



Original Article

## Effects of hippotherapy on the thickness of deep abdominal muscles and activity of daily living in children with intellectual disabilities

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**Abstract.** [Purpose] The purpose of this study is to investigate the effect of hippotherapy exercise on the thickness of deep abdominal muscles and daily activities of children with intellectual disabilities. [Subjects and Methods] Seven children with intellectual disabilities were treated with hippotherapy for 30 minutes twice a week for 6 weeks. The thickness of deep abdominal muscles and Functional Independence Measure (FIM) of the subjects were measured by ultrasonography before and after the experiment. [Results] There was no significant change in the thickness of the External Oblique and Internal Oblique muscles, but there was a statistically significant change in Transverse Abdominis thickness and FIM score after treatment compared to before treatment. [Conclusion] Hippotherapy exercise has a positive effect on the improvement of Transverse Abdominis (TrA) and activity of daily livings of children with intellectual disabilities.

**Key words:** Hippotherapy, Abdominal muscles, Intellectual disability

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### INTRODUCTION

The majority of children with intellectual disabilities are not significantly different from the normal children in terms of their physical externality, but their ability to develop movements, such as balance, emotion, and dexterity has shown to be less<sup>1, 2)</sup>. Children with intellectual disabilities can achieve normal growth, development promotion, and function restoration through a variety of physical activities and exercises, which plays an important role in comprehensive change of their behaviors rather than education in other areas<sup>3)</sup>. Therefore, systematic training for exercise capacity improvement is needed to improve balance sense, visual perception, speed and agility, which are more impaired than normal children<sup>2)</sup>. Children with intellectual disabilities are restricted from normal walking or movements due to limited activities or lack of conative physical activity. In this case, muscle development is not evenly achieved, and hippotherapy for the weighted physical activity plays an important role as one of the appropriate methods of intervention<sup>4)</sup>. Hippotherapy is one of the integrated exercise programs that provides opportunities for balance and strength-building to keep the correct posture for the passengers through the three-dimensional movements of the horse<sup>5)</sup>. The muscles that were not normally used are used through the movements of the horse. Horse riding improves the blood circulation through the whole body exercise and restores the function through the stimulation of the nerve. It is suitable for the children with disabilities who have problems due to lack of exercise<sup>6)</sup>. The hippotherapy program reported positive effects on the body composition of muscle mass and fat mass of the children with intellectual disability as a result<sup>7)</sup>. The hippotherapy program was applied to the children with intellectual disability, and it was shown that there was a positive effect on body composition and equilibrium function<sup>8)</sup>. It is reported that since 2000, children with disabilities have good advantages in physical ability, cognitive ability, and social development when using hippotherapy program<sup>9, 10)</sup>. However, most studies on physical ability and strength development have been conducted to confirm

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the effectiveness of children with cerebral palsy. In this study, we investigate the effects of hippotherapy on the development of deep abdominal muscles and activity of daily livings of children with intellectual disabilities.

## SUBJECTS AND METHODS

This study selected 7 subjects of children with intellectual disabilities from 10 to 18 years of age who were treated with hippotherapy in D riding course in Daegu, totaling 12 times, twice a week for 30 minutes from June 2016 to July 2016 (Table 1). Those who receive intervention understood the purpose of research and provided written informed consent prior to participation according to the ethical standards of the Declaration of Helsinki.

Subjects are children who are diagnosed with intellectual disability and can sit alone, have no visual and auditory impairments, also we selected a subject with a mild level of intellectual ability to listen and to understand the instructions and to carry out task. A mild level of mental disabled children was selected. Parents were fully informed about the intention of this study and the whole process of the experiment and experiments were conducted with voluntary consent.

We measured the thickness of deep abdominal muscles by using ultrasonography and measured the Functional Independence Measure (FIM) for the children with intellectual disability agreed to the experiment before and after the hippotherapy. All children were treated for 30 minutes twice a week for 6 weeks.

The hippotherapy exercise was carried out on the horse, and the preparation exercise (5 min) was performed by upper body stretching. The main exercise (20 min) was performed by regular walking, stepping on a stirrup, and fast walking. The finishing exercise (5 min) was performed by lower body stretching. The members of the hippotherapy program consisted of one horse-drawn leader, two side-walkers to prevent riding accidents beside the horse and one hippotherapy instructor, and the pony were used for the size of the child.

Ultrasound imaging was performed to determine the thickness of the Transverse Abdominis (TrA), Internal Oblique (IO), and External Oblique (EO) of the subject before and after the exercises using the diagnostic ultrasound equipment Accuvix V10 (Samsung Medison Inc., Korea) A 10 MHz linear probe and all measurements were performed by one skilled person. Measurements were taken with the arms folded up on the chest and supine posture in a comfortable state. And the thickness of the muscles was measured to the right. The measurement position was measured on the skin half between the anterior superior iliac spine and the mostly lower ribs in the anterior axillary line<sup>11)</sup>. The environment such as temperature during measurement was the same before and after.

Functional Independence Measure of activity of daily livings was developed for the evaluation and tracking of functional ability through the child's health condition, development, education and social situation. It consists of 6 items of self-help skill, toilet training, moving, placing, communication, social cognition, and 18 subitems. The score is 7 points for each item with 1 points for total dependence and 7 points for total independence. The lowest score is 18 points and the highest score is 126 points. The higher score means the higher functional ability of daily living. The reliability of this instrument was reported to be 0.83–0.99, and the interrater reliability was 0.74–0.96<sup>12)</sup>. Functional activity of daily livings were accompanied by caregivers and evaluated by physical therapists before and after the intervention.

Statistical analysis was performed using SPSS 18.0. In order to investigate the difference of the data before and after the test of hippotherapy exercise, a corresponding sample t-test was conducted. Statistical significance level  $\alpha$  was set to 0.05.

## RESULT

The results of the 6 weeks experiment were analysed by using ultrasonic and FIM test tools to determine the effects of hippotherapy on the thickness of deep abdominal muscles and the changes of activity of daily livings function of children with intellectual disabilities. Table 2 shows changes in muscle thickness and FIM scores for riding treatment for 7 mentally disabled children for 6 weeks. There were no significant changes in the thickness of the External Oblique and Internal Oblique muscles ( $p>0.05$ ), however, there were statistically significant changes in Transverse Abdominis thickness and FIM score after treatment compared with before treatment ( $p<0.05$ ).

**Table 1.** General characteristics of the subjects (n=7)

Measurement	Pre-test
Age (years)	13.7 $\pm$ 2.3
Gender (M/F)	6/1
Weight (kg)	45.7 $\pm$ 5.3

**Table 2.** Changes in abdominal muscle thickness following hippotherapy (n=7) (unit: mm)

	At baseline (n=7)	At 6 weeks (n=7)
	mean $\pm$ SD	mean $\pm$ SD
External oblique	8.42 $\pm$ 2.23	8.44 $\pm$ 2.08
Internal oblique	4.40 $\pm$ 1.32	4.29 $\pm$ 1.27
Transverse abdominis	2.19 $\pm$ 0.32	2.50 $\pm$ 2.41*
FIM	95.71 $\pm$ 11.50	101.00 $\pm$ 10.68*

\* $p<0.05$

## DISCUSSION

The purpose of this study was to investigate the effects of hippotherapy on the thickness of deep abdominal muscles and the development of daily life function in children with intellectual disabilities, and the results are discussed. The hippotherapy is the exercise of whole body which has been shown to improve the function of joint movement, balance, and visuospatial coordination as well as restoring the function of weak physical function and weak walking ability<sup>13)</sup>.

Hippotherapy allows the rider to accelerate the contraction of the trunk muscles to balance on the saddle as the horse moves in three dimensions. Kim<sup>14)</sup> reported an increase in activity of the paraspinal muscle after riding exercises in elderly. In the present study, the thickness of the Transverse Abdominis (TrA) was significantly increased compared with that before the treatment, but the results showed that the Internal Oblique (IO), External Oblique (EO) did not change significantly. Hodges and Richardson<sup>15)</sup> reported that the movement of the trunk muscles plays an important role in the movement of the pelvis and lower limbs and is an essential factor in maintaining the lumbar stability, especially, TrA was the muscle that contracts most rapidly among the abdominal muscles. Hide et al.<sup>16)</sup> reported that the IO, EO and TrA play an important role in trunk's stabilizing and postural control, the most important of these muscles is the TrA<sup>15)</sup>. It is thought that the sway of the three-dimensional trunk through horseback riding resulted in the continuous activation of the transverse muscles.

Also in this study, there was a statistically significant change after the hippotherapy as a result of the activity of daily living FIM (Functional Independence Measure). In this study, similar to the previous study, the sub items of FIM were improved on the whole. Especially, this study showed many improvements in self care and social cognition among the six items. Kim et al.<sup>17)</sup> reported that the equilibrium ability, walking ability and daily life's ability were improved after hippotherapy. Yong et al.<sup>18)</sup> reported that hippotherapy did not produce meaningful results, but that it was effective in the motor and cognitive domains among the six domains of daily life practice. Engel et al.<sup>19)</sup> reported that children who have been treated for a long period of time by combining hippotherapy with occupational therapy acquired daily life skills such as using the phone, making sandwiches, and using computers. These results showed that the improvement of motor ability influenced on self care, and the interaction with living animals such as horses seemed to have a positive effect on the cognitive parts. This suggests that this study was difficult to generalize the experiment with the small sample size and the short period. Hippotherapy has many biases such as walking speed, road surface condition, horse diversity and so on, there is a thing to clarify for future research. In addition, in order to improve the activity of daily living function and the development of the motor ability of the mentally disabled children, it is necessary to develop a variety of education programs in various fields and to carry out the research with the hippotherapy.

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