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Sensorial Integration and Intellectual Disabilities: Influence of Psychomotor Intervention

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Abstract: *The objective of this study was to analyze the effects of a psychomotor intervention from the perspective of sensorial integration in children with Intellectual Disability (ID). Children with ages 5 to 12 participated in the program, diagnosed with ID, and were evaluated before and after by Psychomotor Battery Tests (BPM). The intervention was constructed with sessions of Physical Education, characterized as psychomotor education/reeducation, and was composed of 44 individual sessions of 50 minutes each. The results showed that the program had an influence in the following psychomotor fundaments: tonicity, laterality, body schema, global and final praxis. However, there was less influence in balance and space-time structure. As such, after the test, there was an improvement in the psychomotor profile of the participants. Therefore, it was concluded that psychomotor intervention based on sensorial integration positively influenced the development of psychomotor fundamentals of the participating children with ID.*

Keywords: *Disability, psychomotor, special education.*

I. Introduction

Approximately 3% of the world population has Intellectual Disability [1]. In Brazil, this rate is 1.36% [2]. An Intellectual Disability (ID) is defined by deficits in cognitive and adaptive abilities [3, 4]. According to the American Association of Intellectual Disability and Development (AAIDD), ID is explained as significant limitations in intellectual capacity and adaptive behavior, and the latter being expressed in conceptual, social and practical areas. The occurrence of these factors must be manifested by 18 [5].

One of the present limitations in the practical area refers to motor control. This is due to insufficiency of information between afferent and efferent commands [6], causing late motor development of the individual [7], and alterations in the sensorial system [8].

The sensorial system is composed of distinct receptors, responsible for the perception of external stimulus and internal stimulus [9]. These receptors allow sight, sound, touch, taste, among other senses. This same author affirms that "sensorial integration is based on three basic senses – tactile, verbal, and proprioceptive" [9]. These senses and others are fundamental for the development of children, since birth until maturity. Furthermore, they are essential for the autonomy and learning of the child.

Aside from sensorial integration (SI) being based on three senses, it also follows five functional principals: flow of sensations, feeding of the brain, production of perceptive totality, creation of significations, and elicitation of adaptive answers [9]. Thus, through the three sense systems, associated to the five principals of SI, it is possible for the child to feel, experiment, and send information to the brain in an integrated manner, with the goal of global perception of the body, objects, and the world [10]. However, in some people with ID these systems don't develop fully because that people with ID have atypical muscular and posture development; tactile, kinesthetic, verbal and visual integration, problems with reflexes and posture reaction, neurologic desalignment and unequal bilateral answers [11].

In this way, highlights that the efficiency of the body in space is determined by the harmonic junction of all the senses with the sensorial system [9]. This makes adequate development of sensorial integration necessary, organizing body and environmental sensations. An alteration in sensorial integration may cause distortions in the five senses [9], which can cause dysfunctions in daily life.

Psychomotor treatment serves to help with these dysfunctions and also to develop motor, emotional and social abilities in children. This method is widely studied by Fonseca [8,9], Barbosa and Munster [12], among others. Psychomotor treatment's finality is to contribute to forming personal consciousness of reality of individuals. This allows them to take on psychological growth, valuing physical adjustment, autonomy and emotional investment, providing better adaptation to their environment [13].

Studies involving individuals with ID point out benefits after being submitted to psychomotor stimulus [14]. Psychomotor fundaments that appear the most in these individuals after stimulus are: balance, notions of body, space and time, gross (global) and final motor coordination [15].

As such, psychomotor stimulus can be an efficient tool in human development and in sensorial integration in children with ID because it improves motor, cognitive, emotional, and social function, and helps with daily tasks. Therefore, the goal of the study was to verify the effects of a psychomotor intervention program, based on the principles of sensorial integration in the development of psychomotor aspects in children with ID.

II. Methodology

This study is characterized as field research since it analyzes the aspects of a unique group or community, highlighting the interaction between its components [16].

2.1 *Participants*

The samples were 3 feminine children, with ages 5, 6, and 12, diagnosed with Down syndrome and Intellectual Disability, called in the study by P1, P2, and P3, respectively. The participants were admitted to the Laboratory of Psychomotor Stimulus. P2 and P3 also participated in aquatic activities for individuals with Down Syndrome. These activities were developed by the Department of Physical Education of the Federal University of Viçosa in Minas Gerais.

2.2 *Instruments*

To collect data, Psychomotor Tests Battery of Fonseca – PTB [8] was used to evaluate the psychomotor abilities of the participants, pre and post intervention. The PTB is composed of seven items identified as psychomotor factors (tonicity, balance, lateralization, body schema, space-time structuring, global and fine praxis). These factors were split into 26 subfactors, with tasks ranged from 1 to 4 according to the performance of the child, with 4 being the best score. Dividing the total value of the subfactors by the number of corresponding tasks to each factor, the values of 1 to 4 are obtained, which are added and become the psychomotor profiles of superior, good, normal, below normal, deficient (see Table 1).

Table 1: **Points of PTB and psychomotor profile**

PTB points	Type of psychomotor profile	Learning difficulties
27-28	Superior	---
22-26	Good	---
14-21	Normal	---
9-13	Below normal	Minor and specific
7-8	Deficient	Significant

Besides PTB, a field journal was carried out post fact. After each intervention, the observations were logged in the form of semi standard reports used in the laboratory. The reports contained information referring to motor, social, and emotional behavior of the children; answers from students from the proposed activities; main difficulties and improvements pointed out in the sessions.

2.3 *Procedures*

The present study came out of a scientific initiation project paid by the Foundation for Research of Minas Gerais (FAPEMIG). The study was approved by the Ethics Committee of Research in Human Beings of the Federal University of Viçosa. After authorization of legal guardians, using the Terms of Informed Consent, the procedures began: the initial psychomotor evaluation, followed by the application of psychomotor intervention, and then the final psychomotor reevaluation.

The participants were analyzed individually by two evaluators trained to apply PTB to obtain concordance between the observers. The sessions of the intervention program were based on the Relational and Functional Psychomotor approach, together with the Sensorial Integration of Ayres approach. The first is a method to test the body, with the objective of recovering emotional factors of the child through playing [17]. The Functional psychomotor approach is based on diagnoses of the psychomotor profile and the prescription of exercises to solve possible inefficiencies of motor development [18]. The intervention was administered by the researchers and was carried out at LEP/UFV, which is spacious, well illuminated and with little noise.

The program was applied individually once a week during ten months, lasting fifty minutes each session, in total forty-four sessions. The activities followed a gradual process, proceeding from simple to complex tasks in a ludic way and encompassed psychomotor fundaments. Furthermore, all the sessions used sensorial, sound, texture, smell, etc resources. Tasks involved coloring with focus on laterality, painting, making balls, drawing, jumping rope, dorsal and ventral decubitus and hand-and-knee tunnel passing, throwing balls, kicking balls, paper chains, games that involve quick thinking and perception of time and space, educational toys with tactile and color perception, among others. After 44 sessions, the three participants were submitted to

psychomotor reevaluation. Balls, arcs, jump, rope, paper, figures, glue, string, music, play dough, sand, paint, brushes, rags of different textures, and memory games were used as pedagogical materials.

2.4 *Statistical Analysis*

Descriptive statistical analysis was used to interpret the quantitative data obtained from the PTB. For qualitative data, field journals were evaluated and analyzed, looking to verify the work potential of each participant.

III. Results

Table 2 shows the individual results of the psychomotor profile pre and post program, followed by the final scores obtained by the participants. It was observed that the program of psychomotor stimulus based on the principals of sensorial integration was effective to improve the psychomotor profile of the participants.

Table 2: Individual results of psychomotor profile before and after intervention

Participants	Pre-intervention			Post-intervention		
	P	SD	Profile	P	SD	Profile
P1	8	0.45	Deficent	10	0.58	Below normal*
P2	10	0.57	Below normal	16	0.98	Normal*
P3	12	0.42	Below normal	16	0.79	Normal*

* rate of observer concordance 0,87; P = points obtain by psychomotor battery tests; SD = standard deviation.
Source: research data

The performance results of psychomotor factors pointed out that tonicity, laterality, body schema, global and fine praxis were improved, while balance and space-time structure did not vary.

Fig. 1. Graph referring to the psychomotor performance by factors of the participants pre and post interventions.

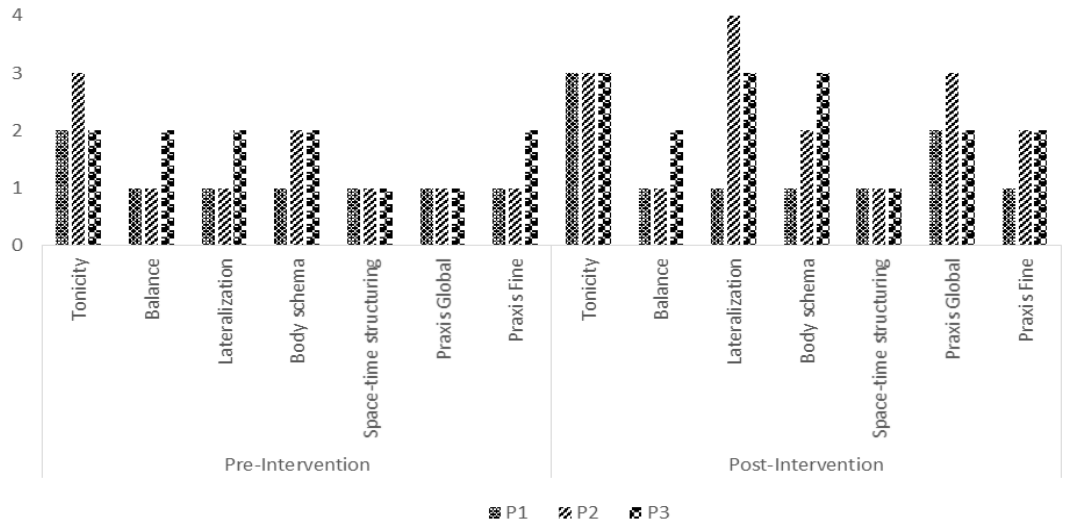

Figure 1. Graph related to psychomotor performance by factors of participants in pre- and post-intervention

The participants P1, P2, and P3 initially reached levels 2, 2, and 1, respectively, in the factor tonicity. After the program, the level increased to 3 in all participants, noting that 4 is the max.

Table 3: shows the points of each participant's psychomotor subfactors, pre and post program.

Psychomotor fundament	Psychomotor subfactor	Pre-intervention			Post-intervention		
		1	2	3	1	2	3
Tonicity	Extensibility	3	3	1	3	3	3
	Passiveness	3	3	2	3	3	4
	Paratonia	3	3	2	4	4	2
	Synkinesis	1	2	2	2	4	4
	Dyskinesia	1	2	1	1	2	3
Balance	Immobility	1	1	2	1	1	2
	Static balance	1	1	2	1	1	2
	Dynamic balance	1	1	2	2	2	4
Body schema	Kinesthetic Sense	1	1	1	1	3	2

	D-E Recognition	1	2	1	1	3	3
	Auto-image	1	3	3	2	3	3
	Gesture imitation	1	1	2	1	1	1
	Body drawing	1	1	2	1	1	3
Space-time structure	Organization	1	1	1	1	1	1
	Dynamic structure	1	1	2	1	1	1
	Topographic representation	**	2	1	**	2	1
	Rhythmic structure	1	1	1	1	1	1
Gross Praxis	Oculus manual	1	1	1	2	2	1
	Oculuspedal	1	2	2	2	4	2
	Dissymmetry	1	1	1	2	3	3
	Disassociation	1	1	1	1	2	1
Fine Praxis	Manual dynamic	1	1	2	1	2	1
	Tapping	1	1	3	2	2	3
	Velocity-precision	1	1	1	1	1	1

** dispensible task up to 5 years old. Source: research data.

It can be observed that the majority of sub-factors had a point increase post-program, contributing to the alteration in the psychomotor profile of the participants.

In the subfactors related to lateralization, P2 showed left eye, left hearing, manual right, and right foot preference, before psychomotor stimulus. After the sessions, the right side was predominant, as shown in Table 4.

Table 4: Points obtained by each child in the lateralization subfactors.

Participant	Pre-intervention				Post-intervention			
	Hearing	Sight	Manual	Foot	Hearing	Sight	Manual	Foot
P1	LL	RR	L	R	RR	LL	R	L
P2	RL	RL	R	R	RR	RR	R	R
P3	LL	RR	L	R	RR	LR	R	R

Legend: LL= left, left; RL= right, left; RR= right, right; L= left; R= right. Source: research data

During the initial test, P2 showed hesitation, confusion, and did not execute some PTB tasks, receiving 1 point. However, by the end of the test P2 had evolved to level 2, executing all tasks, although still showing hesitation and confusion. P1 showed right eye, left manual and right foot preferences, before the interventions.

IV. Discussion

Different studies point out that children with disability, being physical or intellectual, may show late development in psychomotor and cognitive functions [19, 20]. However, this does not mean that these people cannot reach a normal level or even a superior level in different stages of development [21]. Studies indicate that even though people with ID might have low psychomotor performance, intervention programs can positively influence them [14]. The present study has proven that this is true since all three participants show improvements.

Ludlow and Allen, while studying the effects of psychomotor stimulus in children with Down Syndrome, noticed favorable effects in the development of the child. However, the subfactor tonicity is critical for these children because they show disability in adjusting tonic function, with a tendency of hipotonicity [23], characteristic of this syndrome. Nevertheless, the results of this research show an evolution in the tonicity factor, considered the fundamental pillar of motor and posture activities as it prepares movement, sustains motor gestures and keeps balance [22, 23, 24].

Stresses that a program of systemic physical activity may provide benefits in quality of life, such as better motor abilities and emotional state [25]. Studies such as Wiest and Goerl [26] point out alterations in social, emotional and motor behavior through psychomotor interventions are positive, emphasizing that psychomotor functions must be worked alongside sensorial-motor development. As observed by the data, P1, P2, and P3 showed similar alterations after intervention.

In relation to the difficulty of balance in the test subjects, only P3 evolved with intervention, but Santos, Weiss and Almeida [21] affirm that some children with Down syndrome can't stay balanced on one foot for more than two seconds. This present study confirms this information, since PTB tasks that demand one-foot balance were not successful. Moreover, people with ID may develop altered steps, low manual activities, along with other uncoordinated activities. The pattern of observable movements in a child with ID consists of clumsy walking, lowered head, and feet lifted while starting to walk. During the psychomotor activities developed in the program, aspects of clumsy walking with hip abduction and lowered head were observed [27].

Body schema in children with ID, may be reduced due to cerebral functions being affected by the disability, delaying development. In this study, all three participants initially showed low levels in this subfactor [28]. This was also observed in the study of Côrrea, Silva e Gesualdo [29], which evaluated 15 children and

teenagers with Down syndrome and all showed delay in corporal structure. It is known that this fundament is influenced by tonicity, balance, and laterality. It also contributes to space-time organization [8].

In this study, space-time organization was constant in pre and post program in all participants. The structuring of symbolic representations, which occurs naturally in the development in "normal" people, does not take place in the same way in individuals with ID [30]. As such, The demonstration of the movement is crucial. The tasks of the Psychomotor Tests Battery (PTB) of this subfactor interferes in the comprehension of said tasks because they demand understanding of simple and complex orders, in addition to numerical and mathematical acquisitions [31]. Moreover, Souza found difficulties in space-time structure and verbalization while analyzing the psychomotor profile of children with ID, with temporal organization being the greatest deficit in these children [32].

Laterality establishes itself physically around age 4 to 5, which justifies the hesitation of P1. This result can be observed in the study of Almeida [19] , in which the majority of children with ID showed undefined laterality. In addition to this, individuals with Down syndrome have cerebral abnormality, which can affect manual laterality [8, 33]. In this case, the variation of manual preference in P2 and P3 may be related to this disorder.

In general, PTB tasks and other activities that involve fundaments related to fine praxes are difficult to be executed by the participants. Similar results were also found in other studies such as Santos, Weiss and Alemida [21] and Bianconi, and Muster [14]. In the last study, after intervention, fine motor ability was improved. The low performance of the three participants in the present study could be related to hypotonia [34], since all three participants presented high levels of hypotonia due to Down syndrome.

Nevertheless, it is important to consider that children with ID follow the same phases of development in a typical child, but is delayed in the former, making stimulus necessary [35]. Guralnick [36] exposes the benefits of motor intervention and arguments that the effects of such programs can provide long term benefits to these individuals and their families.

V. Conclusion

The results of this study verified that the children presented evolution in tonicity, laterality, body schema, global praxes and fine praxes. On the other hand, balance and space-time structuring did not present variation. However, all the participants in this research had positive improvement in general psychomotor profiles. Therefore, the program positively influenced the profile of the participants.

Even though this study showed some benefits of psychomotor intervention based on sensorial integration, the study had some limitations for significant affirmation, such as the small number of participants and the instrument used to evaluate psychomotor fundaments was too complex for children with Intellectual Disability. Tasks related to space-time structuring and the non-application of biopsychosocial or sociodemographic questionnaires were lacking to better characterize the sample.

Therefore, studies with psychomotor intervention with larger groups of people with Intellectual Disability are suggested. Another factor to analyze is if there is influence in group or individual programs. As such, instruments with adequate psychociometric parameters to analyze better the profile can contribute considerably to adapted physical education.

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