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ORIGINAL ARTICLE

The Effect of Fundamental Movement Skills Education with Rhythm on Auditory Reaction and Coordination Parameters

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ABSTRACT

Background. Rhythm has an important role in ensuring order in the flow of movement and the development of physical skills. Perceiving rhythm well and performing movements in rhythm makes a great contribution to motor development. **Objectives.** This study aimed to assess the effect of fundamental movement skills education with rhythm on auditory reaction and coordination. **Methods.** A total of 22 students who enrolled in the faculty of sports sciences participated in the study. Students participated in the fundamental movement skills education course twice a week for eight weeks. The study categorized the participants into experimental (n=11) and control (n=11) groups. Both groups exercised 60 minutes of these movements two days a week, and the experimental group performed these exercises accompanied by rhythm. The study measured students' auditory reactions and coordination before and after executing the fundamental movements. Auditory reaction time was measured by the Light Trainer®- Reaction Light Exercise System, and coordination was measured by the Togu Challenge Disc 2.0 device to measure coordination scores. It utilized the SPSS 23.0 package program to analyze the collected data. It also performed the Wilcoxon T-test to identify the difference between the pre-test and post-test within groups and the Mann-Whitney U-test to determine the difference between the two groups. The study sets the statistical significance level as $p<0.05$. **Results.** In the intra-group comparison, there was a statistically significant difference in the reaction parameters ($p=0.01$) of the experimental and control groups. However, it was only the coordination parameter ($p=0.01$) in the inter-group comparison ($p<0.05$). **Conclusion.** The study observably concluded that fundamental movement skills education significantly affected the auditory reaction parameter in both groups; however, the rhythm was ineffective. Moreover, in contrast to the auditory reaction, the rhythm positively affected the coordination parameter.

KEYWORDS: ***Rhythm, Fundamental Movement Skills, Coordination, Auditory Reaction.***

INTRODUCTION

Fundamental movement skills (FMS) constitute the basis of complex and specific motor skills used in sports, dance, and physical fitness activities. FMS education is essential in recognizing the body, learning to move, and gaining movement richness. It is typically recognized that individuals who receive coordinative movement education, including displacement, balancing, and object control, display a versatile development and are one step ahead of their peers in motor performance (1, 2) Weikard (1989) reported that it was possible to acquire rhythmic ability by engaging in movement education that calls for the correct response to rhythmic stimuli (3), and Cote-Laurence (2000) documented that understanding and applying rhythmic elements and a controlled synchronization would facilitate ballet training (4). In addition to ensuring regularity in the flow of movement, rhythm has a critical role in the

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basis of the strategies to develop physical skills. The predictability provided by rhythm allows the organism to prepare and coordinate for the future (5, 6). As reportedly stated, perceiving rhythm well and performing movements in rhythm substantially contributes to the psychomotor behavior of individuals (7). Among the most significant reasons for this context may be listed as the favorable impact of the ability to concentrate and act disciplined — the basis of rhythm training — on individuals and its reflection on their success in athletic skills (8). It is feasible to apply various strategies to achieve such development. Each implemented movement retains a regular rhythm. Music may be an option to improve the perception to provide this rhythm and acquire more effective results. Numerous studies have reportedly proven that rhythm exercises favorably influence human behavior in a variety of aspects, including attention, performance, and efficiency (9-13). Reybrouck and colleagues (2018) — one of these research — emphasized that listening to music stimulates different brain lobes by increasing the connections between neurons (14). According to Kravitz (1994), for instance, the impacts of physical strength-based walking performed with various musical genres on endurance performance and motor skills involve a psychological interaction (15). Ferguson, Carbonneau, and Chambliss (1994) recorded scores in a competition environment by playing music that negatively and positively affected the participants in karate sports. Accordingly, they discovered that positively affecting music genre increased participants' athletic performance, whereas negatively affecting music style decreased their performance (16). Another study also indicated that listening to music improved physical activity in general and sportive performance in particular, in addition to advancing physical efficiency due to the synchronization of music and exercise if the rhythm of music is compatible with the movement that the person should implement (11). The review of the relevant literature revealed that studies focusing on different tempos and music genres significantly affected the psychological attributes of individuals (7, 17, 18) in addition to positively influencing some performance parameters (anaerobic capacity, running distance, recovery, heart rate) (17, 19, 20). The literature review recollected whether there is a probable interaction between rhythmic abilities and whether the sense of rhythm or the FMS performed with the rhythm underlying music affect some parameters, such as coordination and auditory reaction, by motivational factors. Therefore, this study aimed to assess the effect of FMS education with rhythm on auditory reaction and coordination parameters among the students studying in the faculty of sports sciences.

MATERIALS AND METHODS

Study Group. The study group consisted of 22 students taking FMS education courses at the faculty of sports sciences. Researchers divided students into two groups: experimental (n=11) and control (n=11). The subject students signed a consent form and declared their voluntary participation in the study. Before beginning, the researchers provided relevant information about the tests and the program to be applied. The study was conducted by the Declaration of Helsinki and approved by the Ethics Committee (Code: E-77082166-604.01.02-487241).

Exercises for FMS Education. Both groups engaged in 60-minute FMS exercises two days a week, with the experimental group accompanying their exercises by rhythm. Although each exercise program retained different content, the study distributed the movement skills that require displacement, balancing, and object control equally, taking the acquisition of each movement skill as a basis (Table 1. Sample FMS exercises) (21). The rhythms that the experimental group implemented for their movement skills ranged between 30-70 BPM (Beats Per Minute), making utmost effort to ensure that each movement was fitting for its internal dynamics and focusing on the application of movement skills — each of which is different from one another — with the proper technique and continuity (22). TAMA Rhythm Watch (Hoshino; USA, INC), a device that provides tempo in various BPM ranges, was used to set the rhythms of the skills (Figure 1. TAMA Rhythm Watch). While diversifying the exercises, participants used numerous auxiliary equipment, such as balls of different sizes and colors, ribbons, and hoops.

Data Collection Techniques. The researchers measured students' height, body weight, and body mass index. Considering the auditory reaction and coordination, students received a pre-test at the beginning of the program and a post-test at the end of eight weeks of exercise. Exercises and

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measurements took place at the faculty gymnastics hall.

Age, Height, Body Weight, Body Mass Index (BMI) Measurements. During the interview, researchers recorded students' ages as day, month, and year according to the date of birth in official records. They also used a Holtaine brand stadiometer, with an accuracy of ±1 mm. Additionally, they measured body weights and BMI values with Tanita TBF-300 M.



Figure 1. TAMA Rhythm Watch.

Table 1. Sample FMS exercises

	Movements	BPM
1.	Throw up a small ball, rotate 180 degrees, hold the right hand/left hand, and hit the target on the wall.	45
2.	In three-person groups, the middle player turns their face and catches the blue balls without paying attention to the green ball left.	35
3.	A hand rotates the hoop while another hand throws and catches the ball.	50
4.	Make a slalom out of running a ball between the Skittles.	65
5.	Make a slalom out of running two balls between the Skittles.	40
6.	Strike the target on the wall with the right foot/left foot, respectively.	55
7.	Performing animal walks.	65
8.	Line up a ring-shaped group and pass the ball to the next player on the right by continuously counting as "1, 2, 3" and expecting the player to complete a tour around the ring before the ball reaches the head of the line.	65
9.	Ask groups to rush to the material pool in the center and transport stuff they select to their assigned locations "in a way that suits their tasks."	55
10.	Ask the leading player to guide nine blindfolded players in a specific area, expecting to avoid their collision.	70

Auditory-Motor Reaction Test. The study measured auditory-motor reaction time using the Light Trainer®-Reaction Light Exercise System (İstanbul, Turkey) (Figure 2). Auditory-motor reaction time consists of a simple response lasting 20 seconds to auditory stimuli appearing on six wireless light discs. The discs were arranged on the table in a half-moon shape, placing the participant's hand in the center of the half-moon. The mid-point of each disk was 40 cm away from the center of the half-moon, and the mid-points of each disk were 25 cm away from each other. The participants initially placed their hand at the starting point, in other words, the center, and the test started. When the participants heard a sound for 20 seconds, they stretched their hands to turn off the light and brought their hands back to the center point in the same way. The test ended automatically at the end of 20 seconds and the device provided information on the participants' average reaction speed throughout a 20-second (23).



Figure 2. Light Trainer®- Reaction Light Exercise System.

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Coordination Test. The study utilized the Togu Challenge Disc 2.0, Germany (Figure 3/. Togu Challenge Disc 2.0) device to measure coordination scores. Togu Challenge Disc 2.0 device is a portable coordination measurement and training system. It operates via Bluetooth with Android and IOS-compatible applications. Participants initiate the test once they log onto the device and choose the coordination test from the coordination training and test menu application. They watch the display for one minute and try to catch the butterflies that appear on the screen with coordinative movements on the balance board. At the end of the test, the application gives a test score to the participants. After repeating twice, the test registers the best score as a degree (24).

Statistical Analysis. The study operated the SPSS 23.0 package program for data analysis. It additionally utilized the Willcoxon T-test to identify the difference between the pre-test and post-test within the group and the Mann-Whitney U-test to specify the difference between the two groups. The study also sets the statistically significant level as $p<0.05$.



Figure 3. Togu Challenge Disc 2.0.

RESULTS

Table 2 lists the descriptive statistics. Accordingly, the measurements of the experimental group were as follows: the average age, height, body weight, and BMI scores of the participants were 20.09±0.04 years, 176.54±10.12 cm, 71.46±11.20 kg, and 21.08±2.98 kg/m2, respectively. The measurements of the same parameters for the control group were also as follows: the average age, height, body, and BMI scores were 20.12±0.02 years, 175.11±12.59 cm, 71.98±11.12 kg, and 21.67±2.73 kg/m2, respectively. Table 3 displays the auditory reaction and coordination parameters before and after the movement education. Accordingly, considering the intra-group analyses, the study identified a statistically significant difference between the experimental and control groups in the time (reaction) scores ($p=0.01$). Considering the inter-group analyses, on the other hand, the study found a statistically significant difference between groups in the coordination parameter ($p=0.01$). The detailed evaluation of the results revealed that the FMS education affected auditory reaction time in both groups. However, rhythm did not make any contribution to this development. Besides, movement education exercises with rhythm had a positive effect only on the coordination parameter.

Table 2. Descriptive Statistics

Parameters	Groups	Mean ±SD
Age (years)	Experimental Group (n=11)	20.09±0.04
	Control Group (n=11)	20.12±0.02
Height (cm)	Experimental Group (n=11)	176.54±10.12
	Control Group (n=11)	175.11±12.59
Body Weight (kg)	Experimental Group (n=11)	71.46±11.20
	Control Group (n=11)	71.98±11.12
BMI (kg/m^2)	Experimental Group (n=11)	21.08±2.98
	Control Group (n=11)	21.67±2.73

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Table 3. Parameters Before and After Movement Education

Parameters	Groups	Pre-Test	Post-Test	Intra-Group	Inter-Group
		Mean ±SD		p	p
Auditory Reaction (ms)	Experimental Group (n=11)	0.67±0.03	0.66±0.05	0.95	0.51
	Control Group (n=11)	0.64±0.03	0.68±0.03	0.41	
Time (Reaction) (ms)	Experimental Group (n=11)	0.45±0.01	0.34±0.01	0.01*	0.13
	Control Group (n=11)	0.48±0.01	0.33±0.02	0.01*	
Coordination	Experimental Group (n=11)	45.2±2.5	50.1±2.32	0.32	0.01*
	Control Group (n=11)	45.2±2.6	47±2.05	0.37	

*: p<0.05

DISCUSSION

The study findings indicated that the FMS education, applied for an 8-week duration affected the reaction time performance in both the experimental and control groups. The FMS education with rhythm also improved the experimental group's coordination parameter.

The FMS education contains movement groups structured within the framework of a specific plan. Given that the relationship between rhythm, music, and fundamental body movements makes this training effective for improving cognitive and motor development, the intra-group comparisons revealed a statistical significance in the reaction parameters of the experimental and control groups (p=0.01). The FMS education was also influential on auditory reaction parameters in both groups. Several studies focusing on athletes (23), primary-school-age children (25, 26) preschool children (27, 28), and children with autism (29) also supported these findings with their comparable results, indicating that the FMS education positively affected reaction time. Undoubtedly, regularly practiced movement will positively impact the reaction time of individuals. Studies in the literature reported myriad movement combinations in FMS education contributing to the development of the reaction. This data also explains why the experimental and control groups displayed simultaneous development. Besides, the rhythm applied in the experimental group yielded no difference compared to the control group. This result may originate from the 8-week exercise; hence, this duration was insufficient for movement development to progress to a certain level. In other words, the narrow exercise duration was the primary reason for the body to develop and adapt to rhythm as it should. The term 'coordination' refers to a neurophysiological activity that regulates the synchronization, intensity of contraction, and relaxation degree of various muscles to perform complex movements in pursuit of set goals. Rhythm indicates the organization of temporal, periodic, and non-periodic successive events within their duration and perceived as a whole. Hence, coordination must be characterized by a proper movement rhythm (30-32). The development of numerous aspects, including a sense of direction, laterality, directionality, space, and time organization, is influenced by rhythm studies conducted in conjunction with FMS education (31). Studies in the literature also emphasized that participants who applied FMS education with rhythm improved their coordination performance. For instance, Karpenko (2003) reported that engaging in exercises accompanied by music is highly effective in education skills, and music and rhythm improve individuals' movement coordination (33). However, as described in some other studies, being sensitive to rhythm, feeling the rhythm, and being able to translate this to the movements is separate things. As a result, movement exercises accompanied by the rhythm enable the transmission of rhythm to the movement. It is also a typical belief — as duly cited by some studies — that exercise accompanied by rhythm potentially improves sports performance by positively motivating athletes. Rhythmic stimuli affect motivation; in turn, they also influence sports performance (34). Various studies revealed that the relationship between rhythmic character and physical skills may possess an aspect of music to help individuals perceive their surroundings and improve their motor skills (5, 17, 18). Considering the issue from a different angle, it becomes explicit that "self-attention," "focusing on the inner world," and "being uninterested in the outer world" are necessary to ensure the development of a self-awareness state in an individual. Using music to achieve this context is the most preferred strategy. Studies also indicated

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that music, as an external factor, positively influences the entire mechanism in the exercises performed with or without music. The current study asserted that movement education accompanied by various BMPs, which are also decisive in the rhythm of the music, resulted in a remarkable increase in coordination performance. Studies in the literature reported that the application practices of music significantly varied (5, 7). What makes this study more original than other studies is that the rhythm in the music accompanied the movement, not the music itself. Hence, it supported the constancy and fluency of the natural movement rhythms while exercising movement education. Therefore, it improved the coordination parameter more effectively. As for the reaction parameter, on the other hand, it is reasonable to state that the simultaneous improvement observed in each group originated from the typical effect and result of movement education rather than rhythm. As a result, it appears that rhythmic stimulus — instead of music — at BPM suitable for movement may be more effective in movement education. Including rhythm in workouts could be ideal for all sports branches, especially during basic education. Consequently, it may promote athletes' skill and coordination development in the long term.

CONCLUSION

The study findings concluded that the FMS education affected auditory reaction time in both groups. However, rhythm failed to generate any development. The study explicitly observed that movement education exercises with rhythm have a positive effect only on the coordination parameter.

APPLICABLE REMARKS

- This study, unlike the others, focused on Fundamental Movement Skills Education with Rhythm. The study explicitly observed that movement education exercises with rhythm have a positive effect on the coordination parameter. It may be recommended that movement training studies supported by rhythm training be implemented in younger age groups. It is thought that development can be achieved in many different parameters by Fundamental Movement Skills Training with Rhythm.

AUTHORS' CONTRIBUTIONS

Study concept and design: Sezen Çimen Polat, Özlem Orhan. Acquisition of data: Musab Çağin, Turgut Çamlibel. Analysis and interpretation of data: Sezen Çimen Polat, Özlem Orhan, Musab Çağin. Drafting the manuscript: Sezen Çimen Polat. Critical revision of the manuscript for important intellectual content: Sezen Çimen Polat, Özlem Orhan. Statistical analysis: Musab Çağin. Administrative, technical, and material support: Sezen Çimen Polat, Özlem Orhan, Musab Çağin, Turgut Çamlibel. Study supervision: Sezen Çimen Polat, Özlem Orhan.

CONFLICT OF INTEREST

There is no conflict of interest between the authors.

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