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DESIGN OF A NEURO REHABILITATION PROTOCOL WITH ECOLOGICAL VALIDITY FOR THE POSTURAL CONTROL OF CHILDREN WITH DOWN SYNDROME

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Abstract: This research aims to design a neuro rehabilitation protocol with ecological validity for postural control in children with Down Syndrome - DS. A mixed method with DITRIAC design was applied, through a Quantitative phase: systematized review of scientific articles, published in the last 10 years, on topics related to exercises to improve postural control; and a Qualitative phase: focus groups with (1) 5 experts with theoretical-practical experience on the research topic, and with (2) 8 families of children with DS who have received neuro rehabilitation treatment. The results indicate that: (a) the population under study must be characterized to identify strengths and difficulties related to postural control, (b) it is important to educate the support network in the neuro rehabilitation process, (c) They must recognize the daily environments of children to apply neuro rehabilitation exercises, (d) it is necessary to adapt, propose and implement neuro rehabilitation strategies from the real environment, (e) they must have the support and monitoring of professionals and (f) propose continuous adjustments if necessary to the application of the protocol. In conclusion, a neuro rehabilitation protocol with ecological validity emphasizes real, natural and systemic environments.
Keywords: Postural control, Ecological Validity, Neuro rehabilitation and Down Syndrome.

INTRODUCTION

There are different motor control systems to allow human body movement. These motor actions depend on the sensory information captured by the different receptors, responsible for converting physical energy into nervous signals that travel through the afferent pathways to the processing centers. neurological, where they are translated into contractile force signals and directed towards the muscles that are effectors to produce movement (Gutiérrez, M. B, et al, 2018).

These motor behaviors follow a hierarchical and parallel organization, represented by three levels: the spinal cord, the brain stem and the cerebral cortex, which have input and output circuits for information, allowing the coordination and regulation of motor responses., also work in parallel, allowing the sensory information that is related to movement to change the descending motor order at any level, as well as the subcortical structures, the basal ganglia and the cerebellum to intervene in the motor system (Gutiérrez, M. B, et al, 2018).

The spinal cord, which is the lowest level of the hierarchy, produces reflex motor skills and rhythmic automatisms, such as locomotion; The brain stem receives input from the cerebral cortex and the subcortical nuclei, projects to the spinal cord and is responsible for postural control, fine movements of the distal muscles of the arm and hand, and eye movements. and of the head. Finally, at the highest level we find the cerebral cortex, which carries out motor control through the primary motor area, premotor area, and supplementary area, producing movement of the skeletal muscles, movement of the eyes, face and tongue.; the coordination and planning of complex movement sequences. For their part, the cerebellum and the basal ganglia work in parallel and influence the cortical motor systems, creating circuits through which they receive afferents from the cerebral cortex, send information through the thalamus and are projected to the spinal cord through the neurons of the brain stem or motor cortex, necessary for carrying out movements and maintaining posture (Gutiérrez, M. B, et al., 2018).

Normal movement depends on a neuromuscular system that perceives, integrates, and responds to stimuli

appropriately to intrinsic and extrinsic stimuli, therefore for effective motor control to exist and the person to be able to perform movements adjusted to their environment, it is necessary to integration of sensory-motor information and to respond to changes that occur in the environment, sensory-motor feedback is necessary through the interaction between neuronal networks and the neuromuscular system. This is how internal mechanisms join with environmental mechanisms, allowing the organization of sensory information and the acquisition of motor skill (Down Syndrome Association in Salamanca, 2022).

The above is related by Duclos et al (2017), who mention that the postural system requires the intervention of the sensory system to inform the central nervous system about the state of the body and the conditions of the environment; the motor system, which provides us with the different necessary motor skills and abilities; the cognitive influence, which according to the demands and conditions of the task to be performed, favors the responses necessary to carry out the action, taking into account the severity (orientation) and stability, to carry out said task. In this sense, postural control depends on the characteristics of the individual, the environment and the task to be performed.

The characteristics of Down syndrome and how it affects postural control are explained below.

Down Syndrome (DS) is a genetic alteration caused by the presence of an extra chromosome (or a part of it) in chromosome pair 21, such that the cells of these people have three chromosomes in said pair. Alterations in the meiotic process can generate: Trisomy 21, chromosomal translocation, Mosaicism, which can lead to Down Syndrome, the diagnosis is made in prenatal stages due to suspicion or confirmation, the history of genetic alterations and the age of the parents, some of the tests performed at this stage are amniocentesis, and the chorionic villus test, and after birth the diagnosis is made thanks to clinical examination, where the traits can be evaluated. and physical characteristics and is confirmed with karyotype testing later.

For the United Nations (UN), the estimated incidence of Down syndrome worldwide is between 1 in 1,000 and 1 in 1,100 newborns. People with Down syndrome tend to have more health problems in general. However, social and medical advances have managed to improve the quality of life; nearly 80% of adults with DS are over the age of 50, so life expectancy has been increasing. Which requires community-based medical and interdisciplinary management.

According to Zuleta (2013), within the physical characteristics of DS Mental deficiency and physical and physiological development problems are identified. Even the physical characteristics of these children, although not the same in all of them, give them a similar morphological appearance: the head is smaller than normal. Alves and Ferrando (2011) and Cuerda and Vázquez (2012), describe that,In children with DS, muscle hypotonia and ligament laxity also predominate, which affects their motor development and generates the risk of suffering serious spinal cord injuries due to excessive stretching of the neck.

The delay in the acquisition of motor skills and postural control directly affects the daily life of the child with DS, hindering their inclusion and quality of life. The hypermobility present in people with DS affects stability and the ability to effectively control posture, considerably altering their proper development in actions such as standing.,when walking, as well as for support during voluntary movements of the limbs, trunk and head. In the same way, motor skills

are a very important component in most physical activities. In the case of children with DS, they show the same patterns of motor development as children with normal development, but it takes them longer to acquire them., and give way to improvement with practice (Zuleta,2013).

According to Molero (2012), among children with DS, muscle hypotonia and ligament laxity affect their motor development. Physically, among people with DS there is usually a certain amount of motor clumsiness, both gross (arms and legs) and fine (hand-eye coordination), slowness in their motor performance and, in many cases, poor coordination. These neurodevelopmental alterations limit cognitive performance and neuropsychological functions to a variable degree. In this sense, hippocampal involvement compromises explicit memory. Alteration of the frontal and temporal lobes affects learning, memory, language acquisition and executive functions. The lesser development of the basal ganglia affects the acquisition of motor skills and the control of movement. The alteration of the cerebellum affects motor coordination and eyelid conditioning (Molero,2012, p. 7).

Braz (2017), in his research "*assessment of the nuanced coordination of the child with Down syndrome in the province of Barcelona*", points out that Down Syndrome has been identified in the form of atrophy of the temporal and frontal cortex (particularly of the dorsolateral prefrontal and orbitofrontal cortex), lower density of cortical granule cells, smaller volume of the hippocampal formation and basal ganglia, and cerebellum, deficit in myelination of associative cortical fibers, lower synaptic density in Brodmann's area 17 (primary visual cortex) and in the arcuate and ventromedial nuclei of the hypothalamus, and lower hypothalamic production of growth hormone (GH)-releasing factor.

In accordance with Malak et. al. (2015), DS presents particular functional characteristics such as hypotonia, joint hypermobility and sensory deficits that influence a delay in motor development. Delays in the acquisition of motor skills and postural control directly affect the daily life of the child with DS and even their inclusion and quality of life.

On the other hand, Guzmán et. al. (2017) compared postural control through shifting the center of pressure in children, adolescents, and adults with DS with a typically developing control group; The results show that there are significant differences in adolescents and adults, with the population with DS showing worse postural control.

According to the Bobath concept, normal movement is explained from the presence of normal postural control mechanisms, which intervene unconsciously and automatically during neuromotor development and are responsible for regulating sensitivity, normal postural tone, correct reciprocal innervation and proper coordination of movements and balance, making possible the sequential appearance of postural, righting and balance reflexes and the automatic adaptation of the muscles to changes in position.

Furthermore, it is worth highlighting according to Bobath (1989 p. 80), a pioneering author on the subject: "… muscle tone is modulated according to neuromuscular needs, the interaction of the nervous and musculoskeletal system: whose objective is to achieve coordinated movement in space and time".

Now, according to Guzmán (2016 p. 12): "postural control is the basis for the development of motor skills in people with Down Syndrome. This is considered a complex motor skill derived from the interaction of multiple sensorimotor processes in order to control the body in space." The maintenance of postural control is then dependent on the

sensory systems and their ability to integrate information; The central nervous system allows generating an appropriate motor response to the needs of the environment.

In this sense, a neurorehabilitative intervention focused from the ecological premise, which takes into account the characteristics of the individual, their environment and the tasks to be performed, is the most pertinent. According to Valle (1995 p.6), he defines ecological validity initially as: *"the need for equivalence between experimental conditions and those of real life if theories formulated based on experimental data are to be applied to actions or behaviors."* that occur in natural environments, which are what we ultimately want to explain"; He also mentions that: *"a research [intervention] is considered ecologically valid if it is carried out in a naturalistic environment and with objects and activities from everyday life."*

According to Guzmán et. al. (2023), ecological validity is understood as the relationship between real-world phenomena and the investigation of these phenomena in experimental contexts. To better understand ecological validity, then, it is useful to look at these themes or dimensions in detail. Furthermore, this term is complemented with what has already been referred to by classic authors such as Briones (1989), who mentions that ecological validity *"is the property that the results of a study may or may not have of being generalized to an environment different from its environment of origin, chosen and treated by the researcher in terms of its experimental conditions and controls"*. And on the other hand, Cárdenas et. al. (2022) indicate: "in the sense that all data must be accompanied by argumentative support in favor of its validity within the framework of certain permitted contextual variations." Therefore, Guzmán et. al. (2023), indicate that the Ecological validity in pediatric neuro rehabilitation is based on natural, everyday reality and sensitive to the patient's reality.

In this sense, ecological validity involves maintaining the integrity of the real-life situation in the experimental context while remaining faithful to the broader social and cultural context; it must be a true environment in which actors behave in a regular manner. Therefore, ecological validity allows us to analyze the different environments where the population under study is located and determine the characteristics that influence its behavior (Guzmán-Jiménez, et. al., 2023; Aldana-Casas, et. al., 2023; Valdés-Torres, et. al., 2023; Barrera-Gómez, et. al., 2022; Pedraza, 2017). For this research, ecological validity is applied in the design of exercises that improve the postural control of children with DS in which we work from the daily environment of the population, identifying particular characteristics that we want to modify to improve and generate a representative impact on the functionality and independence of the patient.

METHOD

The research approached a mixed method which involves a set of processes for collecting, analyzing and linking quantitative and qualitative data, since it provides a much more open and complex look at the situation to be investigated. The type of study that was developed was a study by intervention programs, through a DITRIAC concurrent triangulation design (Hernández and Mendoza, 2008). Therefore, quantitative and qualitative data were collected and analyzed at the same time. In the **Quantitative phase**, An analytical study was developed through a systematized review, 30% of the articles found (60/180) in databases that reported exercises to improve the postural control of children with DS were reviewed; Scientific journals had to be indexed, published in Spanish in

the last 10 years and have a level of evidence 3. On the other hand, in the **Quantitative phase**, two focus groups were carried out from an ethnomethodological perspective to collect experiences in action related to care. of children by 5 experts (physiotherapy professionals with theoretical-practical experience in pediatric neuro rehabilitation) and 8 families with children with DS (with experience in neuro rehabilitation treatments for at least 3 years). This made it possible to identify the actions in daily life that give meaning to work to improve postural control.

During the research, data collection instruments were applied according to the design phases.**Quantitative Phase:**A modified RAE form was applied to record data from scientific articles. In the **Qualitative phase**: a Semi-structured Interview Script validated by three experts in participatory research was carried out.

It must be noted that, for Data analysis, in the **Quantitative phase**: descriptive statistics measures such as mean, mode, percentage and quartiles were developed. In the **Qualitative phase**: the experiences of the experts and families were collected and then a categorical analysis of the discourse was carried out based on the coding of the information.

Finally, the triangulation of the results was carried out through the analysis of the data and information obtained in each of the phases of the research, articulating two preliminary intervention plans (plan 1. Quantitative / plan 2. Qualitative). From these inferences, the neuro rehabilitation protocol was developed and the content validation exercise was carried out using the VA Validity Coefficient.iken.

The research was carried out with reference tocurrent legislation and regulations related to bioethics and health intervention.

RESULTS

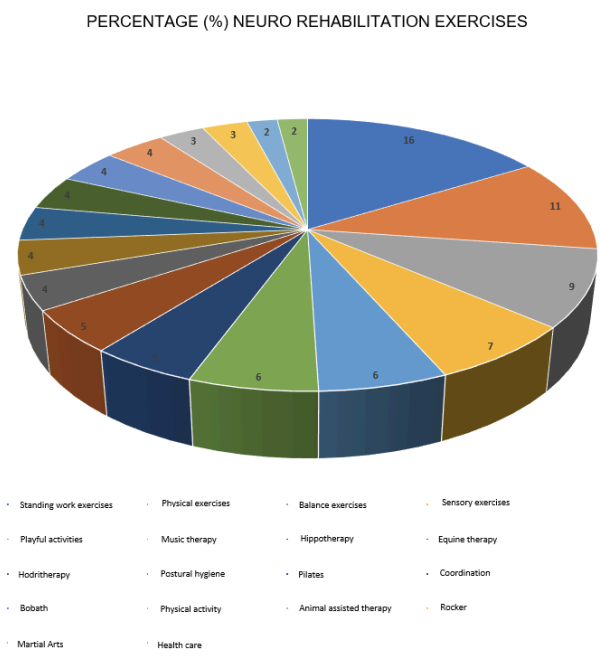
QUANTITATIVE PHASE:

180 articles with scientific evidence were reviewed, of which the analysis was carried out on 33% (X=60). These were extracted from databases related to techniques and/or exercises to improve the postural control of children with DS. Standing exercises were identified in 16% of the articles analyzed, physical exercises in 11%, balance exercises in 9%, sensory exercises in 6% and, finally, recreational activities in 6%. Once the results of the Quantitative phase were analyzed, study variables were identified, taking into account the distribution of the data in the Q2 and Q3 quartiles, which then determined five study variables: Standing Exercises, Physical Exercises, Balance Exercises, Sensory Exercises and Playful Activities (table 1).

#	TECHNIQUE	FREQUENCY
1	STANDING WORK EXERCISES	52
2	PHYSICAL EXERCISES	35
3	BALANCE EXERCISES	28
4	SENSORY EXERCISES	22
5	PLAYFUL ACTIVITIES	20
6	MUSIC THERAPY	20
7	HYPOTHERAPY	16
8	EQUINOTHERAPY	16
9	HYDROTHERAPY	16
10	POSTURAL HYGIENE	13
11	PILATES	13
12	COORDINATION	13
13	BOBATH	12
14	PHYSICAL ACTIVITY	12
15	ANIMAL ASSISTED THERAPY	9
16	ROCKER	9
17	MARTIAL ARTS	5
18	HEALTH CARE	5
	TOTAL	316

Table 1.*Rehabilitation Exercises*

Source: the Authors

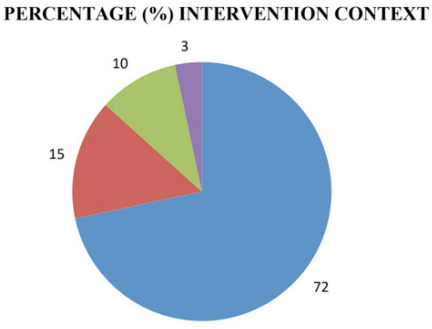


Graph 1. Rehabilitation Exercises

In relation to the context where the interventions are developed, it is identified that:

#	CONTEXT	PERCENTAGE
1	HEALTH INSTITUTION	72%
2	EDUCATIONAL INSTITUTION	15%
3	HYPOTHERAPY CENTER	10%
4	HOME	3%

Table 2.*Context Intervention*



Graph 2.*Intervention context*

On the other hand, taking into account the physical context or place where the interventions of the neuro rehabilitation processes for boys and girls with DS are carried out, it was identified that 72% are carried out in health institutions such as: clinics, IPS, health center. health, among others; Next, 15% are reported to receive attention in educational institutions, with an inclusive education focus; and with 10% actions in specialized settings such as hippotherapy centers; and, finally, 3% of attention is identified in the daily environments of the population such as homes and natural environments (table 2).

Based on the study variables resulting from the Quantitative phase, an evidence-based intervention plan was developed **(proposal 1-P1).**

QUALITATIVE PHASE

The stories obtained from the focus groups with families and professionals were analyzed separately by category. In the group of families, information was collected in eleven emerging categories that highlight from lived experience the importance of timely treatment, the physical context, comprehensive evaluation and interventional skills (of professionals); Other emerging categories point out the importance of tools for interventions, human and professional support, response to social needs and adaptation to basic routines (Matrix 1). While in eSeven categories emerge from the group of professionals: intervention plan, activity prescription, therapeutic techniques and professional experience; Furthermore, three categories emerged that relationally complement the technical aspects suggested by the first: sensitive tools, multidisciplinary team and environment (Matrix 2).

With reference to the above, the triangulation of the information from focus groups was carried out.of professionals and family members (Image 1, see focus groups category), andit was madean intervention plan **(proposal 2 – P2)** from the lived experiences of families and experts.

FAMILY STORIES			
EMERGING CATEGORIES	**DEFINITION**	**FREQUENCY**	**EXAMPLE OF STORIES** (RC- Caregiver Story/Story Number)
TREATMENT	A treatment is a set of means that are used to alleviate or cure an illness, get to the essence of what is unknown, or transform something.	16	"This child will enter daily therapies." (RC5)
ASSESSMENT	It can also mean an examination or analysis in the field of medicine that a health expert performs on a patient to evaluate his or her physical or mental condition.	11	"Alteration is that a good evaluation is made when that person is examined." (RC23).
PHYSICAL CONDITION	It is the set of qualities of a subject at a given moment, it is the sum of four basic capabilities: strength, resistance, flexibility, speed.	8	"The conditions of each child are special." (RC7).
CONTEXT	It is the area that includes or is within certain limits.	13	"I remember that I felt and saw fique, grass, wool, wood, feeling damp, wet with everything, I think this helped them lose their fear." (RC32).
PROFESSIONALS	It is a person who carries out a job in which his or her knowledge, experience, qualities or abilities, aptitudes make him or her a highly qualified person to carry out a specific activity.	8	"Professionals such as physiotherapist, occupational therapist, occupational therapist and especially support with psychology." (RC19).
SOCIAL NEEDS	They are those that are linked to community life, that is, they have to do with the relationship between the individual and the human group to which he belongs.	4	"Involved in the work issue in the parent's time, I wish it were at least 3 days a week." (RC14)
BASIC ACTIVITIES	They are activities oriented towards caring for one's own body such as: bathing or showering, dressing, eating or sleeping.	3	"The child begins to struggle with how to put his feet on the floor and thus begins to use his little arms by bouncing his arms and feet, they will gain what we call balance." (RC34)
SKILLS	A person's ability to do something correctly and with ease.	3	"They always have their learning in the short term, you have to work hard and repeat the repetition" (RC39).
HUMAN SUPPORT	It constitutes the greatest source of meaning to resist in the struggle, and with it, exceed the limits of the individualistic rational logic that overwhelms society and school.	4	"Contact with the family, hopefully also with kids their age with or without condition, activities that have to do with all the senses, the sensory theme and touch music are very important" (RC26).
REQUIREMENTS	Request for a thing that is considered necessary, especially made by an authority.	7	"Well, let's start with the primary needs." (RC12).
TOOLS	Set of instruments used to perform a specific trade or job.	10	"It happens that there were songs that were performed by everyone, possibly." (RC47)
STORIES	**80**	**86**	

Matrix 1. *Family Stories*

Source: The authors

EMERGING CATEGORIES	DEFINITION	FREQUENCY	EXAMPLE OF STORIESRC: Caregiver Story/Story Number
Professional experience	It is the one acquired from the completion and approval of the academic curriculum of the respective professional training, in the exercise of the activities of the profession or academic discipline required for the performance of the job.	12	"Elements to form a neuro rehabilitation protocol are to have a follow-up of each of the cases, to have knowledge in this case of the pathology and the needs and additionally to have some experience in the subject, and to have an objective and approach.". (RP1)
Intervention plan	It is an instrument that will allow you to create a "map" or "route" that you must follow during the intervention period that you will carry out, whether individually, as a family or as a community. In this plan, you will have objectives that you must meet throughout the entire intervention process.	8	"The results are more quantitative, as you say, depending on the skills or developmental milestones they acquire." (RP11)
Activity prescription	It is the process by which a physical activity regimen is recommended in a systematic and individualized manner, according to your needs and preferences, in order to obtain the greatest benefits with the lowest risks. The ordered and systematic set of recommendations constitutes the physical exercise program.	23	"R.Task-oriented motor learning, motor stimulation and vestibular stimulation, all of this generally to enhance head control and trunk stability depending on the developmental milestone and therefore the greatest need in them. In addition to other complementary techniques such as equine therapy and if there is the possibility of therasuit" (RP14).
Multidisciplinary team	The members of the team interact and communicate with each other, know the work of all the components and offer a parallel but independent evaluation and treatment. Regular meetings occur to discuss cases and share results and plans.	12	"Profiles such as Physiotherapy, Speech Therapy, psychology, special education and physical education. (pause) and generally the occupational therapist intervenes from the outpatient department mmm and the treating doctor some specialists depending on the need and the commitments that each of these children have and the complications, for example a cardiologist for management of the cardiovascular part of the patient." (RP6)
Tools sensitive	It is the set of means of any kind whose purpose is the cure or relief of the diseases or symptoms reported by the patient from his feelings.	12	"Looking at and specifying the age at which I am going to impact or intervene in children with Down syndrome, I also have to look at the background, not only physiological and musculoskeletal, but also the core family that makes it up mmm as a support process, in addition the intervention times, spaces, what tool do I also have to promote this type of activities or exercises?(RP25)
Techniques	Set of procedures or resources that are used in an art, a science or a specific activity, especially when they are acquired through practice and require skill.	30	"Use techniques such as the entire part of the Rood technique, also sensory stimulation or multi-sensory stimulation through textures, you can also work on the entire part of the senses, stimulation of the senses to promote and improve that sensory system, but also according to the evaluation that I do in addition to the trunk and extremities massage."(RP20)
Total		97	

Matrix 2.*Professional Stories*

Source: The Authors

TRIANGULATION OF QUANTITATIVE AND QUALITATIVE PHASES

Finally, based on the collection of information from the quantitative and **Qualitative phase**s, it was possible to articulate the emerging categories of the focus groups and the variables of the scientific articles, which had been collected in the proposals for intervention plans (P**1 and P2**). That is how,Triangulation is carried out in four categories: Prescription of activities, context, experiences and tools.With these results, the proposal for the neuro rehabilitation protocol with ecological validity for the postural control of children with Down Syndrome is then prepared (Image 1).

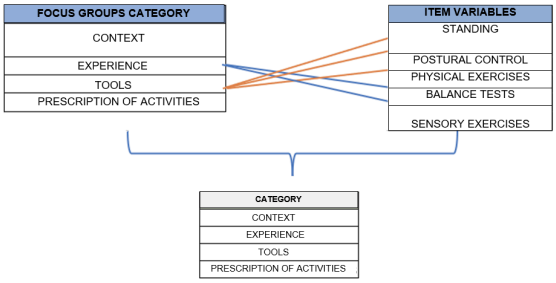


Image 1. Triangulation of emerging and variable categories

Source: The Authors

It must be noted that the validity of the protocol was carried out using the Aiken V coefficient, which allows identifying the content validity of each of the proposed exercises. The degree of pertinence, clarity, sufficiency, relevance and coherence was measured. There was a total of 6 expert judges to validate the protocol exercises. It was then required that 5 agree, for the exercise to be valid, which was achieved in 98% of the exercises (average value of the coefficient = 0.96).

PROTOCOL

The final protocol designed is divided into five stages that allow the child to strengthen and integrate their motor development to achieve greater functionality over time. The proposed activities are developed in different environments to strengthen the ecological validity approach that seeks to develop neuro rehabilitation processes in the natural and real environments of the users (table 3).

DISCUSSION

The findings obtained in this research coincide with the studies carried out by Contreras (2011), who based on them proposes designing and applying physiotherapeutic programs based on physical exercise, in order to influence trunk postural alterations in children with DS. According to the author, there is a significant correlation between the application of physical exercise to modify postural alterations and the environment where care is developed, since the latter requires greater functional adaptation to participate in the proposed activities when the patient's reality is contemplated. On the other hand, it proposes that it is relevant to make individual adjustments in the intervention, include an immediate support network in the neuro rehabilitation process, recognize the daily environments of children with DS, adapt and propose neuro rehabilitation strategies from the real environment, accompany and monitor auxiliary professionals in achieving the established objectives and propose continuous adjustments if necessary.

Likewise, Guzmán, et. al. (2019), as the results of this research suggest, argue that the participation of the support network in the rehabilitation process positively influences the achievement of the intervention objectives and not having this support has a positive influence. negative in the evolution of the patients. This aspect also contributes to the

empowerment that the community has over its health processes and the demand and fulfillment of its rights and duties. Therefore, based on the results obtained, it is suggested to carry out educational processes with the family and caregivers since they are an essential element for the neuro rehabilitation process and adherence to treatments is improved with their participation.

Combined with the above and as mentioned by Aldana, et al. (2023) cited by Yu et al. (2019), by establishing family-centered interventions, short-term neurophysiological maturation is facilitated, children's development benefits, it promotes collaborative work in which parents and teachers intervene, as well as the child's participation in different contexts.

On the other hand, the results show that, although the importance of inclusion in the different areas of daily life is recognized, professionals refer that the office or health institution is the space where neuro rehabilitation processes usually take place. However, they highlight the importance of going out into real environments to implement comprehensive rehabilitation strategies.

Some research (Gómez, et.al., 2018a; Gomez, et. al., 2018b; Schott, et. al., 2015; Apolloni, et. al., 2013), andIn agreement with the findings found, they proposethe development of various exercises and neuro rehabilitation techniques applied in the population to improve postural control from the approach of ecological validity. These specifically suggest implementing rehabilitative exercises in different spaces, which also facilitates and reinforces the work of professionals thanks to the support of the family environment. This is why in the execution of the protocol design with its five phases, natural exercises and strategies are emphasized for the adaptation of different postures (lateral recumbency, quadruped sitting and crawling), standing, taking into account the control of the center of gravity, alignment, body awareness, body scheme, body imagination, sensory exercises and stimuli at the vestibular level, exercises for stability on parallel bars postural adjustment exercises with stimuli physical conditioning and the entire part of virtual reality exercises, training from proprioceptive facilitation techniques and stability on unstable terrain recreational activities posture change exercises.

On the other hand, this research allowed professionals and experts to recognize that there is representative scientific evidence on the exercises and neuro rehabilitation techniques applied to the population to improve postural control and thus strengthen inclusion processes in different areas. of the daily life of the population. Professionals highlight in their stories the importance of starting rehabilitation processes at an early age since it is at this stage of training where children with DS can strengthen and reinforce their motor development to improve and/or enhance abilities and prevent other complications. In addition, they recognize the importance of carrying out educational processes with the family and caregivers since they identify that they are an essential element for the rehabilitation process and it is possible to improve adherence to treatments.

CONCLUSIONS

Sensory, motor and cognitive mechanisms intervene in the postural system, which, according to the demands and conditions of the task to be performed, favors the responses necessary to fulfill the task. In this sense, postural control depends on the characteristics of the individual, the environment and the task to be performed. Therefore, the alteration in any of its mechanisms influences postural performance, causing possible effects on the physical and mental health of an individual.

NEURO REHABILITATION PROTOCOL WITH ECOLOGICAL VALIDITY FOR POSTURAL CONTROL OF BOYS AND GIRLS WITH DOWN SYNDROME.				
PROTOCOL	**STAGES**	**SPOTLIGHTS**	**EXERCISES**	**CONTEXT**
Set of organized and standardized therapeutic exercises that improve the postural control of children with DS to promote greater functionality in the development of daily activities	STAGE 1: Postural tone control	Stability: maturation of the SN, due to balance reactions (anterior-posterior) Promote control of postural tone, trunk control	Adoption of posturesWorking on unstable bases Displacement of the center of gravityPostural alignmentWeight releasesJoint approximations	Natural environments Everyday environments Specialized centers
	STAGE 2: Adaptation, transitions and position changes	Reactions straightening, balance and part of projectives, stability by muscular force. At this stage, the child's adaptation to a stable bipedal position is sought, with adequate control of the center of gravity, with the assistance of the therapist.	Changes in recumbency, adoption and maintenance of posture (prone, sitting, bipedal) Physical exercises Execution of crawling	Natural environments Everyday environments Specialized centers
	STAGE 3: Bipedal stability	Maturation of the system from the midbrain and cortex. At this stage, the aim is for the child to maintain the bipedal position without the help of the therapist with active training of postural control that improves stability.	Work on parallel bars where gait training is performed with weight transfers and unloading. Maintenance of posture on inclined planes such as ramps and postural adjustment. Physical activity Virtual reality	Natural environments Everyday environments Specialized centers
	STEP 4: Adjustments and movements	Righting reactions, balance, adaptation to the environment, levers, base speed of support. At this stage the aim is for the child to maintain a bipedal position and walk.	Gait trainingWork on unstable basesPhysical exerciseVirtual realityBalance exercises	Natural environments Everyday environments Specialized centers
	STAGE 5: Coordination, precise movements	Biomechanics and maturation of the nervous system. At this stage the child must walk independently, change positions to adopt and maintain different postures.	Patient biped on unstable surfaces such as therapeutic ball, therapeutic roll, lentil or bose, stimuli are performed anteriorly, laterally and posteriorly. Playful activities Transfer exercises, Twists, Alternate feet Sensory exercises	Natural environments Everyday environments Specialized centers

Table 3.*Consolidated Neuro rehabilitation Protocol*

Source: The Authors

Motor behavior defines the neural networks that are genetically determined; these are modified throughout life thanks to activity. In the case of Down Syndrome, it is necessary to carry out neuro-rehabilitative intervention that promotes the formation and organization of neuronal connections that allow improving motor abilities.

Early interventions in neuro rehabilitation aim to improve brain connectivity during key periods of development, thus avoiding deterioration and preventing sequelae, which is why it is necessary to care for children with Down Syndrome, under an interdisciplinary approach, in which The characteristics of each child are taken into account, the alterations they present, the evaluation and analysis of their immediate environments and the establishment of intervention plans with planning where postural management programs are established and exercises are included according to their condition, encompassing all activities that impact the child's posture and function, promotes the continued participation of both the child and parents, family and caregivers.

A neuro rehabilitation protocol with ecological validity for postural control in children with Down Syndrome-DS contemplates in its construction: (a) characterization of the population under study to identify strengths and difficulties related to postural control, (b) education to the support network in the neuro rehabilitation process, (c) recognition of children's daily environments to apply neuro rehabilitation exercises, (d) adaptation, proposal and implementation of neuro rehabilitation strategies from the real environment, (e) accompaniment and monitoring of professionals and (f) continuous adjustments if necessary to the application of the protocol. This benefits children and their caregivers, as it facilitates the development of playful and methodological strategies that improve postural control through the application of exercises that have scientific evidence and founded experience.

Furthermore, the protocol, as a research project, makes an investigative-interventional contribution by presenting itself as an innovative proposal that provides new guidelines about the ecological validity of procedures in pediatric neuro rehabilitation; since the proposed exercises are applied in different environments in which children with Down Syndrome naturally develop; This favors independence, functionality and improves the physical, mental and social quality of life of the user, their family and/or caregivers. Therefore, this tool could be used and transcend the contexts and natural environments where the population lives.

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