Original Article
http://mjiri.iums.ac.ir
Medical Journal of the Islamic Republic of Iran (MJIRI)

Med J Islam Repub Iran. 2024 (25 Jun);38.72. https://doi.org/10.47176/mjiri.38.72

Video Training and Telepractice for Parents of Nonverbal Children with Autism Spectrum Disorder: a Randomized Control Trial

Hossein Rezai[1], Hooshang Dadgar[1]*, Amir Kasaeian[2]

Received: 31 Jan 2024 Published: 25 Jun 2024

Abstract

Background: Many children with autism spectrum disorder (ASD) are unable to benefit from timely interventions. This research aimed to indirectly enhance play and communication skills in ASD children by providing a video educational package and distance education for their parents.

Methods: In this clinical trial study, 32 parents and their children with ASD were randomly assigned to either the intervention or waitlist control groups. The intervention group received an educational video package along with 24 one-hour online sessions. The frequency of communication, engagement in functional games, and the use of conventional and unconventional gestures were assessed before, immediately after, and 3 months following the completion of the intervention in the participating children. The variables were analyzed within and between the two groups using a mixed between-within-subjects analysis of variance (ANOVA).

Results: The intervention group achieved significantly higher scores than the control group in the frequency of communication ($P = 0.003$), functional play ($P < 0.001$), and conventional gestures ($P < 0.001$). Conversely, the intervention group had significantly lower scores than the control group in unconventional gestures ($P < 0.001$).

Conclusion: The observed improvements in both parents and children within the intervention group provide compelling support for the effectiveness of telepractice in speech therapy. This suggests that incorporating remote training methods into speech therapy sessions could enhance access for children with ASD to these interventions.

Keywords: Instructional Film and Video, Autism Spectrum Disorder, Nonverbal Communication, Play and Playthings, Prenatal Education

Conflicts of Interest: *None declared*
Funding: *This work was supported by the Tehran University of Medical Sciences (grant number: 1401-3-103-63157). The funder had no input into the study.*

Cite this article as: Rezai H, Dadgar H, Kasaeian A. Video Training and Telepractice for Parents of Nonverbal Children with Autism Spectrum Disorder: a Randomized Control Trial. *Med J Islam Repub Iran.* 2024 (25 Jun);38:72. https://doi.org/10.47176/mjiri.38.72

Introduction

Autism spectrum disorders (ASD) are pervasive neurodevelopmental disorders characterized by impairments in social-communicative interactions and repetitive patterns of behavior, interests, and activities (1). The detrimental impact of ASD on various aspects of a child's development, as well as its association with medical and psychiatric disorders, underscores the necessity for effective treatment. Optimal care often requires 25 to 40 hours of medical and rehabilitation interventions per week (2).

Research findings reveal that parents of children with ASD face greater challenges in accessing suitable treatment services compared to parents of children with other disabilities (3). This underscores the need for targeted support and resources to address the unique difficulties experienced by

Corresponding author: *Dr Hooshang Dadgar, hdadgar@tums.ac.ir*

1. Department of Speech Therapy, School of Rehabilitation, Tehran University of Medical Sciences, Tehran, Iran
2. Hematology, Oncology and Stem Cell Transplantation Research Center, Research Institute for Oncology, Hematology and Cell Therapy, Tehran University of Medical Sciences, Tehran, Iran

↑What is "already known" in this topic:
Due to the adverse effects of ASD on multiple facets of a child's development, these individuals must undergo extensive medical and rehabilitation services across various specialties. Unfortunately, residing in rural areas poses a significant obstacle to accessing these essential interventions, thereby compensating for the developmental delays caused by ASD become very challenging for these children.

→What this article adds:
Empowering parents in rural areas to utilize naturalistic-developmental approaches through tele-practice is effective for improving communication and play skills in nonverbal children with ASD.

families navigating the complexities of ASD treatment.

Research indicates that parents and family members possess numerous opportunities to enhance their child's language and speech skills through daily interactions in various contexts and situations (4). As a result, parent education and coaching have become pivotal treatment goals for children with ASD (5). Today, parents in rural areas, who may face challenges accessing face-to-face interventions, can act as educational service providers under the remote supervision of rehabilitation experts, such as speech therapists (6). Notably, scientific evidence supports the notion that the effectiveness of tele-practice is comparable to or even greater than face-to-face intervention (7).

Telepractice offers several advantages, including the reduction or elimination of travel costs to clinical centers (8). This is particularly beneficial for parents residing in remote areas, as they no longer need to incur expenses on hotels in cities with advanced medical facilities (9). Furthermore, it opens up the possibility of incorporating language training into diverse contexts, thereby enhancing the generalization and consolidation of skills acquired by increasing the involvement of parents in delivering the necessary training to their children (10).

Despite the confirmed effectiveness and efficiency of parent education and coaching in the treatment of children with ASD in numerous studies (11), there is a notable lack of effective measures in speech therapy clinics in Iran to educate parents. Currently, most interventions are provided directly by speech therapists. Compounding this issue, Iranian families face insufficient financial support from government sources for the care and education of their children with ASD.

Given the challenges faced by Iranian families in accessing timely and effective face-to-face treatment services for their autistic children, this study endeavors to develop an educational video package. Considering that non-verbal autistic children have difficulty communicating (12) and have problems with the amount, complexity, and quality of their functional play (13), the primary objective of this study was to assess the potential indirect improvements in the frequency of communication, participation in functional games, and utilization of conventional gestures among ASD children. This improvement was pursued through the provision of a video educational package and remote coaching for parents who lack access to face-to-face speech therapy interventions.

Methods

Participants

In total, 38 children with ASD and their parents initially participated in the study. However, six families withdrew from the study for various reasons. Subsequently, the 32 parents, aged between 25 and 48 years (with a mean age of 35.78 ± 7.21), who have children with ASD aged between 3 and 6 years (with an average age of 4.13 ± 1.13), were randomly divided into control and intervention groups. Each group comprised 16 parent-child dyads (See CONSORT flow diagram, Figure 1).

Inclusion criteria for parents were as follows: a) no prior experience with Parent-Child Interaction Therapy (PCIT); and b) possession of a smartphone with messenger software. For children with ASD, inclusion criteria were: a)

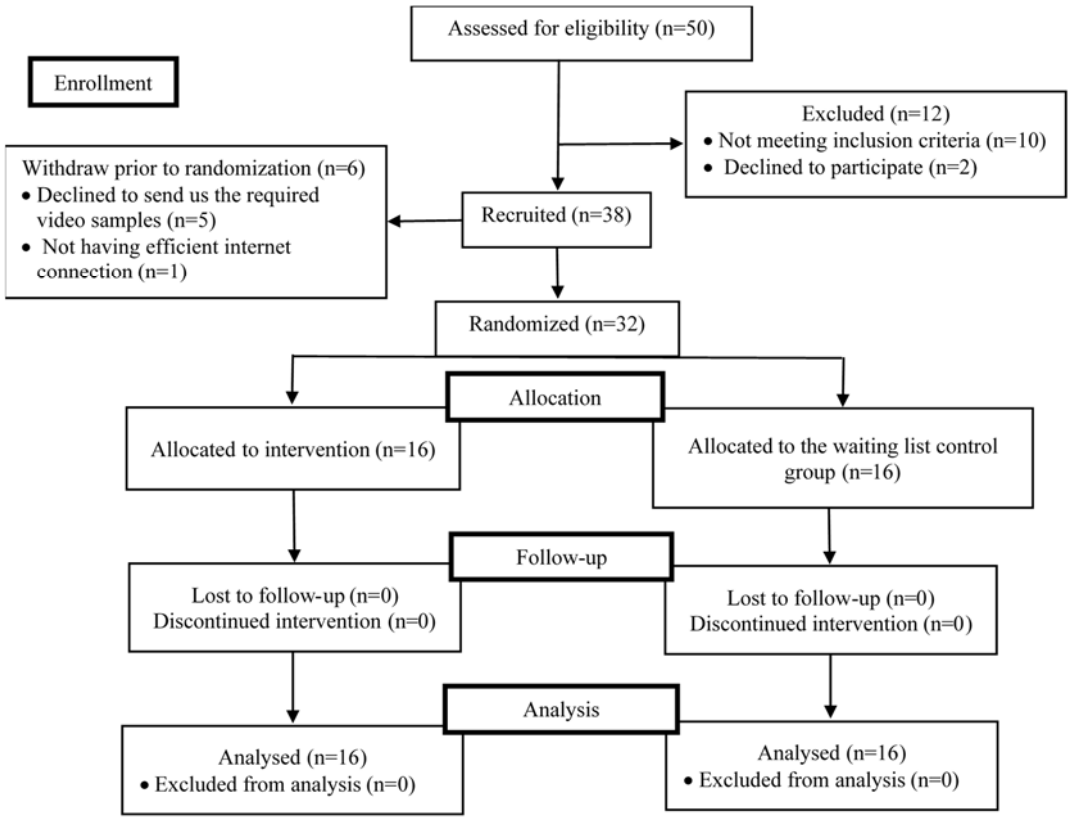

Figure 1. CONSORT Flow Diagram

aged between 3 to 6 years; b) diagnosed with ASD by a licensed child psychiatrist outside of the study; c) having expressive lexicon with fewer than 10 words; d) having normal vision, hearing, and movement behavior; and e) not receiving face-to-face or online speech therapy interventions. Furthermore, not sending the video samples of parent-child interaction, not having an efficient internet connection, and using face-to-face or online speech therapy interventions within our treatment period, were considered as exclusion criteria for the ASD children and their parents.

During the intake phase, parents completed a demographic questionnaire to provide information on family characteristics. Additionally, parents submitted a 15-minute video sample of their interactions with their child with ASD to establish baseline measures for the frequency of communication, engagement in functional games, and use of conventional and unconventional gestures.

Settings and Materials

In the intervention group, parents engaged with the telepractice program using their personal smartphones and internet connections. Without offering specific instructions or feedback, parents were requested to interact with their children in their typical manner during play activities for a 15-minute duration as part of the baseline assessment.

Study Design and Procedure

The current study was a single-blind randomized controlled trial with a 2×3 mixed between–within-subjects design, registered and approved in the Iran Trial Registration Center under the code IRCT20180716040486N1. 1401.049. To improve the validity of a study and also for ethical considerations (e.g., reducing the chance of discriminatory practices to occur), a complete description of the proper randomization method is required to create unbiased comparison groups in controlled trials (14). To randomly allocate subjects to either the intervention or control groups, the following steps were undertaken in the current study: a) assigning codes 1 to 32 for each family, b) preparing sheets of paper labeled as either control or intervention (16 sheets for each group), c) placing the sheets in non-transparent envelopes, d) having an external person, not part of the research team, pick up the envelopes from the floor, and e) assigning the codes 1 to 32 to either the intervention or control groups based on the label on each randomly selected sheet. Given our utilization of a simple randomization method, it's important to acknowledge that this approach may not mitigate imbalances in sample size or prognostic factors, which are prone to arise. (15). Regarding blinding procedures, families participating in the study were kept unaware of their assigned study group, ensuring that the blinding protocol was effectively implemented. The intervention group received the video instructions via the Soroush application (16), and we engaged with parents in this group through 25-to-30-minute video calls twice a week. During these calls, parents were asked to perform each intervention goal step by step to assess their procedural fidelity. In this video training, we guide parents in enhancing their child's communication and language skills through daily interactions, employing Naturalistic Teaching Strategies (NaTS) (17). The video package comprised 10 modules, each ranging from 9 to 42 minutes in length, with a total duration of 206 minutes (Appendix A).

In this video training, we guide parents in enhancing their child's communication and language skills through daily interactions. Parents in the control group did not receive the video package or video calls during the intervention and follow-up phases. They were informed that access to the video package would be granted in the next 6 months.

Measures

Participant Characteristics

A demographic questionnaire created by the researcher was employed to gather information on family characteristics. Parent-related variables encompassed age, gender, educational attainment, marital status, and household income. Child-related variables included age and gender.

In this study, we identified four primary outcomes: communication frequency, conventional and unconventional gestures, and functional play, all of which are presented below.

Communication frequency, conventional and unconventional gestures

To compute the frequency of communication, as well as the number of conventional and unconventional gestures in children, we utilized a modified version of a scale drawn from a study that assessed communication frequency in children with ASD (18). The content validity of this scale was checked and approved by five Persian-speaking speech therapists who specialize in the evaluation and treatment of ASD children (Appendix B). The analysis was conducted on a 15-minute video sample of parent-child interaction. If a child's behavior lacked one of these three characteristics, it was excluded from the calculation of communication frequency: a) Using physical movements (conventional or unconventional gestures), vocalizations, or words; b) Addressing another person with these communication tools; and c) Conveying a communicative function, such as requesting or rejecting.

Functional play

In video analysis, to calculate children's functional play score, we analyzed the child's ability to use the following objects conventionally: including a mobile phone, glass, spoon, hairbrush, towel, hat, socks, blanket, and mask. We assigned a score based on the child's performance in the self-directed, doll-directed, and other-directed play. A score of zero was given if the child couldn't engage with an object in a conventional way, while a score of 3 indicated proficiency in all three types of functional play with a given object. For instance, when assessing play with a hairbrush, a child received a score of 3 if they could successfully perform all three acts: a) combing their own hair with the brush (self-directed play); b) combing the doll's hair with the brush (doll-directed play); and c) combing the hair of a family member with the brush (other-directed play). The conventional use of the other nine objects mentioned above

for personal use, as well as for a doll and others (typically a family member), was also examined and assessed. This way, a child would receive a score between zero and 30, considering that playing three types of functional play with 10 objects is assessed.

Parents' procedural fidelity

In the current study, parents received ongoing training from the first author before applying interventions for their child. The goal was to achieve a fidelity rate of over 80% in implementing the therapeutic techniques. Parents were recorded engaging in a parent-child interaction within the comfort of their homes at both the intake and post-treatment stages to assess alterations in their intervention fidelity. The evaluation of parent behavior involved scoring their adherence to the intervention strategies, utilizing the two fidelity checklists provided in the supplementary files (Appendix C and D). The content validity of the two fidelity checklists was checked and approved by five Persian-speaking speech therapists who specialize in the evaluation and treatment of ASD children.

Sample size

Based on the values reported in a comparable article (19), with a confidence level of 95% and a test power of 95%, the initial sample size was calculated using the formula for comparing the means of two groups (provided below), resulting in a requirement of 7 patients per group. Incorporating a 20% margin for potential changes, the adjusted sample size was set at 9 individuals for each group. However, due to the enthusiastic response from eligible families with children willing to participate in the research, the final decision was made to increase the sample size to 16 individuals for each group.

$$\square = .05$$
$$\square = .95$$
$$\mu_1 = 75, \quad sd = 21.31$$
$$\mu_2 = 22.86, \quad sd = 25.40$$

$$n = \frac{\left(Z_{\alpha/2} + Z_{\beta}\right)^2 * 2 * S_p^2}{(\mu_1 - \mu_2)^2}$$

$$S_p = \sqrt{\frac{(n_1 - 1)s_1^2 + (n_2 - 1)s_2^2}{(n_1 + n_2 - 2)}}$$

Statistical Analysis

Building upon the aforementioned primary objectives and outcomes, our primary analysis employed a mixed between-within-subjects ANOVA to explore the influence of group type (tele-practice vs. no treatment) on children's average frequency of communication, functional games, and scores for conventional and unconventional gestures across three-time points (baseline, post-treatment, and 3 months follow-up). To ensure the validity of the mixed between-within-subjects ANOVA, several assumptions were assessed: a) Normality was checked at each time point using the Shapiro–Wilk test; b) The homogeneity of variances was verified through Levene's test of equality of error variances; and c) The assumption of equality of covariance matrices was examined using Box's M test.

Results

The characteristics of the participating families are summarized in Table 1. Our findings revealed outstanding treatment fidelity among parents, as reflected in mean (SD) ratings of 87.3% (5.6) for the implementation of Prelinguistic Milieu Teaching (PMT) and 94.4% (7.3) for the application of techniques aimed at teaching functional play to their children.

The mixed between-within-subjects ANOVA assessed the within-subjects effects and revealed a significant increase over time in communication frequency scores at baseline (T0), post-treatment (T1), and 3 months follow-up (T2) for both groups (Wilks' lambda = 0.47, F(2, 29) = 16.34, $P < 0.001$, η2 partial = 0.530, observed power = 0.999). A notable interaction between time and group was also observed (Wilks' lambda = 0.75, F(2, 29) = 4.91, $P = .015$, η2 partial = 0.253, observed power = 0.763), indicating significant differences in the evolution of communication frequency scores between the two groups over time (Table 2). Specifically, the intervention group showed a substantial increase in communication frequency from T0 (M = 3.81, SD = 1.42) to T1 (M = 6.00, SD = 1.46), $P = 0.002$, and maintained these gains through T2 (M = 6.00, SD = 2.09), $P < 0.001$, with continued improvement from T1 to T2 ($P = 0.005$). In contrast, the control group did not show significant changes in communication frequency from T0 to T1 ($P = 1.00$) and T0 to T2 ($P = 0.399$), though there was a significant increase from T1 to T2 ($P = 0.024$).

Functional play scores also increased significantly over time for both groups (Wilks' lambda = 0.07, F(2, 29) = 199.45, $P < 0.001$, η2 partial = 0.932, observed power = 1.0), with a pronounced time and group interaction effect (Wilks' lambda = 0.09, F(2, 29) = 144.391, $P < 0.001$, η2 partial = 0.909, observed power = 1.0), highlighting the differences in functional play development between the two groups (Table 2). The intervention group exhibited a dramatic increase in functional play scores from T0 (M = 1.38, SD = 0.957) to T1 (M = 9.4, SD = 3.20), $P < 0.001$, and from T0 to T2 (M = 23.13, SD = 4.67), $P = 0.001$, whereas the control group saw no significant changes across any time points.

Conventional gestures scores also improved significantly over time in both groups (Wilks' lambda = 0.22, F(2, 29) = 52.760, $P < 0.001$, η2 partial = 0.784, observed power = 1.0), with a significant interaction between time and group (Wilks' lambda = 0.24, F(2, 29) = 52.25, $P < 0.001$, η2 partial = 0.757, observed power = 1.0) (Table 2). The intervention group showed significant growth in the use of conventional gestures from T0 to T1 ($P < 0.001$) and continued to improve through T2 ($P < 0.001$), whereas the control group did not demonstrate significant changes at any point.

Conversely, the scores for unconventional gestures did not show a significant difference across time points (Wilks' lambda = 0.98, F(2, 29) = 0.378, $P < 0.001$, η2 partial = 0.689, observed power = .105), but a significant interaction between time and group was noted (Wilks' lambda = 0.31,

Table 1. Participants' family characteristics

Variable	Group	
Parent demographics	Intervention (n = 16)	Control (n = 16)
Age at baseline, years		
Mean (SD)	36.81 (7.22)	34.75 (7.28)
Gender		
Male, n (%)	2 (12.5)	1 (6.3)
Education level		
High school graduate	2 (12.5)	2 (12.5)
Bachelor's degree	12 (75.0)	11 (68.8)
Master's degree	2 (12.5)	3 (18.8)
Marital status		
Married, n (%)	15 (93.8)	16 (100)
Monthly household income (in Rials *)		
Mean (SD)	232762500.0 (46062332.77)	241687500.0 (48564347.35)
Min	168000000	157000000
Max	326000000	352000000
Child demographics		
Age at baseline, years		
Mean (SD)	4.19 (1.17)	4.06 (1.12)
Gender		
Male, n (%)	13 (81.3)	12 (75)

* 1 $ = 574000 Rials (The announced price for one dollar to Rial on March 8, 2024)

Table 2. The results of mixed between-within-subjects ANOVA on the scores for Communication frequency, Functional play, Conventional gestures, and Unconventional gestures in children across three time periods

Variable	Effect	F	*P*-value	Eta squared
Communication frequency	Main effect for time	16.34	< 0.001	0.530
	Main interaction effect	4.91	0.015	0.253
	Main effect for intervention	10.36	0.003	0.257
Functional play	Main effect for time	199.45	< 0.001	0.932
	Main interaction effect	144.391	< 0.001	0.909
	Main effect for intervention	209.41	< 0.001	0.875
Conventional gestures	Main effect for time	52.760	< 0.001	0.784
	Main interaction effect	52.25	< 0.001	0.757
	Main effect for intervention	128.622	< 0.001	0.811
Unconventional gestures	Main effect for time	0.378	< 0.001	0.689
	Main interaction effect	31.90	< 0.001	0.687
	Main effect for intervention	43.229	< 0.001	0.590

Effect size (eta squared) conventions: small effect = 0.01; moderate effect = 0.06; large effect = 0.14

$F(2, 29) = 31.90$, $P < 0.001$, $\eta 2$ partial = 0.687, observed power = 1.0) (Table 2). In the intervention group, unconventional gestures scores decreased significantly from T0 to T2 ($P < 0.001$), and from T1 to T2 ($P = 0.008$), whereas in the control group, these scores significantly increased from T0 to T1 ($P = 0.034$), T0 to T2 ($P < 0.001$), and T1 to T2 ($P < 0.001$), indicating divergent trends in the use of unconventional gestures between the two groups.

Discussion

The significant increase in the number of children diagnosed with ASD has placed substantial demands on medical, educational, and family services globally. Given the gap between the demand for and the availability of effective speech therapy interventions for children with ASD, there is a need to explore alternative service delivery methods. To our knowledge, this was the first study to explore Iranian parents' engagement with a video-based speech therapy telehealth program and assess its effectiveness in improving their child's communication and play skills. Moreover, the study investigated whether the frequency of children's frequency of communication, their use of conventional gestures, and participation in functional play with objects improved through procedures implemented by the parents in the intervention group.

Similar to the prior investigations, this study featured predominantly university-educated parents (87.5%). However, different from most of the comparable research, all participants in this study reside in remote and underserved areas in Iran. Previous studies indicated that residing in rural areas can restrict many families of children with ASD from accessing intervention services (20).

Considering earlier findings suggesting that a self-directed program might be effective for certain parents but not universally applicable, with some parents needing extra assistance (21), in addition to sending parents the video instructions, we offered ongoing support through remote coaching and feedback sessions via weekly video calls to facilitate parents' attainment of a high fidelity level in the successful implementation of therapeutic techniques in the intervention group. According to the literature, assessing the percentage of parents' fidelity in correctly executing therapeutic techniques is crucial to upholding the internal validity of the research (22).

In addressing the second aim of the study, comparing children in the two study groups across three-time points

(baseline, post-treatment, and 3 months follow-up) confirmed that the effects of parent-implemented techniques were evident in the significantly increased frequency of children's communication, their use of conventional gestures, and their involvement in functional play within the intervention group. Arranging the environment is a strategy used to create communication temptations and to provide children with communication opportunities (23). By employing this strategy, the parent structures or manipulates the environment to prompt the child to engage in spontaneous communication with someone else to obtain a desired item or outcome in play or daily routines (24). We presented numerous clear examples to the parents in a video module, demonstrating how to effectively arrange the environment to provoke communication temptations. The significant increase in communication frequency observed in ASD children within the intervention group aligns with findings from previous studies (25).

In line with a previous study employing tele-practice to empower 25 mothers of children with ASD in implementing PMT (26), the current study demonstrated significant improvement among ASD children in the intervention group in using conventional gestures. In a video module, we instructed parents on how to enhance the use of conventional gestures in children by implementing the PMT intervention (27) into the context of everyday activities. in agreement with transactional theory, as children enhance their frequency of nonverbal communication following PMT Implementation, parents become increasingly responsive, thereby contributing to further improvement in the children's communication skills (28).

Consistent with prior research (29), this study demonstrated a noteworthy enhancement in the proficiency of children in the intervention group in performing functional play. Engaging in functional play is important as it enables children not only to comprehend the world but also fosters crucial cognitive development and facilitates social interactions with others, as highlighted by previous studies (30).

In this study, except for frequency of communication scores across three time points, no significant changes were observed in the use of conventional gestures and playing with objects conventionally and functionally in the control group. As evident in Figure 2, the rise in communication frequency among children in the control group is attributed to an increase in the utilization of unconventional gestures. Whereas the increase in the frequency of communication among children in the intervention group is partly a result of the increased frequency of conventional gestures.

Limitations

This study had several limitations. Firstly, the inclusion of families was restricted to those residing in rural and underserved areas. Consequently, it is advisable to extend the scope to include families in more developed urban settings

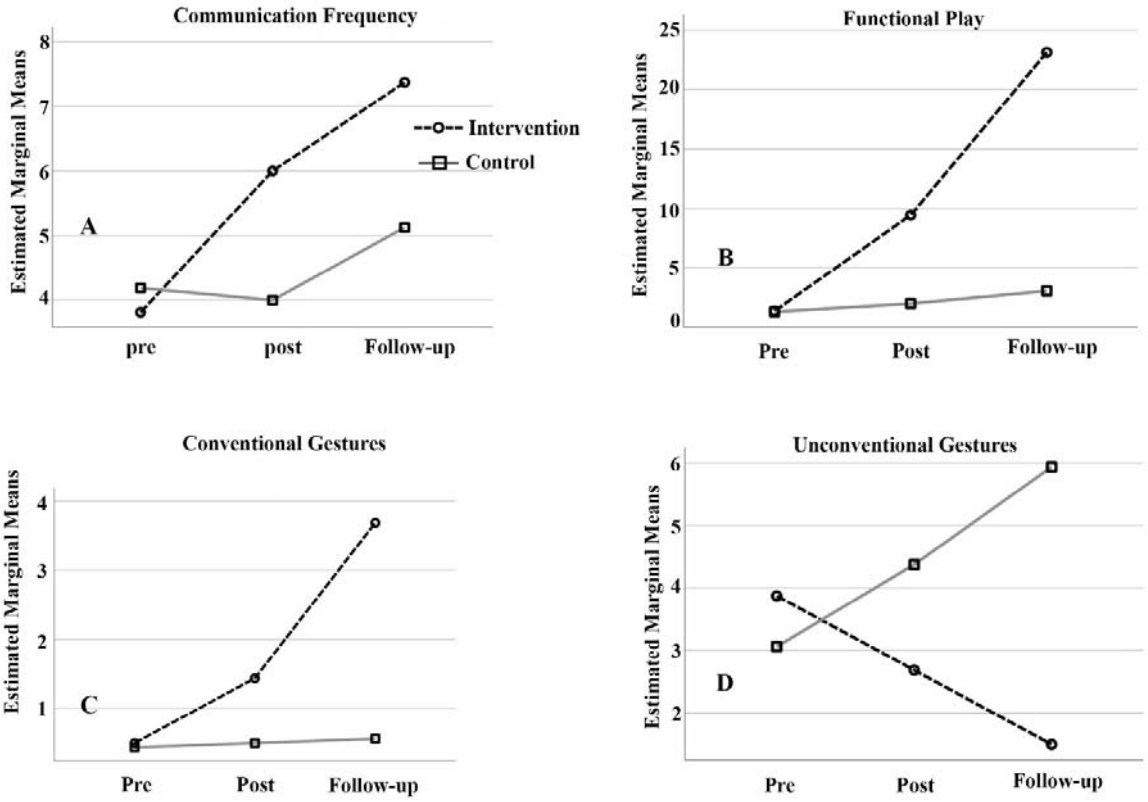

Figure 2. Illustrates a comparison of mean scores for communication frequency, functional play, conventional, and unconventional gestures at pre-intervention, post-intervention, and follow-up stages between the two groups

with accessible rehabilitation centers. Secondly, our utilization of a simple randomization method may not effectively mitigate imbalances in sample size. Consequently, we recommend employing more sophisticated techniques, such as block randomization for comparable future studies. Thirdly, the control group underwent no intervention during the study. To enhance the comparison between the video package and face-to-face interventions, it is suggested to incorporate control groups receiving in-person speech therapy interventions in future similar RCT studies.

Conclusion

Given the favorable outcomes and the potential long-term effects of telehealth on communication frequency, functional play, and using conventional gestures observed in children with ASD in the current study, it is recommended that speech therapists use telehealth platforms to deliver effective educational services to many underserved individuals with ASD.

Authors' Contributions

Study conception and design: HR and HD; Acquisition of data: HR; Analysis and interpretation of data: AK; Drafting of the manuscript: HR and HD; Critical revision: HR, HD, and AK; All the authors read and approved the final article.

Ethical Considerations

This study followed the principles of the Declaration of Helsinki and was approved by the Research Ethics Committee of Tehran University of Medical Sciences with the ethics code IR.TUMS.FNM.REC.

Acknowledgment

The authors express their gratitude to Hamid Taheri, Salman Abdi, Mohyeddin Teimouri Sangani, and Samira Mazaheri for their valuable contributions.

Conflict of Interests

The authors declare that they have no competing interests.

References

1. Association AP. Diagnostic and Statistical Manual of Mental Disorders (DSM-5®): American Psychiatric Publishing; 2013.
2. Dawson G, Rogers S, Munson J, Smith M, Winter J, Greenson J, et al. Randomized, controlled trial of an intervention for toddlers with autism: the Early Start Denver Model. Pediatrics. 2010;125(1):e17-23.
3. Kogan MD, Strickland BB, Blumberg SJ, Singh GK, Perrin JM, van Dyck PC. A national profile of the health care experiences and family impact of autism spectrum disorder among children in the United States, 2005-2006. Pediatrics. 2008;122(6):e1149-58.
4. Stoner JB, Meadan H, Angell ME. A model for coaching parents to implement teaching strategies with their young children with language delay or developmental disabilities. Perspect Lang Learn Educ. 2013;20:112-9.
5. Deb SS, Retzer A, Roy M, Acharya R, Limbu B, Roy A. The effectiveness of parent training for children with autism spectrum disorder: a systematic review and meta-analyses. BMC Psychiatry. 2020;20(1):583.
6. Zuckerman KE, Lindly OJ, Reyes NM, Chavez AE, Macias K, Smith KN, et al. Disparities in Diagnosis and Treatment of Autism in Latino and Non-Latino White Families. Pediatrics. 2017;139(5).
7. Neely L, Rispoli M, Gerow S, Hong ER, Hagan-Burke S. Fidelity Outcomes for Autism-Focused Interventionists Coached via Telepractice: a Systematic Literature Review. J Dev Phys Disabil. 2017;29.
8. Thomas KC, Ellis AR, McLaurin C, Daniels J, Morrissey JP. Access to care for autism-related services. J Autism Dev Disord. 2007;37(10):1902-12.
9. Casale EG, Stainbrook JA, Staubitz JE, Weitlauf AS, Juárez AP. Chapter Six - The Promise of Telepractice to Address Functional and Behavioral Needs of Persons With Autism Spectrum Disorder. In: Hodapp RM, Fidler DJ, editors. International Review of Research in Developmental Disabilities. 53: Academic Press; 2017. p. 235-95.
10. Bagaiolo LF, Mari JJ, Bordini D, Ribeiro TC, Martone MCC, Caetano SC, et al. Procedures and compliance of a video modeling applied behavior analysis intervention for Brazilian parents of children with autism spectrum disorders. Autism. 2017;21(5):603-10.
11. Scudder A, Wong C, Ober N, Hoffman M, Toscolani J, Handen BL. Parent–child interaction therapy (PCIT) in young children with autism spectrum disorder. Child Fam Behav Ther. 2019;41(4):201-20.
12. Adams C, Lockton E, Freed J, Gaile J, Earl G, McBean K, et al. The Social Communication Intervention Project: a randomized controlled trial of the effectiveness of speech and language therapy for school-age children who have pragmatic and social communication problems with or without autism spectrum disorder. Int J Lang Commun Disord. 2012;47(3):233-44.
13. Lifter K, Ellis J, Cannon B, Anderson SR. Developmental Specificity in Targeting and Teaching Play Activities to Children with Pervasive Developmental Disorders. J Early Interv. 2005;27(4):247-67.
14. Lai D, Wang D, McGillivray M, Baajour S, Raja AS, He S. Assessing the quality of randomization methods in randomized control trials. Healthcare (Amsterdam, Netherlands). 2021;9(4):100570.
15. Lim CY, In J. Randomization in clinical studies. Korean J Anesthesiol. 2019;72(3):221-32.
16. Soroush Inc. Soroush Plus [Internet]. Available from: https://splus.ir/; 2022.
17. Charlop M, Lang R, Rispoli M. Keeping It Real: Naturalistic Teaching Strategies (NaTS) for Play and Social Skills with Children with Autism Spectrum Disorder. Play and Social Skills for Children with Autism Spectrum Disorder Evidence-Based Practices in Behavioral Health: Springer, Cham; 2018. p. 53-70.
18. Ye Q, Liu L, Lv S, Cheng S, Zhu H, Xu Y, et al. The Gestures in 2–4-Year-Old Children With Autism Spectrum Disorder. Front Psychol. 2021;12.
19. Nefdt N, Koegel R, Singer G, Gerber M. The Use of a Self-Directed Learning Program to Provide Introductory Training in Pivotal Response Treatment to Parents of Children With Autism. J Posit Behav Interv. 2010;12(1):23-32.
20. Clarke M, McLay L, France K, Blampied N, van Deurs J. Telehealth-Delivered Supports for Daily Living Skills for Autistic Children: a Systematic Review. Rev J Autism Dev Disord. 2023.
21. Vismara LA, McCormick C, Young GS, Nadhan A, Monlux K. Preliminary findings of a telehealth approach to parent training in autism. J Autism Dev Disord. 2013;43(12):2953-69.
22. Horner S, Rew L, Torres R. Enhancing Intervention Fidelity: A Means of Strengthening Study Impact. J Spec Pediatr Nurs. 2006;11(2):80-9.
23. Paul R. Interventions to Improve Communication in Autism. Child Adolesc Psychiatr Clin N Am. 2008;17(4):835-56.
24. Franco JH, Davis BL, Davis JL. Increasing social interaction using prelinguistic milieu teaching with nonverbal school-age children with autism. Am J Speech Lang Pathol. 2013;22(3):489-502.
25. Akemoglu Y, Muharib R, Meadan H. A systematic and quality review of parent-implemented language and communication interventions conducted via telepractice. J Behav Educ. 2020;29(2):282-316.
26. Mohamadi R, teymouri sangani m, Nokhostin Ansari N, soleymani z. A Preliminary Study of Telepractice Prelinguistic Milieu Teaching for Children with Autism Spectrum Disorders. J Iran Med Council. 2022;5(3):471-7.
27. Fey ME, Warren SF, Bredin-Oja SL, Yoder PJ. Responsivity education/prelinguistic milieu teaching. In: McCauley RJ, Fey ME, editors. Treatment of language disorders in children 2nd ed: Brookes Publishing; 2017.
28. Warren S, Bredin-Oja S, Fairchild M, Finestack L, Fey M, Brady N. Responsivity education/prelinguistic milieu teaching. Treat Lang Disord Child. 2006:47-75.
29. Lee SY, Lo YY, Lo Y. Teaching Functional Play Skills to a Young

Child with Autism Spectrum Disorder through Video Self-Modeling. J Autism Dev Disord. 2017;47(8):2295-306.
30. McConnell SR. Interventions to facilitate social interaction for young children with autism: review of available research and recommendations for educational intervention and future research. J Autism Dev Disord. 2002;32(5):351-72.

Appendix A. Details of the video modules

Video Module	Details	Dur in min*
Introductory speech	Characteristics and needs of children with ASD Benefits of remote training	25
Active participation of parents in children's educational programs	Increasing the duration of speech and language interventions assisting the child in manipulating and utilizing real objects to gain richer information about sensory-physical properties of the objects enhancing the generalization of speech and language skills to daily interactions by the child Elevating the quality of life for the child	24
Transforming the home space into an effective learning environment	Enhancing the emotional atmosphere at home Improving the organization of household items Minimizing excess noise Eliminating unnecessary visual stimuli Selecting appropriate lighting sources Managing color coordination	22
Creating communication temptations	Learning to arrange the environment in a manner that keeps the child's favorite objects visible but out of reach.	11
Following the child's lead	Recognizing objects, activities, and individuals that captivate the child's interest. Supplying the child with the necessary objects and activities. Being present alongside the child, actively participating in their activities or games. Verbally describing the child's actions during their activities or games.	15
Strengthening parental responsiveness	Recognizing the child's non-verbal messages Following the child's lead Verbally describing the phenomena and events in the child's surroundings Adjusting responses to child misbehavior	15
Prelinguistic Milieu Teaching (PMT)	Environmental arrangement Increasing the frequency of vocalizations Increasing the eye gaze Increasing the use of conventional and unconventional gestures Simultaneous use of pointing, vocalization and eye gaze	42
Joint attention	The nature of joint attention Teaching the child to initiate joint attention	13
Requesting and rejecting	Teaching the child to request and protest	9
Functional play	The developmental stages of play in young children Assessing the level of play development in children How functional play benefits children Teaching functional play	30
Total		206

* Duration in minutes

Appendix B. The scale for assessing communication frequency, number of conventional gestures and unconventional gestures

Communication means		Details	No*
Gestures			
Conventional gestures	Moving the head up and down	Moving the head up and down to express "yes", "ok", "agree" and "hello".	
	Moving the head to the sides	Moving the head to the sides to express "no", "I don't want", "I can't" and "I disagree".	
	Pointing	Keeping the index finger straight while the other four fingers are folded and pointing to an object.	
	Giving	Transferring the object from one's hand to another person's hand.	
	Showing	Briefly lifting and presenting something to another person for 1 to 2 seconds, or waving an item at someone to capture their attention without explicitly seeking help.	
	Full-hand Pointing	Indicating the desired object by extending the palm and pointing with open fingers.	
	Gentle tapping	Gently tapping a part of a person's body (hand, arm, and wrist) with the hand to redirect attention towards oneself, these taps are not aggressive or violent.	
	Raising hands to be hugged	Extending hands to others as a need to be hugged.	
	Clapping	Clapping to express happiness.	
	Waving hands	Waving hands to say goodbye.	
	Swinging hands	Raising and lowering the hands to attract attention and draw others to oneself.	
	Sending a kiss	Placing one hand on the lips and then slowly moving it away, extending it towards another person, signifies a farewell or goodbye gesture.	
	Waving hands to the sides	Waving hands to indicate "no", "don't", and "decline".	
	Open your hands	Holding the hands to the sides with the palms facing up to express "nothing" and "something is over".	
	Thumbs up	Holding the thumb up while folding the rest of the fingers to mean "great".	
	Iconic gestures	Employing iconic gestures to convey the characteristics of objects or animals, such as flapping the arms to represent a "bird."	
	facial expressions	Depending on the situation, trying to comfort the person who is upset by smiling.	
Uconventional gestures	Pulling	Gently pulling someone closer by grasping a part of their body (hand, arm, and shoulder) or their clothing to direct their attention toward oneself or an object of interest.	
	Pushing	Pushing others with one hand to signal "no" or "get away from me".	
	Instrumental pointing	Putting others' hands on the required object.	
Vocalizations	Vocalization along with intonation change	Modulating vocalization by adjusting pitch to attract attention, make requests, or express refusal.	
	One-word or multi-word phrases	Expressing single or multi-word utterances to get attention, request, or reject something.	
Eye gaze	Three-point gaze	The child alternates between looking at the audience and the object, either starting by looking at the audience first, then the object, and back at the audience, or beginning by focusing on the object, then turning to the audience, and returning to the object.	
Total			

*Number or frequency

Appendix C. The checklist for assessing parents' procedural fidelity in implementing PMT

Teaching episode	Scoring
Physical imitation	Assign one point to the parent when he or she imitates the child's action.
Vocal imitation	Assign one point to the parent when he or she imitates the child's vocalization
Arranging the environment	If the parent creates an appropriate and clear scenario to acknowledge the child's communication efforts and directs the child's attention to developmentally suitable toys, he or she will earn one point. To achieve this, the parent should arrange the environment by ensuring the child's favorite items are visible but placed out of reach. For instance, this could involve placing the child's beloved cookie in a sealed glass container within the child's sight.
Following the child's lead	Assign one point to the parent If he or she complies with the child's nonverbal requests to play with a certain toy or to perform a certain activity.
Descriptive talk	Assign one point to the parent if he or she talks about what the child is doing.
Modeling the desired behavior	Assign one point to the parent if he or she models the child how to establish eye gaze or to use conventional gestures, and vocalizations.
Prompting the child the desired behavior	Assign one point to the parent if he or she asks the child to establish eye gaze or to use conventional gestures, and vocalizations.

Appendix D. The checklist for evaluating parents' procedural fidelity in guiding a child to play in a conventional manner with a toy.
Please give the parent one score for each "yes".

The name of the toy:	Session number				
Stages	……	……	……	……	……
1. By saying "let's watch the video", the parent asks the child to watch the edited video clip of playing with the target toy.	Yes, No, N.A.*	Yes, No, N.A.	Yes, No, N.A.	Yes, No, N.A.	Yes, No, N.A.
2. The parent plays the video clip and the child watches the video clip twice.	Yes, No, N.A.	Yes, No, N.A.	Yes, No, N.A.	Yes, No, N.A.	Yes, No, N.A.
3. The parent does not provide any feedback to the child while playing the video clip.	Yes, No, N.A.	Yes, No, N.A.	Yes, No, N.A.	Yes, No, N.A.	Yes, No, N.A.
Video clip					
4. At the beginning of the video clip, a photo of the child and a toy were shown, and this audio file of the parent was played (assuming that the child's name is Ali): "This movie shows Ali!" The famous Ali! Let's see how Ali plays with... (the toy)".	Yes, No, N.A.	Yes, No, N.A.	Yes, No, N.A.	Yes, No, N.A.	Yes, No, N.A.
5. After the parent's voice (which was played at the beginning of the clip while showing the image of the child and the toy), an encouraging sound effect was played.	Yes, No, N.A.	Yes, No, N.A.	Yes, No, N.A.	Yes, No, N.A.	Yes, No, N.A.
6. In the video clip, it was shown that the child is playing with the toy independently and correctly, and the parent does not provide any clues.	Yes, No, N.A.	Yes, No, N.A.	Yes, No, N.A.	Yes, No, N.A.	Yes, No, N.A.
7. After the completion of the video clip related to the child's independent play with the toy, a picture of the child and the toy was shown and this audio file of the parent was played (assuming that the child's name is Ali): "Well done Ali!" You played well with ... (the toy)!" And this sentence of the parent was accompanied by playing an encouraging sound effect.	Yes, No, N.A.	Yes, No, N.A.	Yes, No, N.A.	Yes, No, N.A.	Yes, No, N.A.
8. After the encouraging sound effect was finished, this audio clip was played: "Let's see again how Ali plays with ... (the toy)" and the video clip of the child playing correctly with the toy was played again.	Yes, No, N.A.	Yes, No, N.A.	Yes, No, N.A.	Yes, No, N.A.	Yes, No, N.A.
Prompting the child					
9. The parent placed the target toy in the corner of the room.	Yes, No, N.A.	Yes, No, N.A.	Yes, No, N.A.	Yes, No, N.A.	Yes, No, N.A.
10. The parent said to the child: "Go play with the toy."	Yes, No, N.A.	Yes, No, N.A.	Yes, No, N.A.	Yes, No, N.A.	Yes, No, N.A.
11. Without providing feedback, the child was given two minutes to play with the toy.	Yes, No, N.A.	Yes, No, N.A.	Yes, No, N.A.	Yes, No, N.A.	Yes, No, N.A.
12. If after 10 seconds, the child tries to leave the play area or does not play with the toy, the parent reminds him/her to play with the toy by saying "Play first and rest later ".	Yes, No, N.A.	Yes, No, N.A.	Yes, No, N.A.	Yes, No, N.A.	Yes, No, N.A.

*N.A. = Not Applicable