

ORIGINAL STUDIES

The role of occupational therapy in children with Down's syndrome

Rolul terapiei ocupaționale la copiii cu sindrom Down

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Abstract

Background. The role of occupational therapy in the functional development and social reintegration of children with Down's syndrome.

Aims. The improvement of fine motor and ADL skills, social and communication skills, participation in group games and cooperation skills.

Methods. The present paper is a primary study based on case series, conducted on children with Down's syndrome in Cluj-Napoca in their home environment. The research involved the application of an occupational therapy program to a group of 5 children with Down's syndrome, consisting of 2 boys and 3 girls, aged 5 to 11, over a period of 6 weeks. The program consisted of 2 sessions per week, each with a duration of 50 minutes. Progress was quantified using data collected through assessment scales, as follows: the Waisman Activities of Daily Living (W-ADL) scale, the finger dexterity test (FDT), the hand dexterity test (HDT) and Ozeretski's dynamic coordination of hands test (DCHT). The tests were performed on days 1 and 42 of treatment.

Results. Specificity was calculated by comparing the results obtained upon conducting the study on the same group of subjects at those points during treatment using the T-Paired Two Sample for Means test. The significance levels were measured at 95% for $p < 0.05$ and 99% for $p < 0.01$. Upon performing the W-ADL, FDT, HDT and DCHT tests, the following results were obtained: W-ADL – $p = 0.03$, $p < 0.05$; FDT - left hand: $p = 0.01$, right hand: $p = 0.006$, $p < 0.05$; HDT - $p = 0.01$, $p < 0.05$; DCHT - left hand: $p = 0.006$, right hand: $p = 0.003$, $p < 0.01$;

Conclusions. Upon conducting the research, the main occupational therapy program objectives were achieved. Also, important considerations were formulated regarding the improvement of ADL performance by means of increased levels of independence, an improved quality of life and improved sensory and fine motor skills as a result of symptom improvement.

Keywords: Down's syndrome, occupational therapy, rehabilitation medicine

Rezumat

Premize. Aportul terapiei ocupaționale în dezvoltarea funcțională și reintegrarea socială a copiilor cu sindrom Down.

Obiective. Îmbunătățirea abilităților motrice fine, a aptitudinilor pentru realizarea activităților de zi cu zi și dezvoltarea aptitudinilor de socializare, comunicare, participare la jocuri de grup și cooperare.

Metode. Această lucrare este un studiu primar bazat pe serii de cazuri, efectuat pe copii cu sindrom Down din Cluj-Napoca, la domiciliul fiecărui participant. Cercetarea a constat într-un program de terapie ocupațională aplicat unui grup de 5 copii cu sindrom Down, dintre care 2 băieți și 3 fete, cu vârsta cuprinsă între 5-11 ani, pe o perioadă de 6 săptămâni, 2 ore pe săptămână, 50 minute pentru fiecare ședință. Pentru cuantificarea evoluției s-au utilizat date ce au fost colectate din scalele de evaluare: Waisman Activities of Daily Living (W-ADL), testul dexterității degetelor (finger dexterity test- FDT), testul dexterității mâinilor (hand dexterity test- HDT) și testul de coordonare dinamică a mâinilor (testul Ozeretski - the dynamic coordination of hands test- DCHT), care au fost aplicate în ziua 1 a programului și respectiv în ziua 42.

Rezultate. Pentru determinarea specificității, s-a utilizat testul T- Paired Two Sample for Means de comparație a rezultatelor pe același grup de subiecți în cadrul celor două momente. S-au obținut valori ale pragului de semnificație în proporție de 95% pentru $p < 0,05$ și 99% pentru $p < 0,01$. În urma aplicării testelor s-a obținut pentru testul WADL ($p = 0,03$, $p < 0,05$), pentru FDT (mâna stângă: $p = 0,01$; mâna dreaptă: $p = 0,006$, $p < 0,05$), pentru HDT ($p = 0,01$, $p < 0,05$) și pentru efectuarea DCHT (mâna

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stângă: $p=0,006$ și mâna dreaptă: $p=0,003$, $p<0,01$).

Concluzii. În cadrul programului de terapie ocupațională, obiectivele principale ale studiului au fost atinse și s-au adus considerente importante în gradul de realizare a activităților de zi cu zi prin dezvoltarea nivelelor de independență, precum și creșterea calității vieții, a achizițiilor în cadrul funcției motorii fine și a celei senzoriale prin reducerea simptomatologiei.

Cuvinte cheie: sindrom Down, terapie ocupațională.

Introduction

General considerations

Langdon Down disease, also known as trisomy 21 or mongoloidism, is the first and most commonly encountered chromosomal abnormality among humans. There is an increased probability for people with Down's syndrome to present with health problems, such as dysmorphia, developmental delay or a malformation syndrome (Vlad et al., 2012).

Generally, children with Down's syndrome present a set of mental and physical characteristics, such as cognitive, behavioral disorders or learning disabilities, speech, communication and short-term memory delays, fine or gross motor deficits (Delavarian et al., 2012), ataxia or hypotonia (Lautslager et al., 1998). Motor impairment may result in slow movements, lack of precision, reduced stability and coordination. Also, it affects the non-physiological motor mechanisms, also known as compensatory mechanisms.

Due to a particular brain structure, patients with Down's syndrome need extended periods of time to collect, process, interpret and manage information. Numerous authors associate this particularity with motor and cognitive development delays (Agulló et al., 2006).

Most patients with Down's syndrome present several physical particularities, as follows:

1. hypotonia in association with a poor Moro reflex, ligamentous hyperlaxity and instability - reduced muscle strength causes instability in the joint structures and therefore, motor coordination, walking and also fine motor impairment (Weijerman & de Winter, 2010); hypotonia can be marked, moderate or mild, each form affecting the child's walking timeline as shown in Table I (Martinez & Martinez, 2008); the most affected joints are the weight-bearing joints (i.e. hip, knee) and the atlanto-axial joint (Vlad et al., 2012);

2. brachycephaly, round flattened face, protruding tongue, small ears, short neck, loose skin at the nape of the neck, short broad hands, incurving little fingers (clinodactyly), often single transverse palmar crease (Crookshank's crease or simian crease), dermatoglyphic abnormalities (excess of ulnar or radial loops on the distal line), short lower limbs, collapsed plantar arches, short toes with gaps between the hallux and second toe, short height (max. 140-160 cm in adults), often accompanied by obesity, delayed and problematic sexual development (Weijerman & de Winter, 2010).

The diagnosis of Down's syndrome in neonates and infants can be confirmed based on the clinical criteria presented in Table II (***, 2008).

Table II
The cardinal symptoms of Down's syndrome in neonates and infants (after Hall, 1966)

Symptoms	Incidence rate
Muscular hypotonia	100%
Poor Moro reflex	85%
Flat facial profile	90%
Upslanting palpebral fissures	80%
Small low-set round ears	60%
Loose skin at the nape of the neck	80%
Simian crease	45%
Ligamentous hyperlaxity	80%
Hip dysplasia	70%
Clinodactyly	60%
The presence of 6 out of 10 symptoms supports a Down's syndrome diagnosis	

Low postural tone prevents co-contraction, i.e. balance and feedback, during walking. Thus, the motor development of children with Down's syndrome is affected by postural control impairments (Lautslager et al., 1998), or cerebellar hypoplasia, which include cerebral maturation or pathophysiological processes (Malak et al., 2015).

Along with ligamentous and capsular hyperlaxity, hypotonia causes instability in most joints and therefore, impaired imbalance and motor coordination. Obesity can also be considered as one of the factors that affect posture, strength, movement and grasp stability (Agulló et al., 2006).

The role of occupational therapy within a rehabilitation program is to train an individual's participation in activities of daily living and undertaking of significant tasks of life, as well as to improve educational development and management, participation in leisure activities and social participation, among other major functions (Irsay & Popa, 2016).

Occupational therapy activities focus on and are adapted depending on the child's and family's needs. The occupational therapist focuses on the development of target areas, such as personal grooming, participation in education, play and leisure, motor and sensory rehabilitation.

The parents' participation also represents a very important factor as they can assist their children in the learning process through planned and unplanned play and structured teaching (Crețu et al., 2010).

In the context of the participation of children with Down's syndrome in occupational therapy activities, the occupational therapist must take into consideration a number of principles, as follows:

- Making sure that the child is not tired as a result of the activities performed.
- Following the child's pace and dynamics and showing patience in their achievement of the best results by engaging them in the activities performed.
- Encouraging the child to make various objects, and

keeping them after the therapy sessions.

- Maintaining interaction with the child and adapting the conversation to suit their age.

- Assessing the level of independence, as well as the manual and intellectual skills achieved by the child on a constant basis.

- Making sure that intellectually or physically demanding activities are not followed by any manual ones (Dan, 2005).

The workspace

The environment where the occupational therapy sessions take place must meet the following conditions:

- It must be set up in a quiet space, with big tall windows, which does not cause any distractions.

- The furniture must be adapted to the child's needs.

- It must be equipped with objects for everyday use, such as paper, bottles, etc., as well as objects to be used for exercises and exploration (Dan, 2005).

Certainly, there is an entire set of factors that bear an influence on the process of fine motor development, such as movement, sight, sensory integration, visual proprioception or cognitive capacity, as well as socio-cultural factors. Most programs involving fine motor development consist of hand exercises and activities. Fine motor skill development therapy includes bimanual coordination, prehension, hand dexterity and single grip development, strengthening of hand muscles needed for self-serving, performing activities of daily living and successive motor actions (Lersilp et al., 2016). The success rate of a fine motor skill rehabilitation program must be, by all means, continuous and systemized.

Fine motor skill development is directly linked to speech (pronunciation and language) and thinking development, thus playing a role in the development of intelligence (Haraszosi et al., 2015). This relationship between the two is supported by recent research, whereby fine motor skills have a significant impact on the school performance of children with Down's syndrome (Memišević & Mačak, 2014).

Hypothesis

The issues of compliance and success of occupational therapy programs among children with Down's syndrome have been raised numerous times, the debate leading to the conclusion that occupational therapy plays a paramount role within rehabilitation programs due to its contribution to social integration and participation in group activities.

The formation of children with Down's syndrome as future adults must begin in childhood. Therefore, the earlier occupational therapy is undertaken, the more uniform will be their long-term progress.

The purpose of the present paper is to contribute to the integration of children with Down's syndrome in daily activities by means of ADL, I-ADL, fine motor skill and social integration development, as well as the establishment of relationships with family members and others using occupational therapy.

Material and methods

The study was approved by the Ethics Committee and all parents whose children were included in the study agreed with the fact that the results of their evolution will

be used for research purposes and published.

a) Period and place of the research

The research group benefited from an occupational therapy program over a period of 6 weeks. The program consisted of 2 sessions per week, each with a duration of 50 minutes. The program was carried out in the participants' home environment in Cluj-Napoca between 30 April and 10 June 2017.

b) Subjects and groups

The research involved the application of an occupational therapy program to a group of 5 children with Down's syndrome, 2 boys and 3 girls, aged 5 to 11, over a period of 6 weeks.

The protocol was established on a weekly basis and carried out in accordance with the objectives. It consisted of approximately 3-4 activities adapted to suit the participants' age and cognitive levels, based on their initial assessment, as follows:

Week 1

1. Grip, precision and prehension improvement

- Playing pinch pin games - pinch pins are attached around color-coded shapes and then removed

- Screwing/unscrewing lids - various types and sizes of lids are used

- Playing the Octoplus game

2. Getting dressed/undressed & adjusting clothing items

- Simulating the process of getting dressed – using buttoned pillow cases, zipped pillow cases, shoe lacing, etc.

- Adjusting footwear – using stickers which are put inside in order for the footwear to be worn correctly

- Improving dental hygiene – educational games, bite plane exercises

Week 2

1. Hand coordination development

- Playing tennis ball games – catching and throwing

- Playing mosaic games – grasping and placing game pieces by pressing

- Using scissors to cut over thick lines

- Building pasta towers

2. Personal grooming and sensory stimulation

- Simulating hand washing by playing with the hands in a bowl filled with couscous

- Toilet training – step-by-step education on using the toilet, modifying the environment to facilitate access to the toilet, sink, soap, towel

- Preparing for bedtime – step-by-step education: tooth brushing, putting on the pajamas, making the bed

Week 3

1. Coordination, perception and memory development

- Using card boxes – fitting animal flashcards into their corresponding spaces

- Using post boxes – fitting sticks in different shapes into their corresponding spaces

- Fitting geometrical shapes into their corresponding color-coded spaces

2. Graphomotricity

- Drawing lines using various models

Week 4

- 1. Coordination, precision, grip and aesthetic development*

- Playing the Fruit Basket game – gluing various fruit shapes to a board
- Playing the Farm Animals game – gluing various animal shapes to a specially designed board
- Doing a simple two-piece jigsaw puzzle – putting the pieces of the puzzle together as per a given image
- Playing the Tooth game – gluing pieces of cotton to a board in the shape of a tooth

2. *Development of skills necessary for table setting and chores*

- Playing with a specially designed tableware board – fitting tableware items into the corresponding spaces according to their shape
- Rolling the carpet
- Slicing fruit using plastic knives and making fruit salad

Week 5

1. *Bimanual coordination and fine grip development*

- Playing with themed beads, such as animal or flower beads, and laying them out in their corresponding spaces
- Making necklaces and bracelets out of beads
- Modeling clay figures
- Playing with Lego games – building towers
- Playing the Egg Carton game – placing cotton/clay balls in the color-coded egg carton

2. *Development of cooperation and participation in group/team games*

- Playing the Couscous Box game – hiding objects inside the box for the others to find
- Doing puzzles in groups
- Drawing/painting in groups

Week 6

1. *Writing re-education and correct desk positioning while writing*

- Using a correct pencil grip
- Modifying objects to facilitate use (e.g. replacing thick pencils with thin ones)
- Developing and maintaining a correct position and posture at the desk (i.e. hands on the desk, holding the paper with one hand while writing)

2. *Sensory education*

- Hand-fishing for rubber fish in a bowl containing hydrophilic balls
- Fishing for objects in a bowl filled with rice
- Exploring new sensations – playing with sensory

balls, touching and bubble wraps, walking on fluffy carpets and cold/hot tiles barefoot

c) *Tests applied*

The motor skills and daily activities of children with Down’s syndrome were assessed using three motor tests and one ADL test, as follows: the hand dexterity test (HDT) to assess the motor control of their hands, the finger dexterity test (FDT) to assess their fine motor skills in both hands, Ozeretski’s dynamic coordination of hands test (DCHT) to assess their dynamic coordination in both hands, and the Waisman Activities of Daily Living (W-ADL) scale to assess the level of independence in performing activities of daily living. The tests were performed on days 1 and 42 of treatment by the same person.

The participants in the study were assessed in multiple stages. The participation of their caregivers was necessary. Parental consent was obtained to access the children’s data and carry out the therapy sessions.

d) *Statistical processing*

The statistical analysis performed in this study aimed to highlight the statistically relevant differences between the results obtained upon assessment before and after the application of the occupational therapy program.

The results were compared using the paired two sample for means T-test to assess the same group of subjects on days 1 and 42 of treatment, and introduced in the Microsoft Excel 2007 spreadsheet program. The significance levels were measured at 95% and 99%.

Results

The rehabilitation protocol was followed by a new set of assessment tests upon completion. The results are indicated in Table III.

Upon quantification, on day 42 of treatment, the W-ADL test indicated an increase in the average value by 1.8, whereas the DCHT indicated a decrease in execution times by 2.8 seconds using the right hand and 2.9 seconds using the left hand. The FDT indicated a decrease in execution times by 17.2 seconds using the right hand and 11.8 seconds using the left hand. Finally, the HDT indicated an increase in the number of transferred cubes by 10.6. The results were compared to those obtained on day 1 of treatment.

The results obtained upon performing the T-test are described in Table IV.

Table III
Results at a glance after 42 days

Patient	Day of treatment	W-ADL points	DCHT		FDT		HDT
			Seconds (s)		Seconds (s)		No. of cubes
			Left hand	Right hand	Left hand	Right hand	Both hands
1	1	20p	25.5s	18.5 s	120s	100s	35 cubes
	42	22p	22s	17s	100s	85s	40 cubes
2	1	21p	28.5s	24.5s	160s	149s	25 cubes
	42	23p	24.5s	22s	145s	130s	30 cubes
3	1	22p	24.5s	21s	113s	77s	38 cubes
	42	25p	21.5s	18s	105s	55s	48 cubes
4	1	20p	21.5s	20.5s	120s	100s	36 cubes
	42	21p	19.5s	18s	112s	80s	44 cubes
5	1	21p	28s	25s	140s	120s	24 cubes
	42	22p	25.5s	22s	132s	110s	29 cubes

Tabel IV

Significance for W-ADL, DCHT, FDT and HDT					
W-ADL	DCHT		FDT		HDT
	Left hand	Right hand	Left hand	Right hand	
0.03	0.006	0.003	0.01	0.006	0.01

Discussion

Development is a dynamic process involving the child's gradual transition from dependence on others to physical, social, psychological maturity in teenage years. The interaction with the family members or guardian plays a particular role in this dynamic process. Therefore, the child's performance must not be regarded in an isolated manner (***, 2013). Thus, an early development of relationships and interaction with others plays a significantly positive role in their formation and thus, uniform development (Ferreira-Vasquez & Lamônica, 2015).

Due to their limited participation, the primary focus is the use of their habitual motor skills (i.e. motor skills related to the activities of daily living) in the home, school and public environments. Motor limitations as well as communication limitations affect their quality of life and thus, their socio-cultural integration, causing a low level of self-esteem in the future adults (Jackson et al., 2004; Dolva et al., 2004). The difficulties encountered throughout the application of the rehabilitation program were related to the level of engagement due to a rapid loss of interest.

The children showed a high level of interest in gluing activities, sensory games, table setting and household activities.

Female participants preferred sequencing activities, as well as bracelet or necklace making, whereas male participants showed particular interest in the Farm Animals gluing game, as well as memory and perception development games.

The limitations of the study were the reduced number of participants and the subjective data reporting and filling out of the Waisman questionnaire by their parents. The relatively short time span and the absence of a reference group can also be regarded as limiting factors.

Conclusions

1. The present study focuses on the role of occupational therapy in children with Down's syndrome aged 5 to 11 years. The study group consisted of 60% female and 40% male participants.

2. The results obtained were positive and indicated modifications in all the assessed areas (finger dexterity, hand dexterity, dynamic coordination of the hands and ADL performance) between days 1 and 42 of treatment. The statistical data analysis revealed significance levels of 95% for $p < 0.05$ and 99% for $p < 0.01$.

3. Research must be conducted over a minimum period of 6 weeks in order to obtain uniform results. In addition, it must focus on the specific effects of occupational therapy and be conducted on samples consisting of larger numbers of participants.

4. Multidisciplinary involvement and family interaction play an essential role in the achievement of objectives within a therapy program.

5. The achievement of objectives is facilitated by focusing on simple short tasks and continuity of therapy.

Conflicts of interest

There were no conflicts of interest to declare. Parental consent was obtained to carry out the activities and publish the research data collected.

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