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Effectiveness of evidence-based intervention on social skill and communication among autism spectrum disorder children

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ABSTRACT

Aim: Evidence-based intervention is an effective method for improving autism spectrum disorder (ASD) in children on socialization, behavior, and communication and may have an impact on brain activity. The aim of this study is to find the effectiveness of picture exchange communication system (PECS) and parent-implemented intervention (PII) among ASD children.

Materials and methods: Sixty ASD children who fulfilled the inclusion criteria were selected and assigned into control (n=30) and experimental (n=30) groups. The experimental group received evidence-based intervention with PECS and PII for 6 months, whereas the control group received routine care. The children were assessed for social relationship and reciprocity (SRR) and speech language communication (SLC) before and after the intervention. For the experimental group, a 3-month post-intervention was also assessed. Parametric and nonparametric statistical methods were used.

Results: The data showed that male nuclear family and birth order above 1 was more among ASD. Two-way RM ANOVA showed a significant difference among the groups and tests ($P < 0.001$) and interaction of groups with tests ($P < 0.001$). Experimental post-test-2, that is, after 6 months, showed significant improvement in SRR and SLC compared with the control group.

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Conclusion: The present study shows that the PECS and PII as a nursing strategy can improve ASD children socialization and communication.

Keywords: *Autism spectrum disorder, parent-implemented intervention, picture exchange communication system, social relationship and reciprocity, speech language communication.*

INTRODUCTION

Autism is a neuronal development disorder characterized by persistent deficit in socialization, communication, and interaction.[1] There are many challenges in the development, particularly loneliness, resistance to touch, and unusual interests in objects (peering, spinning, watching objects fall, and sniffing or licking nonfood items). Engaging in repetitious motor movements (running in circles and jumping), repeating words or phrases, laughing, crying, or showing distress without reason are the other complications. Lack of response to verbal instructions, though there may be normal hearing.[2] About 1 in 59 children (1.7%) has been identified with autism spectrum disorder (ASD) according to estimates from Center for Disease Control and Prevention (CDC) Autism and Developmental Disabilities Monitoring. ASD is reported to occur in all racial, ethnic, and socioeconomic groups. The CDC released data on the prevalence of autism in the United States and reported that about 1% of the world population has ASD (CDC, 2014). The prevalence of ASD is increasing due to broadened diagnostic features. The estimated median prevalence of ASD was 62 per 10,000 children (0.62%) globally and no association of prevalence with geographic region, ethnicity, or socioeconomic factors could be identified.[3] However, recent studies show the association with race and ethnicity.[4] The ASD prevalence in India is reported to be 0.1%.[5] But the number of children with ASD is increasing in India. About 3% of school children have been reported to have learning disability in India.[6] Children with autism have several disadvantages.[4,7]

Autism is estimated to be four times higher in boys (2%) compared to girls (0.5%).[8] The etiology of autism is multidimensional and complex. Though there is evidence for genetic background, no single cause has been identified for ASD. It is generally accepted that ASD is caused by abnormalities in brain structure and functions. Studies with magnetic resonance imaging (MRI) have highlighted that a few brain regions are structurally different in children with autism. Children and adolescents with autism often have an enlarged hippocampus and decreased brain tissue in the cerebellum. Children with autism have excess cerebrospinal fluid, and diffusion MRI revealed multiple white matter tracts.[9] Functional MRI (fMRI) has been shown to be an important tool for the mechanism of pathophysiology of ASD to identify the etiological cause and targeted treatments.[10]

The parents of ASD children experience many psychological problems than children with other disabilities. Having a child with ASD impacts several aspects of family lives financially, emotionally, and mentally. The parents experience challenges in many aspects, viz., marital relationships, health of family members, sibling relationships, friends and neighbors, and recreation and leisure activities.[11] The struggling behavior of children with autism negatively impacts parent and family functioning and creates significant stress on all family members.[12] Thus, socialization and communication deficits affect the entire family. It is important that once ASD is identified, the families should be offered relevant information, services, referrals, and support according to individual needs. There is no known cure for ASD, but symptomatic treatments to control the behavior are known.[13] Evidence-based intervention for ASD can improve the developmental problem and address the family needs. Many social

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science research and guidelines support a combination of picture exchange communication system (PECS) and parent-implemented intervention (PII).[14] Early intensive behavioral intervention (EIBI) given for a duration of 20–40 hours per week is a well-established treatment for ASD.[15] Evidence-based intervention is an effective practice for improving child socialization, communication, playing, decrease parental stress, and improve parent–child interaction. Early intervention can mitigate the severity and improve the long-term outcome and can reverse some of the ASD symptoms.[16,17]

As ASD prevalence increases, care and hospitalization are required. Pediatricians and other health-care professionals have an important role to recognize ASD at an early stage. The primary objective should be to make the child functionally independent to improve the quality of living of both the child and parents.[18] Children with ASD and their parents require extensive support and specialized care. Many studies have proven that PECS is an evidence-based intervention and improves socialization and communication.[19] PECS can also be implemented in the hospital settings in the pediatric ward to handle children effectively. PECS has been found to be effective during preventive dental procedures for ASD.[20] Hence, the aim of the present study is to evaluate the effectiveness of PECS and PII in ASD children in day care and hospital settings.

MATERIALS AND METHODS

Study Design

The present study is a prospective, nonrandomized design with pre-test and post-test assessment. The study was approved by the Institutional Ethics Committee of Saveetha Medical College and Hospital (No .001/02/2019/IEC/SMCH.) An information sheet was provided about the study in English and local language (Tamil) to the parents of the children, and a signed consent for participation in the study was obtained. Confidentiality was maintained.

Participants

The study was conducted at Kiddos Rehabilitation Center (Chennai, India) and Saveetha Medical College and Hospital (Chennai, India). A total of 60 ASD children from the two centers who met the inclusion criteria were selected and assigned to control and experimental groups equally (30 each). Children between 5 and 10 years of age, male and female with mild and moderate ASD were the inclusion criteria. Children diagnosed with attention deficit disorder, learning disability, severe ASD, and cerebral palsy were excluded.

Methodology

The experimental group received evidence-based intervention with PECS and PII for 6 months, whereas the control group received routine care. The children were assessed for social relationship and reciprocity (SRR) and speech language communication (SLC) before and after the intervention. For the experimental group, a 3-month post-intervention was also assessed. National Institute for Mentally Handicapped (NIMH) developed the Indian Scale for Assessment of Autism (ISAA) for diagnosing and measuring the severity of autism (Patra & Arun, 2011). The SRR and SLC were assessed using the ISAA questionnaire consisting of 18 items. The PECS consisted of picture cards and communication books. The children were trained to hand over a picture to the investigator in exchange for a desired item. The children recognized a picture from their communication book and delivered it to the investigator. The children were able to differentiate desired items and nondesired items. The children were trained to use specific phrases followed by the desired item for picture discrimination and sentence completion. As a part of PII, the parent's involvement was used to promote PECS from the cards and books after the hospital and rehabilitation center sessions. The sessions were for 3 days per week followed by PII for 2 days at home for a total of 6 months.

Statistical Analysis

Parametric and nonparametric statistical procedures were used for the analysis. The demographic

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profiles of control and experimental groups were analyzed by χ^2 test for homogeneity. The control and experimental groups' pre-test and post-test 2 (between groups) were analyzed by Mann–Whitney rank sum test. The control pre-test and post-test (within group) were analyzed using the Wilcoxon signed rank test, and the experimental pre-test, post-test 1, and post-test 2 (within group) were analyzed using Friedman RM ANOVA with Dunnett's test. Additionally, two-way RM ANOVA was also used for the comparison of groups (control and experimental), tests (pre-test and post-test 2), the interactions with Bonferroni '*t*' test. SigmaPlot 14.5 (Systat Software, San Jose, CA, USA) was used for statistical analysis and graph plotting.

RESULTS

The age distribution in control group for 5–6, 7–8, and 9–10 years was 26.6%, 33.3%, and 40.0%, respectively. In the experimental group, it was 36.6%, 36.6%, and 26.6%, respectively ($\chi^2 = 1.321$; $P = 0.517$). In the control group, 66.6% were males and 33.3% were females, and in the experimental group, 70.0% were male and 30.0% were female ($\chi^2 = 0$; $P = 1.0$). In the control group, 30.0% were joint family and 70.0% were nuclear family, and in the experimental group, 33.3% were joint family and 66.6% were nuclear family ($\chi^2 = 0$; $P = 1.0$). In the control group, 13.3% were consanguineous marriage and 86.6% were nonconsanguineous marriage, and in the experimental group, 20.0% were consanguineous marriage and 80.0% were non-consanguineous marriage ($\chi^2 = 0.120$; $P = 0.729$). In the control group, 80.0% were normal delivery and 20.0% were caesarian delivery, and in the experimental group, 90.0% were normal delivery and 10.0% were caesarian delivery ($\chi^2 = 0.523$; $P = 0.470$). In the control group, the first, second, and third order of birth were 26.6%, 53.3%, and 20.0%, respectively. In experimental group, it was 33.3%, 50%, and 16.6%, respectively ($\chi^2 = 0.345$; $P = 0.841$). The total data revealed that male with a nuclear family and birth order above one was more in ASD (Table 1).

The general observation was that the children took 2 months to acquire the skill to exchange a

TABLE 1. Demographic variables of control and experimental groups.

Variables	Category	Control	Experimental	Total	
Age (years)	5–6	8	11	19	(31.7)
	7–8	10	11	21	(35.0)
	9–10	12	8	20	(33.3)
Gender	Male	20	21	41	(68.3)
	Female	10	9	19	(31.7)
Type of family	Joint family	9	10	19	(31.7)
	Nuclear family	21	20	41	(68.3)
Type of marriage	Consanguineous	4	6	10	(16.7)
	Nonconsanguineous	26	24	50	(83.3)
Mode of delivery	Normal delivery	24	27	51	(85.0)
	Cesarean section	6	3	9	(15.0)
Birth order	First	8	10	18	(30.0)
	Second	16	15	31	(51.7)
	Third	6	5	11	(18.3)

n–control = 30; experimental = 30. Figures in parentheses are percentage of total.

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picture for an item. A period of 2 months was taken for discrimination of cards. Another 2 months were taken for sentence building. In about 6 months, the children were able to gain functional communication skills by PECS.

The median of SRR for the control group pre-test and post-test 2 were 12.0 and 11.0, respectively. It was statistically significant ($P < 0.001$), The median for the experimental group pre-test, post-test 1, and post-test 2 were 12.0, 10.0, and 8.5, respectively. It was also found to be statistically significant ($P < 0.001$). Post-test 1 and post-test 2 were found to be significantly lesser than the pre-test. Pre-test of the control and experimental groups were not statistically significant ($U = 450$; $P = 1.0$), whereas post-test 2 of the control and experimental groups showed statistical significance ($U = 302$; $P = 0.028$). Two-way RM ANOVA showed no significance for the groups ($F = 0.598$; $P = 0.442$). Tests and interaction showed statistical significance ($F = 157.075$; $P < 0.001$ and $F = 50.181$; $P < 0.001$, respectively). Bonferroni '*t*' test revealed no significance for the control and experimental groups' pre-test ($P = 1.0$), while the control and experimental groups' post-test 2 showed significance ($P < 0.001$). Control pre-test and post-test 2, and experimental pre-test and post-test 2 also showed significance ($P < 0.001$). The improvement in the experimental group was better than the control group.

The median of SLC for the control group pre-test and post-test 2 were 32.0 and 31.0, respectively. It was statistically significant ($P < 0.001$), The median of experimental group pre-test, post-test 1 and post-test 2 were 32.0, 29.0, and 26.5, respectively. It was also found to be statistically significant ($P < 0.001$). The post-test 1 and post-test 2 were found to be significantly lesser than the pre-test. The pre-test of control and experimental groups were not statistically significant ($U = 450$; $P = 1.0$), whereas the post-test 2 of the control and experimental groups showed statistical significance ($U = 176$; $P < 0.001$). Two-way RM ANOVA showed no significance for the groups ($F = 3.288$; $P = 0.075$). The tests and the interaction showed statistical significance ($F = 454.195$; $P < 0.001$ and $F = 152.237$; $P < 0.001$, respectively). Bonferroni '*t*' test revealed no significance for control and experimental groups pre-test ($P = 1.0$), while the control and experimental post-test 2 showed significance ($P < 0.001$). Control pre-test and post-test 2 and the experimental groups pre-test and post-test 2 also showed significance ($P < 0.001$). The improvement in the experimental group was better than the control group.

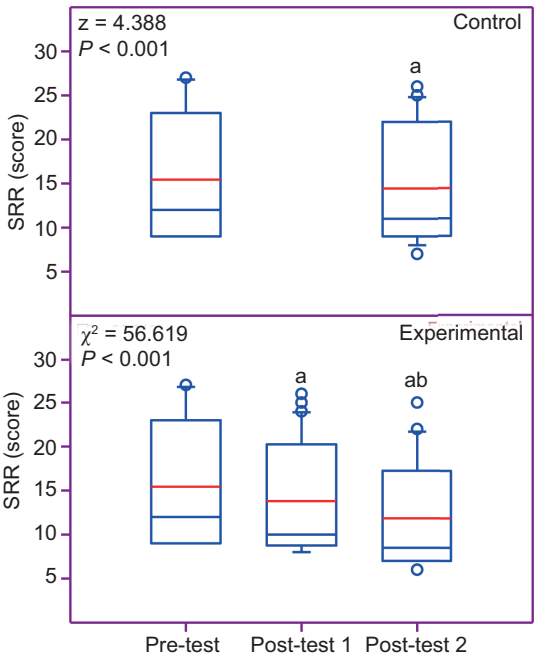

FIGURE 1. Comparative effectiveness of regular intervention (control) and PECS with PII (experimental) on social relationship and reciprocity (SRR). The middle red line is the mean ($n = 30$ each). The control group was tested by Wilcoxon signed rank test. The experimental group was tested by Friedman RM ANOVA with Dunnett's test.

[a]Significantly different from the respective pre-test (within groups).

The pre-test and post-test 2 of the respective groups were tested by Mann Whitney rank sum test.

[b]Significantly different from the respective groups (between groups).

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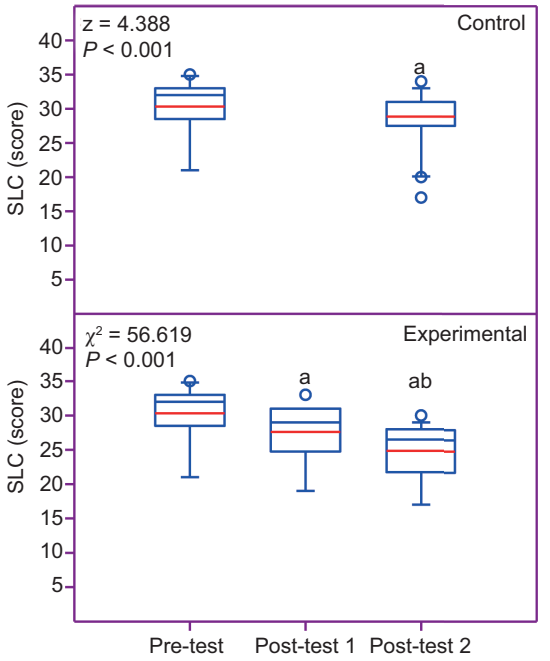

FIGURE 2. Comparative effectiveness of regular intervention (control) and PECS with PII (experimental) on speech language communication (SLC). The middle red line is the mean (n = 30 each). The control group was tested by Wilcoxon signed rank test. The experimental group was tested by Friedman RM ANOVA with Dunnett's test.

[a]Significantly different from the respective pre-test (within groups)

The pre-test and post-test 2 of the respective groups were tested by Mann Whitney rank sum test.

[b]Significantly different from the respective groups (between groups).

DISCUSSION

ASD is a heterogeneous group of neurodevelopmental disorder. Consanguineous marriages have been reported with increased genetic risks with birth defects and blood disorders in the offspring].[21] Parental consanguinity of children with developmental disorders is not known but the information is necessary for early diagnosis.[22] In the present study, 16.7% of children were by consanguineous marriage, indicating this as a risk factor for ASD. The mode of delivery as normal or cesarean has a significant impact on the child's life. It has been reported that cesarean section increases the risk of ASD (Curran et al., 2015).[23] But in the present study, ASD with normal delivery was higher (85%), indicating that neurodevelopment is unrelated to the mode of delivery. In families that have more than one child, the second-born has a higher risk of developing autism than other children in the family.[24] In the present study, 70% of ASD children were either second or third born, indicating the birth order as a risk factor. The occurrence of ASD in a nuclear family was more (68.3%) compared to a joint family. The breakdown of the joint family system, minimal social interactions, and usage of electronic devices are the causes of behavioral and communication problems in children.

The ASD prevalence has been reported to be from 0.5% to 2.0% (CDC, 2014). One of the important observations is that there is a higher proportion of male children with ASD. In a meta-analysis in India, the reported prevalence is about 0.1%. For every female child, 4.5 male children are reported with ASD (CDC, 2014). A study conducted from 2018 to 2020 in England showed that the male-to-female ratio was 4.3:1 and was also dependent on ethnicity.[4,7,25] A lower proportion of male and–to-female of 2.8:1 was also reported without any difference between gender and age at diagnosis.[26] In the present study, the proportion of male–to-female was 2.2:1. Several theories have been proposed, involving sex chromosomes in the etiology of ASD, and the role of hormonal influences *in utero*.[27] Males showed less imaginative play and learning, while females showed more proprioception and vestibular problems.[26,28] There are no defined reasons for male dominance in ASD, but metabolomic studies of urinary samples showed a few biomarkers responsible for ASD.[29] Genetic and hormonal factors may also contribute to the lesser prevalence in females.[30] Another possible reason may be that females mask their behavioral problems better than males. In developing countries, more attention is devoted for the development of male

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child compared to female child and unwillingness to report behavioral problems of the female child. Sex differences in social and communication skills have been observed in ASD and have to be taken into consideration in the diagnosis and treatment.

Evidence-based intervention for ASD has the potential to improve developmental problems and also address family requirements. Early identification of children with ASD and evidence-based treatment have to be implemented.[31] Intensive and early treatment would reduce the debilitating effects of autism.[15,32] Naturalistic approaches and child-centered methods have been developed for social communication, speech, and language for diagnosis and evaluation of the severity of autism (Paul, 2008). The severity of autism is evaluated by the ISAA consisting of 40 items in six domains viz., SRR, emotional responsiveness, SLC, behavior patterns, sensory aspects and cognitive component. The items are rated from 1 to 5 based on intensity, frequency, and duration. Score 1 is the minimum and score 5 is the maximum.[33] In the present study, SRR and SLC were taken for the assessment of the intervention. The domains contain nine questions each with a minimum score of 9 and a maximum score of 45 for each. In the present study, SRR showed improvement by PECS in ASD children. The control group showed a reduction of 1 score while the PECS group showed a reduction of 3.5 score in the post test. PECS has been reported to improve functional communication skills of ASD children.[34]

Speech, language, and communication is very important for improving the skills of ASD children.[35] This is an important domain for diagnosing and measuring the severity of autism. Sex differences in social and communication skills have been observed in ASD children and have to be taken into consideration during diagnosis and treatment.[36] In the present study, PECS was used for speech, language, and communication. An earlier study reported that PECS was mastered rapidly with picture discrimination, sentence construction, and an increase in the number of words used.[37] PECS has been shown to be very effective and promote spontaneous speech.[38,39] The PECS showed better understanding on visual and oral instructions, and as a good communication tool to express the requirements.[40] PECS can improve coordinated attention to the object and person without eye contact in ASD.[41] In the present study, SLC was improvement by PECS in ASD children. The control group showed a reduction of 1 score while the PECS group showed a reduction of 5.5 score in the post test.

An important consideration is that ASD children are less interested in socialization and communication, and are not motivated by praise and appreciation. Preston and Carter[42] reviewed 27 studies conducted on children with ASD to evaluate the strength of the evidence for the effectiveness of PECS. But the analysis could not delineate the effectiveness on social communication, challenging behavior, and speech development. However, the present study showed that PECS combined with PII was very effective in improving SRR and SLC.

CONCLUSION

The present study shows that the PECS and PII significantly can improve social skills and communication among ASD children.

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CONFLICT OF INTEREST

The authors declare no conflict of interest.

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