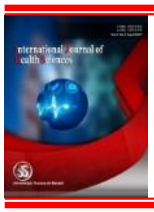

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# Evaluation of the Strength of the Upper Extremity and the Balance in Pediatric Population with Hemiplegia After Stroke

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***Keywords***

*children;*
*hemiplegia;*
*jamar dynamometer;*
*PBS;*
*stroke;*

**Abstract**

Introduction: The brain is a system with multidimensional organization and architecture and requires a continuous blood supply to function normally. If blood flow is interrupted for more than a few seconds, the brain is deprived of blood and oxygen, causing death in nerve cells in the affected area. The stroke in children after birth appears even more rarely than in adults. Methods: For the study, 20 children with hemiplegic cerebral palsy (14 boys and 6 girls) participated (mean age 10,9 years), from the "General Hospital Hippocratio" of Thessaloniki, according to the inclusion criteria. The strength of the upper extremity was measured using the Jamar dynamometer. To assess the balance, the Pediatric Balance Scale (PBS) Affected and contralateral hands results were analyzed and compared with norms for age and sex and related to the affected balance. Results: It was found that the strength of the non-affected upper extremities was also reduced according to the data of the normal children and the balance was also affected because of the stroke. Discussion: Physiotherapy programs may include exercises that emphasize the non-affected upper extremities, more similar research must be done on a bigger population.



**Contents**



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## 1 Introduction

The World Health Organization characterizes stroke as harm to brain tissue or the spinal cord, that is caused by a disturbance to the blood circulation and they exist sudden side effects. Stroke is included among the most critical issues of the world's well-being and is recorded as the third cause of passing after cancer and heart infections (Kolk et al., 2011; Pacheco et al., 2018). It is the result of ischemia (diminished blood circulation), either blockage, which is caused either by thrombosis or blood vessel embolism, or hemorrhage. As a result, the influenced part of the brain dysfunctions leads to the appearance of neurological and mental dysfunctions (Rose, 2019). They are classified into ischemic, which incorporates blood vessel infarcts venous sinus thrombosis, and hemorrhagic, and happen within the pediatric populace more once in a while than in grown-ups (Brobeck & Grant, 2005). They are moreover partitioned into perinatal, (creating between the 20th week of fetal life and the 28th day after birth) and strokes in children (showing up from the 29th day after birth to the age of 18 a long time) (Brobeck & Grant, 2005; Bryant et al., 2005; Freundlich et al., 2012). Frequency rates shift within the worldwide writing with a lower rate in children 0.2/100,000 children/year and the next 7.9/100,000 children/year and in newborns around 20-30/100,000 newborns/year (i.e. 1/4,000-5,000 births/year) (Freundlich et al., 2012; Fox & Fullerton, 2010). The incidence rate of stroke, either ischemic or hemorrhagic, is higher in boys than in young girls (1.5/1 concurring to one ponder), and so is the mortality rate (Katsantoni et al., 2023; Titomanlio et al., 2013; Fox & Fullerton, 2010; Sofronas et al., 2006). The clinical appearances of stroke change due to the complex structures of the brain and its vasculature. The reason for this investigation was the assessment of children with Stroke, particularly the quality of the upper extremities (Chabrier et al., 2016). There is a lack of research regarding the measurements of the non-affected upper limb in children with hemiplegia and that was a motive to conduct the research.

## 2 Materials and Methods

*Strategies*
*Subjects*

The patients were chosen from the "General Clinic Hippocratio" of Thessaloniki. The choice criteria were children, who were diagnosed with hemiplegia and who all had independent functional mobility. The children age was between 4-18 old. All the children were able to communicate and understand the instructions that were given to them and conjointly were able to utilize the upper extremities. Exclusion criteria from the inquiry were children who were analyzed with Tetraplegia or Diplegia and were younger than 4 years old and older than 18, on the off chance that they were incapable of getting a handle on utilizing their upper appendages, might not communicate or get it enlightening (Samanta, 2020; Fehlings et al., 2000).

At last, twenty children took portion in the investigation, analyzed with hemiplegia (agreeing on the determination of the Pediatric Neurologist), matured six to fifteen (cruel age 10,9), with a add up to six girls and fourteen boys. Twelve children with cleared-out hemiplegia and eight children with right hemiplegia were recorded conjointly the somatometric characteristics of tallness and weight. (Figures 4 and 5).

The ponder included a test of (20) children after stroke of which 70% were boys and 30% were young ladies. (Figure 1) The cruel age for boys was 10.9 a long time and for young ladies 11 a long time (Figure 2). The rate of cleared-out hemiplegia within the whole test was recorded at 70% and of right hemiplegia at 30% (Figure 3) with the boys scoring an add up to 71% cleared out hemiplegia and 28.65 right hemiplegia, whereas among the young ladies the percentages of cleared out hemiplegia were 66.6% and 33.3% right hemiplegia.


Figure 1. Percentages of boys and girls who participated

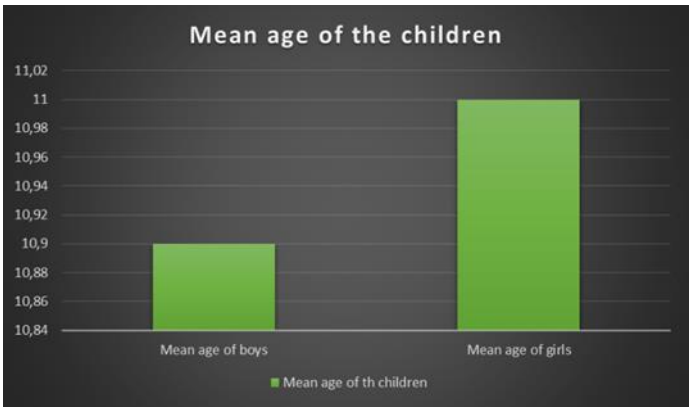



Figure 2. Mean age of boys and girls

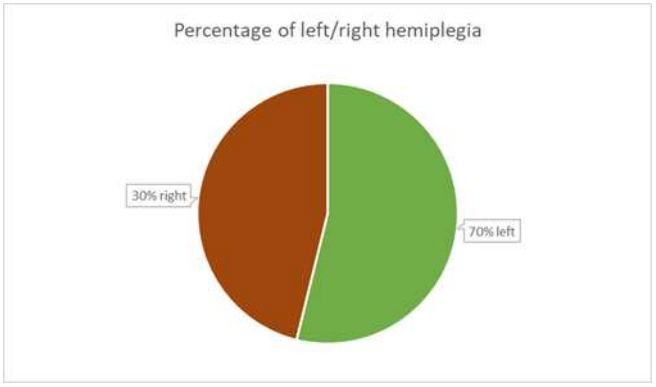



Figure 3. Rates of left and right hemiplegia

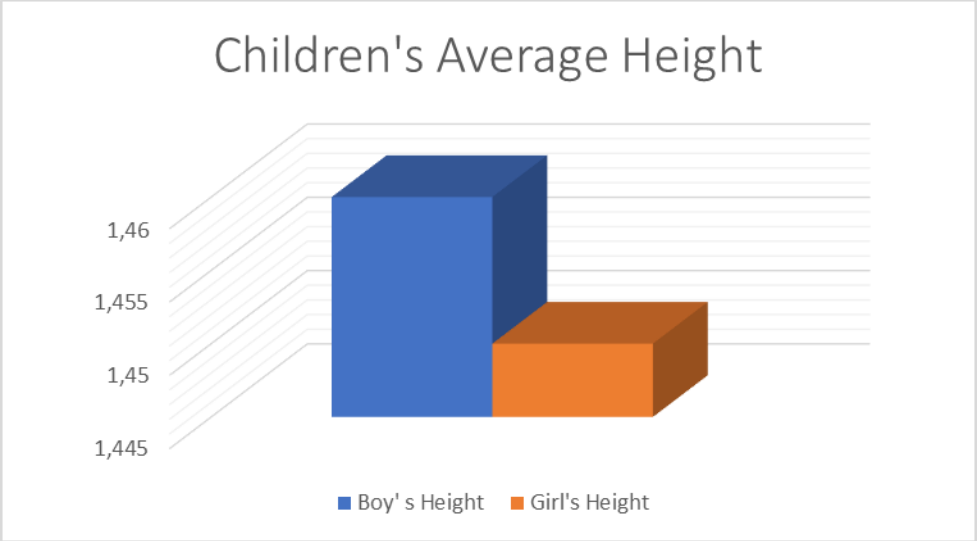



Figure 4. Average height of the children who participated

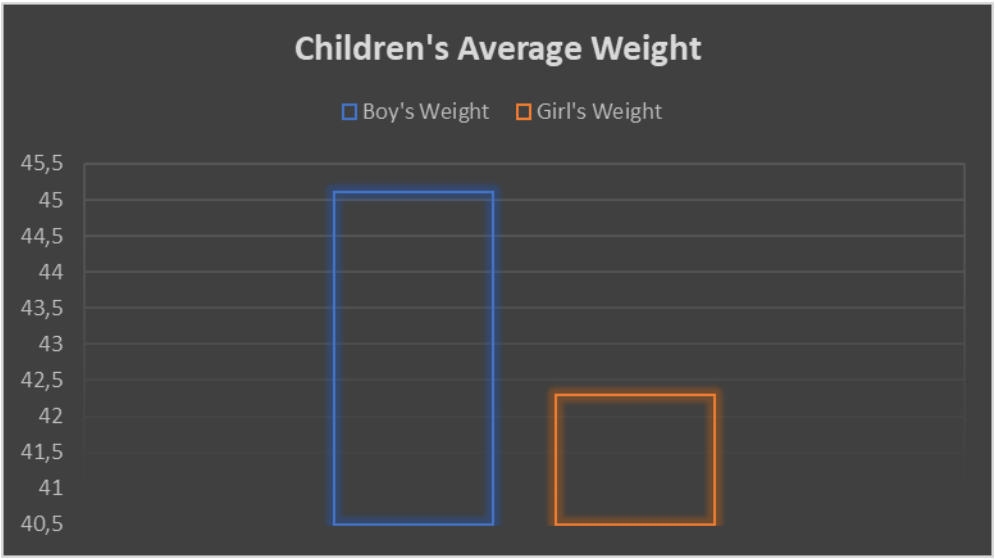



Figure 5. The average weight of the children who participated

The point of the study was to discover contrasts in quality between right/left upper extremities (healthy and impaired) compared to information within the common population through Dynamometry and if these come about were related to the affected balance of the children, which were measured with the assistance of the PBS. All parents/guardians concurred with the cooperation of the children by signing an articulation of consent.

*Estimations*

The JAMAR dynamometer for the estimations of the upper limbs was chosen and the Pediatric Balance Scale (PBS) for the assessment of Balance. Handgrip Strength (HGS) is utilized as an implication of foreseeing a person's well-being all through life (Chen et al., 2013; Jantakat et al., 2015). The HGS is an imperative marker that makes a difference in recognizing the level of improvement and degree of inability. It moreover makes a difference decide the viability of recovery and survey the integrity of upper extremity work. The JAMAR

dynamometer contains a dual scale readout which shows isometric grip force from 0-90 kg (0-200 lb). The external dial registers the result in kg and the inward dial registers the result in lb. It contains a crest hold needle which consequently holds the most noteworthy reading until the gadget is reset. The handle effectively alters to five grasp positions from 35-87 mm (1½ - 3¼") in 13 mm (½") increments. Continuously utilize the wrist strap to prevent the dynamometer from falling on the floor in case incidentally dropped (Vannucci & Hurn, 2009).

The PBS was initially created within the United States as an altered form of the Berg Balance Scale (BBS). It comprises 14 things based on exercises of daily living beginning from the easiest to the most difficult. Each PBS item is rated on a 5-point scale, with zero showing failure to act without help, and 4 showing the capacity to perform the assignment independently. Each item's scores are summed to get the whole PBS score (most extreme = 56 focuses). Expecting for utilize in school-aged children (5-15 years) with mild to moderate motor disabilities such as cerebral palsy and other pediatric disorders (Friedman, 2009). It can be effortlessly performed and scored in less than 20 minutes utilizing minimal equipment commonly found in schools and clinics. Its reason is to assess the functional balance and motor disorders of school-aged children with mild to moderate motor dysfunctions in the setting of day-by-day exercises. PBS moreover can recognize between normally developing children and those with mild motor disabilities, as well as, those with moderate to serious motor impairment. Within the investigation, the form, which was utilized, was deciphered in Greek by Laspa et al. (2020).

*Assessment – Strategy*

Within the Research, a non-random sample of 20 patients from the General Hospital of Thessaloniki "Hippocratio" was included with a diagnosis of hemiplegia. To begin with, the strength of both upper limbs was measured using a JAMAR dynamometer, and after that the Pediatric Balance Scale tests were recorded (Bohannon et al., 2006). Each subject was put in a straight-backed chair with both feet level on the floor. Arm placement was demonstrated by the assessor, and at that point, each child was instructed to put their left hand on the left thigh, and vice versa, and to put the shoulders in adduction without turning. For the arm to be tested, the elbow was to test the arm, the elbow was flexed to 90°, the forearm and wrist were in neutral positions, and the fingers were flexed so that the thumb touched the child's index finger.
The method we followed was:
To begin with, the participant was asked to remove any objects that they wore. After they sat in a chair, that was chosen for the test and it was demonstrated how to hold the dynamometer and it was clarified that the best result would be given in case they pressed the dynamometer firmly. At that point, the child had to rest their forearms on the arms of the chair and keep their feet level on the floor. Their feet had to remain level on the floor when they pressed the dynamometer. At that point, they were asked to position their thumb around one side and their fingers around the other side of the handle. It was ensured that the position of the handle was adjusted according to the size of the children's hands. Before the estimation, it was ensured that the red needle was in the "0" position by turning the dial. Children had to press the dynamometer as tight as possible. The strategy was repeated twice and it was recorded the average of the results.

## 3 Results and Discussions

*3.1 Results*

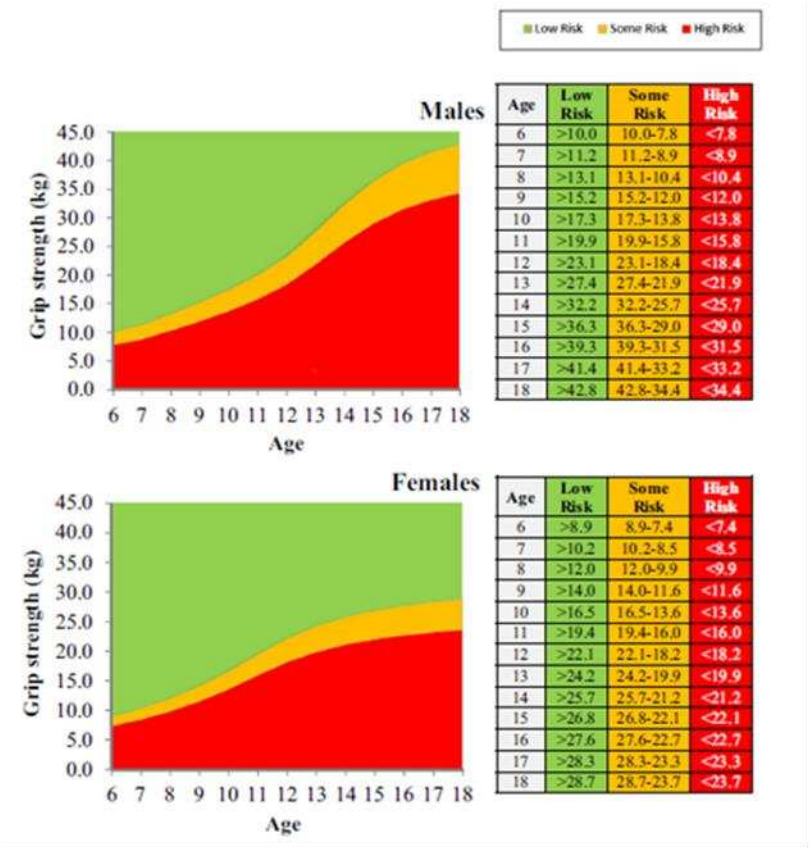
In the results of the measurements of the strength of the upper limb (Hand Grip) agreeing to the common population, increased deviations were recorded within the entirety test with results of strength of the upper limb recording a high degree of difficulty and risk (High Risk) an average degree of difficulty and risk (Some Risk) and low level of difficulties (Low Risk). Particularly, on the hemiplegic side of children, 80% of boys with left hemiplegia had a place (High Risk) whereas 20% to (Some Risk) whereas on the right hemiplegia, 100 belonged to (High Risk). Moreover, 100% of the boys with right hemiplegia had a place to (Some risk) according to their non-hemiplegic side. As for the hemiplegic side of the girls, 100% of them with left hemiplegia had a place to (High Risk) whereas with right hemiplegia 100% as (High Risk). Critical was the

report of estimations that record rates of upper extremity strength deviations on the non-hemiplegic side. The boys with left hemiplegia, their unaffected upper limb had a place to 57.1% at High Risk, 28.6% at (Some Risk), and 14.3% at (Low Risk). In girls, the 100% left non-hemiplegic upper limb had a place to (Some Risk) and the right non-hemiplegic 100% as (Some Risk). (Table 1)

Table 1
Results of the test with the Jamar dynamometer

| Gender/Age | Hemiplegia | Measurements of the left upper limb | Measurements of the right upper limb |
|---|---|---|---|
| Male/15,5 | Left | High risk (2) | Low risk (12) |
| Male/7 | Left | High risk (4) | High risk (4) |
| Male/7 | Right | Some risk (11) | High risk (8) |
| Male/14 | Left | High risk (22) | Some risk (26) |
| Female/14 | Right | Some risk (24) | High risk (19) |
| Female/7 | Left | High risk (6) | Some risk (8,9) |
| Male/16 | Right | Some risk (33) | High risk (23) |
| Female/12 | Left | High risk (14) | Some risk (20) |
| Male/10 | Left | High risk (13) | Some risk (17) |
| Male/7 | Left | Some risk (11) | High risk (8) |
| Female/14 | Right | Some risk (24) | High risk (19) |
| Female/12 | Left | High risk (12) | Some risk (18,9) |
| Female/13 | Left | High risk (8) | Some risk (10) |
| Male/13 | Right | Some risk (11) | Low risk (12) |
| Male/7 | Left | High risk (5) | High risk (8) |
| Male/12 | Left | High risk (20) | Some risk (24) |
| Male/16 | Right | Some risk (33) | High risk (23) |
| Male/6 | Left | High risk (15) | Some risk (19) |
| Male/7 | Left | Some risk (11) | High risk (8) |
| Male/9 | Left | High risk (1) | High risk (4) |

Table 2
Rates of the normal strength of children based on their age




| Age | Low Risk | Some Risk | High Risk |
|---|---|---|---|
| 6 | >10.0 | 10.0-7.8 | <7.8 |
| 7 | >11.2 | 11.2-8.9 | <8.9 |
| 8 | >13.1 | 13.1-10.4 | <10.4 |
| 9 | >15.2 | 15.2-12.0 | <12.0 |
| 10 | >17.3 | 17.3-13.8 | <13.8 |
| 11 | >19.9 | 19.9-15.8 | <15.8 |
| 12 | >23.1 | 23.1-18.4 | <18.4 |
| 13 | >27.4 | 27.4-21.9 | <21.9 |
| 14 | >32.2 | 32.2-25.7 | <25.7 |
| 15 | >36.3 | 36.3-29.0 | <29.0 |
| 16 | >39.3 | 39.3-31.5 | <31.5 |
| 17 | >41.4 | 41.4-33.2 | <33.2 |
| 18 | >42.8 | 42.8-34.4 | <34.4 |

| Age | Low Risk | Some Risk | High Risk |
|---|---|---|---|
| 6 | >8.9 | 8.9-7.4 | <7.4 |
| 7 | >10.2 | 10.2-8.5 | <8.5 |
| 8 | >12.0 | 12.0-9.9 | <9.9 |
| 9 | >14.0 | 14.0-11.6 | <11.6 |
| 10 | >16.5 | 16.5-13.6 | <13.6 |
| 11 | >19.4 | 19.4-16.0 | <16.0 |
| 12 | >22.1 | 22.1-18.2 | <18.2 |
| 13 | >24.2 | 24.2-19.9 | <19.9 |
| 14 | >25.7 | 25.7-21.2 | <21.2 |
| 15 | >26.8 | 26.8-22.1 | <22.1 |
| 16 | >27.6 | 27.6-22.7 | <22.7 |
| 17 | >28.3 | 28.3-23.3 | <23.3 |
| 18 | >28.7 | 28.7-23.7 | <23.7 |

*Measurements of PBS*

Rates of deviations moreover refer to the balancing capacity of the children with the biggest percentage of 40% of the sample recording 49/56, 20% recording the most noteworthy percentage of score 53/56 and correspondingly the lowest balance 41/56 in 20%, whereas in 10 % the average values of scores are found with 50-52/56. The whole sample records challenges in balancing capacity with score deviations lowest score being recorded as min=41/56 and most noteworthy as max=53/56. (Table 3)

Table 3
Results of the Pediatric Balance Scale test

| Participants | Score on the Pediatric Balance Scale | Percentage |
|---|---|---|
| A male with Left hemiplegia | 41/56 | 10% |
| 4 Male with Right/ Left hemiplegia | 41/56 | 10% |
| 8 Male with Left hemiplegia | 49/56 | 40% |
| 2 Females with Left hemiplegia | 50/56 | 10% |
| 2 Females with Right hemiplegia | 52/56 | 10% |
| 2 Females with Right hemiplegia | 53/56 | 10% |
| 2 Male with Left hemiplegia | 53/56 | 10% |

*3.2Discussion*

The human hand performs different complex and detailed functions that permit people to complete errands such as writing, computing and numerous others. Exact estimations of muscle strength can give bits of knowledge into children's development. Until nowadays it hasn't been reported if the handgrip of the non-affected hand on the children population was affected because of the stroke, even though research on adults has been conducted. Through this research, it's been clear that as physiotherapists we have to provide consideration to both hands giving the children exercises for empowering the muscles. From the above results, it follows that the handgrip of children with hemiplegia after stroke is critically influenced. Regarding strength, the hemiplegic upper limb was influenced which was anticipated but it has appeared that strength was moreover influenced within the healthy upper limb (L/R). Concurring with the research that was conducted by Soohee Park, and Joo-Young Park we conclude that in adults with a mean age of 60 years, the grip strength of the unaffected side of patients with hemiplegia was found to be significantly lower. In any case, similar research for children and adolescents has not been executed since now.

Regarding Balance, the average score was 48.6, with an excellent 56, which indicates a disturbance of balance, which was anticipated due to the spasticity they showed on the hemiplegic side, so there was a poor base of support, reduced balancing reactions and alignment in the trunk. At last, it may be possible that the influenced strength of the non-affected hand could be a factor that influences the balance of these children. This can be a motive for research.

## 4 Conclusion

From the research we conducted, we concluded that too the un-affected hand must be included within the programs, which we execute, and provide exercises for strengthening.

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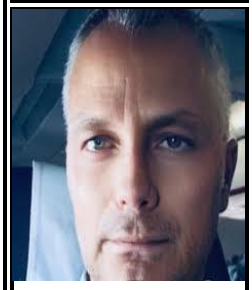

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