TILTAI, 2024, 1, 75–88 ISSN 1392-3137 (Print), ISSN 2351-6569 (Online); DOI: https://dx.doi.org/10.15181/tbb.v92i1.2625

THE IMPACT OF THE 'ANIMAL FUN' PROGRAMME ON PHYSICAL AND FUNCTIONAL CHANGES IN CHILDREN WITH AUTISM SPECTRUM DISORDER: A CASE ANALYSIS

Laura Jankovskytė, Vaida Aleknavičiūtė-Ablonskė
Šiauliai State College

Abstract
Autism Spectrum Disorder (ASD) is a developmental disability that affects progress. Children with ASD often experience motor skill impairments. The 'Animal Fun' programme aims to develop motor, cognitive and social skills in children aged three to six. The study aimed to evaluate the effectiveness of the 'Animal Fun' programme on physical and functional changes in a seven-year-old child with autism spectrum disorder. During the study, there were three assessments. Test I was conducted before the intervention, test II was performed after five weeks, and test III was carried out after ten weeks of 'Animal Fun' intervention. The study assessed static and dynamic balance, the strength of the grip, core and lower limb muscles, and psychomotor reaction speed. It was found that the 'Animal Fun' programme improved results in static and dynamic balance, and abdominal and lower limb muscle strength.
KEY WORDS: static and dynamic balance, muscle strength, psychomotor reactions.

Anotacija
Autizmo spektro sutrikimas (ASS) – tai vystymosi negalia, dėl kurios sutrinka raida. Vaikams, turintiems ASS, dažnai pasireiškia motorinių įgūdžių sutrikimai. „Animal Fun" programa skirta lavinti 3–6 metų amžiaus vaikų motorinius, kognityvinius ir socialinius įgūdžius. Tyrimo tikslas – įvertinti šios programos veiksmingumą, siekiant fizinių ir funkcinių septynerių metų vaiko su autizmo spektro sutrikimu rodiklių pokyčių. Vykdant tyrimą atlikti trys testavimai: I testavimas – prieš intervenciją, II testavimas – po 5 savaičių intervencijos ir III testavimas – po 10 savaičių intervencijos. Vertinta statinė ir dinaminė pusiausvyra, plaštakų, liemens korseto ir apatinių galūnių raumenų jėga, psichomotorinių reakcijų greitis. Nustatyta, kad „Animal Fun" programa pagerino statinės ir dinaminės pusiausvyros, pilvo ir apatinių galūnių raumenų jėgos rezultatus.
PAGRINDINIAI ŽODŽIAI: statinė ir dinaminė pusiausvyra, raumenų jėga, psichomotorinės reakcijos.
DOI: https://dx.doi.org/10.15181/tbb.v92i1.2625

Introduction

Autism spectrum disorder (ASD) is a developmental disability that affects developmental progress (Wiggins et al., 2019). Children with ASD often exhibit motor skill impairments (Iliadis, Apteslis, 2020). The number of identified cases of ASD in children in Lithuania from 2016 to 2021 increased from 105.6 to 238.9

Received 05/05/2024. Accepted 16/05/2024

(per 100,000 children). Analysing the data by age group revealed that the highest number of ASD cases in childhood were identified in children aged four to six from 2016 to 2021, and in 2016 in children aged seven to ten. The fewest cases of ASD were identified in children aged up to three from 2016 to 2017, and from 2018 to 2021 in adolescents aged 15 to 17 (Institute of Hygiene, 2022).

Children with ASD experience communication, learning and behavioural difficulties (Plaza-Diaz et al., 2022). An increasing number of scientific articles demonstrate that children with ASD exhibit various motor impairments, including coordination issues, instability in posture, and impaired balance. Additionally, children with ASD tend to have lower muscle strength and endurance, which may lead to reduced physical activity (Ansari et al., 2021; Iliadis, Apteslis, 2020; Huang, Du, Liu, Tan, 2020).

It has been established that interventions lasting no less than 12 weeks and involving physical activity exercises improve motor skills in children with ASD (Huang, Du, Liu, Tan, 2020; Iliadis, Apteslis, 2020). More complex balance exercises have been proven to increase lower limb muscle strength and foot pressure force. Foot pressure force is important for maintaining balance during exercise (Stins, Emck, 2019; Rosca et al., 2022). A six-week balance training programme has been found to improve balance in children with ASD (Stins, Emck, 2019), while an intervention incorporating playful elements enhances children's balance, and frequent repetition of movements promotes variability in motor skills (Rosca et al., 2022). Physical activity is crucial for children with ASD during interventions with various exercises (De Oliveira et al., 2018). It has been demonstrated that children diagnosed with ASD have impaired balance and reduced muscle strength and endurance. The 'Animal Fun' programme, which is designed to improve motor skills in children with ASD, has not been implemented in Lithuania. Scientific articles show that physiotherapy interventions for children with ASD are effective in improving balance, muscle strength and endurance. However, such interventions are usually applied separately to develop these three impaired components. This study aims to evaluate the effectiveness of the 'Animal Fun' programme on physical and functional changes in a child with autism spectrum disorder.

1. Methods

The study involved a seven-year-old male child diagnosed with autism spectrum disorder. The participant attends a mainstream school, but follows a modified learning programme. The chosen instrumentation could be applied to both typically developing and atypical development children. Therefore, the evaluation criteria for all instruments used were not adjusted based on the diagnosis of the research

participant as autism spectrum disorder. The main selection criteria applied to the research participant were age, and cognitive and or neurological impairments that could potentially influence the course of the study. The study was conducted after obtaining written consent from the parents of the research participant, and from the Helsinki Declaration of Principles on the Ethics of Human Experimentation of 1964.

The evaluation of static balance was performed when a modified version of the Flamingo Stand Test was used. During the test, the research participant stood on his dominant leg, with the other leg bent at the knee and hip joints, so that the heel of the raised foot was aligned with the supporting knee joint. The participant's hands were placed on the waist. When the raised foot touched the ground, the time ended. This test was performed twice, and the shorter time was recorded. The time was counted to maintain balance from the initial position until the balance was lost, and was measured in seconds using a stopwatch (Salar et al., 2014).

The evaluation of dynamic balance was performed using the 'Tandem Walk Test'. During the test, the research participant was required to walk 15 steps in a straight line, with the heel of one foot placed in front of the toes of the other foot. The participant's result was the number of steps taken. The test was stopped if the participant deviated from the line while walking. This test was performed twice, and the higher number of steps completed was recorded (Salar et al., 2014).

The assessment of forearm muscle strength was performed using a dynamometer. During the test, the research participant sat on a chair, with the forearm snug against the torso and the elbow bent at a 90-degree angle. In this position, the participant squeezed the dynamometer with maximum effort. The test began with the right hand, followed by the left hand; with each hand tested twice, and the higher result was recorded for each hand (Labanauskaitė et al., 2014).

The assessment of abdominal muscle strength was performed using the 'Sit and Reach' test. During the test, the participant sat on a mattress with a straight back, palms above the head, knees bent at a 90° angle over the hip and knee joints, and with the feet resting on the ground. During the test, the participant had to sit up from a lying position so that the elbows reached the knees, and return to the lying position. The test result was the number of sit-ups and returns performed within a specified time (1 repetition = sitting up from a lying position and returning to it (Labanauskaitė et al., 2014).

The evaluation of lower limb muscle endurance was performed using the 'Squat and Stand' test. During the test, the research participant stood with the feet shoulder-width apart, toes rotated outward at a 45° angle, and arms extended forward. During the test, the participant had to squat until the hips and buttocks reached knee level. The research participant had to perform as many squats as possible in

30 seconds. The test result was the number of squats completed (Labanauskaitė et al., 2014).

The assessment of psychomotor reactions to light stimuli was performed using a reactionometer. During the test, the research participant sat on a chair at a table with his arms bent at a 90° angle at the elbow joints. Responding to light signals appearing on the reactionometer, the participant pressed the buttons on the reactionometer with the index finger. When the green light was on, the button on the right-hand side was pressed with the right hand, and when the red light was on, the button on the left-hand side was pressed with the left hand (Mockevičienė et al., 2022).

The duration of the study was ten weeks, with test II conducted after five weeks, and test III after ten weeks of intervention. All evaluations were performed three times (Fig. 1), evaluating static and dynamic balance, forearm, abdominal, and lower limb muscle strength, and psychomotor reaction speed. Between the test I, II and III testing sessions, the 'Animal Fun' programme was implemented to improve a child's motor skills. The 'Animal Fun' programme consists of nine modules. The first four modules focus on trunk and lower limb coordination (walking, jumping on two legs or one leg, weight-shifting jumps between legs), and object control (throwing, catching, kicking). The next four modules focus on fine motor skills, including core, shoulder and hip stability, motor activity sequence, object control, and functional use of hand skills (using pencils, scissors or keyboards). The ninth and last module is devoted to social and emotional development. It includes the skills of laughter, relaxation and emotion recognition (Piek et al., 2015). From the nine modules, five modules were applied in the intervention. Module 1 was devoted to body control. Most attention was paid to the coordination and stability of the trunk and lower limbs. In this module, exercises for balance improvement were performed, as well as climbing on bars or ropes (e.g. walking like an emu). Module 2 was devoted to promoting movement. Exercises were performed that encouraged running and jumping by imitating animal movements (e.g. jumping like kangaroos). Module 3 was devoted to controlling contralateral movements. Exercises were performed by imitating animal movements, and movements of the opposite limbs were executed (e.g. crawling like bears). Module 4 was devoted to body control. The focus was on the coordination and stability of the trunk and upper limbs. Exercises were performed that encouraged the improvement of trunk stability and strengthened the upper limb muscles by imitating animals (e.g. lying down like an angry cobra). Module 5 was devoted to fine motor planning. In implementing the module, exercises for fine motor skills were performed. The 'Animal Fun' programme consists of 96 exercises, and 61 of them were used in the intervention. The 'Animal Fun' programme was applied four times a week for 30 minutes.

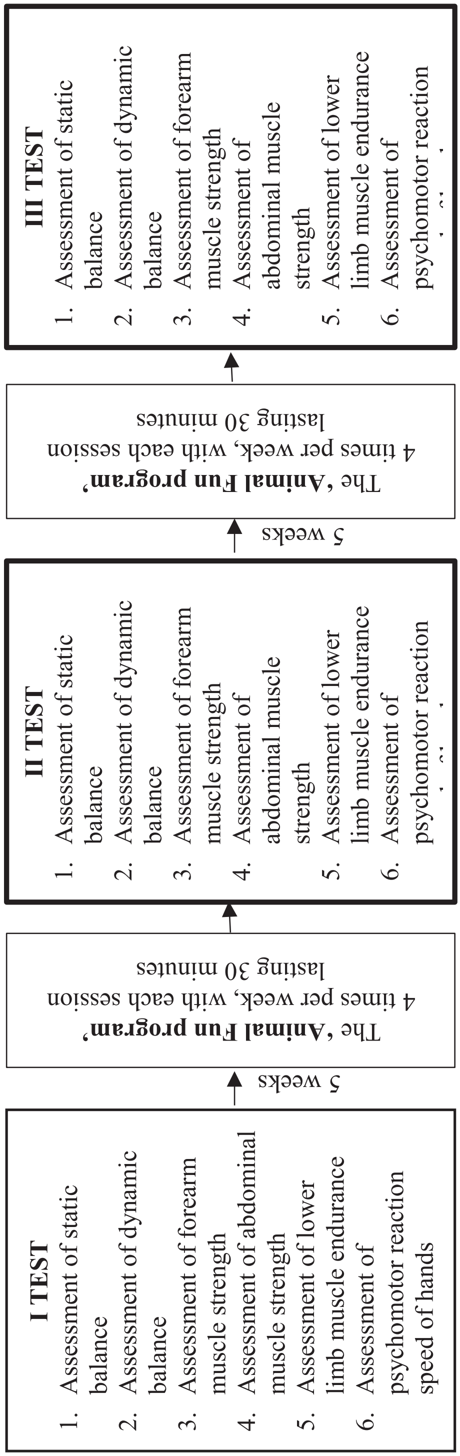

Figure 1. The study's design

Data description and comparative analysis: The research data underwent analysis using descriptive statistical methods facilitated by the Microsoft Excel 2019 software package. This data processing procedure encompassed the computation and comparison of parameters before and after the intervention. The analytical framework examined disparities concerning temporal factors (pre- and post-intervention) results. When calculating the data, statistical significance was not considered, as a single-case study was chosen to be conducted. This is a qualitative comparative case study, employing testing and measurement.

2. Results

Comparing *the results of static balance assessment* (Fig. 2), between the testing sessions, it was found that static balance tended to deteriorate by test II (0.7 sec) compared to the test I session. It also tended to increase by test III (6.48 sec) compared to the test II session, and by III (5.78 sec) compared to the test I session.

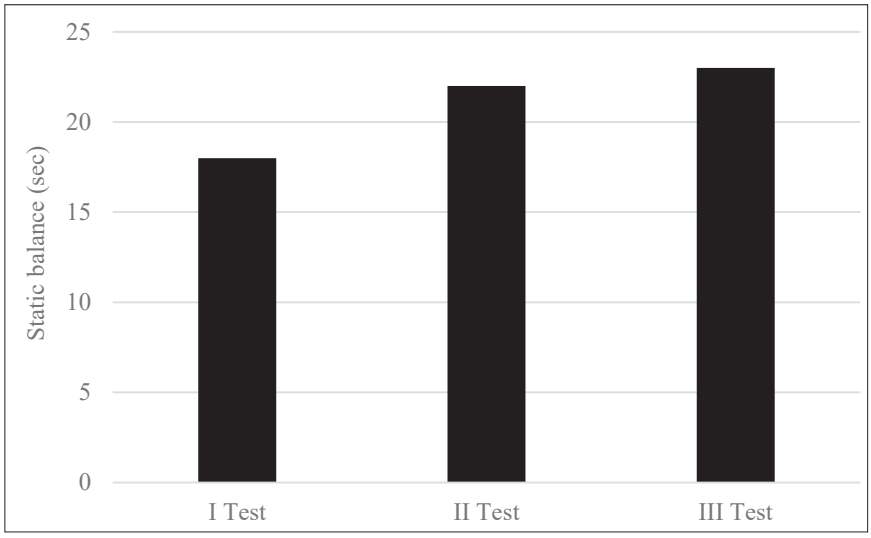

Figure 2. The results of the static balance assessment

Comparing *the results of dynamic balance assessment* (Fig. 3), between the testing sessions, it was found that dynamic balance tended to improve by test II (8 steps) compared to the test I session. Dynamic balance remained unchanged in test III compared to the test II session, but dynamic balance tended to improve by test III (8 steps) compared to the test I session.

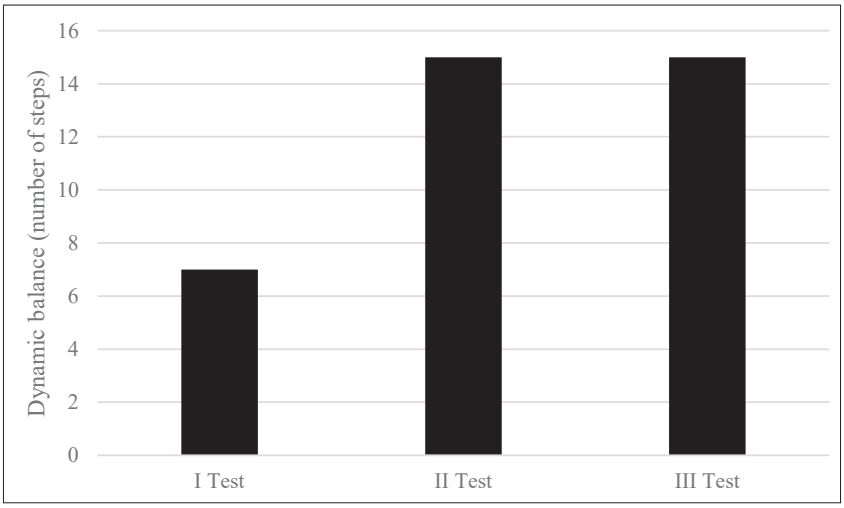

Figure 3. The results of the dynamic equilibrium assessment

Comparing *the results of the forearm muscle strength assessment* (Fig. 4), between the testing sessions, it was found that the strength of the forearm muscles of both the right and left arms tended to decrease by test II compared to the test I session (correspondingly 1 kg and kg). The strength of the forearm muscles of the left arm tended to increase by III (3 kg) compared to the test II session and by III (1 kg) compared to the test I session. However, the strength of the forearm muscles of the right arm remained unchanged in III compared to the test II session, and tended to decrease by III (1 kg) compared to the test I session.

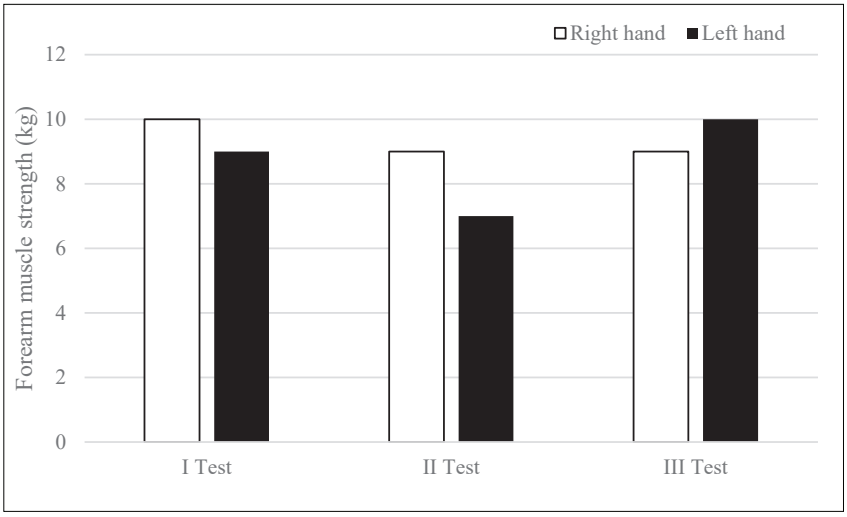

Figure 4. The results of muscle strength in the right and left forearm assessments

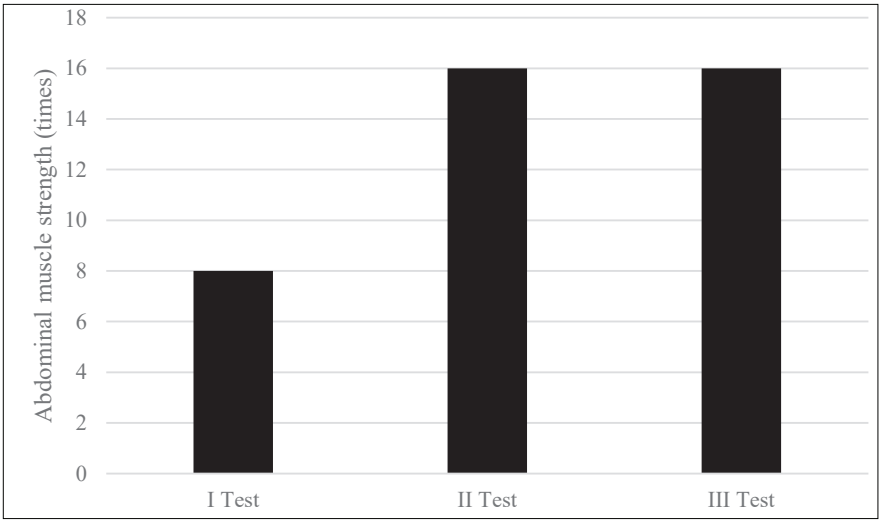

Figure 5. The results of the abdominal muscle strength assessment

Comparing *the results of abdominal muscle strength assessment* (Fig. 5), between the testing sessions, it was found that abdominal muscle strength tended to improve by II (eight sit-ups) compared to the test I session. However, abdominal muscle strength remained unchanged in III compared to the test II session, and abdominal muscle strength tended to improve in III (eight sit-ups) compared to the test I session.

Comparing *the results of the lower limb muscle endurance assessment* (Fig. 6), between the testing sessions, it was found that lower limb muscle endurance tended to improve by test II (4 squats) compared to the test I session. Additionally, lower limb muscle endurance tended to improve by test III (1 squats) compared to the test II session, and lower limb muscle endurance tended to improve by test III (5 squats) compared to the test I session.

Comparing the results of the average speed assessment of psychomotor reactions of the hands (Fig. 7) between the testing sessions, it was found that the psychomotor reaction speed of the right hand tended to deteriorate by 143 ms, while that of the left hand improved by 95 ms in the test II session compared to test I. However, the psychomotor reaction speed of the right hand tended to improve by 183 ms, while that of the left hand deteriorated by 83 ms in the test III session compared to test II. Moreover, the average speed of psychomotor reactions of both the right and left hands tended to improve in the test III session compared to test I, with respective improvements of 40 ms and 12 ms.

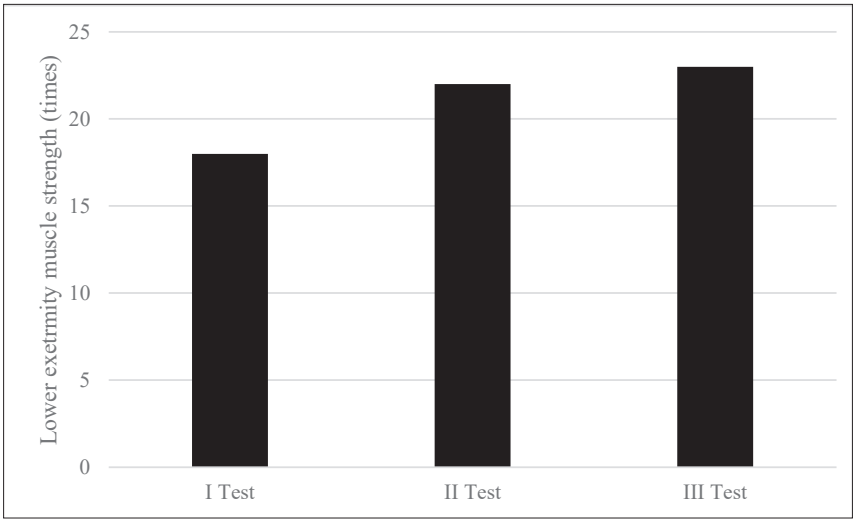

Figure 6. The results of the lower extremity muscle strength assessment

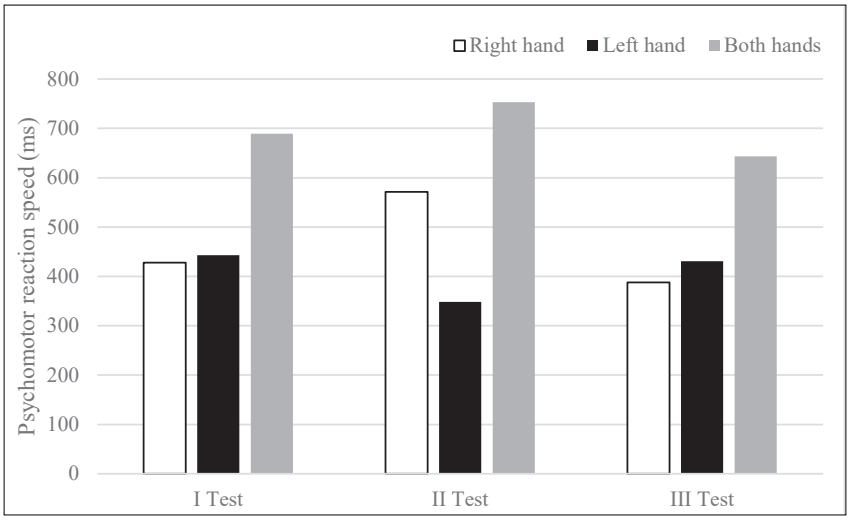

Figure 7. The results of the psychomotor reaction speed assessment

Comparing the results of the average speed assessment of psychomotor reactions of both hands (Fig. 7) between the testing sessions, it was found that the average speed of psychomotor reactions of both hands tended to deteriorate by 64 ms in the test II session compared to test I. However, the average speed of psychomotor reactions of both hands tended to improve by 110 ms in the test III session compared to test II, and by 46 ms compared to test I.

3. Discussion

The study aimed to evaluate the effectiveness of the 'Animal Fun' programme on physical and functional changes in children with autism spectrum disorder. It was found that the application of the 'Animal Fun' programme improves and develops children's motor skills (Piek et al., 2015).

It has been established that physical activity programmes improve the static balance of children with ASD (Ansari et al., 2021). Children's balance is associated with the control of fundamental motor skills (Cupryś et al., 2014). Static balance demonstrates a person's ability to maintain a proper posture in a stationary position (Banerjee, Ghosh, 2021). During the study, it was found that the static balance deteriorated by 10.37% between the test I and test II sessions. It has been demonstrated that poor results in assessing static balance may be associated with neuropsychological problems and poor physical fitness (Salar et al., 2014).

Dynamic balance is important for performing tasks and maintaining a stable position (Banerjee, Ghosh, 2021). Studies show that physical activity exercises improve the dynamic balance of children with ASD (Ansari et al., 2021). During the study, we found that dynamic balance tended to improve by 53.34% between the test I and test II sessions. It has been demonstrated that physical exercise programmes, which affect balance directly or indirectly, improve the dynamic balance of children with ASD. It is known that children with ASD have impaired social skills, causing them to lack confidence and experience anxiety when performing physical activity tasks (Stins, Emck, 2019). Balance training exercises reduce children's anxiety, increase self-confidence, and improve dynamic balance. It has been shown that improving balance is also influenced by strength training exercises. During exercise, balance reflexes help control body balance, and at a higher level of the nervous system (cerebral cortex and cerebellum), individuals consciously strive to control balance. The 'Animal Fun' programme includes muscle-strengthening exercises (Sam, Smith, Kai, 2017; De Oliveira et al., 2018).

Children with ASD have impaired motor skills, lower muscle strength, hypotonia, and poor sensory-motor functioning. Due to these reasons, their level of physical activity is lower, which is closely related to their lower muscle strength (Kern et al., 2011). During the study, we found that the grip strength of the left forearm muscles deteriorated by 22.22% between the test I and test II sessions. The grip strength of the right forearm muscles tended to decrease by 10% between the test I and test II sessions. The 'Animal Fun' programme includes muscle-strengthening exercises (De Oliveira et al., 2018). However, only a few exercises in the 'Animal Fun' programme are specifically designed to increase grip muscle strength. The 'Animal Fun' programme is focused on developing upper limb muscle strength,

without emphasising grip muscle strength training. Grip strength is related to forearm muscle strength. Grip strength also indicates the development of fine motor skills, which children with ASD often struggle with (Travers et al., 2016).

During the study, we found that abdominal muscle strength increased by 50% between the test I and test II sessions. Scientific research indicates that increased muscle strength in children with ASD is associated with long-term physical activity (Pan et al., 2016; Ansari et al., 2021). The 'Animal Fun' programme lasts for ten weeks, and includes muscle-strengthening exercises such as rolling over without using the hands or legs, only activating abdominal and neck muscles (Piek et al., 2015; Mancini, Rigoli, Cairney, Roberts, Piek, 2016).

It is known that physical activity increases muscle endurance in children with ASD (Pan et al., 2016). During the study, we found that lower limb muscle endurance improved by 18.18% between the test I and test II sessions. Research shows that individual physiotherapy interventions involving physical activity exercises improve muscle endurance in children with ASD. Physical activity exercises should be applied for at least four weeks to improve muscle endurance results (Labanauskaitė et al., 2014). Additionally, scientific studies indicate that balance training exercises affect muscle endurance. As the balance is trained, muscle endurance also increases. During balance training exercises, activating the core muscles is necessary to maintain body stability (Salar et al., 2015).

It has been demonstrated that psychomotor abilities determine the structure of motor skills. Psychomotor skills reflect how each movement is purposefully executed within the totality of movements (Krivokapić, Tanase, 2016). It is known that the 'Animal Fun' programme is designed to develop children's motor skills (Piek et al., 2015). It has been established that reaction time is important for movement perception and execution (Mockevičienė et al., 2022). During the study, we found that the results of psychomotor reaction time for the right hand deteriorated by 25.04% between the test I and test II sessions. The psychomotor reaction time for the left hand improved by 21.44% between the test I and test II sessions. The psychomotor reaction time for both the right and left hands deteriorated by 8.49% between the test I and test II sessions. We believe that the deteriorated results may be related to individual characteristics of the child: a lack of concentration, and difficulty in focusing while performing the test.

It has been established that physical activity exercises are important for developing motor skills in children with ASD. Improving physical activity enhances motor skills. Fundamental motor skills include running, catching, jumping, and throwing movements. These movements are performed during physical activity (Ansari et al., 2021; Hassani, Shahrbanian, Shahidi, Sheikh, 2022). Applying the 'Animal Fun' programme improves children's specific movement skills. The imi-

tation of animal movements has a great impact on the improvement of movement performance skills. The programme includes exercises that encourage performing movements in a certain sequence. To perform an exercise correctly, it is necessary to isolate individual body parts first, and then gradually integrate them (De Oliveira et al., 2018). We believe that the implementation of the 'Animal Fun' programme could have contributed to the improved results of psychomotor reactions during the test II session.

Conclusions

We found that after the implementation of the 'Animal Fun' programme, the results of static and dynamic balance, as well as abdominal and lower limb muscle strength, tended to improve between the I, II and III testing sessions. However, grip strength results tended to deteriorate. The results of psychomotor reaction speed varied, initially showing an increasing trend, and later decreasing.

This study was conducted as a pilot study, so the conclusions drawn from the research cannot be generalised. Since the study was conducted using a single-case analysis, further research with a larger sample size is necessary, along with the evaluation of psychomotor reactions and lower limb assessment.

References

Allen, K. A., Bredero, B., Van Damme, T., Ulrich, D. A., Simons, J. (2017). Test of gross motor development-3 (TGMD-3) with the use of visual supports for children with autism spectrum disorder: validity and reliability. *Journal of autism and developmental disorders*, *47*, 813–833.

Ansari, S., Hosseinkhanzadeh, A. A., AdibSaber, F., Shojaei, M., Daneshfar, A. (2021). The effects of aquatic versus kata techniques training on static and dynamic balance in children with autism spectrum disorder. *Journal of Autism and Developmental Disorders*, *51*, 3180–3186.

Banerjee, S., Ghosh, S. S. (2021). A study on static balance of school children in India with different degrees of hearing impairement. *Journal of Physical Education and Sport*, *21* (5), 2722–2729.

De Oliveira, J. A., Rigoli, D., Kane, R., McLaren, S., Goulardins, J. B., Straker, L.M., Dender, A., Rooney, R., Piek, J. P. (2019). Does 'Animal Fun' improve aiming and catching, and balance skills in young children? *Research in Developmental Disabilities*, *1* (84), 122–30.

Hassani, F., Shahrbanian, S., Shahidi, S. H., Sheikh, M. (2022). Playing games can improve physical performance in children with autism. *International Journal of Developmental Disabilities*, *68* (2), 219–226.

Higienos institutas. (2022). *Vaikų ligotumo įvairiapusiais raidos sutrikimais apžvalga. Visuomenės sveikatos netolygumai.* https://www.hi.lt/leidinys-57/informaciniai-leidiniai/visuomenes-sveikatos-netolygumai-2022-nr-2-46-vaiku-ligotumo-ivairiapusiais-raidos-sutrikimais-apzvalga-2016-2021-m/

Huang, J., Du, C., Liu, J., Tan, G. (2020). Meta-analysis on intervention effects of physical activities on children and adolescents with autism. *International journal of environmental research and public health*, *17* (6), DOI: https//10.3390/ijerph17061950. https://pubmed.ncbi.nlm.nih.gov/32192008/

Iliadis, I., Apteslis, N. (2020). The role of physical education and exercise for children with Autism Spectrum Disorder and the effects on socialization, communication, behavior, fitness, and quality of life. *Dialogues in Clinical Neuroscience & Mental Health*, *3* (1), 71–81.

Karim, A. E., Mohammed, A. H. (2015). Effectiveness of sensory integration program in motor skills in children with autism. *Egyptian Journal of Medical Human Genetic*, *16* (4), 375–380.

Kern, J. K., Geier, D. A., Adams, J. B., Troutman, M. R., Davis, G., King, P. G., ... Geier, M. R. (2011). Autism severity and muscle strength: A correlation analysis. *Research in Autism Spectrum Disorders*, *5* (3), 1011–1015. https://www.sciencedirect.com/science/article/abs/pii/S1750946710001698

Koumenidou, M., Kotzamanidou, M. C., Panoutsakopoulos, V., Siaperas, P., Misailidou, V., Tsalis, G. A. (2023). The Long-Term Adaptations of a Combined Swimming and Aquatic Therapy Intervention in an Adult Person with High-Functioning Autism (Asperger's Syndrome): A Case Study. *In Healthcare*, *11* (22), 2986. https://www.mdpi.com/2227-9032/11/22/2986.

Krivokapić, D., Tanase, G. (2016). Methods for evaluation of some psychomotor abilities. *Sport Mont*, *14* (2), 17–19.

Labanauskaitė, I., Lileikytė, A., Vasilionytė, A., Dudonienė, V., Urbonavičius, V., Čižauskienė, S., Juknevičienė, R. (2014). Impact of physiotherapy on physical capacity of 7–11-year-old children with autism disorder. *Reabilitacijos mokslai: slauga, kineziterapija, ergoterapija*, *2* (11), 30. https://journals.lsu.lt/reabilitacijos-mokslai/article/view/837.

Mancini, V. O., Rigoli, D., Cairney, J., Roberts, L. D., Piek, J. P. (2016). The elaborated environmental stress hypothesis as a framework for understanding the association between motor skills and internalizing problems: a mini-review. *Frontiers in psychology*, *7*, 180438. https://www.frontiersin.org/journals/psychology/articles/10.3389/fpsyg.2016.00239/full

Mockevičienė, D., Šimkutė-Karalevičienė, I., Kreivinienė, B., Razbadauskas, A. (2022). Changes in the psychomotor reactions of six and seven-year-old children when applying physical therapy. *Tiltai: socialiniai mokslai*, *1*, 1–21.

Plaza-Diaz, J., Radar, A. M., Baig, A. T., Leyba, M. F., Costabel, M. M., Zavala-Crichton, J. P., Sanchez-Martinez, J., MacKenzie, A. E., Solis-Urra, P. (2022). Physical Activity, Gut Microbiota, and Genetic Background for Children and Adolescents with Autism Spectrum Disorder. *Children*, *9* (12), 1834. DOI: https//10.3390/children9121834; https://pubmed.ncbi.nlm.nih.gov/36553278/

Pan, C. Y., Chu, C. H., Tsai, C. L., Sung, M. C., Huang, C. Y., Ma, W. Y. (2017). The impacts of physical activity intervention on physical and cognitive outcomes in children with autism spectrum disorder. *Autism*, *21* (2), 190–202. https://journals.sagepub.com/doi/abs/10.1177/1362361316633562

Piek, J. P., Kane, R., Rigoli, D., McLaren, S., Roberts, C. M, Rooney, R., Straker, L. (2015). Does the Animal Fun program improve social-emotional and behavioural outcomes in children aged 4–6 years? *Human movement science*, *43*, 155–163. https://www.sciencedirect.com/science/article/abs/pii/S0167945715300142

Roșca, A. M., Rusu, L., Marin, M. I., Ene Voiculescu, V., Ene Voiculescu, C. (2022). Physical Activity Design for Balance Rehabilitation in Children with Autism Spectrum Disorder. *Children*, *9* (8), 1152. DOI: https//10.3390/children9081152. https://pubmed.ncbi.nlm.nih.gov/36010043/

Salar, S., Daneshmandi, H., Panaghi, L., Karimizadeh Ardekani, M., Nazari Sharif, H. (2015) The investigation of the relationship between core endurance with static and dynamic balance in children with autism spectrum disorder. *International Journal of Sport Studies*, *5* (1), 48–56.

Salar, S., Daneshmandi, H., Karimizadeh Ardakani, M., Nazari Sharif, H. (2014). The relationship of core strength with static and dynamic balance in children with autism. *Annals of Applied Sport Science*, *2* (4), 33–42. https://www.researchgate.net/profile/Sarvin-Salar/publication/327155349_The_investigation_of_the_relationship_between_core_endurance_with_static_and_dynamic_balance_in_children_with_Autism_Spectrum_Disorders/links/5b7d208e299bf1d5a71bcfa3/The-investigation-of-the-relationship-between-core-endurance-with-static-and-dynamic-balance-in-children-with-Autism-Spectrum-Disorders.pdf

Sam, K. L., Smith, A. W., Kai, L. S. (2017). Visual cognition and dynamic balance in persons with autism spectrum disorder. *International Journal of Social Science and Humanity*, *7* (5), 274–277. https://www.ijssh.net/vol7/833-EP0038.pdf

Sarabzadeh, M., Azari, B. B., Helalizadeh, M. (2019). The effect of six weeks of Tai Chi Chuan training on the motor skills of children with autism spectrum disorder. *Journal of bodywork and movement therapies*, *23* (2), 284–290.

Stins, J. F., Emck, C. (2019). Balance performance in autism: A brief overview. *Frontiers in psychology*. DOI: https//10.3389/fpsyg.2018.00901. https://pubmed.ncbi.nlm.nih.gov/29922206.

Travers, B. G., Bigler, E. D., Duffield, T. C., Prigge, M. D., Froehlich, A. L., Lange, N., ... Lainhart, J. E. (2017). Longitudinal development of manual motor ability in autism spectrum disorder from childhood to mid-adulthood relates to adaptive daily living skills. *Developmental science*, *20* (4), e12401. https://onlinelibrary.wiley.com/doi/abs/10.1111/desc.12401

Walicka-Cupryś, K., Przygoda, Ł., Czenczek, E., Truszczyńska, A., Drzał-Grabiec, J., Zbigniew, T., Tarnowski, A. (2014). Balance assessment in hearing-impaired children. *Research in developmental disabilities*, *35* (11), 2728–2734. https://www.sciencedirect.com/science/article/abs/pii/S0891422214002789

Wiggins, L. D., Rice, C. E., Barger, B., Soke, G. N., Lee, L. C., Moody, E., Edmondson-Pretzel, R., Levy, S. E. (2019). DSM-5 criteria for autism spectrum disorder maximizes diagnostic sensitivity and specificity in preschool children. *Social psychiatry and psychiatric epidemiology*, *1* (54), 693–701.

Vaida Aleknavičiūtė-Ablonskė – associate professor, doctor of Social Sciences (Education 07S), Šiauliai State College.

E-mail. Vaida.aleknaviciute@gmail.com