Ovidius University Annals, Series Physical Education and Sport / SCIENCE, MOVEMENT AND HEALTH
Vol. XVIII, ISSUE 2 Supplement, 2018, Romania
The journal is indexed in: Ebsco, SPORTDiscus, INDEX COPERNICUS JOURNAL MASTER LIST,
DOAJ DIRECTORY OF OPEN ACCES JOURNALS, Caby, Gale Cengage Learning, Cabell's Directories

Science, Movement and Health, Vol. XVIII, ISSUE 2 Supplement, 2018
September 2018, 18 (2 supplement): 414 - 421
Original article

USING KINESIOTHERAPY PROGRAMS IN CHILDREN WITH DOWN SYNDROME

TIMNEA OLIVIA CARMEN[1], POTOP LARISA[2], TIMNEA ANDREEA CONSUELA[3]

Abstract

Objective. This paper is meant to highlight the influence of the kinesiotherapy programs on the children with Down syndrome.

Methods. The studies and the kinesiotherapeutic treatment were performed in the General Directorate for Social Assistance and Child Protection of Bucharest during the period 2014-2015 and in the „Lokomat" Recovery Centre of Bucharest from 2015 to 2016. Research methods: bibliographic study of the specialized literature, pedagogic observation, case study, method of tests. The subjects were two children of preschool and school age, diagnosed with Down syndrome. The 1st clinical case is a 9-year-old girl with the general intellectual development as follows: mental retardation, Q.I. = 54 and Down syndrome. The kinesiotherapy programs were developed after making the articular and muscular clinical testing which included: articular assessment (articular laxity is specific to children with Down syndrome); muscular assessment (muscle hypotonicity is one of the characteristics of the children with Down syndrome); assessment of the alignment and body correct posture; assessment of the walk; global assessment. The 2nd clinical case is a 7-year-old boy with the general intellectual development: severe intellectual disability with Down syndrome. This child with Down syndrome received a Pediasuit intensive recovery treatment, also known as Polish Suit, Therapy Suit, Penguin Suit or Adeli Suit.

Results. The results of the research demonstrate that the social, emotional, cognitive, communication abilities and the motor skills as well are practiced during the programs of kinesiotherapy. It was also proven that the intense physical exercises led to the diminution of the aggressiveness and self-aggressiveness, of the hyperkinetic behavior and the stereotypies in autistic children. The movement abilities of the children with Down syndrome are delayed rather than different, because these children make progress in the rhythm of their general development. Most of them succeed to get satisfactory results regarding the rough motor skills, balance inclusively, a little slower than the normal children.

Conclusions. Nevertheless, despite the increased mobility of the ligaments and a possible hypotonia, it was not proven that these kids have a weaker control over this type of movements because the central nervous system controls all the movements and compensates such impairments.

Key Words: children, kinesiotherapy, Down syndrome, programs.

Introduction

The term „Kinesiology "– introduced by Dally in 1857– defines the science that deals with the living organisms and studies the neuro-muscular and articular mechanisms that ensure human normal motor activity. „ Medical kinesiology" – the object of study of the physical medicine – includes three components: prophylactic, therapeutical and rehabilitation one. The methods used by the kinesiotherapy are: heat, electric currents, movement, massage and water (Sbenghe, 1987; Cordun, 1999).

The kinesiotherapy is defined as therapy by movement, achieved through rehabilitation programs intended to recover the diminished functions or to rehabilitate the functions of the organs after certain disorders (Sbenghe, 1987).

Down syndrome is a disorder consisting in multiple congenital anomalies caused by the supplementary chromosome 21 (about 93% of the cases). It is a chromosome abnormality (a disorder from birth, present in the child since the conception) There are 3 different types of Down syndrome: Trisomy 21 standard, Translocation and Mosaicism. The predominant element is the mental handicap: the intellectual level can range from severe retardation up to average retardation (Dyke, Leonard, Bourke, et al, 2007; Vimercati, 2014).

Unlike the normal kids, who have different physical characteristics, many children with Down syndrome have similar physical characteristics specific to this disorder (more than 80% of the cases).

Kinesiotherapy (or the movement therapy) has developed over centuries on the basis of the mutual relationship of practice and observation. Children

[1] Faculty of Physical Education, Sport and Kinesiotherapy, Romanian-American University; Bucharest, Romania;
[2] PhD. Student, State University of Physical Education and Sport, Chişinău, Moldova
[3] Chiajna Medical Center, Ilfov, Romania,
Email: oliviatimnea@yahoo.com, potop.larisa@yahoo.com, consuela.timnea@yahoo.com
* the abstract was published in the 18th I.S.C. "Perspectives in Physical Education and Sport" - Ovidius University of Constanta, May 17-19, 2018, Romania
Received 10 march 2018 / Accepted 5 may 2018

Ovidius University Annals, Series Physical Education and Sport / SCIENCE, MOVEMENT AND HEALTH
Vol. XVIII, ISSUE 2 Supplement, 2018, Romania
The journal is indexed in: Ebsco, SPORTDiscus, INDEX COPERNICUS JOURNAL MASTER LIST,
DOAJ DIRECTORY OF OPEN ACCES JOURNALS, Caby, Gale Cengage Learning, Cabell's Directories

with Down syndrome (DS) have a particular level of motor development, because they have a delay in reaching the somatic patterns. When determining the work program for each child separately, it is necessary to take into account all contraindications correlated with the health status of this one (Almeida, Moreira, Tempski, 2013).

The main purpose of the paper is to reveal the influence of the kinesiotherapy programs in the children with Down syndrome.

Hypothesis of the paper: We believe that the muscular-articular clinical testing of the children with Down syndrome will contribute to the efficient elaboration of the individualized kinesiotherapeutic programs and will highlight the influence of these ones on the motor, emotional, cognitive, communication and social skills.

Methods

The studies and the kinesiotherapy treatment were conducted in the General Directorate of Social Assistance and Child Protection, Bucharest from 2014 to 2015 and in „Lokomat" Rehabilitation Center of Bucharest respectively, during the period 2015-2016. The subjects are two children of preschool and school age, diagnosed with Down syndrome (a 9-year-old girl and a 7-year-old boy).

Subject no. 1, R.M has the following psycho-pedagogical data regarding the general intellectual development: psychic retardation, Q.I. = 54 and Down Syndrome; in terms of school performances: sufficient; writing - reading: good; mathematics: sufficient. Interests and preferences related to school activities: Romanian, Geography, ludic activities; regarding the development of personal autonomy and self-service skills: good; temperamental, motivational and affective-emotional structure: apathetic temperament, low-spirited and lacking of self-confidence; affective-emotional development: under the level of the chronological age. Social integration into family: she belongs to a legally formed family but the father left the family, without keeping connection with wife and child. The girl has very good relationship with her mother. Integration into students group: she is integrated.

Subject no. 2, A.P has the following psycho-pedagogical data regarding the general intellectual development: severe intellectual deficiency and Down syndrome; school performances: poor; writing-reading assimilation: poor; mathematics - calculus: very poor. Regarding the interests and preferences related to school activities: none; development of personal autonomy and self-service skills: poor; temperamental, motivational and affective-emotional structure: apathetic temperament, rigidity, panic attacks and increased susceptibility. Social integration into family: normal relationship with parents and siblings. Integration into students group: he is isolated.

Research methods: bibliographic study of the specialized literature, pedagogic observation, case study, method of tests.

Two individualized kinesiotherapeutic programs were created, depending on the gravity and complexity of the clinical cases.

Program of kinesiotherapy no. 1, for the subject R.M., was performed after the muscular-articular clinical testing which consisted of:

- articular testing (articular laxity specific to children with Down syndrome);
- muscular testing (muscle weakness or hypotonia is one of the specific features of the children with Down syndrome);
- assessment of body correct posture and alignment;
- assessment of the gait;
- global assessment.

Basic objectives of the kinesiotherapeutic program:

- relaxation by passive movements, because it was not always possible to count on child's capacity for concentration, given the psychic retardation ;
- cervical column alignment;
- alignment of thoracic column and scapular belt (shoulders rise and back strengthening);
- alignment of lumbar column and pelvis (diminution of lumbar hyperlordosis);
- alignment of lower limbs.

It should be mentioned that in all situations the child was prevented from doing exercises that overstress the cervico-occipital joint, because this one is very lax and there is the risk of dislocation with dramatic consequences.

In order to increase the muscular strength, some techniques and exercises for strength development were executed as follows:

- isometric exercises;
- dynamic strength exercises;
- other types of exercises (complex exercises, rope games, ball games);
- massage.

For endurance, the methodological principle used was the repetition and the slow increase of the duration of exercises.

For increasing the coordination, control and

balance − the achievement of the motor control had the following basic stages: re-education of the mobility, re-education of the stability, re-education of the controlled mobility, re-education of the abilities.

The exercises were performed in the gym of the Medical Center, five times a week, 2-3 hours/day, for 7 months.

Program of kinesiotherapy no. 2, for the subject A.P.: intensive rehabilitation treatment Pediasuit, also called Polish Suit, Therapy Suit, Penguin Suit, Adeli Suit (Scheeren, Mascarenhas, Chiarello, et al, 2012). The Pediasuit outfit is formed of hood, waistcoat, short, knee pads, device for hands and device for shoes. All elements are interconnected through an adjustable system of elastic cords. The suit operates as an elastic frame that dresses the body without limiting the amplitude of movements and gives the sensation of an additional weight that influences the body within the intended limits and stimulates it to adopt a correct posture for walking. The main goals of Pediasuit: change and improvement (pressure in wrists, ligaments, muscles); diminution of the pathological reflexes and regaining of muscular pathological synergy (correct characteristics of movement).

The vestibular system processes, analyzes and sends back all information received from muscles, joints, tendons etc.; thus it influences the muscular tone, the balance and the body posture. The proprioceptive information given by muscles, ligaments, tendons and joints leads to a correct posture.

Pediasuit Rehabilitation Program

The program of Intensive Care is intended to accelerate the progresses achieved in the neuro-motor and functional skills development of the children with Down syndrome. The system improves the strength, the capacity for passive and active movement and the muscle flexibility. By means of this system, the therapist is able to work with any group of muscles independently; hence the muscle tone (usually increased) does not influence the movement. The costume creates the sensation of a supplementary weight that acts on the body within intended and adjustable limits; thus, during the active exercises performed with the kinesiotherapist, there is an additional permanent passive resistance imposed by the suit.

The quality of gait, balance and movements coordination improves very fast.

The Intensive Care Program had the following structure:

- Warm-up and massage of the profound tissues;
- Diminution of muscle tone and techniques of sensorial integration;
- Reduction of pathological movement models;
- Development of correct movement models;
- Stretching, strengthening of the specific muscle groups in charge with the functional movement;
- Exercises of progressive resistance;
- Training for balance, coordination and endurance;
- Functional activities and training of gait.

The work attendance was 3-5 sessions/per week; effective time of work: 2 hours/session (in the initial stages).

After a working session of 3 to 4 weeks, it is recommended to take a break of 2 weeks at least, enabling the child to recover physically and to stabilize the elements learnt; then the following working scheme will be applied:

Compulsory attendance: 5 sessions/a week;

Working period: 3-4 weeks;

Effective time of work: 3-4 hours/session.

Individualized program depending on the objectives set:

- Thermotherapy (paraffin wraps);
- Segmental massage;
- Stretching;
- Mechanotherapy (activities for balance, coordination, flexibility);
- Functional activities and training of gait.

The cooperation and active participation of the child was extremely important for reaching the intended goals and for maximizing the efficiency of the therapy.

At the beginning of each working session (3-4 weeks) the motor assessment of the child was made by means of a standardized tool called IMFM (Initial Motor Function Measure) and the main objectives of the therapy were determined together with the parents; then the work schedule was established based on these objectives.

The parents received the recommendation to work with the child at home throughout this period, on the basis of the exercises indicated by the therapist at the end of the session and/or to continue the training of the child in a less strenuous rhythm in the Medical Center of Rehabilitation.

Results

The results of the research will try to demonstrate that the social, emotional, cognitive, communication and motor skills in the children with Down syndrome are practiced throughout the kinesiotherapy programs too.

The main goals of the kinesiotherapy treatment (Sbenghe, 1987):

- Re-establishment of the body alignment;

- Gaining and maintaining the articular mobility;
- Preserving or gaining again the muscular strength and endurance;
- Rehabilitation of coordination and balance;
- Re-education of sensitivity;
- Regaining the capacity for effort;
- Creation of the capacity for relaxation.

Benefits noticed regarding the application of the programs:
- Stimulation of the central nervous system;
- Normalization of the muscle tone;
- Alignment of the body as normal as possible;
- Correction of the gait characteristics;
- Influence on the vestibular system;
- Improvement of balance;
- Improvement of coordination;
- Diminution of uncontrolled and hesitating movements;
- Improvement of spatial and body perception;
- Supporting the decreased tone muscles (hypotonia);
- Improvement of speaking and its fluency by controlling the posture of body and trunk;
- Adjustment of gross and fine motor skills;
- Improvement of hip alignment by vertical loading on the hip joints.

Therefore the child with Down syndrome must not be related, under no circumstances, to the biological ages of the children with standard karyotype.

The children with Down syndrome have different personalities, different needs and a different understanding capacity. Thus, only a good knowledge of child's personality and the acceptance of child's best interest, beyond the personal ambitions and intentions of the parents, can offer a feasible solution in this case.

The kinesiotherapy imposes strict rules of application valid for patient and kinesiotherapist as well. The observance of the principle „primum non nocere", namely "first do no harm", is of vital importance. The rule of „no pain" associated with the rule of effort gradation are basic principles in kinesiotherapy.

The kinesiotherapy programs aim at developing the motor skills but also the social, emotional, cognitive and communication skills as well. It was also demonstrated that the intense physical exercises resulted in the diminution of the aggressiveness and self-aggressiveness, of the hyperkinetic behavior and the stereotypies in autistic children.

The motor skills of the children with Down syndrome are rather delayed than different, because these children make progresses consistent with the rhythm of their general development. Most of them succeed to obtain satisfactory results regarding the gross and fine motor skills – balance inclusively – a little later than the normal children.

However, despite the laxity of the ligaments and the possible hypotonia, it was not found out that these children had a poorer control of this type of movements; the reason is that the central nervous system is the one that controls all movements and compensates such deficiencies. It is not yet clear why the mental development is associated with the motor one. One explanation could be that this control of motor skills is an activity that belongs mostly to the central nervous system and therefore the brain functions play an important part in both motor and cognitive development. So the delay is caused by the same differences resulting from the slower processing of the brain. Another explanation could be the capacity to assimilate the patterns learnt.

The two studies of case shown in this paper highlight the irregularities of the results obtained by the children with Down syndrome who need more time to effectively strengthen what they have learnt. The balance, specially, is very difficult to get. This fact is obvious in particular when these children must ride a bicycle: some of them succeed to do this thing, but most of them deal better with a tricycle that does not require such a big effort to keep the balance.

Strength is another problematic element in these children because they are weaker than the other children of same age, even if their mental skills are similar. The explanation could be that everybody increases the muscle strength by physical activity while the children with Down syndrome participate less in physical exercises; therefore it is possible that these children need more exercises for a longer period of time to reach the same strength level as the normal kids.

One can also observe that the children with Down syndrome have a certain clumsiness in movements and gestures, mainly the fine ones and the coordination ones, but after some time they succeed to obtain satisfactory results in this regard as they get to have more and more control of their brain.

Therefore it is very important to find entertaining modalities to encourage these children to invent and practice their own movements consistent with their interests, wishes, inborn qualities, age and also with their mental and physical basic skills.

Discussion

Although a large amount of studies related to Down Syndrome is available worldwide, we focused only on the literature that deal with the subject matter of our research, namely the use of kinesiotherapy

programs meant to improve the life and social integration of the children with Down Syndrome.

Down syndrome is the most common known cause of intellectual disability, accounting for 12-15% of the population with intellectual disabilities in developed countries. The prevalence of Down syndrome varies throughout the world and is modified over time (Dyke, Leonard, Bourke et al, 2007). Down syndrome (or Trisomy 21) is a naturally occurring chromosomal arrangement that has always been a part of the human condition worldwide; like other diseases (cardiologic, pulmonary, hearing, vision etc), this condition entails different neurological development, which results in structural changes and atypical patterns of brain activity (Down Syndrome International; Dierssen, Herault, Estivill, 2009; Vimercati, 2014).

The children with Down syndrome have motor control problems since their birth (such as hypotonia, low joint stability and joint hypermobility) with negative influence on both development of motor control and vestibular system function if early rehabilitation is not performed (Carvalho, Vasconcelos, 2011; Georgescu, Cernea, Bălan, 2016;).

Motor deficiencies in these children are related to the deficits in their automatic postural control system (Shumway-Cook, Woollacott, 1985) and their ability to assimilate and perform motor skills in different environmental contexts (Horvath, Croce, Fallaize, 2016). The studies revealed that the performance in strength and dexterity evaluation was not different in boys and girls (Priosti, Blascovi-Assis, Cymrot, et al, 2013).

Many of the daily challenges faced by persons with Down syndrome are caused by the difficulties existing in their perceptual-motor behavior. These challenges and their behavioral consequences have been the center of multi-disciplined research efforts over the past century (Weeks, Chua, Elliott, 2000).

The specific aspects of development in children with Down syndrome, such as gross and fine motor skills, language, cognitive, social and selfhelp development, especially the motor development in terms of health and medical conditions that could affect this one, must be also taken into consideration (Block, 1991; Zulkefli, 2012).

The early intervention in Down syndrome children provides activities meant to support the evolution of the children with development delays, especially in terms of basic motor skills (Connolly, Mopan, Russell, Fulliton, 1993; Lauteslager, 2005; Crețu, Mara, Mara et al, 2010). The control of the manual skills and sensorimotor deficits in the children with Down syndrome is highly important (Charlton, Ihsen, Lavelle, 2000; Almeida, Marconi, Tortoza, et al, 2000). The effects of early intervention for children with Down syndrome are enhanced by incorporating the new developmental findings into the early intervention programs (Guralnick, 1999).

Children with Down syndrome have delay in both motor and mental age, thus the simultaneous utilization of motor and mental practice through rehabilitation programs is more effective than mere practice (Sourtiji, Hosseini, Soleimani, Hosseini, 2010). The studies reveal the effects of the neurodevelopmental therapy on motor performance of children with Down's syndrome (Harris, 1981).

Monitoring the posture of DS children in relation to a stable visual surround appears to be fundamental to the normal development of motor control (Butterworth, Cicchetti, 1978; Dulaney, Tomporowski, 2000). The place where the testing of Down syndrome children is performed (home or in classroom) is also very important (Dunst, 1981).

As the result of a limited sensory experience, the child with DS has problems in physical, cognitive, and sensory integration, which diminishes his or her functional abilities and creates delays in its development, so physiotherapeutic intervention is needed **(**Almeida, Moreira, Tempski, 2013)

Children with Down syndrome master the basic gross motor skills (from rolling over to running)just as their peers do, but may need additional help and encouragement to maximise development. Therefore, parents and professionals are recommended to practice appropriate activities with DS children and to monitor their progress (Winders, 1997).

The physiotherapy and the massage therapy can also lead to the improvement of the motor functioning and the muscle tone of the children with Down syndrome (Hernandez-Reif, Field, Largie, et al, 2006; Morais, Fiamenghi-Jr, Campos, Blascovi-Assis, 2016).

The environmental and task constraints have a clear effect on the locomotor patterns of individuals with Down syndrome (Mauerberg-de Castro, Angulo-Kinzler, 2000); the relationship between sensory information and motor action in these children can be changed with experience and practice (Polastri, Barela, 2005).

The fine motor skills (FMS) represent the main part of various activities of daily living (ADL). The children with Down syndrome have a lower performance than peers with typical development in all aspects of FMS proficiency. Fine motor performance should be taken into account when evaluating school-aged children with DS, as it is

essential in planning the early rehabilitation programs for them (Maksoud, 2016).

The underlying perceptual-motor competencies that influence motor behavior in Down syndrome must be carefully evaluated (Virji-Babul, Kerns, Zhou, et al, 2006).

The early intervention programs (EIP) help children with Down syndrome to improve their social development, to reach their potential and attend the mainstream schools. Many students with Down syndrome complete their high school studies and go on to post-school training or tertiary education (Connolly, Morgan, Russell, 1984; Dew-Hughes, 1998; Better Health Channel, 1999-2018).

The majority of young people growing up with Down syndrome today will be able to lead quite ordinary normal lives in their community, with varying degrees of support (Down Syndrome Victoria; Down syndrome Australia).

Conclusions

The results of the research demonstrate that the social, emotional, cognitive, communication abilities and the motor skills as well are practised during the programs of kinesiotherapy.

It was also proven that the intense physical exercises led to the diminution of the aggressiveness and self-aggressiveness, of the hyperkinetic behavior and the stereotypies in autistic children.

The movement abilities of the children with Down syndrome are delayed rather than different, because these children make progress in the rhythm of their general development.

Most of them succeed to get satisfactory results regarding the rough motor skills, balance inclusively, a little slower than the normal children.

Nevertheless, despite the increased mobility of the ligaments and a possible hypotonia, it was not proven that these kids have a weaker control over this type of movements because the central nervous system is the one that controls all the movements and counterbalances the impairments.

The clinical muscular-articular tests of the children with Down syndrome contributed to the efficient creation of the individualized kinesiotherapeutic programs and revealed their influence on the motor, emotional, cognitive, communication and social skills.

Acknowledgments

We also express our gratitude to the kinesiotherapist Doni Maxim for acceptance and for the support she offered us in the achievement of this study.

References

Almeida G.L., Marconi N.F., Tortoza C. Ferreira, M.S., Gottlieb, G.L. Corcos, D.M., 2000, Sensorimotor deficits in Down syndrome: implications for facilitating motor performance. In D.J. Weeks, R. Chua & D. Elliott (Eds.) Perceptual-motor behaviour in Down syndrome. (p. 151-174). Champaign, IL: Human Kinetics.

Almeida, M.D., Moreira, M.C.S., Tempski, P.Z., 2013, Physiotherapeutic intervention in the outpatient care of persons with Down syndrome at the Institute of Physical Medicine and Rehabilitation at HC FMUSP, Acta Fisiatr. 2013;20(1):55-62, doi: 10.5935/0104-7795.20130010

Better Health Channel, 1999-2018, Down syndrome and learning, Down Syndrome Victoria, Better Start for Children with Disability. https://www.betterhealth.vic.gov.au/

Block, M.E., 1991, Motor development in children with Down syndrome: a review of the literature. Adapted Physical Quarterly, 8(3):179-209. doi: 10.1123/apaq.8.3.179

Butterworth, G., Cicchetti, D., 1978, Visual calibration of posture in normal and motor retarded Down syndrome infants. Perception, p. 513-525. doi: 10.1068/p070513.

Carvalho, R.L., Vasconcelos, D.A., 2011, Motor Behavior in Down Syndrome: Atypical Sensoriomotor Control, Prenatal Diagnosis and Screening for Down Syndrome, Prof. Subrata Dey (Ed.), pp.33-43, InTech, Available from: http://www.intechopen.com/books/prenatal-diagnosis-andscreening-for-down-syndrome/motor-behavior-in-down-syndrome-atypical-sensoriomotor-control

Charlton, J.L., Ihsen, E., Lavelle, B.M., 2000, Control of manual skills in children with Down syndrome. În D.J. Weeks, R. Chua & D. Elliott (Eds.) Perceptual-motor behaviour in Down syndrome. (p. 25-48). Champaign, IL: Human Kinetics.

Connolly, B.H., Morgan, S., Russell, F.F., 1984, Evaluation of children with Down syndrome who participated in an early intervention programme: second follow up study. Physical Therapy, p. 1515-1519.

Cordun, M., 1999, Medical Kinesiology, Bucharest: AXA Publishing House

Creţu, C., Mara, D., Mara, E.L., Andrei, O., Bologa, L., 2010, Intervenţia timpurie şi abordarea

învățării la copiii cu sindrom down, Acta Medica Transilvanica; 2(4): 150-153.

Dew-Hughes, D., 1998, The social development of children in special schools. Down Syndrome News and Update, 1(1), 16-19. doi:10.3104/case-studies.140

Dierssen, M., Herault, Y., Estivill, X., 2009, Aneuploidy: From a Physiological Mechanism of Variance to Down Syndrome. Physiol Rev 89: 887–920; doi:10.1152/physrev.00032.2007.

Down syndrome International. Improving Life for People with Down Syndrome. https://ds-int.org/down-syndrome

Down syndrome Australia. Research and statistics. https://www.downsyndrome.org.au/down_syndrome.html

Down Syndrome Victoria. http://www.downsyndromevictoria.org.au/

Dulaney, C.L., Tomporowski, P.D., 2000, Attention and cognitive-skill acquisition. În D.J. Weeks, R. Chua & D. Elliott. (Eds.) Perceptual-motor behaviour in Down syndrome, p. 175-198. Champaign, IL: Human Kinetics.

Dunst, C.J., 1981, Test settings and the sensorimotor performance of infants with Down's syndrome. Percept Mot Skills; 53(2):575-8. DOI: 10.2466/pms.1981.53.2.575

Dyke, P., Leonard H., Bourke, J., Bebbington, A., Bower, C., 2007, Down Syndrome Needs Opinions Wishes Study Report. Perth, WA: Telethon Institute for Child Health Research.

Georgescu, M., Cernea, M., Bălan, V., 2016, Postural Control in Down Syndrome Subjects, ICPESK 2015: 5th International Congress of Physical Education, Sports and Kinetotherapy, The European Proceedings of Social & Behavioural Sciences, 11:258-265, http://dx.doi.org/10.15405/epsbs.2016.06.35

Guralnick, M. J. (1999). Developmental and systems linkages in early intervention for children with Down syndrome. In J. A. Rondal J Perera & L Nadel (Eds.). Down syndrome: A review of current knowledge (pp. 51-63). London: C. Whurr.

Harris, S.R., 1981, Effects of neurodevelopmental therapy on motor performance of infants with Down's syndrome. Developmental Medicine and Child Neurology, 23, 477-483.

Hernandez-Reif, M., Field, T., Largie, S., Mora, D., Bornstein, J., Waldman, R., 2006, Children with Down syndrome improved in motor functioning and muscle tone following massage therapy. Journal Early Child Development and Care, 176(3-4):395-410, https://doi.org/10.1080/03004430500105233

Horvat, M., Croce, R., Fallaize, A., 2016, Information Processing and Motor Control in Down Syndrome. J Down Syndr Chr Abnorm 2: 107. doi:10.4172/2472-1115.1000107

Lauteslager, P.E., 2005, Children with Down syndrome – Motor development and intervention, South Publishing House, Craiova.

Mauerberg-de Castro, E., Angulo-Kinzler, R.M., 2000, Locomotor patterns of individuals with Down syndrome: effects of environmental and task constraints. În D.J. Weeks, R. Chua & D. Elliott (Eds.) Perceptual-motor behaviour in Down syndrome. p. 71-98. Champaign, ÎL: Human Kinetics.

Maksoud, G.M.A-E., 2016, Fine Motor Skill Proficiency in Children with and Without Down Syndrome, Journal of Physical Therapy and Health Promotion, 4(1): 43-50, DOI: 10.18005/PTHP0401007

Morais, K.D.W., Fiamenghi-Jr, G.A., Campos, D., Blascovi-Assis, S.M., 2016, Profile of physiotherapy intervention for Down syndrome children, Fisioter. Mov., Curitiba, v. 29, n. 4, p. 693-701, Oct./Dec. 2016, DOI: http://dx.doi.org/10.1590/1980-5918.029.004.AO05

Polastri, PF., Barela, J.A., 2005, Perception-Action Couplingin Infants With Down Syndrome:Effects of Experience and Practice, Adapted physical activity quarterly, Human Kinetics Publishers, Inc. 22, 3-56, DOI: 10.1123/apaq.22.1.39

Priosti, P.A., Blascovi-Assis, S.M., Cymrot, R., Vianna, D.L., Caromano, F.A., 2013, Grip strength and manual dexterity in Down Syndrome children, Fisioter Pesq. 20(3):278-285.

Sbenghe, T., 1987, Prophylactic, Therapeutic and Rehabilitation Kinesiology, Medical Publishing House, Bucharest.

Shumway-Cook, A., Woollacott, M. H. (1985). Dynamics of postural control in child with Down syndrome. Physical Therapy, 65 (9), 1315-1322.

Sourtiji, S.M.S., Hosseini, F., Soleimani, M.D., Hosseini, S.A., 2010, Relationship between Motor and Mental Age in Children with Down Syndrome, Iranian Rehabilitation Journal, 8(1):4-7.

Vimercati, S.L., 2014, Perceptual-motor integration and motor control in Down syndrome. Politecnico di milano, Facoltà di Ingegneria dei Sistemi, Dipartimento di Elettronica, Informazione e Bioingegneria. PhD study.

Virji-Babul, N., Kerns, K., Zhou, E., Kapur, A., Shiffrar, M., 2006, Perceptual-motor deficits in children with Down syndrome: Implications for intervention, Down Syndrome Research and Practice 10(2), 74-82

Weeks, D.J., Chua, R. Elliott, D., 2000, (Eds.) Perceptual-motor behaviour in Down syndrome. Champaign, IL: Human Kinetics.

Winders, P., 1997, Gross Motor Skills in Children with Down Syndrome: A Guide for Parents and Professionals, Woodbine House.

Zulkefli, A.H.B., 2012, Development of children with down syndrome from bith to six years old based on six areas of development. A report submitted in fulfillment of the requirements for the award of the degree of Master of Education (Psychology), Education Faculty Universiti Teknologi Malaysia.