Proximus Journal of Sports Science and Physical Education
Volume 1, Issue 12, December 2024
https://proximusjournal.com/index.php/PJSSPE
ISSN (E): 2942-9943

EFFECTIVENESS OF A STRUCTURED TRAINING PROGRAM TO DEVELOP MOTOR COORDINATION, BALANCE, AND SOCIAL INTERACTION IN INDIVIDUALS WITH AUTISM SPECTRUM DISORDER

Jassam SAIF, High Institute of Sport and Physical Education University of Sfax, Tunisia.
jassamabass@yahoo.com
Hamdi CHTOURO, High Institute of Sport and Physical Education University of Sfax, Tunisia.
h_chtourou@yahoo.com
Mohamed Sami Bouzid, High Institute of Sport and Physical Education of Ksar-Saïd University of ManoubaTunisia.
med.sami.bouzid@gmail.com

Abstract
Autism is a disorder that causes problems with motor performance, balance, fine motor skills, balance challenges, and communication difficulties. This study sheds light on the aspect of evaluating the effectiveness of an organized training program based on play and training that aims to develop motor skills and balance and helps in developing social interaction for those with ASD .The research aimed to enhance components and try to overcome these difficulties through a comprehensive training program as the program is characterized by containing various activities that aim to develop motor coordination and work to increase muscle strength and develop social participation between individuals and thus develop their physical fitness. The study was conducted for a group of 30 individuals ranging in age from 10-16 years grouped into two categories., each includes 15 individuals, which is the intervention group and 15 individuals, the control group. The organized training program was applied for three months at a rate of two sessions per week and the duration of the session was 60 minutes. Several measures were used to evaluate motor skills, as the motor efficiency test (BOT-2) was used to measure speed, balance, and movement accuracy. The medicine ball throwing test weighing 1 kg was also used to measure strength. Muscles This test examines upper body strength by assessing the distance a child can throw a ball.
To measure cardiovascular endurance and general fitness, the Barrow Zigzag Run test was used, which measures the time taken to complete a zigzag path. To assess the communication and social interaction skills of the training program participants, the Social Responsiveness Scale (SRS) and the Autism Diagnostic Observation Schedule (ADOS) were used. Participants in the training program showed a specific beneficial change, with results showing significant improvements in motor coordination and balance when taking the BOT-2 test. Shorter finishing times of the Barrow Zigzag Run test showed a considerable improvement in endurance, emphasizing the improvement in overall cardiovascular fitness. The training program's effectiveness was evident in the increased social interaction of individuals with autism spectrum disorder who participated in group exercises and games, as shown by higher scores on the SRS and ADOS, indicating better social and peer interaction. The goals of the training program are to enhance cooperation and increase social interaction between individuals and are not limited to physical fitness only, as it supports the motor and social skills of individuals with this disorder in order to have a positive impact on their lives, thus enhancing the importance of developing programs dedicated to this important group and increasing awareness to integrate them in addition to other treatment methods to help individuals with autism overcome the difficulties they suffer from.

Proximus Journal of Sports Science and Physical Education
Volume 1, Issue 12, December 2024
https://proximusjournal.com/index.php/PJSSPE
ISSN (E): 2942-9943

Keywords: Autism spectrum disorder, motor coordination, social interaction and cooperation, balance. Endurance

1-Introductio

A disorder in which individuals suffer from problems and difficulties due to problems in neurodevelopment, as individuals are characterized by problems with motor coordination and balance, poor communication, and repetitive and stereotyped behaviors. This disorder ranges from mild to severe and can be predicted in early childhood (American Psychiatric Association [APA], 2013). Mental and behavioral difficulties in individuals can be observed through early diagnosis, as according to studies conducted in previous years, it has been shown that boys are more susceptible to this disorder than girls. There is a continuous increase in the prevalence of autism spectrum, as it was noted in 2000 that 1 in 150 children were affected, while studies conducted in 2020 confirmed that 1 in 36 children were affected by this disorder. [1]., There is still uncertainty about the exact cause of autism spectrum disorder.13 Among the important factors that may have an impact on this disorder are the hereditary factor and genetic factors. There are also environmental factors that may have an impact on causing autism spectrum disorder [2-3-4] Epigenetic factors are biological processes, such as DNA methylation and microRNA modifications, that alter gene expression by chemically altering DNA without changing the genomic sequence [5-6] Neurotransmitter imbalances, aberrant neural pathways, aberrant neural connectivity, and aberrant synapses are all caused by these factors. Genetic and environmental factors. Research has shown that physical activity is beneficial to the health of people with developmental difficulties, including children with ASD [7]. Physical activities can help children with ASD overcome various obstacles [8]. The study found that physical activity can help individuals with autism spectrum disorder develop important social skills that enable them to interact better with their peers (9). According to research, physical activity can enhance psychological well-being in children with autism spectrum disorder, leading to higher self-esteem, better behavior, and happiness [10-11]. Furthermore, evidence reveals. Furthermore, evidence shows. Furthermore, evidence suggests that physical activity has a direct impact on strength,[12] as well as specific favorable effects on children's cognitive and adaptive capacities (for example, on-task conduct and academic performance). Research suggests that social activity-based interventions can improve the behavior and functioning of individuals with ASD in their everyday environments. Many countries have implemented intervention programs such as auditory training, vitamin therapy, medication, and music, which have been shown to be effective in improving skills and difficulties. (Centers). for Disease Control and Prevention (2014). Regular programs and treatments targeting the behaviors of children with autism spectrum disorder have already had some therapeutic effects and modest success.

Research conducted in the 1990s [13-14]. and early 2000s demonstrated delays and impairments in motor development, in addition to the social and emotional developmental characteristics defined in the DSM-5 (APA, 2013). Furthermore, individuals have reduced and delayed fine motor skills than other people of the same age. The cause of autism spectrum disorder remains mostly unknown. Autism spectrum condition is characterized by poor speaking skills, limited social involvement, and repetitive activities. [15-16-17-18-19-20-21-22] Research suggests that motor delays in children with autism can begin early [23-24] and are now the norm rather than the exception [25-26-27Motor difficulties are one of the most important features that individuals with autism spectrum disorder suffer from, and they are important diagnostic criteria for these individuals.

As the weakness in balance, strength and motor coordination prevents individuals with autism from participating in activities and isolates them from the rest and makes it difficult for them to participate

Proximus Journal of Sports Science and Physical Education
Volume 1, Issue 12, December 2024
https://proximusjournal.com/index.php/PJSSPE
ISSN (E): 2942-9943

in recreational activities, which negatively affects their lives [28], The execution of structured programs and interventions that aim to develop skills, improve coordination, improve balance, increase social interaction, increase physical fitness and endurance, all of this contributes to the positive development of children with autism spectrum disorder and improves their fitness and participation in various programs. [29]

There are many studies that have focused on developing this aspect. It has been proven that developing interventions that aim to increase balance and increase strength for individuals with this disorder led to an improvement in motor efficiency and development in social skills [30]

We seek to highlight an important feature that is just as essential as the motor part: improving social problems for those with autism, as our program aims to increase motor efficiency and processing while also improving social interaction.

This study aims to examine the effect of a training program based on training, play, and various physical and motor activities that aim to develop the skills and difficulties of individuals with autism spectrum disorder. The program focused on the training being diverse and aiming to address weakness in some difficulties such as motor coordination difficulties and balance difficulties through specific exercises. Group play was also integrated into the program due to its importance in enhancing social interaction between individuals in order to address weakness in this point, which represents an important problem for individuals with autism. This program was based on previous studies in this field, and we developed an organized training program that can improve physical fitness, strength, and endurance through training, play, and various activities. The effect was measured through various tests such as choosing the Barrow Zig-Zag Run test to measure endurance [31], and the BOT-2 test was also chosen for motor efficiency [32]. Through this program, we wanted to know the improvement in the social interaction of the participating individuals, so this was done using the Autism Diagnostic Observation Schedule (ADOS) and the Social Responsiveness Scale (SRS) [33-34].In addition, endurance was measured through the medicine ball test of 1 kg for the upper body [35].; The improvement in social outcomes is observed through the participation of individuals in the training program, which can encourage individuals to improve behaviors and interaction with individuals participating in training and organized group games, as the program aims to improve motor efficiency, muscle strength, and social participation. The results found in this research can highlight the importance of developing such organized programs, which provides Important information for conducting interventions using sport as an important aspect to overcome the difficulties experienced by individuals with autism spectrum disorder

2-Methodology

2.1. Study selection

2.1.1. Participants

1- In this study, we selected 30 individuals from the Autism Association of Tunisia (19 males and 11 females) aged 10 to 16 years, all diagnosed with autism spectrum disorder (ASD). Participants were divided into two groups: a physical education training group (n = 15) and a control group (n = 15). All participants and their legal guardians were fully informed, either in writing or orally, about the study design, including the potential risks and benefits of participation. As a result, parents or legal guardians were given written informed consent. Participants could withdraw from the study at any time without any penalty.

2- 2.2.2 Study Design

The structured training program was carried out in an exercise with integrated equipment, with the assistance of specialist trainers who have extensive experience working with people with autism spectrum condition. The program lasted three months and consisted of two 60-minute sessions per week. The program featured concentrated exercise to improve motor skills, coordination, and balance, training to boost strength

Proximus Journal of Sports Science and Physical Education
Volume 1, Issue 12, December 2024
https://proximusjournal.com/index.php/PJSSPE
ISSN (E): 2942-9943

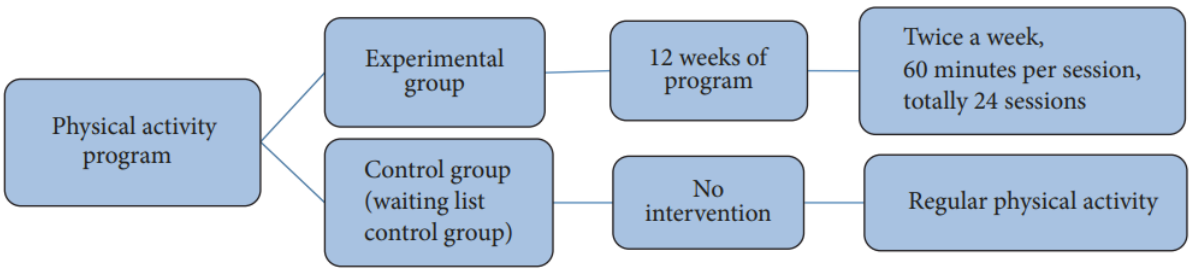
and endurance, and group games that aid in improving communication, attention, and collaboration among participants. Table 1 displays the details of the training program.

3- Table (1) Training Program

Phase	Targeted Skills	Suggested Activities/Exercises	Duration (Minutes)	Tools Used
Physical Preparation	Warm-up and Activation	Walking and stretching exercises for activation and preparation	10	Exercise mats, cones
Motor Skills	Balance and Coordination	Barbell exercises for balance and single leg stance	15	Balance beam, colored cones
Social Interaction	Communication and Rule Following	Team games by passing balls between the team ("follow the leader"),	10	Colored balls, visual cues
Muscle Strength	Upper Body Strength	Medicine ball exercises	10	Medicine ball, exercise mats
Endurance	Cardiovascular and Physical Endurance	Zig-zag running around Race training with cones and short races	15	Colored cones, sports field
Cool Down & Relaxation	Stress Reduction and Focus Improvement	Breathing exercises and meditation exercises to enhance focus and relaxation.	5	Yoga mats, soothing music

2.2.3. Intervention

The training program focused on improving four critical skills that people with autism spectrum disorder lack. We focused on developing motor coordination skills, developing balance, increasing strength, increasing endurance, and in addition to enhancing social interaction and developing social skills by enhancing cooperation among individuals participating in the organized and diverse training program with various exercises and group games to have an important impact in overcoming difficulties and addressing these problems during the training period, which lasted about three months. with two sessions per week.



3-Results

After completing the application of the organized training program based on physical activity and motor exercises to develop skills and overcome difficulties in balance and motor coordination and increase

Proximus Journal of Sports Science and Physical Education
Volume 1, Issue 12, December 2024
https://proximusjournal.com/index.php/PJSSPE
ISSN (E): 2942-9943

endurance and increase strength for individuals with ASD, the results significant improvement through the results that appeared after applying the tests.

3.1 The effect of the intervention on social skills and social interaction

Individuals' participation in structured physical exercise during the training session shown a beneficial effect on their movement development and had a major impact on their development of interpersonal communication skills. As demonstrated in the table below [31], the results revealed (an improvement of 13.9%, $p < 0.01$, Cohen's $d = 1.01$) that group games and program engagement promote interpersonal communication, which in turn improves social communication skills.[31]

Table 2: Results of Social Interaction

Group	Pre-Test (Mean ± SD)	Post-Test (Mean ± SD)	% Improvement	p-value	Cohen's d
Physical Exercise	75.3 ± 12.5	85.7 ± 10.3	13.9%	< 0.01	1.01
Control Group	76.2 ± 13.1	75.8 ± 12.7	0.5%	0.78	0.06

4- The table shows important and noticeable results in increasing the interaction between individuals in the physical exercise group, as the social behaviors of individuals with autism spectrum disorder constitute an important matter and important difficulties for conducting the exercises. The table shows that there has been improvement in this point, which reflects the development of communication skills between individuals, as the application of training programs has a positive impact on the social communication skill of individuals with autism ([33]).

3.2Effect of the intervention in the structured training program on motor skills

Individuals with autism suffer from motor difficulties and difficulties in motor coordination and balance. This program can work to improve these difficulties and develop motor skills. The results showed that the training program that used a variety of different exercises showed an improvement in balance and motor coordination. The results show gains in balance (13.7%) and speed and accuracy (12.9%), supported by medium to large effect sizes (Cohen's $d = 0.88$-0.92), and significant progress in motor coordination (see Table 3)., Our results are consistent with Zhao, M., & Chen, S. (2018), Habib, K., Montreuil, T., & Bertone, A. (2018), Arslan, E., Ince, G., & Akyüz, M. (2022), where studies have shown that the use of structured training programs has a positive effect on the development of motor competence in individuals with autism spectrum disorder. This translates into improved task execution for activities such as walking, climbing stairs, and participating in group games. In addition, better motor coordination promotes cognitive and emotional development, as these areas are closely linked to motor control areas in the brain ([34-35]

Table 3: Results of Motor Skills (Balance, Speed, and Precision)

Group	Pre-Test (Mean ± SD)	Post-Test (Mean ± SD)	% Improvement	p-value	Cohen's d
Physical Exercise	Balance: 32.1 ± 5.3	Balance: 36.5 ± 4.7	13.7%	< 0.01	0.92
	Speed & Precision: 28.7 ± 6.4	Speed & Precision: 32.4 ± 5.6	12.9%	< 0.01	0.88
Control Group	Balance: 33.4 ± 6.1	Balance: 33.9 ± 6.0	1.5%	0.67	0.10
	Speed & Precision: 29.2 ± 7.2	Speed & Precision: 29.6 ± 7.1	1.3%	0.72	0.07

Proximus Journal of Sports Science and Physical Education
Volume 1, Issue 12, December 2024
https://proximusjournal.com/index.php/PJSSPE
ISSN (E): 2942-9943

5-
6-

3 Effect of intervention on muscle strength development

Improving physical fitness is essential to support people with autism spectrum disorder overcome their challenges. Applying the training program resulted in a substantial improvement in the exercise group's strength development (33.2%, $p < 0.01$, Cohen's $d = 1.88$). People frequently struggle with strength, which has a detrimental impact on their physical development. Numerous studies suggest that improving a person's motor skills and strength can positively affect their life and aid in their integration into society. The results showed that the control group that did not do any physical activity had poor results compared to the group with organized physical activity, which is important Engaging in targeted physical activity. Without the intervention of structured exercise, there was no significant improvement in muscle strength in the control group, confirming the role of intentional exercise programs in facilitating physical development in children with ASD ([35]).

Table 4: Results of Muscular Strength

Group	Pre-Test (Mean ± SD)	Post-Test (Mean ± SD)	% Improvement	p-value	Cohen's d
Physical Exercise	3.8 ± 0.6	5.1 ± 0.6	33.2%	< 0.01	1.88
Control Group	3.7 ± 0.5	3.8 ± 0.5	3.4%	0.51	0.12

7-

3.4 Effect of the training program on endurance

Individuals with ASD show lower levels of physical endurance, which may limit their participation in prolonged physical activities and social interactions The results showed significant improvements in endurance (14.1%, $p < 0.01$, Cohen's $d = 1.62$) in individuals who participated in structured exercise throughout the duration of the program. This finding highlights the effectiveness of specifically designed exercise interventions in enhancing physical performance, which is critical to improving overall participation in physical and social activities among children with ASD. These findings are consistent with scientific research that has shown that endurance training significantly improves cardiovascular health in individuals with autism spectrum disorder (34), ultimately improving their daily functioning (35-36). The small improvement (1.3%) observed in the control group, with a p-value of 0.73, underscores the need for structured exercise interventions to achieve significant progress. Without targeted physical activity, children with autism spectrum disorder are unlikely to show measurable improvements in endurance, reinforcing the need to integrate exercise programs into therapeutic practices (38).

Table 5: Results of Endurance Improvement

Group	Pre-Test (Mean ± SD)	Post-Test (Mean ± SD)	% Improvement	p-value	Cohen's d
Physical Exercise	16.3 ± 2.5	14.0 ± 2.3	14.1%	< 0.01	1.62
Control Group	16.0 ± 2.3	15.8 ± 2.5	1.3%	0.73	0.08

8-
9- 4.Discussion

Proximus Journal of Sports Science and Physical Education
Volume 1, Issue 12, December 2024
https://proximusjournal.com/index.php/PJSSPE
ISSN (E): 2942-9943

10- This study evaluated the effect of a 12-week structured physical activity program on social interaction and communication in individuals with ASD. This study shows that regular physical activity can improve specific autistic traits in individuals with autism spectrum disorder. Researchers have identified effective solutions to improve social and communication skills in individuals with autism spectrum disorder. However, no single approach is better than another.

11- Through the application of the training program, the results showed that there is a noticeable improvement in the motor aspect and an increase in motor efficiency in coordination, balance, strength and endurance, which is positively reflected in improving effectiveness in cooperation and increasing social skills, as enhancing and developing physical fitness leads to developing social communication through the program based on training, group play and communication between individuals with autism spectrum disorder.

12- 4.1 Effectiveness of the organized training program on developing motor efficiency

The results show significant improvements in strength, balance, and motor coordination, focusing on the efficacy of the training program implemented during the intervention period. The program included several of exercises and group games that are essential for each skill, like weaving cones and walking on a balance beam, as well as balance and coordination exercises designed to address issues with fundamental motor and social skills and foster greater social interaction with participants with autism spectrum disorder., During the implementation of the structured training program, a noticeable improvement in the physical aspect and physical fitness was shown, in addition to significant improvements in motor coordination, which in turn had a noticeable impact on the improvement in social interaction, as these results were consistent with other studies conducted in this field, such as Ozonov et al. (2008), Bremer et al. (2015), and Ketcheson (2017). -

Proximus Journal of Sports Science and Physical Education
Volume 1, Issue 12, December 2024
https://proximusjournal.com/index.php/PJSSPE
ISSN (E): 2942-9943

13- Which showed that training programs have a positive impact on treating motor problems for individuals with autism spectrum disorder, which in turn has a positive impact on the lives of individuals in overcoming the problems they suffer from in public life, as physical training has a positive impact on the psychological and social aspects, which was confirmed by studies conducted by Posti-Ciccarelli et al. (2020) and Liu (2012). In addition, the impact of the physical aspect extends to enhancing social interaction between individuals, as individuals' participation in organized programs can have a noticeable impact in reducing behaviors, social problems, and emotional regulation of individuals, which is consistent with Lloyd et al. (2013), McDonald et al. (2014), Kitchison (2017) and Awda et al. (2022).

14- Effects of Physical Activity on Motor Skill Development:

15- The results of this study showed that there is a noticeable improvement in the motor aspect, which is one of the important problems that individuals with autism spectrum disorder suffer from, as they have difficulties in motor coordination and balance difficulties. When conducting an organized intervention through specific exercises, important results were obtained in this area, which confirms that the motor aspect of individuals can be developed through the use of organized programs, as these results are consistent with studies conducted in this field, such as Bremer et al. (2015) and Kitchison et al. (2017), Rafie Milajardi et al. (2021), where they confirmed that interventions can have real gains in enhancing the important difficulties and important problems of individuals with autism spectrum disorder in the fine motor aspect, motor coordination and balance.

16- 4.2 Effects of a Structured Physical Activity Program on Impact on Social Interaction:

The importance of the organized training program lies in addressing many problems that have an impact on individuals with autism spectrum disorder, as it was noted that the improvement shown by the participants in the physical and motor aspect has gained the participants a clear improvement in social interaction and cooperation with peers, and this is what the results showed, as intervention programs, group play, and communication between individuals in designed games and exercises have produced a noticeable improvement in the social aspect and have provided an effective environment for addressing some difficulties in this area. This is consistent with the research conducted in this field and Bossard and Visconti (2022), Ozonov et al. (2008), which indicated that training programs and interventions have a positive impact on the social aspect of individuals with autism spectrum disorder, which can improve their ability to interact with their peers and improve their social skills, which is reflected positively on their lives in general.

Proximus Journal of Sports Science and Physical Education
Volume 1, Issue 12, December 2024
https://proximusjournal.com/index.php/PJSSPE
ISSN (E): 2942-9943

17-4.3 Effects of a Structured Physical Activity Program on Effects on Social Skills Development:

18-The results confirm that there is a noticeable impact on multiple aspects of the individuals participating in the intervention program, which included various trainings, activities, and group games that had an impact on an important aspect, which is improving social skills and increasing emotional regulation for individuals with autism spectrum disorder, as the program followed allowed the participating individuals to develop an important aspect, which is how to manage their emotions in an important way while participating in group games, which can be positively reflected in enhancing their self-confidence and improving their social skills. All of this can develop their quality of life. These results are consistent with many studies conducted in this field, such as Bhat et al. (2011) and Seetoh et al. (2017), which confirmed that the participation of autistic individuals in organized activities can reduce difficulties in social skills and reduce repetitive and annoying behaviors, and also enhance their emotional regulation, which highlights the importance of supporting such programs aimed at enhancing the motor aspect and also developing social skills and reducing the behaviors and difficulties suffered by individuals with autism spectrum disorder and enhancing their self-confidence.

19-5.Conclusion

In general, it has been observed that the application of organized training programs has a noticeable effect on the motor and social aspects and can also develop physical fitness by developing strength and endurance. All of this can be greatly reflected in enhancing and developing social skills, regulating emotions, and developing self-confidence, which leads to treating many of the basic problems of individuals with autism spectrum disorder. Thus, it highlights the need for research and development of such programs, as organized physical activity can play an important role in improving the developmental skills of individuals with autism spectrum disorder. Future studies should investigate the long-term effects of these interventions, as well as how to integrate them with other therapeutic approaches such as sensory therapy or behavioral interventions.

References

1. **American Psychiatric Association.** (2013). Diagnostic and statistical manual of mental disorders (5th ed.). Arlington, VA: American Psychiatric Publishing
2. . Zeidan, J., Fombonne, E., Scorah, J., Ibrahim, A., Durkin, M. S., Saxena, S., Yusuf, A., Shih, A., & Elsabbagh, M. (2022). Global prevalence of autism: A systematic review update. Autism Research. 15(5), 778–90. https://doi.org/10.1002/aur.2696
3.] S. L. Berkeley, L. L. Zittel, L. V. Pitney, and S. E. Nichols, “Locomotor and object control skills of children diagnosed with autism,” Adapted Physical Activity Quarterly, vol. 18, no. 4, pp. 405–416, 2001.
4. S. M. Srinivasan, L. S. Pescatello, and A. N. Bhat, “Current perspectives on physical activity and exercise recommendations for children and adolescents with autism spectrum disorders,” Physical Terapy in Sport, vol. 94, no. 6, pp. 875–889, 2014.
5. J. D. McPhail, “Te therapeutic benefts of physical activity,” American Athletic Medical Association Journal, vol. 19, no. 1, pp. 9-10, 2006
6. R. P. Pangrazi, A. Beighle, T. Vehige, and C. Vack, “Impact of promoting lifestyle activity for youth (PLAY) on children’s physical activity,” Journal of School Health, vol. 73, no. 8, pp. 317– 321, 2003

Proximus Journal of Sports Science and Physical Education
Volume 1, Issue 12, December 2024
https://proximusjournal.com/index.php/PJSSPE
ISSN (E): 2942-9943

7. G. Reid and J. O'Connor, "Te autistic spectrum disorders: activity selection, assessment, and program organization," Palaestra, vol. 19, pp. 20–27, 2003
8. . Modabbernia A, Velthorst E, Reichenberg A. Environmental risk factors for autism: an evidence-based review of systematic reviews and meta-analyses. Mol Autism. 2017; 8:13. doi: 10.1186/s13229-017-0121-4.
9. 14. Johnson CP, Myers SM, Lipkin PH, Cartwright JD, Desch LW, Duby JC, et al. Identification and evaluation of children with autism spectrum disorders.PediatricsNovember 2007; 120 (5): 1183–215.
10. 15. Krishnan V, Krishnakumar P, Gireeshan VK, George B, Basheer S. Early Social Experience and Digital-Media Exposure in Children with Autism Spectrum Disorder. Indian J Pediatr. 2021;88(8):793-9. doi: 10.1007/s12098-021-03666-z.
11. 16. Gyawali S, Patra BN. Autism spectrum disorder: Trends in research exploring etiopathogenesis. Psychiatry Clin Neurosci. 2019;73(8): 466-75.doi: 10.1111/pcn.12860.
12. 17. Doi M, Usui N, Shimada S. Prenatal Environment and Neurodevelopmental Disorders. Front Endocrinol (Lausanne). 2022 Mar 15; 13:860110. doi: 10.3389/fendo.2022.860110.
13. 18. Masini E, Loi E, Vega-Benedetti AF, Carta M, Doneddu G, Fadda R, Zavattari P. An Overview of the Main Genetic, Epigenetic and Environmental Factors Involved in Autism Spectrum Disorder Focusing on Synaptic Activity. Int J Mol Sci. 2020;21(21):8290. doi: 10.3390/ijms21218290.
14. Teitelbaum, J. S., Zatorre, R. J., Carpenter, S., Gendron, D., Evans, A. C., Gjedde, A., & Cashman, N. R. (1990). Neurologic sequelae of domoic acid intoxication due to the ingestion of contaminated mussels. New England Journal of Medicine, 322(25), 1781-1787
15. Ozonoff, S., Iosif, A. M., Baguio, F., Cook, I. C., Hill, M. M., Hutman, T., ... & Young, G. S. (2010). A prospective study of the emergence of early behavioral signs of autism. Journal of the American Academy of Child & Adolescent Psychiatry, 49(3), 256-266.
16. Bremer, P., Cabrera, E., Leino-Kilpi, H., Lethin, C., Saks, K., Sutcliffe, C., ... & RightTimePlaceCare Consortium. (2015). Informal dementia care: Consequences for caregivers' health and health care use in 8 European countries. Health Policy, 119(11), 1459-1471.
17. Busti Ceccarelli, S., Ferrante, C., Gazzola, E., Marzocchi, G. M., Nobile, M., Molteni, M., & Crippa, A. (2020). Fundamental motor skills intervention for children with autism spectrum disorder: A 10-year narrative review. Children, 7(11), 250.
18. Xu, X., Liu, X., Ge, S., Jensen, J. D., Hu, F., Li, X., ... & Wang, W. (2012). Resequencing 50 accessions of cultivated and wild rice yields markers for identifying agronomically important genes. Nature biotechnology, 30(1), 105-111.
19. Breslin, S., & O'Driscoll, L. (2013). Three-dimensional cell culture: the missing link in drug discovery. Drug discovery today, 18(5-6), 240-249.
20. Lloyd, A. S., Plank, T., Ruprecht, P., Hauri, E. H., & Rose, W. (2013). Volatile loss from melt inclusions in pyroclasts of differing sizes. Contributions to Mineralogy and Petrology, 165, 129-153.;
21. McDonald, M., Benson, B. A., Vikhlinin, A., Aird, K. A., Allen, S. W., Bautz, M., ... & Zenteno, A. (2014). The redshift evolution of the mean temperature, pressure, and entropy profiles in 80 SPT-selected galaxy clusters. The Astrophysical Journal, 794(1), 67.
22. Odeh, A., & Paul, M. C. (2024). Effects of hydrogen enrichment on the heat generation and emission of natural gas turbulent premixed flame. International Journal of Hydrogen Energy, 49, 1176-1191.
23. Oliveira, E. A., Colosimo, E. A., e Silva, A. C. S., Mak, R. H., Martelli, D. B., Silva, L. R., ... & Oliveira, M. C. L. (2021). Clinical characteristics and risk factors for death among hospitalised

children and adolescents with COVID-19 in Brazil: an analysis of a nationwide database. The Lancet Child & Adolescent Health, 5(8), 559-568.

24. Botha, M. (2022). Community psychology as reparations for violence in the construction of autism knowledge 1. In The Routledge international handbook of critical autism studies (pp. 76-94). Routledge.
25. Posar, A., & Visconti, P. (2023). Autism spectrum disorder in 2023: a challenge still open. Turkish Archives of Pediatrics, 58(6), 566.
26. Bhat, S., Coleman, H. G., Yousef, F., Johnston, B. T., McManus, D. T., Gavin, A. T., & Murray, L. J. (2011). Risk of malignant progression in Barrett's esophagus patients: results from a large population-based study. Journal of the National Cancer Institute, 103(13), 1049-1057.
27. Setoh, P., Scott, R. M., & Baillargeon, R. (2016). Two-and-a-half-year-olds succeed at a traditional false-belief task with reduced processing demands. Proceedings of the National Academy of Sciences, 113(47), 13360-13365.
28. Zampella, E., Piscopo, L., Manganelli, M., Volpe, F., Nappi, C., Gaudieri, V., ... & Klain, M. (2023). Prognostic value of 12-month response to therapy in pediatric patients with differentiated thyroid cancer. Endocrine, 80(3), 612-618.
29. Skuse, D., Greaves-Lord, K., Rodrigues da Cunha, G., & Baird, G. (2024). Autism spectrum disorder.
30. Bruininks, P., & Malle, B. F. (2005). Distinguishing hope from optimism and related affective states. Motivation and emotion, 29, 324-352. Costantino, T. G., Bruno, E. C., Handly, N., & Dean, A. J. (2005). Accuracy of emergency medicine ultrasound in the evaluation of abdominal aortic aneurysm. The Journal of emergency medicine, 29(4), 455-460. Lord et al., 2000)
31. Miller, K. D., Siegel, R. L., Lin, C. C., Mariotto, A. B., Kramer, J. L., Rowland, J. H., ... & Jemal, A. (2016). Cancer treatment and survivorship statistics, 2016. CA: a cancer journal for clinicians, 66(4), 271-289. Chan et al., 2021
32. Helsel, B. C., Bodde, A. E., Ptomey, L. T., Sherman, J. R., Rice, A., Donnelly, J. E., & Washburn, R. A. (2024). Physical Activity Patterns in Adolescents and Adults with Intellectual and Developmental Disabilities. Exercise, Sport, and Movement, 2(3), e00024.
33. Bremer, E., Balogh, R., & Lloyd, M. (2015). Effectiveness of a fundamental motor skill intervention for 4-year-old children with autism spectrum disorder: A pilot study. Autism, 19(8), 980-991.
34. Ketcheson, L., Hauck, J., & Ulrich, D. (2017). 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, 21(4), 481-492.
35. Rafiei Milajerdi, H., Sheikh, M., Najafabadi, M. G., Saghaei, B., Naghdi, N., & Dewey, D. (2021). The effects of physical activity and exergaming on motor skills and executive functions in children with autism spectrum disorder. Games for health journal, 10(1), 33-42.