REVIEW

Comparison of physiological and psychological efficacy of training methods in autism

K. Bakan[1], O. Oral[2], S. Gür[3], Z. Rezaee[4], M. Damat[3], A. S. Eroglu[5], O. Can[6]

[1] Marmara University, Faculty of Sports Sciences, Istanbul, Turkey, [2] Ege University, Faculty of Sports Sciences, Izmir, Turkey, [3] Istanbul Gelisim University, School of Physical Education and Sports, Turkey, [4] Department of Exercise Physiology, Ferdowsi University Of Mashhad, Mashhad, Iran, [5] Gazi University, Faculty of Sports Sciences, Ankara, Turkey, [6] Çukurova University, Faculty of Sports Sciences, Adana, Turkey

ABSTRACT

The prevalence of autism spectrum disorder (OSB) has been increasing worldwide for many reasons. This situation triggers an intense concern in public health in terms of both families and authorities. Studies are aimed at increasing the quality of life of individuals with ASD. Many studies show that various exercises provide physical and mental development for them. This review is carried out to understand the effectiveness of different physical activities on individuals with ASD. The study was performed by an extensive search of six databases of CINAHL, Clinical Trials, Cochrane, PEDro, PubMed, and Web of Knowledge, with medical topics and terms used, including autism spectrum disorder, autism and exercise intervention, and autism and motor skill development.

Keywords: Autism, Physical Development, Training Methods, Psychological Development

K. Bakan, O. Oral, S. Gür, Z. Rezaee, M. Damat, A. S. Eroglu, O. Can. Comparison of physiological and psychological efficacy of training methods in autism. Scientific Chronicles 2024; 29(2): 235-244

INTRODUCTION

Autism social spectrum disorder (ASD) is distinguished from a neurodevelopmental disorder. It is a mental disorder characterized by deficits mostly in communication and interaction, motor skills, and cognitive functions [1]. The prevalence of ASD has been increasing worldwide over the past 50 years. According to the World Health Organization (WHO), 1 out of 160 children is diagnosed with ASD [2]. The prevalence rate is higher in the United States. While 1 out of every 68 children is diagnosed with ASD [3,4], in a study of 7 million school-aged children in the UK, 1 out of every 64 children was found to have ASD [5].

The causes of ASD remain unclear, but the opinion among researchers that it may be environmental [6], biological [7], and genetically based [8] is dominant. The benefits of early intervention are very important in the treatment of ASD, however, it is observed that intervention at any age makes a difference in the quality of life of the individual [9,10].

Although no single best treatment has been found for ASD, different programs, such as physical therapy, speech/language therapy, occupational therapy, and behavioral intervention, have produced beneficial effects throughout clinical practice [11].

It has been observed that these therapeutic interventions are effective in controlling situations such as aggression, self-harm, atypical behaviors, and repetitive behaviors, although children with ASD have different characteristics.

Currently, there is no standard treatment for ASD. However, there are many different ways to minimize symptoms and maximize abilities. Most individuals with ASD respond well to highly structured and elaborate exercise practices [12,13]. In this study, we will evaluate the possible pros and cons of the studies that have been carried out before.

1. Autism and Physical Activity

It is also known that physical activities and exercise contribute positively to mental health. In addition, it is known that exercise provides extra benefits for neurological and psychological diseases. It is emphasized that this situation results from the positive effects of exercise, such as the increase in the hormones that provide the feeling of happiness and the reduction of oxidative stress [14,15]. Currently, autism is a disease with physiological and psychological effects that cannot be treated with medication. However, the treatment of ASD requires combined approaches such as pharmacological, psychotherapeutic interventions, and pedagogical treatment for self-control and certain behavioral symptoms such as insomnia, hyperactivity, stereotyped behavior, and hetero-aggression.

In the 1970s, the first studies on the positive effects of intervention with physical exercise as an additional therapy for ASD patients have begun [16]. Systematic reviews and meta-analysis studies have shown the existence of a positive association between physical exercise and the reduction of "stereotypical behavior" [17, 18]. Exercise is performed with many combinations. These combinations are made by considering the different frequency, volume, and intensity features based on the condition of the individuals. However, while this performance can be described with certain definitions, the definition of these models for the ASD population is not yet clear [19, 20, 21]. Exercise reduces behavioral stereotypes and improves cognitive function. It also develops the psychopathological profile and reduces aggressive behavior [22].

Poor motor coordination is a fairly common symptom in individuals with ASD. In these conducted studies, moderate to vigorous physical activities were measured over seven days using accelerometers, and physical exercise was observed to improve physical motor deficits in children with developmental coordination disorders [23].

ASD causes sleep disorders in children. This rate was found to be 44-83% among individuals with ASD. Studies have shown that these children have fewer sleep disturbance patterns and less difficulty falling asleep, with reports of overall sleep quality given by parents of physically active children with ASD [24]. Conditions associated with depression, anxiety, and additional psychiatric comorbidities develop in individuals with

ASD. In addition, studies have claimed the probability of such diseases is 4 times higher in individuals with ASD [25].

In their study, Bueno-Antequera and Munguia-Izquierdo stated that it is now a generally accepted fact that exercise effectively treats mild to moderate depression compared to cognitive behavioral therapy and basic antidepressant drugs. Physical exercise stimulates a few of the necessary organs to secrete cytokines or metabolic hormones that affect the whole body and the brain to maintain healthy function. Exercise-induced cytokine release has important roles in modulating neuroinflammation, neuroplasticity, and neuronal metabolism, which underlie the causes of pseudo-brain function [26].

2. *Effects of Physical Activity Methodologies on Autism*

In a study carried out to evaluate the effect of physical exercise on significant stereotyped behaviors of individuals with ASD related to martial arts by Bahrami et al. (2012), the exercise program was regulated as 60-minute sessions for four days a week for 14 weeks and essential reduction was observed in stereotyped behaviors. In the study, Gilliam Autism Rating Scale - 2nd Edition was used [27]. Similarly, a significant reduction in stereotyped behavior was observed with riding practice (60-minute session/week/10 consecutive weeks). The Aberrant Behavior Checklist–Community-scale was used in the study [28]. In addition, in other riding studies based on parental reports of children with ASD, it is reported that riding has significantly improved adaptive behavior, including responsiveness and social interactions, and communication as well as daily living skills [29]. Evaluations were performed with the studies (Vineland Adaptive Behavior Scales – Interview Edition, Questionnaire Form) and a positive effect size of 0.9 was observed for the studies [28]. In the study performed with physical exercise based on coordination and strength exercises (2 Sessions 40 minutes/session per week for 40 weeks), a reduction in the number of accumulated items was observed for attention deficit, verbal stereotypes, motor stereotypes, social interaction, and reactivity. In intervention studies using jogging (20 minutes/sessions, 1-5 sessions per week, 10 sessions in total), improvement was noted with an effect size of 3.0 in the context of stereotypical behaviors (body shaking, biting oneself, clapping hands, etc.). The Autistic Traits Rating Scale was used in these two studies [30].

Focusing is a major obstacle to learning and perception for individuals with ASD. In the studies carried out by Nicholson et al., 15-minute running studies with subjects, it is reported that running increased the focus time on given tasks by approximately 7.5% [31].

Yoga and dance practice with children (8 sessions of 45 min/session) resulted in significant reductions in stereotypical behavioral symptoms [32]. A 12-week mini-basketball training program (40 minutes/session, five sessions per week) with children with ASD (as assessed by the Childhood Autism Rating Scale and with lower scores in social communication) has been shown to provide positive results on these children [33].

In a published meta-analytical systematic review, it was evaluated that

exercise programs with an average frequency of three times a week for 8 to 48 weeks and varying session duration between 15 and 90 minutes per session had positive effects on ASD symptomatology [34].

While physical exercise shows improvements in obesity in children with ASD, it also decreases body mass. For individuals with ASD, apart from obesity, the incidence is high in conditions that prevent focus, such as high brain activity and hyperactivity as a result of excessive energy intake. Reducing energy intake as well as increasing energy expenditure provides effectiveness in many physical and cognitive controls.

Participants in a 36-week study using a moderate treadmill walking program of 15-20 minutes daily, three days a week for children achieved a significant increase in exercise capacity, and a significant reduction in the subject's body mass index was observed [35].

In a study in which individuals with ASD played a physically active video game for 30 minutes, 4 days a week for 6 weeks, in children, there was a reduction in body mass and body mass index, with minimal changes in triceps skinfolds, waist-to-hip ratios and hamstring skinfolds [36]. In another 48-week, 2 days a week, 30-minute daily moderate physical exercise program based on coordination and strength exercises, it was observed that the metabolic profile of the individual decreased in LDL and TOTAL Cholesterol while providing a positive increase in HDL. However, no significant changes in body mass were observed in these children [37].

In the study of 46 individuals with ASD carried out by Shanok et al. (2019), they did a program including golf with the subjects for 6 weeks and it was observed that the sportive activity performed provided a measurable benefit to these individuals' communication skills, social skills, motor skills, and regulatory skills. It has been reported in the study that since golf especially requires balance and coordination skills, hand-arm and body coordination might improve but the exercise will not make a significant contribution to the cardiovascular system [38].

Tse (2020) performed the exercise with jogging in his 12-week study on 27 children with ASD in the 8-12 age group, including 15 subjects and 12 control groups. The study was performed as 5 minutes of warm-up, 20 minutes of jogging, and 5 minutes of cool-down. In the study, a family questionnaire on emotion regulation and behavioral functionality revealed that the study provided positive improvements in children's emotion regulation and behavioral functionality [39].

Tarr et al.(2020) observed in their meta-analysis that in the studies they examined focusing on stereotyped behaviors that most attract and cause a decrease in their living standards, especially in children with ASD, exercise provides a significant effect on reducing stereotyped behaviors. In addition, in the study, they stated that reducing stereotyped behaviors before focusing on the social and functional skills of individuals would positively affect their other skills [40].

Ketcheson et al. (2016) followed the development of motor skills of children as a result of exercise manipulation in a study they conducted with a group of 20 children with ASD aged between 4-6. The study lasted for 4 hours a day, 5 days a week, and 8 weeks. In the study, significant gains in motor skills were

observed in children with a series of combined play-based physical activity exercises. However, the expected result could not be obtained because each individual with ASD has different skills [41].

DISCUSSION

Studies have shown that ASD causes an observable decrease in individuals' social interactions and social sensitivity. As a result of the study carried out by Gabriels et al. regarding exercise with horse riding, the study carried out by Cai and Yu. on exercise including mini-basketball, and the study conducted by Shanok et al. on golf exercises, it is observed that the behavioral models of individuals with ASD regarding social interaction and social sensitivity were improved [28, 33, 38].

Stereotyped behaviors are one of the most typical determinants for individuals with ASD. Although there are similar types of behavior for many people with ASD, there are different types of behavior that vary from person to person. These stereotyped behaviors cause many problems such as focusing, mobility, posture, and behavior problems of individuals and trigger them. In the study carried out by Bahrami et al. on martial arts, another study conducted by Gabriels et al. on horse riding exercise, the study by Rosenthal-Malek and Mitchell based on the strength and coordination studies, and the study performed by Rosenblatt et al. regarding yoga studies, all the results stated that exercise significantly improves the mobility as well as the stereotyped behaviors of individuals with ASD and increases the focus of them [27, 28, 30, 32].

The majority of individuals with ASD have developmental problems in motor behavior. This can lead to further retardation in the mental and physical development of individuals. As the results of the study carried out by Shanok et al. on golf exercise and the study conducted by Ketcheson et al. on play-based exercises designed to develop motor skills and many other studies, whether it is sports activities with standard movements or specially designed game-based exercise studies, it was observed that they all significantly contribute to the development of motor skills on individuals with ASD [38,41].

It has been stated in many diagnostic studies on ASD that as a result of the lack of active life in these individuals and the predominance of monotonous nutrition with the effect of ASD, individuals may have weight gain and cardiovascular diseases due to lubrication in the vessels and organs. It has been determined by many studies on exercises that these effects are reduced and health improvement is achieved through exercise [36, 37, 40].

Studies have shown that children with ASD have difficulty falling asleep and have more sleep disorders. On the other hand, it has been observed that individuals with physical activity levels and individuals with special exercise programs have an effective improvement in overall sleep quality in exercise studies [24, 40].

In studies, it has been accepted that physical exercise has beneficial effects in the treatment of many existing psychiatric disorders by stimulating molecular effects that induce an anti-inflammatory state on a chronic proinflammatory state that occurs in the periphery as well as on the central nervous

system. Due to the current situation in individuals with ASD, the background of many psychiatric disorders might be formed. Therefore, exercises make a positive contribution to individuals [25, 39, 40].

Since the anti-inflammatory formations formed by the effect of exercise affect the regulation of neurotransmitters, physical exercise helps to decrease body mass in children with ASD, as well as reduce inflammatory conditions that cause psychological attacks [25, 39, 40].

CONCLUSION

The human physiological structure needs a certain amount of physical activity in terms of health. For this reason, exercise provides a positive contribution to both healthy individuals and individuals with ASD. In addition, all exercise studies show that sports activities and exercise-based play activities have positive contributions to individuals with ASD. Studies have also proved that these contributions not only protect physical health but also contribute to improving and increasing physical and psychological health.

ASD causes many developmental delays in individuals. It has been seen in many studies that exercise contributes to all of these goals in terms of preventing and improving these situations, making the lives of individuals easier, and reducing the burden of care on their families.

On the other hand, there has been no sufficient number of studies in terms of studies on motor skills that provide the daily work necessary for individuals with ASD to maintain their lives healthily. Our motor skills are very important for us to be able to do many simple life activities.

In summary, the literature acknowledges a wide range of benefits of physical exercise studies in symptomatology in the ASD population.

Given the differences in the intensity of the symptomatology of ASD, additional research is required to better understand which specific physical exercise is more appropriate, more effective, and more inclusive in interventions for the population with ASD. It is recommended to provide a literature consensus by designing exercise plans that include specific exercise intervention protocols, procedures to motivate children and adolescents with ASD's commitment to and participation in physical exercise programs, and applicable protocols for each individual.

.

Acknowledgment:

We would like to express our special thanks of gratitude to George N. NOMIKOS for his very successful contribution to the literature research process and unique academic support in the publication during the process of this review article.

Conflict of interest:

The author certifies that there is no conflict of interest with any financial organization regarding the material discussed in the manuscript.

Funding:

The author certifies that there is no funding from any financial organization regarding the material discussed in the manuscript.or contributions:

Author contributions:

All the authors read and approved the final version of the manuscript.

REFERENCES

1. Developmental Disabilities Monitoring Network Surveillance Year 2010 Principal Investigators; Centers for Disease Control and Prevention (CDC). Prevalence of autism spectrum disorder among children aged 8 years - autism and developmental disabilities monitoring network, 11 sites, United States, 2010. MMWR Surveill Summ. 2014 Mar 28;63(2):1-21.

2. World Health Organization. Autism Spectrum Disorders & Other Developmental Disorders. Geneva, Switzerland, World Health Organization; 2013.3.

3. Christensen DL, Bilder DA, Zahorodny W, Pettygrove S, Durkin MS, Fitzgerald RT, Rice C, Kurzius-Spencer M, Baio J, Yeargin-Allsopp M. Prevalence and Characteristics of Autism Spectrum Disorder Among 4-Year-Old Children in the Autism and Developmental Disabilities Monitoring Network. J Dev Behav Pediatr. 2016 Jan;37(1):1-8.

4. Baio J, Wiggins L, Christensen DL, Maenner MJ, Daniels J, Warren Z, Kurzius-Spencer M, Zahorodny W, Robinson Rosenberg C, White T, Durkin MS, Imm P, Nikolaou L, Yeargin-Allsopp M, Lee LC, Harrington R, Lopez M, Fitzgerald RT, Hewitt A, Pettygrove S, Constantino JN, Vehorn A, Shenouda J, Hall-Lande J, Van Naarden Braun K, Dowling NF. Prevalence of Autism Spectrum Disorder Among Children Aged 8 Years - Autism and Developmental Disabilities Monitoring Network, 11 Sites, United States, 2014. MMWR Surveill Summ. 2018 Apr 27;67(6):1-23.

5. Roman-Urrestarazu A, van Kessel R, Allison C, Matthews FE, Brayne C, Baron-Cohen S. Association of Race/Ethnicity and Social Disadvantage With Autism Prevalence in 7 Million School Children in England. JAMA Pediatr. 2021 Jun 1;175(6):e210054.

6. Sealey LA, Hughes BW, Sriskanda AN, Guest JR, Gibson AD, Johnson-Williams L, Pace DG, Bagasra O. Environmental factors in the development of autism spectrum disorders. Environ Int. 2016 Mar;88:288-298.

7. Van Wijngaarden-Cremers PJ, van Eeten E, Groen WB, Van Deurzen PA, Oosterling IJ, Van der Gaag RJ. Gender and age differences in the core triad of impairments in autism spectrum disorders: a systematic review and meta-analysis. J Autism Dev Disord. 2014 Mar;44(3):627-35.

8. Hall L, Kelley E. The contribution of epigenetics to understanding genetic factors in autism. Autism. 2014 Nov;18(8):872-81.

9. Christensen DL, Baio J, Van Naarden Braun K, Bilder D, Charles J, Constantino JN, Daniels J, Durkin MS, Fitzgerald RT, Kurzius-Spencer M, Lee LC, Pettygrove S, Robinson C, Schulz E, Wells C, Wingate MS, Zahorodny W, Yeargin-Allsopp M; Centers for Disease Control and Prevention (CDC). Prevalence and Characteristics of Autism Spectrum Disorder Among Children Aged 8 Years--Autism and Developmental Disabilities Monitoring Network, 11 Sites, United States, 2012. MMWR Surveill Summ. 2016 Apr 1;65(3):1-23.

10. Lang R, Koegel LK, Ashbaugh K, Regester A, Ence W, Smith W. Physical exercise and individuals with autism spectrum disorders: A systematic review. Res Autism Spectr Disord 2010; 4:565–576.

11. Fang Q, Aiken CA, Fang C, Pan Z. Effects of Exergaming on Physical and Cognitive Functions in Individuals with Autism Spectrum Disorder: A Systematic Review. Games Health J. 2019 Apr;8(2):74-84.

12. Eissa N, Al-Houqani M, Sadeq A, Ojha SK, Sasse A, Sadek B. Current Enlightenment About Etiology and Pharmacological Treatment of Autism Spectrum Disorder. Front Neurosci. 2018 May 16;12:304.

13. Toscano CVA, Barros L, Lima AB, Nunes T, Carvalho HM, Gaspar JM. Neuroinflammation in autism spectrum disorders: Exercise as a "pharmacological" tool. Neurosci Biobehav Rev. 2021 Oct;129:63-74.

14. Chen Z, Lan W, Yang G, Li Y, Ji X, Chen L, Zhou Y, Li S. Exercise Intervention in Treatment of Neuropsychological Diseases: A Review. Front Psychol. 2020 Oct 22;11:569206.

15. Zhao JL, Jiang WT, Wang X, Cai ZD, Liu ZH, Liu GR. Exercise, brain plasticity, and depression. CNS Neurosci Ther. 2020 Sep;26(9):885-895.

16. Best JF, Jones JG. Movement therapy in the treatment of autistic children*. Aust. Occup. Ther. J. 1974; 21, 72–86.

17. Petrus C, Adamson SR, Block L, Einarson SJ, Sharifnejad M, Harris SR. Effects of exercise interventions on stereotypic behaviours in children with autism spectrum disorder. Physiother Can. 2008 Spring;60(2):134-45.

18. Toscano CVA, Carvalho HM, Ferreira JP. Exercise Effects for Children With Autism Spectrum Disorder: Metabolic Health, Autistic Traits, and Quality of Life. Percept Mot Skills. 2018 Feb;125(1):126-146.

19. Bremer E, Crozier M, Lloyd M. A systematic review of the behavioural outcomes following exercise interventions for children and youth with autism spectrum disorder. Autism. 2016 Nov;20(8):899-915.

20. Lang R., Koegel LK, Ashbaugh K, Regeste, A, Ence W, Smith W. Physical exercise and individuals with autism spectrum disorders: a systematic review. Res. Autism Spectr. Disord. 2010; 4, 565–576.

21. Sowa M., Meulenbroek, R.. Effects of physical exercise on autism spectrum disorders: a meta-analysis. Res. Autism Spectr. Disord. 2012; 6, 46–57.

22. Tan BW, Pooley JA, Speelman CP. A Meta-Analytic Review of the Efficacy of Physical Exercise Interventions on Cognition in Individuals with Autism Spectrum Disorder and ADHD. J Autism Dev Disord. 2016 Sep;46(9):3126-43.

23. Batey CA, Missiuna CA, Timmons BW, Hay JA, Faught BE, Cairney J. Self-efficacy toward physical activity and the physical activity behavior of children with and without Developmental Coordination Disorder. Hum Mov Sci. 2014 Aug;36:258-71.

24. Shui AM, Katz T, Malow BA, Mazurek MO. Predicting sleep problems in children with autism spectrum disorders. Res Dev Disabil. 2018 Dec;83:270-279.

25. Hudson CC, Hall L, Harkness KL. Prevalence of Depressive Disorders in Individuals with Autism Spectrum Disorder: a Meta-Analysis. J Abnorm Child Psychol. 2019 Jan;47(1):165-175.

26. Bueno-Antequera J, Munguía-Izquierdo D. Exercise and Depressive Disorder. Adv Exp Med Biol. 2020;1228:271-287.

27. Bahrami F, Movahedi A, Marandi SM, Sorensen C. The Effect of Karate Techniques Training on Communication Deficit of Children with Autism Spectrum Disorders. J Autism Dev Disord. 2016 Mar;46(3):978-86.

28. Gabriels RL., Agnew JA, Holt KD, Shoffner A, Zhaoxing P, Ruzzano S, Clayton GH, Mesibov G. Pilot study measuring the effects of therapeutic horseback riding on school-age children and adolescents with autism spectrum disorders. Res. Autism Spectr. Disord.2012; 6, 578–588.

29. Ward SC, Whalon K, Rusnak K, Wendell K, Paschall N. The association between therapeutic horseback riding and the social communication and sensory reactions of children with autism. J Autism Dev Disord. 2013 Sep;43(9):2190-8.

30. Rosenthal-Malek A, Mitchell S. Brief report: the effects of exercise on the self-stimulatory behaviors and positive responding of adolescents with autism. J Autism Dev Disord. 1997 Apr;27(2):193-202.

31. Nicholson, H., Kehle, T.J., Bray, M.A., Heest, J.V. The effects of antecedent physical activity on the academic engagement of children with an autism spectrum disorder. Psychol. Sch. 2011; 48, 198–213.

32. Rosenblatt LE, Gorantla S, Torres JA, Yarmush RS, Rao S, Park ER, Denninger JW, Benson H, Fricchione GL, Bernstein B, Levine JB. Relaxation response-based yoga improves functioning in young children with autism: a pilot study. J Altern Complement Med. 2011 Nov;17(11):1029-35.

33. Cai K, Yu Q, Herold F, Liu Z, Wang J, Zhu L, Xiong X, Chen A, Müller P, Kramer AF, Müller NG, Zou L. Mini-Basketball Training Program Improves Social Communication and White Matter Integrity in Children with Autism. Brain Sci. 2020 Oct 31;10(11):803.

34. Ferreira JP, Ghiarone T, Júnior CRC, Furtado GE, Carvalho HM, Rodrigues AM, Toscano CVA. Effects of Physical Exercise on the Stereotyped Behavior of Children with Autism Spectrum Disorders. Medicina (Kaunas). 2019 Oct 14;55(10):685.

35. Pitetti KH, Rendoff AD, Grover T, Beets MW. The efficacy of a 9-month treadmill walking program on the exercise capacity and weight reduction for adolescents with severe autism. J Autism Dev Disord. 2007 Jul;37(6):997-1006.

36. Strahan BE, Elder JH. Video Game Playing Effects on Obesity in an Adolescent with Autism Spectrum Disorder: A Case Study. Autism Res Treat. 2015;2015:128365.

37. Toscano CVA, Ferreira JP, Gaspar JM, Carvalho HM. Growth and weight status of Brazilian children with autism spectrum disorders: A mixed longitudinal study. J Pediatr (Rio J). 2019 Nov-Dec;95(6):705-712.

38. Shanok NA, Sotelo M, Hong J. Brief Report: The Utility of a Golf Training Program for Individuals with Autism Spectrum Disorder. J Autism Dev Disord. 2019 Nov;49(11):4691-4697.

39. Tse ACY. Brief Report: Impact of a Physical Exercise Intervention on Emotion Regulation and Behavioral Functioning in Children with Autism Spectrum Disorder. J Autism Dev Disord. 2020 Nov;50(11):4191-4198.

40. Tarr CW, Rineer-Hershey A, Larwin K. The Effects of Physical Exercise on Stereotypic Behaviors in Autism: Small-n Meta-Analyses. Focus on Autism and Other Developmental Disabilities, 2020; 35(1), 26–35.

41. Ketcheson L, Hauck J, Ulrich D. 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 May;21(4):481-492.

Corresponding author: **Onur Oral,** E-mail: onur.oral@ege.edu.tr