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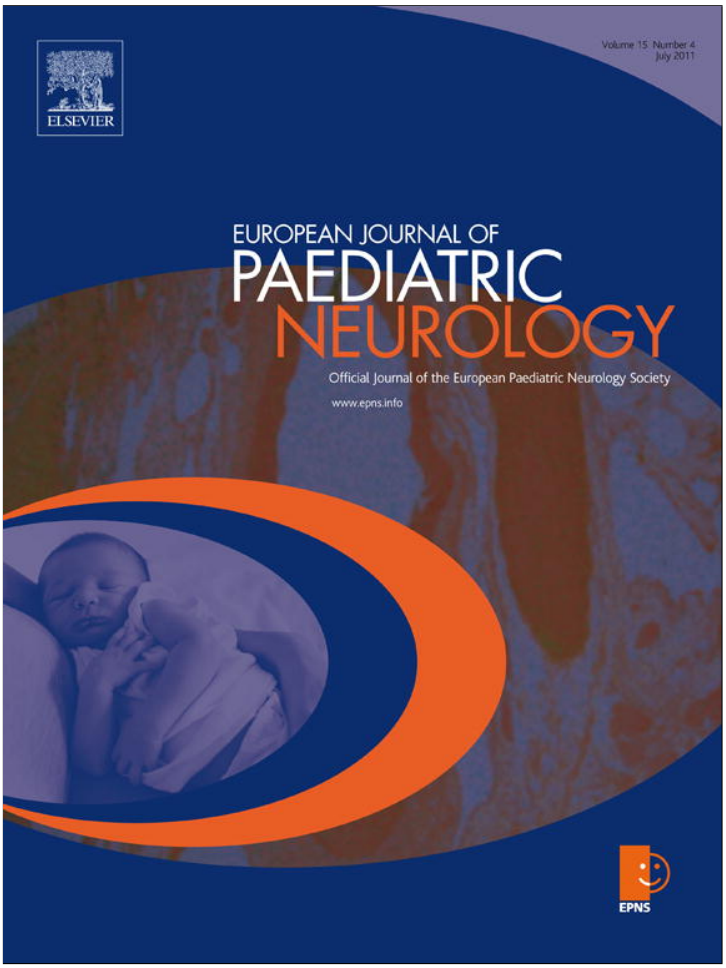

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Original article

The effect of a psycho-educational program on CARS scores and short sensory profile in autistic children

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ABSTRACT

There is great demand for effective management of children with Autistic Spectrum Disorders (ASD). This study aimed to investigate the effect of an individually tailored psycho-educational program for autistic children on the scores of the Childhood Autism Rating Scale (CARS) and the Short Sensory Profile (SSP).

Methods: Forty children (36 males) were enrolled into an intervention program which consisted of occupational therapy including sensory integration techniques, speech therapy, social skills therapy and parent-directed approaches. Autism severity was assessed using CARS; sensory response capability with the SSP pre- and post-treatment.

Results: Eight children were intellectually normal; 12 borderline and 20 of low intelligence. Pre-treatment CARS showed that 8 were mildly autistic, 32 moderately–severely autistic. Post-treatment, 24 children changed category; 11 were no longer autistic. The percentage of children performing in the definitive difference region, according to total SSP score, changed slightly (45% vs 32.5%). Comparison of the pre- and post-treatment values revealed that CARS decreased significantly ($p < 0.001$), whereas total SSP did not ($p = 0.294$). Tactile sensitivity and low energy/weakness sections, though, were significantly different pre- and post-treatment. Longitudinal analysis, taking into account other confounding factors besides time, further revealed a significant decrement for CARS score with time but not for SSP score ($p < 0.001$ and $p = 0.288$, respectively). Similarly, intelligence levels affected CARS but not SSP values ($p < 0.001$ and $p = 0.813$, respectively).

Conclusion: Individually tailored psycho-educational therapy had a significant effect on autism severity according to CARS. Changes in the SSP scores were not significant.

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1. Introduction

Autism and Autistic Spectrum Disorders (ASDs) are lifelong neuro-developmental disorders with considerable diversity in clinical expression and severity. This heterogeneous group of disorders is defined by impairments in three core domains: social interaction, language and range of interests. Despite the general consensus regarding a developmental onset, little agreement exists around the primary nature of the insult(s). While a neurobiological basis is largely accepted, no single

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theory currently dominates the ASDs; this reflects both the heterogeneity of the mechanisms involved as well as the short history of research in the molecular basis and in other aspects of the neurobiology of these disorders.[1]

The increasing numbers of children with ASDs in combination with advocacy for interventions have created a need for diagnostic tools and treatment techniques that allow early identification and timely intervention. Evidence based research on psycho-educational and behavioral interventions has been emphasized. Improvements have been demonstrated in several developmental parameters in spite of difficulties with intervention research and relative lack of solid scientific evidence for most of the utilized therapies.[2] The most frequently employed treatment modalities are occupational therapy, speech and language therapy, behavioral and developmental approaches; the last two are the main treatments for promoting social and adaptive function based on efficacy demonstrated in mostly empirical studies.[3] The Treatment and Education of Autistic and related Communication Handicapped Children (TEACCH) program and the Applied Behavior Analytic interventions for children (ABA) are frequently discussed.[4,5] It is claimed that the only therapies that have been shown to produce comprehensive, lasting results in autism have been based on the principles of ABA.[6,7] The Early Intensive Behavioral Intervention (EIBI) for young children with autism (Lovaas method) is an effective treatment, on average.[8] In general, parents are positive about EIBI; however, there are some challenging aspects of managing home-based EIBI.[9] A systematic review of behavioral and developmental interventions for ASDs suggested that Lovaas method was superior to special education on measures of adaptive behavior, communication and interaction, comprehensive language, daily living skills, expressive language, overall intellectual functioning and socialization.[3] In conclusion, as no definitive behavioral or developmental intervention improves all manifestations for all patients with ASDs, it is recommended that clinical management be guided by individual needs and availability of resources.[3]

Another factor that has an effect on the child's life is the existence of sensory and motor difficulties.[10] Although sensory processing abnormalities are not universal or specific to ASDs, the prevalence of such abnormalities in autism is relatively high.[11] Sensory processing refers to the way that sensory information e.g. visual, auditory, vestibular or proprioceptive stimuli is managed by the cerebral cortex and brainstem for the purpose of enabling adaptive responses to the environment and engagement in meaningful daily life activities.[12] The effect of sensory integration therapy (SIT) on challenging behavior was compared to behavioral intervention in four children with ASDs; behavioral intervention was more effective than the SIT.[13]

In spite of improvements in the accumulated scientific evidence on some of the aforementioned techniques, the fact remains that most of them are very time intensive, expensive and largely unavailable for many patients. Moreover, there is no clear answer regarding the most effective therapy to improve symptoms associated with ASDs. The main goal remains to help improve the overall picture of the child and make him look and act "less autistic". Developed as an instrument that could be used as an objective descriptor for compulsive behavior in autism, the Childhood Autism Rating Scale is a tool used in many studies that support its reliability and validity.[14–16] The CARS combines caregiver's report and direct observation by the professional for the differential diagnosis of autism from other developmental disorders. It rates the severity of autistic behavior (non-autistic, mildly autistic and moderately–severely autistic); successive scores have been used in order to evaluate intervention protocols by various investigators.[17,18]

The objective of this study was to investigate the effect of an individually tailored psycho-educational intervention program for autistic children on their CARS and Short Sensory Profile (SSP) scores. The SSP is a method used by professionals to measure a child's sensory processing abilities and to profile the effect of sensory processing on functional performance in the daily life of a child.[19,20]

2. Methods

2.1. *Patients*

The children included in this study were selected according to the following criteria: a. successively referred to our center for evaluation, b. diagnosis of ASDs, according to the Diagnostic and Statistical Manual of Mental Disorders, Fourth edition (DSM-IV),[21] c. residing within a municipality that could be served by a pre-selected team of therapists who were willing and available to plan and implement an individually tailored program for the management of ASDs, d. availability of public insurance fully covering the recommended services, upon review and approval by their staff physicians. Demographic data such as age at initiation of therapeutic intervention, gender and mental status were extracted from patients' medical records. Intelligence level of these children was estimated using Miller Assessment for Preschoolers (for children 4.5 years of age or below) and Miller Assessment in combination with Test of Visual–Perceptual Skills (TVPS) and comprehension Clinical Evaluation of Language Fundamentals (CELF), for older children.[22–24] Upon enrollment, these children initiated a treatment program which included the following: a. occupational therapy that included developmental skill-based programs, sensory integration and sensory-based interventions as well as relationship-based, interactive interventions; b. speech therapy; c. social skills training that included social stories, video modeling interventions, computer based intervention and social problem solving; d. parent-directed approaches. Therapists were experienced in TEACCH, ABA and Picture Exchange Communication System (PECS)[25] and applied these techniques as needed. The weekly duration of the intervention program ranged between 1 and 8 h; this depended on the decision of the therapeutic team based on the goals and the treatment plan. Twenty seven autistic children (67.5%) followed the intervention for up to 4 h per week and 13 children (32.5%), for more than 4 h per week. In addition to the child-directed intervention there were parent-directed sessions; parental teaching and support was provided on a weekly basis for 1–2 h. In order to be included in the study, compliance with the program was required.

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2.2. Measures and times of measurement

2.2.1. CARS

Severity of autistic behavior was assessed using the CARS. The CARS evaluation was carried out by a professional that was not directly involved with the child. The CARS consists of 15 clinical items, scaling from one to four. CARS scores range from 15 to 60; scores below 30 are considered within normal range, those between 30 and 36 indicate mild ASD and scores above 37 represent moderate to severe ASD.

2.2.2. Short Sensory Profile (SSP)

The SSP, that is derived from the longer Sensory Profile is a parent (or caregiver) questionnaire designed for children 3–8 years old.[26] In the present study the SSP was used as a secondary outcome measure; this is a valid and reliable instrument for comprehensive assessment and effective intervention planning suggested for research programs.[26] The SSP contains 38 items using a 5 point Likert scale and is completed by the caregivers. SSP is a way of assessing children's response capability to sensory and behavioral/emotional stimuli and daily performance. Higher scores relate to typical child performance and lower scores are attributed to performance clearly differentiated.

There were two times of measurement; the first prior to the initiation of the treatment and the second after the child was treated for at least one year.

2.2.3. Statistical analysis

Continuous data were tested for normality using the Shapiro Wilk test. Normally distributed continuous variables were expressed as mean values (±standard deviation) whereas non normal data were expressed as median values (interquantile range). Categorical data were presented as frequencies and percentages. A paired sample t-test was used to compare CARS and SSP scores pre- and post-treatment, testing the hypothesis that the individually tailored psycho-educational therapy would result in a significant change in CARS and SSP scores. Additionally, mixed-effects models (with patients treated as random effect) were used to identify factors, besides time, influencing severity and sensory processing in children with ASD such as, age at treatment initiation (<4 years vs ≥4 years), sex, intelligence level (normal/borderline intelligence vs mental handicap), and hours of intervention per week.

3. Results

The study sample consisted of 40 children, with mean age 3 years and 10 months at treatment initiation (±7 months, range: 3–5 years). The majority of them were males ($n = 36$). Eight out of them were categorized as intellectually within normal limits, twelve had borderline intelligence and twenty, low intelligence.

Upon referral to our clinic, all participating children had CARS scores between 31 and 60, compatible with their diagnosis of autism. The mean CARS value was 44 (±7). CARS values were not different in children younger than 4 years of age as compared to children older than 4 years of age even though younger children tended to have higher CARS values than the older age group (Table 1). However, children with lower IQ had significantly higher CARS scores as compared with those who had borderline or normal intelligence ($p = 0.001$) as it is shown in Table 1.

Prior to the initiation of the psycho-educational program, according to CARS scores, 32 children (80%) were characterized as moderately–severely autistic and 8 children (20%) as mildly autistic. After the intervention program, 21 children had changed severity category; 15 children (37.5%) were then characterized as moderately–severely autistic, 14 children (35%) as mildly autistic and 11 children (27.5%) as non-autistic. Fig. 1 displays the categorization of children according to severity in the two distinct observation times. Half of the children who were scored as mildly autistic ($n = 4$) and almost one fifth of those who were moderately–severely autistic pre-treatment ($n = 7$), were categorized as non-autistic post-treatment. In accordance with this finding, CARS substantially decreased post-treatment ($p < 0.001$). Mean CARS scores pre- and post-treatment are shown in Table 2. The mixed-effects model which was fitted to accommodate additional factors influencing CARS values indicated that examination time (pre- and post-treatment) and intelligence level were prognostic variables for the longitudinal evolution of CARS values ($p < 0.001$ for both parameters). CARS values were ~9 units lower in the re-examination visit compared to the pre-treatment visit, adjusting for all other variables; there were also ~7 units lower in children mentally handicapped compared to those with normal or borderline intelligence, adjusting for all other variables. On the other hand, the hours of intervention per week, age at treatment initiation and sex were not ($p = 0.312$, $p = 0.078$ and $p = 0.127$, respectively).

SSP scores were also recorded for the children included in our study pre- and post-treatment. The mean SSP value for the whole sample was 146 (±19, range: 85–175), a score that describes a probable difference in general performance of our sample group, in comparison with normal children. The pre-treatment total SSP score did not differ between patient subgroups (Table 1). Pre-treatment values for the SSP domains are displayed in Table 2. As was the case for the total score,

Table 1 – Pre-treatment CARS and SSP total values in children according to age group and intelligence level.

Variables		CARS[a]		SSP total score[a]	
Age	<4 years ($n = 21$)	46 (±7)	$p = 0.07$	143 (±4)	$p = 0.229$
	≥4years ($n = 19$)	41 (±6)		150 (±5)	
Intelligence	Normal/borderline ($n = 20$)	40 (±6)	$p = 0.001$	148 (±5)	$p = 0.514$
	Below normal ($n = 20$)	47 (±7)		144 (±4)	

a Mean (±SD).

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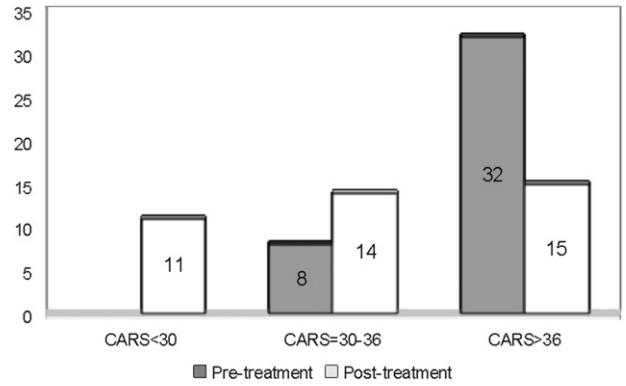

Fig. 1 – CARS – Category frequency in children with autism pre- and post-treatment.

these sub-scores were not different in patients younger than 4 years vs those older than 4 years or in children with different IQ level. There was no statistically significant difference pre- and post-treatment in the total SSP scores ($t_{(39)} = -1.063$, $p = 0.294$). Although the general sensory processing of our study group did not change, tactile sensitivity and low energy/weakness properties of these children showed statistically significant improvements and the movement sensitivity performance borderline significant improvement (Table 2).

Table 3 displays the number of patients within three performance levels, according to their SSP and SSP – subcategories values before and after treatment. At first evaluation, 37.5% of patients ($n = 16$) showed typical performance, 17.5% ($n = 7$) probable difference and 45% ($n = 18$) definitive difference in the total SSP score. After entering in the therapeutic intervention, it seemed that fewer children had definitively different capabilities from normal children (32.5% vs 45%). Children having typical performance accounted for 40% and children with probable difference 27.5%. Longitudinal analysis of SSP values revealed that total SSP remained stable across time ($p = 0.288$). However, older children presented significantly higher (~12 units) SSP values compared to those <4 years of age ($p = 0.035$). None of the remaining factors that we examined proved to significantly affect sensory processing (IQ: $p = 0.813$, intervention hours per week: $p = 0.097$ and sex: $p = 0.209$, respectively).

4. Discussion

This study was performed because there is insufficient evidence regarding the type of program that needs to be prescribed for children with ASDs in order to achieve clinically relevant outcomes. Controversy exists regarding the type of the offered treatments with data supporting the efficacy of highly structured behavioral approaches guided by a therapist.[6–8] The intensity required to achieve positive outcomes and the efficacy of one approach compared to another remain open questions.[3] The importance of targeting the choice of intervention to the individual needs of the child and the symptoms that are most important for the each child and their family has been stressed.[3]

In this study we examined if a program targeting individual needs and taking into account availability of resources could affect the severity of autistic behavior, as this is measured by CARS scores as well as the children's sensory processing abilities. We also examined the effect of duration of treatment per week, intelligence and age of initiation of intervention on the CARS and SSP scores. This study demonstrated that CARS scores decreased significantly after treatment. This is an important finding for those situations where specific training programs for ASD are unavailable or financially unattainable but also for those professionals who face the methods of highly structured education for autism with skepticism. Similar were the findings of a research made by Kielinen, Linna and Moilanen that indicated that 178 out of 187 children and adolescents aged 3–18 years showed improvement on the CARS, even if no statistically significant difference was found between the outcome of the available habilitation methods.[27] In their study the most common therapies were physiotherapy as well as speech, occupational and music therapy and the children and adolescents that participated in the study received specific training according to the TEACCH, Lovaas or Portage program. In addition, in the review article of Helt et al, it appeared that between 3% and 25% of children with autism lost their ASD diagnosis and entered the normal range.[28] These are encouraging findings, however, many questions remain unanswered. For example, which children have the potential for recovery through behavioral or other therapeutic interventions? Can recovery occur due to spontaneous reorganization of the brain and what genetic or

Table 2 – Comparison of CARS, SSP and SSP subcategories values in children with autism, pre- and post-treatment.

	Pre-treatment value	Post-treatment value	t-test or z-test (Wilcoxon)	p-value
CARS[a]	44 (±7)	35 (±8)	9.905	0.000
Total SSP[a]	146 (±19)	149 (±17)	−1.063	0.294
Tactile sensitivity[a]	27 (±4)	29 (±4)	−2.7	0.010
Taste/smell sensitivity[a]	14 (±5)	15 (±4)	−0.272	0.787
Movement sensitivity[b]	14 (8–15)	14 (6–15)	−1.898	0.058
Underresponsive seeks sensation[a]	23 (±6)	24 (±6)	−0.480	0.684
Auditoring filtering[b]	21 (15–30)	23 (16–29)	−0.580	0.562
Low energy/weak[b]	27 (17–30)	30 (18–30)	2.090	0.04
Visual/auditory sensitivity[b]	20 (16–24)	22 (16–25)	−1.503	0.133

a Mean (±SD).
b Median (IQR).

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Table 3 – Performance classification based on total SSP and the SSP subsections pre- and post-treatment.

SSP section	Time of testing	Typical performance[a]	Probable difference[a]	Definite dIfference[a]
Tactile sensitivity	Pre-treatment	12 (30%)	13 (32.5%)	15 (37.5%)
	Post-treatment	19 (47.5%)	11(27.5%)	10 (25%)
Movement sensitivity	Pre-treatment	25 (62.5%)	6 (15%)	9 (2.5%)
	Post-treatment	26 (65%)	7 (17.5%)	7 (17.5%)
Auditoring filtering	Pre-treatment	15 (37.5%)	19 (47.5%)	6 (15%)
	Post-treatment	21 (52.5%)	11 (27.5%)	8 (20%)
Visual/auditory sensitivity	Pre-treatment	32 (80%)	5 (12.5%)	3 (7.5%)
	Post-treatment	31 (77.5%)	6 (15%)	3 (7.5%)
Taste/smell sensitivity	Pre-treatment	20 (50%)	10 (25%)	10 (25%)
	Post-treatment	23 (57.5%)	8 (20%)	9 (22.5%)
Underresponsive seeks sensation	Pre-treatment	13 (32.5%)	7 (17.5%)	20 (50%)
	Post-treatment	12 (30%)	10 (25%)	18 (45%)
Low energy/weak	Pre-treatment	30 (75%)	1 (2.5%)	9 (22.5%)
	Post-treatment	23 (57.5%)	6 (15%)	11 (27.5%)
Total SSP	Pre-treatment	15 (37.5%)	7 (17.5%)	18 (45%)
	Post-treatment	16 (40%)	11 (27.5%)	13 (32.5%)

a Absolute number (percentage).

developmental factors may predict recovery, either spontaneous or through therapeutic interventions? In this study half of the children who were scored as mildly autistic and almost one fifth of those who were moderately–severely autistic pre-treatment, were categorized as non-autistic post-treatment. We assume that our interventions played an important role but we have no way of knowing how many of those would have exhibited spontaneous recovery; we feel however that this is rather unlikely particularly for those in the moderately–severely autistic range.

The amount of intervention is a factor that is frequently discussed with some of the highly structured behavioral approaches being provided for up to 40 hours per week. In our study the hours of intervention per week was not a prognostic variable for the longitudinal evolution of CARS values; children demonstrated improvement even with less intense programs. This outcome could be explained by the fact that these programs were individualized interventions, designed and performed by well trained therapists, geared towards very specific goals and supplemented by parent-mediated approaches. This result warrants further exploration because so far intensive programs have gained strong support in ASDs; for example, a recent study on intensive behavioral intervention for children with autism which gathered individual participant data from 16 group design studies demonstrated that intensity of intervention predicted gains in both IQ and adaptive behavior.[29] In contrast, another study on the outcome of young children with autism pointed out that the amount of intervention (in terms of number of hours) was not related to outcome.[30]

The findings of our study indicated that not only children who were highly functioning with normal or near-normal IQ were less severely affected, but also that intelligence level was a prognostic variable for CARS values. In the study of Eldevik et al., IQ at intake predicted gains in adaptive behavior.[29]

Our research also indicated that age at treatment onset was not an independent prognostic factor for improvement of CARS values. This result may be explained by the fact that all children who participated in this research initiated therapy early enough with a narrow age range; they started treatment at a mean age of 3 years and 10 months and all of them had started intervention before the age of 5 years. In general, the importance of early intensive intervention in autism has been proven.[28,31]

In contrast to the significant change in CARS scores, the general sensory processing score of our study group did not change significantly, despite some significant improvements in few sub-scores and a trend towards normalization of behavior of several children post-treatment. SIT based interventions are widely used among therapists working with children with developmental and behavioral problems including ASDs; eighty two percent of Occupational Therapists reported that they ''always'' use such an approach when working with children with autism[32] because many symptoms associated with autism are conceptualized by proponents of SIT as behaviors that are caused by sensory abnormalities. In the review of Schaaf and Miller, the controversy on the effectiveness of occupational therapies using this approach for children with developmental disabilities is discussed.[33] It has been shown that an SIT program positively affects treated children with autism.[34] A recent study demonstrated that behavioral intervention was more effective than SIT in the treatment of challenging behavior in ASTs.[13]

CARS is one of the best diagnostic instruments for ASD with studies supporting its utility in diagnostic decision-making across a variety of settings. CARS also has the potential to provide information on individual differences among children diagnosed with ASD.[16] The need for rating instruments to be validated in order for a clinical study to provide reliable and meaningful estimate of treatment effects has been acknowledged, but the use of such instruments as outcome measures in research studies has received little attention.[35] In the present study CARS was used as a means to

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re-assess the overall severity of the ASD after the intervention.[16] CARS, is not an outcome measure and it was not used as such; it simply provided an accurate description of the severity of the autistic involvement of the children at the times of the observation. We conclude from the results of this study that both the scores from the CARS and SSP scales can help the professionals to find an appropriate treatment intervention for the autistic children they treat.

The lack of a control group is a weak point of the present study, although most of the children diagnosed with ASD start therapy in a very short time and therefore a non-therapy group would be difficult to find. Furthermore, it has been stated that the results of the studies that included a comparison group (wait-list or no treatment) group should be interpreted with caution.[3] Nevertheless, future research should include the above mentioned parameter so as a more complete model could be formed. Also the degree of atypicality, the level of intelligence together with age should be measured as suggested by Coplan and Jawad as well as the pre-intervention cognitive and social interaction levels.[31,36] Lastly, the effect of the type of therapy was not examined. There is research suggesting that some methods are more effective than others.[37] Positive intervention outcomes have been reported in the majority of the reviews that evaluated treatments based on behavioral theory or communication-focused therapies, suggesting that some form of treatment is favorable over no treatment.[38] However, there are methodological weaknesses that make these reviews vulnerable to bias.[38]

In conclusion, our results suggest that a carefully designed and delivered, individualized psycho-educational treatment program, does have a significant effect on autism severity according to CARS; after at least one year of systematic intervention, our patients had lower CARS values.

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