

AUTISM SPECTRUM DISORDER AS A PREDICTOR OF WORKING MEMORY AND PLANNING IMPAIRMENT IN CHILDREN

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ABSTRACT

The present study aimed to assess the Autism Spectrum Disorder as Predictor of Impaired Working memory and Inhibition in autistic children. It was hypothesized that Autism Spectrum Disorder impaired working memory and planning. Additionally, To investigate the frequency of ASD in term of gender. The sample (n=120) with the age 4-13 years were drawn through purposive sampling technique from Centre of Excellence for children Autism, Directorate of Social Welfare, the Autism Unit, University of Peshawar and the Autism Jewel. Childhood Executive Functioning Inventory (CHEXI) and the Childhood Autism Rating Scale (CARS) were utilized to assess impact of asd on working memory, planning respectively. Descriptive Statistic, Stepwise Regression analysis was used. The results revealed that Autism Spectrum Disorder significantly affect Working Memory and Planning. Hence Autism Spectrum Disorder was significant predictor of impaired working memory and planning. the results of present study help mental health workers such aspsychologist and ABA therapist to design strength based intervention which help child to manage their executive functioning in academic and non-academic setting.

Keywords: autism spectrum disorder, working memory, planning, children with autism

INTRODUCTION

Autism spectrum disorder (ASD) is a neurological and developmental disorder that impacts one's social interaction, communication, learning, and behaviour. Although autism can be assessed and investigated at any age, it is sketched as a "developmental disorder" because symptom appear is early year of the life such as 2 years (Johnson, 2007). The social concurrence or interaction domain involves complications in supplementary social interaction (Wagner,2018); defalcations in body language (Papagiannopoulou, et al, 2014) and detriments in ability to grow, stabilize, and comprehend relationships (Happé & Frith,2006). Signs

related to limited and repeated behaviours appear in movement, speech, body language, and sensory activities (Ozonoff,2005). Common behaviours in the restricted and repetitive domain may include repeated body movements, copying words or phrases, a strong need for routines, fixed habits, very focused interests and unusual reactions to sensory things like sounds, lights, or touch – either too sensitive or not sensitive enough (APA.DSM,2013).

ASD is a developmental condition that mainly affects child's communication and behavior, and social connection with others. Children with Autism Spectrum Disorder often find it difficult to interact in social settings or express their thoughts clearly. They may also rely heavily on

routines and feel upset when their usual patterns are changed (Roehr, 2013)

The early signs of ASD typically become noticeable during the first two years of life. Because of these challenges, many children require guidance and assistance in their everyday activities. The term “spectrum” highlights that this condition is not the same for everyone. Some individuals experience mild difficulties, while others may need more consistent support in different areas of life (Albin et al, 2026).

Even with these challenges, many individuals with ASD possess strong abilities in certain areas. For instance, they may show creativity or talent in activities such as art, drawing, or detailed work. Although the condition begins in early childhood, its effects usually continue throughout life (Simon, 2022). ASD is present across the globe and has been identified more frequently in recent years. Research indicates that it is more commonly diagnosed in boys than in girls. On a global scale, roughly one out of every hundred children is affected by this condition (Starkstein et al, 2015).

Globally, Autism Spectrum Disorder (ASD) affects a small but significant portion of the population—around 0.6%. In simpler terms, this is close to 1 out of every 100 children worldwide. Research also shows that ASD is diagnosed more often in boys than in girls, with an estimated ratio of about 3.8 boys for every 1 girl. The impact of ASD can be seen in different aspects of daily life. Difficulties in communication and social behaviour can make school adjustment and learning more challenging. As individuals grow older, these issues may also influence their independence, job opportunities, and social relationships. In some situations, it may also lead to isolation, stress within the family, or exposure to unfair treatment (Minn, 2017).

Working memory (WM) can be understood as a temporary mental space where the brain holds and processes information for a short period of time. It has a limited capacity, yet it plays an essential role in many thinking activities such as reasoning, decision-making, problem-solving, and planning. This ability helps us stay focused on what we are doing at the moment, especially when dealing with tasks like solving mathematics problems, following step-by-step instructions, or organizing a project. It is considered an important executive function because it allows

us to concentrate on relevant information while filtering out distractions (Hulme, 2013). In this way, working memory helps maintain attention and prevents us from being easily diverted by unimportant details (Jha et al, 2025).

Working memory refers to the mental process that enables individual to briefly hold and recall brief information in an active and accessible form. It works closely with long-term memory and supports higher-level thinking skills such as organizing ideas, understanding concepts, reading, writing, and solving problems. Since this function is involved in nearly all learning activities, especially in school settings, it has become a key area of interest in both psychology and education research (Cowan, 2014).

Baddeley’s (2003) WM Model is the one that most researchers use today but there are numerous good models to explain how our brain works. Different researchers, including “Anderson (1983), Cowan (2008), Ericsson and Kintsch (1995), Miyake and Shah (1999), and Oberauer (2005)”, have proposed various models to explain how working memory functions. These models mainly differ in how they describe the connection between working memory and long-term memory, the role of control processes, and how much information working memory can hold. Despite these differences, most researchers agree that WM is cluster of psychological process work together to temporarily store and use information (Cowan, 2008).

Working memory includes both verbal and visual-spatial systems. The verbal part, often called the articulatory or phonological loop, is responsible for handling spoken and heard information. It has two main parts: a phonological store, which briefly holds sounds, and a rehearsal process that helps repeat and maintain this information. This system helps us understand and organize sounds into meaningful units like words and sentences.

The visual-spatial part, known as the visuospatial sketchpad, deals with images and spatial details. It is also divided into two components: one that stores visual information (such as shapes or images) and another that helps rehearse and manage spatial details. These processes allow us to combine and understand what we see around us, instead of experiencing it as disconnected pieces (Buchsbaum, 2016; Simmering, 2016).

Different research have shown that working memory handle the visuo-spatial information differently. Moreover, impaired WM leads to problematic development of neuropsychological constructs such as: “joint attention, facial expression recognition, behavioural imitation, executive function, language skills, and social adaptation in ASD (Dahiya et al., 2020, Delbruck et al., 2019, Kercood et al., 2014, Mo et al., 2019, Rabiee et al., 2020, Roemer et al., 2022, Schuh et al., 2016). However, findings regarding VWM deficits in ASD remain inconsistent. However, a meta-analysis review of 28 studies found that ASD have inconsistent working memory difficulties (Wang, 2017)

Planning defined as that when a child figures out what to do with tasks that are focused on the future. Planning is sub-category of Executive functioning and play major role in deciding day to day task. Frontal lobe, more particularly prefrontal cortex plays an important role in maintaining higher order and lower order process (An et al., 2025)

Additionally, the higher order process disturbed in ASD (Alsaedi, 2025). Children's planning behaviours include figuring out what responsibilities and events are coming up, setting goals for how to finish them, and figuring out what steps need to be taken to get the tasks done ahead of time. Research findings indicate that parents often report greater difficulties in planning abilities among children with ASD compared to other groups (Smithson, 2013).

Planning is an essential management function and plays a key role in any organization. Along with organizing, directing, and supervising, it helps ensure that activities are carried out in a structured and effective way. Planning provides a clear direction and acts as a guide for achieving goals. It is not just a separate step but forms the foundation on which other management functions are built (Meditama, 2025).

Numerous studies showed that individuals with ASD often face challenges in planning (Olde Dubbelink, 2017). These difficulties may appear in everyday life, such as managing unstructured time, maintaining daily routines, and organizing activities (Reilly, 2021). Compared to typically developing children, parents and caregivers often notice that children with ASD struggle more with planning skills in their day-to-day

functioning (Rosenthal, 2013). Children with ASD commonly experiencing deficit in executive functioning more particularly in WM, and planning. These disturbances are more pronounced when children try to learn formally (academic setting) and informally (day to day learning). However, the specific and particular nature of executive functioning is still unclear in case of Autism. Furthermore, through the present study cognitive training and strategy-based intervention will improve to firmly target the impaired executive functioning. This study aim to address the gap by examining the importance of “working-memory” and “planning” in ASD.

Objectives

1. To examine effect of autism spectrum disorder on working memory in children with ASD.
2. To examine effect of autism spectrum disorder on Planning in children with ASD
3. To examining the gender-based frequency of autism spectrum disorder screen positively between male and female children aged 4 -13 years.

Hypotheses

- H1: The Autism Spectrum Disorder will significantly impair working memory in children with autism spectrum disorder.
- H2: The Autism Spectrum Disorder will significantly impair working memory in children with autism spectrum disorder.
- H3: Boys will have significantly higher rates of ASD as compared to girls between the age 4-13 years .

Method

Sample Size

The available sample of (n=120) under the age of 4-13 years were taken from Centre of Excellence for Children with Autism, Directorate of Social Welfare, the Autism Jewel and the Autism Unit, University of Peshawar.

Instruments

Demographic Information

The demographic sheet was used for evaluating socio-demographic traits such as: socioeconomic level, gender, and age, parental age at the time of birth, birth-weight, premature birth and either

the mother was diagnosed with diabetes at time of birth or not.

Childhood Executive Functioning Inventory (CHEXI)

The The Childhood Executive Functioning Inventory (CHEXI) is a scale of 24 items designed to assess executive function in children aged 4-12. It was developed Catale et al. (2008) The scale focuses on two underlying factors: Working Memory and Inhibition. The 24 items were designed to reflect four initial subdomains of executive function: Working Memory (9 items), Planning (4 items), Regulation (5 items), and Inhibition (6 items). However, factor analysis identified that Working Memory and Inhibition are the most robust and consistent factors. Parents or teachers evaluate the child's behaviour on each item using a Likert scale with five points: 1 represents "definitely not true," 2 represents "not true," 3 represents "partially true," 4 represents "true," and 5 represents "definitely true." The Chronbach alpha is .89

The Childhood Autism Rating Scale (CARS)

The Childhood Autism Rating Scale (CARS) is a 15-item, observation-based tool used to evaluate the severity of autism. It was developed by (Schopler et al. 1980, 1988). Each item is rated on a scale from 1 to 4, where higher scores reflect greater levels of autism-related symptoms. The main purpose of CARS is to help

differentiate children with autism from those who may have other developmental delays. The scale was initially tested on a large group of children with autism over a period of ten years and has shown strong reliability and validity, with good consistency with DSM-IV diagnostic criteria. The overall score is obtained by adding all item scores, giving a total range from 15 to 60. The range of score on CARS is "15-29 interpreted as non-autistics, 30-36.5: Mild to moderate autism, 37-60: Severe autism".

Procedure

The procedure of the study was begun from taking formal permission from director of Centre of Excellence for Children with Autism, Directorate of Social Welfare, CEO of the Autism Jewel and the head of Department of Psychology, University of Peshawar. After taking permission, the contact was made with autistic children. As the sample (n=120) was chosen through purposive sampling with mean age 4-13 years, therefore, informed consent were taken from the parents as well. After the completion of prerequisites of the study, the

Questionnaire such as Childhood Autism Rating Scale (CARS) and CHEXI, were filled with the help of psychologist working in the mentioned centers. After the completion of questionnaire, the research was ended at brief note of thanks to the participants and institutional authority

Result

Table 1

Socio-Demographics traits of the participants (N=120)

Variable	N	%
Age		
4-8	75	62.5
9-13	45	37.5
Gender		
Boy	93	77.5
Girl	27	22.5
Socioeconomic status		
Lower	3	2.5
Middle	77	64.5
Upper	39	32.5

Parental Age		
20-25	23	19.2
26-30	37	30.8
31-35	23	19.2
36-40	21	17.5
Above 40	16	13.3

Table 1 displays the major socio-demographic traits of the total sample. Frequencies (N) and percentages (%) of each level of characteristics are shown.

Table 2
Psychometric properties of the study variable (N=120)

Variables	Mean	Std. Deviation	Range	Cronbach's α
EF	90.26	20.82	46-120	.96
CARS	39.03	10.24	19-59	.93

Note: EF=Executive Functioning, CARS=Childhood Autism Rating Scales.

The Table 2 revealed the psychometric properties of the major study variables. The Cronbach's alpha of executive functioning scale is $\alpha=.96$, while CARS has $\alpha= .93$ which indicated that these scales have higher internal consistency.

Table 3
Descriptive Statistics and Correlation for Executive Functioning and Childhood Autism Rating (N=120)

Variable	N	M	SD	1	2
EF	120	90.26	20.82	-	-
CARS	120	39.03	10.24	.872 ^{xxx}	-

Note: EF= Executive functioning, CARS= Childhood Autism Rating Scale

The table 3 shows the Pearson Product-Moment Correlation between EF and CARS. The results show that executive functioning (EF) are positively related with Autism Spectrum Disorder (CARS) ($r=.872$, $p<0.01$), indicating that higher scores of autism spectrum significant impairments in executive functioning.

Additionally, there is a positive correlation between autism spectrum disorder and executive functioning, indicating that higher scores Childhood Autism Rating Scale contributes to impaired executive functioning.

Table 4
Stepwise Regression for Working memory (WM) and ASD (N=120)

Variable	B	95%+CI		SE	B	R ²	ΔR ²
		LL	UL				
Step 1							
(Constant)	9.22	5.90	12.53	1.67	-	.62	.65 ^{xx}
Gi.tot	7.95	6.89	9.011	.535	.80		
Step 2							
(Constant)	7.66	4.48	10.83	1.60	-	.69	.04 ^{xxx}
Gi.tot	5.90	4.53	7.28	.694	.60		
Rtp.tot	2.65	1.41	3.89	.625	.29		
Step 3							
(Constant)	6.75	3.73	9.7	1.52	-	.73	.04 ^{xxx}
Gi.tot	5.15	3.81	6.5	.067	.52		
Rtp.tot	2.71	1.55	3.87	.528	.31		
Vr.tot	1.71	.888	2.53	.416	.41		
Step 4							
(Constant)		2.89		1.556	-	.74	.01 ^x
Gi.tot		3.10		.732	.46		
Rtp.tot	5.97	1.49	9.05	.580	.29		
Vr.tot	4.55	.623	6.00	.428	.18		
Nvc.tot	2.63	.012	3.78	.622	.12		
	1.47		2.32				
	1.24		2.47				

Note: Constant=Working memory, Gi= General impressions, Rtp= Relating to people, Vr= Visual response, Nvc= Non-verbal communication.

*P<.05, ***p<.001

In Table 4, A stepwise regression equation was used to determine the most significant predictor of impaired Executive Functioning. First, GI was added to the model, which produced a notable reduction in EF, F (221.01) =P<.001. In the second step, GI and RTP were added, leading to another significant reduction in EF, F (135.462)

=P<.001. In step 3, Rtp, Vr entered a significant predictors were found to impaired executive functioning. In step 4, GI, Rtp, Vr, Nvc were the significant predictor of impaired executive functioning. The I, II, III demonstrated a strong fit, accounting for substantial portion of variance in EF.

Table 5
Stepwise Regression for Planning (PI) and ASD (N=120)

Variable	B	95%CI		SE	β	R^2	ΔR^2
		LL	UL				
Step 1							
(Constant)	4.66	2.96	6.36	.86	-	.58	.58 ^{xx}
Gi.tot	3.53	2.98	4.07	.27	.76		
Step 2							
(Constant)	4.04	2.63	5.73	.85	-	.62	
Gi.tot	2.72	1.99	3.44	.36	.59		
Rtp.tot	1.05	.398	1.704	.33	.25		.03 ^{xxx}
Step 3							
(Constant)	3.69	2.04	5.34	.83	-	.64	
Gi.tot	2.42	1.69	3.16	.37	.52		.02 ^{xxx}
Rtp.tot	1.07	.422	1.71	.32	.26		
Vr.tot	.666	.217	1.12	.22	.17		
Step 4							
(Constant)		1.88	15.14	.82	-		
Gi.tot	3.51	1.14	2.81	.42	.43		
Rtp.tot	1.98	.329	1.59	.32	.23	.65	
Vr.tot	.962	.186	1.074	.22	.16		
Al.tot	.630	.030	1.337	.33	.16		
	.684						.01 ^x

Note: Constant=Planning, Gi= General impressions, Rtp= Relating to people, Vr= Visual response, Al= Activity level . *P<.05, ***p<.001

Table 5 shows the impact of Autism Spectrum Disorder on Executive functioning. In step 1, the R^2 value of .585 indicated that GI explained 58% variance in Executive functioning with $F(166.032) = P<.001$. The finding revealed that GI is significant positive predictor of impaired executive functioning ($\beta = .76, P<.001$). In step 2, the R^2 value of .618 indicated that GI and Rtp.tot explained 61% variance in EF with $F(94.53) = P<.001$. The finding revealed that GI, Rtp (.25, $P<.001$) both positively signifies predictor of impaired executive functioning. In step 3, the R^2 value of .644 revealed that GI, Rtp, Vr explained 64% variance in EF with $F(70.01) = P<.001$. The finding revealed that GI, Rtp, Vr are the significant predictor of EF. In step 4, the R^2 value of .65 revealed that GI, Rtp, Vr, Al.tot explained 65% variance in executive functioning. The model III demonstrated a

strong fit, accounting for substantial portion of variance in EF.

Discussion

The current study's objective was to examine the autism spectrum disorder as a predictor of impaired working memory and planning. In the present study, the children (n=120) aged between 4-13 years were selected from different autism centers of Peshawar.

The objective of the current study i.e., to investigate the impact of autism spectrum disorder on working memory and planning in children with autism spectrum disorder. Moreover the present study's objective was to find the frequency of screening between girls and boys between age 4 to 13 years. The result of the study in terms of assessing effect ASD on WM and planning was found to be significant. The result of step wise regression's model 1

general impression to the people, in step 2 relating to the people, in step 3 again general impression to the people and step 4 non verbal communication were significantly predicted lower working memory. The finding of present are consistent with previous study. According to the previous study by Maria Ishtiaq (2022), Children with autism spectrum disorder exhibit severe executive functioning deficiencies (Working memory) when compared to normal children. As per findings of the Marotta et al. (2019), there were profound deficits in several dimensions of executive functions (working memory) in ASD children. According to a meta-analysis by Demetriou et al. (2018), a wide EF impairment is more common in children and people with ASD as a group and is found to be generally stable throughout development. Similarly, this conclusion aligns with the findings reported by Wang et al. (2017) examined impairments in both verbal and working memory in ASD. Habib et al. (2019) also assessed that ASD showed significant deficits in the accuracy and error rate of VWM tests. Additionally, the present study assesses the impaired level of planning in children with ASD, again the result of stepwise Regression analysis revealed that in model 1 general impression to the people, in step 2 relating to the people and in step 3 general impression and step 4 disturbed activity level is strong predictor of impaired planning. The results were aligned with previous literature, planning is most demanding psychological process in executive functioning which require social assistance and higher active mind set which the children with autism spectrum lacks. In terms of gender the result of current study revealed that boys were more screened with autism spectrum disorder as compared to female. The results are aligned with previous study. It was found that male have higher prevalence of ASD than female (Maenner et al, 2021). Another study also elaborated that most girls are underdiagnosed because they have internalized the sign and boys show externalized sign (Fusar-Poli et al, 2020). The outcome of the present study provides evidence for the impaired executive functioning (Working memory and planning) in autistic children. Moreover, it also demonstrates that boys have a more frequency of autism spectrum disorder than that of the girls.

The present study can be used in order to assess and evaluate autism spectrum disorder.

Limitation

Limitations of the present study are:

1. As the study research design was cross-sectional research design, therefore, there were bare minimum chances to control confounding variables.
2. Sample was less so the studies generalizability is not up to the mark.
3. Through stratified sampling of the selection of centre of autism from different cities of Khyber Pakhtunkhwa can give clear picture of the differences found in the identification and management of autism spectrum disorder.

Recommendation

1. Future research should involve larger and more diverse participant groups from different regions to enhance the generalizability of the findings.
2. Innovative screening tools should be used to determine individuals who are at risk for developing autism spectrum disorder even before behavioral symptoms become apparent.
3. Future studies should investigate comorbidities such as anxiety, ADHD and intellectual disability to develop integrated and effective treatment approaches
4. Engaging autistic individuals along with their parents in the research process should be considered crucial to ensure that research questions are relevant and research findings are interpreted in meaningful ways for the community.

Conclusion

The current study aims to investigate the autism spectrum disorder as predictor of impaired working memory and planning. The study anticipated that autism spectrum disorder causes clinically significant impairments in executive functioning (Working memory and planning) of autistic children. The sample of the study was collected from

Center of Excellence for Children with Autism, Directorate of Social Welfare, the Autism Jewel and the Autism Unit, University of Peshawar that is N= 120 aged between 4-13 years.

The present study revealed that the prevalence of impaired working memory and planning was

significantly higher in children aged between 4-8 years and boys have higher prevalence of autism spectrum disorder, hence impaired executive functioning than those of girls. Two instruments were used in the present study in order to examine the level of impairments in executive functioning among autistic children. These scales are childhood Executive Function Inventory (CHEXI) and Childhood Autism Rating Scale (CARS). After the stepwise regression analysis for executive functioning, it was revealed that autism spectrum disorder is the significant predictor of impaired working memory and planning. So, from findings of the study we get to know that if we treat autism spectrum disorder, we can decrease impairments in working memory and planning among autistic children. Early treatment of autism spectrum disorder through occupational therapy, speech therapy and ABA analysis in rehabilitation centers helps to facilitate them to recover from psychological problems as well as improvement in levels of impaired executive functioning (Working memory and planning).

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