ประสิทธิภาพของโปรแกรมการฝึกที่บ้านต่อการทำงานประสานงานกันของกล้ามเนื้อในเด็กวัยประถมศึกษาที่ได้รับการวินิจฉัยโรคสมาธิสั้น

Efficacy of Structured Home Program to Improve Motor Coordination in Elementary School Children with Attention-Deficit/Hyperactivity Disorder

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บทคัดย่อ

วัตถุประสงค์ เพื่อศึกษาผลของโปรแกรมการเพิ่มสมรรถนะการทำงานประสานงานกันของกล้ามเนื้อที่บ้านต่อการทำงานประสานงานกันของกล้ามเนื้อและอาการสมาธิสั้นในเด็กวัยประถมศึกษาที่ได้รับการวินิจฉัยโรคสมาธิสั้น

วิธีการศึกษา การศึกษานี้เป็นการศึกษาเชิงทดลองขั้นต้นแบบกลุ่มเดี่ยวเปรียบเทียบก่อนและหลังได้รับสิ่งทดลอง ผู้ป่วยเด็กทั้งหมด 7 คนที่ได้รับการวินิจฉัยโรคสมาธิสั้นร่วมกับมีปัญหาการทำงานประสานงานกันของกล้ามเนื้อ จากแผนกผู้ป่วยนอกจิตเวชเด็กและวัยรุ่นโรงพยาบาลมหาราชนครเชียงใหม่ ในช่วงปีพ.ศ. 2559 ถึง 2561 ได้เข้าร่วมโปรแกรมการเพิ่มสมรรถนะการทำงานประสานงานกันของกล้ามเนื้อผ่านกิจกรรมที่บ้านในช่วงระยะเวลา 3 เดือน ผู้เข้าร่วมการวิจัยแต่ละรายได้รับการประเมินสมรรถนะของกล้ามเนื้อและอาการสมาธิสั้นก่อนและหลังการทำกิจกรรม อาการสมาธิสั้นได้รับการประเมินโดยใช้แบบประเมินความรุนแรงของอาการสมาธิสั้น SNAP-IV (Swanson, Nolan and Pelham IV questionnaire) (short form) ฉบับภาษาไทย สมรรถนะของกล้ามเนื้อได้รับการคัดกรองโดยใช้เครื่องมือประเมินกล้ามเนื้อมัดใหญ่และมัดเล็ก ชื่อ Bruininks-Oseretsky test of motor proficiency-second edition (BOT-2) วิเคราะห์ประสิทธิภาพของโปรแกรมการฝึกโดยใช้โปรแกรม SPSS รุ่น 26 และการวิเคราะห์ทางสถิติแบบ Wilcoxon signed rank test

ผลการศึกษา ผู้เข้าร่วมวิจัย 5 ใน 7 คนเข้าร่วมโปรแกรมการฝึกจนเสร็จสิ้น โดยทุกคนที่เข้าร่วมโปรแกรมการฝึกครบ 12 สัปดาห์ พบว่ามีสมรรถนะกล้ามเนื้อในด้านความแม่นยำของกล้ามเนื้อมัดเล็ก การประมวลผลของกล้ามเนื้อมัดเล็ก และความคล่องแคล่วพัฒนาดีขึ้น อย่างไรก็ตามไม่พบความแตกต่างอย่างมีนัยสำคัญทางสถิติระหว่างคะแนน BOT-2 ($p>0.5$) และอาการสมาธิสั้น ก่อนและหลังการเข้าร่วมโปรแกรม

สรุป โปรแกรมกิจกรรมที่บ้านอาจมีประโยชน์ต่อการพัฒนาความสามารถในการควบคุมกล้ามเนื้อมัดเล็กและการทำงานประสานกันของกล้ามเนื้อในเด็กสมาธิสั้นที่มีปัญหาการประสานงานกันของกล้ามเนื้อ เนื่องจากไม่ความแตกต่างอย่างมีนัยสำคัญทางสถิติ ผลของประสิทธิภาพของโปรแกรมที่เข้มข้นมากขึ้นจำเป็นต้องได้รับศึกษาต่อไปในอนาคต

คำสำคัญ การทำงานประสานกันของกล้ามเนื้อ โรคสมาธิสั้น เด็ก

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ABSTRACT

Objectives : To evaluate whether the motor coordinate rehabilitation structural home program affected motor incoordination and attention-deficit/hyperactivity symptoms in elementary school children with attention-deficit/hyperactivity disorder.

Methods : The study was a one-group pretest-posttest experimental design. Seven children (n=7) who had been diagnosed with attention/deficit hyperactivity disorder (ADHD) with motor coordination problems at childhood and adolescent psychiatric outpatient department at Maharaj Nakorn Chiang Mai Hospital in 2016-2018 agreed to participate in the three-month motor coordinated rehabilitation structured activities home program. Each participant was assessed before and after the intervention using measures of ADHD symptoms and motor proficiency to evaluate the efficacy of interventions. ADHD symptoms were evaluated by the Swanson, Nolan, and Pelham IV questionnaire-short form (SNAP-IV) Thai version, and the motor proficiency was evaluated by the Bruininks-Oseretsky test of motor proficiency-second edition (BOT-2). The effects of interventions were analyzed using the Wilcoxon signed ranks test by the SPSS software version 26.

Results : Five of seven participants completed the interventions. All participants who followed the 12-week intervention period had clinical improvement in motor proficiency in the aspects of fine motor precision, fine motor integration, and manual dexterity after the training. However, there was no statistically significant difference between the pre-intervention and the post-intervention score on BOT-2 ($p>0.05$). No significant difference was found in ADHD symptoms

Conclusion : Structure activities home program may have benefits to clinical improvement on fine manual control and manual coordination in children with ADHD and motor coordination problems. Due to no statistically significant outcomes, further investigation is needed to determine the effect of the structured home program in a more intensive regimen.

Keywords : motor coordination, attention deficit hyperactivity disorder, children

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Introduction

The worldwide prevalence of attention/deficit hyperactivity disorder (ADHD) is estimated at 5.29%.[1] Classified by age group, the prevalence in child and adolescent is 5.9-7.1%.[2] ADHD impacts on the quality of life[3,4], school performance, work[4], social interactions, the burden in family responsibility[5,6] and also including increasing cost in health services.[7]

Common comorbid psychiatric disorders in ADHD are oppositional defiant disorder (ODD), conduct disorder, anxiety disorder, depression disorder, learning disorder, autistic spectrum disorder. Developmental coordination disorder (DCD) is one of the important comorbidities in children with ADHD. Approximately 30-50 % of ADHD patients have motor problems.[8-10] and might meet the diagnostic criteria of DCD.[11] Impaired movement performance such as postural deficit[12,13], poor fine motor controlled[11,12,14,] and coordination problem[12,15,16] can be found in a patient with ADHD. Children with ADHD who have motor coordination problems have disorganization[17], low quality of activities of daily life[18], anxiety, and depression more than the patient with only ADHD.[19] It is important to pay attention and evaluate this problem among children with ADHD for preventing a negative impact on social functioning.

Motor-based interventions were used for treatment in developmental coordination disorder (DCD). The systemic review supports the body-function and activity-oriented intervention can improve motor skills in DCD.[20] For example, if we use cutting paper for improving eye-hand coordination, it was labeled as body-function oriented. If the goal of cutting paper is to improve the skill itself, it was labeled as activity-oriented. Using the International Classification of Functioning, Disability, and Health (ICF) terminology, the body-function oriented approach uses engaged activity to improve troublesome body function, meanwhile, the activity-oriented approach uses engaged activity to improve performance in that activity.[20,21]

To our knowledge, current information does not provide clear recommendations on intervention protocols for individuals with DCD. It still has no research to determine the efficacy of interventions at the parent-level for motor incoordination in children.[20] There are currently few studies in treatment for motor coordination in children with ADHD and lack of standard treatment for this condition. Some studies suggested that physical therapy can improve motor performance in children with ADHD[22-24] and fine motor training is effective in treatment for motor incoordination in children with ADHD.[25] The evidence base is insufficient to developed treatment home programs, so our purpose of this study is to develop structural home programs at parent-level interventions for children with ADHD and DCD and examine their efficacy on motor incoordination in elementary school children with ADHD.

Material and Method

1. Objectives

Our primary objective was to evaluate the effect of motor coordinate rehabilitation structural

home program on motor incoordination in elementary school children with attention-deficit/hyperactivity disorder. Also, the secondary objective was to evaluate its effect on attention-deficit/hyperactivity symptoms.

2. Participants

Informed content was obtained from parents of all participants and informed assent was obtained from all participants. Approval was obtained from the Research Ethics Committee Faculty of Medicine Chiang Mai University (CMUREC No. 295/2019).

Inclusion criteria were as follows: (1) participants were 6 to 12 years old; (2) participants understood and communicated in Thai; (3) participants had a diagnosis of ADHD and followed up on Childhood and Adolescent Psychiatric Outpatient Department at Maharaj Nakorn Chiang Mai Hospital; (4) participants were screened by the Bruininks-Oseretsky test of motor proficiency-2nd edition, short-form (BOT-2, short form) at the Childhood and Adolescent Psychiatric outpatient Department at Maharaj Nakorn Chiang Mai Hospital.

Participants with depressive disorder, anxiety disorder, Intellectual disability, visual impairment, cerebral palsy, or muscular atrophy and who cannot understand and communicate in Thai were excluded from the study.

A sample of seven children diagnosed with ADHD with motor coordination problems screening by the Bruininks-Oseretsky test of motor proficiency-second edition (BOT-2)-short form (6 boys and 1 girl) between the ages of 6 and 12 years who were followed in the Childhood and Adolescent Psychiatric Outpatient Department at Maharaj Nakorn Chiang Mai Hospital in 2016-2018 agreed to participate this study. All participants were from the same populations from a previous study in 2018 which studied the prevalence and associated factors of DCD among patients with ADHD at Maharaj Nakorn Chiang Mai Hospital.[26] All children (n=21) meeting the inclusion criteria were contacted and approached by a child psychiatrist to participate in this study. Only seven out of 21 participants agreed to attend the present study. The reasons for refusal were unavailable due to the current covid-19 pandemic situation and limited transportation by national government law (n=4), missing an appointment (n=4), contact failures (n = 2), inattention (n=2), and no further ADHD follow up (n= 2). The diagnosis of ADHD was made by child psychiatrists according to the American Psychiatric Association's Diagnostic Statistical Manual of Mental Disorders—5th Edition (DSM-5).[27] None of the children were trained in a motor training program during the study.

3. Materials

3.1 General information

General information questionnaires including gender, age, body weight, height, gestational age at birth, birthweight, education, history of repeating a year/class, grade point average, right/left-handed, exercise frequency,

parental education, parental underlying disease, and medical records were completed by children and their parents.

3.2 Screening tools

3.2.1 Attention /deficit hyperactivity measures

The Thai version of Swanson, Nolan, and Pelham IV (SNAP-IV) questionnaire- short form was used to assess ADHD symptoms. The Thai version of SNAP-IV is a valid and reliable screening tool for ADHD in a child psychiatric clinic. Test reliability is favorable (Cronbach's alpha = 0.93-0.96).[28,29]

The SNAP-IV Thai version is a questionnaire and consists of 26 items measuring ADHD symptoms in 3 domains including hyperactivity/impulsivity, inattention, and ODD symptoms. It is designed to be replied to by either the parent or teacher of a school-aged child. Scoring is based on 0-3 scale; 0 point: "not at all", 1 point: "just a little", 2 points: "quite a bit", 3 points: "very much". Subscale score cutoffs in each domain are as follows; hyperactivity/impulsive: teacher score of 18, parent score of 16, inattention: teacher score of 11, parent score of 14, and ODD symptoms: teacher score of 8, parent score of 12.[29]

All participants were assessed SNAP-IV Thai version by their parents at the Childhood and Adolescent Psychiatric Outpatient Department at Maharaj Nakorn Chiang Mai Hospital.

3.2.2 Motor proficiency measures

The Bruininks-Oseretsky test of motor proficiency-2nd edition (BOT-2) was used to assessed motor coordination and designed to measure motor skills in the age range from 4 to 21. The test has the most evidence to assess and identify motor coordination[30] providing adequate validity and reliability for measurement for diagnosis of developmental coordination disorder.[31] Test-retest reliability is excellent in individuals ages 4 to 12 (ages 4-7;ICC = 0.83, ages 8-12;ICC = 0.82).[32] The BOT-2 covers fine and gross motor skills within four motor areas including fine manual control, manual coordination, body coordination, and strength and agility. The scores for BOT-2 are reported as total point scores, standard scores, or percentile ranks. Descriptive categories ranges are interpreted from "well-below average" to "well-above average".[33]

All participants in the present study were tested the BOT-2 by occupational therapists at the Occupational Therapy Department, Faculty of Associated Medical Sciences, Chiang Mai University at Maharaj Nakorn Chiang Mai Hospital.

3.2.3 Anxiety measure

The screen for child anxiety related disorder (SCARED)-41 items Thai version was utilized for screening anxiety symptom dimensions. SCARED is a reliable and valid screening tool for anxiety symptoms in children and adolescent[34-36] which is multidimensional self-report questionnaires indicating panic disorder, generalized anxiety disorder, separation anxiety disorder, social

anxiety disorder, and significant school avoidance. Scoring is based on a 1-3 scale; 1 point: “almost never”, 2 point: “sometimes”, 3 points: “often”. Total and subscale scores can be obtained by summing across relevant items.[37] All participants were screened using the SCARED-41 items Thai version.

3.2.4 Depression measure

Children’s depression inventory (CDI) Thai version was used for screening depressive symptoms in children and adolescents between the ages of 7 and 17. The reliability coefficient (Alpha) is 0.83. CDI Thai version SNAP-IV is a 27-item, self-report questionnaire with scoring based on 0-2 scales. The cut point score for significant depressive symptoms is 15.[38,39] All participants were screened using the CDI Thai version.

3.2.5 Intelligence measure

The Wechsler intelligence scale for children-IV (WISC-IV) was used to evaluate a child’s intellectual ability using paper and pencil administration. WISC-IV was interpreted by manual scoring using four composite scores as follows: verbal comprehension, perceptual reasoning, working memory, and processing speed.[40] In the present study, we used full-scale IQ scores for screening intellectual functions. All participants were evaluated by psychologists at the Department of Psychiatry, Faculty of Medicine, Chiang Mai University.

3.2.6 Visual screening

The Snellen chart was recommended for assessing vision screening for children six years and older.[41,42] All participants were assessed the test by physicians at the Childhood and Adolescent Psychiatric Outpatient Department.

3.3 History taking and Physical examination

History taking and physical examination including neurological examinations were performed by two physicians to rule out muscular atrophy and cerebral palsy.[43-45]

4. Procedure

Informed consent and assent were collected from participants and their families before attending the intervention.

Children were assessed ADHD symptoms using SNAP-IV at childhood and adolescent psychiatric outpatient department before starting a structural home program and within one month after finishing the program. In the meantime, they were evaluated a motor performance using BOT-2 at the Department of Occupational Therapy at Maharaj Nakorn Chiang Mai Hospital before and after the program.

All Participants received a three-month structured home program sheet under assigned advice and guidance by researchers. We applied various activities to design the motor coordination rehabilitation structural home program. The eight activities in the structural home program were as follows:

Activities	Intensities
Cutting papers into instructed shapes	2 pieces per week
Drawing lines to connect dots	1 page per day
Folding papers into origami	1 piece per day
Drawing pictures from examples	10 pictures per day
Separating beads by colors	1 time per day
Threading beads	1 time per day
Rope jumping	2 sets per day
Running to catch the ball	1 set per day

Activities were designed based on 2017 international clinical practice recommendations (CPR) for developmental coordination disorder (DCD) which was initiated by the European Academy of Childhood Disability (EACD).[46] Participants were allowed to choose the day to cut papers and time to engage in other activities.

The intervention program continued for 12 weeks and took place between April and July 2020. Parents were asked to keep a diary in a program handbook for 12 weeks and to record performed activities. During the program, parents/caregivers and/or the child were given seven follow-up appointments to submit assignments and checked compliance by occupational therapists at the childhood and adolescent psychiatric outpatient department. Appointments compliance was ensured by recording scheduled appointments and telephone contact before the meeting. Compliance in completing activities was verified by workpieces, homework sheets, and pictures or recording videos. Results from the follow-up report in each activity were scored and summarized into percentages. Follow-up scoring was based on 1-3 scale; 1 point: "Less than 50% completion", 2 point: "50% completion", 3 points: "100% completion". Three-points scores meant good compliance.

5. Statistical Analysis

Descriptive statistics were used to describe the characteristics of the samples. Medians and interquartile ranges (IQR) were used to describe continuous variables including age, body weight, height, gestational age at birth, birth bodyweight, grade point average, CDI scores, SCARED scores, and WISC-IV scores. Frequencies and percentages were used to describe categorical variables including gender, education, history of repeating a year/class, right-handed/left-handed, exercise frequency, parental education, parental underlying disease, medical record, and visual screening.

Wilcoxon signed ranks test was conducted to determine differences between BOT-2 subtest total point scores and standard scores in pre-and post-intervention. Paired t-test was used to determine differences in attention and motor coordination between pre-and post-intervention.

All analyses were performed using SPSS 22 for Windows.

Results

Participants

Seven children (males = 6, females = 1) with ADHD with a median age = 10 [range = 8-11 years] agreed to participate in the study. Five children completed the interventions. Of those, one was unavailable to the appointment and decided to leave the study before the intervention started. Another one left after the first initial demonstration. Table 1 outlines the characteristics of the entire sample. The flow of the participants is shown in Figure 1.

Table 1 Participant Characteristics.

Characteristics	n (%) or median [IQR]
Sex	
Females	0 (0%)
Males	5 (100%)
Prematurity(weeks)	
<37	0 (0%)
>37	5 (100%)
Repeated grade	
Yes	1 (20%)
No	4 (80%)
School-records (grade)	
<1.00	0 (0%)
1.01-2.00	0 (0%)
2.01-3.00	3 (60%)
3.01-4.00	2 (40%)
Handed	
Left	0 (0%)
Right	5 (100%)
Exercise frequency	
No exercise	
1-3 days per week	2 (40%)
3-5 days per week	2 (40%)
6-7 days per week	1 (20%)
Everyday	0 (0%)
Paternal education	
Below elementary school	0 (0%)
Elementary school	1 (20%)
High school	0 (0%)
Higher education	4 (80%)
Maternal education	
Below elementary school	0 (0%)
Elementary school	2 (40%)
High school	0 (0%)
Higher education	3 (60%)
Parental underlying disease	
Yes	1(20%)
No	4(80%)
Comorbidities	
Yes	4 (80%)
No	1 (20%)
Current stimulant medications	
Yes	4 (80%)
No	1 (20%)
Age (years)	10 [8-11]
Weight (kg)	38.70 [28.25-57.00]
Height (cm)	136.00 [129.00-149.50]
BBW (gm)	3400.0 [2960.0-3662.5]
IQ	94.0 [69.0-119.5]
SCARED	14.0 [6.0-37.0]
CDI	6.0 [2.0-7.5]

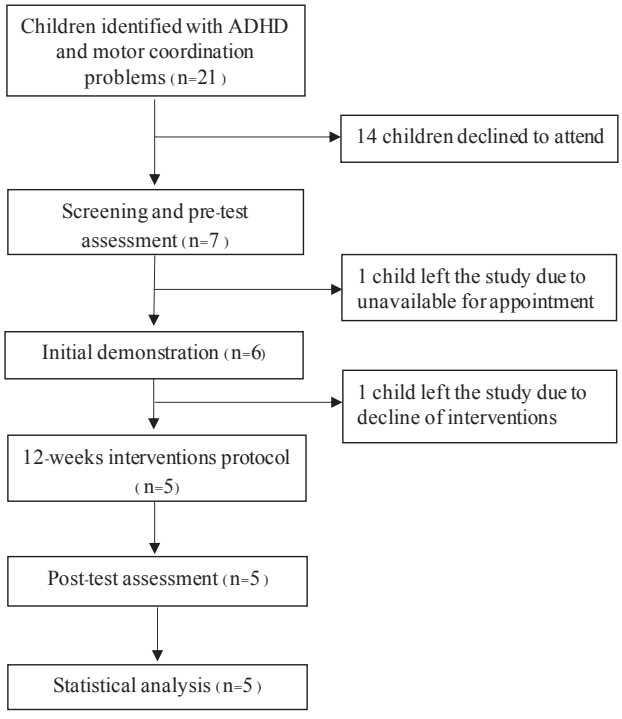

Figure 1 Flow of the Participants.

Other comorbidities were present in almost all of the children (80%). According to the DSM-V criteria, one was diagnosed with a comorbidity with a specific learning disorder, one was diagnosed with comorbidity with the oppositional defiant disorder. Other comorbidities were sensory neural hearing loss and primary enuresis. For paternal underlying disease, only one individual had paternal depression (20%). The current stimulant medications taken by the children included Ritalin (methylphenidate chlorhydrate, short-acting) in four cases, Concerta (methylphenidate chlorhydrate, long-acting) in one case. As completed by the parents, the median total score on the SNAP-IV was 27 [23-29]. After the intervention program, the median score was 26 [23.0-30.5]

An IQ test (The Wechsler Intelligence Scale for Children fourth edition) was performed. The median IQ was 94 [69.0-119.5]. One participant whose IQ was 69 does not meet the criteria for intellectual disability due to good adaptive functioning.

All participants came on follow-up schedule protocol (100%). Compliance rate to activities protocol was good with a median of 87.71% [76.79-100] of completed activities.

Efficacies of Structural Home Program on Motor Skills

Even though participants showed improvement on the BOT-2 standard score which focused on enhancing motor coordination, no statistically significant differences between the

pre-and post-intervention scores were found. No significant improvement was found in the fine manual control, manual coordination, body coordination, and speed and agility ($p > 0.050$) following the 12-week intervention period.

However, there was trend toward improvements in fine motor integration ($p = 0.068$) and upper-limb coordination ($p = 0.078$). Being classified under the motor category, all participants were grouped into average motor proficiency in the aspects of fine motor precision, fine motor integration, and manual dexterity after the training. Clinical improvement was found on the motor category and standard scores in subtest fine manual control, manual coordination, and strength and agility. Table 2 and Figure 2 shows the results as described.

Table 2 Comparison of pre-and post-test on total point scores and standard scores of BOT-2 and SNAP-IV scores

Scale	Median [IQR]		Z	p-value[a]
	Pre-test	Post-test		
BOT-2: TPS				
Fine motor precision	37.0 [34.0-38.0]	39.0 [38.0-40.0]	-1.625	0.104
Fine motor integration	33.0 [30.0-35.5]	38.0 [36.5-39.0]	-1.826	0.068
Manual dexterity	28.0 [25.0-28.5]	31.0 [27.0-34.0]	-1.633	0.102
Upper-limb coordination	23.0 [15.5-28.5]	30.0 [20.0-33.5]	-1.761	0.078
Bilateral coordination	16.0 [15.5-21.0]	21.0 [17.5-22.5]	-0.813	0.416
Balance	22.0 [19.5-28.0]	23.0 [20.0-25.0]	-0.687	0.492
Running speed and agility	26.0 [23.5-32.5]	28.0 [27.0-31.5]	-0.405	0.686
Strength: knee push-up	18.0 [16.5-21.0]	18.0 [13.0-22.5]	-0.557	0.577
BOT-2: SS				
Fine manual control	39.0 [34.5-52.5]	54.0 [47.5-57.5]	-1.753	0.080
Manual coordination	38.0 [31.0-43.0]	41.0 [36.0-52.5]	-1.355	0.176
Body coordination	31.0 [28.5-41.0]	32.0 [31.5-39.0]	-0.674	0.500
Speed and agility	38.0 [35.0-41.5]	40.0 [37.5-42.0]	-1.105	0.269
Total motor composite	33.0 [31.5-40.5]	39.0 [35.0-45.5]	-1.214	0.216
SNAP-IV	27.0 [23.0-29.0]	26.0 [23.0-30.5]	-0.271	0.786

Abbreviations: BOT-2, the Bruininks-Oseretsky Test of Motor Proficiency Second Edition; IQR, the interquartile range; SS, standard scale; TPS, total point score; SNAP-IV, Swanson, Nolan, and Pelham IV Questionnaire

a. Wilcoxon Signed Ranks Test

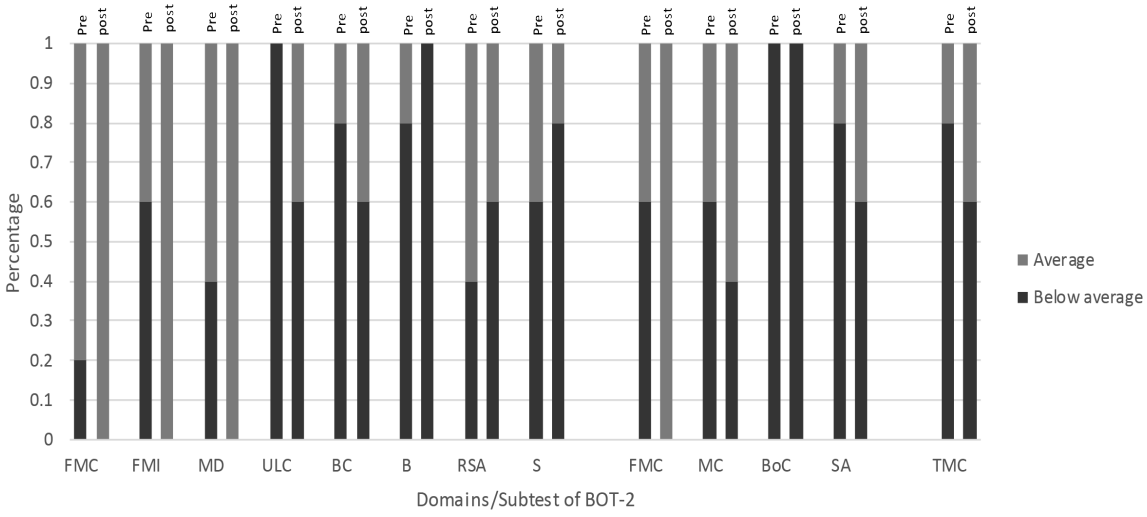

Figure 2 Comparison between pre- and post-test on BOT-2 category ranging in total motor composite (TMC) and each subtest of 4 domains: 1) fine manual control (FMC): fine motor precision (FMP) and integration (FMI); 2) manual coordination (MC): manual dexterity(MD) and upper-limb coordination (ULC); 3) body coordination (BoC): bilateral coordination (BC) and balance (B); and 4) strength and agility (SA): running speed and agility (RSA), and strength (S).

Efficacies of Structured Home Program on ADHD Symptoms

There was no significant difference between pre-and post- interventions in the total SNAP-IV score ($p = 0.786$). Moreover, there was no significant differences between SNAP-IV scores in each item group related to impulsivity/hyperactivity, inattention, and ODD symptoms.

Discussion

To our knowledge, this is the first study investigating the effect of a structured activity home program on motor proficiency in a sample of children with ADHD and motor coordination difficulties. The study assured good compliance to ensure the results.

The main finding of this study shows that fine motor precision, fine motor integration, and manual dexterity in children with ADHD and motor coordination difficulties had clinical improvement after a 12-week structured activities home program. The improvement in BOT-2 standard scores on subtest fine manual control and manual coordination were observed, although results showed no statistically significant differences. Moreover, no significant differences in SNAP-IV scores were reported by parents between pre-and post-interventions.

The higher standard scores on BOT-2 suggest that the 12-weeks structured activities home program may have been effective in improving motor proficiency preferred increasing motor coordination skills. Results of the previous study have been suggested that a structured physical activity program improved motor performance in children with ADHD.[47] Physical interventions have been related to improvement in motor performance in children with both ADHD and motor coordination difficulties.[10,47] A systemic review and meta-analysis showed that activity-oriented and body function-oriented interventions could have a positive effect on motor function and skills.[20]

The present results underline the recommendations from 2017 international clinical practice recommendations from the European Academy of Childhood Disability (EACD) that activity-oriented and participation-oriented approaches be used as a means to improve general, fundamental, and specific motor skills in individuals with DCD. The mean duration of new effective studies was ten weeks (range 2–18wks).[46]

Our findings which showed an improvement in fine manual control consisting of fine motor precision and fine motor integration concurred with the results from the previous study that children benefitted from scissor skill programs to improve bilateral fine motor skills and were able to retain their skills after three months.[48] Fine motor control, bilateral and visual-motor integration are some components of handwriting skill of and providing supplementary handwriting instruction was suggested.[49] Children also achieved better fine motor tasks after three months of physiotherapy based on writing exercises.[50] Following earlier designed programs paper art activities including paper folding can improve eye-hand coordination.[51-53] Practicing copying geometrical shapes and two-dimensional pictures for four weeks can also improve coordination.[54] Drawing and copying forms can be used in therapeutic intervention for visual-motor integration.[54- 56]

In the present study, children showed an enhancement in manual dexterity as a result of the interventions. These findings were consistent with the results from a previous four week home-based dexterity training program that improved manual dexterity and dexterity-related ADL.[57]

The previous study of the efficacy of rope jumping on bilateral coordination and balance showed a positive effect as they use a fixed period training session, guided rate of rope rotations per minute[58, 59], and selected rope weight.[59] Considering the differences in intensity, timing, and weighed rope material, we found no clinical change in body coordination consisting of bilateral coordination and balance after completing the interventions. In the present study, we permitted participants to perform rope jumping at an individual comfortable speed and time frame , which probably affects the results. Gross motor training with a ball-catching activity can be used to improve motor functions in DCD.[60] Running experiences can enhance coordination and its variability.[61] Running to catch

the ball was allowed to be performed in comfortable times for individuals, in the same way as rope jumping, which conflicts with the previous study that underwent continuous running.[62]

In our opinion, the results suggested the benefits of a structured activity home program on enhancing motor coordination especially fine manual control and manual coordination. The home-based training program allows child patients to train independently with their parents at any time of the day. Moreover, patients who are unavailable to the hospital can perform the program, particularly in the current covid-19 pandemic situation. The program was also performed with cheap material costs then the program can be easily applied to the therapeutic plan in children with both ADHD and motor coordination problems. Parents can use the program for additional choices to improve motor skills in their children.

Limitations

There are several limitations in the present study. First, limited sample sizes and one-group pretest-posttest experimental design may have limited ability to detect significant differences. As a one-group design, the lack of a control group may not have verified the efficacy of interventions. Although the sample is relatively small, to our knowledge we are the first to present the effectiveness of a structured activity home programs in children with both ADHD and motor coordination problems. A further randomized controlled trial is needed to determine the effect of structured home programs in large sample sizes. Second, participants in the study were approached by a child psychiatrist resulting in selection bias. Third, the design of the structured home program limited our ability to differentiate the independent effects of each activity on motor coordination. Single activity home programs should be explored for further study. Moreover, exact timing and more intensive settings are necessary. Fourth, environmental and social occurrences that were not covered by exclusion criteria can influence the results. Fifth, the potential impact of some covariates (e.g., pharmacological status) in the individuals has not been explored and should be considered in further studies.

Conclusion

Although no statistically significant difference was found, results suggest that a structured activity home program may benefit clinical improvement on fine manual control and manual coordination in children with ADHD and motor coordination problems. Instead, the intervention program had no significant differences in ADHD symptoms for these groups.

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