



A LITERATURE REVIEW ON ASSESSMENT TOOLS USED TO EVALUATE BALANCE AMONG AUTISTIC CHILDREN

Prasanth Kumar. K¹ Dr.Alice Jebba²,Dr C.N Prabushanker³

¹Second-Year MPT Student Garden City University, Bangalore

²Associate Professor, Garden City University,

³Assistant Professor Garden City University

Article DOI: <https://doi.org/10.36713/epra17181>

DOI No: 10.36713/epra17181

ABSTRACT

Background: ASD is a neurological developmental disorder that is typically characterized by repetitive or stereotyped behavior, social and communication difficulties, and balance issues. However, there is a close relationship between ASD, gross motor skills, and sensory-motor integration.

Objective: The main objective of this literature review is, to analyze and to provide the overview of the available balance evaluation tools for autistic children which were widely in use from last 5-7 years.

Method: In this review of literature, the selection of the articles is sourced from various reputable platforms including Google scholar, science direct, and Pubmed. These articles are from the years 2016 to 2024.

Results: It is challenging to choose one acceptable balance assessment approach because of the availability of numerous methods, different studies have determined how to evaluate balance based on different goals, and no one measure has emerged. In this study we addressed a few specific evaluation tools that help to identify balance issues especially for ASD children. A simple following criteria is applied for the selection of the evaluation of tools: 1) Commonly used in practice (ii) evaluation of static balance and dynamic balance and (iii) it has to be suitable for autism children. They include the Pediatric balance scale, the Bruininks-Oseretsky motor proficiency test -2, and Movement assessment battery for children.

Conclusion:- In conclusion, the study outlines the three assessment tools that are being widely in use, in the clinical field to evaluate the balance among children with ASD. This review examines and contrasts the limitations and strengths of these different tools useful for assessing dynamic balance and static balance. However, to determine the potential implications of these tools for evaluating balance in individuals with ASD further, it is essential to conduct more meticulously designed randomized controlled trials.

INTRODUCTION

Autism spectrum disorder (ASD) impacts how people behave, learn, connect with others, and communicate^[1]. Autism is classified as a "developmental disorder" even though a diagnosis can be made at any age. This is because most symptoms usually manifest in the early two years of life. Severe deficiencies in socialization, communication, and repetitive or odd activities are hallmarks of autism spectrum disorders^[2]. A multitude of interrelated risk factors contribute to the highly hereditary and complex nature of autism spectrum diseases^[1,2].

From 1.1% in 2008 to 2.3% in 2018, the estimated rate of prevalence of ASD has been rising in the US^[1]. Current studies have estimated the prevalence of ASD at around 1 in 59 children, where males are four times more effected with ASD than females^[2]. The rate of prevalence of ASD is still rising. The growing evidence showed that Autism Spectrum Disorder impacts not only mood and emotion, behavior regulation, communication, and cognition but also motor control. Many of the abnormalities of body structures and functions associated with ASD affect postural control and balance^[2]. The afferents engaged in the intricate process of upright balance maintenance in humans are the vestibular, somatosensory (including proprioceptive and cutaneous inputs), and ocular systems. Balance could be impacted by any shortcomings in these systems or in the way the information from these systems is integrated^[3,5].

Basic motor skills including walking, running, and leaping are frequently difficult for kids with ASD^[2]. One must have adequate balance to execute basic motor tasks and engage in various physical activities. Balance is intimately tied to the inertial forces acting on the body and the inertial properties of body segments. Sustaining one's center of mass above one's base of support is necessary for maintaining equilibrium. Static and dynamic balances are the two general categories^[3]. Preserving equilibrium for a stationary body position is the goal of static balance, whereas maintaining equilibrium while in motion is the goal of dynamic balance^[4].



Balance evaluation, The selection of an appropriate method for evaluating balance is more challenging due to the availability of numerous methods, and the goals of researchers have influenced how balance is measured across studies. As a result, no one measure has developed, making it challenging to choose a suitable balance evaluation process. The "classic" balance assessment was built on the ability to characterize a child showing equilibrium reactions, defensive reactions, and righting reactions in response to disturbances created by the therapist. The challenges have to be documented through various pediatric balance assessments [6,7].

Balance Assessment Tools

Pediatric Balance Scale – A modified Berg Balance Scale is known as the Pediatric Balance Scale (PBS)^[8]. Its primary purpose is to evaluate balance impairment and functional mobility in children, especially those with motor impairments^[9]. During the assessment, the child performs 14 different balance tasks, and the evaluator assigns a score based on predetermined criteria. The tasks included in the PBS cover a range of activities that challenge different aspects of balance control, including static balance and dynamic balance, weight shifting, reaching, and transitioning between positions. Some examples of tasks include standing on one leg, standing to sitting, reaching forward while standing, and walking forward on a line. Each balance task on the PBS is scored according to five-point scale, generally if the scores are high, indicating high functional mobility. The maximum possible total score is 56^[10].

Strengths

- Age appropriate tool for ASD children
- Used as a standardised protocol to test static and dynamic balance
- Can use minimal equipment which can easily available in clinics
- Cost efficient

Limitations

- Majority of the items in this test are influenced by height
- Mostly it does not test the movement balance of subject
- It does not test the overhead reaching of subject

Bruininks-Oseretsky Test For Motor Proficiency – For both clinical and research purposes, this test is frequently used to evaluate a variety of motor skills. The BOTMP-2 is intended for participants between the ages of 4 and 21^[11]. It is composed of 8 subtests that are then arranged into 4 composites based on the limbs and muscle groups used in the task motions. It offers helpful information to researchers, educators, and physicians to assess kids' motor proficiency^[12]. Both students with normal development and those with mild to severe motor skill deficiencies can be assessed with the BOTMP-2. It is used in the study has four motor domains. They include motor coordination, fine motor control body coordination, and strength and agility. The total motor proficiency score is 320. The researchers assessed the subjects on each subtest item^[13,14]

Strengths

- Age-appropriate for subjects
- pictures are used for the administration of the test
- Most of the test involves games like tasks and easy instructions
- language won't be a main barrier because of pictures

Limitations

- Difficulty in administering the tool.
- it requires a large test room to conduct the assessment
- It may take Longer duration time to perform the test upto one hour

Movement Assessment Battery for Children – it is a comprehensive tool designed to evaluate the motor skills of children aged between 3 and 16 years old. The major goal of this tool is to identify any motor impairments which may impact their daily activities, physical education, and leisure time pursuits. The assessment encompasses essential motor skills such as balance, aiming and catching, and manual dexterity [15,16]. It is a test that assesses a child's motor skills through various tasks. These tasks evaluate their manual dexterity, catching and aiming ability, as well as their balance. Manual dexterity tasks include posting coins into a box, threading beads, and drawing a trail. Aiming and catching tasks include catching or throwing a beanbag and kicking a ball. Balance tasks involve standing on one leg, walking heel-to-toe, and jumping on mats. Each task has a standardized procedure in place to ensure consistency in assessment results [15,16].

Strengths

- Used as a screening and evaluation tool for motor impairment and balance
- Easier to administer to children with short spans of attention



• Limitations

- Results may invalidate if the equipment is used other than the test kit
- Full range of motor abilities are not covered
- A full range of motor abilities are not covered that might be implicated
- For the eight items duration may take longer
- Restricted to a certain age groups
- Repeated trials has to encoperate

Having an adequate balance control assessment tool is crucial for identifying possible balance issues in children. Number of tests are available for measuring balance in clinical practice. Evidence generally indicates that knowledge on the validity and reliability of these chosen tools for kids with ASD is insufficient. nevertheless the examination of these instruments—the BOT-2, MABC-2, and PBS—shows that they possess some potent psychometric properties [17,18].

In this study we examines some standardized tools that are used to help the children with Autism Spectrum Disorder (ASD) who are having issues with balance. At the moment, a lot of physicians, physical therapists, and educators in special education use these tools in work. The evaluation contrasts the advantages and limitations of these three tools and outlines their features. The three tools selected for this review are: 1) PBS, 2) BOTM-2, and 3) MABC-2.

Methodology

Materials and Methods

- Comprehensive research was conducted in electronic databases like Google scholar , Science Direct, and PubMed.
- Keywords such as autism spectrum disorder, balance, assessment, and evaluation were used.

Study Selection

Inclusion criteria

- Articles were included from years 2016 – 2024
- Articles includes evaluation tools used to assess balance among autism children

Exclusion criteria

- Articles before the year 2016
- Articles excludes children with balance problems other than ASD

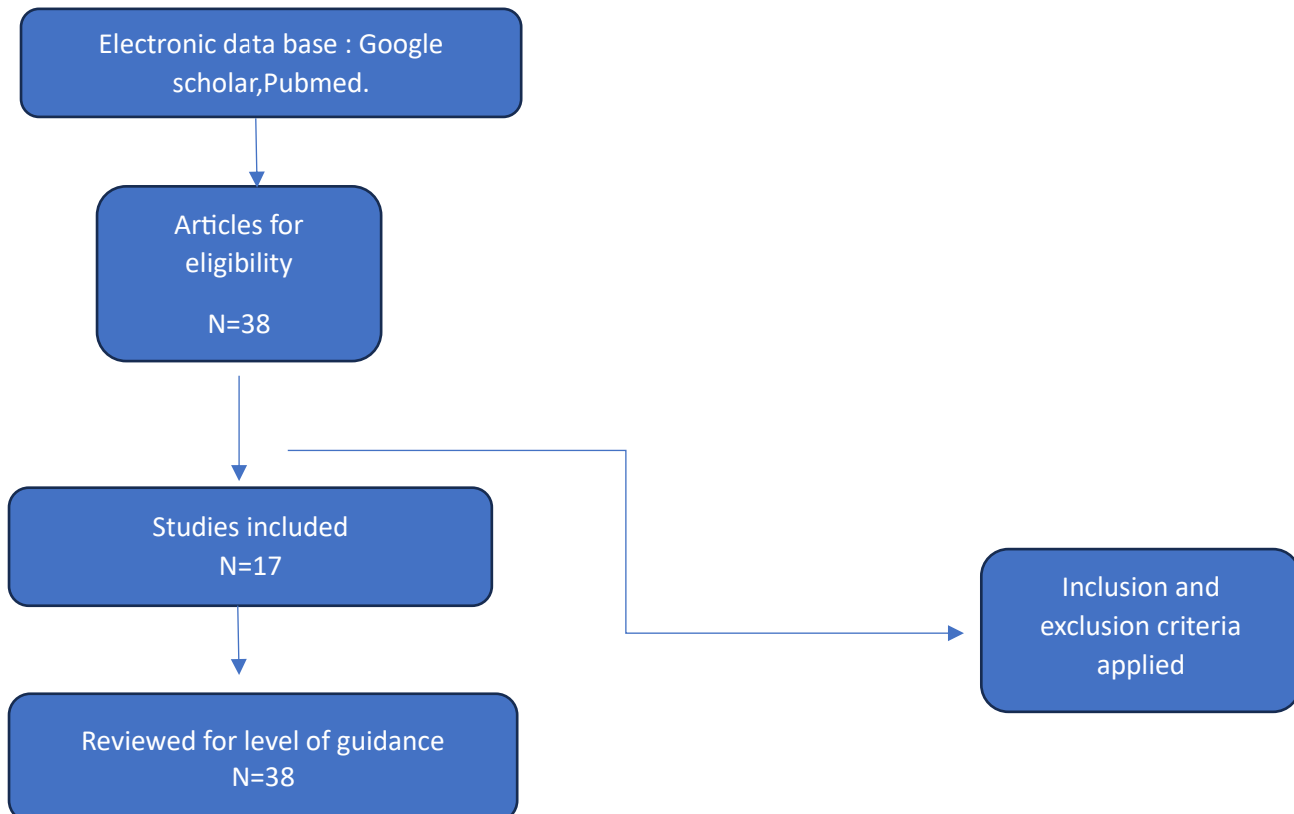




Table 1: Summary of studies evaluating the tools to assess balance in autism children

S.NO	Author	Title	Tools used	Conclusion
1.	S Soniyasr et al.,2024	Impact of Xbox Gaming on Object control skills and Balance for children with autism spectrum disorder-A Pilot study	Pediatric balance scale	The main objective of the study is to Find , how Xbox gaming affects children with ASD's balance and object control abilities.according to this study's findings, children who are having ASD can have benefit from playing video games on Xbox One to help with balance and object handling ^[19] .
2.	Bania, Theofani A et al.,2023	Pediatric Balance Scale: Translation and Cross-Cultural Adaptation Into Greek	Pediatric balance scale	Translation of the Pediatric Balance Scale (PBS) into Greek by cross-cultural adaption. they analyzed the PBS for content equivalency and translated it backward. On 26 children with mobility limitations, the Greek PBS (PBSGR) was administered. Interrater, test-retest, and internal consistency reliability of the scale were found to be excellent ^[20] .
3.	sakshi namishi shah et al., 2022	Determining Balance Performances in Children Having Autism Spectrum Disorder	Pediatric balance scale	Children who are having Autism spectrum disorder have balance abnormalities when evaluated through the Pediatric Balance Scale. This highlights that ASD can affect both static and dynamic balance, as well as communication, cognition, mood, and behavior in varying degrees ^[21] .
4.	Erika Suenya Gomes Cordeiro et al.,2021	Postural balance in children with Autism Spectrum Disorders	Pediatric balance scale	The main purpose of this study is to describe how the children with ASD perform on two postural balance evaluation measures.They concluded that Pediatric Balance Scale and sensory organisation test were completed by the participants without any trouble, and their scores were quite near to the maximum value ^[22] .
5.	Carla lourenco et al.,2023	Motor Proficiency of Children with Typically Developing Children and Children with Autism Spectrum Disorder	Bruninks oseretsky test for motor proficiency	The main purpose of this reserch is to compare the motor skills of neurotypical and ASD children.The Bruininks-Oseretsky test of motor proficiency (BOT-2) was used to assess motor proficiency. On several motor proficiency criteria (fine manual accuracy, , upper limb coordination, manual dexterity balance, and motor proficiency profile), children with ASD significantly scored less ^[23] .
6.	Karacar,ebru et al., 2023	An Investigation of Motor Skills of 8- to 12-Year-Old Children With Autism Spectrum Disorder	Bruninks -oseretsky test for motor proficiency	A study compared the gross motor skills of 8-12-year-old ASD children ,to typically developning children. Results concluded that autism children had lower gross motor scores, bilateral



		Compared to Typically Developing Peers		coordination, balance, agility, strength, and upper extremity coordination skills than TD children ^[24] .
7.	Liu,ting et al.,2021	Fine and Gross Motor Competence in Children With Autism Spectrum Disorder	Bruninks-oseretsky test for motor proficiency	Children with ASD are having significant delays in both Fine and Gross motor skills abilities compared to their typically developing peers. However, they exhibit superior performance in various motor skills such as accuracy, integration, dexterity, coordination, and agility ^[25] .
8.	Carlos Pelayo Ramos-Sánchez et al.,2022	The Relationship between Motor Skills and Intelligence in Children with Autism Spectrum Disorder	Movement assessment battery for children	This study investigates the relationship between motor impairment and intellectual disability (ID) in children with ASD , As well as correlation between intelligence and motor abilities in the group after adjusting for Attention Deficit Hyper Activity Diorder (ADHD). The findings suggests that the children with ASD are having moderate relationship between performance IQ and manual dexterity and balance, and a modest correleation between the prevalence of ID and motor disability ^[26] .
9.	Christina E.odeh et al.,2020	Comprehensive motor skills assessment in children with autism spectrum disorder yields global deficits	Movement assessment battery for children	This study compared the motor abilites of children with autism to neurotypical peers using standardized assessments MABC-2 , BOT -2 and a parent report measure. It is found that children with autism are having more difficulties with Global motor performance, including complicated motor skills and balancing activities ^[27] .
10.	Purpura G et al., 2020	Motor coordination impairment in children with autism spectrum disorder: a pilot study using Movement Assessment Battery for Children-2 Checklist.	Movement assessment battery for children	This study examines the motor functioning of school aged children . The Children Movement Assessmnt Battery is used to assess the motor profile, and the study analyzed the correlation between the subjects' clinical traits and their motor performance. Children with autism have difficulty with specific abilities that require integrating perception and action to anticipate and coordinate movement ^[28] .

DISCUSSION

Reduced social reciprocity, limited behavior, and impaired communication are the main features of Autism Spectrum Disorder(ASD) . Even though many individuals have encountered of these features, autism children may also exhibit additional sensory deficiencies or impairments. Growing evidence has shown that ASD impacts not only behavior, mood/emotion, communication and cognition but also motor control and balance. ASD is a long-term disorder that impacts people at all stages of their lives. Impaired balance is one among the emerging issues for children with autism^[29].

It is challenging to choose an acceptable balance assessment approach because of the availability numerous of ways , different studies have determined how to evaluate balance based on different goals, and no one measure has emerged ^[30].



So, this study aims to provide the available assessment tools to evaluate balance problems, particularly in autistic children. Researchers can use the thorough overview of assessment tools that we have provided in this article to evaluate balance in people with autism. The criteria used to select these assessment tools are: 1) widely in practice from the past 5-7 years 2) The tools have to evaluate static balance and dynamic balance 3) Tools have to be suitable for ASD children. Based on the above criteria only three tools are considered in this study while several tools have boundaries when it comes to their administration and practice.

This literature review suggests that when working with children, evaluation instruments with shorter administration times are recommended. A lengthy test duration could make it difficult for smaller kids to participate for the full examination. Future research on assessment tools for evaluating balance in individuals with autism may be guided by the practical implications of the current literature review.

CONCLUSION

This review suggests some standardized tools that are used to help the children with Autism Spectrum Disorder (ASD) who are having balance issues. At the moment, a lot of physicians, physiotherapists, and teachers in special education use such tools in their work. The evaluation outlines the features, advantages, and disadvantages of three tools. Based on the characteristics of these evaluation tools, PBS can be administered with great ease, while others can need minimal to moderate equipment. Based on a preliminary analysis, the current research concluded that these assessment methods tailored for people with autism may be useful in evaluating their static and dynamic balance. To determine the potential implications of different assessment tools for the evaluation of balance in individuals with ASD, implementation of more meticulously planned randomized controlled trials are needed.

REFERENCES

1. Hirota T, King BH. *Autism spectrum disorder: A review*. *Jama*. 2023 Jan 10;329(2):157-68.
2. Djordjević M, Memisević H, Potic S, Djuric U. *Exercise-based interventions aimed at improving balance in children with autism spectrum disorder: a meta-analysis*. *Perceptual and Motor Skills*. 2022 Feb;129(1):90-119.
3. Stins JF, Emck C. *Balance performance in autism: A brief overview*. *Frontiers in psychology*. 2018 Jun 5;9:323618.
4. Ansari S, Hosseinkhanzadeh AA, AdibSaber F, Shojaei M, Daneshfar A. *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*. 2021 Sep;51:3180-6.
5. Roşca AM, Rusu L, Marin MI, Ene Voiculescu V, Ene Voiculescu C. *Physical activity design for balance rehabilitation in children with autism spectrum disorder*. *Children*. 2022 Jul 30;9(8):1152.
6. *berg balance scale for the school-age child with mild to moderate motor impairment*. *Pediatric physical therapy*. 2003 Jul 1;15(2):114-28.
7. Kaur M, Gochyyev P, Tiwari D. *Use of standardized motor assessments in children with autism spectrum disorder: A meta-analysis and systematic review*. *Research in Autism Spectrum Disorders*. 2024 Feb 1;110:102298.
8. Erden A, Acar Arslan E, Dündar B, Topbaş M, Cavlak U. *Reliability and validity of Turkish version of pediatric balance scale*. *Acta Neurologica Belgica*. 2021 Jun;121(3):669-75.
9. Sival DA. *Application of pediatric balance scales in children with cerebral palsy*. *Neuropediatrics*. 2012 Nov 1:305-6.
10. 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*. *Pediatric physical therapy*. 2003 Jul 1;15(2):114-28.
11. Deitz JC, Kartin D, Kopp K. *Review of the Bruininks-Oseretsky test of motor proficiency, (BOT-2)*. *Physical & occupational therapy in pediatrics*. 2007 Jan 1;27(4):87-102.
12. Wuang YP, Su CY. *Reliability and responsiveness of the Bruininks-Oseretsky Test of Motor Proficiency-in children with intellectual disability*. *Research in developmental disabilities*. 2009 Sep 1;30(5):847-55.
13. Jeoung B. *Motor proficiency differences among students with intellectual disabilities, autism, and developmental disability*. *Journal of exercise rehabilitation*. 2018 Apr;14(2):275.
14. Pan CY. *Motor proficiency and physical fitness in adolescent males with and without autism spectrum disorders*. *Autism*. 2014 Feb;18(2):156-65.
15. Brown T, Lalor A. *The movement assessment battery for children – second edition (MABC-2): a review and critique*. *Physical & occupational therapy in pediatrics*. 2009 Jan 1;29(1):86-103.
16. Odeh CE, Gladfelter AL, Stoesser C, Roth S. *Comprehensive motor skills assessment in children with autism spectrum disorder yields global deficits*. *International Journal of Developmental Disabilities*. 2022 May 20;68(3):290-300.
17. Baharudin NS, Harun D, Kadar M. *An assessment of the movement and function of children with specific learning disabilities: A review of five standardised assessment tools*. *The Malaysian journal of medical sciences: MJMS*. 2020 Mar;27(2):21.
18. Verbecque E, Lobo Da Costa PH, Vereeck L, Halleman A. *Psychometric properties of functional balance tests in children: a literature review*. *Developmental medicine & child neurology*. 2015 Jun;57(6):521-9.
19. Soniyasri S, Alagesan J. *Impact of Xbox Gaming on Object control skills and Balance for children with autism spectrum disorder-A Pilot study*. *Indian Journal of Physiotherapy & Occupational Therapy*. 2024 Jan 2;18.



20. Bania TA, GkoutSIDou P, Billis E, Lampropoulou S. *Pediatric Balance Scale: Translation and Cross-Cultural Adaptation Into Greek. Pediatric Physical Therapy.* 2023 Oct 1;35(4):430-7.
21. Shah SN, Desai M. *Determining Balance Performances in Children Having Autism Spectrum Disorder.*
22. 23. Azoni CA, Cordeiro ES, Aprígio LC, Gazzola JM. *Postural balance in children with Autism Spectrum Disorders.*
23. Lourenço C, Esteves D, Pinheiro M. *Motor Proficiency of Children with Typically Developing Children and Children with Autism Spectrum Disorder.*
24. Karacar E, Özer D, Şahin M, Özcan GH. *An Investigation of Motor Skills of 8-to 12-Year-Old Children With Autism Spectrum Disorder Compared to Typically Developing Peers. Palaestra.* 2023 Jul 1;37(3).
25. Liu T, Capistran J, ElGarhy S. *Fine and gross motor competence in children with autism spectrum disorder. Physical Educator.* 2021 Oct 1;78(3):227-41.
26. Ramos-Sánchez CP, Kortekaas D, Van Biesen D, Vancampfort D, Van Damme T. *The relationship between motor skills and intelligence in children with autism spectrum disorder. Journal of Autism and Developmental Disorders.* 2021 Apr 22:1-1.
27. Odeh CE, Gladfelder AL, Stoesser C, Roth S. *Comprehensive motor skills assessment in children with autism spectrum disorder yields global deficits. International Journal of Developmental Disabilities.* 2022 May 20;68(3):290-300.
28. Purpura G, Fulceri F, Puglisi V, Masoni P, Contaldo A. *Motor coordination impairment in children with autism spectrum disorder: a pilot study using Movement Assessment Battery for Children-2 Checklist. Minerva Pediatrica.* 2020 Feb;72(1):22-29. DOI: 10.23736/s0026-4946.16.04633-8. PMID: 27733748.
29. Oster LM, Zhou G. *Balance and vestibular deficits in pediatric patients with autism spectrum disorder: An underappreciated clinical aspect. Autism research and treatment.* 2022 Aug 16;2022.
30. Rudolf M, Vidmar G, Goljar N. *A comparison of three balance-assessment scales for patients after stroke with various levels of balance disorder. International journal of rehabilitation research.* 2020 Dec 1;43(4):337-41.