Spark Motor Program to develop Psychomotor Skills in learning disorder Chinese students

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ABSTRACT

The objective of the present study was to develop an effective motor program for developing speed and agility, bilateral coordination, balance and strength, and developed motor skills of preschool students with learning disorder. The sample consisted of 21 students of male and female from 4 preschool classes in China. We divided participants in two groups: a Spark group (11 students), with a 8-week motor program, and a routine exercise group (10 students). The findings demonstrated that Spark motor program has positive effects during the reading, writing and speaking. Further, we found significant differences between the groups. Motor skills and enjoyed physical activity increased in the Spark group, but not in the routine exercise group. Male students attained more significant differences than female students in the Spark and routine exercise groups. The outcome was that exercise programs such as Spark motor program develop psychomotor skills in students with learning disorder.

Key Words: Spark Motor Program, Psychomotor Skills, Learning Disorder, Developed Motor Skills

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Introduction

For more than a century, specialists were seeking the diagnosis and treatment of children with special learning disabilities (Xiaoxu *et al*., 2017). Studies showed that about 2 to 10 percent of children have learning disabilities, and learning disorders levels among males are higher compared with females during their lifetime (Tabatabaei *et al*., 2017). Litt Jonathan *et al*. (2005) believes that learning disabilities often occur in pre-primary school.

Learning disorders mean disruption in one or more basic psychological processes that was related to the use of written and spoken language and can be manifested in the form of a complete disability in the real understanding of a variety of languages, such as spoken, written, audible, thinking, talking, reading, writing, spelling, and calculating mathematics (Litt Jonathan *et al*., 2005). Churchill (2008) described learning disability as one of the largest and perhaps most controversial categories in exceptional education. Learning disorder is a term used to describe children with language impairment and communication skills disorder. Children with learning difficulties due to visual, auditory and motor impairments, emotional problems, cultural constraints or overall mental retardation are not considered part of this category. The intelligence of this category is not lower than their classmates, but they have a natural appearance and a natural growth in weight and height, and play like all other children. The children have difficulty in activities such as reading, writing, speaking and doing homework (Churchill, 2008). Learning disability is a biological disorder associated with deficiencies in the child or adolescent in terms of obtaining the expected skills of reading, writing, speaking, listening, reasoning, and mathematics (Mafra, 2015).

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Litt Jonathan *et al*. (2005) has shown that learning disabilities are related to various forms of developmental neuropsychological, such as biological-genetic disorders, perceptual-motor disorders, visual processing disorders, audio processing disorders, memory disorders, and attention disorders. Westendorp *et al*. (2011) reported that young children with normal growth skills easily learn pre-school skills before entering formal school, but any developmental deviation may be a prelude to learning disabilities. Special intervention strategies should be used for such children to earn the initial skills needed to succeed in learning future education (Westendorp *et al*., 2011; Gao 2017).

Given the importance of activity in youth's health, a well-designed motor program can help children to grow skills related to daily life, improve mental status and increase self-esteem (Larouche *et al*., 2013). In this regard, preschool ages are the most important period of motor development. The characteristic of this period is the continuous development of physical, motor, cognitive and emotional. Effective development in basic motor skills, including mobility, solidity and manipulation skills, is the basis for the development of advanced motor skills and sports skills (Rimmer & Kelly, 2003).

Children with learning disabilities have problems in motor balance, visual-motor integration, deep feeling, space perception, sustainable attention and sensory awareness (Sanghavi & Kelkar, 2005). Studies reported that there are defects in visual-space processing, motor perception, and sensory integration of these children (Biotteau *et al*., 2016). Many children with learning disabilities experience problems in visual-motor and visual-spatial areas. The processing disorder is observed in some motor and cognitive perceptual symptoms in most children with learning disabilities (Sanghavi & Kelkar, 2005). Burininks and Burininks (1977) examined motor skills in children with learning disabilities and normal children. Students with learning disabilities were significantly worse in fine and gross motor skills (Burininks & Burininks, 1977). Pan *et al*. (2009) investigated defective fine motor skills levels through Kinematic analysis of fine motor performance for children with developmental coordination and learning disorders compared with normal children and showed that both groups emphasized on motor feedback. Children with learning disabilities are reluctant to learn new motor skills, because they have a learning difficulty, which causes some gross and fine motor problems, and on the other hand, these children are having difficulty in motor planning, motor regulation and flexible motor response that makes a poor motor function (Von Hofsten, 2004). Whereas children with motor behaviors suited to the calendar age represent a physical and mental health, children with motor deficiency indicate a physical and mental disorder (Soares *et al*., 2015).

Recent studies have proved that regular motor activities are useful for students 4.5-14.5 years of age (Kosari *et al*., 2013). In this age group, children's physical, emotional, cognitive and rational growth is faster than the future years and the ability to modify in the elementary level is extremely high. It can also be said that motor experiences in this time period provides the basis for the child's knowledge and learning. So we can conclude that presenting motor programs in preschool is an important factor in the correction of the complications due to lack of motor experiences and the development of children's motor skills, which promotes educational achievement and succeeds in all aspects of life.

Solberg *et al*. (2013) reported that motor problems lead to academic failure and waste in household and country economy. On the other hand, the problems often lead to humiliate and blame the students and create an unpleasant feeling of self-weakness and low self-esteem, because of poor awareness of parents and educators. Thus, the health of such children is at risk and may lead to behavioral abnormalities and aggression in the child. Further, learning disorders are the main cause of poor educational performance, and because of this, a large number of students experience problems in learning content every year.

Although studies have shown motor interventions are effective in improving life quality and physical and mental factors of people with learning disabilities, evidence concerning direct relationships between motor exercises and developed fine and gross motor skills is weak. The purpose of this study is to test the effects of a Spark motor program on developed motor skills for students with learning disorder in China. Some studies have proved that fine motor skills (upper limb coordination, response rate, visual-motor control and agile speed of Inner limb) and gross motor skills (agility and speed, bilateral coordination, strength, and balance) can improve motor skills in children (Bruininks & Bruininks,

1977; Bruininks, 1978; Cao 2016). We used the variables fine motor skills and gross motor skills. Furthermore, we included enjoyed physical activity as an important motion-related outcome variable. For our sample of preschool students with learning disorder, who have to do school homework, we expected growing learning difficulties during the reading, writing and speaking. We used the variable difficulties (Willcutt *et al*., 2011) to examine this effect. Growing difficulties are expected to lead to a decrease of fine and gross motor skills during the reading, writing and speaking. Spark motor program is thought to prevent such a decrease. While the Spark group should show an increase in fine motor skills and gross motor skills, the routine exercises group should not, due to the Spark motor program.

Methods

Design

Although there are similarities between the methods of our study and the methods used in previous studies, our study has a different aim and subject. We investigated the effectiveness of an intervention program with two groups: the control group (routine exercises group) and the Spark group.

Participants

Recent studies have proved that Spark motor program enhances psychomotor skills in students 4.5-14.5 years of age, but the effectiveness of the same results in students with learning disorder is unknown. It is the purpose of our experimental intervention study to evaluate whether Spark motor program can enhance psychomotor skills in Chinese preschool students with learning disorder with conditions such as mathematic disorder (MD), reading disorder (RD) or writing disorder (WD). Many preschool students with learning disorder, including students with MD, RD, or WD were interviewed to recruit suitable volunteer students. Our study selected an appropriate age group (Spark group: M= 6.16, SD = 2.43; routine exercises group: M= 6.21, SD = 2.11). Furthermore, there were no differences concerning sex (Spark group: 48% male, 52% female; routine exercises group: 51%male, 49% female), learning disorder type (Spark group: 27.3% MD, 54.5% RD, 18.2% WD; routine exercises group: 30% MD, 50% RD, 20% WD).

For the Spark group, we implemented a 8-week (3-session per week) Spark motor program to develop psychomotor skills in Chinese preschool students with learning disorder. For the routine exercises group, a home motor exercise and something about how to develop exercise courses were provided to develop psychomotor skills. We selected groups of 4 preschool students with MD, RD, or WD separately to join the Spark groups and the routine exercises groups. One of these students from the Spark group and two from the routine exercises group withdrew from the study (Figs. 1 and 2).

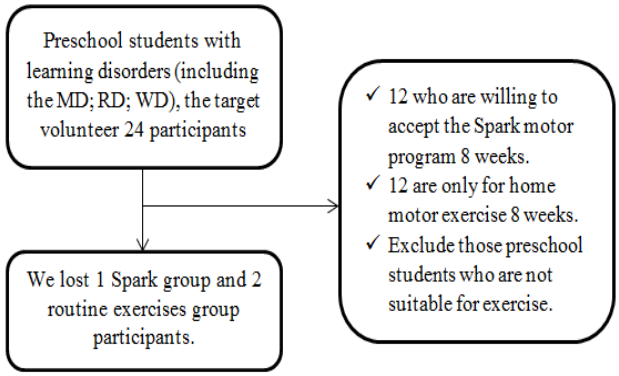

Figure 1. Material and participants for this study.

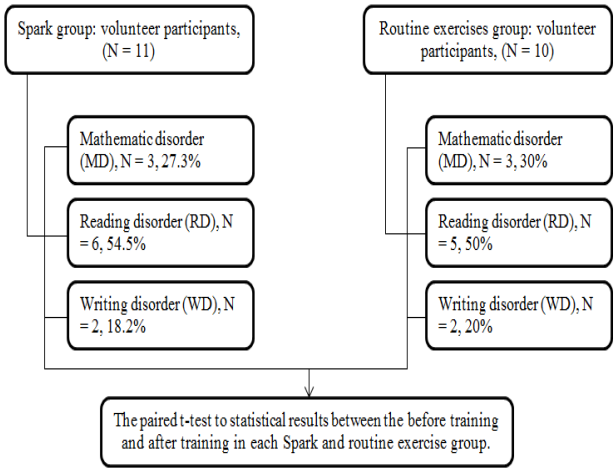

Figure 2. Participant flow chart.

Spark motor program

We developed the program with respect to another Spark motor program, which has been shown to have a positive effect on developed motor skills in the occupational context (Sallis, McKenzie & Alcaraz, 1997). The program was based on game and fun. The program includes activities that can be implemented realistically in kindergartens and schools. In this program, inactive games and dry exercises are gone or adjusted. Each training package includes two types of class activities: (a) health-related physical activity, the goal is to develop muscular strength and endurance, cardiovascular endurance, flexibility and motor skills, (b) skills-

related activities, the goal is to develop general hands-on and exercise-related skills. The program, which has been used in many researches, is a large-scale program that provides goals such as increasing physical fitness and motor skills to enjoy physical activity at high levels of activity. The program was run in 45-minute four sections. The first 15 minutes is to warm up, then 10 minutes for displacement skills, 10 minutes for manipulation skills, and finally 10 minutes for cool down.

Measures

Difficulties

We used the scale difficulties of the Colorado Learning Difficulties Questionnaire (CLDQ). The scale covers ratings of learning difficulties (Willcutt, 2011). The scale consists of five main factors, including reading, counting, social recognition, social anxiety and space functions. Previous studies supported the reliability and validity of the scale (Willcutt, 2011).

Fine and gross motor skills

We used the scales fine motor skills and gross motor skills of the Bruininks- Oseretsky Test of Motor Proficiency (BOTMP) questionnaire as indicator of developed motor skills (Bruininks & Bruininks, 1977; Bruininks, 1978;Nazari,2016). The questionnaire is a reference normative motor scale for fine and gross motor skills of children aged 4.5 to 14.5 years. Bruininks, in 1978, has prepared this test by modifying Oseretsky's motor skill tests. He standardized the test on a sample of 756 children who were selected based on age, gender, race, population size and geographical area, according to the 1970 census. The test helps researchers to recognize the distinction between normal children and children with motor disorder. It consists of 8 sub-tests that have a 46-substance long form and a 14-substance short form. The test-retest reliability coefficient of this test was reported 0.87 in the long form and 0.86 in the short form (Bruininks and Bruininks, 2005). There are four subtests for measuring gross motor skills and four subtests for fine motor skills.

Enjoyed physical activity

Enjoyed physical activity was measured with an international version of the scale enjoyed physical activity of the International Physical Activity Questionnaire (IPAQ) made in Geneva. Studies supported the reliability and validity of the questionnaire in 12 countries (Booth *et al*., 2003). The alpha coefficient of this study was obtained 0.78 before the intervention and 0.81 after the intervention.

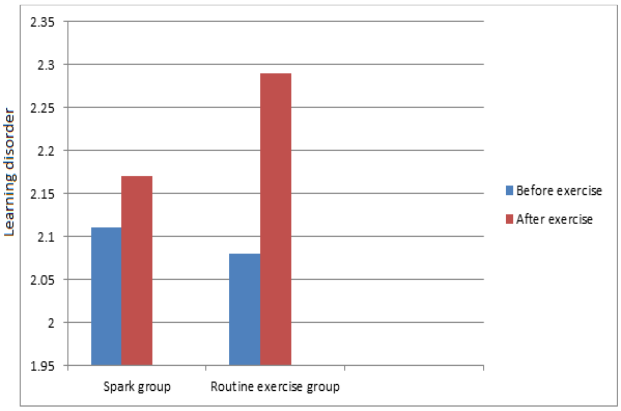

Figure 3. Changes in learning disorder over time at before and after exercise.

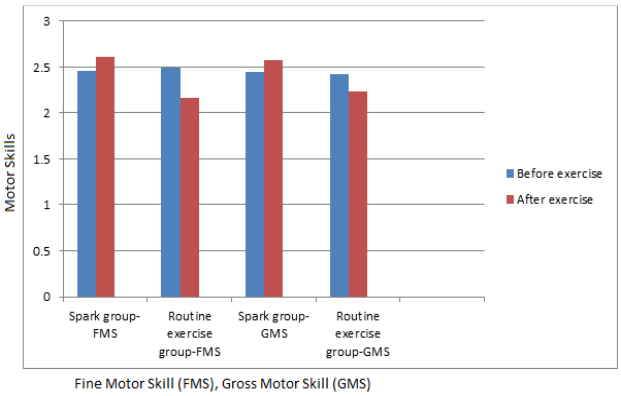

Figure 4. Changes in fine motor skill and gross motor skill over time at before and after exercise.

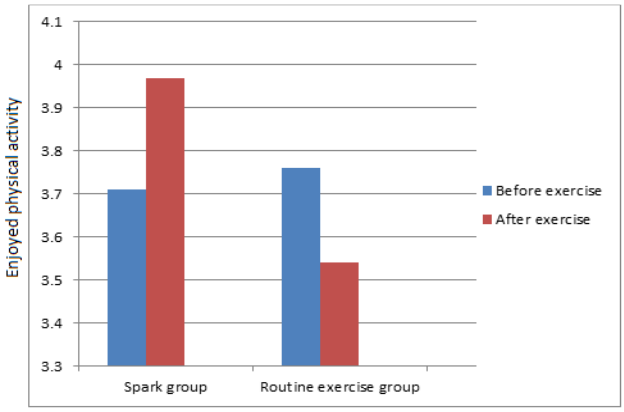

Figure 5. Changes in Enjoyed physical activity over time at before and after exercise.

Results

In this experimental study, we invited 24 preschool students with learning disorder, 4.5-14.5 years of age, of whom 11 (27.3% MD, 54.5% RD, 18.2 WD) completed the 8-week Spark motor exercise and finished the assessment in the Spark group, whereas 10 of the 24 students (30% MD, 50% RD, 20% WD) finished the assessment in the routine exercise group (Table 2). We collected data from before the intervention to after the intervention.

Table 1. The statistical difference and results with participants gait function characteristics between the exercised and control group.

	Spark group (n = 11)			Routine exercise group (n = 10)		
	Total	Before exercise	After exercise	Total	Before exercise	After exercise
Age	6.16±2.43	-	-	6.21±2.11	-	-
Male (%)	64%	-	-	60%	-	-
CLDQ test	-	4.26±1.57	4.31±2.11	-	4.21±2.42	4.36±1.56**
BOTMP test	-	6.71±2.49	7.53±1.95*	-	6.64±2.05	6.53±1.48*
IPAQ test	-	5.49±0.87	6.61±1.19**	-	5.53±0.86	5.59±1.09

Table 2. The Bruininks- Oseretsky Motor Proficiency (BOTMP) test with different disorder type and gender results of the Spark and routine exercise group participants.

	Spark group; n = 11, age = 6.16±2.43				Routine exercise group; n = 10, age = 6.21±2.11			
	%	n	Before exercise	After exercise	%	n	Before exercise	After exercise
Students with mathematic disorder (MD)	36	4	5.23±1.08	4.66±2.29*	30	3	4.15±0.91	4.04±1.11
Students with reading disorder (RD)	73	8	6.58±1.48	6.32±2.17**	70	7	5.19±1.07	5.03±2.18
Students with writing disorder (WD)	54	6	7.44±2.08	6.98±1.47*	70	7	6.28±1.14	6.11±2.27
Male students	64	7	6.28±2.71	5.04±1.09*	60	6	7.03±1.12	6.79±1.22
Female students	36	4	6.34±1.25	5.55±1.61*	40	4	6.84±1.09	6.33±2.19

Table 3. Average scores and standard deviations of the Spark group and routine exercise group

Variables	Spark group, n=11, age = 6.16±2.43				Routine exercise group, n=10, age = 6.21±2.11			
	Before exercise		After exercise		Before exercise		After exercise	
	M	SD	M	SD	M	SD	M	SD
Difficulties	2.11	0.38	2.17	0.49	2.08	0.55	2.29	0.71
Fine motor skill	2.46	0.47	2.61	0.73	2.49	0.45	2.16	0.48
Gross motor skill	2.44	0.67	2.58	0.93	2.42	0.11	2.29	0.25
Enjoyed physical activity	3.71	0.48	3.97	0.57	3.76	0.29	3.54	0.34

Table 1 shows the results of the tests as 'before exercise' and 'after exercise''. As can be seen, the before exercise scores were the poorest. In the Spark group, the CLDQ test shows a minor and non-significant change from 4.26±1.57 to 4.31±2.11, the BOTMP test a significant change from 6.71±2.49 to7.53±1.95*, and the IPAQ test a significant change from 5.49±0.87 to 6.61±1.19**. In the routine exercise group, the CLDQ test shows a significant change from 4.21±2.42 to 4.36±1.56**, the BOTMP test a significant change from 6.64±2.05 to 6.53±1.48*, and the IPAQ test a non-significant change from 5.53±0.86 to 5.59±1.09. The findings in Table 1 resulted significant differences between the before exercise and after exercise periods after 8 weeks ($p < 0.01, 0.05$).

Table 2 shows comparison of the differences between before exercise and after exercise in details by analyzing the statistical data regarding disorder type and gender for the Spark and routine exercise groups. The findings of Table 2 show that male students attained more significant differences than did female students regarding the Spark and routine groups.

To evaluate psychomotor skills and the effects of Spark motor program on fine and gross motor skills in preschool students, we used the two-way multivariate analysis of variance for the four dependent variables (difficulties, fine motor skill, gross motor skill, enjoyed physical activity) (Table 3). We observed a significant increase of fine motor skill in the Spark group (before exercise: M= 2.46, SD = 0.47, and after exercise: M= 2.61, SD = 0.73), but the same skill decreased in the routine exercise group (before exercise: M= 2.49, SD = 0.45, and after exercise: M= 2.16, SD = 0.48). For gross motor skill, we observed a significant increase in the Spark group (before exercise: M= 2.44, SD = 0.67, and after exercise: M= 2.58, SD = 0.93), but the same skill decreased in the routine exercise group (before exercise: M= 2.42, SD = 0.11, and after exercise: M= 2.29, SD = 0.25).

Discussion

Hypothesis 1: The Spark motor program has a positive effect on preschool students' learning disorder.

The results are shown in Table 2 to prove this hypothesis. The preschool students with learning disorder reported an increase of difficulties during the reading, writing and speaking in the routine exercise group. In the Spark group a tendency of non-significant increased difficulties was found. In fact, the reading, writing and speaking at preschool are marked by a strong increase in learning difficulties for students with learning disorder in the routine exercise group. This implies that doing school homework and motor-related difficulties are potential unsuccessful psychomotor skills causes for most of the students. We observed a minor and nonsignificant increase of difficulties in the Spark group (Fig. 3). This probably implies that the Spark motor program had a positive effect on learning difficulties. Hypothesis 1 could be partially proved for participants in the routine exercise group, which demonstrated the minor and nonsignificant increase of difficulties. There were no differences concerning learning difficulties for the students in both groups. Our findings show that the Spark motor program has a positive effect on preschool students' learning disorder to deal with a variety of problems.

Hypothesis 2: The Spark motor program has a positive effect on psychomotor skills.

Studies (Glozman Janna, 2014) indicate that the effectiveness of some motor programs can be further improved. In order to investigate such evidences, we used two-way multivariate analysis of variance. The preschool students with learning disorder reported an increase of fine motor skill and gross motor skill after the intervention in the Spark group. Hypothesis 2 could be proved for participants in the Spark group, which demonstrated a significant increase of fine motor skill and gross motor skill. In the routine exercise group, increase of fine motor skill and gross motor skill did not appear. As expected, the reading, writing and speaking at preschool are marked by a strong increase in fine motor skill and gross motor skill for students with learning disorder in the Spark group. We observed a significant increase of fine motor skill and gross motor skill in the Spark group (Fig. 4). Our findings show that a Spark motor program can be a specific tool to prevent learning difficulties from becoming reflected in lower levels of fine motor skill and gross motor skill.

Hypothesis 3: The Spark motor program has a positive effect on enjoyed physical activity.

As expected, enjoyed physical activity in the Spark group improved significantly compared with the routine exercise group. This implies that the Spark motor program had a positive effect on enjoyed physical activity. Hypothesis 3 could be proved for participants in the Spark group, which demonstrated the significant increase of enjoyed physical activity. Based on this discussion, we can conclude that the attendance at the intervention led to an increase in enjoyed physical activity which led to an increase in fine motor skill and gross motor skill.

All the results from this study and similar studies can be seen in the framework of dynamic system theories. Dynamic system theory considers the environment as an effective factor in motor skills development. This theory implies that motor development factors, including the special needs of motor duties in exchange with the individual (biological and hereditary factors) and the environment (experience and learning factors) are effective in developing basic motor abilities. This is contrary to the maturation view that believes only the central nervous system is responsible for movement, and also contrary to the information processing viewpoint that states only one factor decides on all movements. Based on the dynamic systems theory, individuals have very complex systems coordinated; behavior is the result of the function of all individual systems. This is in contrast to the maturation theory, which believes only growth and maturation factors are effective in the development of motor skills. Factors affecting the development of basic skills include family geographical and environmental status and exercise time. Exercise time depends on a regular and targeted exercise. Children with learning disability spend a lot of time in schools, and at home, they have to spend more hours doing their homework and learning to compensate for their weaknesses.

According to the results of this study, compared to routine exercises in preschool, the Spark motor program that provided an

appropriate exercise time by creating more appropriate facilities and equipment, and had a coordinated content program with the development of basic gross skills, has a greater impact on the psychomotor development of students with learning disabilities. Therefore, rehabilitation specialists believe that this method is suitable for motor skills and effective in the treatment of learning disorders. They also believe that the method is a basis for improving the brain's excellent performance and improves the motor and cognitive functions of children with learning disabilities.

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