

The Effect of Motor Skill Training Program on Activity of Daily Living in Children with Developmental Coordination Disorder

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ABSTRACT

The incidence of children with developmental coordination disorder (DCD) is about 5% to 6% in school-age with 1.7 to 2.8 times more likely to occur in boys than girls. Difficulties in all motor activities, including activities daily living (ADL) are experienced by children with DCD. Motor skill training (MST) which a task-oriented based on basic motor abilities is highly recommended to improve motor achievement and execution of specific motor functions in children with DCD. The purpose of this study was to determine the effect of MST in increasing ADL ability in children with DCD. This research used pre-experimental study with 'the one group pretest-posttest design'. Ten children were selected as respondents to observe their ADL ability using DCDDaily before and after being given MST. The result of statistical analysis showed significant change in the total ADL score before and after being given MST (mean difference 13.95, p-value 0.001), with mean difference of total score before and after 15.9 (p-value 0.001) and mean difference of total score quality before and after 8.4 (p-value 0.005). The conclusion of this research is motor skill training can help improve ADL abilities in children with DCD.

Keywords: Activity of Daily Living (ADL); Developmental Coordination Disorder (DCD); Motor Skill Training (MST)

ABSTRAK

Insiden anak dengan Gangguan Koordinasi Perkembangan (DCD) sekitar 5% sampai 6% pada anak usia sekolah dengan 1,7 sampai 2,8 kali lebih mungkin terjadi pada anak laki-laki dibanding perempuan. Kesulitan dalam keseluruhan aktivitas motorik, termasuk aktivitas kehidupan sehari-hari (ADL) dialami oleh anak DCD. Pelatihan Keterampilan Motorik (MST) yang berorientasi pada tugas berdasarkan keterampilan gerak dasar sangat direkomendasikan untuk meningkatkan pencapaian motorik dan eksekusi fungsi motorik yang spesifik pada anak DCD. Penelitian ini bertujuan untuk mengetahui pengaruh pemberian MST dalam meningkatkan kemampuan ADL pada anak dengan DCD. Penelitian ini menggunakan studi pre-eksperimental dengan 'one group pretest-posttest design'. Sepuluh anak dipilih sebagai responden untuk diobservasi kemampuan ADL mereka menggunakan DCDDaily sebelum dan

sesudah diberikan MST. Hasil analisis statistik menunjukkan perubahan signifikan pada skor total ADL sebelum dan sesudah diberikan MST (beda rerata 13,95, p-value 0,001), dengan beda rerata total skor time sebelum dan sesudah sebesar 15,9 (p-value 0,001) dan beda rerata total skor *quality* sebelum dan sesudah sebesar 8,4 (p-value 0,005). Kesimpulan dari penelitian ini adalah *motor skill training* dapat membantu meningkatkan kemampuan ADL pada anak dengan DCD.

Kata Kunci: Aktivitas Hidup Sehari-hari (ADL); Gangguan Koordinasi Perkembangan (DCD); Pelatihan Keterampilan Motorik (MST)

INTRODUCTION

Developmental Coordination Disorder (DCD) is a developmental disorder incoordination of voluntary movement, timing, and motor learning. These disorders have an impact to all motor activities, including the activity of daily living (ADL) which is very important in the daily functioning of children. Children with DCD show lower abilities on ADL compared to their typical peers (Linde et al., 2015). The term DCD is used to replace previous terms such as clumsy child syndrome and motor-learning difficulties, which are often referred to as dyspraxia (Ball, 2006).

The American Psychiatric Association (APA) in 2013 reported an incidence of DCD was about 5% to 6% in school-age. DCD is 1.7 to 2.8 times more likely to occur in boys than girls (Harris et al., 2015). The American Physical Therapy Association (2006) reported that 5% of children aged 5-11 years are diagnosed with DCD. Tanaya Clinic Bandung noted a high trend in the number of DCD cases. In 2018 there were

104 children with DCD. In 2019 there were 100 children with DCD. Meanwhile in 2020 there are 73 children with DCD. The decline in numbers in 2020 is strongly suspected as a result of the COVID-19 pandemic which began in March. Meanwhile, until January 2021, there were 20 children with DCD.

Various ADLs may be affected by DCD, depending on the individual's age. Children entering kindergarten display a strange gait, have problems getting dressed (buttons, shoelaces) and using cutlery and crockery (spoon, cup), poor drawing or painting skills, clumsy use of scissors, and difficulty riding a tricycle or bicycle. At primary school, they have difficulty writing, drawing, and using scissors, and demonstrate clumsiness in ballgames (Geuze et al., 2001). At secondary school, they continue to have problems with handwriting or typing (Kirby et al., 2010, 2013). Because of these difficulties at school, they often choose courses designed for lower-ability pupils. They gradually lose motivation and experience repeated

failures, which makes it considerably more difficult for them to access higher education and prestigious occupations. In addition, they are generally poor at sports and tend to avoid sporting activities and other forms of physical activity (Magalhães et al., 2011). Consequently, they have a heightened risk of health problems such as being overweight, obesity, and cardiovascular disease (Cairney et al., 2012).

According to APTA Pediatrics (2020), physiotherapy has a major role in developing the right diagnosis and treatment for children with DCD so that they can actively participate in activities of daily living and achieve maximum quality of life according to their potential. They have recommended task-oriented interventions as the first choice in treating children with DCD. Task-oriented interventions are motor activities or programs to improve the achievement and execution of specific functional motor tasks.

Motor Skill Training (MST) is a physiotherapy intervention with a task-oriented approach. Task-oriented is the theoretical basis of motor control and motor learning, focuses on achieving goals through active participation, and progressively increasing task demands (Dannemiller et al., 2020). A variety of functional tasks and exercises are designed

to address common motor difficulties faced by children with DCD, such as agility, balance, core stability, and poor movement coordination. When training takes place, task-oriented is adapted to ensure successful task execution while providing adequate challenges for children's motor skills (Farhat et al., 2016).

The study conducted by (Farhat et al., 2015) showed that the physical capacity of DCD children increased after being given the MST program for 8 weeks. The study also reported a significant increase in motor skills in the group of DCD children after being given the MST program (mean difference: 8.89 ± 0.99). The writing ability of DCD children, which is an important ADL in school-age children, also showed an increase after being given the MST program (Farhat et al., 2016).

This study generally aims to determine the effect of providing Motor Skill Training (MST) on the activity of daily living using DCDDaily in children with DCD. Specifically: (1) Knowing the frequency distribution of cases of children with DCD based on age, gender, causes/risk factors, and ADL before and after treatment; (2) Knowing the condition of ADL in children with DCD before being given treatment; (3) Knowing the condition of ADL in children with DCD after being given treatment; (4)

Knowing the average ADL in children with DCD before and after treatment.

METHOD

This study used pre-experimental with one group pre-test and post-test design. The variables in this study were Motor Skill Training (MST) as the independent variable and activity of daily living (ADL) as the dependent variable. This study used one group that was given MST for 8 weeks with a frequency of 3 times a week.

This research was conducted at Tanaya Clinic, Bandung, in mid-March 2021 to mid-May 2021. The population in this study were all children with diagnosis of DCD at Tanaya Clinic, Bandung. There were 11 samples that met the inclusion and exclusion criteria using purposive sampling. But then 1 respondent withdrew from the study so that the total sample was 10 people.

This number is in accordance with the provisions of the number of samples for simple experimental research, ie 10-20 people (Sugiyono, 2015). Inclusion criteria: (1) 5-8 years old; (2) Experiencing DCD without other neurological disorders as proven by a doctor's diagnosis; (3) The results of the DCDDaily examination are 95th percentile, ie the total score for children aged 5 years ≥ 36 , children aged 6 years ≥ 31 , and children aged 7-8 years ≥ 27 ; (4) Referred by a doctor/psychologist for physiotherapy treatment. Meanwhile, the exclusion criteria were: (1) The presence of other accompanying neurodevelopmental disorders; (2) The presence of hearing and/or vision impairment; and (3) The presence of intellectual or other disorders that affect the child's ability to understand instructions.

Table 1. Norms and Interpretation of ADL Scores by Age

Percentile	5 y	6 y	7 and 8 y	Interpretation
$\geq 95^{\text{th}}$ percentile	≥ 36	$\geq 31,0$	$\geq 27,0$	Problems with ADL
85 th -95 th percentile	35 34	30 29 28	26 25 24	At risk for problems with ADL
Until 85 th percentile	$\leq 33,0$	≤ 27	≤ 23	No problems with ADL

Source: DCDDaily Manual, 2018

Before being given the MST intervention, respondents' ADL ability was measured using DCDDaily. This measuring instrument has sensitivity and specificity values of 80%, cocurrent validity of the

Movement Assessment Battery for Children (MABC-2) of $p = -0.51$. Meanwhile, the internal consistency reliability value was $\alpha = 0.83$, test-retest reliability ICC = 0.90, and interer reliability ICC = 0.93. The data

obtained are total time score, total quality score, and total ADL score. The total ADL score is then classified into percentiles based on the age of the respondent and interpreted (DerLinde et al., 2018).

MST was then given for 8 weeks with a frequency of 3 times a week. The duration of MST was 60 minutes consisting of 10 minutes of warm-up, 35-45 minutes of exercise, and 5 minutes of cooling down. Exercise is given in group sessions of at least 2 people, the form of exercises are aerobic power, strength-neuromuscular joining, flexibility, strength-coordination, balance, balance-ball skills, and reaction speed (Farhat et al., 2016). After being given MST, the measurements were taken again using DCDDaily. Data processing and analysis is done by using data processing software. Data analysis performed was univariate and bivariate. Univariate analysis used frequency distribution, mean, minimum value, maximum value, and

standard deviation. Bivariate analysis was performed using Paired sample t-test for data on total time scores and total ADL scores which were normally distributed. Wilcoxon rank test was used for total quality score data which was not normally distributed. The normality test of the data was carried out using the Saphiro-wilk test. This research has been carried out by considering the ethical principles of health research and has been approved by the Health Research Ethics Commission of Poltekkes Kemenkes Jakarta III No. KEPK-PKJ3/005/V/2021.

RESULTS AND DISCUSSION

Univariate analysis showed the characteristics of respondents in this study. Age, gender, education level, and ADL ability were the variables analyzed to determine the characteristics of the respondents involved in this study.

Table 2. Frequency distribution of respondent characteristics

Characteristic	Variable	n	%	Mean	SD
Gender	Male	9	90	-	-
	Female	1	10		
Age	6 years	1	10	7.4	0.221
	7 years	4	40		
	8 years	5	50		
School grades	Kindergarten	3	30	-	-
	Grade 1 elementary school	1	10		
	Grade 2 elementary school	2	20		
	Grade 3 elementary school	4	40		
ADL (DCDDaily)	Problems with ADL	10	100	-	-
	At risk for problems with ADL	0	0		
	No problems with ADL	0	0		

Based on the results of the analysis, the average age of the respondents was 7.4 years and the standard deviation was 0.221. Most respondents are 8 years old, which is 50%, while 40% of respondents are 7 years old and 10% of respondents are 6 years old. All respondents are of school age, 70% are in elementary school and 30% in kindergarten. Respondents who are in elementary school are 10% in grade 1, 20% in grade 2, and 40% in grade 3. Ninety percent of respondents are male and 10% female.

Table 2 shows all respondents in the category are having problems with ADL. These results are the interpretation of the measurement of ADL ability using DCDDaily before being given the MST intervention. The mean total score of ADL before being given MST was 40.85 with a standard deviation of 2.47 (Table 9). Motor skills of school-age children are very important in their ADL including activities at school such as writing, drawing, cutting, wearing shoes, putting on clothes, opening and closing backpacks, and so on, including playing with their peers. Children with DCD will stand out because of their inability to execute motor functions properly. The difficulties experienced by children with DCD will also have an impact on academic

achievement so teachers and parents are aware of this and try to seek professional help. DCD affects 5-10% of all school-age children and is considered one of the most common disorders affecting this age group (Wilson et al., 2013). Ninety percent of the respondents are male, it is as previously known that boys have 1.7 to 2.8 times higher risk of experiencing DCD than girls (Harris et al., 2015).

Time

The time score was determined based on the length of time in seconds that respondents needed to complete the examination task. The average total time score before MST was given was 43.4 and standard deviation was 3.4. Table 3 showed the average value, standard deviation, minimum value, and maximum value of the time it takes the respondent (time score) to complete 18 tasks in the examination using DCDDaily. Children with DCD take longer to understand and process motion learning due to the inaccuracy of motion execution and the slowness of children with DCD in processing motor learning. Timing is a problem that hinders motor performance in children with DCD because they need lots of examples and directions as well as lots of experiments to be able to complete a motor-task (Yu et al., 2018). Dysfunction in basic visuo-sensory processing, visual-spatial,

tactile perception, kinesthetic, greatly affects basic processing speed (time). The findings of this study also indicated that there is a large need for time due to motor-

timing problems experienced by DCD children. But overall the time it takes by respondents is less after being given MST.

Table 3. Analysis of Task Time Score

No.	Variable Task	Pre-test				Post-test			
		Mean	SD	Min	Max	Mean	SD	Min	Max
1	Buttering a piece of bread	90.00	40.40	55	186	66.2	20.63	36	97
2	Cutting a piece of bread	22.70	6.05	15	30	11.9	1.37	10	14
3	Opening and closing a backpack	60.40	24.19	27	110	35.6	6.58	26	47
4	Gluing paper	75.50	36.44	38	137	42.8	21.15	26	100
5	Folding paper strips	133.40	22.33	111	186	100.0	4.83	91	110
6	Writing	102.90	21.29	70	136	74.0	14.28	51	96
7	Colouring a picture	101.40	26.70	70	143	73.2	27.64	34	132
8	Cutting paper with scissors	90.50	30.59	30	139	92.3	30.45	61	142
9	Building with lego	160.00	40.51	110	221	106.4	19.12	87	138
10	Pouring juice	34.60	9.31	20	47	24.0	5.45	16	35
11	Walking with a filled cup	23.70	5.88	17	36	15.8	1.13	14	18
12	Eating with a spoon	105.20	74.94	50	311	54.7	15.36	21	75
13	Opening a package	50.10	48.57	18	180	23.4	3.20	18	27
14	Tying shoelaces	121.70	43.25	63	186	81.3	34.30	47	136
15	Putting on trousers	69.30	28.57	38	120	39.0	5.14	32	45
16	Putting on a t-shirt	74.10	23.33	37	121	45.3	8.78	36	61
17	Putting on bodywarmer	62.50	11.89	48	82	50.5	13.07	30	69
18	Playing hopscotch	18.00	9.14	8	36	8.4	4.24	6	20

In the paper cutting task (task 8) the average time increased by 2.3. This increase in time was caused by the fact that children become calmer and more patient in cutting so that they become more careful and take longer

time. The decrease in the average value of the time required to perform tasks showed that the speed of children with DCD in performing motor tasks increased after being given MST (Farhat et al., 2015).

Table 4. Analysis of Total Time Before and After Giving Intervention

Variable	Pre-test			Post-test			MD ± SD	df	P-value
	Mean ± SD	Min	Max	Mean ± SD	Min	Max			
Time	43.4 ± 3.4	36	47	27.5 ± 3.3	22	31	15.9 ± 0.1	9	0.001

Note: MD, Mean Difference; df, degree of freedom

The average before being given MST (pre-test) was 43.4, while the average score after

being given MST (post-test) was 27.5. Paired sample t-test was then performed to

determine whether the MST intervention was statistically significant to the total score of time required to complete the task. Table 4 shows the average difference in the total time score before and after the intervention was given at 15.9 and the standard deviation was 0.1, p-value $0.001 < \alpha (0.05)$, which explained that there is a significant difference between the results of the time scores before and after the intervention is given, so it can be concluded that there was an effect of using MST on the time required for children with DCD to complete tasks. This is in accordance with the results of research conducted (Farhat et al., 2015) that

the speed of children with DCD in doing motor-task increases after being given MST using the Movement Assessment Battery for Children (MABC) measuring instrument.

Quality

The quality score was assessed based on the quality of the results of the respondents doing the examination tasks. The classification of quality scores was determined based on the quality criteria for each task, score of 1 = Good; 2 = Moderate; 3 = Poor. The average total quality score found in the respondents of this study was 38.3 and standard deviation was 2.94.

Tabel 5. Analysis of Task Quality Score

No.	Variable Task	Pre-test				Post-test			
		Total	Mean	Min	Max	Total	Mean	Min	Max
1	Buttering a piece of bread	21	2.1	2	2	15	1.5	1	3
2	Cutting a piece of bread	20	2	2	2	10	1	1	2
3	Opening and closing a backpack	20	2	1	3	11	1.1	1	2
4	Gluing paper	22	2.2	2	3	18	1.8	1	3
5	Folding paper strips	29	2.9	2	3	20	2	1	3
6	Writing	30	3	3	3	19	1.9	1	3
7	Colouring a picture	12	1.2	1	2	10	1	1	1
8	Cutting paper with scissors	26	2.6	2	3	19	1.9	1	2
9	Building with lego	20	2	2	2	13	1.3	1	2
10	Pouring juice	20	2	2	2	12	1.2	1	2
11	Walking with a filled cup	17	1.7	2	2	10	1	1	1
12	Eating with a spoon	21	2.1	2	3	15	1.5	1	2
13	Opening a package	20	2	2	2	16	1.6	1	2
14	Tying shoelaces	22	2.2	2	3	18	1.8	1	3
15	Putting on trousers	21	2.1	2	3	15	1.5	1	2
16	Putting on a t-shirt	21	2.1	2	3	16	1.6	1	2
17	Putting on bodywarmer	21	2.1	2	3	16	1.6	1	2
18	Playing hopscotch	20	2	1	3	10	1	1	1

The poor quality of the tasks performed by the respondents was caused by dysfunction in basic visuo-sensory processing, visual-spatial, tactile perception, kinesthetic, greatly affecting the basic processing speed. These dysfunctions lead to poorly planned and uncoordinated movements, therefore children with DCD produce poor quality work. A praxis deficit in imitating

movements and understanding verbal commands was found in DCD children, resulting in impaired motor planning. The deficit is related to left parietal dysfunction so that children with DCD have poor synergy in movement production. This causes DCD children to produce poor quality assignments/work (Wilson et al., 2013).

Table 6. Normality Test Results Total Pre and Post Quality

Variable	Statistic (df = 10)	Sig.
Pre Quality	0.341	0.002
Post Quality	0.209	0.245

Table 7. Analysis of Total Quality Before and After Giving Intervention

Variable	Pre-test			Post-test			MD ± SD	df	P-value
	Mean ± SD	Min	Max	Mean ± SD	Min	Max			
Quality	38.3 ± 2.94	36	34	26.3 ± 3.4	21	34	8.4 ± 4.9	9	0.005

Note: MD, Mean Difference; df, degree of freedom

After being given the MST intervention, the average total quality score was 26.3 and the standard deviation was 3.4 (Table 7). The decrease in the average value of this quality score indicates an increase in the quality of the tasks produced by respondents after being given the MST intervention. For example, the total score quality of writing decreased from 30 to 19, it showed that writing task is hard to accomplished by respondents before the intervention is given. Poor control over the kinematic and dynamic variables may disturb handwriting movements (Biotteau et al., 2019). The

Wilcoxon rank test was then performed to determine whether the MST intervention was statistically significant to the total quality score. This test was chosen because the quality score data before being given treatment was normally distributed while the quality score data after being given treatment was not normally distributed (Table 6). The mean difference was 8.4, standard deviation 4.9, p-value $0.005 < \alpha$ (0.05) which means there is a significant difference between the quality scores before and after the intervention, so that it can be concluded that there is an effect of giving

MST on the quality of tasks produced by DCD children as research conducted by Farhat et al., (2016) that the quality of ADL tasks in the intervention group experienced a significant increase after being given MST.

Activity of Daily Living

In this study, it was found that all respondents were in the category of having problems with ADL. These results are the

interpretation of the measurement of ADL ability using DCDDaily before being given the MST intervention. The total ADL score was the result of the sum of the total time scores and the total quality scores then divided by two. The average total ADL score before being given the MST (pre-test) was 40.85 and the standard deviation was 2.47 (Table 9).

Table 8. Total Score of Time, Quality, and ADL Before and After Giving Intervention

Respondent	Pre-test			Post-test		
	TS	QS	ADL	TS	QS	ADL
001	45	40	42.5	29	27	28
002	44	37	40.5	26	24	25
003	36	36	36	22	25	23.5
004	41	37	39	23	25	24
005	47	44	46.5	31	34	32.5
006	40	47	39	25	28	26.5
007	45	38	41.5	30	25	27.5
008	46	38	42	31	28	29.5
009	44	36	40	28	26	27
010	46	37	41.5	30	21	25.5

Note: TS, Time Score; QS, Quality Score; ADL, ADL Score

It is known that children with DCD show poor ADL performance and rarely participate in daily activities (Linde et al., 2015). The explanation for this is because ADL which is ‘motor-based activity’, requires good movement planning and coordination which is obtained from motor learning and motor control learning. The motor cortex and basal ganglia are the main areas that work in motor learning mechanisms while the brainstem and

cerebellum are the main areas that work in motor control. Meanwhile, the hippocampus and cortex play a major role in storing memory for the motor skills that have been learned (Purves et al., 2004). Meanwhile research conducted by Zwicker et al., (2010) found that these brain areas in children with DCD have different dysfunctions and activities than typical children. It caused children with DCD have difficulty executing coordinated motor

actions, and fine and gross motor disorders, resulting in clumsiness, slowness, and inaccurate motor performances. Individuals with DCD may therefore exhibit deficits in postural, sensorimotor coordination, and motor learning (motor planning, learning new movements, adaptation to change) (Biotteau et al., 2019).

The average total score of ADL before being given MST (pre-test) was 40.85 with

a standard deviation of 2.47. After being given the MST intervention, the mean total of ADL score (post-test) was 26.9 with a standard deviation of 2.74 (Table 9). The difference between the pre-test and post-test mean scores is 13.95. The decrease in the average value of the total ADL score indicates a better change in ADL ability after being given MST.

Table 9. Analysis of Total ADL Before and After Giving Intervention

Variable	Pre-test			Post-test			MD ± SD	df	P-value
	Mean ± SD	Min	Max	Mean ± SD	Min	Max			
ADL	40.85 ± 2.74	36	46.5	26.90 ± 2.69	23.5	32.5	13.95 ± 0.05	9	0.001

Note: MD, Mean Difference; df, degree of freedom

Paired sample t-test was then performed to determine whether the MST intervention was statistically significant. Table 9 shows the difference in the mean total ADL score before and after being given the intervention of 13.95 with a p-value of $0.001 < \alpha (0.05)$ which means that there is a statistically significant difference in the mean total ADL score before and after the intervention, so that it can be concluded that MST can help children with DCD to improve their speed and quality in performing daily activities. As in the research of Yu et al., (2018), that motor skills intervention is effective for improving the motor, cognitive, emotional, and abilities of DCD children in performing activity of daily living (ADL).

CONCLUSION

Based on the results and discussions that have been described in this study, it can be concluded that Motor Skill Training has an effect on increasing the ability of activity of daily living in children with DCD. The speed (time) and quality of ADL in DCD children increased after being given MST.

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