Revista CEFAC

eISSN 1982-0216

DOI: 10.1590/1982-0216/20242651624 | Rev. CEFAC. 2024;26(5):e1624

Original articles

Analysis of scores in the Childhood Autism Rating Scale of children with Autism Spectrum Disorder before and after intervention with the method – Development of Communication Skills in Autism

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A study conducted at the Universidade Federal de Pernambuco, Recife, Pernambuco, Brazil.

Financial support: Undergraduate Research Program of the Universidade Federal de Pernambuco (Propesqi) (210417256); Outreach and Culture Program of the Universidade Federal de Pernambuco (381598.2167.268534.06062022)

Conflict of interests: Nonexistent

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Received on February 29, 2024
Received in a reviewed version on April 18, 2024
Accepted on May 23, 2024

ABSTRACT

Purpose: to analyze changes in autism classification after intervention with the Development of Communication Skills in Autism (DHACA method) in children assessed with the Childhood Autism Classification Scale.

Methods: a quantitative analysis study applying the Childhood Autism Rating Scale before and after 20 speech-language-hearing sessions, using the DHACA method with 14 nonverbal or minimally verbal children, of both sexes, aged 2 to 6 years, presented with autism spectrum disorder. The Shapiro-Wilk test was used to verify the normality pattern, and the Wilcoxon test to compare measures of central tendency of the items assessed by the scale before and after the intervention, with a p-value < 0.05 (5%) considered significant.

Results: the level of autism support needs in the sample decreased after the intervention. The largest sample group classified by the scale before the intervention was "Moderate Autism" (42.86%), followed by "Severe Autism" and "Mild Autism", both with 28.57%. After the intervention, most groups had scores equivalent to "Mild Autism" (64.29%), followed by "No Autism" (21.43%), "Moderate Autism" and "Severe Autism", both with 7.14%.

Conclusion: implementing the DHACA method helped develop communication, cognitive, and behavioral skills and decreased the level of autism support needs in this sample of children.

Keywords: Autism Spectrum Disorder; Communication; Diagnosis

INTRODUCTION

Autism Spectrum Disorder (ASD) is a neurodevelopmental disorder characterized by impaired social interaction and communication in multiple contexts and restrictive and repetitive patterns of behavior, interest, or activity[1]. These characteristics are present from the early developmental period and significantly impair the person's social and professional functioning and other important areas of their lives.

ASD is clinically diagnosed through direct observation of the child's behavior, interviews with parents or guardians, and scales, questionnaires, and standardized protocols for observing behavior. The publication of the DSM-5-TR and ICD-11 has recently updated the diagnostic criteria. However, challenges for ASD assessment and diagnosis persist, given the heterogeneous manifestation of symptoms and behaviors. Furthermore, despite the encouragement of early diagnosis, establishing it in very young children with language disorders can be difficult – which highlights the relevance of validated assessment instruments with good psychometric properties[2].

Hence, the Childhood Autism Rating Scale (CARS)[3,4] is used worldwide to diagnose ASD and, more specifically, distinguish mild to moderate from severe ASD. Using the scale requires little training, is low cost, has already been standardized with large populations, and is applicable to children over 2 years old. It is considered the most widely used scale in assessing behaviors associated with autism[2] and has consistently demonstrated good psychometric properties, helping identify impairments in general child development skills and guide intervention.

Impaired communication skills in ASD vary greatly and may manifest as difficulty initiating and maintaining interaction, understanding and interpreting the interlocutor's speech, avoiding eye contact, and having stereotyped language and scarce expressive and receptive vocabulary. There may also be a preference for gestures and vocalizations to express communicative intention[5].

Augmentative and alternative communication (AAC) is a multidisciplinary therapeutic resource that considers the clinical specificities of people with ASD and enables the development and improvement of socio-communicative skills of children with ASD who have complex communication needs[6]. AAC enables functional communication between individuals with such needs, and it is mainly consolidated by the interlocutors' daily use for imitation and shared attention[7].

According to Tomasello, the development of communication depends on the child's ability, in the first years of life, to understand others as intentional agents of everyday social interactions[8]. Thus, the socio-communicative impairment of children with autism is justified in part by their difficulty in understanding others as intentional and mental agents[9]. The method named Development of Communication Skills in Autism (DHACA, in Portuguese), whose theoretical basis is Tomasello's socio-pragmatic approach, was created to help develop communication skills with AAC[10].

DHACA enables the development of functional communication by using a robust AAC system, with pictograms selected based on the concept of "core words" and "fringe words". Core words comprise nuclear words of the language, mostly verbs, adjectives, adverbs, and pronouns, and rarely nouns. These are highly frequent in general interactions and commonly used in daily situations such as "I", "want" and "go", and can be easily combined to communicate clearly. Fringe words include nouns and a range of words more closely linked to specific contexts and of interest to the AAC user, enabling individualized communication[11].

Furthermore, the intervention with DHACA uses modeling, which consists in the simultaneous and contextualized association of one or more elements of the adult's speech with the symbols of the robust AAC system to provide a model of language use, favoring communication and language development[7].

Thus, this study aimed to analyze the changes in autism severity classification after intervention with the DHACA method in children assessed with CARS.

METHODS

This quantitative analysis study was approved by the Research Ethics Committee of the Universidade Federal de Pernambuco, PE, Brazil, registered under protocol number 4.692.479 and CAAE 45050721.2.1001.5208. The research initially included 14 nonverbal or minimally verbal children with an ongoing or conclusive ASD diagnosis, aged 2 to 6 years, of both sexes, from the Metropolitan Regions of Recife, PE, and Natal, RN, Brazil.

The research was carried out between 2020 and 2021. Both institutions were able to carry out assessment, diagnosis, and intervention procedures for children with ASD. They also had the necessary equipment to collect data, namely: a treatment room, toys, personal protective equipment (PPE), computers, and office supplies. The research teams comprised

speech-language-hearing (SLH) students and pathologists and a child psychiatrist.

First, the children's parents/guardians read and signed an informed consent form. Then, they answered the "PROTEA-R Form for Sociodemographic and Development Data" (PROTEA-R ASD Assessment System) and medical history survey to collect data on each child's profile and confirm the research inclusion criteria[12].

After the interview, participants underwent the initial CARS assessment[3,4]. It assesses 14 domains generally affected by autism, namely: relating to people; imitation; emotional response; body use; object use; adaptation to changes; visual response; listening response; taste, smell, and touch response and use; fear or nervousness; verbal communication; nonverbal communication; activity level; and level and consistency of intellectual response, in addition to the general impressions of autism.

The assessment took three sessions, in which the therapist interacted with the child playfully with toys suggested by the PROTEA-R protocol and followed the child's focus of interest. The sessions were filmed to analyze the child's behavior and complete the CARS posteriorly. The information to fill out the CARS was collected by observing the first three assessment sessions.

Two teams of judges analyzed the data – a psychiatrist and a team with an SLH pathologist and two students participating in the research. When they diverged on the results, a third SLH pathologist judge analyzed the results and decided the issue.

After watching the videos, the judges classified the child in each CARS domain with a 7-point scale, ranging from 1 to 4, with intermediate half-point values (1.5, 2.5, and 3.5). The score ranged from 15 to 60, and the cutoff for autism was 30. Scores below 30 were considered at no risk for ASD, between 30 and 36 indicated mild to moderate symptoms, and above 37 indicated severe symptoms. This study divided the protocol's mild/moderate ASD category into mild ASD (30 to 33.5) and moderate ASD (34 to 36.5).

The intervention with the DHACA method held weekly sessions lasting approximately 40 minutes, following the objectives to develop each skill[13]. It used the DHACA alternative communication book, initially presented on a single A4 page with 66 pictograms (forming the core vocabulary) and separate figures at the top (each child's reinforcers). Later, as the child acquired the skills, the book included both core and fringe vocabulary (sets of 10 pictograms, classified into semantic groups and superimposed at the top, linked to the core vocabulary by a spiral). The intervention process included weekly guidance to parents/guardians through guided conversation, demonstration of strategies for using the communication book, and listening to the family's needs.

The therapists and assistants photographed, filmed, and recorded the intervention sessions on each patient's progress sheet, previously authorized by the parents/guardians when they signed the informed consent form. The children were reassessed with the CARS after 20 SLH intervention sessions using the DHACA method, following the pre-intervention assessment standard described above.

The data were allocated to a Microsoft Excel spreadsheet shared between the institutions via Google Drive to perform a descriptive statistical analysis. The Shapiro-Wilk test assessed the normality of the values. A boxplot used the medians, minimum and maximum values, and quartiles 1, 2, and 3 to assess variations in the level of autism according to CARS. The Wilcoxon test compared two groups to verify whether they had the same measure of central tendency and analyzed the magnitude of the difference between measures before and after the intervention. Significant associations in both tests were based on p-values < 0.05 (5%).

RESULTS

The CARS identified the sample children's ASD severity level, observing significant changes in its classification (Table 1). The largest groups classified by CARS in the sample before intervention were Moderate ASD, with 42.86%, followed by Severe ASD and Mild ASD, both with 28.57%. The same sample mostly had a score equivalent to Mild ASD (64.29%) after the intervention, followed by No ASD (21.43%) and Moderate ASD and Severe ASD, both with 7.14%, the lowest percentages.

Mild ASD increased by 125% in the sample from before to after the intervention with DHACA. After the intervention, the CARS classified only one child as Moderate ASD, an 83.33% decrease. There was also a significant 75% decrease in the last protocol category, as only one child scored above 37 points (equivalent to Severe ASD, according to the CARS).

Table 1. Classification of the children's level of autism and mean score distribution, according to the levels of the Childhood Autism Rating Scale

Levels of autism/General impressions (CARS)	Characterization of the sample BEFORE THE INTERVENTION		Characterization of the sample AFTER THE INTERVENTION		Mean distribution BEFORE THE INTERVENTION	Mean distribution AFTER THE INTERVENTION
-	n*	%	n*	%	-	-
No ASD	0	0.00	3	21.43	0.00	27.30
Mild ASD	4	28.57	9	64.29	32.40	31.00
Moderate ASD	6	42.86	1	7.14	34.70	34.50
Severe ASD	4	28.57	1	7. 14	39. 25	37.50
TOTAL	14	100	14	100	-	-

*n: number of children with autism.
Captions: CARS: Childhood Autism Rating Scale; ASD: autism spectrum disorder

The Wilcoxon signed-rank test compared the CARS score before and after the intervention and found a p-value = 0.007 (i.e., p-value < 0.05) in both cases. This indicates sufficient evidence to reject the null hypothesis, indicating a significant difference between the groups (Figure 1). Post-intervention results were grouped in lower values than the ones before the intervention.

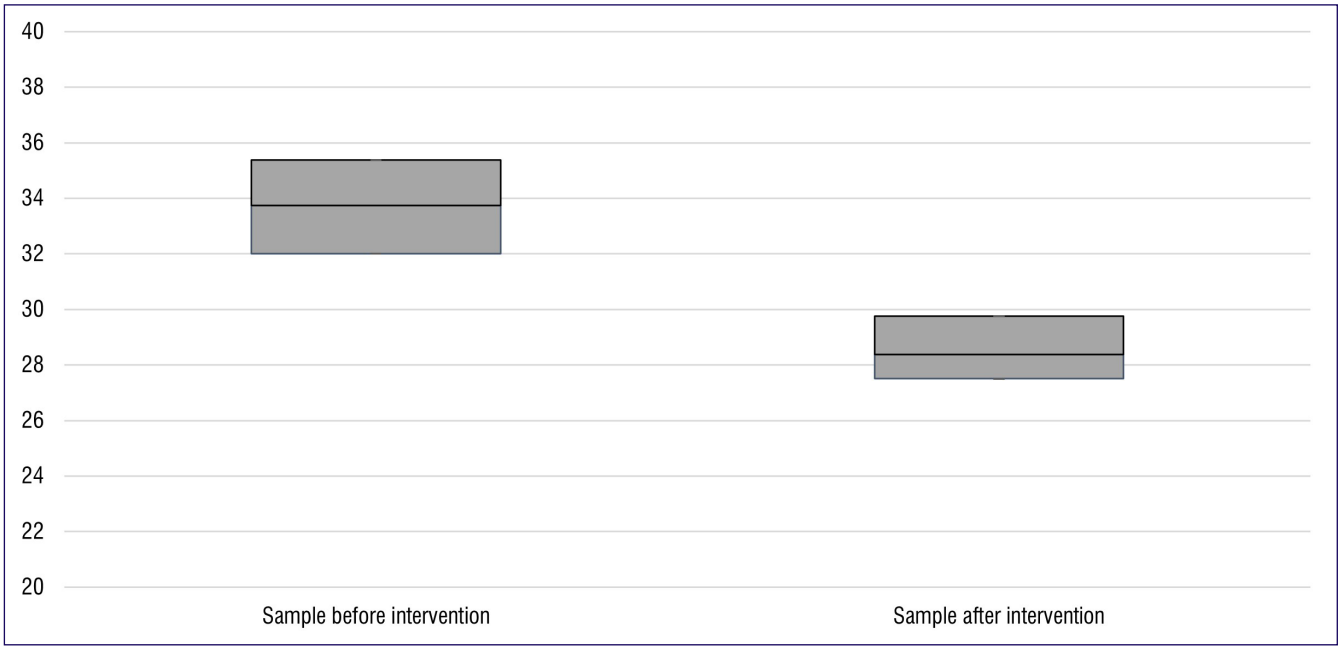

Figure 1. Boxplot of Childhood Autism Rating Scale values before and after the intervention with the DHACA method – Development of Communication Skills in Autism

Table 2 shows the significance level for each CARS domain. The following ones stood out: relating to people (p = 0.014), emotional response (p = 0.003), fear or nervousness (p = 0.007), and verbal communication (p = 0.004).

Table 2. Mean scores of the domains assessed by the Childhood Autism Rating Scale before and after speech-language-hearing intervention with the DHACA method – Development of Communication Skills in Autism

Items assessed by the Childhood Autism Rating Scale (CARS)	Mean distribution BEFORE the intervention with DHACA	Mean distribution AFTER the intervention with DHACA	Valor de p
Relating to people	2.85	2.35	p (1) = 0.014 *
Imitation	3.00	2.67	p (1) = 0.091
Emotional response	2.82	2.25	p (1) = 0.013*
Body use	2.53	2.28	p (1) = 0.288
Object use	2.42	2.28	p (1) = 0.085
Adaptation to change	2.71	1.92	p (1) = 0.226
Visual response	2.10	1.78	p (1) = 0.106
Listening response	2.14	2.10	p (1) = 0.963
Taste, smell, and touch response and use	2.17	2.10	p (1) = 0.916
Fear or nervousness	2.42	1.96	p (1) = 0.007*
Verbal communication	3.35	2.78	p (1) = 0.004*
Nonverbal communication	2.53	2.35	p (1) = 0.406
Activity level	2.25	2.17	p (1) = 0.927
Intellectual response	2.35	2.25	p (1) = 0.676

(*) Significant association at 5.0%.
(1) With Wilcoxon W test of items assessed by the Childhood Autism Rating Scale.
Caption: DHACA: Development of Communication Skills in Autism.

In the established margin of error (5%), positive correlations ($p < 0.05$) were found between "imitation" and "object use" ($p = 0.008$) and "imitation" and "emotional response" ($p = 0.011$). Also, "emotional response" was significantly positively correlated with "object use" ($p = 0.023$), "emotional response" with "fear or nervousness" ($p = 0.030$), and "relating to people" with "listening response" ($p = 0.017$).

DISCUSSION

The decreased ASD severity demonstrates that the intervention with the DHACA method improved the ASD symptoms (as verified by the scale's verification items) and increased their capacity for imitation and self-regulation (body use, emotional response, adaptation to change, and fear or nervousness), social interaction (assessed with relating to people), and challenging behaviors, according to the CARS assessment.

The establishment of functional communication favors the overall development, cognitive skills development, greater autonomy, and a better quality of education and personal relationships, with an impact on quality of life[14]. A study[15] points out that 6 to 16% of children diagnosed with ASD may have significant gains in the different areas of development assessed by the protocol after early intervention so that they no longer meet the diagnostic criteria for the disorder. Early intervention that stimulates and develops new skills and minimizes deficits in children with ASD helps reduce the severity of manifestations throughout development, as they enable changes in neural connections due to neuroplasticity[16].

The DHACA method prioritizes early intervention, which stimulates the development of social interaction and communication, improves learning, and reduces challenging behaviors – which hinder learning and the opportunities for everyday experiences. Moreover, it helps families cope with autism, corroborating a study in the area[13]. Early and continuous intervention helps the child's evolution and development, according to the specific therapeutic program[17].

According to a case report, early SLH intervention with AAC is essential for language development, especially for the development of expressive skills in ASD, which includes more frequent verbalizations[7]. The present study found decreased scores in the CARS expressive skills (emotional, visual, and listening response, adaptation to change, and verbal and nonverbal communication), which agrees with another study[7].

The DHACA helps develop morphosyntactic, semantic, and pragmatic aspects of the communication skills of children with ASD. It also increases their shared attention time and improves the quality of social interaction[13]. This research observed the development of

the sample's verbal and nonverbal communication in the CARS protocol, as their mean scores decreased after the intervention with DHACA. A study[18] points out that the consistent association of speech with graphic symbols and their AAC referents leads to an increased internal phonological representation of spoken words. This, in turn, can facilitate speech production.

The socio-communicative deficit in autism is known to be generally accompanied by language and speech impairment. A significant portion of people with autism do not develop functional communication with verbal language acquisition. Approximately 20 to 30% of people with ASD do not develop verbal language or have atypical verbalization patterns[19].

It is important to highlight that the DHACA method includes the participation of communication partners, who use the DHACA communication book together with the child, through modeling[7]. The interlocutors in the study sample were therapists in the therapeutic setting. They were also responsible for guiding and training parents, guardians, and teachers on the most effective strategies for individual language stimulation and the possibilities of using the communication book by each user in varied and everyday contexts.

Implementing AAC and training focused on parents as communication partners effectively improves children's communication skills. For AAC to be successful with young children, their communication partners need to be in tune with the child. When parents are guided on the AAC use and implementation strategies and realize the importance of AAC in their children's communicative success, they are more likely to implement it in their daily lives[20].

The changes in expressive skills and verbal communication items in the present study agree with other ones[7,13,21] that bring communication partners as part of the assistance and intervention in AAC since significant changes are observed in the communication patterns of AAC users with the help of these interlocutors. In addition, the authors state that AAC training can include communication partners in different contexts, playing the role of interpreting what AAC users want to communicate, mediating their forms of expression, selecting vocabulary, promoting meaningful interactions, and adapting contexts so that the AAC user can communicate functionally, promoting the development of communication skills.

This study assessed "object use" with CARS during playful activities, simultaneously assessing functional and symbolic play. The plays in question followed each child's interests and preferences to reinforce the functional and pleasurable relationship with both the toy and their interlocutors[22].

Play is a fundamental aspect of child language development, as it enables the functional and comfortable use of language during social interactions. Furthermore, when included in the therapeutic process, it stimulates communicative intention, problem-solving, language development, and social interaction opportunities[17].

Shared attention behavior is defined as the ability to share attention between two social partners in relation to a third external reference, configuring a triadic relationship. Examples include pointing, showing something, giving objects, and alternating gaze between the interlocutor and the object. Shared attention makes up the sociocognitive basis of language, and impaired skills in this area of development have been referred to as important predictive markers for early ASD identification[23,24].

The CARS assessment considered the influence of shared attention on relating to people, imitation, and verbal and nonverbal communication and the decreased mean scores after intervention with DHACA. The development of shared attention helps them interpret the interlocutor's behaviors and thus perceive other people as intentional subjects in the socio-communicative process. Hence, it can be inferred that it helps develop verbal communication in interactive processes[25,26].

Despite being widely used, diagnostic assessment with CARS may be limited, as its score is often not sensitive to diagnose cases in the borderline range between typical development and mild disorder changes[4]. This was observed in the study sample, as the protocol classified two children as "No ASD".

It is worth noting that ASD is clinically diagnosed through behavioral observation of the child and an interview with the parents, requiring complementary evaluation by other professionals, such as SLH pathologists, psychologists, occupational therapists, physical therapists, and educational psychologists[27].

The participation and adherence of the families in the study sample to the SLH intervention with the DHACA method was essential for the child's overall development. Family engagement in ASD interventions ensures that the therapeutic goals are extended to their homes[28]. For the child to learn to use the AAC system, they must be immersed in an environment with interlocutors using AAC[7]. Furthermore, SLH intervention

for children with ASD must ensure their adherence by providing information about the child's development, listening to their needs, and inviting all interlocutors to participate in the language process[29].

The findings highlight the need for further studies with the DHACA method, including a more significant sample from different regions of the country to shed light on the variables and possibilities of SLH intervention for children presented with ASD and their families.

CONCLUSION

The results of this study demonstrate that SLH intervention with the DHACA method favors the development of communication, cognitive, and behavioral skills in children presented with ASD, evidenced by the decreased level of autism support needs in the sample of children assessed with CARS.

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IALNX: Writing – review and editing.

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ACAM: Data curation; Investigation; Project administration; Writing – review and editing.

Data sharing statement:

We declare that the data used in this article were collected for the purposes of this research only and cannot be made publicly available.