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Effect of exergaming on balance among children with intellectual disability

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ABSTRACT

Background: Intellectual disability (ID) is associated with balance and motor coordination challenges, leading to increased fall risk and limitations in daily activities. Traditional occupational therapy interventions have shown efficacy in addressing these issues, but there is a growing interest in integrating modern technologies, such as exergaming, into therapeutic programs. Exergaming combines physical activity with interactive video games, potentially enhancing motivation and engagement among children with ID. This study focuses on assessing the impact of exergaming on improving balance in children with ID, an area that remains underexplored in the Indian context.

Objectives: This study aimed to determine the effect of an exergaming intervention on improving balance in clients with intellectual disabilities.

Materials and methods: The study involved 30 children aged 6-12 years diagnosed with mild to moderate ID. Participants were randomly divided into two groups: the experimental group (N=15) received exergaming-based balance training, and the control group (N=15) underwent conventional occupational therapy. Both groups participated in 36 sessions over three months, each lasting 45 minutes. Balance was assessed using the Pediatric Balance Scale (PBS) before and after the intervention. The PBS includes 14 tasks that evaluate balance through various daily activities, with scores ranging from 0 (unable to perform) to 4 (independent).

Results: The results demonstrated a significant improvement in balance for both groups. However, the experimental group, which engaged in exergaming, showed a more substantial improvement in PBS scores, increasing from a mean of 29.07 to 41.93. In contrast, the control group's mean PBS score increased from 28.13 to 33.73. Statistical analysis confirmed that the improvement in the experimental group was significantly more significant (p<0.001), indicating the added benefit of exergaming in enhancing balance among children with ID.

Conclusion: The results indicate that exergaming is an effective intervention for improving balance in children with intellectual disabilities, as it offers engaging, challenging, and play-based therapy. Enhancing balance and postural control may also lead to broader physical and cognitive benefits, such as improved cardiovascular health, muscular strength, and cognitive processing. These improvements can further support functional independence, promoting inclusivity and better community engagement. Ultimately, this study highlights the potential of exergaming to empower individuals with intellectual disabilities, fostering their overall well-being and quality of life.

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Introduction

Occupational therapists provide support to individuals with intellectual disabilities (ID) throughout their lives and in a variety of practice settings. However, more needs to be done by the profession to address the specific needs of this marginalized population. ID is one kind of developmental disability that frequently co-occurs with other developmental disorders like autism spectrum disorder (ASD) or cerebral palsy.[1]

The World Health Organization reports that approximately 2% of Indians of all ages have an intellectual handicap based on surveys conducted among the country's general population. However, if the issue is limited to children (those under the age of 18), then roughly 3% of all the children in the same community who are under the age of 18 will have an intellectual handicap. Based on a comprehensive analysis of individual prevalence studies conducted over the past six decades, the established prevalence of ID in India is 2%.[2]

A strategic element of coordination capacities called balance ability depends on several variables. Individuals with ID frequently experience falls that result in injuries, which can be attributed to their poor balancing abilities, which could be a sign of incomplete development. The most noticeable impairments in balance and motor skills are seen in inactive adults with ID, who may be more vulnerable to a loss of basic functioning and have less autonomy in daily life activities.[3]

Reduced postural stability has been observed in individuals with ID.[4-8] This has been linked to increased body sway and/or higher sway velocity during quiet stance,[9] an increased fall risk,[10,11] abnormal gait patterns,[12,6,13] delayed responses to balance perturbations,[14] and using fewer effective strategies for maintaining balance. Postural instability has also been linked to a disrupted central integration of multisensory information in this population.[15]

Exergaming is the practice of mixing video game technology with physical activity to promote an active and healthy lifestyle.[16] Exergames, often known as active video games, have user interfaces that call for active participation and physical effort from players. Players can have fun while exercising with these fitness games, which are made to track body motion. The effectiveness of these games for rehabilitation or exercise has been the subject of numerous studies.[17]

A waiting-list control group was contrasted with the exergaming intervention. Microsoft's Xbox Kinect implemented the exergaming intervention (Microsoft, Redmond, WA). This game console has an input device that detects motion. Users move their bodies to control and interact with the console.[23] Active video games that double as exercise are referred to as exergaming. Exergaming has the potential to support preschool children's PA, even if it is screen-based. Exergaming has been employed increasingly recently in school-based settings as a creative and enjoyable way to encourage an active lifestyle with encouraging and hopeful outcomes.[18-20]

Materials and methods

The study was ethically approved by the Institutional Review Board of Saveetha College of Occupational Therapy (SCOT/ISRB/061/2023) and was conducted at Aadhuraa Special School, Kanchipuram, India. A quasi-experimental quantitative study design was employed, involving 30 children with mild to moderate intellectual disabilities aged 6 to 12 years. The participants were divided equally into experimental and control groups, with 15 children in each group. The experimental group received balance training using exergaming intervention and conventional occupational therapy consisting of 45-minute sessions held three times per week over approximately 3 months, totaling around 36 sessions. The control group received only conventional occupational therapy for the same duration. The Pediatric Balance Scale was used to measure balance levels in both groups through pre-test and post-test assessments.

Participants

Thirty children aged 6 to 12 years, 10 females and 20 males diagnosed with mild to moderate intellectual disability, participated in this study to enhance their balance skills. Initially, all participants underwent a pre-assessment of their balance using the Pediatric Balance Scale. Following the pre-assessment conducted during the first two sessions of the study, the children were randomly allocated into an experimental group (N=15) and a control group (N=15). The inclusion criteria for this study were 1) children diagnosed with mild (Intelligence Quotient 55-70) and moderate ID (Intelligence Quotient 40-55), 2) children aged from 6 to 12 years, both males and females included, and 3) children with poor balance scores above 20. The exclusion criteria for this study were 1) children with poor comprehension skills, 2) children with poor visual foundation skills, and 3) children using wheelchairs and walking aids.

Instruments

The Pediatric Balance Scale (PBS) is a refined version of the Leaflet Scale designed to assess functional balance in school children with mild to moderate disabilities.21 This assessment consists of 14 tasks that repeat daily activities, and each task is evaluated on a five-point scale (0 to 4). A score of 0 indicates no ability to act independently, while a score of 4 indicates high independence. The qualification criteria assess factors such as the duration of position maintenance, the distance to the upper extremities, and the time required to complete the task with a maximum score of 56.[22] A reliability analysis conducted with a group of twenty 5- to 15-year-old children with varying degrees of movement disorders showed high interrater reliability (ICC=0.997) and reliability of test-retest (ICC=0.998).[21] A valid test including 30 children with cerebral palsy, 4 to 10 years old and classified

GMFCS levels I-III, there is a strong relationship between PBS and movement (*r*=0.82, *p*<0.001) and self-care (*r*=0.73) showed, *p*<0.001) dimensions of the Disability Evaluation Questionnaire (PDEI).[22] In addition, a descriptive study with 23 children aged 6 to 15 years with cerebral palsy (hemiplegia or diplegia) showed a significant correlation between PBS and the Selective Lower Extremity Control Evaluation.

Procedure

The experimental group participated in a balance training program that combined exergaming with conventional occupational therapy. In contrast, the control group received standard occupational therapy sessions. Both groups underwent 36 sessions, each lasting 45 minutes, conducted three times per week over 12 weeks. To assess the efficacy of the exergaming intervention in enhancing balance among children with intellectual disabilities, the Pediatric Balance Scale was administered post-intervention to both groups.

The exergaming intervention utilized an interactive system designed to improve balance using dynamic light and sound cues. The system consisted of three towers, each approximately 6 feet tall and arranged in a triangular formation, with 10 lights per tower. Lights were illuminated in random sequences, accompanied by corresponding tones, prompting participants to touch the lit targets. The program advanced through three graded levels:

Grade 1: Participants touched the lights while walking.
Grade 2: Participants touched the lights while hopping.
Grade 3: Participants performed the task while standing on one leg.

Participants earned one point for each correct light touched. Upon achieving 8 or more points, they progressed to the next grade.

The experimental group's exergaming intervention not only targeted motor control but also engaged cognitive domains such as executive function (e.g., planning, attention, and working memory), visual-motor coordination, and decision-making. For example, during the exergaming tasks, children had to remember target sequences, shift attention between lights, and respond to visual and auditory cues stimulating their cognitive flexibility and processing speed. In contrast, the control group's task-oriented interventions emphasized structured physical activities such as reaching tasks and balance exercises without the same level of cognitive engagement.

The control group received standard occupational therapy in a special school setting, which focused on balance training through conventional methods. This included recreational activities aimed at improving standing and sitting balance and performing activities of daily living (ADLs). Interventions included task-oriented training, perceptual exercises, task-specific reaching, visual feedback, balance biofeedback, and multisensory training. Table 1 listed below the intervention procedure for experimental group and control group.

Table 1. Intervention procedure for experimental group and control group.

Step	Component	Experimental group	Control group
1	Type of intervention	Exergaming + conventional occupational therapy	Conventional occupational therapy only
2	Session duration	45 minutes	45 minutes
3	Frequency	3 sessions per week	3 sessions per week
4	Total sessions	36 sessions over 12 weeks	36 sessions over 12 weeks
5	Exergaming setup	Interactive system with 3 towers (6 feet tall) arranged in a triangle, each with 10 lights; lights flash randomly with sound cues	Not applicable
6	Exergaming tasks	Grade 1: Walking while touching lit targets Grade 2: Hopping to targets Grade 3: Touching targets while standing on one leg	Not applicable
7	Progression criteria	Earn ≥8 points to progress to next grade level	Not applicable
8	Balance training activities	Integrated balance training with exergaming tasks like dynamic and static balance training by using hip and ankle strategies and leaning and reaching forward, lateral and backward.	Task-oriented interventions, perceptual exercises, visual feedback training, balance biofeedback, and multisensory training

Table 1. Intervention procedure for experimental group and control group (continued).

Step	Component	Experimental group	Control group
9	Exergaming with traditional occupational therapy	Exergaming was blended with traditional occupational therapy by incorporating balance boards, foam surfaces, and interactive light cues to enhance gross motor, balance, sensory, and cognitive skills in a game-like setup that boosts motivation and participation.	Children in the control group received conventional occupational therapy focusing on balance and coordination using activities like standing on foam pads, stepping over obstacles, and catching balls, guided directly by the therapist without the use of digital or exergaming tools.
10	Functional focus	Balance improvement via interactive gaming and traditional methods	Balance training integrated with activities of daily living (ADLs)
11	Outcome measure	Pediatric Balance Scale (PBS), pre- and post-intervention	Pediatric Balance Scale (PBS), pre- and post-intervention

Figure 1 illustrates the customized exergaming tower designed for children with intellectual disability. The setup includes vertically aligned light units with motion sensors. These lights are programmed to illuminate in specific sequences to encourage targeted motor responses such as reaching, stepping, or shifting weight. The tower's height and light placement were adjusted based on each child's functional ability as shown in Figure 1A. The child actively engaging with the exergaming tower is demonstrated in Figure 1B. The task requires the child to maintain balance on a foam surface or balance board while responding to randomly activated lights by touching or stepping toward them. This dynamic task integrates both balance control and cognitive processing such as attention, visual tracking, and response inhibition.

Figure 1. *Exergaming intervention setup. A: exergaming tower setup, B: child performing balance task using exergaming.*

Statistical analysis

This study used inferential statistical methods to evaluate the effect of a physical activity intervention on the balance of children with intellectual disabilities. Descriptive statistics, including mean and standard deviation, were used to summarize data and evaluate the distribution of participants. Due to the small sample size (30 people) and the nature of the data, non-parametric statistical methods were used. Wilcoxon signed rank scores were used to evaluate differences between pre-and post-test test scores in the experimental and control groups. The analysis showed a significant improvement in balance scores for the control group (Z=-3.425, p=0.001). Accordingly, the experimental group showed substantially increased balance scores (Z=3.425, p=0.001). The Mann-Whitney U test was used to compare the effectiveness of the interventions between the control and experimental groups. The results after the test showed a significant difference between the two groups (Z=-4.646, p<0.001), which shows that the intervention of physical activity has a significant effect in improving the remainder were treated with conventional occupational therapy. A significance level of p<0.05 was used for all statistical analyses.

Results

The study demonstrated that the exergaming intervention led to a significant improvement in balance among children with intellectual disabilities when compared to conventional occupational therapy. The experimental group, which engaged in exergaming, showed a substantial increase in their Pediatric Balance Scale (PBS) scores from a pre-test mean of 29.07 to a post-test mean of 41.93. Conversely, the control group, which received standard occupational therapy, showed a more modest improvement, with scores increasing from 28.13 to 33.73. Statistical analysis confirmed that the improvement in the experimental group was significantly more significant than that in the control group.

Table 2 shows that the *p* value of 0.001 is less than 0.05, so the alternate hypothesis is accepted. Hence, there is a statistically significant difference between the pre-test and post-test scores in the PBS control group. This suggests that the intervention received by the control group had a significant improvement.

Table 3 shows the *p* value of the experimental group is 0.001 is less than 0.05, alternate hypothesis is accepted. Hence, there is a highly statistically significant difference in the experimental group between pre-test and post-test scores of PBS. This suggests that the intervention received by the experimental group had significant improvement.

Table 4 shows a *p* value of 0.00 is less than 0.05; an alternate hypothesis is accepted. Hence, there is a highly statistically significant difference in post-test scores between the experimental and control groups of the PBS. This suggests that the intervention received by the experimental group showed more improvement than the control group.

Table 2. Statistical analysis of pre-test and post-test in control group.

Test	Mean	SD	N	Z value	*p* value
Pre-test	28.1333	2.89992	15	-3.425	0.001*
Post-test	33.7333	2.49189	15		

Note: **significant at 5% alpha level.*

Table 3. Statistical analysis of pre-test and post-test in the experimental group.

Test	Mean	SD	N	Z value	*p* value
Pre-test	29.0667	2.25093	15	-3.425	0.001*
Post-test	41.9333	1.43759	15		

Note: **significant at 5% alpha level.*

Table 4. Statistical analysis between the post-test scores of the control and experimental group.

Group	Mean	SD	N	Z value	*p* value
Control group	33.7333	2.49189	15	-4.645	0.00*
Experimental group	41.9333	1.43759	15		

Note: ** Significant at 5% alpha level*

Discussion

This study aimed to evaluate the effectiveness of exergaming interventions in enhancing balance among children with intellectual disabilities. Specifically, the study aimed to compare the effects of exergaming with conventional occupational therapy on balance improvement in a sample of 30 children, who were evenly divided into control and experimental groups. This investigation supports prior research by Hilton *et al*. which emphasized the necessity of a control group in determining the efficacy of balance interventions.[17]

The current study analyzed pre-test and post-test scores using the Pediatric Balance Scale (PBS) to assess improvements in balance and postural control abilities among the participants. The analysis revealed a statistically significant improvement in the control group's balance, as indicated by the pre-test and post-test scores (p=0.001). This improvement can be attributed to the conventional occupational therapy provided to the control group, consistent with findings from Lourenco *et al*. which highlighted the positive impact of organized and systematic interventions on motor proficiency, including balance, in children with autism spectrum disorder (ASD).[24]

The results in the experimental group demonstrated a statistically significant difference between pre-test and post-test scores (p=0.001), suggesting that the exergaming intervention was particularly effective in enhancing balance and motor skills. This result has been supported by the previous articles by Nikolaos *et al*. which showed that exergaming interventions effectively stimulate a wide range of fundamental motor skills.[25] Hanley *et al*. conducted a study on autism and exergaming: impacts on cognitive processes and repetitive actions in that study, two pilot studies examined the potential behavioral and cognitive advantages of exergaming.[26] A dozen kids with Pilot I involved teens with autism spectrum disorders and involved a control task and an acute bout of Dance Dance Revolution (DDR);

Pilot II involved ten more teenagers and an acute bout of cybercycling. Executive function and repeated behaviors were evaluated both before and after each activity. After the exercise, compared to the control condition, repeated behaviors decreased, and Digits Backwards performance improved. Although Hanley et al. studied children with autism spectrum disorders, the findings on executive function and reduced repetitive behaviors provide indirect support for the cognitive benefits of interactive exergaming.[26] While our primary outcome was balance improvement, these cognitive domains are often impaired in children with intellectual disabilities as well and stimulating them through exergaming may contribute to improved postural control. Schmidt *et al*. determined a study on effect of exergaming on executive function in attention deficit hyperactivity disorder.[27] The study was a parallel group randomized trial, 51 children between 8-12 years diagnosed with ADHD were assigned either to an 8-week exergaming intervention group or a waiting-list control group. The core executive functions such as inhibition, switching, updating, parent ratings of symptoms, and motor abilities were assessed before and after the intervention. Finding of the study was exergaming intervention group improved in specific executive functions, general psychopathology as well as motor abilities compared to control group. Claudia list Hilton *et al*. conducted a pilot study investigated the impact of Makoto arena training on children with autism spectrum disorder (ASD).[17] Results showed improved response speed, Executive Function (EF), and motor skills. Strong correlations were found between EF and motor scores. Participants demonstrated increased reaction speed (effect size = 1.18). Significant enhancements were observed in working memory, metacognition, strength, and agility. Exergaming, particularly the Makoto arena, could complement standard interventions for ASD children with motor and EF deficits.

Moreover, the comparison between the post-test scores of the control and experimental groups (p=0.00) revealed a significantly greater improvement in the experimental group. This underscores the superior efficacy of exergaming interventions over conventional therapy in improving balance among children with intellectual disabilities. These findings are consistent with Hilton *et al.*,[17] which demonstrated the positive effects of exergaming on various outcomes, including motor skills and executive function, in children with developmental disorders.

Limitations

The study is subject to limitations due to its small sample size and the limited number of sessions, which may constrain the generalizability of the findings. Additionally, the reliance on a convenience sampling method introduces potential selection bias and affects the sample's representativeness. These limitations should be carefully considered when assessing the applicability of the results to broader populations.

The study did not statistically compare pre-test PBS scores between the two groups to confirm baseline equivalence. While mean values were similar, a formal test (e. g., Mann-Whitney U test) could strengthen the assumption of comparability.

Although random assignment was used, the distribution of participants based on the severity of intellectual disability (mild vs moderate), age, and gender was not stratified. This could have influenced the intervention outcomes.

Pre- and post-assessments were conducted by the research team, and blinding was not implemented. This could introduce observer bias and affect the objectivity of the outcome evaluation.

Conclusion

The findings of this study underscore the efficacy of exergaming as an innovative therapeutic intervention for improving balance in children with intellectual disabilities. Exergaming was more effective than conventional occupational therapy alone, suggesting that it could be a valuable addition to therapeutic programs aimed at enhancing motor skills and functional independence in this population. This approach improves physical outcomes and provides a more engaging and motivating form of therapy. The results advocate for the broader application of exergaming in occupational therapy and suggest that further research should explore its long-term benefits and potential in various pediatric populations.

Ethical approval

This study was approved by the Institutional Review Board of Saveetha College of Occupational Therapy, Saveetha Institute of Medical and Technical Sciences (Approval No: SCOT/ISRB/061/2023).

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None

Conflict of interest

The authors have no potential conflicts of interest to disclose.

CRedit authorship contribution statement

Sivapriya S: conceptualization, methodology, writing; original draft, statistical analysis; **Punitha P:** supervision, validation, review and editing; **Ahamed Ashwaq HA:** data collection, study execution at the school, manuscript editing.

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References

[1] Johnson KR, Blaskowitz M, Mahoney WJ. Occupational therapy practice with adults with intellectual disability: What more can we do? Open J Occup Ther. 2019; 7: 1-15. doi: 10.15453/2168-6408.1573.

[2] Russell PSS, Nagaraj S, Vengadavaradan A, Russell S, Mammen PM, Shankar SR, et al. Prevalence of intellectual disability in India: A meta-analysis. World J Clin Pediatr. 2022; 11: 206-14. doi: 10.5409/wjcp.v11.i2.206.

[3] Dehghani M, Gunay M. The effect of balance training on static and dynamic balance in children with intellectual disability. J Appl Environ Biol Sci. 2015; 5: 127-31. doi: 10.5958/2249-7315.2015.00108.2

[4] Blomqvist S, Olsson J, Wallin L, Wester A, Rehn B. Adolescents with intellectual disability have reduced postural balance and muscle performance in trunk and lower limbs compared to peers without intellectual disability. Res Dev Disabil. 2013; 34: 198-206. doi: 10.1016/j.ridd.2012.07.008.

[5] Rine RM, Dannenbaum E, Szabo J. 2015 section on pediatrics knowledge translation lecture: Pediatric vestibular-related impairments. Pediatr Phys Ther. 2016; 28: 2-6. doi: 10.1097/PEP.0000000000000226.

[6] Boonyong S, Siu K-C, van Donkelaar P, Chou L-S, Woollacott MH. Development of postural control during gait in typically developing children: the effects of dual-task conditions. Gait Posture. 2012; 35: 428-34. doi: 10.1016/j.gaitpost.2011.11.002.

[7] Karachi C, Grabli D, Bernard FA, Tandé D, Wattiez N, Belaid H, et al. Cholinergic mesencephalic neurons are involved in gait and postural disorders in Parkinson disease. J Clin Invest. 2010; 120: 2745-54. doi: 10. 1172/JCI42642.

[8] Zur O, Ronen A, Melzer I, Carmeli E. Vestibulo-ocular response and balance control in children and young adults with mild-to-moderate intellectual and developmental disability: a pilot study. Res Dev Disabil. 2013; 34: 1951-7. doi: 10.1016/j.ridd.2013.03.007.

[9] Dellavia C, Pallavera A, Orlando F, Sforza C. Postural stability of athletes in special olympics. Percept Mot Skills. 2009; 108: 608-22. doi: 10.2466/PMS.108.2.608-622.

[10] Chiba Y, Shimada A, Yoshida F, Keino H, Hasegawa M, Ikari H, et al. Risk of fall for individuals with intellectual disability. Am J Intellect Dev Disabil. 2009; 114: 225-36. doi: 10.1352/1944-7558-114.4:225-236.

[11] Wajda DA, Motl RW, Sosnoff JJ. Dual task cost of walking is related to fall risk in persons with multiple sclerosis. J Neurol Sci. 2013; 335: 160-3. doi: 10.1016/ j.jns.2013.09.021.

[12] Almuhtaseb S, Oppewal A, Hilgenkamp TIM. Gait characteristics in individuals with intellectual disabilities: a literature review. Res Dev Disabil. 2014; 35: 2858-83. doi: 10.1016/j.ridd.2014.07.017.

[13] Joseph C, Leavy B, Franzén E. Predictors of improved balance performance in persons with Parkinson's disease following a training intervention: analysis of data from an effectiveness-implementation trial. Clin Rehabil. 2020; 34: 837-44. doi: 10.1177/0269215520917199.

[14] Oppewal A, Hilgenkamp TIM. The association between gait and physical fitness in adults with intellectual disabilities: Gait and physical fitness in adults with intellectual disabilities. J Intellect Disabil Res. 2018; 62: 454-66. doi: 10.1111/jir.12484.

[15] Blomqvist S, Wester A, Rehn B. Postural muscle responses and adaptations to backward platform perturbations in young people with and without intellectual disability. Gait Posture. 2014; 39: 904-8. doi: 10.1016/j.gaitpost. 2013.11.018.

[16] Bogost I. The rhetoric of exergaming. In: DAC '05: Proceedings of the Digital Arts and Cultures Conference; 2005 Dec 1–3; Copenhagen, Denmark. p.51. https://share.google/PggimpB9BECJOQTlL

[17] Hilton CL, Cumpata K, Klohr C, Gaetke S, Artner A, Johnson H, et al. Effects of exergaming on executive function and motor skills in children with autism spectrum disorder: a pilot study. Am J Occup Ther. 2014; 68: 57-65. doi: 10.5014/ajot.2014.008664.

[18] Gao Z, Pope Z, Lee JE, Stodden D, Roncesvalles N, Pasco D, et al. Impact of exergaming on young children's school day energy expenditure and moderate-to-vigorous physical activity levels. J Sport Health Sci. 2017; 6: 11-6. doi: 10.1016/j.jshs.2016.11.008.

[19] Gao Z, Hannon JC, Newton M, Huang C. Effects of curricular activity on students' situational motivation and physical activity levels. Res Q Exerc Sport. 2011; 82: 536-44. doi: 10.1080/02701367.2011.10599786.

[20] Gao Z, Chen S, Pasco D, Pope Z. Effects of active video games on physiological and psychological outcomes among children and adolescents: A meta-analysis. Obes Rev. 2015; 16: 783-94.doi: 10.1111/obr.12287

[21] Franjoine MR, Gunther JS, Taylor MJ. Pediatric balance scale: a modified version of the berg balance scale for the school-age child with mild to moderate motor impairment. Pediatr Phys Ther. 2003; 15: 114-28. doi: 10.1097/01.PEP.0000068117.48023.18.

[22] Ac Duarte N, Grecco LA, Franco RC, Zanon N, Oliveira CS. Correlation between Pediatric Balance Scale and functional test in children with cerebral palsy. J Phys Ther Sci. 2014; 26: 849-53. doi: 10.1589/jpts.26.849

[23] Benzing V, Schmidt M. Exergaming for children and adolescents: Strengths, weaknesses, opportunities and threats. J Clin Med. 2018; 7: 422. doi: 10.3390/jcm7110422.

[24] Lourenço C, Esteves D, Corredeira R, Seabra A. The effect of a trampoline-based training program on the muscle strength of the inferior limbs and motor proficiency in children with autism spectrum

disorders. J Phys Educ Sport. 2015; 15(3): 479-86 doi: 10.7752/jpes.2015.03073.

[25] Vernadakis N, Papastergiou M, Zetou E, Antoniou P. The impact of an exergame-based intervention on children's fundamental motor skills. Comput Educ. 2015; 83: 90-102. doi: 10.1016/j.compedu. 2015.01. 001.

[26] Ferguson MB, Anderson-Hanley PC, Mazurek MO, Parsons S, Warren Z. Game interventions for autism spectrum disorder. Games Health. 2012; 1: 248-53. doi: 10.1089/g4h.2012.0717.

[27] Benzing V, Schmidt M. The effect of exergaming on executive functions in children with ADHD: A randomized clinical trial. Scand J Med Sci Sports. 2019; 29: 1243-53. doi: 10.1111/sms.13446.