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Assessment of Motor Skills and Overall Well-Being in Children with Developmental Coordination Disorder

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ABSTRACT

A specific intervention was conducted for children with DCD (developmental coordination disorder) in order to assess their motor skills. There were 14 subjects in the control group (28%) who were aged 8, 10 (20%) who were aged 9, 13 (26%) who were aged 10, and 13 (26%) who were aged 11. Compared with the control group, the interventional group included 15 (30.6%) participants aged 8, 14 (28.5%) aged 9, 12 (24.4%) aged 10, and 8 (16.3%) aged 11. The mean age of the control group was 9.5 ± 1.16, while that of the intervention group was 9.26 ± 1.06. According to the gender distribution of participants, 52% of the control group were males and 48% were females, while 40.85% of the intervention group were males and 59.2% were females. In order to assess motor skills, a Mini BESTest was used, which contains 14 domains and a total score of 28 points. In the control group, mean scores were 8.62±1.14, 9.81±1.1, 10.8±1.14, and 12.2±1.2 at baseline, 2, 4, and 6 weeks, respectively, with a significant p-value of 0.002. Also, the intervention group demonstrated mean scores of 11.1±1.5, 12.7±1.7, 14.3±2.0, and 16.0±2.4 at baseline, 2, 4, and 6 weeks, respectively, with a highly significant p-value of 0.0001. Additionally, both groups were tested on their ability to cover a distance during a six-minute walk. Compared to the control group at baseline, the second week, the fourth week, and the sixth week, there were significant differences in distances. In the intervention group, as well as in the control group, p-values of 0.05, signifying significance, were detected at the end of each week for the third week. In the study, motor skills improved more in children with DCD than those in the control group. Although the study had limitations, such as a small sample size and a short intervention period, there were also some positive results. Although this research does not prove a cure for DCD, it contributes valuable information to the growing body of knowledge about the disorder and describes how to develop tailored interventions to improve motor skills, as well as overall well-being, in people with DCD.

Keywords: Development Coordination Disorder, Virtual reality, BESTest, 6-minute walk test

INTRODUCTION

Participating in activities allows people with disabilities to develop skills and competence and form relationships and friendships, stay mentally and physically healthy, express creativity, cultivate identity, and find meaning and purpose. [1,2]. Participants have healthy lifestyles, are mobile, exchange information, interact with others, live in communities, pursue education, work, find jobs, live economically, and participate in social, civic, and community activities [3]. In daily life and at school, the performance of a child's motor skills plays a significant role.

Various researchers and practitioners use Virtual Reality (VR) when dealing with motor learning and movement problems [4]. VR allows the user to explore a multidimensional computer-generated environment in real-time, which is essential to its functional use [5]. The use of technology by children has increased in recent decades.

The Nintendo Wii and Sony Eye-Toy have been found to promote physical activity among children of school age in previous research [6]. Video games that encourage players to use their arms, legs, and whole body to interact with on-screen images may help prevent childhood obesity [7]. Research on virtual reality has recently examined movements with virtual objects or towards them, comparing them to real-world movements [8]. Movements with virtual objects or towards them have recently been examined in research on virtual reality to compare them with motions in real life [9].

It is not known what causes coordination problems in DCD, but VR can be used to assess its severity. VR-based activities such as long jump and stair climbing aid in improving balance, running, agility, and functional activities [10]. Physiological systems play an important role in maintaining balance. Balancing Evaluation Systems Test (BESTest) is designed to assist in distinguishing between possible imbalance causes [11]. In studies assessing the self-perceived balance of PD patients, vestibular dysfunction patients, hip arthroplasty patients, and healthy controls, the BESTest total score has been shown to be highly inter-rater reliable and moderately valid. An original BESTest consists of 36 items, but the Mini-BESTest only has 16 items, measures dynamic balance, and takes about 10–15 minutes to complete [12]. As well as external perturbations, transfers, and gait, cognitive performance during dual tasks affects an individual's dynamic balance. The Mini-BESTest, which is used to predict falls, has also been shown to be reliable, valid, and useful. An important study for the treatment of patients is the 6-minute walk test (6MWT). It provides an assessment of functional and therapeutic responses and prognostic information. A consolidated image of musculoskeletal response to exercise can be obtained by this method because of its simplicity and reproducibility. Several conditions can be treated with this inexpensive test, which provides a wealth of information. A flat corridor is walked by the patients at their own pace over six minutes, while standardized instructions and encouragement are provided.

METHODOLOGY

This study was approved by the institutional review board, the MCH and RC of SRM, as well as the IST of SRM. The study was registered with the Clinical Trials Registry-India as well. CTRI registrant number: CTRI/2021/09/036196, Ethics clearance number: 1911/IEC/2020

STUDY PROTOCOL

Before the selected subjects were enrolled in the study, their parents or guardians (if the parents were unavailable) provided informed consent. Inclusion and exclusion criteria guided the selection of subjects. Randomization was conducted using a computer to randomly assign subjects to control and test groups.

Group A was labelled as the control group and the subjects in the control group received conventional gross motor training for six weeks. The training consists of activities that enhanced the core strength and mobility. The subjects in the control group were trained for running, catching, jumping, throwing the ball, catching and kicking the ball. This pattern of training was seen to have a positive effect on children.

Group B was labelled as the interventional group and the participants allocated to the interventional group were provided with a virtual reality gaming program for six weeks, three times every day for 45 minutes.

Inclusion criteria

Patients Aged between 8-11years

Both Male and Female patients

Exclusion Criteria:

Patients Diagnosed neurological or other movement disorders

Patients with Congenital, musculoskeletal or cardio-pulmonary disorder that could affect motor performance

Patients diagnosed with visual impairment

Patients with sensory impairment

Patients with cognitive impairment

Epilepsy

Patients who are undergoing physiotherapy management

Patients with Hearing impairment

Monitoring parameters:

Balance; Balance Control Upper Extremity Range of Motion; Shoulder Flexo-extension; Shoulder Adduction Abduction Coordination; Alternating Coordination; Simultaneous Coordination; Upper Extremity Coordination Body Control; Trunk Control; Stances; Speed; Strength; Precision; Direction of movement; Extreme manipulative task

At the baseline visit, the subjects were assessed for their motor coordination using Kids- Bes Test, and six-minute walk test. The follow up visits were conducted at 2, 4 and 6 weeks when Kids- Bes Test and 6MWT were performed.

Six Minute Walk Test (6MWT):

In the 6MWT, subjects are assessed for their psychometric properties and functional capacities. American Thoracic Society guidelines have been issued for the 6MWT. The distance a patient can walk in six minutes without any hindrance is the only measure used to determine their fitness [13]. A large number of children had high tolerance levels and found the method easy to use [14]. Depending on the other factors associated with the walking distance, the variation in walking distance can indicate different deficits or conditions [15].

Mini BESTest:

This balance test was developed in 2010 and is reputable and reliable for identifying adult impairment causes [16]. An assessment of dynamic mobility, functional mobility and gait is included in the dynamic balance test [17]. A total of 28 points are awarded for each of the 14 items in the test. There are various aspects of postural control assessed in these items, including anticipatory tasks (standing on one leg, rising to your toes), reactive postural control (compensatory step correction forward, backward, and lateral), sensory orientation (standing on firm, foam, or incline surfaces with closed eyes), and dynamic gait (changing gait speed, rotating head horizontally, pivoting, stepping over obstacles, timed up, dual task). To perform the test successfully, subjects must wear flat-heeled shoes or remove their shoes and socks.

STATISTICAL ANALYSIS

Mean and standard deviation are used to express all the values. An ANOVA test was used to analyze all tests. Estimated and interpreted comparisons between and within groups were performed. Statistical significance was determined by a p value of 0.05.

RESULTS AND DISCUSSION

Demographic Data

Table 1 provides the age-wise distribution of the participants in the study. In the control group, 28% (14) of the patients were 8 yrs old, 20% (10) were 9 yrs old, 26% (13) were 10 yrs old, and 26% (13) were 11 yrs old. In the intervention group, 30.6% (15) of the participants were 8 years old, 28.5% (14) were 9 yrs old, 24.4% (12) were 10 yrs old, and 16.3% (8) were 11 yrs old. The mean age of the subjects in the control group was 9.5 ± 1.16, while the mean age of the subjects in the interventional group was 9.26 ± 1.06. Table 2 presents the gender-wise distribution of the participants. In the control group, 52% were male, and 48% were female. In the intervention group, 40.85% were male, while 59.2% were female.

Table: 1 Age wise distribution of subjects

Age	Group A (Control) N (%)	Group B (Intervention) N (%)
8	14 (28%)	15 (30.6%)
9	10 (20%)	14 (28.5%)
10	13 (26%)	12 (24.4%)
11	13 (26%)	8 (16.3%)
Total	50	49
Range	8-11 years	8-11 years
Mean ± SD (Age in years)	9.5 ± 1.16	9.26 ± 1.06

Table: 2 Gender wise distribution of subjects

Gender	Group A (Control) N (%)	Group B (Test) N (%)
Male	26 (52%)	20 (40.8%)
Female	24 (48%)	29 (59.2%)
Total	50	49

Mini-BESTest

The Mini BESTest contains 14 domains and the total score to be assessed for is 28 points. The control group showed 8.62±1.14, 9.81±1.1, 10.8±1.14 and 12.2±1.2 at baseline, 2,4 and 6 weeks respectively with a p value of 0.002 indicating statistical significance. In the intervention group, the recorded scores were found to be 11.1±1.5, 12.7±1.7, 14.3±2.0 and 16.0±2.4 at baseline, 2, 4 and 6 weeks respectively with p value of 0.0001 indicating that it is statistically significant. The results are shown in table 3 and is graphically presented in figure 1.

Table: 3 Results of Mini BESTest expressed as Mean ± SD

Parameter	Group	Baseline	2nd week	4th week	6th week	p value
Overall Mini BESTest score	**Control**	**8.62±1.14**	**9.81±1.1**	**10.8±1.14**	**12.2±1.2**	**0.002**
	Intervention	**11.1±1.5**	**12.7±1.7**	**14.3±2.0**	**16.0±2.4**	**0.0001**

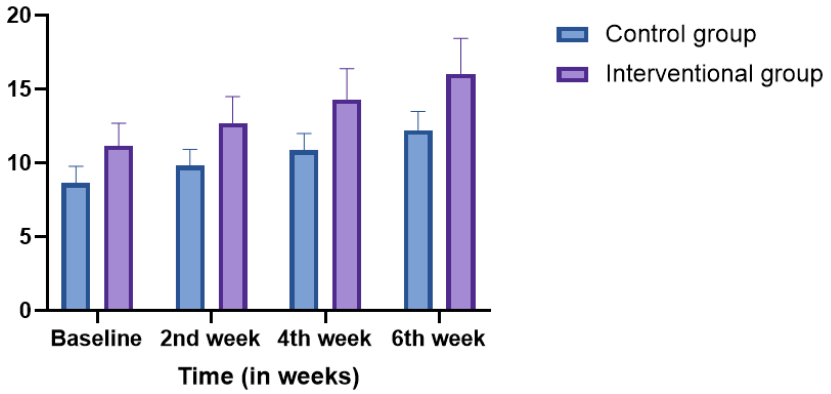

Figure: 1 Mini BESTest scores between control and interventional groups at baseline, 2nd,4th and 6th weeks

Six Minute Walk Test

As the distance covered in meters by the control and intervention groups, we calculated the mean and standard deviation. A control group showed 307.9±9.8 at baseline, 315±9.4 at 2nd week, 323.8±9.1 at 4th week and 325.1±8.9 at 6th week. There was a statistically significant difference between the two groups with a p value of 0.0004. Meanwhile, the intervention group recorded 326.9±5.8 at baseline, 333.4±5.8 at 2nd week, 340.7±6.4 at 4th week and 346.9±7.2 at 6th week. The results were found to be significant with p value 0.05. This is shown graphically in figure 2 and in table 4.

Table: 4. Results of 6MWT expressed as Mean ± SD

Parameter	Group	Baseline	2nd week	4th week	6th week	p value
Distance covered (m)	Control	307.9±9.8	315±9.4	323.8±9.1	325.1±8.9	0.0004
	Intervention	326.9±5.8	333.4±5.8	340.7±6.4	346.9±7.2	0.05

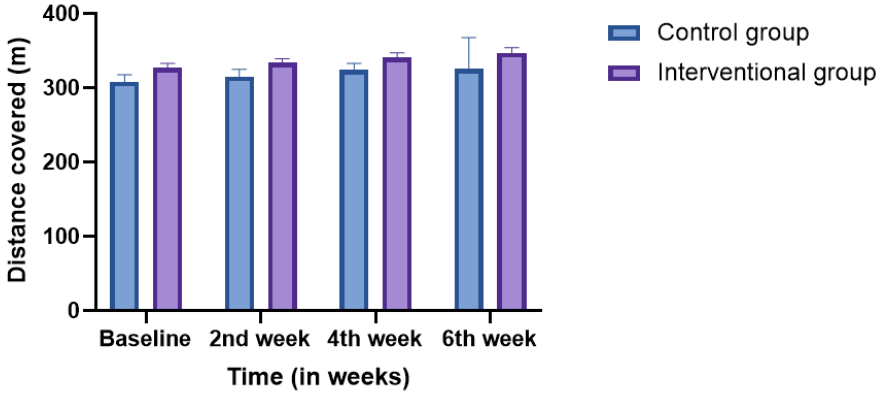

Figure: 2 Results of 6-minute walk test between control and interventional groups at baseline, 2nd,4th and 6th weeks

Discussion

In addition to improving balance, running, agility, and functional activities such as long jump and stair climbing, research suggests that VR-based games can improve social skills, memory, and cognitive function [18]. Balance impairments are common in Parkinson's disease, multiple sclerosis, and other conditions. According to these

studies, it was reliable to use these measures for assessing balance [19-22]. It was reported that Intraclass Correlation Coefficients (ICCs) for each subsystem ranged from 0.70 to 0.96 [23-25]. While there is a one-month interval between measures of BESTest, both versions are highly reliable. It was reported that the highest MDC values found in these populations [26]. Patients with vestibular disorders, stroke, and chronic obstructive pulmonary disease were found to exhibit a Mini-BEST MDC [27-29]. In addition, [29] found an MDC95 of 28 points for the Brief BESTest total score. Based on the analysis of the studies, 60 to 4,200 minutes of therapy were analyzed. It is important to train for a sufficient amount and duration of time in order to learn motor skills. To eliminate the possibility of missing information, articles that combined balance tests and upper extremity functions tests without subscores were excluded. Two tests were excluded based on this criterion. Due to the fact that Virtual Reality Therapy (VRT) is a relatively new intervention without an established definition, the interventions utilized across studies vary considerably. There is a need for standardized assessment tools for children to be developed and implemented in VRT interventions with a greater level of consensus.

Conclusion

Children with DCD showed positive improvements in motor skills after the intervention. Both control and intervention groups demonstrated improvements in all three domains (Fine motor/handwriting, Gross Motor Control, and Control during movement) six weeks after the intervention. The control group showed statistically significant improvement in the mentioned domains. However, the intervention group displayed even greater improvements, indicating the effectiveness of the specific intervention. Motor difficulties in affected children can significantly impact daily activities and long-term outcomes, emphasizing the importance of tailored interventions to enhance their quality of life and social participation. Although the study has limitations such as a small sample size and short intervention period, it provides valuable insights into Developmental Coordination Disorder research and paves the way for targeted interventions to improve motor skills and overall well-being.

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