Relationship Between Laterality and Motor Processes in Children Aged 7–8 Years with Malnutrition


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Abstract

Childhood is a transcendental phase in the evolutionary life of the human being where two phenomena occur: growth and development for which a correct nutrition is necessary. The organ most affected by lack of nutrients is the brain where irreversible metabolic damage occurs and the aftermath become evident in the school stage. Undernutrition affects learning problems, retention and memory, hindering the child’s life. The objective of the study is to find the relationship between laterality and motor processes in children of 7–8 years with malnutrition. The sample consisted of 60 participants, 30 with malnutrition and 30 without. For the evaluation of the variables, a laterality test and a Neuromotor Assessment test (NVAEV) was used, and for the nutritional status, the Body Mass Index (BMI) was observed. The obtained results from the variables were: the participants without malnutrition have a defined laterality in 70% being right-handed and an acquired and automated motor pattern in 87% and in children with malnutrition, crossed laterality is observed in 57% and motor undefined pattern in 63%; There is no statistically significant relationship between laterality and motor pattern with each group, but there is a positive and intense relationship between the groups and two variables with a p = 0.001. In conclusion it is necessary to delve into the topic in order to help children with nutritional problems that affect their academic performance due to the retardment in the acquisition of neuromotor development.

Keywords: Functional laterality, Psychomotor performance; Body mass index; Neuromotor disorder; Malnutrition

Introduction

School failure in education is what the most concerns to parents and educators since they misunderstood that their children or students are lazy or inactive because parents and teachers believe they have a coefficient lower than average and there is no perception of the neuromotor problems which are perceived in the classroom when there is no correct relationship with the environment and even with their behavior and self-esteem.

When a poor neuromotor development is presented in a child, it is possible to find that this condition causes problems in learning and this conditioning is probably due to poor nutrition taking it to a student failure if it is not intervened on time since as a consequence the malnutrition produces retardment of the psychomotor development, alterations at the level of personal, social and socio-affective behavior, deficit in higher brain functions, ability to solve problems, alteration of coordination, static and dynamic balance, sensory integration and cognitive ability and in severe cases involuntary movements such as choreoathetosis [1].

The development of the nervous system begins from the conception and nutrition plays an important role for neurodevelopment in the child since the nutrients act within the processes of cerebral cellularity, synaptogenesis and myelogenesis [1–4]. It is noted that the processes of laterality and motor development are demonstrating the psychic, motor, sensory, social and affective capacity to perform various motor movements and demonstrate the preference to use one side of the body in comparison to the other side [5–8].

Among the nutrients that help the development of the nervous system in the studies carried out by“It is stated: Carbohydrates that collaborate in physical brain growth and having repetitive periods of hypoglycemia have been related to damage in the parieto-occipital lobe and as a consequence slow learning. Another related nutrient to brain maturity is iron that whose decrease causes changes in behavior such as apathy, irritability, difficulty in concentration and possible alteration in the development and cognitive function. The decrease of Folic acid is related to poor memory and learning. The fatty acids are conformers of a high proportion of myelin which produces that there is not a good myelination of the pyramidal way and as a result a poor motor development in the child. Calcium participates as a second messenger within the signals of the precursors of neurons and glial cells, also through its channels it contributes to the production of a response by the membrane of the neuron and its inhibition causes no proliferation of neuroblasts nor a response to the excitability of the neuronal membrane. Vitamin A intervenes since its inception in synaptic plasticity, learning, memory and sleep. Vitamin B1 is related to the conduction of nerve signals and the absorption of glucose from the cerebellum, brainstem and limbic system. Vitamin B12 helps to preserve the myelin sheath and its deficiency is associated with delayed myelination and loss of white matter. Vitamin C helps to maintain the oxide balance, brain reduction, modulation of the cholinergic, catecholnergic and glutaminergic systems and the development through the maturation, differentiation and formation of myelin.
Vitamin D deficit is associated with behavioral problems of learning and memory by intervening in the growth of neurites and inhibiting hippocampal neuronal death [7].

Malnutrition affects worldwide to more than 150 million children [9] from the decrease in the IQ, retention and memory within learning problems [10] as well as evidence of poor muscle development, muscle tone and presence of frequent infectious diseases in childhood, even an increased risk of chronic diseases in adulthood, altering the behavior on a personal, socio-emotional and social level with a deficit of functions and superior brain abilities, coordination, static and dynamic balance, sensory and cognitive integration [3,9,11,12].

Several authors emphasize that malnutrition might cause alterations in neurodevelopment depending on the conditions during the gestation period as well as in the postnatal period that can be evident with morphological alterations in brain structures such as the hippocampus, the cerebellum and the cortex affecting the physiology of the central nervous system with the decrease in nerve conduction velocity of axons, the production of neurotransmitters, neuronal development, axonal degeneration, affecting the process of myelination, the number of pyramidal cell dendrites, reduction of the hard body and decreasing the intracranial volume (7,9).

It has been demonstrated that malnutrition is the cause of growth retardation and it generates modifications that affect the biological and body functions, being the severe malnutrition that affects more in the critical period of the development of the Central Nervous System producing structural alterations that lead to diminish intellectual functions, behavioral patterns and a global psychomotor retardment [9].

The term cerebral dominance and laterality are usually associated but they do not refer to identical phenomena, cerebral dominance is an unconscious process that is performed at the central, involuntary level which is out of the control of the person [13,14]; the laterality contrary to dominance is manifested as the effector part of the cerebral dominance, being a conscious function and that is carried out voluntarily, peripherally and is modified with the training [15].

In the world population, the percentage of right-handed, left-handed or ambidextrous people depends on the evaluation methods but it is accepted that the proportion of left-handed people is 10% which are around of 500 to 600 million people that are modified according to the conditions such as type of manual activity that is evaluated, brain injury and others; 85% of the population is right-handed and 5% is ambidextrous; all of this is referred of manual laterality, however there is a part of the population with crossed laterality [15].

Laterality is defined as the preference to use and the superior aptitude of one side of the body in comparison to the other side, according to the preference in the use of the eye, ear, hand and right or left foot, people tend to be right or left handed as a result of cerebral asymmetry, a highly complex function that facilitates orientation in time and space [13].

The possession of a well-defined laterality allows us to understand, classify and interrelate the coded messages, being a manifestation of the asymmetry of the functions of both cerebral hemispheres, the distribution of the sensory and motor areas is evenly dispersed due to the interweaving of the pyramidal path at the level of the bulbary pyramids of the brainstem so that the innervated limb will depend on the opposite hemisphere [16].

It can be seen from newly borns the development of laterality as they acquire and manifests certain neuromotor patterns that are maturing and are doing connections between the hard body and the brain hemispheres, where the information is integrated and coordinated, also it reinforces and acquires around seven years old [13].

The motor pattern is characterized by a simultaneous use of body parts and carry out more complex motor activities where it will depend on postural control, tone and balance; the inhibition of reflexes gives way to voluntary motor development, emerging the different fundamental movements that involve the mobility of two or more parts of the body.

It is stated about motor development to the abilities and capabilities that the child acquires as the maturation processes occur together with the influence and interaction with the environment [17]. The evolution of motor skills and psychism is in the first months of life and the first years distinguish the importance of motor skills in intelligence and cognitive functions as well as relationships with the environment [14]. One of the detections of these problems in the control of a healthy child is the early identification of children with some condition or pathology associated with psychomotor development difficulties [18–21].

The corporal scheme is the organization of bodily sensations in relation to the information provided by the outside, since the child acquires awareness of his own body and motor coordination while he is growing and his marked motor pattern is implanting from the first months through of tactile and visual experiences of the environment.

This body scheme serves as a reference for performing and coordination of movements and it guide us with respect to what the world poses to us and our asymmetry makes us to have two axes, both right and left and in front and behind; it will be modified by the sensorial experiences and will integrate the afferences conscious or unconscious, which are the postural control as a postural scheme, the limit of the middle body as cutaneous scheme and the visual scheme that is the image of our own body; the bad body scheme is therefore a bad conscience of the parts of the body that mean poor motor coordination [25].

In the USA and in developed countries the level of malnutrition is low with 4 to 5% in ages between 2 months and 11 years in relation to developing countries [23]; In countries like Ecuador, a 12% rate of underweight children and 26% with short stature is shown, within the anthropometric measures to classify it as malnutrition, being higher in rural areas with 10 percentage points in relation to countries such as Peru and Colombia [24].

In Ecuador there is no information about the influence of malnutrition on motor or laterality disorders in the performance of school-age children that must be consolidated at this age, creating low academic performance [22], so it is imperative to carry out a study that contribute with updated and real information of the students in the city and be able to provide information for the creation of future intervention programs to improve academic performance and decrease school failure and loss of year.

**Methods**

The study was carried out with a non-experimental comparative descriptive design as an independent variable, including the body mass index (BMI) with two levels (group with malnutrition and group without). In the study there are two dependent variables: laterality and motor pattern. The sample was children from the group without malnutrition of the study belong to the same academic institution and the same school year.
### Table 1: Description of the Sample Gender and Age.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Mean</th>
<th>Std. Dev</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>7,43</td>
<td>0,5</td>
<td>7</td>
<td>8</td>
</tr>
<tr>
<td>Gender</td>
<td>N</td>
<td>%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>60</td>
<td>100</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>30</td>
<td>50</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Table 2: Lateralty test.

<table>
<thead>
<tr>
<th>Vision</th>
<th>Audition</th>
<th>Hand</th>
<th>Foot</th>
</tr>
</thead>
<tbody>
<tr>
<td>Look through a big spyglass or similar</td>
<td>Listen the sound of a small clock</td>
<td>Write</td>
<td>Kick a ball</td>
</tr>
<tr>
<td>Look through a small tuve</td>
<td>Listen through the Wall</td>
<td>Ignore a lighter or a match.</td>
<td>Kick to the air</td>
</tr>
<tr>
<td>Point with the finger</td>
<td>Listen sounds in the floor</td>
<td>Hand outlets</td>
<td>Cross the leg</td>
</tr>
<tr>
<td>Look close through the hole of a paper</td>
<td>Get close the ear to the door for listening</td>
<td>Cleanshoes</td>
<td>Write the name with the foot on the floor</td>
</tr>
<tr>
<td>Look away through the hole of a paper</td>
<td>Talk by pone</td>
<td>Open and close cans</td>
<td>Walk with one foot</td>
</tr>
<tr>
<td>Cover one eye to look closer</td>
<td>Turn around to response to somebody that talks in my back</td>
<td>Pass small objects from one recipient to another</td>
<td>Run in one foot</td>
</tr>
<tr>
<td>Get close a piece of paper to one of the eyes from certain distance</td>
<td>Listen a Story through one ear and cover the other</td>
<td>Dot a paper</td>
<td>Walk in one foot following a path drawn on the floor</td>
</tr>
<tr>
<td>Imitate the shot of a gun</td>
<td>Move an object that contains things and try to Guess what it is</td>
<td>Handle a marionette and puppet</td>
<td>Try to pick up an object in one foot</td>
</tr>
<tr>
<td>Look through a big tube</td>
<td>Listen through the glass of a window an external sound</td>
<td>Take a spoon</td>
<td>Go up a step of a staircase</td>
</tr>
</tbody>
</table>

### Table 3: Test of Evaluation of Neuromotor Development

<table>
<thead>
<tr>
<th>Test of Evaluation of Neuromotor Development</th>
<th>1: without acquiring</th>
<th>2: in process</th>
<th>3: acquired and automated</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drag</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Crawl</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>March</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Set</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Run</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Postural control</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Balance</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Muscle Tone</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

they are students of the fourth year of basic of a private school in the city of Guayaquil and participants of the group with malnutrition are taken from the General Hospital South Guasmo who are taken care of in the external consultation of the pediatric specialty. The sample consists of two groups: A group of 30 participants of 7–8 years with malnutrition and a group of 30 participants of 7–8 years without malnutrition. Among the 60 evaluated participants, there is 50% of boys and girls, and from the 30 evaluated participants in each group, 15 are 7 years and 15, 8 years. (Table 1). As inclusion criteria, children between 7 and 9 years old were included, with a BMI less than 12, BMI appropriate to age, moderate and chronic malnutrition; as exclusion criteria associated diseases, sensory or cognitive deficits, neurological, psychiatric, known psychological disorders were determined. For the measurement of variables there is: laterality. Qualitative variable measured with the laterality test adapted by Martin Lobo, Castellón, Rodríguez (2011) (Table 2) Motor Pattern. Qualitative variable, has been measured with the EVANM test. (Table 3). For malnutrition, BMI is taken as a quantitative variable, calculated using the formula BMI = weight (Kg)/height 2 (m) and measured in the tables of the WHO score Z. In the used instruments we have: To assess the laterality, it was taken account the laterality test of the neuropsychological experiment that is applied since they are 4 years and consists of 10 actions where manual, pediatric, ocular and auditory laterality is valued, where the child must use more than 7 times one side to consider his laterality; To measure the motor pattern, the Neuromotor Assessment test (EVANM) is performed which is applied in children of 7 years and consists in the observation of the basic patterns of movement (drag, crawl, march, set and race), as well as the postural control, balance and muscle tone; With this test, it is determined from each of the evaluated elements, if they have been acquired and automated, if they are in the process of being acquired or if they are not acquired yet.

**Process**

First, the data corresponding to the BMI variable was collected. For this, in case of participants with a normal BMI, the weight and height were taken and the BMI was obtained and taken to the WHO tables for classification and determine the participant’s degree of nutrition and the choice for the study; the hospital participants (low IMC) were chosen from the registries of the vital signs of outpatient care.

The second variable that was measured was the laterality where the explanation is made to the participant and each corporal index was evaluated in the following ocular, auditory, hand and foot order, the ten activities were requested and the side chosen was noted.

The third measured variable was the motor pattern in the two groups, the scenarios were adapted to be able to perform the different motor skills tests in the case of the participants with normal BMI and in participants with a low BMI the area of hospital rehabilitation was adapted; the different motor patterns were evaluated by means of the Neuromotor Development Observation Test that is developed individually in the following order: drag, crawl, gait, march, set, run, muscle tone and balance.

The statistical analysis will be carried out with the SPSS program. For the descriptive analysis, frequencies, percentages and chi-square will be obtained for the qualitative variables. For the analysis of the relationship between independent nonparametric groups, U of Mann Whitney will be done for qualitative variables.
Results

The development of laterality is obtained as results in children without malnutrition; they have a laterality defined in 70% as right-handed and 17% left-handed and the acquisition of the motor pattern in 87%, they have an acquired and automated pattern which does not occur in children with malnutrition where there are marked differences since they have 57% of contrary laterality and 17% of undefined one and in relation to the motor pattern 63% of undefined pattern (Graph 1 and 2).

It is observed that there is no statistically significant relationship by chi-square between the variables laterality and motor pattern in children without malnutrition with a value of $p = 0.750$, as well as in children with malnutrition between the two variables with a value of $p = 0.413$.

With the U Mann Whitney test, it is stated that for both the motor pattern variable and the malnutrition variable exist a statistically significant difference between the two groups since the value of $p <= 0.001$, it means that, while the child is well nourished, the motor pattern and laterality will be developed and acquired according to age.

Discussion

The purpose of this research study was to determine if there is a relationship between malnutrition based on BMI and the development of laterality and basic motor patterns. One of the found limitations in the work was the size of the sample to have more reliable results, it might be necessary to perform it in children with acute malnutrition. It should be noted that one limitation was access to patients with malnutrition because there is no control or registration of children from 7 to 8 years since there is a program in the country against malnutrition in children under five years old.

Through the study it was confirmed that in the majority of students their laterality is not defined in children with malnutrition, in previous studies such as Zamudillo, Gasca, and Herrera in 2014 showed that malnutrition causes problems in psychomotor development affecting definition of laterality in these patients.

Children with malnutrition do not have a defined pattern that is affirmed what in other studies such as Quino A and Barreto B in 2015 show that chronic or acute malnutrition results in alterations in the development of both gross and fine motor skills, being the most affected.

It would be interesting to carry out comparative studies between children with acute and chronic malnutrition and make a comparison after the intervention not only nutritional but also in neuromotor development.

In conclusion of the research, it is distinguished that in the sample that was analyzed there are significant differences in the two groups, and children with malnutrition do not have a defined laterality and an acquired motor pattern yet due to nutritional deficiencies, which is different in the children without malnutrition.

There are no studies that study the relationship between these two aspects, so it is necessary to deepen into the topic in order to help patients with nutritional problems that affect their academic performance due to the delay in the acquisition of neurodevelopment, since with proper stimulation and guidance the child will be able to improve his academic performance.

Conflict of Interest

Authors declared that they have no conflict of interest

References

2. Aguirre, M. Food is the key to a child’s cognitive development. Emotional Education. 2016:1.


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