Do children with developmental disorders have low gross motor abilities? -A comparison with normal children, using Motor Ability ests for young children

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Abstract

It has been noted that the symptoms of children with developmental disorders (DD) include problems such as high frequency of accidentally bumping into objects or people. However, as of yet there has been no clarification of the characteristics of gross motor abilities in children with DD. The purpose of this study was to clarify those characteristics by comparing the gross motor abilities of children with DD to that of normal children.

Participants were 5- and 6-year-old children, of whom 9 had DD and 9 were normal. For testing, we used the motor ability tests for young children designed by Sugihara et al. [1]. We tested 6 skills, including 25 m runs and standing long-jumps to evaluate quickness, tennis-ball throws, repetitive jump-overs, and ball catches to evaluate coordination, and continuous body-support to evaluate endurance.

When we compared children with DD to normal children, no significant differences were observed in any of the motor skills tested. Gross motor abilities of children with DD were equal to those of the normal children in terms of quickness, coordination, and endurance. Therefore, we infer that the high frequency of accidentally bumping into objects or people by children with DD cannot be attributed simply to underdeveloped gross motor abilities.

Introduction

Primary symptoms of children with developmental disorders (DD) such as attention-deficit hyperactivity disorder and Asperger syndrome include restlessness, inability to complete tasks, inability to read people's feelings and situational circumstances, and motor activity characteristics such as high frequency of accidentally bumping into objects or people[2,3]. These issues have been evaluated with activity questionnaire surveys, activity observation, intellectual development tests, and interviews, then diagnosed by physicians with clinical experience using diagnostic standards [2,3]. Moreover, with respect to the motor activities of children with DD undergoing rehabilitation, a variety of methods have been used, including drawing tests, posture-imitation tests, posture and movement observation, and various evaluations on desk, to investigate their perception, body schema, postural control, and motor coordination, among others [4].

Although children with DD showed no developmental delay in body site recall in drawing tests, evaluation of body schema by postural imitation tests, in which children observed the movement of other people and responded accordingly, showed that children with DD were inferior to normal children [5]. Additionally, in studies of balance function, children with DD have been shown to be less developed with respect to standing postural control, and have visual control predominance in comparison to normal children [6]. In studies of motor coordination in children with DD, tests involving the tracing of lines and the reproduction of diagrams have shown that these children lack precision in

their movements [7]. Moreover, based on the fact that children with DD are unable to cut out shapes accurately when using scissors in motor coordina- tion tasks, it has been shown that they have problems with hand-eye coordination [8].

In addition to the postural control tasks, motor coordination tasks, and various evaluations on desk mentioned above, it is crucial to evaluate the problems associated with the many gross motor activities performed on a daily basis by children with DD. For example, in studies that had children perform passing-under movements in order to assess their frequency of physical contact with obstacles in daily life, such children had physical contact with obstacles more frequently than did normal children [9]. This type of task requires subjects to pass under obstacles of various heights by moving quickly through tight spaces, and furthermore without letting their bodies touch the obstacles. Therefore, it is possible that gross motor abilities such as quickness and coordination would be inferior in children with DD. However, no studies have been conducted in which speed and coordination as gross motor abilities were analyzed as separate entities in children with DD and compared with normal children. Such a study would make it possible to categorize and measure the gross motor abilities of children with DD in detail, and thereby to investigate the kinds of motor ability problems of children with DD compared to normal children. Additionally, it would be possible to infer the causes responsible for the higher rate of children with DD accidentally making contact with physical obstacles.

The purpose of this study, therefore, was to compare the gross motor abilities of young children diagnosed with DD, with those of normal children, and to clarify the characteristics of gross motor abilities in children with DD. Sugihara et al. [1] have developed a motor ability test for young children aimed specifically at measuring the gross motor abilities of young children. Because this test categorizes and measures gross motor abilities in terms of speed, coordination, and endurance, we decided to use this motor ability test for young children in our study.

Participants and Methods

1. Participants

This study was conducted after obtaining authorization from the Ethics Committee at Hiroshima Prefectural University, and then explaining the content of the study to cooperating research facilities and the guardians of the participants so as to obtain their consent.

Participants were 9 normal young children (3 boys, 6 girls) and 9 young children with DD (6 boys, 3 girls). In both groups, 2 children were in the first half of their 6th year, and 7 children in the latter half of their 5th year. The height of the normal children was 111.6±4.9 cm, and of the children with DD was 112.9±4.1 cm. The weight of the normal children was 18.0±1.7 kg, and of the children with DD was 19.3±1.9 kg. No significant differences were observed in either height（$t(16)=.33$, $p=.54$) or weight（$t(16)=.51$, $p=.14$). The children with DD in this study had been diagnosed as either attention-deficit hyperactivity disorder or Asperger syndrome. Because symptoms of these disorders often coexist within a patient, the line of demarcation between the two is not well defined [3]. WHO also classified these disorders as DD [10]. Therefore, the children with one of these disorders were classified as a group of children with DD in this study.

2. Methods

Measurements were taken in 6 tasks, following the meth- ods of Sugihara et al., who revised the motor ability test for young children created by the Physical Education and Psychology Research Lab at the Tokyo University of Education [1]. The 6 tasks included the following: a race by either 2 boys or 2 girls on a 25 m course to measure speed (25 m run); throwing a tennis ball over-handed as far as possible to measure coordination (tennis-ball throw); jumping one after another over 10, 5 cm-high building blocks with their legs together to measure coordination (repetitive jump-over); supporting one's body as long as possible using only upper limbs on platforms placed on either side at elbow height to measure endurance (body-support endurance); catching balls thrown at them so as to clear a 170 cm-high bar to measure coordination (ball catch); and jumping as far as possible with their legs together to measure quickness (standing longjump). Following the methods from Sugihara et al. [1], we conducted the measurements as follows: once for the 25 m run, twice for the tennis-ball throw, twice for the repetitive jump-over, once for body-support endurance, 10 times for the ball catch, and twice for the standing long-jump. Where 2 measurements were taken, we recorded the better result, and with the ball catch we recorded the number of times out of 10 throws that each participant was able to catch the ball. Each task was performed in a randomized order.

Because motor abilities differ in young children according to age and gender, we converted the actual measurements for each of the motor tasks performed by all participants in this study into T-scores based on national averages and national standard deviations for each motor task, differentiated by gender and age. Additionally, using the average T-scores for each grouping on the 6 motor tasks, we conducted a t-test for independent groups in order to compare the children with DD and normal children. Where we could not postulate an equal variance in the t-tests, we used the Welch test. We designated the significance level of all tests to be less than 5% . Do children with developmental disorders have low gross motor abilities?

Results

The T-scores for the 6 tasks of motor ability tests of the children with DD and normal children are indicated in Table 1. Based on the following t-test results of the children with DD and normal children in the 6 tasks of motor ability tests, no significant differences were

observed between the developmentally-disordered and normal children in any task examined: the 25 m run （t （16 ＝93, p＝.37）, the ball throw（t（16＝48, p ＝.64）, the repetitive jump-over （t(9.77)1.09, p ＝.30), body-support endurance （t（16＝1.43, p ＝.17）, the ball catch （t(16)＝.86, p＝.40), the standing long-jump (t(16)＝.29, p＝.77). For the repetitive jump-over test, we were unable to postulate an equal variance by means of a t-test, so adjustments of variance were made with the Welch test.

Table 1: Gross motor abilities of children with developmental disorders and normal children. （Average and Standard Deviation of actual measure and T-score.）

		25 m run (sec)	Ball throw (m)	Repetitive Jump-over (sec)	Body-support endurance (sec)	Ball catch (times)	Stand long-ju (cm
normal children	Actual Measure	6.59±0.57	7.61±3.06	5.53±0.29	28.90±20.35	9.22±1.30	109.56±
	T-score	50.08±0.70	65.66±1.78	49.35±1.48	44.92±35.82	55.59±17.66	60.48±2
children with developmental disorders	Actual Measure	6.32±0.44	8.56±2.91	5.84±0.87	17.91±12.11	8.78±1.92	111.67±
	T-score	46.71±0.65	63.45±2.16	51.78±1.48	41.59±36.17	58.02±2.71	54.64±1

Discussion

According to prior research, it has been pointed out that motor abilities during early childhood are influenced by bodily factors such as height and weight [11]. But in a comparison of these bodily factors among the participants of this study, no difference was observed between those with DD and normal children. Also, when compared with the 2007 School Health Statistical Survey Report [12] by the Japanese Ministry of Education, Culture, Sports, Science and Technology, the height and weight of participants was nearly identical to the national average. Therefore, we can eliminate the influence of age and bodily factors in comparing the 2 groups of children.

The purpose of this study was to analyze the gross motor abilities of young children diagnosed with DD by separating the elements of quickness, coordination, and endurance, and compare the results with those of normal children. The results of motor ability tests in 6 tasks show that, with respect to the T-scores on ball throwing and catching, both groups of children who participated in this study achieved higher values than the national average. According to prior research, when it comes to throwing and catching balls, young children who are experienced at physical games involving balls, such as baseball or soccer, have better motor abilities than young children with little such experience

[1]. We found that in this study as well, participants showed strong motor abilities with respect to throwing and catching balls because they had significant experience playing physical games involving balls.

Next, a comparison of the children with DD and normal children with regards to the results from the motor ability tests showed that there were no significant differences in any of the following motor ability areas: 25 m run, tennis-ball throw, repetitive jump-over, body-support endurance, ball catch, and standing long-jump. In other words, the gross motor abilities of the children with DD were equivalent to those of normal children in terms of the speed necessary for running, the total-body coordination necessary for throwing balls, the total-body rhythmic coordination necessary for repetitive jump-overs, the endurance necessary for body-support endurance, the vision and upper-extremity coordination needed for catching balls, and the quickness needed for standing long-jumps.

Prior research on gross motor abilities which tested passing-under movements [9] has shown that children with DD have a higher rate of accidentally making contact with physical obstacles. However, the results of this study suggest that underdevelopment of gross motor skills does not seem to be the cause of such children making contact with obstacles. According to Higuchi et al. [13] and Warren et al. [14], in order to pass through a tight space it is necessary, based on environmentally-indicated information that changes from moment to moment, to assess accurately the possibility of taking action, and simultaneously to use information regarding one's own bodily characteristics to appraise whether one can indeed pass through. Therefore, it is possible that children with DD have insufficient ability to use information regarding bodily characteristics to appraise their actions. It will be necessary in future studies to investigate the ability of children with DD to evaluate their actions in order to clarify further the issue of why they have a higher rate of accidentally making contact with physical obstacles.

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