

# Advance in Psichology and Education

## Psychomotor development in children with Down syndrome and physiotherapy in early intervention\*

N. Buzunáriz Martínez & M. Martínez García

*Centre de Desenvolupament Infantil i Atenció Precoç - Fundació Catalana Síndrome de Down*

### Abstract

Children with Down syndrome have unique defining traits with a specific bearing on their psychomotor development. Brain characteristics, musculoskeletal abnormalities and associated medical conditions are the most significant factors that affect their psychomotor development, both in terms of milestone timing and in the quality of movements. The main aim of early intervention is to optimize and support the child's development, fostering their capabilities and taking on board their individuality. Physiotherapy is offered primarily as a preventive service. Children are given the chance to experience appropriate movement, by setting optimum patterns and preventing misaligned ones. Parents and significant others in the child's environment are also given advice.

**Keywords:** Down syndrome. Psychomotor development. Early intervention. Physiotherapy.

### 1. Psychomotor development in children with Down syndrome

Child development is a lifelong dynamic and complex process that is based on biological, psychological and social development. Early childhood is a particularly important stage in overall development, as this is when children

develop the perceptive, motor, cognitive, linguistic, affective and social skills that enable them to interact in a balanced way with their environment. Development is closely linked to the maturation process of the nervous system—which commences in the womb—and the emotional and mental organization of the child.

Human beings exist and relate in a general sense through neuromotor, affective, cognitive, and sociocultural patterns that develop in response to genetic and environmental influences.

Development refers to all newly learned capabilities that serve a function. Motor behavior in particular is determined by a set of systems that interact dynamically to produce movement. Human movement is not just the result of the contraction of a muscle; it is a voluntary act aimed at achieving a specific purpose and consisting of a goal, a plan, and an intention. Since the goal is located in the environment, the motivation underlying any given movement will depend on stimuli from this environment. People move because they wish to obtain or reach something of interest to them in their environment—whether an object or person—and this desire triggers the necessary mechanisms.

Psychomotor development is based on learning experienced through movement. Children explore and experiment with the world

\*Paper presented orally at the Family Education and Food-for-Thought Meetings. Fundació Catalana Síndrome de Down. February 2008.

that surrounds them through movement and in this process they learn to recognize their capacities and the limitations of the body.

The motor development of children with Down syndrome (DS) is marked by a delay in achieving gross and fine motor milestones.

### 1.1 Factors affecting psychomotor development in children with Down syndrome

The etiology of delayed motor development in children with DS derives basically from structural factors that are common in DS but specific to each individual. These factors include:

- Brain-related characteristics
- Musculoskeletal disorders
- Associated medical problems.

#### 1.1.1. Brain-related characteristics

The genetic overload arising from the presence of an extra chromosome 21 produces a generalized and diffuse imbalance in the brain of persons with DS. The different anomalies that have been observed include a reduction in the number of certain types of neurons located in the cerebral cortex, an alteration in the structure of dendritic spines and a reduction in their number, a reduction in the size of certain areas and nuclei of the brain, and less efficient biochemical organization.

These disorders modify a child's capacity to transmit information. The particular brain structure of children with DS means that they are slower at taking in, processing, interpreting, and elaborating information, and this is one of the underlying reasons for delayed motor development.

#### 1.1.2. Musculoskeletal disorders

Some of the factors that explain delayed motor development in children with DS are low muscle tone, slack ligaments, weak muscles, and shortened upper and lower limbs. These factors condition motor development, milestone

timing, and movement quality; in other words, they essentially affect how a child moves.

Muscle tone, which is the tension in a muscle when it is in the resting state, is controlled by the brain. Lowered muscle tone, called hypotonia, affects children with DS in different ways, and means that they have greater difficulty in motor learning. Hypotonia also means that the muscles are incapable of sufficiently stabilizing the joint structures, making it more difficult to achieve balance and coordination of movements.

Like hypotonia, ligament laxity is present from birth and this fact explains why motor development is delayed in children with DS.

Hypotonia may exist in different degrees: marked, moderate, and mild. The age of onset of walking depends on the degree of hypotonia (Table I).

Low muscle tone, extreme ligament laxity, and joint instability all provide anomalous proprioceptive inputs to the thalamus, negatively affecting the motor development of the child with DS.

The fact that soft tissues in the joints have a diminished restraining effect results in increased joint instability. The joints most affected are those that continuously support the greatest loads (hips, knees, and feet) or experience the greatest mobility (the atlantoaxial joint). This lack of soft-tissue restraint and consequent joint instability is the reason why children with DS have trouble maintaining their balance.

#### 1.1.3. Associated medical problems

People with DS have a tendency to develop medical problems that interfere with their development. The most frequent disorders are heart and respiratory disorders, visual and auditory deficiencies, digestive and hormonal alterations, and epilepsy (Table II).

**Table I**

Age of onset of walking depending on hypotonia severity.

Marked hypotonia	28,90 months
Moderate hypotonia	23,84 months
Mild hypotonia	22,94 months

## 1.2. Specific movement patterns in children with Down syndrome

The motor development of children with DS is characterized by delayed achievement of development milestones in terms of gross and fine motor skills, visual control, speed, muscle strength, and balance.

The typical posture of the child with DS and hypotonia is legs in abduction, external rotation, and flexed knees. This posture affects the child's way of moving as it becomes habitual to the point of being maintained in postural changes.

Appropriate motor skills are not just functional but also ensure suitable movement patterns. Although children with DS may repeat motor patterns that are functional, these are often inappropriate and are likely to produce alterations in musculoskeletal structures. Children with DS often display compensatory patterns, with a lack of dexterity that is the result of the presence of more or less marked hypotonia, ligament laxity, and poor

coordination and balance. They thus tend to develop movement patterns that compensate for lack of strength, joint instability, and limb shortness (Table III).

## 2. Early intervention physiotherapy for children with Down syndrome

Early intervention is defined as the set of development actions aimed at children aged 0 to 6 years, their families, and significant others in order to respond as early as possible to transient or permanent needs in children with development disorders or at risk of developing such disorders as a consequence of organic, psychological, or social problems. Early intervention needs to take into account the overall situation of the child and so should be planned by an interdisciplinary team of professionals.

In Catalonia, early intervention is offered by a network of child development and early intervention centers (Centres de Desenvolupament Infantil i Atenció Precoç, or CDIAP). This public, universally accessible network offers its services free of charge to all infants aged less than 6 years. Operated according to a management model that applies efficiency and quality criteria, the centers are run by both public and private entities and are funded by means of regularly renewed financial agreements.

**Table II**

Motor development milestones for children with or without associated conditions (age in months).

Milestone	Healthy children	Children with associated conditions
Aligns the head in a face down lying position	2.29	4.15
Controls the head vertically	3.84	5.90
Pulls to sit without head lag	5.23	8.00
Is stable when seated	9.64	10.72
Moves unassisted to a seated position	14.94	17.61
Stands with support	12.15	16.00
Moves to a standing position with support	18.02	20.27
Commences independent locomotion	11.5	14.0
Walks independently	22.76	27.40

Study conducted by Drs. Pilar Póo and Rosa Gassió, Neur pediatrics Department of the Hospital St. Joan de Déu, Barcelona 2000.

**Table III**

Motor development milestones in children with Down syndrome (age in months).

Aligns the head in a face-down lying position	2.7 months
Vertically controls the head	4.4 months
Pulls to sit	6.0 months
Shows support reactions	8.3 months
Is stable when seated	9.7 months
Stands	13.3 months
Rolls over	8.0 months
Commences independent locomotion	12.2 months
Drags	13.6 months
Crawls	17.7 months
Shuffles	17.9 months
Walks independently	24.1 months

Study conducted by Drs. Pilar Póo and Rosa Gassió, Neur pediatrics Department of the Hospital St. Joan de Déu, Barcelona 2000.

The first child development and early intervention centres were opened in Catalonia in 1970. The terminology used then was 'early stimulation' and the therapeutic care offered to children with specific disabilities was aimed at reducing the effects of the disability. This concept was both restrictive and overly centered on the disability, resulting in a therapeutic attitude that focused exclusively on the symptoms rather than on the subjects themselves. In other words, emphasis was placed on techniques rather than on persons.

Present practice is referred to as 'early intervention'. Under this approach, different specialists in an interdisciplinary team contribute with their specific knowledge to developing a shared interpretation of the symptoms. In this case, the child and the family are central to the process, and the perspective is one in which the child plays a key role in his or her own development process. In planning the intervention, account is taken not just of the specific disorder or disability, but also of all aspects of the child's developmental stage and needs.

The main aim of early intervention is to optimize and support children's development processes by developing their capacities so that they have every opportunity to develop their potential to the maximum. Rather than focusing on accelerating development, the physiotherapy provided by the CDIAP to children with DS is basically preventative.

Physiotherapy focuses on training that facilitates movement. Movement is ultimately function—and function in the case of children is represented by play. Therapeutic objectives for children with DS are achieved by their active participation in play. Play helps children develop their mobility potential and extrapolate this mobility to other situations in day-to-day routines.

Physiotherapy requires participation and effort from the child. However, in motor learning a balance has to be struck between play and therapeutic aim. Motor, visual, and perceptive difficulties may prove an obstacle to play, and the role of the physiotherapist is to help the child develop the necessary motor control.

The child can be expected to be particularly receptive for a time span that will vary depending on age, intellectual potential and concentration capacity. The emergence of appropriate motor responses requires that the child adopt positions in which he or she feels physically comfortable, be willing to tackle the difficulty implied by the therapy, and be capable of learning through play.

Physiotherapy offers children the possibility of experiencing appropriate movements, by helping children learn optimal movement patterns and ensuring that they do not adopt poorly aligned postural patterns. Physiotherapy also provides parents with guidelines on preventing unsuitable postures in their children. Postural control ultimately has a positive impact on function. Children with DS often move using anomalous patterns (e.g., shuffling or sitting up from a lying position with the legs opened too wide), so the role of the physiotherapist is to guide a child's movement by facilitating appropriate movement, enabling the child to experience correct patterns, and fostering correct proprioception.

Insoles enable good alignment and so facilitate appropriate patterns and proprioception. These supports should not be prescribed too early, however, as the foot should be allowed to strengthen its muscles naturally.

It should also be borne in mind that a pattern of movement (such as shuffling) is sometimes transient; consequently, a child should not be denied such movements, given that they represent an expression of the desire to move.

It is also important to bear in mind the individuality of each child, given that, although many children may have the same diagnosis, each one is ultimately different and has different needs. Early intervention should be applied according to the specific characteristics and needs of a child. Intervention of a generalized nature is not appropriate for children with DS, as both genetic and environmental factors—which are different for each child—play a part in psychomotor development.

In regard to genetic factors, hypotonia means that a child's attitude to movement is somewhat passive. Physiotherapy deals with hypotonia by helping children to be more dexterous in their



movements and to feel their body become stronger and more agile. As a child's experience of movement becomes positive, he or she becomes more active. Helping children with DS from an early age improves their chances of practicing sports later in life, and this, in turn, helps prevent the tendency to obesity that is a feature of children with DS.

As for environmental factors, paying attention to the needs and desires of the child with DS will go a long way to helping them develop appropriately. This is why it is important for parents to be present in therapy sessions.

The desire for mobility is the driving force that motivates a child when he or she reaches out for something. Movement for its own sake makes no sense. Inspiring each movement is the wish to approach an object or person, to pick up a toy or to move away from something no longer of interest. Making excessive demands of a child or imposing a motor experience as an obligation can block the desire to move. Early intervention works with the child's interest, modifying his or her surroundings, and providing favorable conditions that will encourage achievement of the established objectives. It is important to allow children the time necessary to initiate movement and also to respect time-lags in their response. Children need to be given adequate time and space to play a central role in their own explorations and discoveries. Learning is most likely to happen if it is significant and meaningful and if it serves some purpose. If, in addition, it is the child himself or herself who discovers this, then the learning is internalized.

Children have to play a central role in their own learning. Early intervention views the child as an active subject rather than as a container to be filled with skills and knowledge.

## Bibliography

- Escribá A. Síndrome de Down, Propuestas de intervención. Madrid: Gimno; 2002.
- Gassió R. Trastornos Neurológicos y el niño con síndrome de Down. En: Corretger JM, Serés A, Casaldàliga J, Trias K (eds). Síndrome de Down. Aspectos médicos actuales. Barcelona. Masson y Fundació Catalana Síndrome de Down; 2005. pp.70-82.
- Macias L. Desarrollo Motor y aprendizaje del movimiento, Conceptos contemporáneos. En: Macias L, Fagoaga J. Fisioterapia en Pediatría. Madrid. McGraw-Hill Interamericana; 2003. pp. 1-29.
- Poo P, Gassió R. Desarrollo motor en niños con síndrome de Down, SD-DS Revista Médica Internacional sobre el Síndrome de Down, 2000; 4:34-40.
- Real Patronato de Prevención y de Atención a Personas con Minusvalía. Grupo de Atención Temprana.. Libro Blanco de la Atención Temprana. Madrid 2000.
- Peter E.M, Lauteslager, PhD. Children with Down's syndrome. Motor development and Intervention. 's Heeren Loo Zorggroep, Amersfoort, The Netherlands, 2004.
- Riquelme Agulló I, Manzanal Gonzalez B. Factores que influyen en el desarrollo motor de los niños con síndrome de Down, SD-DS Revista Médica Internacional sobre el Síndrome de Down, 2006; 10:18-24.
- Riquelme Agulló I, Manzanal González B. Desenvolupament motor del nen amb síndrome de Down i patologia articular associada, SD-DS Revista Médica Internacional sobre el Síndrome de Down, 2006;10:34-40.
- Unió Catalana de Centres de Desenvolupament Infantil i Atenció Precoç. UCCAP. Informe sobre l'Atenció Precoç a Catalunya. Any 2005.