

**Original article:**

**Relationship Between Functional Activity And Nutritional Status, Manual Ability And Intelligence In Children With Cerebral Palsy**

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**Abstract**

Cerebral palsy (CP) is a non-specific term associated with impaired motor function that is clearly visible at the beginning of birth and characterized by changes in muscle tone, muscle weakness, involuntary movements, ataxia, or a combination of these disorders. Nutritional status in people with cerebral palsy is related to the health status of children who will affect the development of cognition and motto in the future. Manual Ability Classification System (MACS) is an assessment of the hand ability of a person with cerebral palsy that will affect daily life. CP children tend to experience disorders in brain development that will be associated with decreased intellective function. Impaired overall motor function will affect the child's ability to perform mobilisai classified according to the Gross Motor Function Classification System (GMFCS) which will affect the child's ability to interact with family and the surrounding environment. The aim of the study was to assess the relationship between functional activity and nutritional status, manual ability and IQ in children with cerebral palsy. Method of observational analytical research using cross sectional approach, independent variable consist of functional activity and dependent variable are assessment is nutritional status (Z-score) manual ability (MACS) integensia (IQ) in children with Cerebral Palsy in YPAC city of Semarang

The results of functional activity research are mostly GMFCS3-4 (25%), the Spasticity 2 as much as 58.3%, most intellectual rank borderline and moron 37.5%, normal nutritional status (54.2%) for manual ability 3.3% MACS 1. Spearman's non-parametric correlation test were used and obtained a sig value of 0.004 ( $p < 0.05$ ) between GMFCS and intellectual level with an intellectual value of  $r = 0.564$ , with a nutritional status of 0.008 ( $p < 0.05$ ) with a value of  $r = 0.531$  and with MACs of 0.004 ( $p < 0.05$ ) with  $r = 0.561$  moderate correlation.

**Keywords:** Cerebral Palsy, Nutritional Status, IQ, MACs, GMFCS.

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**Introduction**

Cerebral palsy describes a group of movement and posture developmental disorders that are permanent, causing limited, non-progressive activity that occurs in the developing fetus. Motor disorders are often accompanied by impaired sensation, perception, cognition, communication and behavior, with epilepsy (1)

This impaired motor function is not caused by abnormalities in the muscles or nerves, but the presence of problems in the brain such as the brain that is not developing properly. This problem can affect the way the brain controls movement and posture. Children with Cerebral palsy often exhibit other neurological disorders such as intellectual impairment, epilepsy, speech and language impairment, hearing and vision loss,

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behavioral disorders, and other musculoskeletal problems (2) Children with CP will experience dependence on others, as they have motor limitations when cared for and self-care.

The Gross Motor Function Classification System (GMFCS) for cerebral palsy is based on self-directed movements, with an emphasis on sitting, transfer, and mobility. When defining a five-tier classification system, the main criteria have differences between meaningful levels in everyday life. Differences are based on functional limitations, such as mobility aids, crutches, sticks or wheeled mobility to a lesser extent. The difference between level I and II is not as striking as the difference between other levels, especially for children less than 2 years of age (3) Spasticity is one of the signs of upper motor neuron syndrome that can affect function, limit daily life activities and reduce quality of life in children with spastic Cerebral Palsy (CP). Spasticity assessment is important to determine the effectiveness of spasticity treatment and to plan medical applications and also to measure the regulation of tone, to decide the purpose of physiotherapy, and to give CP children and their families encouragement. (4)

Intellectual impairment in CP has not been studied much. The use of measuring instruments to assess intellectuals in CP children is still a challenge to the use of standard measures of intelligence to assess children with CP. Studies from Iceland and Australia estimate that a third of children with CP are unable to complete all tasks on those steps due to inadequate fine and verbal motoric abilities and even among those who complete the final score task are less likely to describe the child's actual level of function with the inclusion of tasks that require speed or fine motor responses. (5) The study used a scale of internet obtained from the medical records of each child were assessed by a psychologist.

The study (6) revealed the high prevalence of malnutrition in CP children, also emphasizing the possibility of malnutrition in children with CP if anthropometric assessments were based on the use of growth charts for the general pediatric population. This study provides important data on the assessment of nutritional status and prevalence of malnutrition among children with CP in Turkey, which can be used for future proactive strategies in the prevention and treatment of malnutrition in the pediatric population with CP in particular.

Children with CP who have a higher GMFCS, CP with tri/quadruplegia type show a proportion of severe malnutrition. Therefore, this vulnerable group should be focused on designing nutritional intervention and rehabilitation programs. Factors that affect the nutritional status of children with CP are complex. Several studies have reported malnutrition disorder among children with CP and higher along with the severity of CP. Other studies reported poor nutritional status associated with more severe functional limitations according to the GMFCS and Manual Capability Classification System (MACS). Evidence also suggests that the severity of GMFCS and MACS is often accompanied by high levels of oral motor disorders so that CP children have difficulty swallowing, causing nutritional disorders. (7)

Manual Ability Classification System (MACS) is a classification used to measure the hand ability of a person with cerebral palsy in everyday life. MACS assessments are used to describe the child's general ability in his or her daily life. Therefore, information is needed from caregivers or parents who know the child's abilities at home, at school, and in his playing environment. MACS is also not used to assess the ability of each hand. This assessment can be used in children aged 4-18 years. Benda which is generally held by a 4-year-old is certainly different from the object that is generally held by a 17-year-old teenager. Therefore, it will be more accurate if the object used as a benchmark assessment is an object that is used daily for activities by children his age. For children aged 1-4 years, the classification used is Mini-MACS. There is no difference in the assessment component between Mini-MACS and MACS (8)

The study aimed to assess whether there is a relationship between gross motor functional activity and the nutritional, intellectual and macs status of children with cerebral palsy.

## Research Methods

This type of research is an analytical observational study with a cross sectional approach with variables free of functional activity and teriabel tied nutritional status, intellectual and manual abilities. The instrument used in this study, the Gross Motor Function Classification System to assess the functional activities of CP children consists of levels I, II, III, IV and V, for intellectuals using the score of the internet taken from the medical

records of psychologist examination results with the lowest rating of idiots < 30 to genius >140 with a ordinal measurement scale. Nutritional status is measured using IMT/U and Z-score indicators. Body Mass Index is obtained from the results of TB and BB measurements calculated using the BMI formula. The results of the calculation are adjusted to the standard value table(Z-score) based on BMI / U according to WHO,the criteria for nutritional status from very thin to obese, with a ordinal data scale. Manual ability is assessed using the Manual Ability Classification System (MACS) consisting of degree I can hold objects up to degree V Cannot hold objects and very limited ability to perform even simple actions and need for total assistance.

After completing the permit and ethical clearance, the study was conducted at YPAC Semarang City, before carrying out research researchers explained what will be studied by providing informed consent to the parents of patients, the study was conducted in September - November 2019 with ethical clearance number: 657 /X / 2019 / FK Unissula Bioethic Commission. The study sample was a child with cerebral palsy who met the inclusion criteria, namely suffering from cerebral palsy, 6-12 years old, undergoing a therapy program of at least 1 year while children who were sick post-seizure due to epilepsy in exclusion, large samples taken based on consecutive sampling so that 24 cerebral palsy children were obtained during October - November 2019.

## Results

This research was conducted at the Foundation for The Education of Disabled Children (YPAC) of Semarang City, from September to November 2019. The study sample was a child with cerebral palsy that met the criteria for inclusion and exclusion, resulting in 24 children. After research, the following data characteristics were obtained:

**Table 4. 1. Characteristics of The Research Subject**

| Characteristic | n            | Persentase |
|----------------|--------------|------------|
| Age            | 7 years old  | 4 16,7%    |
|                | 8 years old  | 3 12,5%    |
|                | 9 years old  | 5 20.8 %   |
|                | 10 years old | 3 12,5%    |
|                | 11 years old | 4 16,7%    |
|                | 12 years old | 5 20.8 %   |

| Characteristic       | n                           | Persentase |
|----------------------|-----------------------------|------------|
| Gender               | Male                        | 11 45,8%   |
|                      | Female                      | 13 54,2%   |
| Cerebral Palsy Type  | Spastic hemiplegia          | 1 4,2%     |
|                      | Spastic diplegia            | 10 41,7%   |
|                      | Spastic triplegia           | 1 4,2%     |
|                      | Spastic quadriplegia        | 7 29,2%    |
|                      | Ataxia                      | 1 4,2%     |
|                      | Athetoid Ataxia             | 1 4,2%     |
|                      | Athetoid Diplegi Spasticity | 3 12,5%    |
| GMFCS Level          | GMFCS 1                     | 4 16,7%    |
|                      | GMFCS 2                     | 4 16,7%    |
|                      | GMFCS 3                     | 6 25,0%    |
|                      | GMFCS 4                     | 6 25,0%    |
|                      | GMFCS 5                     | 4 16,7%    |
| Intellectual level   | Dull                        | 3 12,5%    |
|                      | Border line                 | 9 37,5%    |
|                      | Moron                       | 9 37,5%    |
|                      | Imbecile                    | 3 12,5%    |
| Nutritional Status   | Very thin                   | 3 12.5 %   |
|                      | Thin                        | 3 12.5 %   |
|                      | Normal                      | 13 54.2 %  |
|                      | Fat                         | 2 8,3 %    |
|                      | Obese                       | 3 12.5 %   |
|                      | MACS 1                      | 8 33,3%    |
| Manual Ability Level | MACS 2                      | 5 20,8%    |
|                      | MACS 3                      | 4 16,7%    |
|                      | MACS 4                      | 4 16,7%    |
|                      | MACS 5                      | 3 12,5%    |

In table 4. 1, it was seen that the study subjects were mostly 9 and 12 years old, with more female sex (54.2%) than men. The vast majority of CP children experienced a spastic type of CP Diplegi (41.7%) followed by a 29.2% spastic Quadriplegia. Functional activities are mostly GMFCS 3 and 4 (25%). From spasticity examinations using the asworth scale obtained mostly asworth 2 as much as 58.3%. The most intellectual levels are borderline and moron as much as 37.5%. From the assessment of nutritional status obtained mostly is normal nutritional status (54.2%) while for manual ability assessed using MACS obtained 33.3% is MACS 1.

**Table 4.2 GMFCS relationship with IQ, Nutritional Status and MACS**

| Spearman Correlation |                         | Sig   | Correlation Coefficient |
|----------------------|-------------------------|-------|-------------------------|
| GMFCS                | Intellectual Level (IQ) | 0.004 | 0.564                   |
|                      | Nutritional Status      | 0.008 | 0.531                   |
|                      | MACS                    | 0.004 | 0.561                   |

Based on data in table 4.2, the results of spearman correlation non-parametric test calculations obtained sig value of 0.004 ( $p < 0.05$ ) between GMFCS with intellectual level with a value of  $r = 0.564$ , with a nutritional status of 0.008 ( $p < 0.05$ ) with a value of  $r = 0.531$  and with MACs of 0.004 ( $p < 0.05$ ) with  $r = 0.561$  moderate correlation.

## DISCUSSION

In this study it was found that the largest number of MACs was level 1 as much as 33.3% in line with Jo et al., 2012 showed that MACS at level 1 is mostly at the age of 6-11 years as many as 106 children (48%) compared to the age of  $< 5$  years as many as 68 children (31%). High levels of GMFCS and MACS are also affected by cp types. Cerebral palsy patients who have GMFCS level I are most commonly obtained by people with hemiplegia type CP of 44% and Diplegia as much as 38%. People with CP who have the most MACS level I in diplegi type as much as 44% and Hemiplegi 33% (JoJo et al., 2012

The results of correlation analysis using spearman method showed that there was a correlation between GMFCS and MACS cerebral palsy patients ( $p = 0.004$ ). The results of this study are in line with research conducted by (11) correlation between GMFCS and MACS, although correlation calculations are carried out in each type of cerebral palsy.

Another study that also showed similar results was research by Gunel et al. (2009). Research that uses subjects in the form of spastic cerebral palsy patients also states that there is a correlation between GMFCS and MACS. Because the study conducted by the authors also consisted of the majority of patients with spastic cerebral palsy, the two results of this study were mutually supportive.

The results of the correlation coefficient calculation show that the value  $r$  is 0.561 which

means the strength of the correlation between GMFCS and MACS is moderate and the direction of the correlation is positive. In other words, the larger the GMFCS, the larger the MACS. These results are in line with research conducted by Gunel et al. (2009) and Palisano et al. (2018). This is because the large muscles used for gross motor movements in children will develop and mature first compared to small muscles that function as fine motor movements, so that their manual ability will increase along with the increase in gross motor skills (4)(12)

A limitation of the study is the absence of correlation calculations for each type of cerebral palsy. All previous studies have analyzed the correlation of GMFCS and MACS based on the type of cerebral palsy. While the study conducted by the authors did not group by type of cerebral palsy because of the limited subject of the study. Based on the table it appears that patients hemiplegic spastic, triplegi spastic, ataxia, and athetoid ataxia only number one person, so correlation analysis is not possible. In addition, research conducted by Compagnone et al. (2014) showed that IQ has a large influence on children's fine motor skills ( $p < 0.001$  and  $r = 0.585$ ), so children who have a low IQ are more likely to have low MACS so, the absence of cognitive ability data that is usually described with IQ scores risks tightening the results of the study if not considered.

The presence of comorbidities including epilepsy, communication and behavioral difficulties, neurological disability associated with a greater risk of malnutrition (14) Greater nutritional needs, increased nutritional loss, and decreased nutrient intake all contribute to this. In addition, malnutrition can worsen disability through decreased muscle mass strength, reduced immunity, and reduced brain development.

Cerebral Palsy (CP) is a disorder of posture and/or movement, due to non-progressive brain lesions, impaired movement and posture problems, children with CP can be associated with mental or intellectual retardation deficits, impaired vision and hearing, speech and language impairment and oral-motor dysfunction. Poor growth and poor nutritional status occur due to poor oral motor function (oro-motor). Abnormal nutritional status has serious health impacts and not only affects the child concerned, but also on their family and society. Therefore, it is very important to improve



health care providers and raise awareness about the importance of health issues to provide optimal care for children with CP and to improve their quality of life. Another reason for malnutrition in CP children is multi-factorial hormonal, physical, neurological and social. Nevertheless, it seems that most of the poor growth is linked to acute and chronic malnutrition that occurs during a child's growth and development. (15)

This study statistical test showed that there is a meaningful relationship between GMFCS and intellectual levels in people with cerebral palsy with a negative correlation direction means that the higher the level of GMFCS, the lower the IQ score of cerebral palsy sufferers. This picture is in line with the results of research conducted by Dalvand et al., (2012) often accompanies and is relatively common in children with CP that has the potential to affect daily activities, burden of care, quality of life, effectiveness of interventions, and age. Intellectual disability can also exacerbate existing health care gaps due to increased reliance on caregivers and health care issues and lower social participation rates in health promotion. (5) realistic explanation of the relationship between gross motor function and intelligence levels may be related to the acceptance of stimuli from the environment which in this case will affect the level of intelligence. The storage of information that relies on experience is the incorporation of specialized environmental information, such as learning about the physical environment or vocabulary. (5)

Research conducted by Nadya et al, (2018) disorders in children with cerebral palsy are often accompanied by intellectual impairment (62%), which is associated with the level of GMFCS sufferers. This relationship is associated with the acceptance of stimulation from the environment that is more widely received by motor function, which in this case can affect the level of intelligence. Impairment in the first 1000 days of birth (golden period) can create a lack of reception of the stimulation necessary in human development of gross and intellectual motor function, thus causing abnormalities. In accordance with this opinion, children who are in GMFCS level 5 have more IQs below 70. As in

research conducted by Sulasminah, (2013) that children with cerebral palsy have difficulties in motoric movement that cause environmental exploration activities to be limited so that sensory input becomes limited as well, this affects the intellectual development of the child.

The limitation in this study is that this study did not analyze the involvement of extremes or types of cerebral palsy that might have an effect on the results of the study.

## Conclusion

Most CP children had GMFCS 3 and 4 (25%). The most Intellectual levels were borderline and moron 37.5%. For the assessment of nutritional status obtained most CP children have normal nutritional status (54.2%) while for manual abilities assessed using MACS obtained 33.3% is MACS 1. Spearman's non-parametric correlation test result was obtained a p value of 0.004 ( $p < 0.05$ ) between GMFCS with an intellectual level of  $r = 0.564$ , between GMFCS with nutritional status of 0.008 ( $p < 0.05$ ) with a value of  $r = 0.531$  and between GMFCS with MACs of 0.004 ( $p < 0.05$ ) with  $r = 0.561$  moderate correlation.

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