental movements skills and the results were compared with the results of the pre-test day. Significant differences were found between the bouncing scores of the control and experimental group before and after the LK exercises ($p<0.05$). Additionally statistically significant differences were found between the self-movement scores of the control and experimental groups after the LK exercises ($p<0.05$). However, there were not statistically significant difference in object and self movement between the control and experimental group according to gender ($p>0.05$). It was concluded that LK exercises had a positive effect on the total change scores of subject and object movements. This shows that LK exercises may improve children's motor competence and skill tendencies.
Keywords: Fundamental motor skills; Life kinetic; MOBAK-3 test battery; Object movements; Self movements.

Resumen. El objetivo de este estudio fue evaluar el efecto de los ejercicios regulares de Life Kinetic (LK) en el desarrollo de las habilidades motoras fundamentales en alumnos de 3º de primaria (grupos de 8-9 años). Participaron en el estudio un total de 218 alumnos que cursaban 3º de primaria (nacidos en 2014) en Chipre. Los participantes seleccionados al azar se dividieron en dos grupos: grupo experimental (n= 112) y grupo de control (n= 106). El día previo a la prueba, se midieron los movimientos de los objetos (lanzar, lanzar y atrapar, botar, driblar) y los movimientos propios (balancearse, rodar, saltar la cuerda, moverse de forma variable) de todos los participantes con la batería de pruebas MOBAK-3. El grupo experimental realizó ejercicios de LK durante 12 semanas, mientras que el grupo de control no participó en estos ejercicios. Al final de este programa de 12 semanas, el día posterior a la prueba, se volvió a aplicar la batería de pruebas MOBAK-3 a todos los participantes para medir los cambios en las habilidades de movimientos fundamentales y se compararon los resultados con los del día anterior a la prueba. Se encontraron diferencias significativas entre las puntuaciones de rebote del grupo de control y del grupo experimental antes y después de los ejercicios LK ($p<0,05$). Además, se encontraron diferencias estadísticamente significativas entre las puntuaciones de auto-movimiento de los grupos control y experimental después de los ejercicios LK ($p<0,05$). Sin embargo, no hubo diferencias estadísticamente significativas en el movimiento del objeto y del yo entre el grupo de control y el experimental en función del sexo ($p>0,05$). Conclusiones: Se concluyó que los ejercicios LK tuvieron un efecto positivo en las puntuaciones totales de cambio de los movimientos del sujeto y del objeto. Esto demuestra que los ejercicios LK influyen en la competencia motora de los niños y en sus tendencias de habilidad.
Palabras clave: Habilidades motoras fundamentales; Life Kinetic; Batería de pruebas MOBAK-3; Movimientos de objetos; Movimientos propios.

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Berk Tuna
cyberk1976@gmail.com

Introduction

Fundamental Movement Skills (FMS) describe a group of motor behaviour including loco-motor movements (locomotor), object control skills (manipulative) and balance skills (stability) (Gallahue et al., 2012). While high FMS levels are crucial for an active lifestyle and contribute to children's physical, cognitive and social development; (Payne and Isaacs, 1995) low FMS levels are suggested to negatively affect health status and physical activity (Barnett et al., 2008; Jaakkola et al., 2015). Early identification of possible motor skill problems is known to be beneficial. The important methods used to assess and measure FMS in children and different age of adolescent are the MOBAK test batteries. This comprehensive evaluation tool meticulously measures an individual's proficiency in a spectrum of fundamental movements, providing valuable insights into their motor skill development (Hermann et al., 2015). Understanding and effectively using the MOBAK test batteries are crucial in the adaptation of exercise or training programs aimed at optimizing the acquisition of fundamental movement skills.

Life Kinetic (LK) exercises is a type of training that aims to improve cognitive-motor coordination. It encompasses three key forms of exercise: motion exercise training, cognitive challenge training, and visual perception training. Basic features of this training involve moving limbs in different unusual combinations, catching and throwing objects, thus training visual perception and limb-eye coordination. Therefore, LK training helps individuals develop coordination abilities and enhances the ability to move and react effectively (Demirakca et al., 2016). The essence of this method lies in combining different motor activities (often disrupting fundamental movement techniques) that activate associative cortical areas and increase the efficiency of an individual's thought processes. This method not only shapes movement technique but also activates cortical representations of movements (Lutz, 2010). By training the

muscles with this method and activating the associative cortical fields, more control over the muscles can be achieved in the execution of the movement. Therefore, voluntary movements can be performed more efficiently (Duda, 2015).

Motor skill development in childhood can be an important prerequisite for children's participation in physical activity and take place in physical activity for later periods of their lives (Loprinzi et al., 2012). In addition, motor skill competence in children is associated with improved cognitive, neurological, social and emotional outcomes (Piek et al., 2006; Piek et al., 2008; Skinner and Piek, 2001; Pagani et al., 2010; Grissmer et al., 2010). The content of school-based physical education lessons is extremely important to ensure that children have fundamental movement skills, which can provide increased immediate and long-term physical activity (Uil et al., 2023). Therefore, there are studies indicating that there should be a stronger focus on motor competence in primary school (Cicović et al., 2015; Gallahue et al., 2012). LK can be a different approach to develop fundamental motor skills and encourage physical activity.

According to the literature, the number of studies on LK exercises is limited. There are studies investigating LK exercises on concentration (Komarudin et al., 2021), brain plasticity (Demirakca et al., 2016) and mental rotation performance (Pietsch et al., 2017), however less research has explored the effect on the FMS. Studies examining the effect of LK exercises on FMS have been conducted with athletes, and the effect on motor competence of primary school students needs to be clarified. One study reported that LK exercises increased the motor effectiveness of 14-15 years old football players (Duda, 2015). To the best of our knowledge, there is no study that investigated the effect of LK exercises on the FSM in the 8-9 age group. From that perspective, this study aimed to investigate the effect of LK exercises on object movement, self-movement in the MOBAK-3 test battery. It was hypothesized that LK exercises would have an effect on object movement, self-movement and overall total results in the MOBAK-3 test battery in 8-9 years old children. It was also expected that LK exercises would have an effect on these parameters in children aged 8-9 years according to gender.

Materials and methods

Subjects

218 students joined the study who are studying in the 3rd grade of primary school (born in 2014) in Cyprus. All participants were selected randomly and divided into two groups who are the experimental group (n = 112) and control group (n = 106). Healthy participants without any acute or chronic neuromuscular disease and without taking any medication participated in the study. The research was approved by the Committee for Scientific Research and Ethics of the Faculty of Sport Sciences at Girne American University and all data was collected in accordance with the Declaration of Helsinki. Since the participants were under 18 years of age, permission was obtained from their families. In addition, approval was obtained from the Ministry of Education to conduct the study.

Design of the study

On the day of the pre-test, all participants in the experimental and control groups applied the MOBAK-3 test battery to determine their motor competence. Object movements (throwing, throwing and catching, bouncing, dribbling) and self-movements (balancing, rolling, rope skipping, moving variably) values which are the components of the MOBAK-3 test battery were recorded. Experimental group performed LK exercises. The difficulty levels of the LK exercises were determined through an adaptation process to the Mobak test battery, which comprises eight basic movements. These exercises were performed with regularity for 12 weeks, two days per week for 40 minutes, during physical education class hours. Each exercise was executed with an incremental increase in difficulty (from simple to complex) with the objective of the Mobak-3 test battery. Prior to commencing the exercise practices, each movement was verbally explained, demonstrated in practice, and potential errors were identified and explained. Prior to commencing the exercises, the students attempted the movements and, following the identification of errors, the study section commenced. At the conclusion of 20 minutes of practice, each command (as numbers, colors, numbers and colors) was requested to be performed for one minute each for a total of three minutes without verbal intervention regarding the errors. However, the control group did not participate in this training. The MOBAK-3 test battery was re-administered to all participants on the post-test day, 12 weeks after the pre-test day. The results of the post-test in FMS were compared with the results of the pre-test day.

Mobak-3 test battery

Various MOBAK test batteries are used to assess motor competence (Herrmann et al., 2015). The MOBAK-3 test protocol evaluates two areas of motor competence and eight components (a-object movements: throwing, throwing and catching, bouncing, dribbling; b-self-movements: balancing, rolling, rope skipping, moving variably) of these areas (Herrmann, 2018). Motor competence components and scoring were based on the model developed by Herrmann and Seeling (2016) and are shown in Table 1.

Table 1.
Motor competence components and scoring

Components (Object Movement)	Qualification	Components Tasks	Scoreboard (passed attempts)
Throwing	The aim is hitting the target in 6 attempts	Overhead throwing juggling balls from a 3m distance at a target. Number of hits is recorded.	0-2 hits = 0 point 3-4 hits = 1 point 5-6 hits = 2 points

Throwing & Catching	The aim is catching the ball while moving in 6 attempts	Small gymnastic ball should be thrown and caught between two lines at a distance of 1.5m. Number of catches is recorded.	0-2 catch = 0 point 3-4 catch = 1 point 5-6 catch = 2 points
Bouncing	The aim is bouncing a ball (basketball) without loosing control in 2 attempts	Bouncing the ball fluently with two or one hand in a 7.5m long, 1.4m wide area with 70cm wide obstacles every 1.5m without going out of the lines or holding the ball	0 passed = 0 point 1 passed = 1 point 2 passed = 2 points
Dribbling	The aim is dribbling a ball (football) without loosing control in 2 attempts	Dribbling the ball fluently with two or one hand in a 7.5m long, 1.4m wide area with 70cm wide obstacles every 1.5m without going out of the lines or holding the ball	0 passed = 0 point 1 passed = 1 point 2 passed = 2 points
Components (Self-Movement)	Qualification	Components Tasks	Scoreboard (passed attempts)
Balancing	The aim is being in a balance back and forth across a long upside down bench by walking in 2 attempts	Fluid crossing with normal walking (no half steps allowed). The aim is being in a balance back and forth across a long upside down bench by walking in 2 attempts	0 passed = 0 point 1 passed = 1 point 2 passed = 2 points
Rolling	The aim is rolling forward starting with a jump in 2 attempts	Two piece high vaulting boxes gym mat lay on top and one behind stand alongside each other.	0 passed = 0 point 1 passed = 1 point 2 passed = 2 points
Rope Skipping	The aim is rope skipping in 20 seconds in 2 attempts	Rope skipping must be accurate and continuous	0 passed = 0 point 1 passed = 1 point 2 passed = 2 points
Moving Variably	The aim is following the markers with moving forwards and sideways around the cones in 2 attempts	A rectangle 2m wide and 4m long was formed with tape and the short sides were taped diagonally. Forward step in short lines, side step in diagonal lines, movement should be completed with a fluid change	0 passed = 0 point 1 passed = 1 point 2 passed = 2 points

Data analysis

Data organization and descriptive statistics were performed using SPSS 26. Demographic characteristics were analyzed for percentage, frequency, and mean values. Differences between groups based on variables were examined using t-tests, and ANCOVA was used to determine differences between the control and experimental groups in the motor skills areas of object movements (throwing, throwing and catching, bouncing, dribbling) and self-movements (balancing, rolling, rope skipping, moving variably) In this model, MOBAK test items were treated as an ordinal scale.

Results

The 12-week application results revealed a significant difference between the experimental and control groups. ANCOVA results indicated a significant difference in bouncing a ball related to object movement, self-movement, and moving variably.

Table 2.
Comparison of the change in object movement MOBAK-3 scores of control and experimental group

	Group	n	Pre-test		Post-test		F	p	η^2
			$\bar{X}$	s	$\bar{X}$	s			
Throwing	Control	106	0,48	0,64	0,46	0,65	0,985	0,322	0,005
	Experimental	112	0,19	0,48	0,29	0,48			
Throwing & Catching	Control	106	0,72	0,77	0,78	0,76	0,328	0,568	0,002
	Experimental	112	0,52	0,70	0,77	0,79			
Bouncing	Control	106	1,07	0,86	1,33	0,78	16,094	0,001**	0,070
	Experimental	112	0,88	0,86	1,66	0,61			
Dribbling	Control	106	0,54	0,72	0,92	0,82	0,140	0,708	0,001
	Experimental	112	0,55	0,79	0,88	0,78			
Object Movement Total	Control	106	1,60	1,29	3,49	1,85	0,914	0,340	0,004
	Experimental	112	2,14	1,73	3,61	1,71			

Note: *p<0,05 **p<0,01 (2x2 ANCOVA)

Statistically significant differences were found between the bouncing scores of the control and experimental group students before and after the training ($p<0.05$), (Table 2). The bouncing scores of the experimental group students increased more than those of the control group students after the training. No statistically significant differences were observed between the changes in the total scores of throwing, throwing/catching, dribbling, and object movement of the control and experimental group students before and after the training ($p>0.05$).

Table 3.
Comparison of the change in self movement MOBAK-3 scores of control and experimental group

	Group	n	Pre-test		Post-test		F	p	η^2
			$\bar{X}$	s	$\bar{X}$	s			
Balancing	Control	106	0,71	0,74	0,69	0,80	1,994	0,159	0,009
	Experimental	112	0,33	0,64	0,70	0,79			
Rolling	Control	106	0,89	0,89	0,92	0,87	0,789	0,375	0,004
	Experimental	112	0,50	0,79	0,75	0,93			
Rope Skipping	Control	106	0,15	0,51	0,23	0,59	0,057	0,812	0,000
	Experimental	112	0,05	0,26	0,15	0,47			
Moving Variably	Control	106	0,96	0,87	1,05	0,88	7,801	0,006**	0,035
	Experimental	112	0,91	0,83	1,35	0,86			
Self-Movement Total	Control	106	2,71	1,84	2,88	1,86	9,087	0,003**	0,041

	Experimental	112	1,79	1,60	2,95	1,93			

Note: *p<0,05 **p<0,01 (2x2 ANCOVA)

Statistically significant differences were observed between the self-movement scores of the control and experimental groups after the training (p<0.05) (Table 3). The post-training scores of the students in the experimental group were higher than those of the students in the control group. Additionally, the experimental group showed a greater increase in running and self-movement total scores. There was no statistically significant difference between the changes in the balance, rolling, and rope skipping of the control and experimental group students before and after the training (p>0.05).

Table 4.
Comparison of the changing in MOBAK-3 scores of control and experimental groups before and after the LK exercises

	Group	n	Pre-test		Post-test		F	p	η²
			$\bar{X}$	s	$\bar{X}$	s			
Sub Total	Control	106	4,31	2,45	6,37	3,04	141,964	0,000**	0,398
	Experimental	112	3,94	2,84	6,55	2,92			

Note: *p<0,05 **p<0,01 (2x2 ANCOVA)

This study observed statistically significant differences between the self-movement and object movement scores of the control and experimental groups after the LK exercises (p<0.05) (Table 4).

Table 5.
Comparison of the changes in MOBAK-3 scores of control and experimental group students by gender before and after the LK exercises

	Group	Gender	Pre-test		Post-test			F	p	η²
			$\bar{X}$	s	$\bar{X}$	s				
Sub Total	Control	Female	4,21	2,47	6,79	2,67				
		Male	4,40	2,46	6,02	3,30	Group:	1,677	0,197	0,008
	Experimental	Female	3,25	2,64	5,98	2,78	Gender:	1,346	0,247	0,006
		Male	4,63	2,89	7,13	2,98	Group* Gender	2,932	0,088	0,014

Note: *p<0,05 **p<0,01 (2x2 ANCOVA)

In the analysis, it was found that the differences between the pre-training and post-training changes in the total scores of object and self movement of the control and experimental group according to gender were not statistically significant (p>0.05) (Table 5).

Discussion

The study aimed to assess the effectiveness of the MOBAK-3 battery and LK exercises in improving the quality of physical education and training processes for basic motor skill development in 8-9 years old students.

In contrast to Komarudin et al. (2019) findings that reported no significant difference in the effect of LK exercises on performance, this study found differences between the experimental and control groups. The bouncing scores of the students in the experimental group increased more than those of the control group after the LK exercises. Similarly, the moving variably and self-movement total scores of the experimental group students increased more than control group students.

In studies that support the findings of our research, Arslan and Ermiş (2023) conducted a study on the effects of LK exercises on technical skills and motor skills performance in young football players. The study found that LK exercises had a positive impact on technical skills and some motor skill performances of footballers, specifically on dribbling, pass accuracy, and shooting performance.

Komarudin and Awwaludin (2019) supported our study in their research on LK exercises in "improving the physical conditioning of football players" and found that there are differences in the effect of LK exercises and traditional training on improving the physical conditioning of football players.

Peker and Taşkın (2016) investigated the effect of LK exercises on coordinative abilities. The study found that LK exercises had a positive effect on balance, rhythm, and orientation. A study was conducted to examine the effects of LK exercises on rhythm, balance, reaction, adaptation, and cognitive abilities. The post-test results of the experimental group were significantly higher than the pre-test results (Lutz, 2014).

The study found that the results of training that required hand-eye coordination were very similar to Penka et al. (2009) findings. Another study by Stodden et al. (2008) discovered that children with low motor competence were less physically active than those with high motor competence.

Another finding of the study is that there is no significant difference depending on gender. Our study was supported by the fact that there was no statistically significant difference in the studies. One of these is the study of Stupak (2023), which confirmed that there is no significant dependence between gender and basic motor competence levels in 4-5 year-old children.

Pill and Harvey (2019) conducted a narrative review of research on children's movement competence and found no significant differences between genders or overall scores from 1997 to 2017. In their study, Duncan et. al. (2018), investigated the impact of 10 weeks of integrated neuromuscular training on the physical self-efficacy and basic movement skills of children aged 6-7 years. The study found that gender did not have a significant effect as a between-subject variable.

Similarly, Mukherjee et al. (2017) investigated the proficiency of Singaporean children aged 6 to 9 years in basic motor skills and found no significant gender differences in either subtest or overall performance. Scheuer et al. (2017) similarly reported the absence of gender-related differences in their investigation of the identification of basic motor competencies in primary school children. In a related study on the gender variable, Gramespacher et al. (2020) asserted that the capacity to assess basic motor competencies is not influenced by gender, but rather by the gender-based socialisatizon of sport.

While there is a paucity of studies utilising the MOBAK-3 battery for the 8-9 age group, the findings derived from studies employing MOBAK 1 and 2, MOBAK 5 and 6 batteries (Carcamo-Oyarzun et al., 2024; Andli Marta et al., 2024) corroborate our conclusions. Furthermore, our study aligns with existing research indicating that life kinetic exercises have a positive impact on motor skill development.

Conclusions

LK exercises include movements such as catching and throwing objects, visual perception exercises, and coordination of limbs. Due to the fact that motor competencies can be important for children's physical development, movements that require skill are accompanied by a certain rhythm and harmony (Sağlam & Doğan, 2023). These exercises are the basic features of LK.

This study observed statistically significant differences between the self-movement and object movement scores of the control and experimental groups after the training. This shows that motor competence and capacity affect children's performance and skill tendencies. Therefor it is recommended that physical education teachers and coaches include LC exercises in their lesson and training programs.

There was no statistically significant difference between the pre-training and post-training changes in the total scores of self-movement and object movements of the control and experimental group students included in the study, regardless of gender. The result that there were no gender differences in motor skill development suggests that teachers in physical education should avoid promoting gender-specific roles such as boys playing with the ball and girls doing gymnastics.

It is widely acknowledged that certain physical abilities in sport are genetically determined and can be developed through long-term training (Horička et al., 2018). However, there is a common belief that older children perform better than younger children. As Rodríguez-Briceño et al. (2022) found that fourth-graders performed better than third-graders in motor tasks, it would be beneficial to devote more attention to the development of motor competence. Therefore, future research could also investigate the relationship between height, weight, age and performance levels in movement tasks.

Declaration of conflicting interests

On behalf of all authors, the corresponding author states that there is no conflict of interest.

Data availability statement

The datasets generated for this study are available on request to the corresponding author**.**

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We thank all the students participating in the study.

Ethics approval

This project was approved by the Committee for Scientific Research and Ethics of the Faculty of Sport Sciences at the Girne American University, Cyprus with the 2023-2024/3 reference number. All data was collected in accordance with the Declaration of Helsinki. Parents of participants were informed about the details of the study and all provided written informed consent.

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Datos de los/as autores/as y traductor/a:

Berk Tuna	cyberk1976@gmail.com	Autor/a – Traductor/a
Assist.Prof.Dr. Mustafa Apak	mustafaapak@gau.edu.tr	Autor/a
Assist.Prof.Dr. Çiğdem Karagülmez Sağlam	cigdemkgsaglam@icloud.com	Autor/a
Assist.Prof.Dr. Ezgi Sevilmiş	ezgi.sewilmis@gmail.com	Autor/a