

EFFECTS OF PARENT-MEDIATED INTERVENTION IN TEACHING SOCIAL COMMUNICATION SKILLS TO CHILDREN WITH AUTISM SPECTRUM DISORDERS (ASD): A SYSTEMATIC REVIEW¹

EFEITOS DA INTERVENÇÃO MEDIADA PELOS PAIS NO ENSINO DE COMPETÊNCIAS DE COMUNICAÇÃO SOCIAL A CRIANÇAS COM PERTURBAÇÕES DO ESPETRO DO AUTISMO (PEA): UMA REVISÃO SISTEMÁTICA

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ABSTRACT: Parent-mediated interventions (PMIs) are the most cost-effective way to target social communication and behavioral issues in individuals with Autism Spectrum Disorder (ASD). This research synthesis aims to (a) identify the types of PMI programs that have been used to improve the social communication skills of children with ASD and (b) record the outcomes of these programs that have been reported in previous research on children with ASD and their parents. The PRISMA guidelines were used to identify the published PMI studies from 2004 to 2022. The digital databases Scopus, ERIC, Web of Science, and B-on were screened for relevant publications using the keywords “autism spectrum disorder” AND “home-based intervention” OR “parent-mediated intervention” OR “family-mediated intervention” AND “educational program” OR “training program” AND “social skills” OR “communication skills” in the studies’ titles and/or abstracts. The inclusion criteria were as follows: studies with parent-mediated intervention programs primarily targeting the social communication skills of children with ASD, published in English, and reporting outcomes in children with ASD. The search yielded 462 publications, and only 37 studies were eligible for inclusion in the final analysis. Overall, these studies showed that PMIs were effective in improving social communication and other skills of children with ASD. Additionally, parents showed high fidelity, positive perception, self-efficacy, satisfaction, and a decrease in stress. The limitations of the studies and future implications were discussed.

KEYWORDS: Parent-mediated intervention. Autism Spectrum Disorder. Social communication skills. Home-based intervention.

RESUMO: As intervenções mediadas pelos pais (*Parent-mediated interventions* – PMIs) são a maneira mais eficaz de atingir problemas de comunicação social e comportamentais em indivíduos com Transtorno do Espectro Autista (TEA). Esta síntese de pesquisa visa (a) identificar os tipos de programas PMI que foram usados para melhorar as habilidades de comunicação social de crianças com TEA e (b) registrar os resultados desses programas que foram relatados em pesquisas anteriores sobre crianças com TEA e seus pais.

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Foram utilizadas as diretrizes PRISMA para identificar os estudos sobre PMI publicados entre 2004 e 2022. Os bancos de dados digitais Scopus, ERIC, *Web of Science* e B-on foram rastreados para publicações relevantes, utilizando as palavras-chave “autism spectrum disorder” AND “home-based intervention” OR “parent-mediated intervention” OR “family-mediated intervention” AND “educational program” OR “training program” AND “social skills” OR “communication skills” nos títulos e/ou resumos dos estudos. Os critérios de inclusão foram os seguintes: estudos com programas de intervenção mediados pelos pais, que visassem principalmente as competências de comunicação social de crianças com TEA, publicados em inglês e que relatassem resultados em crianças com TEA. A pesquisa identificou 462 estudos, dos quais 37 foram elegíveis para inclusão na análise final. No geral, esses estudos mostraram que os PMIs foram eficazes na melhoria da comunicação social e de outras competências das crianças com TEA. Além disso, os pais demonstraram elevada fidelidade na implementação das intervenções, bem como uma percepção positiva, autoeficácia, satisfação e uma diminuição do stress. Foram discutidas as limitações dos estudos e as implicações futuras.

PALAVRAS-CHAVE: Intervenção mediada pelos pais. Transtorno do Espectro Autista. Habilidades de comunicação social. Intervenção familiar.

1 INTRODUCTION

Autism spectrum disorder (ASD) is a neurodevelopmental disorder characterized by two core symptoms: social communication difficulties and behavioral problems (American Psychiatric Association [APA], 2021). This population might also present cognitive and language impairments, which are not required for ASD diagnosis (APA, 2021). Many individuals with ASD show a lack of eye contact, sharing interest, initiating or maintaining conversations, abnormal facial expressions, turn-taking, and joint attention (Thomeer et al., 2019).

In the last decade, the prevalence rate of individuals with ASD has increased dramatically and was estimated at 11 sites in the United States of America (USA) to be 1 in 54 children at the age of eight – Centers for Disease Control and Prevention MMWR (Maenner et al., 2020). Globally, the prevalence rate of ASD is estimated to be 62 in 10,000 (Elsabbagh et al., 2012); this increase can be due to social awareness or the development of diagnostic criteria (Crawford, 2016). Consequently, the World Health Organization ([WHO], 2014) declared ASD a public health issue that requires enhancing access to appropriate support services by delivering training to families, caregivers, and other service providers to meet the needs of individuals with ASD and other developmental disabilities. Legally, parents’ participation in their special-needs children’s intervention programs was mandated by the Individuals with Disabilities Education Act ([IDEA], 2024), which states that parents must be active and equal members of Individual Educational Program (IEP) teams and participate in developing IEPs for their children with disabilities to ensure that their children obtain sufficient support to achieve suitable progress in general education.

The significance of parent-mediated interventions (PMIs) for children with ASD and their parents has been well-documented in the literature. Numerous studies have indicated that PMIs yield promising outcomes for children with ASD, including improvements in social communication skills (Ingersoll & Wainer, 2013a), language skills (Hardan et al., 2015; Siller et al., 2013), a decrease in ASD severity (Pickles et al., 2016), restricted and repetitive behaviors (Lin & Koegel, 2018), and sleeping disorders (Delemere & Dounavi, 2018). Most parents of this population experience a high level of stress, which is associated with their child’s social deficiency, self-efficacy, and social support (Li, Xu et al., 2022). However, PMIs were found to be effective in reducing parental stress (Kasari et al., 2015), increasing parents’ satisfaction and self-efficacy (Kurzrok et al., 2021), and overall increasing their knowledge of ASD.

Parent training in ASD is a common term that refers to intervention programs designed to address the needs of individuals with ASD and their parents. Bearss et al. (2015) distinguished between two forms of parent-training programs: “parent support,” and “parent-mediated intervention.” Parent support describes the programs aimed at promoting the knowledge of parents about their child’s diagnosis and treatments “knowledge-focused programs” include psychoeducation and care coordination, with the child being the indirect beneficiary. In contrast, PMIs refer to intervention programs designed to be delivered by parents to their children with ASD, where the child is a direct beneficiary. PMIs can be used to target the core symptoms of ASD, such as social communication, imitation, and play, or to focus on maladaptive behaviors such as feeding, toileting, and disruptive behaviors (Bearss et al., 2015).

Several PMIs are based on the Naturalistic Developmental and Behavioral Intervention Model (NDBI), which focuses on constructing a naturalistic learning environment similar to everyday situations to enhance social communication skills and facilitate developmental progress in children with ASD. This approach emphasizes individualized interventions based on children’s interests, initiations, and natural motivations. NDBIs often include training in joint attention, reciprocal interactions, play activities, and functional communication. The NDBI model aims to support a child’s holistic development while addressing social and communication challenges within the natural context (Schreibman et al., 2015). This intervention model allows children with ASD to practice their skills in their naturalistic settings, including home and community, which enhances their capability to generalize and maintain the acquired skills in various contexts (Conrad et al., 2021).

Many NDBI programs have been developed to target several skills of individuals with ASD, including Parents as Communication Teachers (ImPACT) (Ingersoll & Wainer, 2013b), Reciprocal Imitation Training (RIT) (Ingersoll, 2010a), Joint Attention, Symbolic Play, Engagement, and Regulation Intervention (JASPER) (Kasari et al., 2006), the Early Start Denver Model (ESDM) (Dawson et al., 2010), and Pivotal Response Treatment (PRT) (Koegel & Koegel, 2006). In contrast, some PMIs emerged from the Developmental Social-Pragmatic (DSP) model, which emphasizes that children acquire both language and social communication skills through effective social engagement with caregivers during natural interactions. This model focuses on the use of language in a social context and functional communication, supports the development of joint attention skills to enhance social interaction, and uses play-based activities to promote social engagement (Binns & Cardy, 2019). Examples of PMIs that use the DSP model to promote the social communication skills of children with ASD are DIR/Floortime (Greenspan & Wieder, 2009) and Hanen More Than Words (Sussman, 2012).

Although the NDBIs and DSP interventions have many similarities, they differ in terms of direct prompting. In the NDBI approach, direct prompting varies according to child initiation, such as providing explicit instruction. However, the DSP model does not define this strategy. In addition, the DSP model defines the use of facilitative strategies that aim to increase adult responsiveness to children’s behaviors in order to enhance social communication development. In contrast, the NDBI approach does not define or consider these strategies as an active part of treatment. Instead, it utilizes one or more of these strategies to motivate and develop a relationship with the child through intervention. Finally, both models use different methods to assess the effectiveness of the interventions (Ingersoll, 2010b).

We identified some systematic reviews that showed positive outcomes of PMIs on the social communication skills of children with ASD and their parents; however, these reviews included only studies with a single-subject research design (Patterson et al., 2012), targeted preschool children (Meadan et al., 2009; Pacia et al., 2022), or reported the effects of specific intervention programs, such as JASPER (Waddington et al., 2021). The present review attempts to extend these reviews by exploring the effects of PMIs on the social communication skills of children with ASD or at risk of ASD and their parents by synthesizing the research papers that have been published since the issue of the IDEA Act 2004–2022 to (a) identify the sorts of PMI programs that have been used to improve the social communication skills of children with ASD; (b) report the intensity and duration of these interventions; (c) record the outcomes of PMIs on children with ASD and their parents; and (d) highlight the limitations of these studies and write recommendations for future research.

2 METHOD

The current systematic review was conducted following the guidelines described in the PRISMA statement (Moher et al., 2009) to identify the scientific studies published between 2004 and 2022 in international journals. The digital databases Scopus, ERIC, Web of Science, and B-on were used to identify relevant publications, using the search terms “autism spectrum disorder” AND “home-based intervention” OR “parent-mediated intervention” OR “family mediated intervention” AND “educational program” OR “training program” AND “social skills” OR “communication skills” in the studies’ titles and/or abstracts. The search was limited to autism and social communication skills. The search results revealed 462 publications across all databases.

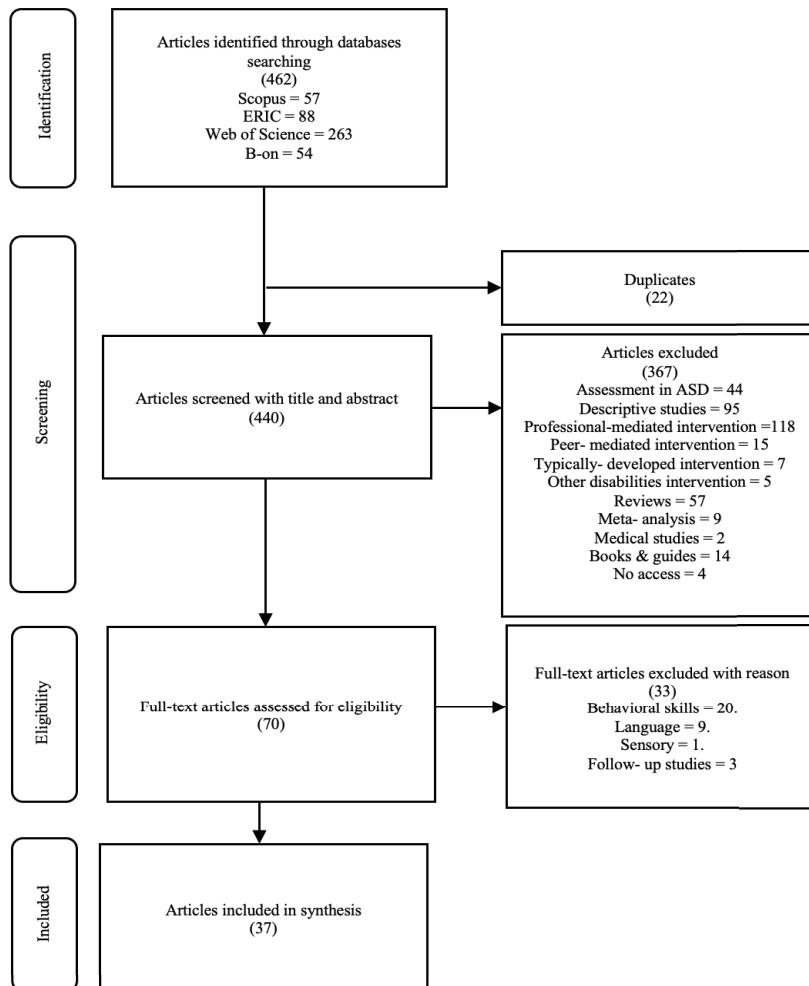
2.1 INCLUSION CRITERIA

The eligibility criteria for the review were set as follows: the focus of the study was on parent-mediated interventions; the study primarily targeted the social communication skills of children with ASD; the study involved an intervention program; the study was published between 2004 and 2022; the study was published in English; the study reported the outcomes of children with ASD.

2.2 SCREENING AND SELECTION OF STUDIES

As shown in Figure 1, at the first stage, the researchers identified a total of 462 articles across all databases: Scopus (57), ERIC (88), Web of Science (263), and B-on (54). In the next step, the duplicate articles were excluded, which reduced the sample size to 440 articles. The articles’ titles and abstracts were screened considering the eligibility criteria. A list was made for the studies about which we were uncertain whether they met the eligibility criteria to be reviewed and discussed in depth. A total of 70 full-text articles were assessed for eligibility, which led to the selection of the remaining 37 articles to be included in the final analysis. The excluded articles were those with no intervention programs (theoretical), targeting other ASD skills (sensory, behavior, and language), or having no child outcomes (parental studies) or follow-up studies.

Figure 1
PRISMA search and selection diagram



Accessibility note: Flowchart composed of rectangular text boxes connected by arrows. On the left side, vertically distributed, the steps: “Identification”, “Screening”, “Eligibility” and “Included”. The first step, “Identification”, comprises: “Articles identified through databases searching (462)”, “Scopus (57)”, “ERIC (88)”, “Web of Science (263)” e “B-on (54)”, “Duplicates (22)”. The second step, “Screening” indicates: “Articles screened with title and abstract (440)”. “Articles excluded (367)”, “Assessment in ASD (44)”, “Descriptive studies (95)”, “Professional-mediated intervention (118)”, “Peer-mediated intervention (15)”, “Typically-developed intervention (7)”, “Other disabilities intervention (5)”, “Reviews (57)”, “Meta-analysis (9)”, “Medical studies (2)”, “Books & guides (14)” e “No access (4)”. The third step indicates: “Full-text articles assessed for eligibility (70)” e: “Full-text articles excluded with reason (33)”, “Behavioral skills (20)”, “Language (9)”, “Sensory (1)” e “Follow-up studies (3)”. The last step refers to “Articles included in synthesis (37)”.

2.3 DATA EXTRACTION AND CODING

The data from studies included in this review were extracted and summarized in terms of (1) study descriptions, including country, participants’ characteristics, research design,

dependent variables, and child-parent measures, as shown in Table 1; and (2) intervention details, including intervention program, format, setting, duration, and intervention outcomes on children with ASD and their parents as shown in Table 2.

3 RESULTS

The results of the studies identified through the database search are presented in Table 1.

Table 1
Studies' descriptions

Study	Country	Research design	Participants with ASD				Dependent variables			Measures	
			Total N (control group)	Age months (Mean)	Male %		Child	Parent	Child	Parent	Parent
Ingersoll et al. (2016)	USA	A pilot RCT: pre-posttest-follow-up design.	27	19 – 73 (M = 12.71)	70		Social skills and language.	Fidelity, stress, perception, and self-efficacy.	MacArthur-Bates Communicative Development Inventory (MCDI), Vineland Adaptive Behavior Scales (VABS-II).	Project ImPACT fidelity checklist, Parent Sense of Competence Scale (PSOC), Family Impact Questionnaire (FIQ).	
Stadnick et al. (2015)	USA	A pilot study: pre-posttest design.	30 (control = 14)	18 – 96 (M = 55.41)	81		Communication skills	Parental Stress	Vineland Adaptive Behavior Scales, (Vineland-II).	Center for Epidemiological Studies-Depression Scale (CES-D), Parenting Stress Index-Short Form (PSI-SF).	
Roberts et al. (2011)	Australia	RCT: pre-post intervention, follow-up design.	84 (control = 28)	41.5 – 43.7 (M = 42.76)	90.5		Social interaction and language	Perception, stress, and quality of life	Vineland Adaptive Behaviour Scales (VABS-II), Reynell Developmental Language Scales (RDLIS-II), The Pragmatics Profile, The Developmental Behaviour Checklist (DBC).	Parenting Stress Index (PSI), The Beach Family Quality of Life Questionnaire, The Parent Perception Questionnaire.	
Brian et al. (2022)	Canada	RCT: pre-posttest-follow-up design.	179	14 – 34 (M = 25.18)	72.6		Functional communication, language, and ASD symptoms.	Fidelity	The Infant-Toddler Checklist (ITC), Autism Diagnostic Observation Schedule (ADOS-2), The Mullen Scales of Early Learning (MSEL), The Vineland Adaptive Behavior Scales (VABS-II), Survey Interview Form.	Video coding for checking parents' fidelity.	
Tripathi et al. (2022)	USA	A pilot study: Pre-posttest-follow-up design.	45	48 – 72 (M = 59.88)	79		Social, play, and behavioral skills.	Parental stress	Social Responsiveness Scale, 2 nd ; School Age (SRS-2), Quality of Play Questionnaire (QOPQ), Social Skills Improvement System Rating Scales (SSIS).	Parenting Stress Inventory, 4 th ed., Short-Form (PSI-4-SF).	
Shire et al. (2022)	Canada	A Pilot – Randomized: Pre-posttest-follow-up design.	56	33 – 33.12 (M = 33.06)	NR		Joint engagement, play, and joint attention.	Fidelity	Mullen Scales of Early Learning (MSEL), Early Social Communication Scales (ESCS), Structured play assessment (SPA).	Caregiver-child interaction (CCXI), Caregivers' JASPER strategy use.	
Li, Wu et al. (2022)	China	A pilot study: pre-posttest design.	68 (control = 33)	24 – 72 (M = 48)	82.4		Social communication, and language skills.	Stress, self-efficacy, and satisfaction.	The Social Responsiveness Scale (SRS), The Autism Treatment Evaluation Checklist (ATEC).	The Parenting Stress Index-Short Form (PSI-SF), Parental Self-Efficacy of Competence Scale.	

Study	Country	Research design	Participants with ASD			Dependent variables		Measures	
			Total N (control group)	Age months (Mean)	Male %	Child	Parent	Child	Parent
Wainer et al. (2021)	USA	RCT: pre-posttest design.	20 (control = 10)	18 – 60 (M = 37.75)	80	Social communication skills	Fidelity, perception, self-efficacy, and quality of life.	Social communication checklist (SCC), Unstructured initiation assessment (UIA).	RTI parent fidelity form (RTI-PFF), Beach Center Family Quality of Life Scale (FQOL), Early Intervention Parenting Self-Efficacy Scale (EIPSES).
Stahmer et al. (2020)	USA	Quasi-experimental: Pre-posttest-follow-up design.	25 (control = 9)	22.46 – 23.08 (M = 22.76)	68%	Social communication, and adaptive behavior	Fidelity, parent-child interaction, and social support.	The Communication and Symbolic Behavior Scales–Infant Toddler Checklist (CSBS–ITC), MacArthur–Bates Communicative Development Inventory, Vineland Adaptive Behavior Scales (VABS– II).	Parent Participatory Engagement Measure, Social Support Index, Parent Interactions with Children: Checklist of Observations Linked to Outcomes, Project ImPACT for Toddlers–Parent Intervention Fidelity.
Ingersoll and Wainer (2013b)	USA	A pilot study: pre-post intervention design.	24	26 – 70 (M = 44.9)	77.7	Social engagement, language, imitation, and play.	Fidelity, and stress.	The Social-Communication Checklist (SCC), the Social Responsiveness Scale (SRS), Observation parent-child interaction.	The ImPACT Fidelity Rating Scale, the Parenting Stress Index 3rd ed (PSI), the Behavioral Intervention Rating Scale (BIRS) to assess project impact acceptability.
Predlock et al. (2011)	USA	A Pilot study: pre-posttest design.	4	37 – 69 (M = 56)	75	Social interaction, and language.	Satisfaction, and perception.	The Communication Symbolic Behavior Scale, Developmental Profile (CSBS-DP), the MacArthur–Bates Communicative Development Inventories (MCDI), Caregiver questionnaire, and the examiners' CSBS-DP observations.	Satisfaction survey, interview.
Yoder et al. (2021)	USA	RCT: pre-posttest-follow-up.	97 (control = 48)	12 – 18 (M = 14)	55	Intentional communicative expressive language, play, and motor skills.	Fidelity.	The Semi-Structured Imitation Scale (SSIS), Adapted Legeesee Imitation Task (ALIT), the Communication and Symbolic Behavior Scales-behavior sample (CSBS), Brief Observation of Social Communication Change (BOSSC), Developmental Play Assessment (DPA), MacArthur–Bates Communicative Development Inventory (MCDI), the Mullen Scales of Early Learning (MSEL), the Autism Diagnostic Observation Scale (version 2; ADOS-2).	Three observers using ProCoder for Digital Video, Frost's Naturalistic Developmental Behavioral Intervention code (adapted).

Study	Country	Research design	Participants with ASD			Dependent variables			Measures	
			Total N (control group)	Age months (Mean)	Male %	Child	Parent	Child	Parent	Parent
Turner-Brown et al. (2019)	USA	RCT: Pre-posttest design.	49 (control = 17)	29.6 – 29.7 (M = 29.65)	81	Social communication skills, and ASD severity.	Stress, quality of life, and fidelity	The Autism Diagnostic Observation Schedule (ADOS2), The Services/Intervention Questionnaire, The Mullen Scales of Early Learning (MSEL), the Parent Interview for Autism-Clinical Version (PIA- CV).	The Parenting Stress Index: Short Form (PSI-SF). The RAND-36 = health-related quality of life (HRQoL) survey instrument, The Parent Implementation Rating Form (PIRF), FITT Fidelity Forms, Parent Feedback Form.	
Penney and Schwartz (2019)	USA	A multiple baseline design: pre-post intervention.	3	48 – 65 (M = 57.66)	66.6	Social initiation	Fidelity, and satisfaction.	Videos coding – observation.	RIT fidelity form = video coding + Inter observer agreement, satisfaction survey.	
Sengupta et al. (2020)	India	Quasi-experimental pre-posttest design.	57	12 – 72 (M = 43.2)	84	Social engagement, expressive language, and social initiation.	Stress, fidelity, and satisfaction.	The Social Communication Checklist.	Video coding for parents' Fidelity of Implementation, A Family Satisfaction Survey, The Parenting Stress Index-Short Form (PSI-SF)-3rd ed.	
Liao et al. (2022)	USA	A multiple baseline design: pre-posttest-follow-up.	3	60 – 180 (M = 104)	100	Social communication skills	Fidelity.	Video coding – Observation.	Video coding - Observation.	
Meadan et al. (2016)	USA	A multiple-baseline design: pre-post intervention.	3	24 - 48 (M = 36)	66.6	Social initiation and responsive communication skills,	Fidelity, and satisfaction.	Video coding – Observation.	A fidelity checklist, interviews.	
Shire et al. (2017)	USA	RCT: pre-posttest-follow-up.	85 (PEI = 42)	> 36 (M = 31)	82	Joint engagement and language.	Fidelity.	Video coding, The Mullen Scales of Early Learning (MSEL).	The Maternal Behavior Rating Scale (MBRS), JASPER strategy use -Video coding.	
Hernandez-Ruiz (2018)	UK	A pilot study: pre-posttest design.	3	30 – 36 (M = 33)	66.6	Social interaction skills, Eye contact, social engagement, turn taking, and verbal reciprocity.	Stress, fidelity, self-efficacy, and perception.	The Social Responsiveness Scale-2 (SRS-2).	Parental Sense of Competence, K-6 Scale/ For parents' mental health, Survey.	
Rollins et al. (2016)	USA	A Multiple-baseline design: pre-post intervention.	4	28 -33 (M = 30.25)	100		Fidelity, and perception.	Video coding – Observation – Interobserver agreement.	Parents fidelity checklist, questionnaire.	

Study	Country	Research design	Participants with ASD			Dependent variables			Measures	
			Total N (control group)	Age months (Mean)	Male %	Child	Parent	Child	Parent	Child
Sengupta et al. (2021)	India	Mixed methods: pre-posttest design.	22	24 – 108 (M = 61.95)	86.3	Communication, social interaction, and adaptive behavior.	Stress, fidelity, and perception.	Vineland Adaptive Scales (VABSII), Social Communication Checklist (SCC), Video coding.	The Adult-Child Interaction Fidelity Scale (video coding), The Caregivers Skills, and Knowledge Measure (WHOCST Team), The Parenting Stress Index-Short Form (PSLSEF)—3 rd ed.	
Glumbic et al. (2022)	Serbia	A pilot: pre-posttest design.	36	48 – 102 (M = 71.52)	69.4	Speech, Language and Communication skills.	Perception.	The Autism Treatment Evaluation Checklist (ATEC).	Caregivers Feedback Form.	
Green et al. (2017)	UK	RCT: pre-posttest-follow-up design.	54 (control = 26)	9 – 36 (M = 22.5)	NR	Communication, language, and ASD symptoms.	Not Reported	The Autism Diagnostic Observation Schedule 2 nd ed., Manchester Assessment of Caregiver-Infant Child Interaction (MACI), The Dyadic Communication Measure for Autism (DCMA), The Mullen Scales of Early Learning (MSEL), Vineland Adaptive Behavior Scales (VABSII).	-	
Manohar et al. (2019)	India	RCT: pre-posttest-follow-up design.	50 (control = 24)	24 – 72 (M = 42.6)	84	Imitation skills, visual response, communication, and ASD severity symptoms.	Stress, fidelity, and perception.	The Childhood Autism Rating Scale (CARS), Vineland Social Maturity Scale.	Family Interview for Stress and Coping (FISC), 10 Point Visual Analog Scale for Parental and Child-Related Outcome Measures, Fidelity survey.	
Brian et al. (2016)	Canada	A multi-site pilot study: pre-post-follow-up design.	20	12 – 32 (M = 22.05)	70	Communication skill (responsivity, initiations), and language skills.	Fidelity, and satisfaction.	The Autism Observation Scale for Infants (AOSI), The Mullen Scales of Early Learning (MSEL), video coding.	Fidelity = video coding, satisfaction questionnaire.	
Youn Kang and Kim (2020)	USA	A multiple baseline design: pre-post intervention – follow-up.	3	36 – 84 (M = 56)	100	Verbal and non-verbal initiations, and responses skills.	Satisfaction.	Video coding – Observation, The Developmental Play Assessment (DPA).	Social validity questionnaire.	

Study	Country	Research design	Participants with ASD				Dependent variables		Measures	
			Total N (control group)	Age months (Mean)	Male %		Child	Parent	Child	Parent
Schertz et al. (2013)	USA	RCT: Pre-posttest-follow-up design.	23 (control = 12)	> 30 (M = 24.6)	NR		Joint intention, receptive language, and social skills.	Fidelity.	The Precursors of Joint Attention Measure (PJAM), Video coding for parent-child interaction, the Mullen Scales of Early Learning (MSEL), the Vineland Adaptive Behavior Scales (VABS).	The Fidelity Checklist.
Schertz et al. (2018)	USA	RCT: Pre-posttest-follow-up design.	144 (control = 71)	16 – 30 (M = 24.55)	79.4		Preverbal social communication	Fidelity.	Video coding, the Communication and Symbolic Behavior Scales (CSBS).	Parent Implementation Fidelity Checklist, the Maternal Behavior Rating Scale Revised (MBRS-R).
Rogers et al. (2019)	USA	RCT: pre-posttest-follow-up.	45	12 – 30 (M = 25.2)	68.8		Social, adaptive behavior, and ASD severity.	Fidelity, and Satisfaction.	Video coding Interobserver agreement, Early Screening of Autistic Traits Questionnaire (ESAT), Infant Toddler Checklist (ITC), The Modified Checklist for Autism in Toddlers (M-CHAT), The Autism Diagnostic Observation Scale for Toddlers (ADOS-T), Mullen Scales of Early Learning, Vineland Adaptive Behavior Scales (VABS II), Child Behavior Checklist for 1–5 Years (CBCL), Child Intervention History (Version 6-10-13).	The ESDM Fidelity Rating System, Parent Satisfaction Survey.
Killmeyer et al. (2019)	USA	A multiple-baseline: pre-posttest-follow-up design.	3	27 – 34 (M = 31)	100		Eye contact	Fidelity, and satisfaction.	The Communication and Symbolic Behavior Scales Developmental Profile-ITC (CSBS DP-ITC), the Mullen Scales of Early Learning (MSEL), the Early Learning Composite (ELC), Videos coding – observation.	Implementation fidelity form, parent satisfaction form.
Wainer and Ingersoll (2013)	USA	A multiple-baseline design: pre-posttest intervention.	8 (therapist = 5, parents = 3)	26 – 88 (M = 58)	100		Social imitation skills.	Fidelity, and satisfaction.	Video coding – observation, Inter-Observer agreement, the Behavioral Intervention Rating Scale (BIRS).	RIT fidelity form, treatment acceptability questionnaire.

Study	Country	Research design	Participants with ASD			Dependent variables			Measures	
			Total N (control group)	Age months (Mean)	Male %	Child	Parent	Child	Parent	
Carter et al. (2011)	USA	RCT; pre-posttest-follow-up.	62 (control = 30)	15 – 25 (M = 20.25)	82.2	Communication skills and object interest.	Fidelity, and satisfaction.	The Screening Tool for Autism in Two-Year-Olds (STAT), The Mullen Scales of Early Learning (MSEL), The Vineland Adaptive Behavior Scales, 2 nd , The Autism Diagnostic Observational Schedule (ADOS), The Early Social Communication Scales (ESCS), The Developmental Play Assessment (DPA).	Parent Interview for Autism–Clinical Version (PIA-CV), The Parent–Child Free Play Procedure (PCFP) Video coding, Fidelity of Treatment Implementation (FOT), A Consumer Satisfaction Survey, A Non-Project Treatment Questionnaire.	
Bagaiolo et al. (2017)	Brazil	Quasi- experimental: pre-posttest design.	67 (control = 33)	36 – 72 (M = 57.72)	82.1	Eye contact, joint attention, and disruptive behavior.	Fidelity.	The Brazilian version of the ADI-R SON-R 212-7-IQ, the Autism Behavior Checklist (ABC), the Vineland Adaptive Behavior Scales, the Child Behavior Checklist (CBCL), SNAP-IV Rating Scale to evaluate attention-deficit hyperactivity disorder (ADHD), The Adult Self-Report Scale (ASRS-18).	Questionnaire.	
Laugesson et al. (2009)	USA	RCT; pre-posttest design.	33 (control = 16)	156 – 204 (M = 175.2)	84.8	Social skills	-	Vineland Adaptive Behavior Scales (VABSII), Social Skills Rating Scale (SSRS), The Quality of Play Questionnaire (QPQ), Test of Adolescent Social Skills Knowledge (TASSK), Friendship Qualities Scale (FQS).	-	
Solomon et al. (2007)	USA	A Polit study: pre-posttest design.	68	24 – 84 (M = 44.4)	75	Social- emotional functional skills.	Satisfaction.	The Functional Emotional Assessment Scale (FEAS), Video coding-observation.	Client satisfaction survey.	
Nefdt et al. (2010)	USA	RCT; pre-posttest design.	27 (control = 14)	60 < (M=38.92)	92.6	Functional verbal utterances.	Fidelity, and satisfaction.	Video coding – observation.	Video coding – observation, questionnaire.	
Klein et al. (2021)	USA	RCT; pre-posttest design.	15	24 – 28 (M = 26.84)	66.6	Social communication, adaptive skills, and severity of ASD.	Fidelity, and satisfaction.	The Brief Observation of Social Communication Change (BOSCC), The Mullen Scales of Early Learning (MSEL), The Vineland Adaptive Behavior Scales (VABSII + III).	Caregiver VF survey, Video coding – observation.	

Table 2
Intervention details

Study	Intervention approach		Intervention		Intervention outcomes	
	Intervention approach	Intervention format	Duration	Setting	Child	Parent
Ingersoll et al. (2016)	Improving Parents as Communication Teachers (ImPACT).	Online ImPACT: Self-Directed (SD) vs Therapist-Assisted group (TAG)	1h15mins (SD) vs 3h 45mins (TAG) weekly 12/24 weeks.	Online	Both groups showed significant improvement on language skills, and only children in TAG showed significant improvement on social skills and maintained at follow-up. No effect on motor and daily living skills.	TAG group showed higher fidelity and positive perceptions than SDG. Also, parents in both groups showed self-efficacy and less stress on the post-test (no differences).
Snadnick et al. (2015)	ImPACT	ImPACT group received individual didactic instruction vs Community based-services group.	1h weekly session/ 12 weeks.	Center	Significant improvement in communication skills over TAU.	Decrease in Parental stress due to changes in child's social skills
Roberts et al. (2011)	Building Blocks	Centre-based program (CB) = six play training groups vs Home-based program (HB) = Individual visits vs non-treatment group (WL).	2h – 20 weekly sessions (HB)/ 40 weeks (CB).	Home + Center.	Both groups showed significant increase in social interaction, and language skills, however, Children in the CB group improved significantly more than HB and WL groups on some social and communication measures.	Parent in CB group making the most gains in perception of competence and quality of life and decrease in stress over HB and WL groups.
Béan et al. (2022)	The Social ABCs.	Individual in-home training on The Social ABCs program.	1.5h - 12 weeks training/ 24 weeks.	Home	Significant improvements in language and functional communication skills and decrease in ASD symptoms.	High fidelity which was associated with their toddlers' outcomes.
Tripathi et al. (2022)	The Program for the Education and Enrichment of Relational Skills (PEERS [®])	Parents and children received group training (8-10) using PEERS curricula (adapted version).	1.5h weekly session/ 16 weeks.	Clinic	Significant improvements and maintained the social and play skills after 1-5 years of intervention, and post-treatment improvements on behavioral problem, but did not maintain at follow up.	Decrease in parental stress but was not maintained at follow-up.
Shire et al. (2022)	Joint Attention, Symbolic Play, Engagement and Regulation intervention (JASPER)	Individual and group training for both JASPER with coaching only vs JASPER with observation and coaching.	2h weekly sessions/ 12 weeks.	Home + Center	No difference between both groups, all participants showed significant growth in joint engagement, play diversity, and joint attention.	Both groups showed significant gains in strategy use. Practitioners showed high fidelity in both groups.
Li, Xu et al. (2022)	ImPACT	Group training on online ImPACT program vs waitlist group.	1.5h weekly session/ 8 weeks.	Online	Significant improvements on social communication, and sociability skills in favor ImPACT group, and no significant effects on language.	Decrease in parental stress and high self-efficacy over WLG, no significant effect on parent satisfaction.
Wainer et al. (2021)	Reciprocal Imitation Training (RIT).	Individual RIT online training vs treatment as usual (TAU).	6-10 weeks training/ 15 weeks (Time NR).	Online	Significant improvements on social skills over TAU group, no difference in imitation skills.	High acceptability and feasibility of the Online RIT digital intervention, no difference between groups in imitation ability and family quality of life, parents in IG showed higher fidelity and self-efficacy.

Study	Intervention approach		Intervention		Intervention outcomes		
	Intervention format		Duration		Setting	Child	Parent
Stahmer et al. (2020)	ImPACT	Individual training on ImPACT program vs Usual Care group (UCG).	2.5h weekly sessions/ 12 weeks.	Home + center	Home + center	Significant improvement in social communication skills over UCG, no significant difference in adaptive skills. Also, significant improvements in positive parent-child interactions in favor of ImPACT group.	ImPACT group shows higher fidelity, supportive parenting behavior, and engagement in the intervention. No difference in social support.
Ingersoll and Wainer (2013b)	ImPACT	Group and individual training on ImPACT strategies.	2h - 45mins weekly/ 16 weeks.	Special school	Special school	Significant improvement in language and social engagement skills, decrease of social impairment, and no effect on imitation and play skills.	High fidelity and decrease in parental stress.
Prelock et al. (2011)	More Than Words (MTW)	Group training MTW strategies + home visit to assess child's skills vs Joint Attention Training (JAT) to assess professionals' impressions about collaborating with families.	2.5h / 8 sessions/ 16 weeks.	School + Home	School + Home	All participants increased their social interaction and vocabulary development.	High satisfaction and positive perspective about the intervention (MTW). Interventionist impressions were positive about collaborating with families to select intervention approach (JAT).
Yoder et al. (2021)	ImPACT	Individual in-home training on ImPACT program vs control group.	5h weekly sessions/ 12 weeks/	Home	Home	Improvements on children intentional communication, expressive language, and play. No effects on motor skills.	Increased the use and generalization of ImPACT strategies.
Turner-Brown et al. (2019)	Family Implemented TEACCH for Toddlers (FITT).	20 individually in-home training sessions + 4 clinic group sessions on TEACCH strategies (adapted) vs Treatment as Usual group (TAU).	1.5h - 24 sessions/ 24 weeks.	Home + clinic	Home + clinic	Significant effects on social communication skills particularly higher score on imitation skills of ASD over CG. No effects on general child measures.	Significant decrease in stress, improved well-being over time and high fidelity.
Penney and Schwartz (2019)	Reciprocal Imitation Training (RIT)	Individual training on Reciprocal imitation training (RIT) + group training = 90 minutes for once.	1.5h + 1h 40 mins weekly/ 6 weeks.	Home	Home	All three children increased in social imitation.	Parents met the fidelity after training and were satisfied with program implementation.
Sengupta et al. (2020)	ImPACT	Group training on adapted ImPACT (2h - 6 weeks) + individual coaching in-home sessions (1h a week).	2h- weekly session/ 6 weeks.	Home + center	Home + center	Significant Increased in social communication (social engagement, expressive language form and function, understanding and following directions, and social imitation), particularly, social engagement.	High fidelity and satisfaction and decrease in the stress.
Liao et al. (2022)	Multimodal communication intervention.	2h webinar group training + individual training sessions on behavioral strategies e.g., prompting, reinforcement, modeling.	2h + (6.5 -19.6 mins a session) 12 -13 sessions /6 weeks.	Online + home.	Online + home.	Improvements in social communication skills (requesting, asking questions, and spontaneous comments).	Parents learned intervention strategies – positive moderate correlation between parents' implementation and children's outcomes.
Mendan et al. (2016)	Internet-Based Parent-Implemented Communication Strategies (I-PCS).	Online training (Sloype)- iPCS, with provision feedback to implement 3 naturalistic teaching strategies: (1) modeling, (2) mand-model, and (3) time delay.	45 mins + 1h weekly sessions / 14 weeks.	Online	Online	Increased social initiation and responsive communication skills for all participants with ASD.	Parents learned the strategies of intervention with fidelity after receiving skype training, and high satisfaction with intervention.

Study	Intervention approach	Intervention		Intervention outcomes		
		Intervention format	Duration	Setting	Child	Parent
Shire et al. (2017)	Joint attention, symbolic play, engagement, and regulation (JASPER)	Individual training on JASPER strategies vs psychoeducation program (PEI).	1h weekly session/ 10 weeks.	Center	All participants in JASPER group achieved significant improvement on joint engagement over PEI group. No differences on development level (MSEL).	JASPER group showed high responsivity and fidelity and maintained after 6 months over PEI group. Parent responsivity was associated with child joint engagement.
Hernandez-Ruiz (2018)	Early Start Denver Model (ESDM)	Group music therapy training based on the P-ESDM to coach parents in the use behavioral strategies.	2h weekly sessions/ 6 weeks.	Clinic	Improvements in social interaction skills for all children.	High efficacy -learned the principles of ESDM, showed high competence, 2 mothers showed decrease in stress, one mother no change (no stress in pre-posttest). Also, mothers rated the intervention as acceptable and enjoyable.
Rollins et al. (2016)	Early Identification and Intensive Behavioral and Developmental Intervention (EIBDI).	In-home individual visits by therapist to coach parents on EIBDI strategies (6 units).	1.5h weekly - 16 sessions/ 8 weeks.	Home	3 out of 4 participants showed moderate to high increase in eye contact, social engagement, and verbal reciprocity but only 2 children improved in nonverbal turn taking.	High fidelity and positive perception about intervention.
Sengupta et al. (2021)	World Health Organization (WHO) program.	The WHO-CST program consists of 2h- 9 group sessions, and 3h- 3 home visits to promote child learning and development through parent-child home activities and play routines.	2-3h – 12 sessions/ 12 weeks.	Home + special school	Participants showed significant improvements in communication, social interaction, and adaptive behavior (daily living skills).	High attendance, and fidelity, and rated the program as feasible, increased in their knowledge and skills, and decrease in level of stress.
Glumbic et al. (2022)	World Health Organization (WHO) program.	The WHO-CST program consists of 2h- 9 group sessions, and 3h- 3 home visits to promote child learning and development through parent-child home activities and play routines.	2-3h – 12 sessions/ 12 weeks.	Home + special school	Significant improvement in Speech, Language and Communication skills.	Parents rated the program positively and useful and increased their knowledge.
Green et al. (2017)	iBASIS-Video Interaction for Promoting Positive Parenting (iBASIS-VIPP)	iBASIS-Video Interaction for Promoting Positive Parenting (iBASIS-VIPP) is in-home training, uses video-aided feedback therapy to help parents of ASD to understand and adapt to their infant's communication style.	12 sessions/ 20 weeks (time NR).	Home	Significant improvement in attention and communication initiation skills, and maintained at follow up, decrease in ASD symptoms, and no effect on language.	NR
Manchar et al. (2019)	Naturalistic Developmental Behavioral Interventions (NDBI)	Individual five home visits by therapist to coach parents on the use of NDBI strategies.	5 sessions/ 12 weeks (time-NR).	Home	Significant improvements on imitation skills, visual response, communication, and decrease in ASD severity symptoms over control group – and maintained in follow-up.	High fidelity, significant decrease in parental stress, and rated the intervention as acceptable and feasible.
Brian et al. (2016)	The Social ABCs	Individual in-home training consists of 8 weeks vivo coaching + 4 weeks consultation through email or phone, and 12 weeks implementation without assistance.	1-1.5h- 12 weeks training/ 24 weeks.	Home	Significant improvements on functional communication skill and language skills but did not maintain the skills at follow-up.	High fidelity and satisfaction.

Study	Intervention approach	Intervention		Intervention outcomes		
		Intervention format	Duration	Setting	Child	Parent
Youn Kang and Kim (2020)	Social stories and Self-modeling	Individual in-home training on using social stories and self-modeling through play activities.	3-4 weekly sessions/ 8 weeks.	Home	Significant improvements in verbal and non-verbal initiations, responses skills and maintained the gains at the follow-up.	High satisfaction.
Scherz et al. (2013)	Joint Attention Mediated Learning (JAML)	Individual in-home training on JAML strategies including focusing, planning, encouraging, giving meaning, and expanding.	30 mins daily + 15 home visits/ 12 weeks.	Home	Participant in JAML group showed significant improvement in joint intention, receptive language, and social skills and maintained the skills at follow-up.	High fidelity.
Scherz et al. (2018)	Joint Attention Mediated Learning (JAML)	Individual in-home training on JAML strategies.	1h – weekly sessions/ 32 weeks.	Home	Significant improvement on preverbal social communication and maintained the outcomes after 6- months.	High fidelity.
Rogers et al. (2019)	Early Start Denver Model (ESDM).	P-ESDM – received 1.5h - 12 weekly clinic visits vs P-ESDM++ - received additional procedures motivational interviewing, multimodal learning tools, and extra 1.5-h home visits weekly for 12 weeks.	1.5h – (12 – 24) sessions/ 12 weeks.	Clinic + home	Both groups showed significant decrease in ASD severity, and significant improvement in social, and adaptive behavior.	P-ESDM ++ group showed more significant interaction skills than basic group. Also, both groups showed high satisfaction, and fidelity (no difference) Positive correlation between parental fidelity and children's improvements.
Killmeyer et al. (2019)	Reciprocal Imitation Training (RIT)	Individual training on contingent imitation (CI) strategies including didactic teaching, responding to their questions, modeling the technique with parents' observation, and feedback.	45 mins – 3 weekly sessions/ not specific.	Home	Two children showed high increase and one with moderate in their social eye gaze and maintained at follow-up.	High fidelity and satisfaction.
Wainer and Ingersoll (2013)	Reciprocal Imitation Training (RIT)	2 weeks RIT online training through university software (self-directed). Post training: parents receive live coaching at home by experts if they are unable to reach the fidelity.	2 weeks training + 40 mins - 12 sessions/ 4 weeks.	Online	High increase in social imitation skills.	Parents and therapists met the fidelity, learn the techniques, and were satisfied with the intervention, and rated the program as useful and acceptable.
Carter et al. (2011)	More than Words' (MTW)	HMW training consists of 8 group sessions with parents only + 3 in-home individualized parent-child sessions to increase playful parent- child interactions.	11 sessions/ 14 weeks – time not specific.	Center + home.	Moderate increase in communication skills and object interest at post-intervention and moderate decrease at the follow-up.	High fidelity and satisfaction.
Bagaiolo et al. (2017)	Video modeling based on applied behavior analysis (ABA).	Group training including 14 videos created by clinicians covering management of disruptive behaviors, eye contact and joint attention to be implemented at home – one video a week (14 sessions) + 8 sessions to discuss parents doubts about the videos.	1.5h – 22 sessions/ 12 weeks.	Clinic	Improvement in eye contact and joint attention and decrease in disruptive behavior.	Parents learned to use a teaching strategy, and the technique was feasible.

Study	Intervention approach	Intervention		Intervention outcomes		
		Intervention format	Duration	Setting	Child	Parent
Laugeson et al. (2009)	PEERS	Parents and teens received group training on adapted social skills program (PEERS) for teens.	1.5h -12 weekly sessions/ 12 weeks.	Clinic	Significant improvements in their knowledge of social skills, increased frequency of hosted get-togethers, and improved overall social skills over the control group.	NR
Solomon et al. (2007)	The PLAY Project Home Consultation (PPHC)	One day workshop about play-based on DIR/Floortime model + 15h weekly one to one interaction with their child through daily routines. Also, 3-4h monthly home visits.	3- 4h monthly visit + 15h weekly / 48 weeks.	Home	Significant increase in social- emotional functional skills, no effects on ASD severity.	High satisfaction.
Neff et al. (2010)	Pivotal Response Treatment (PRT)	Self-directed learning program (SDLP) based on pivotal response treatment (PRT) through DVD, which was sent by mail.	66 mins each video/ NR.	Home	Significant increase functional verbal utterances over control group.	High fidelity and satisfaction.
Klein et al. (2021)	Naturalistic developmental behavioral interventions (NDBI)- Video Feedback (VF).	Both groups showed significant improvements in social communication skills, adaptive skills, and a decrease of severity of ASD. However, NDBI+VF achieved additional gains on adaptive behavior and behavioral problems.				

3.1 STUDIES DESCRIPTIONS

3.1.1 COUNTRY OF PUBLICATION

Most of these studies were carried out in the USA (67.6%), Canada (8.1%), India (8.1%), the United Kingdom (UK) (5.4%), Australia (2.7%), Brazil (2.7%), Serbia (2.7%), and China (2.7%).

3.1.2 PARTICIPANTS

A total of 1,119 children in the intervention group and 427 in the control group, with a mean age of 43.80 months and gender distribution (male = 78.66%)—three studies did not report the gender (Green et al., 2017; Schertz et al., 2013; Shire et al., 2022)—were included in this review. Most of these children were diagnosed with ASD (n = 1,029; 91.96%) or were at risk of ASD (n = 90; 8.04%) (Green et al., 2017; Killmeyer et al., 2019; Stahmer et al., 2020; Yoder et al., 2021). The total number of primary parents/caregivers was higher because of the participation of both parents in the intervention group (1,162: mothers = 92.94%, fathers = 5.85%, other caregivers = 1.21%). Caregivers' age was reported in 13 studies (mean age = 36.178 years); level of education was reported for only 888 caregivers in 26 studies (less than college = 29.28%; college or above = 70.72%). Also, one family had two children with ASD (Ingersoll & Wainer, 2013b).

3.1.3 SETTING

Five studies took place in an online format (Ingersoll et al., 2016; Li, Wu et al., 2022; Meadan et al., 2016; Wainer et al., 2021; Wainer & Ingersoll, 2013), and at home (Liao et al., 2022); six studies were conducted at a center/clinic (Bagaiolo et al., 2017; Hernandez-Ruiz, 2018; Laugeson et al., 2009; Shire et al., 2017; Stadnick et al., 2015; Tripathi et al., 2022), and at home (Carter et al., 2011; Klein et al., 2021; Roberts et al., 2011; Rogers et al., 2019; Sengupta et al., 2020; Shire et al., 2022; Stahmer et al., 2020; Turner-Brown et al., 2019), or at a special school (Ingersoll & Wainer, 2013b), and at home (Glumbic et al., 2022; Prelock et al., 2011; Sengupta et al., 2021); the rest of the studies were conducted solely in home settings.

3.1.4 RESEARCH DESIGN

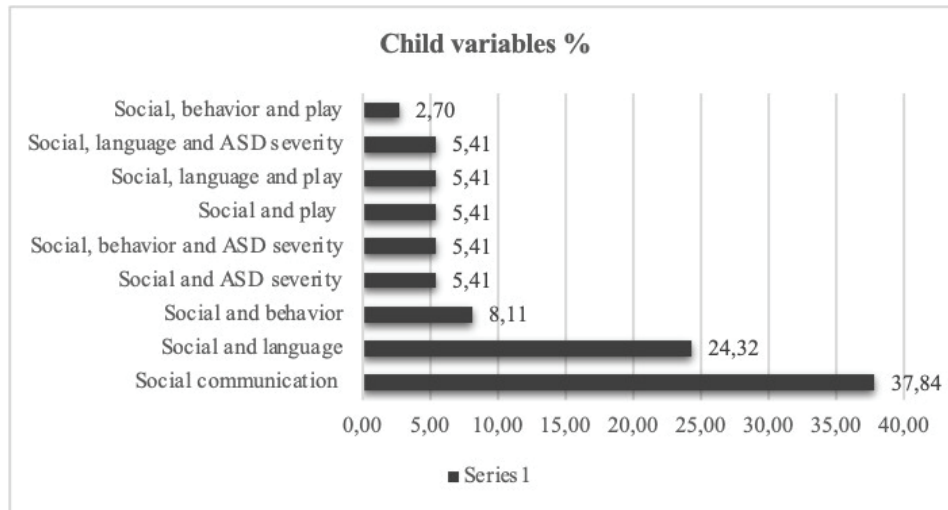
Ten out of 37 studies were conducted using randomized control trials (RCTs) with a pre-posttest-follow-up design, and five were RCTs with only a pre-posttest design. Additionally, nine were pilot studies with a pre-post-test design and follow-up (Brian et al., 2016; Tripathi et al., 2022), and two were pilot randomized studies with a pre-posttest-follow-up design (Ingersoll et al., 2016; Shire et al., 2022). Seven studies used an experimental method with a multiple baseline design; three were quasi-experimental with a pre-posttest design (Bagaiolo et al., 2017; Sengupta et al., 2020) and a follow-up (Stahmer et al., 2020); and one was conducted with a mixed-method pre-posttest design (Sengupta et al., 2021). Furthermore, 15 studies were conducted with a control group, and five with a comparison group, such as online ImPACT therapist-assisted vs. self-directed (Ingersoll et al., 2016), or comparing three groups: center-based program vs. home-based program vs. waitlist group (Roberts et al., 2011), or JASPER training vs. psycho-education (Shire et al., 2017), or Parent-Early Start Denver

Model (P-ESDM) vs P-ESDM++ (received additional procedures) (Rogers et al., 2019), or JASPER coaching vs. observe with coaching (Shire et al., 2022), or Naturalistic Developmental Behavioral Intervention (NDBI) vs. NDBI with Video Feedback (VF) (Klein et al., 2021).

3.1.5 DEPENDENT VARIABLES

Child variables. Four studies targeted social communication skills in general (Hernandez-Ruiz, 2018; Laugeson et al., 2009; Stadnick et al., 2015; Wainer et al., 2021), or targeted specific skills such as social imitation (Penney & Schwartz, 2019; Wainer & Ingersoll, 2013b), or eye contact (Killmeyer et al., 2019), and social engagement, turn-taking, and verbal reciprocity (Rollins et al., 2016), social-emotional functional skills (Solomon et al., 2007), or preverbal social communication (Schertz et al., 2018), or functional verbal utterances (Nefdt et al., 2010), or initiation skills (Meadan et al., 2016; Youn Kang & Kim, 2020), or requesting, asking questions, and spontaneous comments (Liao et al., 2022), or both social communication and ASD severity (Turner-Brown et al., 2019). Eleven studies assessed both social communication and language skills (Brian et al., 2016; Glumbic et al., 2022; Ingersoll et al., 2016; Li, Wu et al., 2022; Prelock et al., 2011; Roberts et al., 2011; Schertz et al., 2013; Sengupta et al., 2020; Shire et al., 2017) and the severity of ASD (Brian et al., 2022; Green et al., 2017).

Some studies examined social and behavioral skills (Sengupta et al., 2021; Stahmer et al., 2020) and ASD severity (Klein et al., 2021; Rogers et al., 2019), or social, play, and behavioral skills (Tripathi et al., 2022), or joint engagement, play, and joint attention (Shire et al., 2022), or social engagement, language, imitation, and play skills (Ingersoll & Wainer, 2013b), or intentional communication, expressive language, play, and motor skills (Yoder et al., 2021), or visual response, imitation skills, and ASD severity (Manohar et al., 2019), or communication and object interest (Carter et al., 2011), or eye contact, joint attention, and disruptive behavior (Bagaiolo et al., 2017). Figure 2 shows the percentage of child variables targeted in these studies.

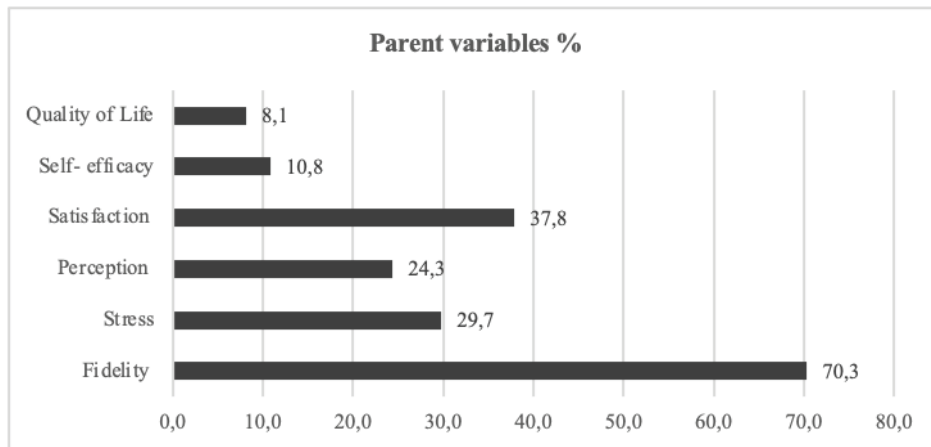
Figure 2*Percentage of child variables*

Accessibility note: Horizontal bar graph in gray. The vertical axis shows the variables and the horizontal axis shows the percentage scale from 0 to 40: “Social, behavior and play”, 2.70; the variables “Social, language and ASD severity”, “Social, language and play, Social and play, “Social, behavior and ASD severity” and “Social and ASD severity”, 5.41 each; “Social and behavior”, 8.11; “Social and language”, 24.32 and “Social communication”, 37.84.

Parent variables. Seven studies targeted only parental fidelity, and ten studies targeted both parental fidelity and satisfaction. Two studies only examined parental stress (Stadnick et al., 2015; Tripathi et al., 2022), or satisfaction (Prelock et al., 2011; Solomon et al., 2007; Youn Kang & Kim, 2020), and stress (Ingersoll & Wainer, 2013b), and self-efficacy (Li, Wu et al., 2022). One study examined only parents’ perception (Glumbic et al., 2022), and fidelity (Rollins et al., 2016), and stress (Manohar et al., 2019; Sengupta et al., 2021), and self-efficacy (Hernandez-Ruiz, 2018; Ingersoll et al., 2016).

Another study examined perception, stress, and quality of life (Roberts et al., 2011), or fidelity, perception, self-efficacy, and quality of life (Wainer et al., 2021), or stress, fidelity, and quality of life (Turner-Brown et al., 2019). Still another study examined fidelity, parent-child interaction, and social support (Stahmer et al., 2020). Two studies did not report parental variables (Green et al., 2017; Laugeson et al., 2009). Figure 3 shows the percentage of parent variables.

Figure 3
Percentage of parent variables



Accessibility note: Horizontal bar graph in gray. The vertical axis shows the variables and the horizontal axis shows the percentage scale from 0 to 80: “Quality of Life”, 8.1; “Self-efficacy”, 10.8; “Satisfaction”, 37.8; “Perception”, 24.3; “Stress”, 29.7 and “Fidelity”, 70.3.

3.1.6 MEASURES

Child measures. These studies used several assessment tools to evaluate participants’ social communication skills, including observation (video coding) (n = 15), the Social Communication Checklist (n = 4), the Social Responsiveness Scale (n = 4), the Communication Symbolic Behavior Scale (n = 4), the Early Social Communication Scales (ESCS) (n = 2), and the Brief Observation of Social Communication Change (BOSCC) (n = 2). Some studies evaluated behavioral skills using the Vineland Adaptive Behavior Scales (VABS-II; III) (n = 11), the Developmental Behavior Checklist (DBC) (n = 1), the SNAP-IV Scale for ADHD (n = 1), or the Child Behavior Checklist for ages 1-5 (CBCL) (n = 2).

Most of these studies evaluated language abilities using the Mullen Scales of Early Learning (MSEL) (n = 12) or the MacArthur-Bates Communicative Inventory (MCDI) (n = 4). Some studies assessed play skills using the Quality of Play Questionnaire (n = 2), structured play assessment (n = 1), or Developmental Play Assessment (n = 3). In addition, some studies used official tools to assess ASD severity, including the Autism Diagnostic Observation Schedule (n = 5) and the Autism Treatment Evaluation Checklist (n = 2). The remaining studies used different assessment tools to evaluate child outcomes, as shown in Table 1.

Parents measures. Most of these studies assessed parents’ fidelity using observations (n = 10) and/or fidelity checklists or surveys (n = 17), such as the ImPACT checklist, RIT parent fidelity form, or FITT fidelity form. Sengupta et al. (2021) evaluated parents’ fidelity through caregiver-child interaction videos using the Adult-Child Interaction Fidelity Scale and the caregivers’ skills, and knowledge measure (WHO-CST Team) to assess parents’ knowledge. Also, parental self-efficacy was assessed using the Parent Sense of Competence Scale (PSOC) (Hernandez-Ruiz, 2018; Ingersoll et al., 2016), the Parental Self-efficacy of Competence

Scale (Li, Wu et al., 2022), and the Early Intervention Parenting Self-Efficacy Scale (EIPSES) (Wainer et al., 2021). Questionnaires and surveys were used to explore parents' perceptions of interventions, such as the Family ImPACT Questionnaire (FIQ) (Ingersoll et al., 2016) or the Parent Feedback Form (Glumbic et al., 2022; Turner-Brown et al., 2019).

Studies that targeted parental stress used the Parenting Stress Index-Short Form (PSI) ($n = 7$), the Center for Epidemiological Studies-Depression Scale (CES-D) (Stadnick et al., 2015), the K-6 scale for parent mental health (Hernandez-Ruiz, 2018), or the Family Interview for Stress and Coping (FISC) (Manohar et al., 2019). Studies that assessed family quality of life used the Beach Family Quality of Life Scale (FQOL) (Roberts et al., 2011; Wainer et al., 2021) or the RAND-36 Health-related Quality of Life (HRQOL) (Turner-Brown et al., 2019).

Parents' satisfaction was evaluated using satisfaction surveys ($n = 11$), interviews (Meadan et al., 2016), or both (Prelock et al., 2011), or satisfaction sub-scale of the Parental Self-efficacy of Competence Scale (Li, Wu et al., 2022). Only one study assessed the level of social support using the Social Support Index (Stahmer et al., 2020). Some studies evaluated parent-child interaction using the Parent Participatory Engagement Measure (Stahmer et al., 2020), Caregiver-Child Interaction (CCX) (Shire et al., 2022), and the Maternal Behavior Rating Scale (MBRS) (Schertz et al., 2018; Shire et al., 2017).

3.2 INTERVENTION DETAILS

3.2.1 INTERVENTION PROGRAMS

These studies were conducted using several intervention programs, including Improving Parents as Communication Teachers (ImPACT) program ($n = 7$; 18.9%), Reciprocal Imitation Training (RIT) program ($n = 4$; 10.8%), the Program for the Education and Enrichment of Relational Skills (PEERS) ($n = 2$; 5.4%), Naturalistic Developmental Behavioral Interventions (NDBI) ($n = 2$; 5.4%), Joint Attention Mediated Learning (JAML) ($n = 2$; 5.4%), the Social ABCs ($n = 2$; 5.4%), Joint Attention, Symbolic Play, Engagement and Regulation intervention (JASPER) ($n = 2$; 5.4%), Hanen's More Than Words (HMTW) ($n = 2$; 5.4%), Parent-Mediated Early Start Denver Model (P-ESDM) ($n = 2$; 5.4%), the World Health Organization (WHO) program ($n = 2$; 5.4%), video modeling based on Applied Behavior Analysis (ABA) ($n = 1$; 2.7%), social stories and video self-modeling ($n = 1$; 2.7%), Family Implemented TEACCH for Toddlers (FITT) ($n = 1$; 2.7%), Building Blocks Program ($n = 1$; 2.7%), Early Identification and Intensive Behavioral and Developmental Intervention (EIBDI) ($n = 1$; 2.7%), Pivotal Response Treatment (PRT) ($n = 1$; 2.7%), Multimodal Communication Intervention ($n = 1$; 2.7%), Internet-Based Parent-Implemented Communication Strategies [i-PiCS] ($n = 1$; 2.7%), iBASIS-Video Interaction for Promoting Positive Parenting (iBASIS-VIPP) ($n = 1$; 2.7%), and The PLAY Project Home Consultation (PPHC) ($n = 1$; 2.7%).

3.2.2 INTERVENTION INTENSITY

The total time of intervention sessions was approximately 1,487 hours ($M = 46$ hours). However, the weekly intervention session time ranged from 1h to 5h ($M = 2\text{h/week}$; $n = 31$). Most of these studies conducted weekly sessions lasting from 1h to 2.5h/week ($n = 27$);

some studies lasted from 3h to 5h/week ($n = 4$), and the longest weekly session time was 15h/week (Solomon et al., 2007).

Five studies did not report the duration of the intervention sessions (Carter et al., 2011; Green et al., 2017; Manohar et al., 2019; Wainer et al., 2021; Youn Kang & Kim, 2020). The total period of intervention was 565 weeks ($M = 16$ weeks). Most of these studies had a total intervention period of 12 weeks ($n = 11$) or 20–24 weeks ($n = 6$). The longest duration of intervention was between 40 and 48 weeks (Roberts et al., 2011; Solomon et al., 2007) or 32 weeks (Schertz et al., 2018). In contrast, five studies conducted interventions with a short duration of 4–6 weeks, and two studies did not report the total intervention period (Killmeyer et al., 2019; Nefdt et al., 2010).

3.2.3 INTERVENTION FORMAT

Some of these studies involved delivering parent training individually one-to-one ($n = 13$), training in a group format ($n = 5$), or both individual and group training ($n = 12$). Two of these studies delivered individual online training (Meadan et al., 2016; Wainer et al., 2021), online self-directed training (Nefdt et al., 2010; Wainer & Ingersoll, 2013), and therapist-assisted training (Ingersoll et al., 2016), or online group training (Li, Wu et al., 2022).

3.2.4 INTERVENTION OUTCOMES

Child outcomes. Out of 37 studies, 27 reported that parent-mediated intervention programs showed a significant effect on social communication skills; seven studies showed an improvement or increase in social communication skills; one study showed a moderate increase in social skills and object interest; and two studies showed high to moderate increases in eye contact (Killmeyer et al., 2019; Rollins et al., 2016). Eight studies showed a significant effect of the intervention on language skills; two studies indicated that children with ASD showed an improvement in vocabulary development (Prelock et al., 2011) and expressive language (Yoder et al., 2021); two studies reported no significant effect on the language domain (Green et al., 2017; Li, Wu et al., 2022); and the rest did not target language skills. Two studies indicated a significant effect of the intervention on play skills (Shire et al., 2022; Tripathi et al., 2022), an improvement (Yoder et al., 2021), or no significant effect (Ingersoll & Wainer, 2013b).

Three studies showed a significant effect on adaptive behavior skills (Klein et al., 2021; Rogers et al., 2019; Sengupta et al., 2021), a decrease in behavioral problems (Bagaiolo et al., 2017; Tripathi et al., 2022), or no effect on adaptive behavior (Ingersoll et al., 2016; Stahmer et al., 2020). Four studies showed no significant effects on motor skills (Ingersoll et al., 2016; Yoder et al., 2021) or imitation skills (Ingersoll & Wainer, 2013b; Wainer et al., 2021). Five studies showed that intervention programs were effective in decreasing ASD severity (Brian et al., 2022; Green et al., 2017; Klein et al., 2021; Manohar et al., 2019; Rogers et al., 2019), and two studies reported no effect on ASD severity (Solomon et al., 2007; Turner-Brown et al., 2019).

Most of the studies that conducted follow-up tests reported that participants maintained their gains after intervention completion. However, some studies indicated that partici-

pants did not maintain improvement in their behavioral skills (Tripathi et al., 2022), language, and communication skills (Brian et al., 2016), or showed a moderate decrease in communication and object interest during the follow-up phase (Carter et al., 2011).

Parent outcomes. Out of 37 studies, 27 targeted parents' fidelity and showed that parents had high fidelity in implementing intervention programs. Nine studies showed that parents demonstrated positive perceptions of the intervention programs and rated them as feasible and acceptable. Only four studies that examined parents' self-efficacy showed that parents demonstrated high competence and self-efficacy in implementing intervention programs (Hernandez-Ruiz, 2018; Ingersoll et al., 2016; Li, Wu et al., 2022; Wainer et al., 2021). Additionally, parents were highly satisfied with the intervention program in 14 out of 15 studies, and only one study showed no significant effect on parental satisfaction (Li, Wu et al., 2022). Eleven studies that evaluated parental stress showed that the intervention effectively decreased parental stress, and only one study reported that parents did not maintain this gain at follow-up (Tripathi et al., 2022). Two out of three studies showed that the intervention program was effective in improving parents' quality of life (Roberts et al., 2011; Turner-Brown et al., 2019), and only one study showed no difference in quality of life between parents in the intervention and control groups (Wainer et al., 2021).

Finally, Stahmer et al. (2020) found no significant differences between parents in the ImPACT program group and the usual care group in the social support domain. In addition, parents in the intervention group showed greater improvements in positive parent-child interactions compared to the control group (Schertz et al., 2018; Stahmer et al., 2020) or the psycho-education group (Shire et al., 2017). Similarly, Shire et al. (2022) reported that the increase in caregivers' JASPER strategy use was associated with an increase in the child's initiations and joint engagement for both the coaching group and the observation-plus- coaching group.

3.2.5 LIMITATIONS

These studies have reported several limitations, including a small sample size ($n = 22$), modest sample size (Green et al., 2017), lack of control or comparison groups ($n = 5$), lack of randomization for the participants ($n = 2$), sample diversity ($n = 4$), heterogeneity of groups ($n = 4$), or withdrawal of participants from the studies. For example, Sengupta et al. (2020) reported the departure of 18 families from the intervention, and some families dropped out of the intervention due to the pandemic (Glumbic et al., 2022). Additionally, there was a lack of follow-up data ($n = 13$), short-term follow-up data ($n = 6$), or data were partially obtained for some of the participants due to a reduction in specialists (Shire et al., 2022), which led to incomplete data information about the maintenance and generalization of the skills. Furthermore, the absence of data on parents' characteristics, such as educational level, age, and background ($n = 10$), might have impacted the intervention outcomes. For instance, Meadan et al. (2016) indicated that all the parents who participated in the study had previous experience in special education. Likewise, data on parents' mental health, wellness, and access to resources were not obtained (Brian et al., 2022). In addition, there was a lack of data on participants' website skills, which might have impacted their access to or engagement with online

training (Wainer et al., 2021). Furthermore, there was a lack of parents' fidelity data ($n = 10$), or the sample size was too small to measure parents' fidelity (Carter et al., 2011).

Some studies have reported limitations in the assessment tools, including the use of parents' and specialists' self-reports ($n = 15$), non-individualized evaluations (Nefdt et al., 2010), and non-blinded assessments (Brian et al., 2022) to evaluate the intervention outcomes, which can impact the studies' findings due to evaluators' biases. Furthermore, using multiple measures due to changes in participants' age throughout the study (Green et al., 2017) or using video recording as an assessment tool could invade families' privacy (Yoder et al., 2021). Moreover, some interventions can be challenging for some caregivers and require significant effort, such as filling out numerous evaluation forms (Sengupta et al., 2020), or traveling to participate in the program (Sengupta et al., 2021), or providing them with a high dosage of video feedback (Klein et al., 2021).

Meadan et al. (2016) indicated that the effect of coaching alone was not examined in relation to the intervention outcomes (Meadan et al., 2016). Some interventions were conducted with low intensity (Roberts et al., 2011; Stadnick et al., 2015; Turner-Brown et al., 2019), or over a short period (Li, Wu et al., 2022; Prelock et al., 2011; Wainer & Ingersoll, 2013). Solomon et al. (2007) suggested that the intervention outcomes might have been impacted by parent-child interaction or the child's enrollment in other programs rather than the parents' training. Additionally, some interventions were limited in scope, targeting only social imitation (Penney & Schwartz, 2019; Wainer & Ingersoll, 2013), eye-contact (Killmeyer et al., 2019), or a few specific skills, such as saying "You try," "Thank you," sharing, and eye contact (Youn Kang & Kim, 2020). Finally, some interventions were limited to participants who had access to the Internet (Wainer & Ingersoll, 2013), DVD devices in their homes (Bagaiolo et al., 2017), or lived in urban areas (Glumbic et al., 2022).

4 DISCUSSION

This review aimed to synthesize PMI studies conducted in the last 18 years to identify the types of PMI programs that have been used to improve the social communication skills of children with ASD and report the outcomes of these intervention programs on children with ASD and their parents. The results of the search revealed a total of 37 articles after the inclusion and exclusion criteria were applied, and the data of the identified articles were extracted into two tables: study descriptions and intervention details.

The results of these studies showed that ImPACT was the most widely used program ($n = 7$; 18.9%), followed by RIT ($n = 4$; 10.8%). Also, most PMIs significantly improved social communication, language, adaptive behavior, and play skills, as well as decreased behavioral problems and ASD severity. Moreover, some studies have shown that children achieved high to moderate increases in eye contact (Killmeyer et al., 2019; Rollins et al., 2016) or moderate improvement in social communication skills (Carter et al., 2011). In contrast, some studies reported no significant effect on language abilities (Green et al., 2017; Li, Wu et al., 2022), play skills (Ingersoll & Wainer, 2013b), adaptive behavior (Ingersoll et al., 2016; Stahmer et al., 2020), motor skills (Ingersoll et al., 2016; Yoder et al., 2021), imitation skills (Ingersoll & Wainer, 2013b; Wainer et al., 2021), or ASD severity (Solomon et al., 2007; Turner-Brown et

al., 2019). This may be related to the nature of the intervention programs, which were designed to enhance the social communication skills of children with ASD (Ingersoll & Dvortcsak, 2019). Therefore, all these studies indicated positive outcomes in the social communication skills domain.

Ingersoll et al. (2016) found that children in both ImPACT groups, self-directed and self-directed with therapist assistance, gained significant improvements in language skills; however, the therapist-assisted group achieved greater gains over the self-directed group in social skills. This indicates the importance of supporting parents during the training and implementation of this type of intervention to obtain more satisfactory results. Likewise, Roberts et al. (2011) indicated that participants in the center-based group showed more significant improvement compared to home-based and waitlist groups. This may be related to the higher intensity of the intervention delivered to the center-based group, which received 80 hours, whereas the home-based group received only 40 hours.

Klein et al. (2021) reported no significant differences between participants in the NDBI and NDBI with video feedback groups, with both groups achieving meaningful gains in social, language, and ASD severity. Nevertheless, the NDBI + VF group achieved additional improvements in adaptive behaviors and a decrease in restricted and repetitive behaviors. Additionally, Shire et al. (2022) indicated that participants in both the coaching-only group and the observation-plus-coaching group showed a significant increase in joint engagement, play, and joint attention. However, there were site differences, as some participants improved more through coaching only, while others improved more through observation with coaching. This was related to the lack of group homogeneity (e.g., age and skills).

Most of these studies showed that parents gained high fidelity, self-efficacy, satisfaction, positive perceptions, and a decrease parental stress level. However, some studies indicated no significant effect of the intervention on parents' satisfaction (Li, Wu et al., 2022), quality of life (Wainer et al., 2021), or social support (Stahmer et al., 2020). Furthermore, Tripathi et al. (2022) reported that parents did not maintain a decrease in stress levels during the follow-up phase. Ingersoll et al. (2016) indicated that online self-directed with therapist-assisted group parents achieved higher fidelity and more positive perceptions than those in the self-directed group. Similarly, parents in the JASPER group showed high fidelity and responsivity compared to the psychoeducation group, and parents' responsiveness was associated with their children's joint engagement (Shire et al., 2017). Also, parents in the P-ESDM++ (additional procedures) group showed more significant interaction skills than those in the basic (P-ESDM) group (Rogers et al., 2019). In turn, there was no difference in parental fidelity between the coaching group and the observation-plus-coaching group, with all practitioners and parents in both groups showing high fidelity (Shire et al., 2022).

The results must be interpreted with caution due to the limitations highlighted by these studies. First, methodological limitations include a small sample size, lack of sample diversity, sample heterogeneity, and lack of a control group. In addition, the absence of follow-up data, short-term follow-up, or partially obtained data for some participants might have led to inadequate information regarding the maintenance and generalization of the targeted skills. Second, a lack of data on parents' characteristics, such as educational level, age, mental health,

access to resources, and skills, may have been an important indicator of intervention outcomes. Furthermore, some evaluation tools were based on parents' or specialists' self-reports, or the assessment was not individualized (Nefdt et al., 2010) or blinded (Brian et al., 2022), which may have impacted the findings due to evaluators' biases or the paucity of individualized measures. Moreover, these intervention programs can be challenging for some caregivers due to evaluation procedures that may invade their privacy, such as video recording, or require significant effort to fill out multiple assessment forms, travel, or have access to Internet and technological devices. This may deprive many families from low socioeconomic levels, rural areas, or those without Internet access from participating in these intervention programs. Finally, some interventions were conducted with low intensity or over a short period of time.

5 LIMITATIONS

This review had some limitations. First, this systematic review might have excluded some important studies that could provide more valuable data about the effects of PMIs due to the use of specific search terms, strict criteria, and a limited search period. Second, some of the included articles did not provide complete information about intervention intensity, which would have allowed for more accurate data regarding the effects of these intervention programs on children with ASD and their parents. For example, five studies (13.51%) did not report the duration of the sessions, and two studies (5.40%) did not report the total intervention period (Killmeyer et al., 2019; Nefdt et al., 2010; Rollins et al., 2016). Therefore, it was impossible to calculate the overall intervention intensity for these programs and determine whether the intensity of the intervention was associated with outcomes for children with ASD. Another limitation is that some studies did not report parental outcomes, such as fidelity or self-efficacy, which are important indicators of intervention outcomes.

6 FUTURE DIRECTIONS

Future research should address these limitations by: (1) Implementing parent-mediated interventions with an appropriate sample size and a control group; (2) Conducting long-term follow-up data to check the generalization and maintenance of acquired skills after intervention completion; (3) Using valid assessment tools to measure children and parents' outcomes, avoiding bias in evaluation; (4) Obtaining parents' demographic information, such as education level, age, and skills, as these factors might impact treatment responses; (5) Examining parents' self-efficacy and fidelity, as they are important indicators of successful intervention; (6) Conducting high-intensity interventions to obtain more satisfactory results; and (7) Facilitating and motivating parents' participation in these programs by providing them with support, training, and accessible resources.

7 CONCLUSION

The results of the current systematic review showed that PMIs were effective in improving social communication and other skills of children with ASD. Parents who participated in their children's interventions demonstrated high fidelity, positive perception, self-efficacy, satisfaction, and a decrease in stress levels. The findings of these studies highlighted the im-

portance of parental participation in their children's interventions, which contributed to the improvement of their children's skills and enhanced parents' mental health. Therefore, it is essential to involve parents more actively in their children's interventions by providing training, support, and accessible resources. Furthermore, future studies should address the methodological limitations of prior research, including sample size, comparison groups, assessment tools, intervention intensity, and collecting more data about children's maintenance and generalization of the acquired skills.

CONFLICT OF INTEREST

The authors declare no conflicts of interest.

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DATA AVAILABILITY STATEMENT

The authors confirm that the data supporting the findings of this study are available within the article.

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