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Effects of mini-basketball training on improving the motor coordination of children with intellectual disabilities and developmental coordination disorders: a randomizedcontrolled trial

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Abstract

Background Motor coordination (MC) is one of the main components of motor competence. Children with Intellectual disabilities (ID) usually have weaknesses in MC and related components. Therefore, the aim of study was to investigate the effect of mini-basketball training (MBT) versus general physical education programs on improving the motor coordination of children with intellectual disabilities ID.

Methods The current study was a semi-experimental and practical research, with a pre-test-post-test design with a control group. The Participants of this study consisted of 30 boy children with ID (aged 11.53 ± 1.87 years old). Then they were randomly assigned to two groups: control ($n=15$) and experimental or MBT ($n=15$). A developmental coordination disorder (DCD) questionnaire was used to identify DCD, and the Körperkoordinationstest für Kinder (KTK) test was used to evaluate MC. The experimental group performed MBT for 45 min, 3 times/week for 8 weeks. The control group only participated in general physical education programs. The data were analyzed by means of 2 × 2 repeated measures ANOVA followed by post hoc comparison (Bonferroni) at the significance level of ($P<0.05$). The statistical analysis was done using SPSS, 25.

Results The results showed that there was a significant difference between the MBT (experimental) and control groups in variables of the walking backwards ($F=25.36$; $P=0.001$; ES = 0.47), vertical hopping ($F=7.15$; $P=0.01$; ES = 0.20), lateral jumping ($F=26.83$; $P=0.001$; ES = 0.48), lateral movement ($F=9.77$; $P=0.004$; ES = 0.25) and overall score of KTK ($F=27.37$; $P=0.001$; ES = 0.49).

Conclusion The results showed that the use of MBT, which is considered a type of sports game, could improve the global motor coordination of the children with ID and DCD. Based on the results, coaches and therapists are advised to use MBT for improving the MC of this population.

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Keywords Motor coordination, Motor competence, Mini-basketball training, Sports game, Intellectual disability, Developmental coordination disorders

Introduction

Intellectual disability (ID) is a disability characterized by significant limitations in both intellectual functioning and adaptive behavior, covering a range of social and practical everyday skills [1]. Prevalence percentages may vary from under 1% in high-income nations to 3–4% in low- and middle-income countries, underscoring the influence of socioeconomic conditions on the identification of ID [2]. Developmental Coordination Disorder (DCD) is a neurodevelopmental disorder marked by considerable impairments in motor skills, impacting both gross and fine motor abilities [3]. Research demonstrates that DCD impacts between 3.8 and 8.53% of school-aged children, underscoring its worldwide significance [4, 5]. Children with ID, despite the ability to learn to read and write through training and practice, have differences compared to typically developing children of their age; probably one of these differences is developmental coordination disorder (DCD) [6]. As Dadmehr et al. showed, the intervention of sensory and motor stimulation can improve motor coordination in people with ID and DCD [7]. Movement execution in children with DCD is usually slower, less accurate, and more unstable than their peers [8]. as well as in the production of simultaneous movement, ball and motor skills are also impaired [9]. Children with ID have a motor weakness that negatively affects the neuromuscular, skeletal, and sensorimotor systems [10, 11]. In this regard, Guidetti et al. [12] and Pitetti et al. [13] have shown that the performance of individuals with ID in strength, endurance, flexibility, motor coordination, and cardiovascular endurance is significantly weaker than that of typically developing people. Therefore, motor coordination (MC) is weak in children with ID and DCD. With these interpretations, children with ID suffering from DCD can have much weaker MC.

MC is the ability to perform precise, controlled, and efficient movements essential for daily activities and physical performance. Factors including balance, agility, and hand-eye coordination are integral to MC [14]. MC constitutes a vital aspect of motor competence, which is intricately linked to a variety of health outcomes; conversely, inadequate MC can adversely influence overall functioning and emotional and social development [15], in addition to impacting physical activity and fitness levels among children [16]. The progression of MC is contingent upon both neuromuscular and biological maturation processes [15]. In this regard, other studies, such as Fotrousia et al. [17], reported that mini basketball training improves children's basic motor skills. Tae Sun et al. [18] also reported that the psychomotor program improves the MC (KTK) of the ID. In another study, Zolghadr et al. [19] showed that balance-postural exercises can improve balance performance, which is considered one of the important factors of MC, in individuals with ID and DCD. The results of these studies show that the use of sport interventions can improve MC and its components.

Physical activity can have many benefits for individuals with disabilities, especially the children with ID and DCD. Today, sports games are used as physical activity programs for these Individuals. Sports games come in various types and can be either active or passive. They may involve groups or be tailored for children while remaining engaging and enjoyable. sports games are actually a kind of sport, and it is a kind of free and enjoyable movement [20]. Sports games have been found to expand developmental skills and maintain physical, mental, and emotional health of children with ID. When children play sports games, their movement leads to the activation of different parts of the body leading to better, coordination among the muscles of the body, and resultantly, the growth and development of social interactions are enhanced [20]. In a systematic review, Aksovi´c et al. (2023) investigated the effect of sports games on the motor skills of the children with ID. The results of this study showed that playing basketball is an effective and practical rehabilitation program for children, adolescents, and young adults with ID and down syndrome (DS) [21]. Sports games provide an effective method for including children and adolescents with disabilities in physical exercise, as these are seen as products of physical and cognitive potentials [22, 23]. Among team sports, basketball is a favorite in sports and physical education programs. Its requirement for diverse physical abilities and its substantial role in fostering development [21] make it especially beneficial for children and individuals with ID [24, 25]. One of the sports games used today by people with limited mobility is mini basketball. The Mini-basketball training (MBT) is performed with various natural movements such as walking, running, jumping, hopping, and balance activities. Practicing and repeating these activities develops movement and balance skills. Moreover, this sport is performed with a ball, so it requires a lot of movement coordination [26–28]. According to the results of a study which has investigated the effects of playing mini-basketball on children with disabilities, mini

basketball training could improve physical fitness and social participation in children with autism [28]. Mini-basketball serves as an effective intervention to support social and physical development in children with intellectual disabilities. This method encourages teamwork and communication, which contributes to improvements in social skills among participants with intellectual disabilities [29]. Furthermore, mini-basketball training (MBT) significantly enhances physical fitness, particularly by improving speed, agility, and muscular strength [28].

There are various sports approaches and programs to improve the coordination and motor competence of the children with intellectual disabilities. However, in the most recent studies, the use of game therapy approaches has been very effective and efficient. Therefore, sports games can be a tool for the development of personality and physical dimensions in children with ID. To the best of our knowledge, no study has investigated the effects of mini-basketball games on global motor coordination of children with ID and DCD. In previous studies, the effect of sports games on balance and motor skills has been used, and the same has been done only focusing on children with ID. The few studies that were conducted on the MC of these children did not use comprehensive MC tests. But in the present study, we tried to fill the gaps of previous research to some extent. Therefore, in this study, a more comprehensive MC test was used to examine its various components more precisely. In this study, children with ID suffering from DCD were selected. As a result, the current study population was considered more specific. Addressing MC is crucial for enhancing the quality of life and independence in children with ID and DCD. Therefore, the aim of this study was to investigate the effects of mini-basketball training on motor coordination in children with ID and DCD.

Methods

Study design

The current study is semi-experimental and practical research, with a pre-test-post-test control group design. conducted without any deviations from the registered protocol.

Participants

Participants of this study included boys with ID and DCD (age = 11.53 ± 1.87 years old) from exceptional schools in Qazvin City, Iran. The sample size and effect size were calculated based on a previous study by Sharifi et al. [30]. Using ANCOVA test in G Power software with a desired power of 0.65, alpha of 0.05, and effect size of 0.75, 30 children with ID and DCD an intelligence quotient (IQ) between 50 and 75 were selected by a purposeful and available manner. Then the participants were randomly allocated into two groups: experimental or MBT group (n = 15) and control group (n = 15).

Randomization

Randomization was performed by an unbiased researcher unfamiliar with the study methods and using a random assignment protocol. The letters A and B were assigned as indicators for the random assignment of groups and then placed in black envelopes. Another researcher opened the envelopes and randomly selected children. Thus, the participants were divided into two groups: A control and B MBT group. Group assignment was kept concealed by utilizing an opaque envelope until after the participants were officially registered for the research project in order to reduce the likelihood of bias. Specifically, access to group information was restricted, and a designated member of the research team managed the allocation process to prevent any potential biases. Moreover, the current study was conducted as a single-blind trial, where solely the researchers were aware of the intervention allocated to the participants, while the subjects remained unaware of their assigned study group until the completion of the study.

Inclusion and exclusion criteria

Inclusion criteria were as follows: mild children with (ID) and (DCD) with an IQ between 50 and 75, willingness to participate in the study as indicated by completion of the consent form, no use of any medications affecting the nervous system or balance, no history of lower limb injury or surgery within the past year, no vestibular system disorders, normal vision without the need for glasses, and male gender [31]. Exclusion criteria included abnormal musculoskeletal pain during testing, need for support or aids to maintain balance and walk, withdrawal of consent to continue participation, absence from more than two training sessions, failure to attend any stage of testing (pre-test or post-test), and signs of maturation [19, 31].

After participants were selected, consent forms detailing the study's stages, goals, and conditions were provided to parents, who signed them to confirm their child's participation. The developmental coordination disorder questionnaire was then completed by parents to identify eligible participants with DCD. Ethical guidelines were strictly followed, with ethical approval (ID IR GUILAN.REC.1402.063) obtained from the Biomedical Research Ethics Committee at Guilan University. This study was registered in the Iranian Registry of Clinical Trials (ID: IRCT20190425043370N2, registered on 01/10/2024) and adhered to the CONSORT guidelines for randomized controlled trials. Participant allocation and dropouts are illustrated in the study flowchart (Fig. 1).

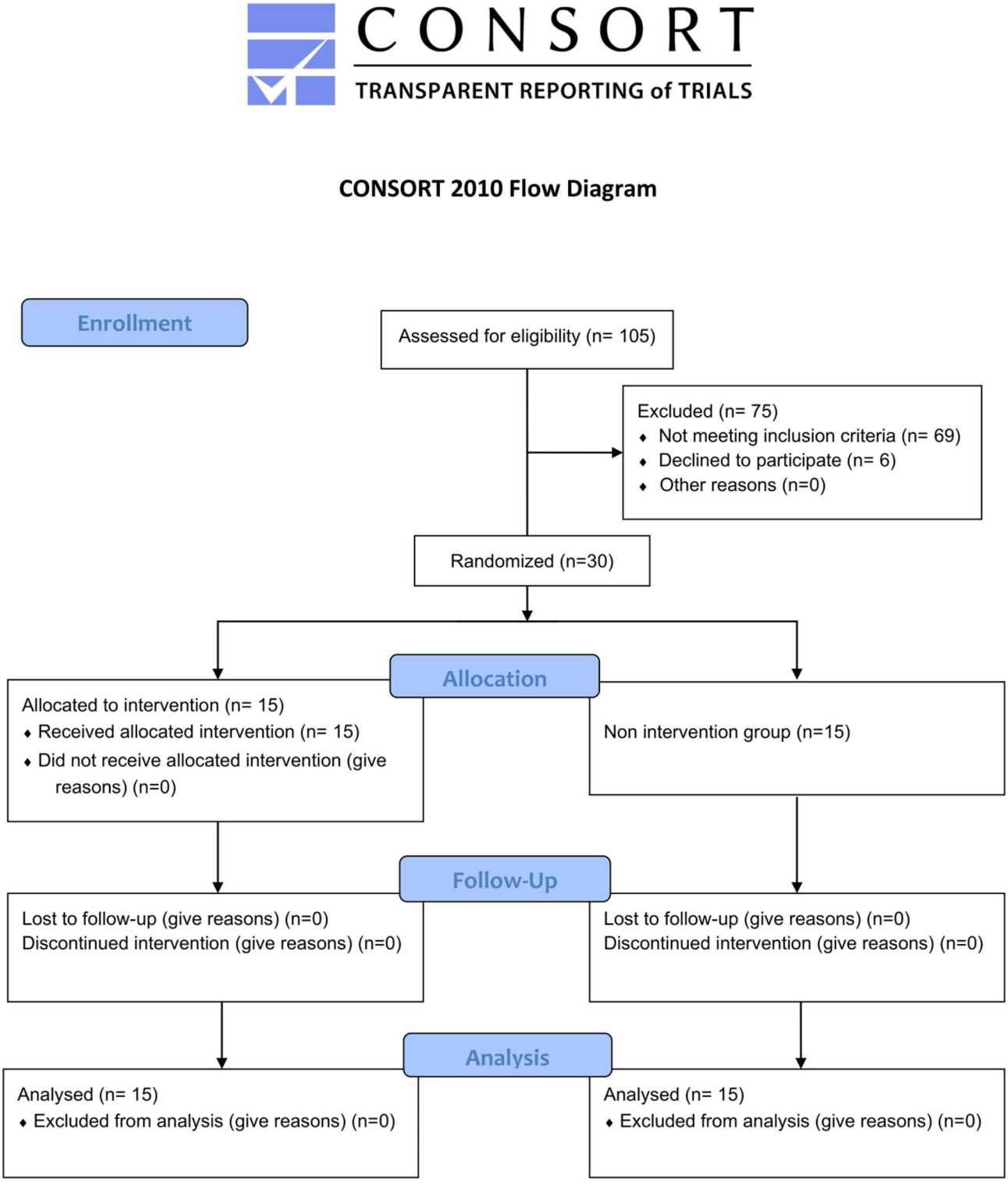

Fig. 1 Study flowchart

Outcome measurement

Developmental coordination disorder questionnaire (DCDQ)

The psychometric properties of the Developmental Coordination Disorder Checklist (DCDQ'07) have been investigated by Wilson et al. [32], and its use has been confirmed for the screening of children with DCD. The questions of this questionnaire evaluate three factors of control during movement: fine movements. handwriting,

and general coordination. This questionnaire is scored in the form of five options. Score 1: not at all like; score 2: a bit like; score 3: moderately like; score 4: quite a bit like; and score 5: extremely like. If the total score of the questionnaire is between 15 and 57, it indicates that the person is prone to DCD. If the score is between 57 and 75, then person does not have DCD [32, 33]. The Persian version of this questionnaire has a reliability of 0.93 [34].

Motor coordination (MC)

The Körperkoordinationstest für Kinder (KTK), functioning as a product-oriented evaluative instrument, is capable of assessing MC in both typically developing children and those with particular needs [35]. The KTK comprises four distinct components: walking backward (WB), vertical hopping (VH), lateral jumping (LJ), and lateral movement (LM). All demographic cohorts, ranging from 5 to 15 years of age, utilize analogous tasks to evaluate MC, rendering this tool appropriate for longitudinal investigations within pediatric populations. The KTK represents a straightforward and efficient evaluation methodology [35]. MC was evaluated by the KTK [36–38]. The overall score (OS) is derived from the aggregation of the raw scores obtained from the components. The reliability of the KTK demonstrates exceptional consistency (overall: $r=0.95$; WB: $r=0.86$; VH: $r=0.91$; LJ: $r=0.87$; LM: $r=0.64$) [38].

1. Walking backward (WB): This particular component systematically investigates the domains of balance control and coordination. The participants were instructed to execute a backward stepping motion three times across three balance beams, which varied in width, each measuring 3 m in length and 8 centimeters in height, with the widths progressively decreasing throughout the assessment (6.0, 4.5, and 3.0 cm, respectively). Each balance beam permitted a maximum of eight steps during each evaluation, culminating in a total highest score of 72 steps. The overall evaluation score was derived as the aggregate sum of the steps accomplished during the assessment [36, 37].
2. Vertical hopping (VH): This component investigates the coordination, strength, and regulation of dynamic stability within the lower extremities. Following a brief approach (approximately 1.5 m), participants executed a unilateral jump over a progressively increasing stack of cushions. Throughout the assessment, the contralateral leg was mandated to remain elevated. Points were allocated to participants who completed the task on the first, second, or third attempts, with three, two, or one point(s) awarded, respectively. In cases where participants failed the initial height trial, the elevation was decreased by 5 cm incrementally until successful completion was attained. Subsequent successes were denoted by the addition of an additional cushion, and the evaluation was terminated after three successive failures. The final score on the assessment was indicative of the total points accrued from both the left and right lower limbs [36, 37].
3. Lateral jumping (LJ): This component assesses the bilateral symmetrical MC, velocity, and dynamic equilibrium of the lower extremities. Subjects were instructed to perform a horizontal leap over a rectangular wooden beam with dimensions of 60 cm × 4 cm × 2 cm using both feet, alternating laterally between the left and right sides, for a maximum duration of 15 s, with the task being repeated twice. The overall score for this assessment was calculated by aggregating the total number of successful jumps completed during the two trials [36, 37].
4. Lateral movement (LM): This component assesses the coordination and agility involved in the side movements. The assessment amalgamates the speed of both the upper and lower extremities with the smoothness of motion, lateral orientation, and spatiotemporal configuration. Participants positioned themselves on two adjacent platforms and manually maneuvered the platforms as swiftly as possible within a 20-second duration. Each participant completed two trials, one directed to the left and the other to the right. The evaluation score was computed by aggregating the results from the two attempts [36, 37].

Intervention

Mini basketball training (MBT)

In this study, the mini basketball training (MBT) protocol by Kelong Cai et al. (2020) was used [28, 39]. Training sessions were designed at three levels, from simple to difficult. The MBT was done for 8 weeks and, 3 sessions a week. Each session lasted for 45 min. Each session consisted of 3 stages: (1) warming up for 10 min; (2) teaching basic mini basketball movements for 30 min; and (3) cooling down for 5 min. The warm-up exercises consisted of jogging and stretching. To get familiar with the children's communication and spatial understanding of the ball, first exercises such as circulating the ball around the head, around the waist, and around the knees were practiced. In the next stage, each participant was asked to throw the ball for the coach, and then the throws became more targeted. In the next step, dribbling and throwing the ball into the mini-basketball basket were taught to the participants. The training items for the second four weeks included jumping and throwing at the same time, which required balance and movement skills. Cool-down exercises were slow walking and gentle stretching in sitting

Table 1 Mini-basketball training content and goal for each session

Category	Content	Duration
Warm-up and Classroom protocols	Stretching, running, and limb movements, etc. Line up, classroom greetings, roll call, etc.	10 min
Mini-basketball training	Phase I: Basic Basketball Training Phase II: Acquisition of mini-basketball skills Phase III: Mini-basketball-based game	30 min
Cool-down	Summary of relaxation techniques	5 min

Table 2 Mini-basketball training (MBT)

Level	Training content	Goal	Duration
Phase I	Standardize classroom protocols Enhance the interest of children in mini-basketball	Classroom protocols (taking turns, waiting, obeying, etc.) Basic basketball training (such as rolling and passing the ball, etc.)	2 weeks
Phase II	Enhance children mini-basketball skills Enhance their social communication skills	Basic basketball skill (dribbling, passing, shooting, etc.) Peer coordination training (passing and catching ball, relay racing, etc.)	4 weeks
Phase III	Improve movement abilities Enhance children cooperative ability and social skills	Group game based on mini-basketball (basketball-dribbling relay, basketball-passing relays, basket-moving shooting, playing ducks, etc.)	2 weeks

Table 3 The demographic characteristics of the participants (mean ± SD)

Variable	Group	Mean ± SD	T	*P*
Age (years)	Control	11.73 ± 1.66	0.57	0.56
	MBT	11.33 ± 2.09		
Height (cm)	Control	1.49 ± 0.13	0.78	0.43
	MBT	1.45 ± 0.14		
Weight (kg)	Control	44.86 ± 16.44	1.14	0.26
	MBT	39.06 ± 10.84		
BMI (kg/m^2)	Control	19.63 ± 5.22	0.86	0.39
	MBT	18.23 ± 3.50		

CON = Control group, MBT = Mini basketball training group

position. In the first two weeks, simple mini-basketball movements were performed to get the attention and interest of the children. In the second to four weeks, the basic movements of mini basketball were taught, and in the last two weeks, group games were played. The specifications of the training program are explained in Tables 1 and 2. The control group maintained normal daily routines or regular school physical education classes without receiving any other specialized exercise interventions.

Data analysis

To evaluate the conformity to normality of the data distribution and the uniformity of variances, Shapiro-Wilk and Levene's tests were employed, respectively. The mean and standard deviation (SD) were used to report descriptive statistics. An independent t-test was used to check the homogeneity of the groups in terms of demographic characteristics. According to the research methodology, a two-way analysis of variance (ANOVA) test with two factors (experimental group, control group) and two levels (pre-test, post-test) was employed to examine the intra-group and inter-group assessments throughout the eight-week MBT. Bonferroni's post hoc test was also used to examine intra-group changes. Effect sizes (ES) using partial eta squared were calculated to increase the analysis power [40]. A modified intention to treat analysis based on the complete case method was used. The analysis was performed only on those who completed the pre-test and post-test. the results were analyzed at a significance level of 95%, with a statistical significance of ($p<0.05$), and performed using IBM SPSS software version 25.

Results

Upon finishing the form for data collection, the participants ($n=30$, age = 11.53 ± 1.87 years, height = 1.47 ± 0.13 cm, weight 41.96 ± 14.00 kg and BMI = 18.93 ± 4.43 kg/m^2) were Available chosen and then randomly allocated into two groups: MBT ($n=15$) and control ($n=15$) groups. There was no significant difference between the two groups in terms of age ($P=0.56$), height ($P=0.43$), weight ($P=0.26$) and body mass index ($P=0.39$) (Table 3).

Hence, the outcomes of the Shapiro-Wilks and Levene's examinations validated the normal distribution of the data and the equality of variances ($P>0.05$). As seen in

Table 4, the ANOVA results revealed significant effects of the 8-week MBT.

The main effect of the group was significant at the WB (F=25.36; *P*=0.001; ES=0.47), VH (F=7.15; *P*=0.01; ES=0.20), LJ (F=26.83; *P*=0.001; ES=0.48), LM (F=9.77; *P*=0.004; ES=0.25) and OS of KTK (F=27.37; *P*=0.001; ES=0.49).

The significant main effects of time were found for the WB (F=7.35; *P*=0.01; ES=0.20), LJ (F=26.32; *P*=0.001; ES=0.48), LM (F=4.93; *P*=0.03; ES=0.15), OS of KTK (F=16.89; *P*=0.001; ES=0.37). But, significant main effects of time were not found for the VH (F=0.00; *P*=1.00; ES=0.01).

The Significant time × group interaction effects were found for the VH (F=12.22; *P*=0.002; ES=0.30), LJ (F=7.83; *P*=0.009; ES=0.21) and OS of KTK (F=6.58; *P*=0.01; ES=0.19). But, significant group × time interaction effects were not found for the WB (F=1.72; *P*=0.20; ES=0.05) and LM (F=0.006; *P*=0.93; ES=0.01).

Post hoc tests showed significant differences in the WB (F=8.09; *P*=0.008; ES=0.22) VH (F=6.11; *P*=0.02; ES=0.17), LJ (F=31.46; *P*=0.001; ES=0.52) and OS of KTK (F=22.26; *P*=0.001; ES=0.44) in the MBT group compared to the control group. However, there was no significant difference between the pre-test and the post-test in the control group. But there were no significant differences in the LM (F=2.64; *P*=0.11; ES=0.08) in the MBT group compared to the control group. However, there was a significant difference between the pre-test and the post-test in the VH (F=6.11; *P*=0.02; ES=0.17) in the control group. The presence of a significant difference in the control group was due to the weaker records of the participants, which inversely made the results significant in this group.

Discussion

This study aimed to investigate the effects of eight weeks of MBT on MC of children with ID and DCD. The results showed that the MBT significantly improved MC and its subtests, such as WB, VH, and LJ of children with ID and DCD. However, no significant difference was observed in the LM subtest. Although the average score in the post-test improved compared to the pre-test, the difference was not so great as to make it significant.

MC is one of the main components of motor competence. Global motor coordination itself consists of other components such as balance, strength, dynamic stability control, speed, equilibrium, agility, and side movements [38]. Having enough coordination is essential for children and adolescents, because they need it in daily activities and sports. In a recent study, Salami et al. [41] reported that the MC of Iranian children and adolescents is weaker compared to that of European and Brazilian children and adolescents. Studies have shown that

Table 4 Results of two-factor ANOVA test to compare the mean of variables

Variable	Group	Pre-test Mean ± SD	Post-test Mean ± SD	F	*P* value	ES	Main effect of group		Main effect of time		Time* Group Interaction effect	
							P value	ES	*P* value	ES	*P* value	ES
WB	CON	15.60 ± 9.36	18.80 ± 10.48	0.98	0.33	0.03	0.001*	0.47	0.01*	0.20	0.20	0.05
	MBT	36.80 ± 18.61	46.00 ± 17.48	8.09	0.008*	0.22						
VH	CON	7.06 ± 3.69	5.20 ± 3.00	6.11	0.02*	0.17	0.01*	0.20	1.00	0.01	0.002*	0.30
	MBT	9.73 ± 6.46	11.60 ± 5.56	6.11	0.02*	0.17						
LJ	CON	12.53 ± 6.61	14.33 ± 4.51	2.71	0.11	0.08	0.001*	0.48	0.001*	0.48	0.009*	0.21
	MBT	22.13 ± 7.07	28.26 ± 7.64	31.46	0.001*	0.52						
LM	CON	9.13 ± 2.66	10.06 ± 3.32	2.30	0.14	0.07	0.004*	0.25	0.03*	0.15	0.93	0.01
	MBT	12.73 ± 3.61	13.73 ± 3.86	2.64	0.11	0.08						
OS	CON	44.33 ± 19.18	48.40 ± 18.34	1.19	0.28	0.04	0.001*	0.49	0.001*	0.37	0.01*	0.19
	MBT	81.40 ± 28.46	98.93 ± 28.24	22.26	0.001*	0.44						

*Significance at the *P*<0.05 level

WB=Walking backwards, VH=Vertical hopping, LJ=Lateral jumping, LM=Lateral movement, OS=Overall score, SD=Standard deviation, ES=Effect size, CON=Control group, MBT=Mini basketball training group

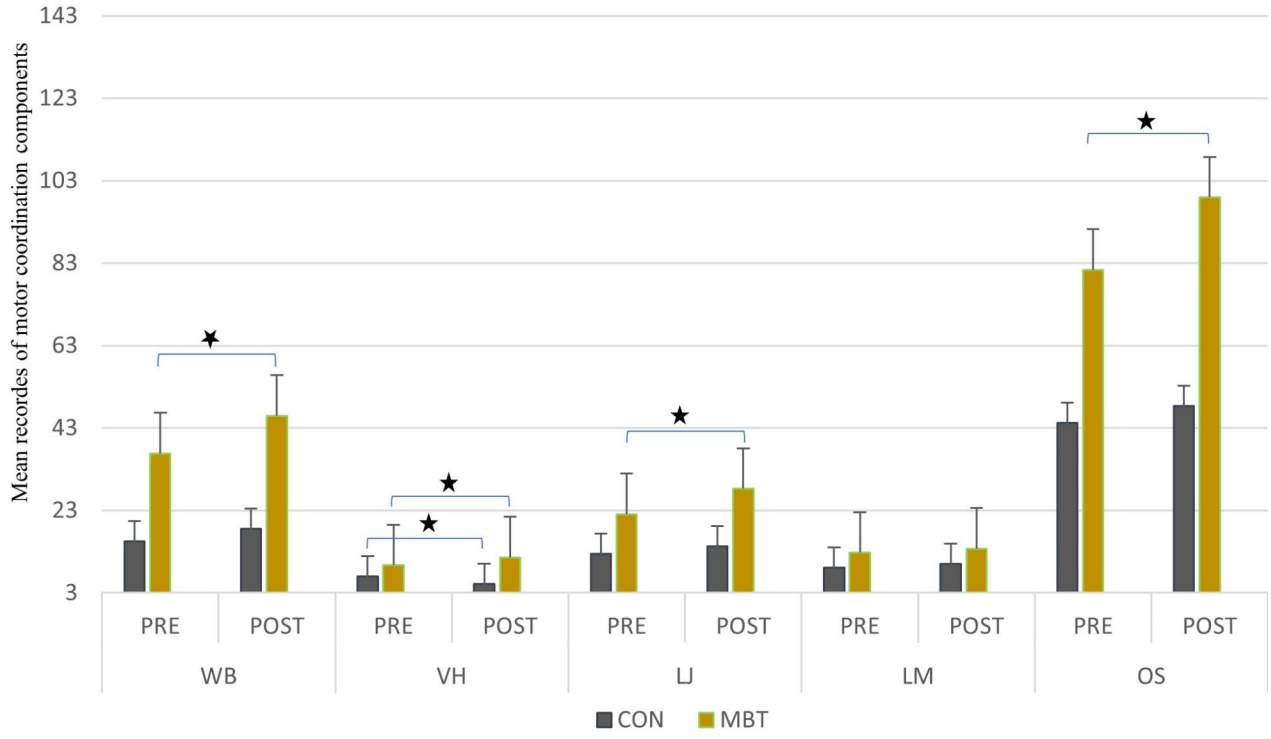

Fig. 2 Comparison of the mean of the pre-test and post-test records in motor coordination components between two groups (* Significant difference between pre-test and post-test at $p < 0.05$.)

MC and its components, such as equilibrium and postural control, are weaker in people with ID compared to healthy children [12, 13, 42]. Especially the ID children who have other disorders such as DCD have a severe weakness in MC. According to Carmelie et al.'s [43], children with developmental coordination disorder due to sensory-motor information disorder receive lower scores in equilibrium and perceptual-motor tests than typically developing children, and their balance and coordination are more unstable than healthy people. Therefore, it has become important to conduct studies and sport that can improve MC in the ID and DCD children. The present study showed that the use of MBT can improve MC of children with ID and DCD. According to the results of the present study, using sport that are games in nature can have a better effect on improving the MC of these children because the game can be attractive and fun. The game is essentially a form of sport, characterized by free and enjoyable movement [20]. The MBT is done with many natural movements, such as walking, running, jumping, hopping, and balance activities. Practicing and repeating these activities will develop MC and balance. on the other hand, this sport is performed with a ball, so it requires a lot of movement coordination [26, 27]. In addition, the MBT has emerged as a promising intervention for preschool children with autism spectrum disorder, offering distinct benefits compared to traditional therapies. Research indicates that MBT significantly enhances physical fitness, social communication, and executive functions in this population [28]. Finally, mini-basketball not only offers a distinct and engaging method for developing physical and social skills but also presents considerable advantages over traditional interventions, making it a highly effective option for children with ID and DCD.

Mini-basketball game positively affect MC components and, finally, their overall score. So, doing quick lateral movements and lateral jumps in the mini basketball game strengthens the leg muscles, especially the muscles of the hip and knee joints. For this reason, it can improve the LJ component. Also, in the mini-basketball game, vertical jumps are needed for rebounding and shooting, strengthening the legs' explosive power. The same techniques can improve children's VH component. In the mini basketball game, children must move quickly left and right, increasing agility, reaction time, and body control. These movements can also improve the LM component. Finally, in the mini-basketball game, children may sometimes walk backwards, strengthening the back muscles and maintaining balance, which can positively affect the WB component. As a result, mini-basketball games can help improve global motor coordination due to various

movements, including jumping, lateral, and backward. Also, creating a competitive and fun environment provides more motivation to practice and improve.

Due to the inappropriate approach, ID children suffer from more movement poverty because these children are either confined at home or are kept as disabled patients due to unconscious compassion, and these behaviors prevent the development of their movement talents. The important issue is that these children may not be able to perform the skills, but it is due to the lack of experience in performing that movement. At the same time, regular sport programs play an influential role in returning children with ID to a healthy and better life physically [44]. Therefore, on this basis, families and relevant authorities should encourage ID-challenged people to participate in physical activities, including sports games. In this way, we can improve MC and its components in these people. Because, MC is considered one of the most important components of health and physical fitness, and it is also effective in the development of movement in the later stages of the lives of children with ID.

Limitation

The limitations that were observed in the present study included: (1) The small sample size was due to the selection of children with DCD among those with ID. The study included 30 participants, which is considered a relatively small size. This limited number may affect the generalizability of the results. For example, a small sample may not be well representative of the larger population, and this can lead to potential biases. But choosing a large sample of people with disabilities will always be difficult. (2) The gender factor, because in the present study, it was only done on the boy gender. This lack of diversity can limit our understanding of how different genders respond to the studied variables. Future research should ideally try to include participants of both genders to provide a more comprehensive perspective and increase the applicability of the results. Due to the limited number of participants, effect sizes may be inflated or deflated, leading to misleading conclusions. Larger samples help stabilize these estimates and allow for more reliable statistical inferences. (3) In the study, a single-blind design was implemented. While single-blind designs effectively minimize participant bias, they may still be susceptible to researcher bias since the researchers are aware of the intervention and could unintentionally influence outcomes during data collection or analysis. Therefore, it is advisable for future studies to employ double or triple-blind designs to enhance the quality of research. (4) In the present study, it was impossible to control the participants' socioeconomic status (SES). (5) Limited Existing Research: There is a scarcity of studies focusing on children with ID and related disorders like DCD. Therefore, researchers can conduct larger-scale randomized controlled trials (RCTs) to increase the reliability of the findings. It is also recommended to compare traditional programs (such as core stability, resistance training, etc.) with sports games in future research. It is even possible to compare different sports games (futsal, handball, football, etc.) to determine which game can have a better effect on the MC of children with ID and DCD.

Conclusion

According to the results of the present study, MBT can improve MC in children with ID and DCD. It seems that the use of MBT can increase the participation of children with ID in physical activities because it is considered a type of sports game. Also, MBT is done with a ball and actually requires skill, concentration, and coordination. Therefore, it can improve and develop the level of global motor coordination. Finally, the researchers of this study recommend that sports teachers who work in schools, coaches who work in gyms, and therapists who work in clinics use MBT to improve and develop the MC of ID children, especially those who have other disorders such as DCD.

Abbreviations

MC	Motor coordination
ID	Intellectual disabilities
DCD	Developmental coordination disorder
MBT	Mini-basketball training
KTK	Körperkoordinationstest für kinder
WB	Walking backwards
VH	Vertical hopping
LJ	Lateral jumping
LM	Lateral movement
IQ	Intelligence quotient
DCDCQ	Developmental coordination disorder questionnaire (DCDQ)
OS	Overall score

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s13102-024-01044-8.

Supplementary Material 1

Supplementary Material 2

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Author contributions

Conceptualization, P.S.; Project Administration, P.S. and H.Z.; Investigation, H.Z.; Methodology, H.Z. and P.S.; Writing-Original Draft, H.Z. and P.S.; Writing-Review and Editing, P.S., H.D., and Y.S. All authors have read and agreed to the published version of the manuscript.

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Data availability

The required data and information can be obtained by contacting the corresponding author for the article (sedaghati@guilan.ac.ir).

Declarations

Ethics approval and consent to participate
All experimental procedures followed the principles of the Helsinki Declaration and were approved by the Ethics Committee in Biomedical Research (ETHICS), Guilan University. (ID IR.GUILAN.REC.1402.063). This research study followed the guidelines set by CONSORT for randomized controlled trials and was duly registered in the Iranian Registry of Clinical Trials (ID: IRCT20190425043370N2, on 10/01/2024). Prior to participation, subjects and their legal representatives provided both verbal and written informed consent after gaining a comprehensive understanding of the experimental protocol along with its potential advantages and drawbacks.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

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