



Case Study

## Physical therapist-led swimming lessons for children with cerebral palsy: a report of 2 cases

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**Abstract.** [Purpose] The purpose of this study was to report that a physical therapist qualified for swimming instruction can provide swimming instruction to children with spastic paraplegia due to cerebral palsy. We examined the role of the physical therapist in the support. [Participants and Methods] Two elementary school children with cerebral palsy participated in this study. The swimming program consisting of 6 sessions was performed over 6 months in an indoor swimming pool. Each session lasted for 30 minutes and was instructed by a trained physical therapist. The 5 categories for evaluation were motor function, muscle tone, activities of daily living, swimming skill, and satisfaction level. [Results] Case A showed improvement in streamline floating distance and 15-m time. Case B could not swim 15 m in the first session but completed 15 m within 102 s in the last session. The 3 other categories besides swimming skills did not improve. [Conclusion] With a skilled physical therapist's instruction, children with cerebral palsy may improve their swimming skills over a limited number of sessions without any adverse events.

**Key words:** Children with a cerebral palsy, Swimming instruction, Physical therapist

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## INTRODUCTION

Cerebral palsy (CP) is the most common childhood-onset physical disability and has a varied impact on daily activities and participation<sup>1)</sup>. Evidence indicates that physical activity is important for healthy growth and development in children and adolescents<sup>2)</sup>. A previous systematic review showed that children and adolescents with CP (aged 5–18 years) have 13–53% less habitual physical activity than their typically developing peers<sup>3)</sup>. Physical activity can be beneficial for health including bone health, cardiorespiratory, and muscular fitness<sup>4)</sup>. Children with CP who are physically active can derive benefits to their general health including both their physical and psychosocial health throughout life<sup>5)</sup>.

In addition, adolescents with CP may accrue benefits from regular physical activity including reduced incidence of chronic pain, fatigue, and osteoporosis<sup>6)</sup>.

Swimming is consistently rated as one of the most frequent activities for all Gross Motor Function Classification System (GMFCS) levels<sup>7)</sup>. Many studies have shown the potential of pediatric aquatic therapy programs to significantly benefit children with cerebral palsy<sup>8, 9)</sup>. Aquatic exercise has many benefits such as improvements in flexibility, respiratory function, muscle strength, gait, and gross motor function<sup>8)</sup>. Previous studies have reported that applying motor skills in water can potentially increase confidence and lead to less resistance with difficult tasks when compared to land training. Moreover,

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activities in the water are a pleasure for children, enhancing motivation and interest<sup>10, 11</sup>). Although aquatic physical therapies conducted and supervised by a physical therapist have been designed for the subject to increase their musculoskeletal function<sup>12</sup>), there has been little research on the effects of aquatic exercise<sup>8</sup>). Few reports have examined the role of physical therapists in conducting swimming instruction for children with CP. We believe that applying the expertise of physical therapists for swimming support and clarifying its role are important in enhancing the physical activity of children with disabilities. In this study, a physical therapist qualified for swimming instruction provided swimming instruction to children with spastic paraplegia due to CP. We examined the role of the physical therapist in the support.

## PARTICIPANTS AND METHODS

The participants were two children with CP who presented with paraplegia due to cerebral palsy. The basic information of the participants is shown in [Table 1](#). Both were elementary school students. None of the children had orthopedic, respiratory, or cardiovascular disease.

This study was approved by the Ethics Review Committee of Kochi Professional University of Rehabilitation (R1-13).

A swimming program was held for children with disabilities living in Suita City in Japan. The swimming program was performed in an indoor swimming pool (I-Hope Suita) that was 15 m long, 6 m wide, and 110 cm deep. The water temperature was 31 °C, and the room temperature was 28 °C. The swimming program consisted of 6 sessions with one session per month. Each session lasted for 30 min for two participants at a time and consisted mainly of warming up and swimming practice. At the end of the session, a play menu with floats was included. When practicing motor learning for swimming, the instructor had to make sure the participants do not fall when entering or leaving the swimming pool. The instructor also had to avoid passively moving the paralyzed limb beyond its capability. Therefore, before starting each class, the physical therapists' evaluation of the participants' physical function and movement must be shared among the instructors. During the swimming class, the facial expressions of the participants were observed. The instructor adjusted the lesson according to the degree of motor paralysis of the participants' limbs. They instructed the participants to use a float for the severely paralyzed limbs and to use their less paralyzed limbs for propulsion.

The program was led by one physical therapist with an assist of a volunteer instructor.

The physical therapist had a swimming instruction qualification, and the volunteer was experienced in swimming instruction. Parents entered the swimming pool together with the child and assisted in the instruction.

The physical therapist performed evaluation and assessed risks of each participant in swimming and the level of assistance needed in water. The volunteer was trained by the therapist about the risks and safety precautions.

Evaluation items were motor function, muscle tone, activities of daily living (ADL), swimming skill, satisfaction level, and adverse events. These evaluation items were measured at the beginning and the end of the session. Adverse events were considered to be a fall or drowning at the time of the class, and the onset of pneumonia after the class. For the evaluation method, the motor functional level was measured using GMFCS<sup>13</sup>). Muscle tone was measured using the Modified Ashworth Scale (MAS)<sup>14</sup>). ADL was measured using the Functional Independence Measure for children (Wee-FIM)<sup>15</sup>). Swimming skill was measured by a streamline distance and a 15-m freestyle. The streamline distance was measured as the maximum distance after a kicking start. The streamline distance was measured as the maximum distance for participants to swim (floating but with faces submerged) after a kicking start. The 15-m freestyle was measured as the time for participants to swim 15 m as fast as possible. Satisfaction levels were measured using the visual analog scale (VAS). The items of VAS assessed recorded the participation of physical activity and satisfaction level of the swimming class. The exercise load was calculated by the Karvonen's formula<sup>16</sup>) based on the pulse rate recorded at the end of the class.

The physical therapist considered individual guidance according to the disability characteristics of the participants and shared the considerations with the volunteer.

## RESULTS

Each participant participated in the swimming class 6 times. The exercise load was 10.4% (Case A) and 15.5% (Case B) for the two participants, respectively. The results of measurement before and after the intervention are presented in [Table 2](#).

Gross motor function level did not change before and after the intervention. Muscle tone was slightly increased in both participants after the intervention. The ADL of Case A improved by 2 points, but did not change for Case B. Amount of energy consumption showed a decrease in both cases after intervention. The results of swimming skill showed an improvement of streamline floating distance and 15-m time. In the 15-m time measure, an improvement of 24.9 s was obtained for Case A. Although Case B could not complete the 15-m distance in one attempt/on the first attempt/during the first session, Case B was able to swim 15 m in 102 s in the final measurement. The results of the satisfaction survey are shown in [Table 3](#). The survey was 10-point scale with 0 being the lowest satisfaction and with 10 being the highest satisfaction.

No adverse events were observed during the intervention period.

**Table 1.** Basic information for the cases

	Case A	Case B
Gender	Male	Female
Age (years)	9	9
Height (cm)	120.0	123.5
Weight (kg)	19.0	26.0
Body mass index (kg/m <sup>2</sup> )	13.2	17.0
Cerebral palsy subtype	Spastic-bilateral	Spastic-bilateral

**Table 2.** Comparison of the results of the evaluation before and after intervention

Variable	Case A			Case B		
	Before	After	Difference	Before	After	Difference
Gross Motor Functional Classification System level	2	2	± 0	2	2	± 0
Muscle tone	14	17	+3	11	14	+3
Upper muscle tone	4	4	± 0	4	4	± 0
Lower muscle tone	10	13	+3	7	10	+3
Wee-FIM <sup>a</sup>	121	123	+2	126	126	± 0
Amount of physical activity <sup>b</sup>	94.3	55.7	-38.6	332.1	300	-32.1
Consumption of energy (kcal/day)	31.4	19.5	-11.9	151.1	147.0	-4.1
Swimming Streamline and floating (m)	2.0	4.0	+2.0	3.5	4.0	+0.5
15-m time (s)	72	47.1	-24.9	- <sup>c</sup>	102	

<sup>a</sup>Functional Independence Measure for children.

<sup>b</sup>(MET × min)/day.

<sup>c</sup>Stopped at the point of 4 m (12.7 s).

**Table 3.** Results of satisfaction level

Item	Case A		Case B	
	Beginning	Final	Beginning	Final
Participation in physical activity within 3 months (point)	8	6	7	10
Health management awareness (point)	10	8	5	10
Physical therapist joining for this service (point) <sup>a</sup>	-	10	-	10
Service of this swimming lesson (point) <sup>a</sup>	-	8	-	10

<sup>a</sup>These items were measured only at the end of this intervention.

## DISCUSSION

This study examined the role of a physical therapist in the support of children with CP. A physical therapist qualified for swimming instruction provided swimming instruction to children with spastic paraplegia due to CP.

As a result of this study, the swimming ability of the target children improved. Declerck et al. investigated the enjoyment and specific benefits of a swimming intervention for youths with CP<sup>17</sup>. After a 10-week swimming intervention (2/week, 40–50 min), the levels of enjoyment were high, and walking and swimming skills improved significantly. They recommended a swimming program for youths with CP to complement a physical therapy program. Roostaei reported improvements in gross motor skills using within-group analyses after aquatic programs were held 2- to 3-times per week for 6–16 weeks for children with CP<sup>18</sup>. Although the frequency of intervention was once a month in this study, it was considered that swimming ability improved through practice according to the ability of each participant.

A physical therapist qualified in swimming instruction implemented the intervention. A therapist must take into account a number of factors in structuring an effective treatment session. The participant's comfort and optimal performance should be a priority, and the tasks should be designed to meet the participant's needs, thereby ensuring optimal cooperation and motivation. In order to focus the participant's attention on the task, the therapist should consider good body mechanics, effective use of gravity and position, and adjust the environment in response to the participant<sup>19</sup>. On this point, this study indicated that the therapist was able to apply the clinical practice improvements of performance for the participants.

The value of muscle tone increased after the intervention compared with that before the exercise.

Previous studies have indicated that exercises with maximum efforts did not increase spasticity in people with CP<sup>20, 21</sup>. The benefits of aquatic exercise are thought to result from water's unique characteristics including warmth, which reduces pain and muscle spasms. When a body is immersed in warm water (30–31 °C), its core temperature increases, causing a reduction in gamma fiber activity, which in turn reduces muscle spindle activity, facilitating a reduction in spasticity<sup>22</sup>. Therefore, it is unlikely that underwater exercises increased muscle tone, so it is possible that psychological factors at the time of the examination may have affected the measurement results. Because the performance showed an improvement, it was thought that it was an increase that did not affect swimming performance.

There were two limitations to this study. First, the number of participants was too small, so it was not possible to examine the effects using statistics. Second, the design was insufficient to measure gross motor outcomes. Therefore, future studies of aquatic exercise for physical therapy intervention should measure gross motor outcomes to determine the impact of the intervention for that child.

Although it was unclear whether the swimming class of this study gave the participants the amount of physical activity they needed, the intervention could have a positive effect on improving their swimming skill. It would be possible to apply the expertise of physical therapy to the implementation of swimming instruction according to the disabled characteristics of participants. It is desirable to develop a social environment that secures opportunities for participation in physical activities and sports suitable for the development of children with cerebral palsy.

### *Conflict of interest*

The authors declare that there are no conflicts of interest.

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