

Effects of Rehabilitation interventions on motor skills of children with Autism spectrum disorder: a narrative review

Abstract

According to studies, children with Autism spectrum disorder have motor skill problems on both the gross and fine levels. Motor skill problems can lead to other developmental problems, including social, cognitive, and other skills because children with motor problems are unable to move and acquire different skills at higher stages of development. In this narrative review study, we reviewed the interventions, techniques, and treatments used in articles and research to improve motor skills. In the articles, valuable and various methods have been used, and the results obtained in most studies show a significant improvement and increase in motor skills scores. Basically, one of the most fundamental problems in children with autism is motor skill problems. In this study, we seek to create a context for increasing studies and research in the field of improving motor skills in autistic children.

Keywords: *Autism, Motor skills, Rehabilitation*

Jafar Masumi, Roya Gholamzadeh, Babak Kashefi Mehr*

Department of Speech Therapy, Faculty of Rehabilitation Sciences, Tabriz University of Medical Science, Tabriz, Iran. Department of occupational therapy, Faculty of Rehabilitation, Tabriz university of medical science, Tabriz, Iran Department of Occupational Therapy, School of Rehabilitation Sciences, Tabriz University of Medical Sciences, Tabriz, Iran.

***Correspondence author:**
kashefimehrb@tbzmed.ac.ir

Introduction

Autism spectrum disorder (ASD) is a multifaceted neurodevelopmental disorder that is identified diagnostically by profiles of difficulty in social communication and social interaction problems. People with ASD often show limited, repetitive, and stereotyped symptoms or patterns of behaviors [1]. However, motor skills problems are not one of the diagnostic criteria for ASD. Nevertheless, 79 to 83% of ASD children have difficulty performing motor skills appropriate for their age [2]. Recently, a large number of authorities in ASD have reported the presence of various movement disorders such as clumsiness, coordination abnormalities, postural instability, and disturbances in gross and fine motor¹ compared to people of normal growth [3]. One of the reasons for considering motor deficits in children with ASD is the result of a perspective that can be considered as one of the diagnostic criteria for ASD [4]. Poor motor skills are not only a barrier to participation in physical activity but also cause problems in plays that develop motor function and severe issues on a large scale compared to normal children. Abilities such as participation, empathy, concentration, and emotional relationships [5].

In terms of treatment, interventions are performed to improve motor skills. In this article, we will review rehabilitation interventions for the motor skills of ASD children. Occupational therapists can use impairment-based interventions to improve problems that evaluate performance components and execute treatment plans based on existing

deficiencies (bottom-up approach) and evaluate the patient's functional status and participation in occupations and plan treatment to Improve participation in these occupations (top-down approach) [6], and Physiotherapy helps improve physical function and enables a person to participate in activities and participatory roles. Physiotherapy also has effects on the cardiorespiratory, musculoskeletal, and neurological systems [7].

In addition to the relationship between autism spectrum disorder and motor skills, there is also a relationship between motor skills, social skills, and adaptive behavior [8], as well as language and cognitive skills [9].

Motor problems perhaps have been tied to delays in babbling, gestures, and acquiring new vocabulary in infancy, and they may have other 'cascading effects' on cognitive, social, and emotional development. That is because motor abilities, such as sitting up, reaching for objects, and walking, give babies access to new experiences that prompt learning. Also, babies who do not move much or cannot grasp objects tend not to elicit interactions from their caregivers, thereby limiting opportunities to learn language and other skills from adults [10]. Poor motor skills later in childhood may make autistic children reluctant to engage in physical activities such as sports, limiting their opportunities to interact with other children and potentially hampering social development. In a more subtle way, having trouble coordinating head movements could make it difficult to follow social interactions in a large group, and trouble with handwriting could affect academic

¹ control objects in small dimensions and manipulate

performance [11]. Visual-motor integration skills in autistic people are crucial to imitating and learning from others and participating in social interactions [12].

Although motor problems certainly interfere with social and cognitive development, it's unlikely that they are the sole cause of social difficulties. Instead, motor and social differences in autistic people may have the same primary cause in the brain. According to the authors, the standard treatments typically include physical and occupational therapy, but these may not fully address autistic children's needs. Moreover, only 32 percent of children with ASD get treatment for their motor problems. Some experts have begun trying out new treatments, such as adapted sports programs, yoga, martial arts, and movement therapies involving music. However, there is little evidence yet whether any of these approaches are effective [13, 14]. This review study was approved by the Ethics Committee of Tabriz University of Medical Sciences (IR.TBZMED.REC.1400.984).

Method:

This study is a narrative review of the literature on the use of rehabilitation intervention on motor skills in children with autism spectrum disorder. For these, we examined Pubmed,

Scopus SID, and Magiran from 2000 to 2021. we limited our study to the English language and Persian. In this study, we used a combination of search keywords that included “autism” OR “ASD” OR “autism spectrum disorder” AND “motor skills” AND “gross motor skills” AND “fine motor skills (control objects in small dimensions and manipulate)” and “intervention” AND “rehabilitation” OR “occupational therapy” OR “Physiotherapy.” to check whether the intervention had been used in Iran and Persian, we also search the keyword “intervention”-“rehabilitation”-“autism”-“motor skills” in SID and magiran. (figure: 1)

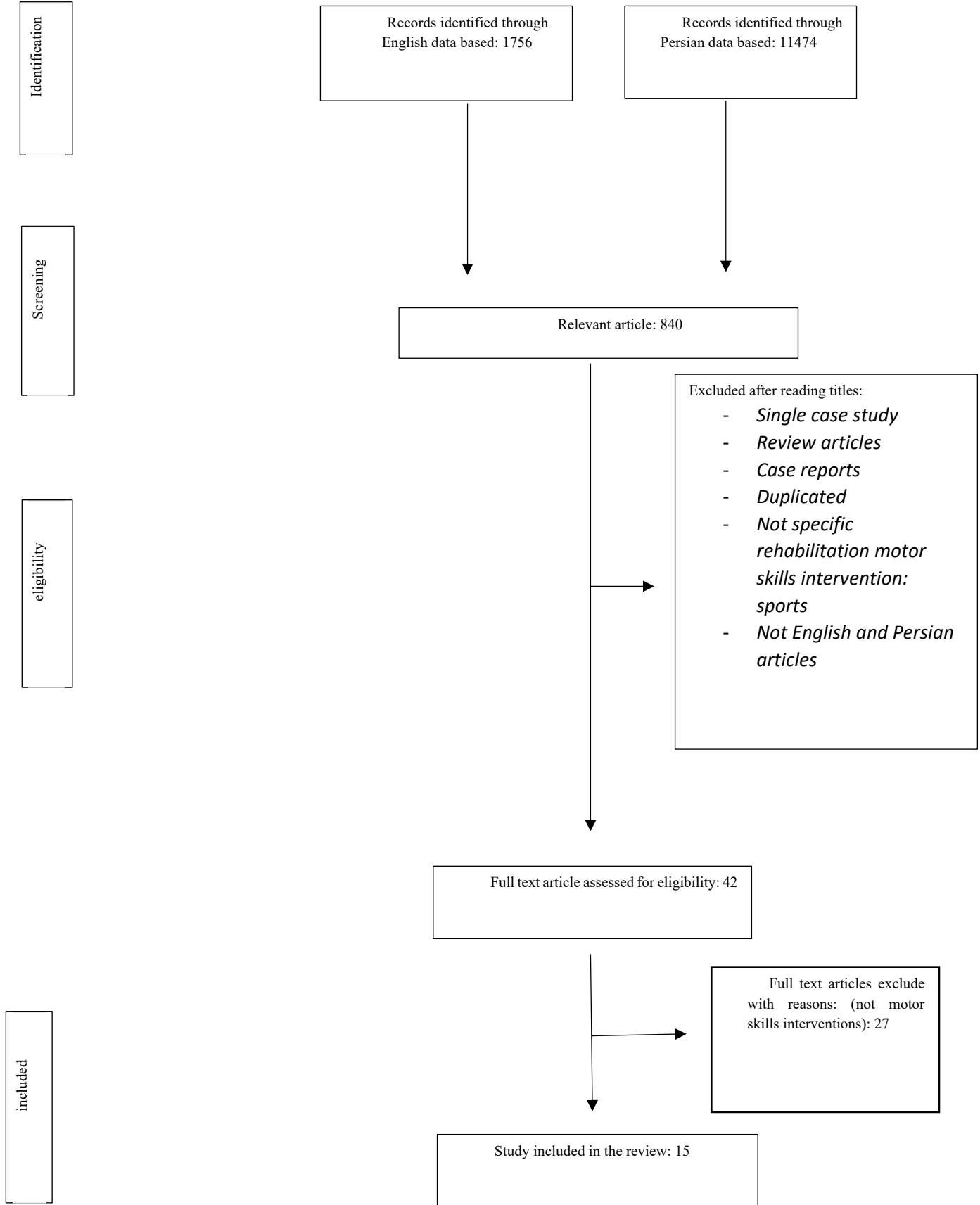
other inclusion criteria were

- a. clients were under 18 years old
- b. used rehabilitation techniques and intervention
- c. English and Persian articles

exclusion criteria were

- a. Clients were above 18 years old
- b. single subjects
- c. case studies
- d. review articles
- e. Non-rehabilitation treatments and interventions

.figure: 1.



Result:

In the studies used for this narrative review article, all of the clients have autism spectrum disorder (ASD). This diagnosis has been made by a psychiatrist, psychologist, or professional in this field or according to diagnostic tests (ADOS-2, SRS-2, GARS-2, ADI-R, SCQ) or DSM4, DSM5 has been performed. The age range of clients is 3 to 17 years, and the average age of participants is 10 years, which is appropriate for the inclusion and exclusion criteria of this study. In the experimental designs of studies, only one of them is randomized clinical trials [15], and the rest of the studies are pre/post-test or semi-experimental designs. In the searches, the main purpose of the selection is to find articles that are among the areas of intervention in rehabilitation, even if this research has not been done by this group.

A. Gross motor skills: we observe studies that achieved the following intervention to treat and improve gross motor skills of the ASD children EAAT [16], RAS with PT [17] SI and motor learning and perceptual motor training with simulated horse riding training [18], tennis[19], ABA and eclectic [20], locomotor training [21], social story [22], Intensive motor skill training [23], Visio motor training, simple and complex whole body and interpersonal synchrony based rhythmic joint action set with music and adult model, multiple imitation synchrony based games [15], TDCS with motor exercise [24].

B. Fine motor skills: art crafts, play DOH legos, ZOOB coloring, rolling pushing pressing [15], intensive motor skill training [23], object control [25], SI [26], ABA, eclectic [20]. 26.6% of researchers [17, 18, 24, 27] present a treatment program to improve gross motor skills, and the 33.3% prepared fundamental motor skills (FMS) treatment program that included pulling, pushing, lifting, carrying, balance jumping [16, 21, 25], And 33.3% include fine and gross motor skill both [15, 20, 23, 26, 28]. A study was focused on movement [22]. Also, there is more than one experimental group in several articles. One of them is the article that used robotic and rhythmic intervention for treatment, and there are 3 groups: one is a control group, and two are experimental groups (robotic group and rhythmic group [25]). Another study focused on fundamental motor skills intervention in 4-year-old ASD children, and in this study, two groups exchanged during the study, and the control group became the experiment group but in two different periods [25]. In one other study that included visual-motor intervention, there were 3 experimental groups (visual group, Visio motor, motor training) [29]. In another study that included two groups (G1 G2), when G1 got treatment, G2 was the control group. After 12 weeks, G1 was controlled and followed up, and G2 got treatment, so both the intervention on G2 and the stability of the treatment on G1 were examined [19]. Other studies investigate the applied

behavioral analysis and Eclectic intervention to compare the effects of those different approaches on the motor skills of ASD children [20]. All studies lasted between 3 and 6 weeks except one study that took 2 years [28]. Researches were conducted at various locations, including rehabilitation clinics [17, 20, 22, 24-26, 28, 29] at school [21], at home [15, 20, 23], in sports [19], and equestrian clubs [16, 18] or in swimming pools [27]. OT PT SLP therapists, examiners, and sports instructors have also been studied in this area [18, 27], as well as the teacher at school [21] or parents at home [15, 20, 23]. The treatment plan is set by the therapist and performed by the examiner, the teacher, or parents.

In all the research, the announced results included improvement and increased GMS & FMS scores in children with autism spectrum disorder. Except in study [27], which did not show a significant difference between the experimental and control groups, and in study [21], which requires more research and studies, a relative improvement in FMS scores was observed. Also, in the study [28], the interventions performed on children were more than on Adolescents, and Russian females had a more significant effect than males. In the [20] study, however, improvement in motor skills scores was observed in both groups, but no difference was observed in the scores of the two experimental groups.

Discussion:

In this review article, the main purpose of the study is to investigate the existing techniques and interventions for motor improvement in children with Autism spectrum disorder. In fact, offering a variety of interventions will improve gross motor skills and fine motor skills and be a kind of treatment guide for therapists or clinicians and even teachers and parents who are in contact with these children.

In summarizing and reviewing the results of the studies, it was observed that the outcomes of most interventions on motor skills in children with autism were significantly effective, and only in a study there are not adequate results [20], and also in interventions that were long-term with follow-up It has been seen both more substantially and with long-term impacts [19]. It was also observed in the review of studies that in addition to the impact of these interventions on motor skills in children with autism, effects were also observed on communication and daily living and verbal skills [22], excursive functions, social behavioral [29], adaptive behavioral [16] and improving repetitive behaviors[15]. Also, depending on the type and severity of ASD and the purpose of motor skills treatment, interventions could be carried out in different environments. Studies have also shown that some of these interventions could be done without direct supervision of the therapist, and by giving some instructions and even turning these instructions into guidelines, be given remotely or online during the COVID-19 pandemic, performed at home by the family for

these children. Also, to increase the variety, make the interventions more attractive, and make the children of ASD more familiar with different environments, rehabilitation exercises can be done in different environments of home, school, swimming pools, gyms and stables in addition to clinical environments.

Recommendation:

To this date, studies on autism motor abilities interventions and comparison of these approaches with each other have been limited. Furthermore, due to the variety of motor and communication profiles in these patients, it is recommended to conduct more extensive and more accurate studies on the intervention of motor skills in people with autism. This way, clinicians could select strategies with more confidence, and they could also design new effective treatments.

Acknowledgment:

I would like to thank the research department of the university who helped us in collecting the data

Conflict of Interest:

All authors declare that they have no conflicts of interest.

Funding:

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors

Reference

1. Edition, F., *Diagnostic and statistical manual of mental disorders*. Am Psychiatric Assoc, 2013. **21**(21): p. 591-643.
2. Green, D., et al., *Impairment in movement skills of children with autistic spectrum disorders*. *Developmental Medicine & Child Neurology*, 2009. **51**(4): p. 311-316.
3. Fournier, K.A., et al., *Motor coordination in autism spectrum disorders: a synthesis and meta-analysis*. *Journal of autism and developmental disorders*, 2010. **40**(10): p. 1227-1240.
4. Harris, S.R., *Early motor delays as diagnostic clues in autism spectrum disorder*. *European journal of pediatrics*, 2017. **176**(9): p. 1259-1262.
5. Bremer, E., M. Crozier, and M. Lloyd, *A systematic review of the behavioral outcomes following exercise interventions for children and youth with autism spectrum disorder*. *Autism*, 2016. **20**(8): p. 899-915.
6. Campbell, P.H., W.F. McInerney, and M.A. Cooper, *Therapeutic programming for students with severe handicaps*. *The American Journal of Occupational Therapy*, 1984. **38**(9): p. 594-602.
7. Hocking, J., A. Pearson, and J. McNeil, *Physiotherapy to improve gross motor skills in people with intellectual disability: a systematic review protocol*. *JB I Evidence Synthesis*, 2013. **11**(12): p. 94-108.
8. MacDonald, M., C. Lord, and D. Ulrich, *The relationship of motor skills and adaptive behavior skills in young children with autism spectrum disorders*. *Research in autism spectrum disorders*, 2013. **7**(11): p. 1383-1390.
9. Berkeley, S.L., et al., *Locomotor and object control skills of children diagnosed with autism*. *Adapted physical activity quarterly*, 2001. **18**(4): p. 405-416.
10. Stoodley, C.J., et al., *Author Correction: Altered cerebellar connectivity in autism and cerebellar-mediated rescue of autism-related behaviors in mice*. *Nature Neuroscience*, 2018. **21**(7): p. 1016-1016.
11. Bhat, A.N., *Is motor impairment in autism spectrum disorder distinct from developmental coordination disorder? A report from the SPARK study*. *Physical therapy*, 2020. **100**(4): p. 633-644.
12. Bishop, S.L., et al., *Identification of developmental and behavioral markers associated with genetic abnormalities in autism spectrum disorder*. *American journal of psychiatry*, 2017. **174**(6): p. 576-585.
13. Thompson, A. et al., *Impaired communication between the motor and somatosensory homunculus is associated with poor manual dexterity in autism spectrum disorder*. *Biological psychiatry*, 2017. **81**(3): p. 211-219.
14. LeBarton, E.S. and J.M. Iverson, *Associations between gross motor and communicative development in at-risk infants*. *Infant Behavior and Development*, 2016. **44**: p. 59-67.
15. Srinivasan, S.M., et al., *The effects of rhythm and robotic interventions on the imitation/praxis, interpersonal synchrony, and motor performance of children with autism spectrum disorder (ASD): a pilot randomized controlled trial*. *Autism research and treatment*, 2015. **2015**.
16. Zoccante, L., et al., *Effectiveness of Equine-Assisted Activities and Therapies for improving adaptive behavior and motor function in autism spectrum disorder*. *Journal of Clinical Medicine*, 2021. **10**(8): p. 1726.
17. El Shemy, S.A. and M.S. El-Sayed, *The impact of auditory rhythmic cueing on gross motor skills in children with autism*. *Journal of Physical Therapy Science*, 2018. **30**(8): p. 1063-1068.
18. Wuang, Y.-P., et al., *The effectiveness of simulated developmental horse-riding program in children with autism*. *Adapted Physical Activity Quarterly*, 2010. **27**(2): p. 113-126.
19. Pan, C.-Y., et al., *The impacts of physical activity intervention on physical and cognitive outcomes in children with autism spectrum disorder*. *Autism*, 2017. **21**(2): p. 190-202.
20. Zachor, D.A. and E.B. Itzhak, *Treatment approach, autism severity and intervention outcomes in young children*. *Research in Autism Spectrum Disorders*, 2010. **4**(3): p. 425-432.

21. Bremer, E. and M. Lloyd, *School-based fundamental-motor-skill intervention for children with autism-like characteristics: an exploratory study*. Adapted Physical Activity Quarterly, 2016. **33**(1): p. 66-88.
22. Manzari-Tavakoli, F., S.E. Hosseini, and L. Karimi, *The Effect of Social Storytelling on Motor Skills and Verbal Communication among the Children and Adolescents (5-17 Years Old) with Severe Autism Spectrum Disorder*. Report of Health Care, 2018. **4**(2): p. 28-37.
23. Ketcheson, L., J. Hauck, and D. Ulrich, *The effects of an early motor skill intervention on motor skills, levels of physical activity, and socialization in young children with autism spectrum disorder: A pilot study*. Autism, 2017. **21**(4): p. 481-492.
24. Mahmoodifar, E. and M.S. Sotoodeh, *Combined transcranial direct current stimulation, and selective motor training enhances balance in children with autism spectrum disorder*. Perceptual and Motor Skills, 2020. **127**(1): p. 113-125.
25. Bremer, E., R. Balogh, and M. Lloyd, *Effectiveness of a fundamental motor skill intervention for 4-year-old children with autism spectrum disorder: A pilot study*. Autism, 2015. **19**(8): p. 980-991.
26. Karim, A.E.A. and A.H. Mohammed, *Effectiveness of sensory integration program in motor skills in children with autism*. Egyptian Journal of Medical Human Genetics, 2015. **16**(4): p. 375-380.
27. Fragala-Pinkham, M.A., S.M. Haley, and M.E. O'Neil, *Group swimming and aquatic exercise program for children with autism spectrum disorders: a pilot study*. Developmental Neurorehabilitation, 2011. **14**(4): p. 230-241.
28. Valenti, M., et al., *Intensive intervention for children and adolescents with autism in a community setting in Italy: A single-group longitudinal study*. Child and Adolescent Psychiatry and Mental Health, 2010. **4**(1): p. 1-9.
29. Arabi, M. et al., *Is visuomotor training an effective intervention for children with autism spectrum disorders?* Neuropsychiatric Disease and Treatment, 2019. **15**: p. 3089.