IS THERE A RELATIONSHIP BETWEEN GROSS MOTOR FUNCTION AND COORDINATION IN CHILDREN WITH SPASTIC CEREBRAL PALSY?: A PILOT STUDY

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ABSTRACT

Background: Cerebral palsy is the most common neurological disorder affecting children worldwide. It’s accompanied by poor motor functional abilities and poor coordination.

Objective: The aim of this pilot study is to find out if there a correlation between gross motor functions and gross motor coordination in children with spastic hemiplegic cerebral palsy.

Subjects & Methods: Thirty children with spastic cerebral palsy were selected from the Pediatric Outpatients’ clinic of the faculty of Physical Therapy Cairo University. The age of the study group was from 6 to 10 years, scored 1 to 1+ on modified Ashworth’ scale and score level 1 on the gross motor classification system. Gross Motor Function Measure was used to measure the gross motor functions and the Bruininks - Oseretsky of Motor Proficiency – 2nd Edition was used to measure the gross motor coordination.

Results: The study revealed a strong positive correlation between the total gross motor score and Body Coordination Standard Score (r= 0.70340, p<0.001), Strength and Agility Standard Score (r= 0.73084, p<0.001), and Gross Motor Composite Standard Score (r= 0.75269, p< 0.001).

Conclusions: Gross motor functions were proven to be strongly correlated to gross motor coordination in children with spastic hemiplegic cerebral palsy.

Keywords: Gross, Motor Functions, Coordination, Children, Spasticity, Cerebral Palsy

I. INTRODUCTION

Cerebral Palsy (CP) is an umbrella term that describes a non-progression lesion in the immature brain. CP causes permanent deformity, dysfunctions and limitations as it decreases motor activity, movement and posture. Usually the motor disorder is accompanied by impairments in cognition, perception, sensation, and behavior(1).

Spasticity one of the main characteristics of spastic CP types, leads to disturbance in motor functions, abnormal sensation, pain and some major musculoskeletal disorders e.g., hip dislocation and muscle shortening (2,3).

Decline in gross motor functions is one of the main features of CP, causing limitation in movements and functional daily living activities(4). This limitation could be a result from primary lesion itself or from secondary causes as spasticity, pain or musculoskeletal abnormalities(5).
Motor coordination is essential for proper acquisition of movements and the smoothness of performance(6). The gross motor coordination encounter many skills as balance, bilateral movement, agility and speed(7). Children with CP experience a decline in their gross motor coordination abilities(8).

Despite the well-known effect of CP on gross motor function and gross motor coordination; the relationship between them was never been assessed. The aim of this pilot study is to find out if there is a correlation between gross motor functions and gross motor coordination in children with spastic hemiplegic CP. It was hypothesized that there was no correlation between the gross motor functions and gross motor coordination in children with spastic CP.

II. METHODOLOGY

Ethical Consideration

An assent form was read, approved and signed by the children’s care givers.

Study Design

Cross sectional study design.

Subjects

Thirty children with spastic CP (27 hemiparesis and 3 diplegic) were selected from the Pediatric Outpatients’ Clinic in the Faculty of Physical Therapy Cairo University as illustrated in the flow chart (Figure 1).

The children aged 6 to 10 years old. They were included if they were able to respond to verbal commands (9), scored 1 to 1+ on Modified Ashworth’ scale (10), and scored Level I on Gross Motor Function Classification System (GMFCS). They were excluded if they suffered from vertigo, epilepsy, or osteoporosis.

Instrumentations & Procedures

Gross Motor Functions:

The Gross Motor Function Measure-88 (GMFM) was used to evaluate the gross motor functions. The GMFM is a reliable, criterion referenced tool that used in assessing the gross motor functions(11). GMFM composite of five dimensions assessing Lying, Sitting, Kneeling, Standing and Walking.

The five dimensions were tested on each child in a quiet room. Each dimension was tested and then a calculation of dimension percentage scores was done; Then, the summation of the five dimensions percentage formed the total gross motor score. We calculated and recorded the total gross motor score.
Gross Motor Coordination:

Bruininks - Oseretsky of Motor Proficiency – 2nd Edition (BOT-2) is a reliable tool used in assessing fine and gross motor coordination in children from four years till 21 years (12).

The gross motor record form of BOT-2 was used to evaluate the gross motor coordination. The gross motor record form is evaluating four subtests (Bilateral coordination, Balance, Running speed and agility, and strength). The summation Bilateral coordination and Balance scale scores form “Body Coordination Scale Score” that then converted to its Standard score; on the other hand, the summation of Running speed & agility, and strength scale scores form “Strength and Agility Scale Score” that can be converted to its standard score. The summation of “Body Coordination scale score” and “Strength and Agility Scale Score” form the Gross Motor Composite Scale Score that also can be converted to its standard score (7).

The four items were tested on each child in a quiet place. The Scale score of the 4 items were scored and the Body coordination, Strength & agility, and gross motor composite scale score and standard scores was calculated and recorded.

Statistical Analysis

SAS® OnDemand for Academics was used for data analysis. Pearson’s correlation coefficient was used to determine a correlation between total gross motor score and body coordination standard score; total gross motor score and Strength and agility standard score, and finally total gross motor score and gross motor composite standard score.

The initial alpha level of the correlational analysis was 0.05.

III. RESULTS

The current study correlates between the total score of gross motor functions and gross motor coordination’s in terms of Body Coordination Standard Score, Strength and Agility Standard Score and total gross motor coordination composite. The correlation was studied using the Person correlation coefficient.

As illustrated in Table 1 and Figure 2, the study revealed a strong positive correlation between Total Gross Motor Functions Score and Body Coordination Standard Score (r= 0.70340, p<0.001) a strong positive correlation between Total Gross Motor Functions Score and Strength and Agility Standard Score (r= 0.73084, p<0.001), and finally a strong positive correlation between Total Gross Motor Functions Score and Gross Motor Composite Standard Score (r= 0.75269, p< 0.001).

Table 1: Pearson Correlation

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<tr>
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<th>Pearson Correlation Coefficient , N=30</th>
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<tr>
<td></td>
<td>Body Coordination Standard Score</td>
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<tr>
<td>Total Gross Motor</td>
<td>r</td>
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<tr>
<td>Functions Score</td>
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IV. DISCUSSION

This study revealed a strong positive correlation between the gross motor functions and gross motor coordination; so, the study rejected the null hypothesis that stated that there was no relationship between gross motor functions and gross motor coordination and approve the alternative hypothesis stating that there was a statistically significant positive correlation between gross motor functions and gross motor coordination.

This research is one of few researches discussed the relationship between functional activities and motor coordination, and may be the only – as to the best of our knowledge- to study this relationship in CP population.

This study was supported by Spittle and Orton who mentioned that motor impairments were associated with the decline of motor coordination (8). Also, Williams et al. found the same relationship between decline in motor coordination and the appearance of motor impairments (13).

The current study results were also supported by the results of Tepeli (14). His results revealed a positive association between gross motor skills and coordination, where the functions improve in association to the coordination and vice versa.

Bilateral coordination and balance are the two items forming body coordination. A clinical trial by Lai et al. examined the realtionship between the bilateral coordination to motor functions revealed a moderate positive association between both variables(15); that support the current study results too.

Some studies tested the relationship between balance and gross motor abilities. Liao & Hwang found a direct relationship between balance and gross motor functions. Whenever there is an improvement in balance, it was associated in enhancement in the motor functions(16).

Indirect association between gross motor functions and gross motor coordination can be extracted when looking on previous studies that associate both gross motor functions and gross motor coordination to mental abilities and executive functions. Several studies found a positive correlation between gross motor functions and executive as well as cognitive functions (17,18) and other studies found positive correlation between motor coordination and cognitive functions (19–22).

Analyzing the current correlation, we found that the scores of the three children with diplegic CP was relatively lower than the rest of the sample of hemiplegia. That revealed that the gross motor abilities and gross motor
coordination in the diplegia may be developed later than hemiplegia or it just due to the small sample size. We encourage fellow researchers to work on this point further on wider population.

Although CP was extensively studied in many aspects, the gross motor coordination had limited studies. We believe that this study could be a small step exploring the gross motor coordination in children with CP in depth.

The limitations of the study were the challenge to collect data with the situation of COVID-19 pandemic lockdown and the sample size could have been larger for more accurate results. We recommend several researches concern motor coordination in child with CP and recommend studying correlation between gross motor functions and gross motor coordination on a larger sample size.

V. CONCLUSION

The study concluded that there a strong relationship between the gross motor functions and gross motor coordination in children with spastic CP.

Conflict of interest

The authors declare no conflict of interest.

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