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Original article

EFFECTIVENESS OF NEUROMUSCULAR TRAINING ON FUNCTIONAL BALANCE FORCHILDREN WITH NEURODEVELOPMENTAL DISORDERS

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Abstract

Purpose. The prevalence of Autism Spectrum Disorder has dramatically increased over the past decades. People with Autism Disorder have weakness in maintaining the balance and disturbance of the posture due to developmental deficits in the nervous system and inferiority. Functional balance is all the balance skills a person needs to live independently.The purpose of the study is toinvestigatethe Neuromuscular training program on improve the functional balance for children with Autism Spectrum Disorder

Methods.

(7) Childs with Autism between the ages of 7 and 10 years were included in this study They were divided into one experimental, Berger Balance Test Scale (BBTS) was used to assess posture control consists of 14 items balance-related skills, with a maximum score of 56. The skill items include sitting to standing, standing to sitting, transfers, standing unsupported, sitting unsupported, standing with eyes closed, standing with feet together, standing with one foot in front, standing on one foot, turning 360 degrees, turning to look behind, retrieving object from floor, placing alternative foot on stool, and reaching forward with outstretched arm. PBS was scored after completion of the static and dynamic balance tests in pre- between and post-assessments.

Results. ANCOVA test was used to analyses the data via SPSS software at the significant level of $P < 0.05$ shows that differences between the post-between and post measurement for experimental group in favor of the post measure in the functional balance test for post assessment for experimental group of the children with Autism Spectrum Disorder)

Conclusions. Neuromuscular training program has a positive effect on the functional balance of children with neurodevelopmental disorders in the experimental group so, these training can be prescribed as an effective program for the rehabilitation of children with autism spectrum.

Key words: Neurodevelopmental Disorders. Autism. Functional balance Neuromuscular training program

Introduction.

Autism is a neurodevelopmental disorder diagnosed according to specific impairments in the areas of communication, reciprocal interaction and stereotypic behavior (DSM-IV., 2000). Autism Spectrum Disorder is an umbrella term for diagnoses that include Autistic disorder, Asperger's syndrome, and Pervasive Developmental Disorder-Not Otherwise Specified (PDD-NOS) (National Institute of Mental Health [NIMH], 2008; S. Tomchek, et al. 2010). ASD's are neurobiological, developmental disorders that occur within the first three years of life and continue throughout the lifespan (American Psychiatric Association [APA], 2000; Autism Speaks, 2009). Children diagnosed with an ASD may have difficulties in all areas of function but are particularly challenged with communication, social interaction, behavior, and sensory processing (Case-Smith, & Arbesman, 2008; NIMH, 2008).

In addition, many may display repetitive behaviors such as flapping or rocking, which are hypothesized by some (Shoener, et al. 2008) to be responses to the need for increased or decreased sensory input. Children with an ASD may also have motor difficulties and delays (Baranek, (2002).

Researchin the area of motor development has suggested that movement disturbances may be present during infancy and may be considered one of the earliest signs of autism (Kraemer, et al. 1998). Furthermore, motor problems have been the most frequently reported non–verbal deficits in children with autism (Han, 2000).

Motion disturbances include disorders of basic movement control (walking, muscle tone, posture,

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coordination, and balance), common in these children. Parents and professionals often see that children with autistic spectrum show abnormal walking, hypotonia, imbalance and lack of manual skills and coordination and balance), common in these children. Parents and professionals often see that children with autistic spectrum show abnormal walking, hypotonia, imbalance andlack of manual skills and coordination (Minshew, et al. 2004).

One of the most common symptoms found in individuals across the range of disorders included in the autism spectrum is a lack of balance (Fournier, et al. 2014). On the other side, the vestibular, somatosensory (including proprioceptive and cutaneous inputs) and visual systems are the afferents involved in the complex process of maintaining upright balance in humans. Any deficit in these systems or in the integration of information from these systems could affect balance. Sensory impairments are common in children with developmental disabilities (Gal, et al. 2010).

Occupational therapists who work with children diagnosed with an ASD focus on building skills in all areas of life such as daily living skills, education, play, and social communication, and in various environments such as school, home, and community (American Occupational Therapy Association [AOTA], 2009). Occupational therapists may use many different methods and interventions to work with children in areas such as daily functions, motor skills, and sensory integration (AOTA, 2008; Autism Speaks, 2009).

Balance is a fundamental aspect of gross motor skills that allows individuals to maintain stability in a place or during locomotion. Without good balance, individuals may have high risk of falling during daily activities such as standing and walking. Therefore, maintaining good balance is also essential for obtaining locomotion or advanced sport skills. Balance is defined as the ability to keep the center of gravity (COG) within its base of support (BOS) (D. Winter, 1995).

COG is an imaginary point and roughly in the center of your body at about 55% ofyour height. BOS is the area within an outline of all ground contact points. The lineof gravity of a body, center of pressure (COP), helps you determine balance, and itcan be represented by drawing a straight line from the COG to the ground. Whenthe line of gravity falls within the BOS, the person has better stability. When theCOP moves outside the BOS, the person becomes unstable. Two types of balanceare used in everyday activities: static and dynamic. Static balance refers to keepingthe COP within BOS while standing still. Dynamic balance requires the ability toreturn the COP within the BOS during walking or under various externaldisturbances (Pollock, et al. 2000).

functional balance describes balancing activities that are required for the performance of functional skills during independent living. For example, uni-pedal standing can be used for improving functional balance, as it is necessary for walking, which is a functional skill (Horak, et al. 1997).

The nervous system, muscles, joints, reflexes, skeletal system, gravity and inertia, sensory input (vision, vestibular, and proprioception), central processing time, and learned strategies all function to maintain balance within an environment (Shumway-Cook & Woollacott 1995), Maintaining balance depends on adequate muscle strength and nerve function, both of which are capable of improvement. Strength can be improved by resistance training (Kraemer and others 1998; McArdle and others 1996). Nerve function (i.e., the recruitment of muscles) can be improved through biofeedback and the use of sensory stimulation (Horak, et al. 1997; JA. Ashton-Miller, et al. 2001).

Neuromuscular training program aim at increasing the magnitude of neuromuscular stabilizing forces required to be generated to resist the destabilizing load applied to the knee prior to ligament damage. Some training programs are designed to improve muscle function (recruitment patterns and reaction time) and increase neuromuscular control, while others seek to improve balance and proprioception at the joint (Ashton-Miller, et al. 2001).

The purpose of the study is to provide progressions of activities that promote the development of proprioception and functional balance control in Neurodevelopmental Disorder children ASD to improve their functional skills and thereby increasing their independence. It is hoped that improved functional balance control would also contribute to a reduction in the risk for falls.

Material and Methods

Samples

The research community is composed of children with neurodevelopmental disorders in Hafez Center Academy for people with special needs. The sample of the research was chosen in a deliberate manner Children with neurodevelopmental disorders and the basic research sample (7) Children after the exclusion of children with different disabilities and multiple disabilities.

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Data collection procedure

Pediatric Balance Scale (PBS) consists of 14 items balance-related skills, with a maximum score of 56. The skill items include sitting to standing, standing to sitting, transfers, standing unsupported, sitting unsupported, standing with eyes closed, standing with feet together, standing with one foot in front, standing on one foot, turning 360 degrees, turning to look behind, retrieving object from floor, placing alternative foot on stool, and reaching forward with outstretched arm. PBS was scored after completion of the static balance tests in pre-between and post-assessments.

Training Program

The program was implemented for a period of two month and three training units per week which included the program has 24 rehabilitation units.

Statistical analysis

A One-Way ANOVA andL.S.D used to analyze differences between pre –between and post measurements of Pediatric Balance Scale (PBS). All data is presented in the tables are the mean ± SD. Data presented in the figures are the mean and 95% confidence interval. SPSS software was used for statistical analyses.

Results.

Table 1. Shows the age, Anthropometric Characteristics Scale for the experimental Group (Mean ± SD)

Group	N	Age [years]	Weight [kg]	Height [cm]
Experimental, control and	7	9.73 ± 0.45	33.60 ± 3.94	135.66± 0.72

Table 1 showed the age, Anthropometric Characteristics. The study sample of children with autism withmean age 9.73 ± 0.45 as seen in table (1), mean weight 33.60 ± 3.94 and mean height 135.66± 0.72

Table 2. Shows the ANOVA of three measurements pre- between and post of balance functional for children with autism.

Group	Sum of squares	df	Mean square]	F	Sig
Between groups	1915.14	2	956.57	60.02	0.00
Within groups	287.14	18	15.95		
Total	2202.28	20			

Table 2 showed significant statistical differences at a significant level 0.05 between different measurements , Where the value of f calculated greater than the value of the scale in the measurement of functional balance, so the researcher will direct these differences by calculating the least significant difference (L.S.D).

Table 3. Shows the (L.S.D) of three measurements pre- between and post of balance functional for children with autism.

Measurements	MD	Pre	Between	Post	L.S.D
Pre	19.71		*9.71	*23.28	3.55
Between	29.42			*13.57	
Post	43.00				

Table 3 shows statistically significant differences between the mean score of the premeasurement and both between and post measurements in the functional balance in favor of the post measurement.

Table 4. Shows the Percentage of improvement and direction of improvement of pre- between measurementsof balance functional for children with autism.

variable	Pre Md ± Sd	between Md ± Sd	the Percentage of improvement	direction of improvement
Functional balance	19.71 ± 3.03	29.42 ±4.96	49.26%	Between measurement ⬆

Table 4 showed Percentage of improvement and direction of improvement of pre- between measurements were 49.26% and direction of improvement in favor of between measurement of balance functional for children with autism.

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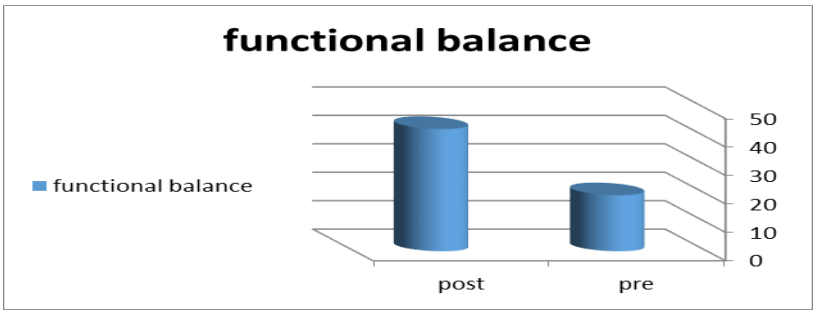

Figure 1 difference of mean of pre – between measurement of functional balance.

Table 5. Shows the Percentage of improvement and direction of improvement of pre- post measurements of balance functional for children with autism.

variable	**Pre** Md ± Sd	**post** Md ± Sd	**the Percentage of improvement**	**direction of improvement**
Functional balance	19.71 ± 3.03	43.00 ±3.74	118.16%	post measurement ↑

Table 5 showed Percentage of improvement and direction of improvement of pre- post measurements were 118.16% and direction of improvement in favor of post measurement of balance functional for children with autism.

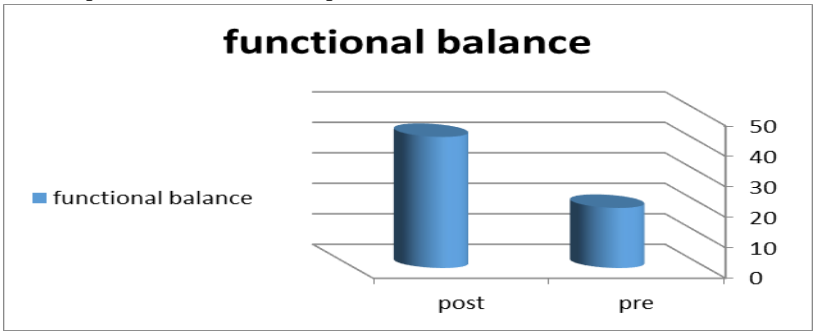

Figure 2 difference of mean of pre – post measurement of functional balance.

Table 6. Shows the Percentage of improvement and direction of improvement of pre- post measurements of balance functional for children with autism.

variable	**between** Md ± Sd	**post** Md ± Sd	**the Percentage of improvement**	**direction of improvement**
Functional balance	29.42 ±4.96	43.00 ±3.74	46.16%	post measurement ↑

Table 6 showed Percentage of improvement and direction of improvement between- post measurements were 46.16% and direction of improvement in favor of post measurement of balance functional for children with autism.

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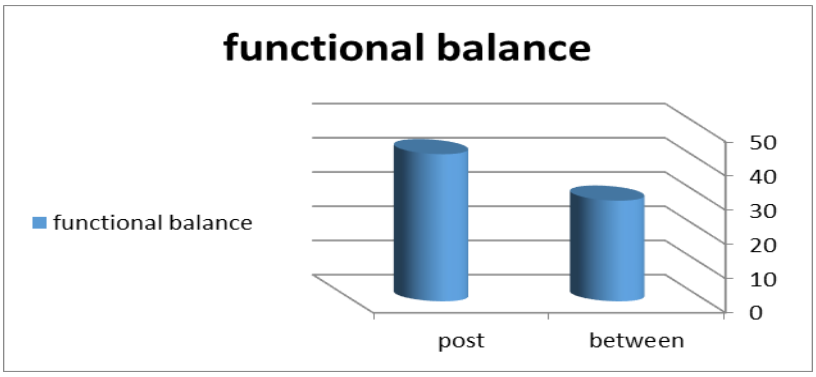

Figure 3 difference of mean of between – post measurement of functional balance.

Discussion

This study included children with neurodevelopmental disorders in Hafez Centre Academy for people with special needs. The sample of the research was chosen in a deliberate manner Children with neurodevelopmental disorders and the basic research sample (7) Children, Anthropometric Characteristics with mean age 9.73 ± 0.45 as seen in table (1) , mean weight 33.60 ± 3.94 and mean height 135.66± 0.72 (table 1).

Functional balance is all the balance skills a person needs to live independently.The better an individual's functional balance is, the better their functional skills would be and the less prone they would be for serious injuries resulting from falls. An individual with good functional skills will also be able to lead a "richer" life as they will be able to do what they want when they want it, not needing anyone to help them with anything. This independence will increase their quality of life.

The primary finding from this study was that participation in an integrative neuromuscular program was found to be an effective, safe and worthwhile method of conditioning for autism spectrum children. Specifically, exercises similar to the functional balance used by the child in his daily life such as sitting to standing, standing to sitting, transfers, standing unsupported, sitting unsupported , turning 360 degrees, turning to look behind, retrieving object from floor, placing alternative foot on stool, and reaching forward with outstretched arm.

On the other side, the vestibular, somatosensory (including proprioceptive and cutaneous inputs) and visual systems are the afferents involved in the complex process of maintaining upright balance in humans. Any deficit in these systems or in the integration of information from these systems could affect balance. Sensory impairments are common in children with developmental disabilities (E. Gal, et al. 2010).

In this study Results Shown from the ANOVA testof three measurements pre- between and post of balance functional of neurodevelopmental disorder. Where (F) 60.02(Table 2), The researcher attributes this to the differences and improvement that the rehabilitation program using Neuromusculartraining has a positive effect in the process of improving the functional balance of children with neurodevelopmental disorder.

The (L.S.D) of three measurements pre- between and post of balance functional of neurodevelopmental disorder, Where (L.S.D) 3.55(Table 3) showed statistically significant differences between the mean score of the pre measurement and both between and post measurements in the functional balance in favor of the post measurement.

(Taylor, May 1996) concluded that somatosensory plays an important role in balancing control. One aspect of the role of the somatosensory of movement control and postural control is the design and modification of the movement commands before and during the implementation of a movement. The movement control system should consider the current and changing state of the joints to estimate the mechanical balance resulting from its implementation. In this context, the somatosensory has the best conditions for supplying information and transmitting it to the centralnervous system; because it is a complex process that can only be carriedout by the somatosensory system.

In the present study, this training program probably improves the somatosensory and changes in the utilizing of motor unit patterns, which increases postural stability and maintains the center of gravity on the base of support and improves balance in these children

Tables (4, 5, 6) and figures (1, 2, 3) Showed the Percentage of improvement and direction of improvement of pre- between and post measurements of balance functional of children with neurodevelopmental disorder, where Percentage of improvement Ranged from (118.16%-46.16%) and direction of improvement in favor of post measurement of balance functional of children with neurodevelopmental disorder.

The training program made significantly greater gains in functional balance. The improvements in functional balance measures are evidence of this treatment's efficacy. No injuries occurred all over the training period and our observations suggest that the training program was well-received by the intervention group. This information demonstrates the potential value of the integrative neuromuscular program for children with neurodevelopmental disorder.

Conclusion

Neuromuscular training program has a positive effect on the functional balance of children with neurodevelopmental disorders in the experimental group so, these training can be prescribed as an effective program for the rehabilitation of children with autism spectrum.

References.

American Psychiatric Association, 2000, Diagnostic and statistical manual of mental disorders (4th ed., text rev.). Washington, DC: Author.

American Occupational Therapy Association, 2009, Occupational therapy's role for children with autism. What is occupational therapy? Retrieved from http://www.aota.org/Practitioners/Resources/Docs/FactSheets/Children/38517.asp.

Ashton-Miller JA, Wojtys EM, Huston LJ, Fry-Welch D, 2001, Can proprioception really be improved by exercises? Knee Surg, Sports Traumatol, Arthosc. 9:128-136.

Baranek, G. T. (2002). Efficacy of sensory and motor interventions for children with autism. Journal of Autism and Developmental Disorders, 32, 397-422.

Case-Smith, J., &Arbesman, M., 2008, Evidence-based review of interventions for autism used in or of relevance to occupational therapy. American Journal of Occupational Therapy, 62, 416-42.

Dawson, G., & Watling, R., 2000, Interventions to facilitate auditory, visual, and motor integration in autism: A review of the evidence. Journal of Autism and Developmental Disorders, 30, 415-421.

Fournier, K. A., Amano, S., Randovich, K. J., Bleser, T. M., & Hass, C. J., 2014, Decreased dynamical complexity during quiet stance in children with autism spectrum disorders. Gait and Posture, 39, 420-423.

Gal, E., Dyck, M. J., & Passmore, A., 2010, Relationships between stereotyped movements and sensory processing disorders in children with and without developmental or sensory disorders. American Journal of Occupational Therapy, 64(3), 453–461.

Han K, 2000, Effects of elastic tubing exercises on postural balance, ankle evertor strength, and peroneus longus latency and preactivation [Dissertation]. Provo, UT: Department of Physical Education, Brigham Young University.

Horak FB, Henry SM, Shumway-Cook A., 1997, Postural perturbations: new insights for treatment of balance disorders. Phys Ther 77(5):517-33.

Kraemer WJ, Volek JS, Fleck SJ., 1998, Chronic musculoskeletal adaptations to resistance training. In: Johnson E, editor. ACSM's resource manual for guidelines for exercise testing and prescription. 3d ed. Baltimore, MD: Williams and Wilkins. p 174-81.

Minshew NJ, Sung K, Jones BL, Furman JM, 2004, Underdevelopment of the postural control system in autism. Neurology 63: 2056-206.

National Institute of Mental Health [NIMH]., 2008, Autism spectrum disorders: Pervasive developmental disorders (NIH Publication No. 08-5511).

Pollock, A. S., Durward, B. R., Rowe, P. J., & Paul, J. P., 2000, What is balance? Clinical Rehabilitation, 14(4), 402-406.

Shoener, R. F., Kinnealey, M., & Koenig, K. P., 2008, You can know me now if you listen: Sensory, motor and communication issues in a nonverbal person with autism. American Journal of Occupational Therapy, 62, 547-553.

Shumway-Cook A, Woollacott MH., 1995, Motor control: theory and practical applications. Philadelphia: J. B. Lippincott.

Taylor AH, May S, 1996 Threat and coping appraisal as determinants of compliance with sports injury rehabilitation: An application of protection motivation theory. J Sports Sci 14: 471-482.

Tomchek, S., LaVesser, P., & Watling, R.,2010, The scope of occupational therapy services for individuals with an autism spectrum disorder across the life course.

Winter, D., 1995, Human balance and posture control during standing and walking. Gait & Posture, 3(4), 193–214. http://doi.org/10.1016/0966-6362(96)82849-9