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The Effect of Treadmill Exercises and Computer Games on Motor Skills of Educable Girls with Intellectuall Disability: A Randomized Clinical Trial Study

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Original Article

Abstract

Introduction: The purpose of this study was to investigate the effect of treadmill training and computer games on motor skills of educable girls with intellectuall disability.

Materials and Methods: This study was a randomized clinical trial. Among the aducable children registered in intellectuall disability society of Alborz Province, Iran, 24 educable girls were selected from Kahrizak Rehabilitation Center, and randomly assigned into 3 groups of computer games, treadmill exercises, and control. At first, basic motor skills were measured, and then training sessions were conducted for 8 weeks, 3 sessions per week for experimental groups. The untreated control group did not receive any training during this time, and went through the usual routine of the center program. After the training sessions, motor skills were re-measured. Data were analyzed using analysis of covariance method.

Results: The motor skill scores in treadmill group were significantly higher than of the computer game ($P = 0.012$) and untreated control group ($P = 0.001$). In other words, treadmill training significantly improved motor skill scores ($P < 0.05$), while computer game had no significant effect over the untreated control group ($P = 0.066$).

Conclusion: The results showed the significant effect of treadmill training on motor skills of educable mentally retarded children. Based on the results, it is suggested that treadmill exercises can be offered in the education and treatment centers for the children with intellectuall disability.

Keywords: Treadmill exercises; Computer games; Motor skill; Intellectuall disability

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Introduction

Mental retardation is a common disorder that limits the cognitive functions and motor functions of the sufferer and often manifests itself in delayed motor and mental development, poor academic performance, and poor social and communication skills. Since the word mental retardation causes feelings of humiliation and has a high negative connotation, the term mental disability is used instead (1). The American Association on Intellectual and Developmental Disabilities (AAIDD) lists the disorder in terms of educational ability and intelligence in three categories: educable, trainable, and supportable (1). Given the international statistics, the prevalence of this disorder in children 5 to 18 years old is about 5 to 13%, about 75 to 90% of whom are trainable [intelligence quotient (IQ) between 50 to 75] (2). This group usually has intelligence disorders with specific sensory-motor abnormalities (3). The results of studies indicate that there is a growth retardation between 10 and 81% in these children (4). Efforts to identify, plan, and create more educational facilities for students with intellectual disabilities is an effective step towards achieving the lofty goals of any education system. Additionally, lack of proper knowledge of the characteristics of the mentally retarded children and lack of proper use of suitable motivational strategies will cause their academic failure (5).

Mentally retarded children are slower in

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developing motor skills in comparison to their healthy peers and do not even develop some basic skills. These children often go through the basic stages of physical development, but due to problems in cognitive and psychomotor development, they have poor performance in motor skills that require the integration of environmental information and decision-making to perform a specific action. These children score lower on basic motor skills than normal people and perform these skills more poorly and also learn them more slowly (1). On the other hand, new scientific findings suggest that some motor interventions, such as a variety of physical activities and the use of computer games, can increase motor skills and social functions in different groups of healthy or impaired children (6,7).

Due to the mental and physical problems of children with mental disabilities, motor interventions may improve the motor function of this group of people and probably by examining various motor interventions, the best way to improve the motor function of children with mental disabilities can be identified (8). In the first years of their life, humans can get acquainted with their environment and communicate with it only through movement. Movement is the first means of obtaining information which can provide the child with many opportunities for expression (9). When a person performs a coordinated motor activity, he or she actually harmonizes the three cognitive, emotional, and psychological areas of movement. Through play, the child begins to learn and understand the world around him, and as he moves, he feels, thinks, and develops new motor skills (5).

In the research literature, there are many words to describe children with mobility problems. These terms include motor learning difficulties, poor coordination, inability to perform balanced actions, sensory integrity disorder, cognitive-motor disorder, and mental disability (10). Regular exercise training program has an effective role in restoring people with mental disorders to normal life (9,11). Experience of success in movements and games is essential for children with mental disabilities, and participation in sports programs provides a good ground for their acceptance among other students. In this regard, physical education can play a complementary role. The ultimate goal of the physical education program is to improve mobility in mentally retarded children while they enjoy play experiences. It should be noted that the special role of exercise therapy for people with mental disabilities is the development of motor skills (12).

Among various kinds of games, computer games have become one of the hobbies of children, teenagers, young people, and even adults in the new age. Some results of studies on computer games indicate that these games are good resources for teaching and learning and the group use of educational games has a positive effect on children’s educational achievement and social relationships (6,13). On the other hand, these games can indirectly teach children skills that lead to their success in future occupational areas. Attractiveness is one of the features of computer games that distinguishes it from other media. The most basic element in making computer games attractive is small and continuous rewards, which is a psychological principle. According to this principle, giving small rewards to a person continuously leads him to the next rewards. Thus, the games become a combination of reward barriers in which the player receives a small reward when they cross each barrier. Other factors also contribute to this attractiveness, such as learning through designed experience (6). In computer games, learning is much better compared to other methods (13). That is why many countries in the world have long-term plans for learning through games. Due to the attraction of children and adolescents to these games and given their psychological, physical, and social impacts, including the provocation of anger and aggression, obesity, epilepsy caused by games, social isolation, etc., addressing these games today is a turning point of attention of many psychologists and mental health specialists (13).

One of the methods that improves cognitive functions and motor skills is the use of various physical activities (14). In general, motor training can lead to complete physical coordination, which leads to the involvement of cerebellar granule cells, which can ultimately affect a variety of nervous and behavioral systems, including attention, memory, and motor function systems (15). Moreover, research on mentally disabled children suggests that aerobic activities (such as brisk walking, running, and stationary cycling) can improve cognitive function. One of the important and related reasons for this can be the increase in the volume of white matter and gray matter in the frontal cortex of the brain due to the increased blood flow during aerobic exercise (16).

In general, despite the researchers’ efforts to investigate the role of exercise in motor skills of mentally retarded children (14-16), findings have not yet determined which type of exercise intervention can play a more desirable role in improving motor skills. Therefore, considering that the most appropriate period for education is the age range of 8 to 11 years (1), one of the main questions of the study was whether computer games can improve the motor skills of educable children. Accordingly, this study is conducted with the aim to compare and examine the effect of types of physical and cognitive activities of computer games and treadmill exercises on motor skills of children with mental disabilities.

Materials and Methods

This study was a randomized clinical trial performed on the statistical population of children with mental and physical disabilities in welfare centers of Alborz Province, Iran, in 2019-2020. Due to the large size of the population and the limitations of access to all of them, the Tabachnick and Fidell method was used to estimate the sample size. The sample size was estimated to be 21 people, and with overestimation to obtain a suitable sample, 24 people were selected as the final sample. The study inclusion criteria included diagnosis of educable mental retardation disorder (IQ score between 65 and 75), female gender, age range between 8 to 11 years (the most appropriate age period for training), and being peer in terms of motor development. Based on the case file and the necessary observations, with the help of the psychologists and psychiatrists of Kahrizak Center, 24 people were selected and randomly assigned into three groups of 8 people: treadmill, computer game, and control groups. The presence of any other pervasive disorder and failure to meet the input criteria desired by the researcher were also considered as the exclusion criteria. The present study was approved with an ethics code and a registration code in the Iranian Registry of Clinical Trials (IRCT) system. The caregivers of the mentally and physically disabled children were assured that they could withdraw from the study process at any stage of the study if they were unwilling to continue participation in the study. In order to observe the ethical principles in the training at the end of the work, the control group were among the participants of the project and were given sports exercises too. Besides, it was assured that the principles of confidentiality were observed and without obtaining permission, any personal information of participants was not provided to someone outside the research team. In order to measure the variables in the pre-test stage, the motor skill assignments were performed on the experimental and control groups and then the necessary training was performed on the experimental groups for eight weeks and three sessions per week every other day. The control group did not receive any training during this period. After the training sessions on the experimental groups, the tasks were performed on the experimental and control groups to determine their scores in the post-test stage.

In order to evaluate the effects of computer games on the motor skills of mentally retarded children, the mental puzzle games (Farms and Castles 1.2.8.5473.21-2, Hapti.co Limited, Copenhagen, Denmark) were used. Since the subjects of the present study were children with mental disabilities, the researcher used the beginner level of the game focusing on the necessary work and guidance. Furthermore, a pediatric treadmill, which is a stable and widely used exercise tool, was utilized. This treadmill was small in size and in line with the objectives of the study, which made it possible to control and measure different intensities of physical exercises and its effects on motor skills of children with mental disabilities. The Bruininks-Oseretsky multi-tasks were employed to measure the motor skills.

The Lincoln-Oseretsky scale was used to measure cognitive-motor abilities. The level of motor skills in this test referred to the score obtained by the child in the short form of the Lincoln-Oseretsky Motor Development Scale. This test is used to assess the development of fine and gross motor skills and to identify people with motor coordination problems aged 4 to 21 years. Execution of the form takes 15 to 20 minutes. The modified Lincoln-Oseretsky form consists of six subscales and 36 subtests, each of which assessing different aspects of the perceptual motor abilities of children aged 5.5 to 14.5 years. This set includes general static coordination, general dynamic coordination, dynamic manual coordination, movement speed, voluntary synchronous symmetrical movements, and perceptual asynchronous asymmetric movements. The subtests of this scale are scored from zero to 3. The reliability coefficient of the test for the whole age range of girls is reported to be 97% (17). The Lincoln-Oseretsky scale has been standardized in Iran and its Persian version and Iranian standards have been used in several studies (18).

The research site was Kahrizak Rehabilitation Center located in Alborz Province. In order to analyze the data collected from the three groups in the two pre-test and post-test stages, descriptive statistics [frequency, frequency percentage, mean, standard deviation (SD), and graphs], and to compare the results of the experimental and control groups considering the pretest effects, the inferential statistics [multivariate analysis of covariance (MANCOVA)] and post hoc test were utilized. Finally, the data were analyzed in SPSS software (version 24, IBM Corporation, Armonk, NY, USA).

Results

All participants completed all stages of the study. In other words, the dropout rate was 0 and therefore, intention-to-treat (ITT) analysis was not possible (Figure 1).

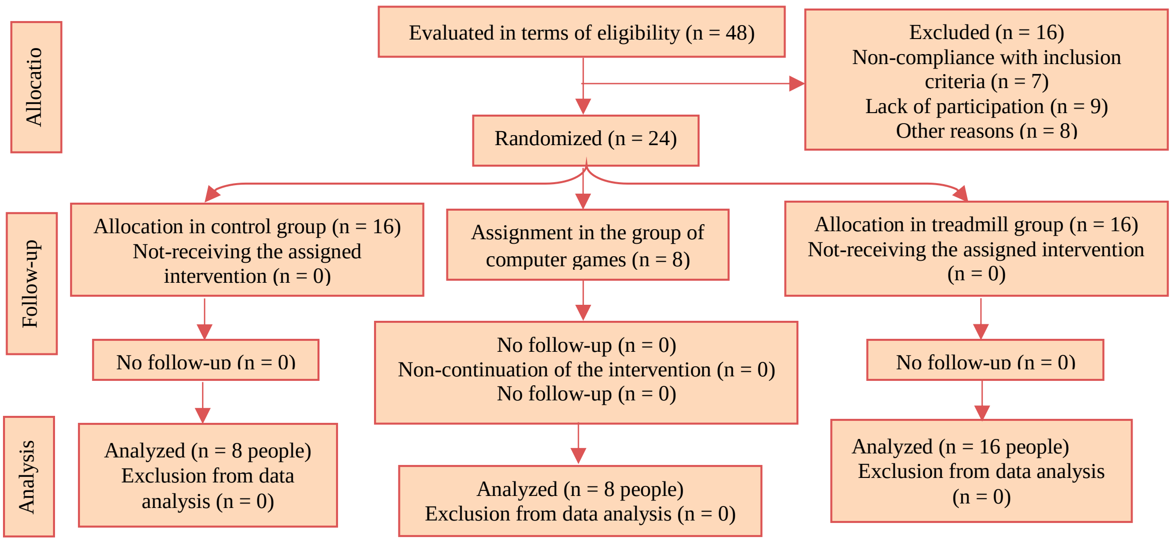

Figure 1. CONSORT flow diagram

In the first step, after determining the location of the study and submitting a call for registration in the study, the necessary coordination was performed with the authorities and the parents of the children. In total, 48 people were identified as eligible, of whom the parents of 9 children did not agree with their children's participation in the study in the initial sample selection stage, and the other 7 cases did not meet the inclusion criteria according to the researcher. Finally, 24 people were selected and assigned to the three groups. Table 1 represents the descriptive specifications of the anthropometric and demographic characteristics of the samples by group.

The results of the interventions performed in each group and the resulting changes are presented in table 2.

In the next step, the assumptions of analysis of covariance, namely normal data distribution, homogeneity of variance, canonical correlation of the independent and covariate variables, and homogeneity of the slope of the regression lines were examined. The results of Shapiro-Wilk test showed that the scores related to motor skill indices in all groups in the stages followed the normal distribution ($P < 0.050$). In all indicators of motor skills, the Levene test to evaluate the homogeneity of variances was not significant ($P < 0.050$). Therefore, the assumption of homogeneity of variance of errors was confirmed as one of the analysis assumptions. Given the results of table 3, the level of significance related to the effect of pre-test of these indicators was significant. It can be said that the assumption of the correlation of the dependent and covariate variables was also observed. The level of significance related to group interaction and pre-test was not significant. Therefore, it can be stated that the assumption of homogeneity of the slope of regression lines was also established.

In table 4, the results of analysis of covariance were examined to evaluate the effect of the groups by controlling the pre-test values.

In the static coordination index, the results of the effects among the subjects showed that after adjusting the pretest effects, the group F value was significant ($P \leq 0.001$, $F = 12.225$). In other words, after removing the pre-test effects, there was a significant difference between the scores of all subjects in the post-test and 0.55 of variance of the static coordination index was explained by the experimental groups ($\eta^2 = 0.555$).

Table 1. Descriptive characteristics of anthropometric and demographic indices of subjects by group

Group	n	Weight (kg)	Height (cm)	BMI (kg/m^2)	Age (year)	IQ
Treadmill	8	31.25 ±6.14	132.50 ± 5.98	17.65 ± 3.34	9.25 ± 1.03	62.25 ±4.65
Computer game	8	32.88 ± 6.24	132.25 ± 6.11	18.61 ± 2.14	9.63 ± 1.30	61.13 ± 4.91
Control	8	32.75 ± 6.18	132.13 ± 5.49	18.39 ± 3.34	9.38 ± 1.18	61.25 ± 4.74
Results of analysis of	Statistics F	0.171	0.047	0.038	0.209	0.134
variance of groups	P value	0.844	0.954	0.852	0.813	0.876

BMI: Body mass index; IQ: Intelligence quotient
* P < 0.05

Data are reported as mean ± standard deviation (SD).

Table 2. Descriptive statistics related to motor skills indices in the three groups

Variable	Group (n = 8 in each group)	Pre-test	Post-test	P value (intragroup changes)
Static coordination	Treadmill	11.50 ± 4.21	13.13 ±4.05#	≤ 0.001*
	Computer game	12.13 ± 4.54	12.63 ± 3.85ł	≤ 0.001*
	Control	12.50 ± 4.04	12.13 ± 3.80	0.258
Dynamic coordination	Treadmill	9.50 ± 2.93	11.25 ± 2.61#	≤ 0.001*
	Computer game	10.00 ± 2.27	10.13 ± 1.96ł	≤ 0.001*
	Control	9.88 ± 2.75	9.38 ± 2.33	0.125
Manual coordination	Treadmill	9.88 ± 2.70	11.00 ±2.33#	≤ 0.001*
	Computer game	9.75 ± 2.25	10.50 ±2.07	≤ 0.001*
	Control	9.75 ± 2.12	9.50 ±2.51	0.181
Speed	Treadmill	5.13 ± 2.03	6.63± 2.07	≤ 0.001*
	Computer game	5.00 ±2.39	5.38 ±2.01	≤ 0.001*
	Control	5.50 ±1.93	5.25 ± 1.75	0.141
Symmetrical movements	Treadmill	8.25 ± 2.82	9.38 ± 2.88#	≤ 0.001*
	Computer game	8.50 ±2.88	8.75 ± 2.96	0.002*
	Control	8.75 ± 2.43	8.50 ± 1.93	0.151
Asymmetric movements	Treadmill	6.50 ± 2.93	7.37± 2.92#	≤ 0.001*
	Computer game	6.88±2.48	7.00±1.85	0.001*
	Control	6.75 ±2.92	6.76 ± 2.55	0.200

*P < 0.05 compared to the pretest of the same group, #P < 0.05 compared to the control group, †P < 0.05 in comparison between the treadmill group and the computer game group
Data are reported as mean ± standard deviation (SD).

In the dynamic coordination index, the F value was reported to be significant (P ≤ 0.001, F = 20.051) and 0.67 variance of the dynamic coordination index was explained by the experimental groups (η^2 = 0.667). In the manual coordination index, the group F value was obtained significant (P = 0.008, F = 6.268) and 0.39 of the variance of the dynamic coordination index was explained by the experimental groups (η^2 = 0.385).

In the speed index, the group F value was significant (P ≤ 0.001, F = 12.622) and 0.56 of variance of the speed index was explained by the experimental groups (η^2 = 0.558). In the symmetric movement index, the group F value was reported to be significant (P = 0.019, F = 4.896) and 0.33 variance of the symmetric movement index was explained by the experimental groups (η^2 = 0.329). In the asymmetric movement index, the group F value was obtained significant (P = 0.022, F = 4.677) and 0.32 of the variance of the asymmetric movement index was explained by the experimental groups (η^2 = 0.319).

Table 3. Investigation of assumptions of correlation of dependent variable on covariate variable and homogeneity of regression slopes

Variable	Source of variations	Sum of squares	Degree of freedom	Mean squares	F statistic	P
Static coordination	Pre-test	307.554	1	307.554	512.320	≤ 0.001*
	Pre-test × group interaction	0.869	2	0.435	0.724	0.498
	Error	10.806	20	0.580		
Dynamic coordination	Pre-test	96.403	1	96.403	178.965	≤ 0.001*
	Pre-test × group interaction	0.311	2	0.156	0.289	0.753
	Error	9.696	20	0.529		
Manual coordination	Pre-test	98.626	1	98.626	155.521	≤ 0.001*
	Pre-test × group interaction	1.633	2	0.816	1.287	0.301
	Error	11.415	20	0.534		
Speed	Pre-test	68.405	1	68.405	139.842	≤ 0.001*
	Pre-test × group interaction	0.649	2	0.325	0.664	0.527
	Error	8.805	20	0.429		
Symmetrical movements	Pre-test	123.477	1	123.477	168.723	≤ 0.001*
	Pre-test × group interaction	1.653	2	0.827	1.130	0.345
	Error	13.173	20	0.712		
Asymmetric movements	Pre-test	115.697	1	115.697	408.702	≤ 0.001*
	Pre-test × group interaction	1.814	2	0.920	3.251	0.602
	Error	5.095	20	0.263		

*P < 0.05

Table 4. Results of analysis of covariance for intergroup comparisons (dependent variable: motor skills indices)

Source of variations	Variable	Sum of squares	Degree of freedom	Mean squares	F statistic	P	η^2
Pre-test	Static coordination	307.950	1	307.950	527.542	≤ 0.001*	0.963
Group		14.307	2	7.154	12.255	≤ 0.001*	0.551
Error		11.675	20	0.584			
Pre-test	Dynamic coordination	102.243	1	102.243	204.338	≤ 0.001*	0.911
Group		20.066	2	10.033	20.051	≤ 0.001*	0.667
Error		10.007	20	0.470			
Pre-test	Manual coordination	98.952	1	98.952	151.678	≤ 0.001*	0.884
Group		8.179	2	4.089	6.268	0.008*	0.385
Error		13.048	20	0.652			
Pre-test	Speed	69.796	1	69.796	147.653	≤ 0.001*	0.881
Group		11.933	2	5.966	12.622	≤ 0.001*	0.558
Error		9.454	20	0.473			
Pre-test	Symmetrical movements	130.549	1	130.549	176.105	≤ 0.001*	0.898
Group		7.259	2	3.629	4.896	0.019*	0.329
Error		14.826	20	0.741			
Pre-test	Asymmetrical movements	122.439	1	122.439	353.043	≤ 0.001*	0.946
Group		3.244	2	1.622	4.677	0.022*	0.319
Error		6.936	20	0.347			

*P < 0.05

Table 5 presents the pairwise comparison of the scores of the subjects' motor skills indices in the three groups.

As can be seen in table 4, the mean score of the subjects' static coordination index in the treadmill group was significantly higher than that of the computer game and control groups, but no significant difference was observed between the computer game and control groups. Taking into account the multiple comparisons in table 4, it can be said that the treadmill had the most significant effect on the static coordination index, but the computer game did not have a significant effect on it. The mean score of the subjects' dynamic coordination index in the treadmill group was significantly higher compared to the computer game and control groups, with no significant difference observed between the computer game group and the control group. Therefore, it can be claimed that the treadmill had the highest significant effect on the dynamic coordination index, but computer games did not have a significant effect on it.

Table 5. Pairwise comparison of subjects' scores in the three groups (dependent variable: motor skills indices)

Variable	Group (I)	Group (J)	Mean difference (I-J)	Standard error	P	95% confidence interval	
						Lower bound	Upper bound
Static coordination	Treadmill	Computer game	1.061	0.383	0.012*	0.262	1.859
		Control	1.897	0.384	≤ 0.001*	1.096	2.698
	Computer game	Control	0.836	0.382	0.117	-0.159	1.832
Dynamic coordination	Treadmill	Computer game	1.539	0.355	0.001*	0.615	2.464
		Control	2.186	0.354	≤ 0.001*	1.263	3.109
	Computer game	Control	0.646	0.354	0.228	-0.275	1.568
Manual coordination	Treadmill	Computer game	0.385	0.404	0.727	-0.667	1.438
		Control	1.385	0.404	0.008*	0.333	2.437
	Computer game	Control	1.000	0.404	0.066	-0.052	2.052
Speed	Treadmill	Computer game	1.143	0.344	0.010*	0.247	2.039
		Control	1.697	0.345	≤ 0.001*	0.799	2.595
	Computer game	Control	0.554	0.346	0.329	-0.346	1.454
Symmetrical movements	Treadmill	Computer game	0.854	0.431	0.173	-0.268	1.977
		Control	1.334	0.432	0.017*	0.209	2.459
	Computer game	Control	0.479	0.431	0.625	-0.643	1.602
Asymmetrical movements	Treadmill	Computer game	0.701	0.295	0.081	-0.068	1.469
		Control	0.842	0.295	0.029*	0.075	1.610
	Computer game	Control	0.141	0.295	0.952	-0.626	0.909

*P < 0.05

This pattern was also observed for speed; while in case of the manual coordination, symmetrical and asymmetrical movements, the treadmill group showed a significant improvement only in comparison with the control group and no significant difference was recorded between the computer game and treadmill groups and the control group.

Discussion

The present study was conducted to investigate the effect of treadmill exercises and computer games on the motor skills of mentally disabled educable children. The study had a clinical trial design and the results showed a significant effect of treadmill exercises on motor skills of the mentally disabled educable children. Additionally, the findings revealed that 8 weeks of participation in the treadmill training program significantly improved the development of all components of motor skills of these children compared to the control conditions. This improvement in static coordination, dynamic coordination, and movement speed in the treadmill group was significantly higher than in the group of computer games. Accordingly, it can be declared that the differences between the groups were related to the experimental interventions. The results of the present study on the effectiveness of the treadmill exercises on motor skills of educable mentally retarded children were consistent with the findings of the studies by Lotan et al. (19) and Shilpa and Venugopal (20).

Most experts in the field of motor development refer to the practice opportunity as a general explanation in all motor interventions (21-23). Children, especially children with mental disabilities, need the opportunity to practice and experience, a rich and stimulating environment, high quality education in an ecological environment, and encouragement and motivation to develop and strengthen their motor skills (22). In fact, the results of the present study are consistent with Piaget’s view regarding the interaction of genetics and environment in growth (21). According to him, since children learn best through active experience, play and activity should be a method of education in childhood and provide opportunities for children to interact with others and gain experience through it (21). Thus, exercise and motor training can be considered as an effective factor in the development of children’s basic motor skills (24). According to the ecological perspective, the three factors of “facilities, equipment, and time” play a key role in children’s training opportunities to develop manipulation skills. On the other hand, the development of displacement motor skills requires practice and repetition of exercises with motivation; because traditional exercises are tedious and after a few sessions of exercise, the child loses motivation to work and his speed of learning and growth slows down (24).

Treadmill exercises lead to rhythmic and repetitive gait in a position where the person has to maintain balance and weight while standing and moving. One of the most valuable training methods to improve motor skills in mentally retarded children is the use of a treadmill (25). Balance is the ability and skill in which different systems of the body, including all neuromuscular systems and different parts of the brain are integrated. In fact, the central nervous system (CNS) activates synergistic muscle patterns in the organs by processing data from the visual, atrial, and proprioceptive systems and considering pre-learned movement patterns. These muscle patterns lead to the creation of movement strategies that allow the individual to maintain balance (21). Performing selected movement programs with a regular rhythm improves the proprioceptive function, balance, and power in individuals with mental disabilities. Moreover, running on the slippery surface of the treadmill, which can be considered as a balance disorder, leads to the more involvement of the balance systems. Therefore, it can be one of the most effective strategies to improve balance (21,25).

The effect of movement programs on the development of motor and object control skills can be related to the strengthening of sensory information and the integration of information for use in motor fields (21). Sensory information for movement is collected in three different ways that the cooperation and integration of information from these systems with each other, promotes motor activities. These systems include visual system information, atrial system information, and proprioceptive system information (24). The visual system provides appropriate data for the CNS to diagnose stance and control posture by identifying the position and movement of the head and body relative to the environment. The atrial system information, on the other hand, is collected through two sections, which include semicircular canals and otolith organs. Since treadmill exercises require visual information, it seems that the visual information needed to perform these exercises is effective in stabilizing the head and body and, consequently, reducing stature fluctuations in children with intellectual disabilities, thus increasing their balance (24). On the other hand, by increasing the amount of motor activity following a period of motor intervention, the child gradually develops both physically and cognitively (26). He/she experiences the development of balance, strength, and neuromuscular coordination in the physical dimension, and visual perception, spatial orientation, motivation, and self-esteem resulting from the performance of basic motor skills in the cognitive dimension. Therefore, the treadmill intervention program provides the child with motor development and a possible effect on the perceptual, psychological, and emotional domains.

The findings of the current study were in line with studies in which the effectiveness of protocols and training methods was investigated on improving balance as an important factor in maintaining and controlling posture (21,25,27). In this regard, it can be claimed that all these training methods used are effective in stimulating the neuromuscular system and creating the necessary adaptations to improve balance. Therefore, on the basis of the results of the present study and the importance of balance in performing daily activities and gaining other skills as well as the positive effect of various physical programs in improving balance, necessary measures should be taken to treat balance problems in these subjects. Exercise educators can also focus on improving their balance skills through designing and implementing exercise programs for mentally retarded children, especially at younger ages in which movement patterns are forming. How to design and implement such special balance improvement protocols, which are performed taking into account the abilities and limitations of children with mental disabilities, and comparative evaluation of its effect on improving daily motor activities and sports skills, will require further studies in the future.

Future studies can simultaneously examine the effect of a treadmill intervention program on the physical, perceptual, and emotional dimensions of children with disabilities to determine the effectiveness of this type of exercise in all areas of child behavior. Given the results of the present study, it is suggested to use the training program in schools, centers, and educational and medical institutions for children with mental disabilities to enrich the environment, create interest and motivation, increase self-esteem and finally, develop motor skills in children with mental disabilities. Due to the limited sports environment in schools, the treadmill training program, in addition to having an impact on the development of motor skills, can be easily implemented in a limited environment with simple tools and equipment.

Limitations

Lack of simultaneous study of motor skill development with child development in emotional dimensions and the short-term follow-up of the study limited to a few days after the completion of the training were among the limitations of the present study. It should also be noted that all participants in the study were girls. Considering the small number of subjects, the study was conducted only in elementary school and the intervention was performed only on students with mental retardation who were at the educable level (mild). Cautions must be taken about the generalizability of the results. It should be noted that the present study was cross-sectional and more research is needed to gain more validity for its findings. In the present study, the sampling was performed in an accessible and purposive manner and was based on some physiological measuring instruments, and in this regard, caution should be exercised in extending the results to other population groups. Since the study was conducted on educable mentally retarded children in Karaj, Iran, in generalizing the results to other cities due to cultural, ethnic, and social differences, the necessary caution should be exercised by researchers and users of the study results. Finally, the present study could be conducted both quantitatively and qualitatively (combined), but it was not possible due to the lack of circumstances, which was one of the obstacles and limitations of the study.

Recommendations

It is suggested that long-term follow-up be used in future investigations to more accurately assess the effectiveness of these methods on educable mentally retarded children. Furthermore, applied studies with similar topics should be performed. Performing studies to compare these methods with other approved methods can lead to effective results in improving educable mentally retarded children. By raising the awareness of families, the idea and culture can be institutionalized that with sports activities, the success of these children can be facilitated along with improving performance through physical activity and sports, especially selected rhythmic movements as a group in school or other sports venues. According to the results of the study, it is recommended that the authorities try to create places to perform rhythmic movement exercises. Additionally, counselors in schools and other knowledge-raising institutions can use the results of the present study to help the families of these children.

Conclusion

Increasing coordination and effort to maintain balance in treadmill exercise can enhance and organize sensory information, in addition to positively affecting movement skills such as running, trotting, hopping, sliding, and object control skills including kicking the ball; as muscle coordination is an effective factor in the development and transfer of motor skills. Thus, as noted, the lack or delay in the development of advanced patterns of basic motor movements will not only have a directly negative effect on a person's ability to perform specialized and sports skills and even daily activities, but also indirect effects on learning, visual perception, spatial orientation, self-esteem, and motivation for physical activity (24). According to the results of the present study, to enrich the environment, create interest and motivation, enhance self-esteem and finally, to develop motor skills of children with mental disabilities, the training program in schools, centers, and special educational and medical institutions are suggested to be used for these children. Because the treadmill training program, in addition to influencing the development of motor skills, given the limited sports environment in schools, can be easily implemented in a limited environment with available tools and equipment. Considering the results of the present study and its importance for people with mental disabilities, it is suggested that educators, parents, and officials of centers and exceptional schools use the selected exercises in the rehabilitation program for individuals with mental disabilities.

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Authors' Contribution

Manijeh Ghassemi: Study design and ideation, attracting funding for the study, data collection, manuscript preparation, manuscript expert assessment in scientific terms, confirmation of the final manuscript for submission to the journal office, responsibility for maintaining the integrity of the study process from beginning to publication, and responding to the reviewers' comments; Farhad Ghadiri: study support, executive, and scientific services, manuscript preparation, manuscript expert assessment in scientific terms, confirmation of the final manuscript for submission to the journal office, responsibility for maintaining the integrity of the study process from beginning to publication, and responding to the reviewers' comments; Saeed Arsham: providing study equipment and samples, manuscript preparation, manuscript expert assessment in scientific terms, confirmation of the final manuscript for submission to the journal office, responsibility for maintaining the integrity of the study process from beginning to publication, and responding to the reviewers' comments; Afkham Daneshfar: analysis and interpretation of results, expert statistics services, manuscript preparation, manuscript expert assessment in scientific terms, confirmation of the final manuscript for submission to the journal office, responsibility for maintaining the integrity of the study process from beginning to publication, and responding to the reviewers' comments.

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Conflict of Interest

The authors did not have a conflict of interest.

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