

Effectiveness of Audiovisual Stimulation on Behavioral function in Children with Autism Spectrum Disorder, ASD

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Abstract

Autism Spectrum Disorder (ASD) severely impairs the development of a person's ability to interact with other people, as the autistic individual is self-absorbed and unable to relate normally with the outside world. It attacks without discrimination, afflicting all sectors of society.

Objective: To assess the effect of audio-visual stimulation (AVS) on behavioral functions in children with autism spectrum disorder.

Methodology: An intervention study which included thirty-four children with confirmed ASD. Randomly recruited from Pediatric Outpatient Clinic, Center of Special Needs, FPGCS, Ain-Shams University, throughout a period of 12 months starting from June 2018 till the end of May 2019. They were 26 males & 8 females with an age range from 4 to 9 years. All participants were subjected to IQ test Sandford Binet 5th edition (SB5), Childhood Autism Rating Scale (CARS) and AVS sessions. Candidates had received two sessions per week using the Mindspa Personal Development Device, completing a course of eight sessions (each session was 22 mins).

Results: Out of 34 children, were 26 males (76.74%) & 8 females (23.53%), with (M: F= 3.3: 1). Intelligent quotient was; low average: (11.76%), borderline impaired: (23.53%), mildly impaired: (50%) & moderately impaired: (14.71%) with IQ mean \pm S.D. score; (65.1 \pm 10.9). After AVS sessions, results revealed statistical significance decrease (i. e. improvement) (p-value <0.001), between pre- & post- CARS total score with mean \pm S.D (35.46 \pm 4.1), (32.44 \pm 4.5) & moreover, behavioral, symptomatology among studied cases, with mean \pm S. D (3.43 \pm 0.58), (2.4 \pm 0.73).

Conclusion: Using Mindspa software programs as an intervention method of rehabilitation provided a preliminary evidence for the feasibility and use of AVS in children with ASD to improve the target symptomatology.

Keywords: Autism Spectrum Disorder (ASD), Stanford- Binet 5th edition (SB5), Childhood Autism Rating Scale (CARS) score, Audio-visual Stimulation (AVS).

تأثير التحفيز السمعي البصري على الوظائف السلوكية لدى الأطفال المصابين باضطراب طيف التوحد

الهدف: هو تقييم تأثير التحفيز السمعي البصري على الوظائف السلوكية لدى الأطفال الذين يعانون من اضطراب طيف التوحد.

المنهجية: أجريت الدراسة على 34 طفل مصابا باضطراب طيف التوحد. وقد تم اختيارهم عشوائيا من العيادات الخارجية بمركز رعاية ذوي الاحتياجات الخاصة، خلال الفترة من يونيو 2018 إلى مايو 2019. تكونت الدراسة من 26 من الذكور و 8 من الإناث وكانت أعمارهم تتراوح ما بين 4 إلى 9 عاما. لقد تم تقييم جميع الأطفال المدرجين ضمن الدراسة من خلال أخذ التاريخ المرضي، كما تم إجراء الفحوصات اللازمة لكل مريض وفقا للنتائج الإكلينيكية (الكشف)، اختبار الذكاء ستانفورد بينيه (الصورة الخامسة)، لذلك بالإضافة إلى جلسات التحفيز السمعي والبصري للمخ، حيث يبدأ المخ بمحاكاة نفس الترددات Mindspa Device.

النتائج: تبين من التشخيص الإكلينيكي للحالات ومن جمع النتائج وتحليلها إحصائيا وتصويرها على النحو التالي؛ 34 حالة من اضطراب طيف التوحد ASD، تراوحت أعمارهم بين 4 إلى 9 سنوات بمتوسط عمر 6.74 \pm 1.64 سنة. كانوا 26 تذكور (76.74%) و 8 إناث (23.53%)، مع M: F= 3.3 بالإضافة إلى ذلك، كشفت النتائج تحسن القيمة p < 0.001، بين C.A.R.S (قبل وبعد). الدرجة الكلية بين الحالات المدروسة مع اختلاف فرق S.D (35.46 \pm 4.1، 32.44 \pm 4.5)، أيضا، أظهرت النتائج تحسن قيمة p < 0.001، بين الأعراض السلوكية بين الحالات المدروسة، مع فرق متوسط الفرق بين S.D (3.43 \pm 0.58، 2.4 \pm 0.73) على التوالي.

الخلاصة: أشارت نتائج الدراسة إلى الحالية أن التحفيز السمعي البصري قد أثر إيجابيا على سلوكيات الأطفال الذين يعانون من ASD وتحسين مهاراتهم السلوكية.

الكلمات الانتاجية: الأطفال، اضطراب طيف التوحد، التحفيز السمعي والبصري، مقياس تقييم التوحد.

Introduction:

Autism spectrum disorder (ASD) is a complex, pervasive, and multifactorial neurodevelopmental condition (Masi et.al., 2017).

The CDC has reported that the prevalence of ASD is 1: 59, the new estimate represents a 15% increase in prevalence, from 1 in 68 in two previous years. ASD is reported to occur in all racial, ethnic, and socio-economic groups (CDC, 2017).

Brainwave Entrainment (BWE), is a procedure that modulates neural activities by synchronizing brainwave frequency with that of a stimulus (i.e. a mechanism used by the brain to process sensory stimuli of several modalities; Photoc, Audio, Olfactory, Tactile (Shusheng et.al., 2016).

Audiovisual entrainment (AVE) or stimulation (AVS) techniques, unite three modalities, the auditory, visual, and vestibular, into a singular intervention, gently training brainwaves to fall into a predetermined specific brainwave pattern, in a noninvasive manner using frequencies (Eisenberg, 2010).

Objective:

To assess the effect of audio- visual stimulation (AVS) on behavioral functions in children with autism spectrum disorder.

Methodology

Subjects:

This is an intervention study which included thirty- four children with confirmed diagnosis of autism spectrum disorder. They were randomly recruited from Pediatric Outpatient Clinic, Center of Special Needs, Faculty of Post- graduate Childhood Studies (FPGCS), Ain- Shams University, throughout a period of twelve months starting from June 2018 till the end of May 2019. Those who did not fulfill the inclusion criteria were excluded.

Inclusion Criteria:

1. Age: (4- 9) years old (i.e. School- Aged Children).
2. Gender: Both Sexes.
3. Cases: Children diagnosed as autism spectrum disorder.

Exclusion Criteria:

1. Cases with previously diagnosed severe co- morbid chronic medical conditions (e.g. hepatic, cardiac or renal).
2. Cases of specific genetic syndromes.
3. A history of seizures or neurological disorders.
4. Lack of cooperation during the assessment.

Ethical Considerations:

The study proposal was approved by the local ethical committee of the Faculty of Post- graduate Childhood Studies and it was conducted according to the guidelines of Helsinki, the guidelines for the Ethical Conduct of Medical Research involving children, revised by the Royal College of Pediatrics and Child Health: Ethics Advisory Committee (FPGC, 2018). An informed consent was obtained from the parents or the legal guardian of the children enrolled in this study, after plain simple explanation of the nature, aim and procedures of the study and also emphasizing that personal and other data would be used for scientific

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work only.

Methods And Research Tools:

- ⊠ Participants: All participants in this study met diagnostic criteria for autism spectrum disorder as described by the DSM- V. All diagnoses were made by the researcher and a licensed clinical psychologist, and were based upon patient and parent interviews supplemented by Childhood Autism Rating Scale (CARS) (Schopler et.al., 1980).
- ⊠ Demographic and medical data were obtained where all participants were subjected to: Simi structured psychiatric interview (modified clinical child psychiatry sheet), Childhood Autism Rating Scale (CARS); (Arabic version) (Schopler et.al., 1980); Intellectual ability was evaluated by obtaining the Intelligence quotient; IQ test using Stanford- Binet Intelligence Scale V5; (Arabic version), (Abu El- Niel, 2011); Clinical examination; general examination, neurological examination and mental state examination.
- ⊠ Mindspa Personal Development System: In the current study, Mindspa as an AVS device has been used to achieve brainwave entrainment among our ASD 34 studied cases. Among the "Progressive Relaxation Alpha Training" programs, we have chosen program number one. Starting by adjusting the light intensity between settings (3- 5) and volume between settings (1- 3), according to the individual patient's most comfortable level. Candidates had received two sessions per week using the Mindspa Personal Development Device, completing a course of eight sessions (each session was 22 mins).
- ⊠ Data processing and Statistical analysis: Data were collected, entered and analyzed on personal computer using IBM SPSS Statistics release 12.0.0 (SPSS Corporation, Chicago, Illino, U.S.A., 2004). The mean± SD were used for quantitative variables.

The number and percentage were used for qualitative variables. Chi square test and Paired t- test were used to assess statistical differences between qualitative and quantitative variables, respectively. The statistical methods were verified, assuming a significance level of P< 0.05 and a highly significant level of P< 0.001 (Mostafa& El- Shourbagy, 2015). Paired t- tests were applied for exploring the differences between pre- and post- test scores with regard to absolute z- scores in group and for each frequency band.

Limitation Of The Study:

Some participants did not give their consent to be enrolled in the study, some did not fulfill all the investigations required for the study due to inability or lack of importance to return for a post treatment examination and others did not complete the treatment course.

Results:

Table (1) Gender distribution among studied cases

Gender (N= 34)	Number	Percentage%
Male (M)	26	76.74%
Female (F)	8	23.53%
Sex Ratio	M: F= 3.3: 1	

Table (1) shows gender distribution among studied cases with M: F

ratio= 3.3: 1.

Table (2) Descriptive Statistics of age, height, weight, BMI and IQ among studied cases.

	Range	Mean± SD
Age	4-9	6.74± 1.64
Height	90-145	122.35± 14.23
Weight	12- 58	28.53± 12.16
BMI	10.9- 32.69	18.51± 5.22
IQ	40- 85	65.1± 10.9

Table (2) shows candidates' descriptive statistics; mean and SD as follows: age (6.74± 1.64), height (122.35± 14.23), weight (28.53± 12.16), BMI (18.51± 5.22) and IQ (65.1± 10.9).

Table (3) Intelligent Quotient among studied cases, according to Stanford- Binet Fifth Edition (SB5) Classification (Kaufman, 2009)

Intelligent Quotient (N= 34)	N	%
Low Average (89- 80)	4	11.76%
Borderline Impaired (79- 70)	8	23.53%
Mildly Impaired (69- 55)	17	50.00%
Moderately Impaired (54- 40)	5	14.71%
	34	100%

Table (3) shows intelligent quotient results among studied cases, where 50% of cases were mildly impaired.

Table (4) Medications among studied cases

Medication	N	%
Risperidal/ Apixodone	15	44.12
Arpiprex	6	17.65
Quitapex	1	2.94
Haloperidol	1	2.94
Atomox	5	14.71
GABA	0	0.00
Cerebrolysin	6	17.65
Anti- Epileptic	0	0.00
Stimulants	4	11.76

Table (4) Shows That (44. 12%) Of Studied Cases Are Maintained On Risperidal/ Apixodone.

Table (5) Combination Of Antipsychotics

Combination Of Antipsychotics	N	%
One Antipsychotic	8	44.44
Two Antipsychotic	1	5.56
Antipsychotic And Others	9	50.00
Total	18	100.00

Table (5) shows that (50%) among studied cases are maintained on a combination of anti- psychotics with other medication.

Table (6) Supplements among studied cases

Supplements	N	%
Omega 3	17	50.00
Vitamins (A, B, C, D, E)	7	20.59
Supplements	14	41.18

Table (6) shows that (41.18%) among studied cases were generally maintained on supplements, from which (50%) were maintained on Omega- 3 and (20.59%) were maintained on multi- vitamins.

Table (7) Childhood Autism Rating Scale (C.A.R.S.) among studied cases

C.A.R.S.	Mean± SD	Paired Test	
		t	P- Value
Pre- Mean± Sd	35.46± 4.1	13.289	<0.001*
Post Mean± Sd	32.44± 4.5		

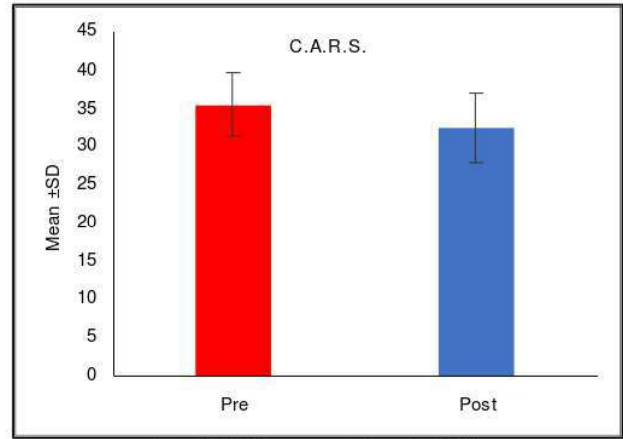


Figure (1) CARS among studied cases (p<0.001).

Table (7) And Figure (1) Show Statistical Significance Decrease (i.e. Improvement) (35.46± 4.1), (32.44± 4.5) (P- Value< 0.001), Between Pre- And Post C.A.R.S.Total Score Among Studied Cases.

Table (8) Behavioral Symptomatology According To CARS Rating Scale; Among Studied Cases

Behavioral Symptomatology	Mean± SD	Paired Test	
		t	P- Value
Pre- Mean± Sd	3.43± 0.58	14.600	<0.001*
Post Mean± Sd	2.4± 0.73		

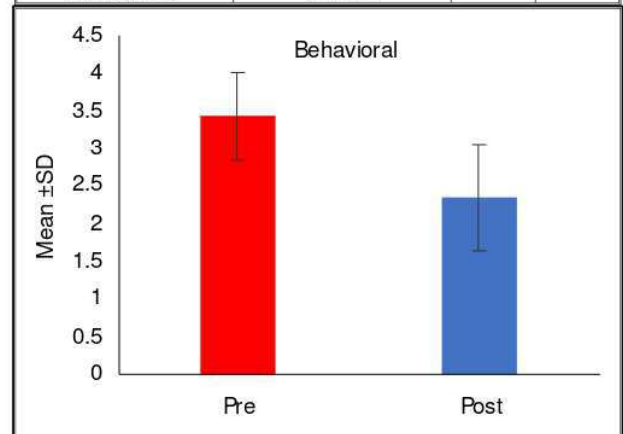


Figure (2) Behavioral symptomatology among studied cases (p<0.001).

Table (8) and figure (2) show statistical significance decrease (i.e. improvement) (3.43± 0.58), (2.4± 0.73) (p- value< 0.001), between pre- and post, behavioral, social& social and cognitive symptomatology among studied cases.

Discussion:

This study was carried out on 34 cases of autism spectrum disorder (ASD), their age ranged from 4 to 9 years old with a mean age mean 6.742± 1.639 years old.

In the present study, ASD cases were 26 males (76. 74%) and 8 females (23.5 3%), with M: F= 3.3: 1, which means that there is male gender predominance in our study population. This is supported with previous studies that reported ASD occurrence at a ratio of approximately 4.5 male: 1 female (Amendah et.al., 2011). In addition, Baio et.al., 2018 stated that ASD is more common among boys than among girls, with a ratio of 1 in 37 boys and 1 in 151 girls respectively (Baio et.al., 2018).

The empirical distribution of IQ in ASD suggests causal heterogeneity. In the present study, Stanford Binet test 5th edition (SB5) revealed the

following intelligent quotient scores among our study population; low average {89- 80}: (11.76%), borderline impaired {79- 70}: (23.53%), mildly impaired {69- 55}: (50%) and moderately impaired {54- 40}: (14.71%) with no severely impaired {39- 25} or profoundly impaired {24- 10} cases.

The prevalence of ASD children with intellectual disability was (31.6%); with (24.5%) on the borderline range and 43.9% in the average and above average range (Christensen et.al., 2016).

In our study, IQ mean± S.D. score was (65.1± 10.9). On the contrary Nishiyama et.al., (2009) reported different results where IQ mean± S.D. score was (73.7± 17.5) respectively. A meta- analytical study by El-Awakly et.al., (2018) showed parallel results; IQ mean± S.D. score was 58.08± 9.2.

Mostafa et.al., (2012), reported that in three different Arab countries, reported that (22 Jordanians, 19 Saudis and 19 Egyptians); the total IQ mean± S.D. score of the included children with autism was (60.93± 20.86) and approximately two- thirds of the sample (60%) had mental retardation.

Research shows increasing rates of psychotropic use and the simultaneous use of multiple psychotropic medications (polypharmacy) among children overall (Chen et.al., 2011) and in children with autism spectrum disorders (ASD) (Coury et.al., 2012).

Current estimates of psychotropic use among children with ASD vary widely. Reported rates of use among children with ASD have ranged from 27% to 83%, with polypharmacy ranging from 10% to 20% (Coury et.al., 2012).

Regarding pharmacological intervention in the current study, (44.12%) of our studied cases were maintained on Resperidal or Apixodone; (44.44%) were maintained on one psycho- tropic medication; (5.56%) were maintained on two psycho- tropic medications and (50%) were maintained on psychotropic medication with others.

In a study carried out by Spencer et.al. (2013) among 33.565 children with ASD, (64%) had a filled prescription for at least one psychotropic medication, (35%) had evidence of psychotropic polypharmacy (> 2 classes), and (15%) used medications from (> 3 classes) concurrently. Among children with evidence of cooccurring conditions (seizures, attention- deficit disorders, anxiety, bipolar disorder, or depression) had higher odds of psychotropic use and/ or polypharmacy.

Among our studied cases forty- one percent were generally maintained on supplements, from which (50%) were maintained on Omega- 3 and (20.59%) were maintained on multi- vitamins. However, in a study by Trudeau et.al., 2019; Seventy- five percent of children with ASD consumed supplements, with omega 3 (42.5%) and multivitamins (77.8%).

In the current study; candidates have completed eight sessions of AVS using Mindspa device. Results of the Childhood Autism Rating Scale (C. A.R.S.) score pre- intervention revealed mean± S. D; (35.46± 4.1) and post- intervention mean± S.D; (32.44± 4.5).

Similarly, El- Awakly et.al., 2018, reported CARS mean± S.D. score;

(37.7± 15.36) for ASD children and in USA, Silva et.al., 2016 reported mean CARS of ASD cases (38.5± 8.1).

The results of this study showed improvement ($P < 0.001$), between pre- and post, behavioral symptomatology among studied cases.

AVS decreased the symptoms and improved problem behaviors and socialization in children diagnosed with ASD; by increasing on- task behaviors. facilitating completion of tasks (reducing Inattention) and decreasing acting- out behaviors (Impulsivity). There are not as much loud or inappropriate voices or behavior, they became able to work more independently for longer periods of time being more focused and there was more positive interaction with others (Woodbury, 1996). Also, in a study done by Olmstead, 2005, there was significant improvement in Learning- disabled children LD, after AVS sessions (that were administered two times weekly for six weeks).

Conclusion:

Using Mindspa software programs as an intervention method of rehabilitation provided a preliminary evidence for the feasibility and use of AVS in children with ASD to improve the target symptomatology.

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