The effect of balance activity on Down syndrome boys

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Abstract

Objective: The aim of the current study was to investigate the effects of sensorimotor integration activities on the static and dynamic balance skills of trainable little boys with Down syndrome.

Materials and Method: In this quasi-experimental study, the purposive and convenience sampling methods were used to select 20 children (aged 8.50±1.60 years old). Then they were randomly divided into the experimental and control groups, each of which had 10 subjects. The modified stork test and the Timed Up and Go test (TUG) were conducted to evaluate the static and dynamic balance skills, respectively. The experimental group received 50 forty-minute training sessions six times a week. In the control group, the subjects used the class training programs. The independent t-tests were carried out to analyze data at 0.05 significance level.

Conclusion: The results indicated that sensorimotor integration activities improved static and dynamic balance skills.

Keywords: Sensorimotor Integration; Static Balance; Dynamic Balance; Down Syndrome

Introduction

Paying full attention to the children, adolescents and youths is one of the important issues and best investments in a society. Nowadays, in all societies, special individuals such as mentally retarded people are taken into particular consideration. Paying careful attention to the physically and mentally disabled people requires considerable investments provided by governments, especially in rehabilitation, education and occupational and vocational trainings [2]. Currently, the number of such individuals, who need special services with respect to their disabilities, is on the rise. Factors like population increase, reduction of mortality, especially in children, and also higher life expectancies have increased the number of the disabled [1], a group of which includes the mentally retarded individuals. According to the epidemiologic information, it is estimated that the prevalence of intellectual disability is around 170 million people in the world. Every year, 200 thousand individuals are added to this number on average. These statistics include almost 3% of the total population of the world, and a large group of them is people with Down syndrome [1].
Down syndrome was first discovered by John Langdon in 1866. Resulting from chromosomal changes, it is the most common genetic disease occurring in one per 800-1000 babies born [13,14]. Trisomy 5 of chromosome 21, which is the most prevalent cause of Down syndrome, results in health and medical complications such as mental, respiratory and heart problems in such individuals [4]. People with Down syndrome have special physiological and anatomic characteristics distinguishing them from normal individuals. In addition to apparel symptoms (on the face), this syndrome is characterized other clinical symptoms such as orthopedic, cardiovascular, neuromuscular, sight, cognitive, and perceptive defects. Several studies indicate that people with Down syndrome have problems in power, balance, visual-motor coordination, and laterality [8,9].

The research results indicate that motor skill development is delayed in such individuals, a fact which makes them acquire the skills at a different time form normal people [8,11]. Some of the main reasons for such disorders include extreme weakness in muscular joints, sensorimotor ability, cerebral hypoplasia, and hypotonia (low muscle tone) [15]. Sensory integration refers to the cerebral ability to receive, recognize, change and use a great deal of sensory information which enters the body and nervous system through external and internal stimuli [12]. Sensorimotor integration is a process resulting from doing activities based on the involvement and participation of different sensorimotor organs [18]. Sensorimotor integration starts from infancy. It is the cornerstone of recognizing senses and learning movements. It appears that the more efficient children are in receiving input stimuli, the more able they will be in understanding. Some of the progresses of children in motor skills can be attributed to the development and growth of their senses and perception. They can gradually select perceptive information better and organize it and integrate it after processing. They can coordinate it with their increasing experiences of motor skills; therefore, they can make progress. The result will be the better implementation of motor skills. A large part of this progress in perceptive performance occurs in the early childhood. Then it will be intangibly refined in the late childhood and adolescence [19].

The deficits of integration and sensory processing are one of the important factors in motor problems of such children. In other words, the sensory performance is disrupted in one or more sensory systems. A sensory overload occurs when one or more stimuli enter a child’s sensory system, and the individual is unable to process or prevent them from entering. Children’s cerebral performances becomes irregular due to sensory overload and respond with natural reactions [12]. The sensory integration approach can improve motor development through improving the performance of central nervous system in processing and integrating information. Kepart believed that learning deficiencies caused by the lack of integration of current sensory stimuli with the stored information was related with past stimuli. Sensory integration is an important phase in the process of motor perception. Kepart suggested that the development of perception and recognition had a motor base, insofar as the child had to reach the motor generalization phase to achieve full intelligence development. Kepart emphasized extensions of stature and balance, lateralization, transfer movements, confrontation, reception and progress, and mental image. He considered seven phases for growth which would present more increasingly performances regarding the strategies of information process. A child who does not learn these phases completely and orderly will face deficits in the next perceptions at higher levels. To Kepart, normal children would pass these phases orderly; however, a child learns slowly or does not make any progress through these phases and their orders or is obviously retarded, a child who has not experienced a phase completely, must go back to that phase through exercise and pass other phases orderly. Therefore, children who are mentally retarded must gain complementary experiences to facilitate their growth. Slow-
learning individuals are those who did not pass the phases of growth in a particular time framework and order. These children’s skills might be recovered and modified by returning to previous phases and exercising missing sensorimotor activities [20].

Balance is a sample motor reaction which depends on the integration of received stimuli from visual and sensorimotor systems. It develops in childhood, adolescence and youth. Balance or stability has been defined as the status of keeping balance between mutual forces. Balance is almost an important component in all motor skills. It is mostly called postural control. Postural control is the ability to maintain balance in a gravity field through staying on or returning to body’s gravity center which is put outside its backrest [20]. With the help of current emphasis on demographic considerations and Burton and dynamic systems, Burton and Davis has recently mentioned that balance is not only a state, skill or ability, but it is also more an aspect of a special activity including various processes. These processes make the orientation of body possible to do the current practical activity. Balance is generally divided into two types: static balance and dynamic balance. Static balance is the ability to maintain position or desirable physical stature at a time when body is on the move. Both static and dynamic balance are used in many motor activities. Tendons and joints are among the elements pertaining to the sensorimotor system, the vestibular apparatus in the inner ear, and sensory receptors in the muscles of head and neck. The senses received by these receptors and visual information provide information which is very important for balance [18].

Balance is different for the implementation of each specific motor skill in various positions (like when you are moving or standing, being in the air or on the ground, your eyes are open or closed, or leaning on one leg, both legs, or other organs, and so on). Therefore, it is important that children gain different and various experiences pertaining to balance. They should experience different balance activities and movements (whether in movement or a still position) or when they are climbing sports devices and staying at different levels and maintain their positions on balance while their eyes are closed on open [21].

Balance problems in children with Down syndrome make them extend their stability range while sitting, standing and walking. Such children also have delays in postural balance and the age they acquire it [4]. The factors influencing the reduction of balance in people with Down syndrome include hypotonia, weakness in muscular power, the small size of the cerebellum and brainstem. Deficit in muscular power reduce balance while standing; therefore, it increases the chance of falling [16].

Tavakol et al. (2013) investigated the effect of one jogging course on the static and dynamic balances in children with Down syndrome. The modified stork test was used to evaluate the static balance, whereas the heel-toe walking test was conducted to assess the dynamic test. The control and experimental groups, including 12 subjects each with Down syndrome, participated in this study. The experimental group received twelve 45-minute sessions of jogging on a treadmill as the training protocol. The results indicated there was a significance difference between the static and dynamic balances of the control and experimental groups before and after training [1]. The muscular power of lower limb was 50% weaker in such children in comparison with other children with mental disorders. Therefore, it is necessary to maintain the muscular power at a desirable level in such children [16]. Kashi et al. (2012) also investigated the effect of a selective training course on the motor perceptive and physical abilities of individuals with Down syndrome. Bruininks Osersky Test of Motor Proficiency (BOTMP) subscales were used to measure the balance. The research results indicated that the implementation of 12 weeks of selective training programs had a significant impact on the static and dynamic balances in the experimental group [3].
Balance is one of the abilities in individuals with Down syndrome which has the highest number of disorders. For instance, there are few individuals, affected by this syndrome, who can maintain balance on one foot for only a few seconds. With eyes closed, almost no one can maintain balance on one foot for a few seconds. Nevertheless, the results of some studies indicated that individuals with Down syndrome could find the ability to improve balance by participating in systematic and good training programs in comparison with other groups of mentally retarded [17]. Carmeli et al. (2002) investigated the effect of a six-month program on walking on treadmill upon the muscular power and balance of old people with Down syndrome. The aim of that study was to compare the relationship of the isokinetic leg strength and dynamic balance with age in 16 individuals with Down syndrome averagely aged 63 years old and 10 individuals with Down syndrome in the control group. After six months of training on treadmill, the dynamic balance and isokinetic leg strength of knee indicated a significant increase in the flexion and extension statuses of old individuals. After one training course on treadmill, the strength and balance improved significantly as individual with Down syndrome aged [9].

The process of sensory integration results from doing rehabilitation and sports activities, although it may not be among the primary objectives of therapy and training. Therefore, with regular and targeted trainings, improvements can be observed in the motor skills of such children. Moreover, the majority of experts believe that physical education programs should have integrated structures for children with perceptive-motor deficits and should be appropriate with their needs and problems [22]. One of the problems of the disabled is obesity which can be prevented by doing sports activities. The poor motor performance and physical readiness resulting from the lack of continuous exercises would decrease their self-esteem and participation. In addition, reduced participation would lead to the weak motor performance and physical readiness [20]. Sport develops and improves circulatory and respiratory systems, strengthens muscles, increases the capacity of muscular performance, increases flexibility of joints, and extends the movements of joints. On the other hand, it leads to perceptive-motor growth and development including improvement in the speed of daily movements, increased balance, control, orientation, and coordination between different parts of the body [23]. Therefore, experts and the members of the rehabilitation group considered the training method of motor skills to be the appropriate and effective method to treat such disorders. They also believe that this method can serve as bases to improve the great cerebral performance and improve motor and cognitive movements in the disabled children and adolescents [22].

Although paying attention to physical readiness is the base for the improvement of health among the mentally retarded individuals, few studies have been domestically conducted to investigate these factors and their relationships with each other, especially by sports sciences experts. The majority of studies were on intelligence, social issues and cognitive areas of such individuals. Nonetheless, presenting any type of health program depends directly on the identification of physical talents among these people. Perhaps, the diversification of this special population and difficulties pertaining to data collection from the intellectually disabled, especially patients with Down syndrome, are the main reasons why few studies have been conducted in this regard. Therefore, the aim of the current study is to investigate the effect of sensorimotor integration of the static and dynamic balances of trainable little boys with Down syndrome.

**Materials and Methods**

**Statistical Population and Sample**

This is a quasi-experimental study with pretest and posttest conducted on two groups (experimental and control). The participants
were 20 trainable children with Down syndrome aged 8.50±1.60 years old. Their average IQ was 43.50±7.83. The purposive and convenience sampling method was used to select them from the little boys with Down syndrome. After running the pretest, they were randomly divided into the control and experimental groups, each of which had 10 subjects.

Research Devices and Tools:
1-Demographics Questionnaire
2-The Modified Stork Test: This test was used to evaluate the static balance (r=0.87).
3-The Timed get Up and Go Test: TUG test was used to evaluate the dynamic balance.

Methodology

Getting a permit from Shahre Rey 2nd District Ministry of education and taking parents and the school managers’ consents, the demographics such as height, weight, age, IQ and medical records (checking any type of orthopedic disease or complication influencing the research results) were collected from children’s medical documents. Then fifty 45-minute sessions of sensorimotor integration group trainings (imitating the instructor’s moves and to match with the group along with signing childish chants) were held as the sports time at the same school.

Some of the activities were as follows: rope playing, walking on footsteps or on the powders on the ground with bare feet, turning in different directions or on a path with barricades and in different positions, marching towards a moving target, moving in different positions on limbs (such as crawling, moving on buttocks, wagging, commando crawling, hopping, and moving on hands or knees at different speeds), jumping on mattresses, tumbling on a specific path, wiltering in different positions (with arms stretched over the head, with arms stretched over the head and holding a bag of beans, holding a pillow between ankles, or putting a paper bag or a pillowcase on the head), jumping up and down or moving forward and backward in different positions on a CP ball (even putting the ball on the mattress when the child is highly balanced), train game, pushing the bag of beans on a specific path on the ground with feet or hands, and throwing the ball between their legs (while standing, lying on the back, or even in a plate next to the subject, and also grabbing the ball with hands after throwing it). Other activities included being placed on a blanket in different positions and lifting the blanket and swaying the child, sitting on a carton which is pulled by another child, two children standing or sitting next in front of each other with their hands embracing each other to push each other and try to maintain the balance, hitting a ball pending in the air with stretched arms or legs, walking with feet covered in sacks or legs attached to each other, crawling inside cartons or big cylinders in different positions, carrying a small rather heavy bucket, sliding and climbing a slope in different positions, and tugging competition in two groups of children [12,18].

Statistical Method

The descriptive statistics were used to calculated mean and standard deviation. The independent t-test was used to determent intragroup and intergroup differences between pretest and posttest at 0.05 significance level. SPSS 19 was employed to analyze data (0.05).

Research Findings and Results

The research results indicated that static balance (p<0.028) and dynamic balance (p<0.001) were significantly increased in the experimental group in comparison with the control group. However, there was no significant differences between two groups in terms of pretest in the static balance (p<0.0872) and dynamic balance (p<0.901) (Table 1).
Table 1: The Results of the Independent t-test for Static and Dynamic Balances in Control and Experimental Groups (mean±SD).

| Variable         | Group       | Pretest  | Sing   | Posttest | Sing   |
|------------------|-------------|----------|--------|----------|--------|
| Static Balance   | Experimental| 6.2±2.79 | 0.0872 | 9.7±3.49 | 0.028* |
|                  | Control     | 6.00±249 |        | 6.3±2.89 |        |
| Dynamic Balance  | Experimental| 4.70±1.56| 0.901  | 7.90±1.59| 0.001* |
|                  | Control     | 4.60±1.95|        | 4.80±1.75|        |

**Discussion and Conclusion**

Generally, the aim of this study was to investigate the effect of one course of sensorimotor integration activities on the improvement of static and dynamic balances of children with Down syndrome in Shahre Rey 2nd District. The results indicated that sensorimotor integration activities improved children’s static and dynamic balances. Moreover, the effect of these activities was greater on the improvement of balance in comparison with ordinary activities. The research results were consistent with the research findings by Tavakol (2013), Krishna (2012), Carmeli (2002), and Kashi et al. (2012) [3,9,1,25]. Since the subjects were selected from Shahre Rey 2nd District, the geographical location, family environment and training chances were controlled by discussions with families. Therefore, it can be stated that the influential factor is to create training opportunities by providing three factors of time, facilities and appropriate equipment for the experimental group. The majority of the debilitated children are deprived of many childish games influencing basic motor skills due to ethnic, cultural and religious problems in the society. Instead, they are encouraged to do activities which have no results other than motor deprivation. Another problem is the children themselves because it is difficult for them to learn the rules of childish games. Sensorimotor integration skills provide these children with necessary time to participate in the favorite games with their peers [26].

Another important factor in the creation of training opportunity is appropriate equipment. The lack of proper environments of games and the need to be accompanied by adults for the participation of debilitated children in such places and the lack of recreational courses for trainable groups with Down syndrome are among the factors preventing them from developing their motor skills [26]. On the other hand, appropriate sports devices are usually expensive, and all families cannot buy them. It appears that these activities have provided children with richer opportunities to gain motor experiences, an opportunity which parents were not able to create. Such an opportunity cannot be acquired in centers, either, because programs are not purposive and regular [21]. It appears that the quality of trainings provided for the experimental group was the important factor in their superiority over the control group [12,21].

Variety of programs and motivation were other important factors of the quality of training. The selective training program was based on a game which would encourage the subject to participate on the one hand. It is different day by day, on the other hand, and makes the subject willing to take part in the program [7]. Moreover, the integration activities would encourage the children to participate in the exercises more willingly due to the variety of movements and attractions. Selective training activities include many series of skills, and the content of these programs is consistent with basic motor skills very well [18]. There is a variety of basic motor skills in different parts of such programs in which the child can participate and practice all basic motor skills every day. This makes the experimental group have more acceptable developments in all basic skills in comparison with the control group.
which participated only in the class training programs including limited activities. Given the fact that the control group also participated in the training program, it can be stated that considering purposive and directed games can lead to better results and higher scores in the posttest for the selective training programs. As mentioned earlier, motivation is among the very important environmental factors influencing basic motor skills. Game is a very important motivational factor for children. It makes them participate in the games more willingly. In fact, the compulsory factor is lifted from them and it is replaced with willingness and motivation.

The ecological perspective also puts much emphasis on the mutual relationships between the environment and an individual. There are two different mindsets in this perspective, one of which concentrates on perception, and the other focuses on motor control and coordination. These two mindsets of motor development result from many systems. It is not just attributed to the central nervous system. This is against mature perspective which considers the central nervous system responsible for movement. It believes that the growth and maturity factor influences the development of motor skills. It is also against the perspective information process in which only one factor makes decisions for all movements [20]. Suratchi et al. (2007) investigated the impact of sensory integration treatment on big and subtle motor skills of children with Down syndrome between 5 and 7 years old. They indicated that sensory integration treatment would improve big and subtle motor skills in the subjects [26].

Abdurrahman et al. also studied the effects of weight-bearing exercises on the balance of children with Down syndrome. Their results were consistent with the current study. Decreased muscular power and joint looseness are common phenomena in individuals with Down syndrome [6]. Due to the performance of some factors such as the number of muscular fibers or a lower percentage of fibers and contraction in patients with Down syndrome, strength is weaker than normal people and the mentally retarded individuals without Down syndrome [27]. This muscular weakness in lower limbs and lack of balance while standing will increase the chance of falling in such individuals. In several studies, the positive impact of walking programs on increasing the strength, muscular stamina and balance were observed in old people with Down syndrome. Improvement in strength and balance after the walking program can have a positive impact on increasing self-confidence and decreasing or slowing down the process of diseases pertaining to age, reducing the chance of falling and encouraging the patients with Down syndrome to participate in social and recreational activities [5].

Uyanik, Bumin and Kayhan (2003) compared the effectiveness of sensory integration treatment methods and the mixture of sensory integration therapy with vestibular stimulation and treatment of nerve growth on children with Down syndrome aged between 7 and 10 years old. The effectiveness of all three programs were confirmed and the results of treatment were confirmed in three programs. The therapy results were not significantly different in three therapy groups. However, there was a significant improvement in relation with subtests pertaining to sensory integration and subtle motor skills in the therapy group [28]. In a meta-analysis, Vargas and Comili (1999) reported that the studies pertaining to sensory integration treatment, conducted from 1972 until 1997, had better motor, mental and educational results in comparison with other areas [29]. Sayadinejad et al. (2013) investigated the effects of progressive resistance trainings on the functional balance of trainable children with Down syndrome and indicated the effectiveness of such activities on isometric balance, performance and muscular strengths of such children [3]. Jankowicz, Mikolajczyk and Wojtanowski (2012) investigated the effect of physical trainings on the static balance of adolescents with Down syndrome and weak intellectual disability. They found out that the experimental group was
significantly more active than the control group in maintaining the balance after doing the activities [31]. Therefore, given the importance of balance in daily activities and acquiring other skills and also the positive effect of different physical programs in balance improvement, necessary measures should be taken to treat balance problems in such individuals. Moreover, improving balance skills through designing and implementing training programs for children with Down syndrome by sports teachers and instructors can be emphasized especially at younger ages when their motor patterns are getting formed. Therefore, the use of such activities can be advised as a method for improving static and dynamic balances in children with Down syndrome. In addition, the quality of designing and implementing such protocols meant to improve the balance should be taken into account with respect to the intelligence level, abilities and limitations of children with Down syndrome. The comparative evaluation of its effect on the improvement of daily motor activities and sports skills require more research works in future.

References

1. Tavakol R, Hojjat Sh, Kohande M. 2013. The impact of a jogging training course on the static and dynamic balances of children with Down syndrome. Special Children Quarterly. 12: 56.
2. Kashi A, Sheikh M, Dadkha A. 2013. Rehabilitation in Down syndrome with an approach to physical activity. University of Social Welfare and Rehabilitation Sciences Press. Arshia Publications. 1: 33.
3. Kashi A, Sheikh, M, Dadkhah A, et al. 2013. The effect of one selective training course on the improvement of physical and mental-motor skills in individuals with Down syndrome. Doctoral Dissertation in Physical Education, University of Tehran, Faculty of Physical Education. 140.
4. Moradi Y. 2012. The effects of eight weeks of training in water on the balance performances of men unilateral lower limb amputation. Master’s Thesis. Razi University of Kermanshah. 57-64.
5. Arshadi R, Rajabi R, Alizadeh M. 2010. Investigating the relationship between flexibility of spines and the amount of kyphosis and lordosis. Journal of Sports Sciences Research. 15: 123-132.
6. Abdel Rahman S. Efficacy of virtual reality-based therapy on balance in children with Down syndrome. World Applied Sciences Journal. 10: 254-261. Ref.: https://bit.ly/33FhJC3
7. Asgari T. 2007. The effect of interrater and intrarater reliability of berg balance scale in balance evaluation of children with spastic cerebral palsy. Thesis of MSc in Tehran University of Medical Sciences. 35.
8. Cabeza Ruiz R, Garcia Masso X, Centeno Prada RA, et al. 2011. Time and frequency analysis of the static balance in young adults with Down syndrome. Gait and Posture. 33: 23-28. Ref.: https://bit.ly/35LdM0s
9. Carmeli E, Kessel S, Coleman R, et al. 2001. Effects of a treadmill walking program on muscle strength and balance in elderly people with Down syndrome. The Journals of Gerontology. 57: 106-110. Ref.: https://bit.ly/2J02HvY
10. Connolly H, Michael BT. 1986. Performance of retarded children, with and without Down’s syndrome, on the Bruininks Oseretsky Test of Motor Proficiency. Physical Therapy. 66: 344-344. Ref.: https://bit.ly/2nU7tGQ
11. Frith U, Frith CD. 1974. Specific motor disabilities in Down’s syndrome. J Child Psychol Psychiatry. 15: 292-301. Ref.: https://bit.ly/33GfJky
12. Cheatum BA, Hammond A. 2011. Physical activity for learning and behavior of children. Sharifiazar K, Saadatmand A, Morad AH (Persian translator). First edition. Azad University Publication. 17-65.
13. Melissa A, Davidson MD. 2008. Primary care for children and adolescents with Down syndrome., J of Pediatr Clin N AM. 1099-1111. Ref.: https://bit.ly/35NZscC
14. Meneghetti CHZ, Blascovi- Assis SM, Deloroso FT, et al. 2009. Static balance
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assessments among children and adolescents with Down syndrome. Rev Bras Fisioter. 13: 230-235. Ref.: https://bit.ly/2BljKHF
15. Polastri PF, Barela JA. 2005. Perception-action coupling in infants with Down syndrome. Effects of experience and practice. Adapt Phys Act. 22: 39-58. Ref.: https://bit.ly/2J031xG
16. Shields N, Taylor NF. 2010. A student-led progressive resistance training program increases lower limb muscle strength in adolescents with Down syndrome. Journal of a randomised controlled trial. 56: 187-193. Ref.: https://bit.ly/31ptn2n
17. Tsimara S, Vassilios K, Eleni G, et al. 2004. Effect of training on the muscle strength and dynamic balance ability of adults with Down syndrome. The Journal of Strength & Conditioning Research. 18: 343-347. Ref.: https://bit.ly/2Bk09ra
18. Fink B. 2004. Sensory-motor integration activities. Raghfar, M. (Persian translator). Tehran. Teymorzadeh & Tabib Publications. 1-227.
19. Kantha T, Boonchai P, Krairach T. 2012. Isan folk game conservation for fine-motor skills development in pre-school children. American Journal of Scientific Research. 53: 5-14.
20. Payne V, Esax L. 2005. Human motor development. Khalaj H, Khajavi D. (Persian translator). Arak University Publication. 132-152.
21. Haywood K. 2008. Life span motor development. Namazizadeh, M., Aslankhany, M. (Persian translators). Ninth edition. Tehran. Samt Publication. 306-367.
22. Davarmanesh A, Baratysadeh F. [Precedent of handicaps rehabilitation principles (Persian)]. First edition. Tehran. Roshd publication 2006; p:169-181.
23. Helm Seresht P, Delpisheh E. 2007. Handicaps and principles of rehabilitation. First edition. Tehran: Chehr Publication. 49-67.
24. Bhamini Krishna R, Kumaran SD. 2011. Effect of strength and balance training in children with down syndrome. Journal of A Randomised controlled trial. Clin Rehabil. 25: 425-432. Ref.: https://bit.ly/2MsifKG
25. Kantha T, Boonchai P, Krairach T. 2012. Isan folk game conservation for fine-motor skills development in pre-school children. American Journal of Scientific Research. 53: 5-14.
26. Soratchi H, Sazmand AH, Karbalalai Nori A, et al. 2006. The effect of sensory integration in gross & fine motor skills children 5-7 years with down syndrome (Persian). Journal of Rehabilitation. 9: 35-40.
27. Smith BA, Kubo M, Black DP, et al. 2007. Effect of practice on a novel task – walking on a treadmill, preadolescents with and without down syndrome. Physical Therapy journal. 87: 766-777. Ref.: https://bit.ly/2J28c09
28. Uyanik M, Bumin G, Kayhan H. 2003. Comparison of deferent therapy approaches in children with Down syndrome. Pediatric International journal. 45: 68-78. Ref.: https://bit.ly/2OYQmyI
29. Comili G, Vargas S. 1999. A meta-analysis of research on sensory integration treatment. American Journal of occupational therapy. 53: 189-198. Ref.: https://bit.ly/2VQuVit
30. Sayyadinezhadm T, Abdolvahhab M, Akbarfahimi M, et al. 2013. The study of the effect of progressive resistance training on functional balance of 8-12 years old children with Down Syndrome (Persian). Novin Rehabilitation journal. 7: 29-34. Ref.: https://bit.ly/35Lrcd2
31. Jankowicz-Szymanska A, Mikolajczyk E, Wojtanowski W. 2012. The effect of physical training on static balance in young people with intellectual disability. Research in Developmental Disabilities J. 33: 675-681. Ref.: https://bit.ly/31lUagd