



THE EFFECT OF THERAPEUTIC RIDING ON SOME MOTOR SKILLS IN CHILDREN WITH ASPERGER'S SYNDROME

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ABSTRACT

Asperger syndrome (AS) is a developmental disorder associated with autism, characterized by repetitive behaviour, significant movement disturbance, including some poor motor skills and clumsiness. Therapeutic riding (TR) focuses on the cognitive, physical, emotional and social well-being of the rider. TR is a form of the physical, occupational and speech therapy that uses the specific movements of equestrian therapeutic techniques to facilitate normal muscle tone and to enhance balance, coordination, and motor development. PURPOSE: The aim is to evaluate the impact of therapeutic riding on motor skills of children with AS. METHODS: Changes in posture were assessed using the Posture Assessment Scale and child's coordination in everyday functional activities using the Developmental Coordination Disorder Questionnaire (DCDQ'2007). Five children with AS, aged 4.9-year-old to 7.2-year-old participated in the study. RESULTS: We registered some improvements during the horseback riding course: better head and posture position and fine motor/handwriting general coordination. CONCLUSION: Although the study is only a pilot one with a small group of participants, the results clearly show that Therapeutic riding causes positive changes of some motor skills for children with AS.

Key words: Equine Assisted Therapy, Autism Spectrum Disorder, Motor learning, Performance

INTRODUCTION

Asperger syndrome (AS) belongs to a group of neurological disorders, known as autism, i.e., autism spectrum disorders (ASD). It was first described in 1944 by Hans Asperger (1, 2). The AS is positioned at the upper end of the autistic continuum. Comparing all elements included in most of the autistic spectrum, Van Kreven (3) notices that children with higher autistic problems are introverts; they have lived in close presence in their own world, while those with less difficulties live in their own way, but in our world. In 2020, [the CDC's Autism and](#)

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Developmental Disabilities Monitoring (ADDM) Network reported that in 2016 approximately 1 in 54 children as identified with autism spectrum disorder (ASD) (4). In Bulgaria, there is no accurate statistics for the respective field.

The thing that essentially distinguishes AS disease from other disorders in the autistic spectrum is the higher level of function and its high dissemination among the male group; the male: female ratio varies from 2:1 up to 7:1 (5). People, with AS, have difficulties in social interconnection and interactivity, communication skills, motor abilities and repetitive or restrictive patterns of behaviour (2). Usually such people have sensory dysfunction, characteristic of all children with ASD. Poor motor coordination creates additional difficulties (6). Therapeutic activities in the case of ASD are aimed at reducing the specific

characteristics of the disorder, which itself, can increase the personal comfort of those with ASD. Motor difficulties, associated with ASD, are not considered identification factors (7), nevertheless, they are observed among 80-90% of the children (6). Motor difficulties were registered among 50% of the children with AS, as well as proprioceptive and vestibular processing (8-10). Moreover, they often show unstable gait, clumsy running, ball handling problems, some balance problems, abnormal movement patterns, poor handwriting skills and inability to distinguish the gestures or movements of others (8, 11.). Weimer (12) suggests that a proprioceptive deficiency may be at the root of the lack of coordination observed in AS cases; these individuals may be over-reliant on visual input to maintain balance and position in space.

Many experts consider Equine Assisted Therapy (EAT), Therapeutic riding and Hippotherapy as alternative therapies, as well as therapies involving dolphins, sand, music, drum, art, and yoga. EAT may alleviate some symptoms in children with ASD; it contributes to their general well-being and psychological health (13). EAT and therapeutic riding affects all sensory groups, such as tactile, vestibular, visual, olfactory, and proprioceptive (13-16). In the case of Therapeutic riding, the different movements of the horse are proven to challenge the standard thinking of the child and as such they provoke different postural reactions, i.e., this type of treatment affects the child's behaviour and then they can control the animal. According to various studies, Hippotherapy brings powerful sensory information, improved balance, coordination of the upper limbs and strength in children with ASD (15, 17-20).

Despite the positive benefits reported by these researchers, the study of Therapeutic riding influence effect on the motor abilities of AS children is still scarce.

The aim of this pilot study is to evaluate the impact of Therapeutic riding on the motor skills of children with Asperger Syndrome.

MATERIALS AND METHODS

The study was performed at Equestrian Sports facilities "Chan Asparuh" in the city of Sofia in a total of 36 sessions over a period of 6-month

(Initial stage: 3 months, once a week, second stage: 3 months, twice a week). Each treatment procedure lasted for 25-30 minutes.

Five AS children (1 girl and 4 boys, aged 4.9-year-old to 7.2-year-old) were involved in the study. None had ever before had regular horseback riding experience. Four children are verbal (phrases or more) and one is low verbal (several words). The functionality of the respondents is moderate. Before starting therapy, the parents gave their consent for the inclusion of their child in the monitored group; they were informed about the procedures and the purpose of the survey. The individual physician of each AS child also gave approval. Each participant was screened by a physiotherapist to further ensure safety.

Posture changes during horseback riding are assessed using the **Posture Assessment Scale**, developed by Bertoti (21). Bertoti's test was used to monitor and evaluate postural changes in children with AS; during therapeutic horse riding the positioned location and symmetry of 5 areas of the body were studied: 1) head and neck; 2) shoulders and scapulae; 3) torso; 4) spine; and 5) the pelvis. One score (1 to 3) was given for each of the five sections of the scale. The total score (TS) is in the range of 5 to 15 points.

Parents were asked to complete **Developmental Coordination Disorder Questionnaire (DCDQ'2007)** to measure their child's coordination in daily functional activities. DCDQ-2007 cannot be used to diagnose DCD (22). This 15-item questionnaire comprises three subscales: 1) Control during movement (throwing a ball, catching a ball, hitting a ball/birdie, jumping, running, and planning an activity), max score of 30; 2) Fine motor/handwriting (writing speed, legibility, effort and pressure, cuts), max score of 20; and 3) General coordination (learning new motor tasks, e.g., swimming, rollerblading, tidying up, putting on shoes, tying shoes, dressing, etc., "Bull in China shop", "Does not fatigue"), max score of 25. The total score (TS) amount is between 15 to 75; it usually takes about 10-15 minutes to complete the questionnaire; DCDQ-2007 is self-administered by the parents, using a 5-point Likert scale, ranging from 1 ('not at all like your child') to 5 ('extremely like your child'). For

the purpose of this study, the first age group associated with DCDQ'2007 (5 years 0 months to 7 years 11 months) was used. A Total Scores of 46 or lower is indicative of, or Suspect for DCD (22).

Paired samples T-test was used to compare the data obtained before and after the Therapeutic riding, i.e., input and output analysis. For Bertoti test, P-value < 0.001 was considered significant. For Developmental Coordination Disorder Questionnaire (DCDQ'2007), P-value<0.05 was considered significant.

Inclusion/Exclusion criteria are as follows:

Inclusion factors: primary diagnosis of Asperger's syndrome; confirmed diagnosis, based on expert clinical opinion of a licensed medical professional, physician's approval for inclusion of each child, parents' consent for the inclusion of their children, proven ability of the child to follow verbal instructions, before seeking treatment at Khan Asparuh Equestrian Sports facilities, Sofia; the child should have no regular horseback riding experience. **Exclusion factors:** other therapies in which the participant is bound at the same time, if any medications were changed in the course or a month prior to the respective pilot study, disorders restricting horse riding for the respective applicant.

Ethical considerations

Confidentiality is an important consideration, that is why the subjects were assessed individually and both parents and participants gave an informed agreement for each child participate in this research.

The therapy program

The structure of each therapeutic session was composed of a preparatory, basic, and final section. The child becomes acquainted with the new environment. Each session included caring for the horses with all the necessary additional activities, such as feeding and grooming, to create a close contact between the child and the horse. The riding session begins with a horse walk, during which the child is taught to take and hold two positions: a) basic riding position, and b) position backward facing. The training includes exercising of the upper limbs, torso flexion, stretching and rotating, abdominal and spinal musculature exercises and some additional exercises and games. By the 10th week of treatment, the program was enriched with riding exercises through various turns in the form of eights and zigzags. The therapy was performed under the direct supervision of a knowledgeable horse physiotherapist. To maintain the interest and enthusiasm of the children, additional therapeutic activities were included, such as ball and ring games, photos, etc. Very exact, short, and clear verbal guidelines were used during all the therapeutic sessions.

RESULTS

Posture Assessment Scale (Bertoti scale)

In the beginning of the research (first session), an average of 7.4 points were registered under Bertoti scale, and in the end (last session) – 11.2 points out of 15 points max. (SD=1.34) ($p \leq 0.001$) (**Figure 1**).

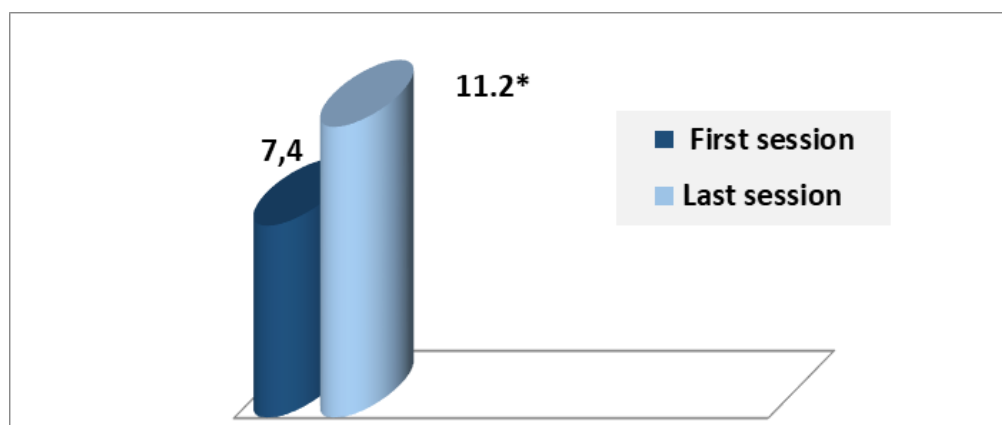


Figure 1. Comparison of Bertoti's scale values at the beginning and end of treatment.

The Bertoti's scale evaluates the visible quality changes in the position and symmetry of different parts of the body, during the horse riding, which

are then transformed into a quantitative score. There were positive changes in the postural response while horse riding among children with

AS. We registered improvement in the head position; at the end of the day the AS children had corrected their lateral flexion and were able to keep their heads in average position for a longer time. In addition, we observed a more upright sitting position, the protraction of the shoulder blades was reduced, the position of the shoulders - corrected, and the symmetry of the torso and pelvis - improved. In our view this is due to the rhythmic oscillating movements on the horseback which stimulate the dynamic balance and helped improve their motor control at the end of the therapeutic riding.

Developmental Coordination Disorder Questionnaire (DCDQ'2007)

The results of DCDQ'2007 registered positive changes in Control during movement, Fine motor/handwriting and General coordination. The changes in Control during movement were statistically reliable: from 11.40 before

(SD=2.40) to 13.20 at the end of the therapy course (SD=2.39) (p≤0.001). There was a statistically significant difference registered in General coordination: from 10.40 (SD=2.07) before the start of the therapy to 13.20 (SD=2.77) at the end of treatment (p=0.002).

The results for Fine Motor were not statistically different in the beginning (10.6) and in its end (11.20). This was expected due to the specific movements of the therapeutic horse riding, which affects more the general motor movement skills, the effects on the fine movements assessed with the questionnaire were less than the effect on the overall coordination. The total score of 29.60 points (SD=5.86) in the beginning of the course increased to 37.60 (SD=6.99) at the end, which, in our opinion is insufficient; the values confirmed the Developmental Coordination Disorder (**Table 1, Figure 2**). The results show that children with AS; participants in our research, need additional motor education (**Table 1**).

Table 1. Value changes registered by the sub-scales of Developmental Coordination Disorder Questionnaire

Sub-scales	Before treatment (mean ± SD)	After treatment (mean ± SD)	T	P
Control During Movement	11.40±2.41	13.20±2.39	-9.000	0.001
Fine Motor/Handwriting	10.60±1,52	11.20±1.92	-2.449	0.070
General Coordination	10.40±2,07	13.20±2.77	-7.483	0.002
Total score	29.60±5,86	37.60±6,99	-2.446	0.071

p < 0.05 statistically significant compared to the first session.

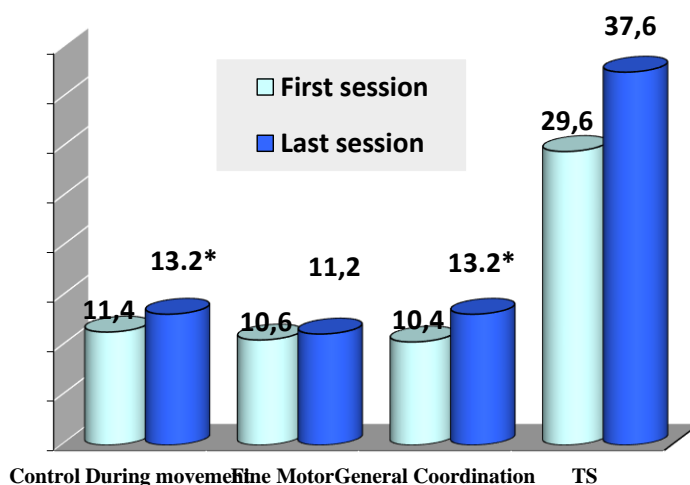


Figure 2. Comparison of Developmental Coordination Disorder Questionnaire (DCDQ'2007) at the beginning and end of treatment

DISCUSSION

This study aims to present an alternative therapy methodology designed to improve movement capability of children with AS. There is no routine method of therapeutic riding for children with AS. The program for this study was prepared according to our pre-established protocol (18). Participants in this study, improved posture and vastly corrected their body position at the end of each therapeutic session. In our view the reason for this betterment is the natural movement of the animal and the need for the child's body to balance on the horseback during the riding exercise. This need has mobilized various muscular groups in their body, in general, and particularly the spinal muscles; and so, it helped to decrease their hypotonia. Repeated rhythmic vibrations and graceful movements in four different plans during the time of the therapeutic sessions were taken in, first, from the pelvis and this helped to stabilize it. The need for young riders to maintain their stability on horseback during the riding exercise requires a continuous alternation of muscle groups that are agonists and antagonists, i.e., spinal, and gluteal musculature relative to abdominal musculature. During the therapy program the children with AS pursued to correct and maintain the necessary horse-riding posture. Bertoti's test provides information on the correction of posture while riding. To assess postural reactivity in everyday life, it is necessary to do additional tests.

Despite not being described in DSM 5 as significant factors, milder motor disorders in Asperger Syndrome can affect children's ability to perform effectively purposeful movements and participate in activities suitable for their development, communication, social interactions and efficiency in everyday activities related to basic and fine motor movements. This conclusion is not far from the results obtained by (23) Leary who studied the relationship between the symptoms, typical for movement disorders, and the symptoms of autism and how the dysfunctional movements significantly influence the human experience of people with ASD. This also proves the argument that the movement skills are significantly affected in the group of

children with ASD and highly correlated with the degree of autism severity and of the IQ (24). The sensory integration and the transfer of newly acquired motor skills in different settings are the most difficult processes for the participants.

One of the main conclusions from this pilot research is that Therapeutic riding influences beneficially the balance and poor motor control of children with AS. The natural movements of the horse are a significant challenge for these children because they get new motor sensations provoked by the oscillations of the horses back (25). The many rhythmic vibrations and smooth movements in the four different plans are transmitted through the pelvis of the young riders; as a result improve their head position and posture while riding. (26). Children with AS actively take advantage of the horse's warmth and transfer it in a relaxing and restful manner. According to Milander (15), children who are afflicted with any kind of disorder from the autism spectrum and who avoid any physical or emotional intimacy demonstrate a readiness to accept the proximity of the horse. Heffernan (27) argues that due to the relaxation achieved during horse riding, the stereotypical movements are vastly reduced and attention is increased. This promotes calm work without stress.

The American Psychiatric Association's Manual of Diagnosis and Statistics of Mental Disorders (DSM-5) confirms that motor impairments can affect children's ability to perform daily activities appropriate to their development and social communication. All the research data, as well as the results of our study, prove the necessity of active influence on the motor deficit for children with AS. This means that a systematic assessment of movement abilities should be considered as a routine investigation among children with AS. All researchers, health and sport professionals and parents were encouraged by the positive results obtained. However, we believe that the good results achieved in all the different motor activities of children with Asperger's syndrome are encouraging in terms of improving their motor skills in general.

CONCLUSION

The six-month pilot study among children with Asperger Syndrome achieved a positive effect on posture, balance, spatial body control, Motor control and General coordination while overcoming the special horse track. This makes us believe that therapeutic riding can improve motor planning, motor performance, and arranging motor tasks.

It is necessary to actively influence the movement deficit and to systematically assess the movement abilities of children with AS. Their involvement in various activities, such as therapeutic riding sessions, can benefit everyone – experts, parents and last but not least, the children themselves. Additional assessments with similar motor tests are justifiable. Although we cannot draw exact conclusions, the results from this research show that after applying Therapeutic Riding there is a positive change in the motor abilities of children with Asperger's Syndrome.

REFERENCES

1. Barahona-Corrêa, J., and Filipe, C., A Concise History of Asperger Syndrome: The Short Reign of a Troublesome Diagnosis. *Frontiers in psychology*, 6 (2024), 2016. <https://doi.org/10.3389/fpsyg.2015.02024>
2. Miller, J., and Ozonoff, S., Did Asperger's cases have Asperger disorder? A research note. *Journal of Child Psychology and Psychiatry*; 38(2): 247-51, 2012. <https://doi.org/10.1111/j.1469-7610.1997.tb02354.x>
3. Wing L. Asperger's syndrome: a clinical account *Psychological Medicine*, 1981, 11, 115-129 DOI: 10.1017/s0033291700053332, Accessed 29.03.2018.
4. Matthew J. et al Prevalence of Autism Spectrum Disorder Among Children Aged 8 Years — Autism and Developmental Disabilities Monitoring Network, 11 Sites, United States, *MMWR Surveill Summ*; 69 (SS-4):1-2., 2020/69(4);1–12, <http://dx.doi.org/10.15585/mmwr.ss6904a1>
5. Asperger, Autism Network – AANE, Recovered <https://www.aane.org/>; Accessed 12 July 2020
6. McCleery, J., Elliott, N., Sampanis, D., Stefanidou, C., Motor development and motor resonance difficulties in autism: relevance to early intervention for language and communication skills. *Front Integr Neurosci* (7):30, 2013. <https://doi.org/10.3389/fnint.2013.00030>
7. DSM-5 Changes: Implications for Child Serious Emotional Disturbance. CBHSQ Methodology Report (2016) Center for Behavioral Health Statistics and Quality, Substance Abuse and Mental Health Services Administration, Rockville, MD. <https://www.ncbi.nlm.nih.gov/books/NBK519712/>.
8. Noterdaeme, N., Wriedt, E., Höhne, C., Asperger's syndrome, and high-functioning autism: language, motor and cognitive profiles, *European child & adolescent psychiatry* 19 (6):475-481, 2009. <https://doi.org/10.1007/s00787-009-0057-0>
9. Zadnikar, M., and Kastrin, A., Effects of hippotherapy and therapeutic horseback riding on postural control or balance in children with cerebral palsy: a meta-analysis. *Dev Med Child Neurol* 53(8):684-691, 2011. <https://doi.org/10.1111/j.1469-8749.2011.03951.x>
10. Miyahara, M., Tsujii, M., Hori, M., Nakanishi, K., Brief report: motor incoordination in children with Asperger syndrome and learning disabilities. *Journal of Autism and Developmental Disorders*, 27(5), 595-603, 1997. <https://doi.org/10.1023/A:1025834211548>
11. Siaperas, P., Ring, H., McAllister, C., et al. Atypical Movement Performance and Sensory Integration in Asperger's Syndrome *J Autism Dev Disord* 42: 718–725, 2012. <https://doi.org/10.1007/s10803-011-1301-2>
12. Weimer, A., Schatz, A., Lincoln, A., Ballantyne, A., Trauner, D., “Motor” impairment in Asperger syndrome: Evidence for a deficit in proprioception. *Developmental and Behavioral Pediatrics* 22(2): 92-101, 2001. <https://doi.org/10.1097/00004703-200104000-00002>
13. Anderson, S., Meints, K., Brief Report: The Effects of Equine-Assisted Activities on the Social Functioning in Children and Adolescents with Autism Spectrum Disorder. *Journal of autism and developmental*

- GENCHEVA N., et al.*
- disorders* 46(10): 3344–3352, 2016. <https://doi.org/10.1007/s10803-016-2869-3>
14. Smith, D., Hippotherapy and Therapeutic Riding: Practicing Social Workers and Undergraduate Social Work Students, *Social Work Theses* 59:7-11, 2010. https://digitalcommons.providence.edu/social_wrk_students/59/
 15. Milander, M., Bradley, S., Fourie, R., Equine-assisted therapy as intervention for motor proficiency in children with autism spectrum disorder: *Case studies South African Journal for Research in Sport, Physical Education and Recreation* 38(3): 37-49, 2016.
 16. Ward, S., Whalon, K., Rusnak, K., et al. The Association Between Therapeutic Horseback Riding and the Social Communication and Sensory Reactions of Children with Autism. *J Autism Dev Disord* 43: 2190–2198, 2013. <https://doi.org/10.1007/s10803-013-1773-3>
 17. Gencheva, N., and Chalgazhieva, D., Changes in communication skills in children with spectrum disorders after therapeutic riding. Congress Proceedings 9th FIEP European Congress & 7th International Scientific Congress Sport, Stress, Adaptation, National Sports Academy, Sofia: 624-628, 2014.
 18. Gencheva, N., and Zaharieva, D., The Fit-ball balance training in children with bad posture Book of proceedings „FIS Communications” University of Nis: 257-263, 2013.
 19. Bremer, E., Crozier, M., Lloyd, M., A systematic review of the behavioral outcomes following exercise interventions for children and youth with autism spectrum disorder. *Autism* 20(8):899-915, 2016. <https://doi.org/10.1177/1362361315616002>
 20. Al-Shirawi, M., Al-Zayer, R., The Effect of Therapeutic Horseback Riding on Sensory Processing of Children with Autism. *European Scientific Journal*, ESJ 14(15): 364-386, 2018. <https://doi.org/10.19044/esj.2018.v14n15p364>
 21. Bertoti, D., Effect of therapeutic horseback riding on posture in children with cerebral palsy. *Physical Therapy*, 68(10):1505-1512, 1988. <https://pubmed.ncbi.nlm.nih.gov/3174832/>
 22. Schoemaker, M., Flapper, B., Reinders-Messelink, A., & de Kloet, A., Validity of the motor observation questionnaire for teachers as a screening instrument for children at risk for developmental coordination disorder. *Human Movement Science*, 27, 190–199, 2008.
 23. Leary, M., and Hill, D., Moving on: autism and movement disturbance. *Mental Retardation* 34(1):39-53, 1996.
 24. Hilton, C., Wente, L., La Vesser, P., Ito, M., Reed, C., Herzberg, G., Relationship between motor skill impairment and severity in children with Asperger syndrome. *Research in Autism Spectrum Disorders*, 1(4): 339–349, 2007. <https://doi.org/10.1016/j.rasd.2006.12.003>
 25. Gencheva N. Therapeutic riding, Bolid Ins, Sofia, 2017
 26. Bass, M., Duchowny, C., Llabre, M., The Effect of Therapeutic Horseback Riding on Social Functioning in Children with Autism. *J Autism Dev Disorder*, 39: 1261–1267, 2009. <https://doi.org/10.1007/s10803-009-0734-3>
 27. Heffernan, K., The effect of an equine assisted therapy (EAT) program on children’s occupational performance – a pilot study, *Irish Journal of Occupational Therapy* 45 (1): 28-39, 2017. <https://doi.org/10.1108/IJOT-02-2017-0005>