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Effectiveness of a training program among parents of preschool children with ASD in Tunisia: a randomized controlled trial

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Raising a child with ASD can be overwhelming and challenging for parents, and it poses different needs that require support, guidance, and education. Purpose: The aim of this study was to assess the effectiveness of a psychoeducational intervention developed to support parents of children with ASD in Tunisia. A randomized controlled trial was carried out in three Autism socio-educational centers in Tunisia. The study was conducted among parents of children with ASD aged 3 to 8 years from November 2020 to January 2022 ($N = 31$) compared to a control sample of parents of children attending the same centers but received no specific parent intervention ($n = 31$). The “Blue Hope” program includes eight training sessions delivered through a combination of face-to-face and online sessions. Results showed that the program significantly improved communication and reduced behavior problems in preschool children with ASD, with a significant positive difference noted at the 6-month follow-up. The program also had a positive impact on parental anxiety and depression, with significant and positive differences observed in anxiety and depression scores and the total score at follow-up compared to baseline. These findings suggest that the “Blue Hope” program could be a cost-effective and valuable solution for parents of children with ASD in Tunisia and could be the first step in developing and improving training programs for parents in low-income countries.

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Introduction

Autism spectrum disorder (ASD) is a lifelong neurodevelopmental disorder characterized by deficits in social communication as well as the presence of repetitive, stereotyped behaviors and restricted interests, with the presence or absence of sensory disturbances (American Psychiatric Association (APA), 2013).

In recent years, the prevalence of ASD among children have increased, generating claims about an “epidemic” of autism: A systematic review and meta-analysis by Salari et al. (2022) estimated the global prevalence of autism, in the world, to be 0.6% of the population (Salari et al., 2022). The CDC reports that 1.68% of children aged 8 years in the United States (1 in 59 children) are diagnosed with ASD. This disorder can be accurately identified as young as 18 months of age (Hyman et al., 2020).

ASD related challenges impose an enormous burden on children and families. It has considerable repercussions on the child who often exhibit a variety of problem behaviors including withdrawal, aggression, self-injury, tantrums, property destruction, and repetitive behaviors (Horner et al., 2002). These difficulties generate psychological distress such as stress, anxiety and depression (Kerns et al., 2021; Vasa et al., 2020).

ASD affects not only the child but also parents. The journey of raising a child with ASD can be an overwhelming experience and a burden on parents and families. Parents are likely to experience unique challenges associated with interacting and bonding with their child, addressing externalized behavior issues, coping with cognitive impairments, and managing lower levels of adaptive functioning. Importantly, these experiences and behaviors exhibited by the child both influence and are influenced by the parents’ well-being and interactions. (Rodriguez et al., 2019) (D et al., 2018; Ilias et al., 2018; Karst and Van Hecke, 2012; Rodriguez et al., 2019).

Helping parents to deal with their own emotions and strategies of coping through supportive and training interventions have long been considered an important component of early care for children with autism. Indeed, interventions for young children with autism spectrum disorder (ASD) can lead to meaningful improvement in communication skills, cognitive ability, and reduced ASD symptoms (Lecavalier et al., 2017; Lichtlé et al., 2019; Nevill et al., 2018; Oono et al., 2013; Tonge et al., 2006).

Interventions were categorized as parent education or parent-mediated interventions (Bearss et al., 2015): *parent psychoeducation interventions* designed for the benefit of parents, focusing on parental well-being for parents, providing information about the child with ASD’s conditions and behaviors, supporting parents to improve their coping styles and reduce psychological distress (Davis et al., 2019; Francis et al., 2019; Hemdi and Daley, 2017; Iida et al., 2018; Patra et al., 2015), whereas *parent training (PT) interventions* or parent mediated interventions generally focus on children as primary beneficiaries. These interventions help parents to adapt their own behavior, change and support parent interactions with their children, improve the management of children’s difficulties. Psychoeducation interventions, improved social communication and showed less impairment, compared to the control group (Bearss et al., 2015; Ho and Lin, 2020; Iida et al., 2018; Leadbitter et al., 2020; Oono et al., 2013; Ratliff-Black and Therrien, 2021). Although the effect was stronger for parent-mediated intervention (Bearss et al., 2015).

These interventions which may be an important source of empowerment for parents can provide a more economical and practical means for families to support their children’s development, particularly in low-resource settings (Lee and Meadan, 2021).

In published scientific literature, interventions for children with ASD and their families are often well designed for English-speaking, middle-class families, which fail to consider other cultures (Al-Khalaf et al., 2014; Lee and Meadan, 2021; Magaña et al., 2020; Mirza et al., 2020). In Arab countries PT is not clearly investigated, there is a shortage of PT programs, with delayed referral of children at risk, possibly due to late identification of needs, or lack of knowledge about PT, acting as barriers to delivering PT services (Alqatarneh et al., 2022).

In our Tunisian context, the only available study conducted by (Gaddour et al., 2012), showed a prevalence rate of 3.5 per 1000 children (Gaddour et al., 2012). Systematic barriers impact the experience of families of children with ASD, including limited personnel, limited health coverage/financial resources, schedule conflicts, lack of child/respite care, and lower health literacy rates (Chlebowski et al., 2018; Moody et al., 2019). Persons with ASD in Tunisia are faced with a lack of structures and human resources, limited knowledge about ASD, and of effective educational approaches, which are often costly and cannot be adopted with a low-income country like Tunisia (Abid et al., 2022). Cultural and linguistic aspects can also be a barrier: Unlike in North American or European cultures, Tunisians, speaking primarily Arabic, are less prone to express their emotions. Tunisian colloquial Arabic, the spoken language in the country, provides few directions expressions of how individuals can describe their emotions, hence anxiety and depression are often described by metaphors and body complaints (Douki et al., 1997). However, the formation of parent groups can also be the solution: indeed, several studies have shown that it is a cost-effective, and practical method of intervention for families and focused on results for children with disabilities, in low- and middle-income countries (Alanazi et al., 2022; Al-Khalaf et al., 2014; Alqatarneh et al., 2022).

Therefore, there is a need for mental health providers and specialists who are providing services and education for children with ASD to try and discover new approaches based on parent as a partner in caring adequately his child through training intervention and to develop evidence-based interventions (Abid et al., 2022; Alqatarneh et al., 2022).

From a national perspective, despite the alarming need of parents of support, guide and training, neither research assessed the impact of training program on children and their parents. Hence, we aimed at exploring associations between parental mental distress and outcome of ASD in their children and we focused on developing a culturally tailored intervention for Tunisian (and Arab) families because of documented disparities in treatment and services for this population.

General aim

The aim of this study was to assess the effectiveness of training program (PT) named “Blue Hope” developed to support parents of children with ASD in Tunisia.

Our primary hypothesis was that the parent training would improve developmental outcomes and severity of ASD symptoms.

Moreover, the secondary hypothesis was that the parent-implemented early intervention would also alleviate the parenting psychological distress and improve the quality of life of parents of preschool children with ASD.

General methods

Study design. A randomized controlled trial was carried out in three Autism socio-educational centers in Tunisia (Centers “les Colombes” Sousse, Monastir, and Mahdia). Les Colombes is an NGO-established network of 11 facilities spread throughout the

country and offering social and educational services for children aged 2 to 18 years old with ASD. The study was conducted among parents of children with ASD aged 3 to 8 years from November 2020 to January 2022 ($N = 62$). Participants were randomly assigned to either the intervention group ($n = 31$) or the control group ($n = 31$) using a random number list. The principal researcher allocated eligible children by employing sealed envelopes.

The study compared the intervention of a parent psycho-educational program and a control sample to determine whether there are additional therapeutic effects of parenting skills training and education on child outcomes and parent well-being.

The intervention program lasted over 14 months and included eight educational sessions of 120 min each and 6-months follow-up after the end of the intervention. Three waves of data were collected for both intervention and control groups: pretreatment (T0), baseline (T1), and 6 months after baseline (T2). The program was broadly based on multiple early intervention and cognitive-behavioral techniques and has several purposes. This study was relevant to the CONSORT checklist of randomized controlled trial (Cuschieri, 2019).

Eligibility criteria. Inclusion criteria included the following:

- Parents of a child aged 3–8 years diagnosed with ASD based on expert evaluation using Diagnostic Statistical Manual - 4th edition (DSM-4) criteria, confirmed by the ADI-R (A. D. I.-R. Lord et al., 1994) and the scale CARS-T (Schopler et al., 2010).
- Child received local intervention services as usual.
- The parent has lived with the child for at least 6 months.

Non-inclusion criteria.

- Parents with a diagnosed mental health problem.
- Parents who have current or past enrollment in a structured parenting program (to better grasp understand the impact of the current program).

Participants' recruitment procedure. Participants were recruited through les Colombes Autism Centers that shared the study brochure with them, also to boost the sample size we shared study brochure on social media to enroll participants. Then interested participants contacted researcher via email or telephone. Parents who expressed interest in the study were called and screened for eligibility. Although both fathers and mothers were encouraged to be involved in the intervention, mostly mothers were asked to go through the intervention.

Recruited parents were asked to provide informed written consent for participation. At first, 75 parents were enrolled in the study. Thirteen children did not meet eligibility criteria (9 aged 9 years and above and 4 families could not participate due to work commitments for both parents or the difficulty to access the venue). Finally, a total of 62 were enrolled. At follow-up, 29 families completed the study in each group: two families in the intervention group and two families in the control group dropped out for various reasons such as unavailability for contact or declining to continue participation (Fig. 1).

Measures

Parent outcome measures

HADS. Anxiety and depression were assessed using the Hospital Anxiety and Depression Scale (Zigmond and Snaith, 1983). It contains 14 self-report items, with seven items forming the

Anxiety subscale (HADS-A) and seven items forming the Depression subscale (HADS-D). Each item has a choice of four responses that are scored from 0 to 3 yielding a maximum score of 21 for each subscale. Cut-off score of 8 has been found to offer the best balance between sensitivity and specificity for both HADS-A and HADS-D scales (Brennan et al., 2010). Scores of 11 or more for either subscale of depression or anxiety are considered to indicate a significant "case" of psychiatric comorbidity.

This scale is widely used to assess anxiety and depression among parents of children with ASD (Hemdi and Daley, 2017).

Parental quality of life. Quality of life was assessed using WHOQOL-BRIEF (World Health Organization. Division of Mental Health, 1996) which is widely used in assessing QoL among parents and caregivers of children with ASD (Dardas and Ahmad, 2014; Derguy et al., 2018; Eapen et al., 2014; McKechnie et al., 2017; Musetti et al., 2021; Vasilopoulou and Nisbet, 2016).

This scale intends to assess a general measure of quality of life. It is composed of 26 questions allowing an evaluation in four domains, physical, psychological, social, and environmental, and two questions on the global domain.

Child outcome measures

Aberrant behavior checklist. The ABC (Aman et al., 1985; Kaat et al., 2014) is a valid 58-item parent-report measure scored from 0 (not a problem) to 3 (severe in degree). It is designed to measure the severity of a range of problem behaviors commonly observed in individuals with intellectual and developmental disabilities (IDD) across five domains : (a) Irritability (tantrums, aggression, and self-injury; 15 items), (b) Social Withdrawal (response to others, initiation of interaction; 16 items), (c) Stereotypic Behavior (mannerisms and repetitive movements; seven items), (d) Hyperactivity/Noncompliance (hyperactivity and noncompliance; 16 items), and (e) Inappropriate Speech (repetitive vocalizations; four items).

Social communication questionnaire. Social Communication Questionnaire (SCQ; (Lord and Rutter, 2003), parent version, is derived from the Autism Diagnostic Interview-Revised (A. D. I.-R. Lord et al., 1994). Designed at first to be used by clinicians for screening children 4 years of age or older for ASD (Berument et al., 1999; C. Lord and Rutter, 2003). It is a screening measure that was developed to identify the severity of ASD symptoms. It consists of 40 items that assess communication skills and social functioning. The questionnaire is suitable for both verbal and non-verbal children. Total scores on the SCQ range from 0 to 39, with higher scores indicating greater impairment in social communication. When used with younger children, the sensitivity and specificity of the SCQ are optimized at lower cut-off scores (Wiggins et al., 2007). In this study, a cut-off score of 11 points was employed to indicate the presence of ASD risk (Wiggins et al., 2015).

Intervention design: parent education training program. The training program is designed to assist and support parents of pre-school children who had recently been diagnosed with an ASD.

Description of the parent-training program named "Parents in action: Blue Hope" (Abid et al., 2022; Dawson-Squibb et al., 2020; Karst and Van Hecke, 2012). The Blue Hope program is based on the transmission of information and skills to parents in a context where parents/careers and trained facilitators are the direct actors. The program was designed based on a qualitative study that identified the unmet needs and challenges of parents of children with ASD in a Tunisian context (Abid et al., 2022). It was

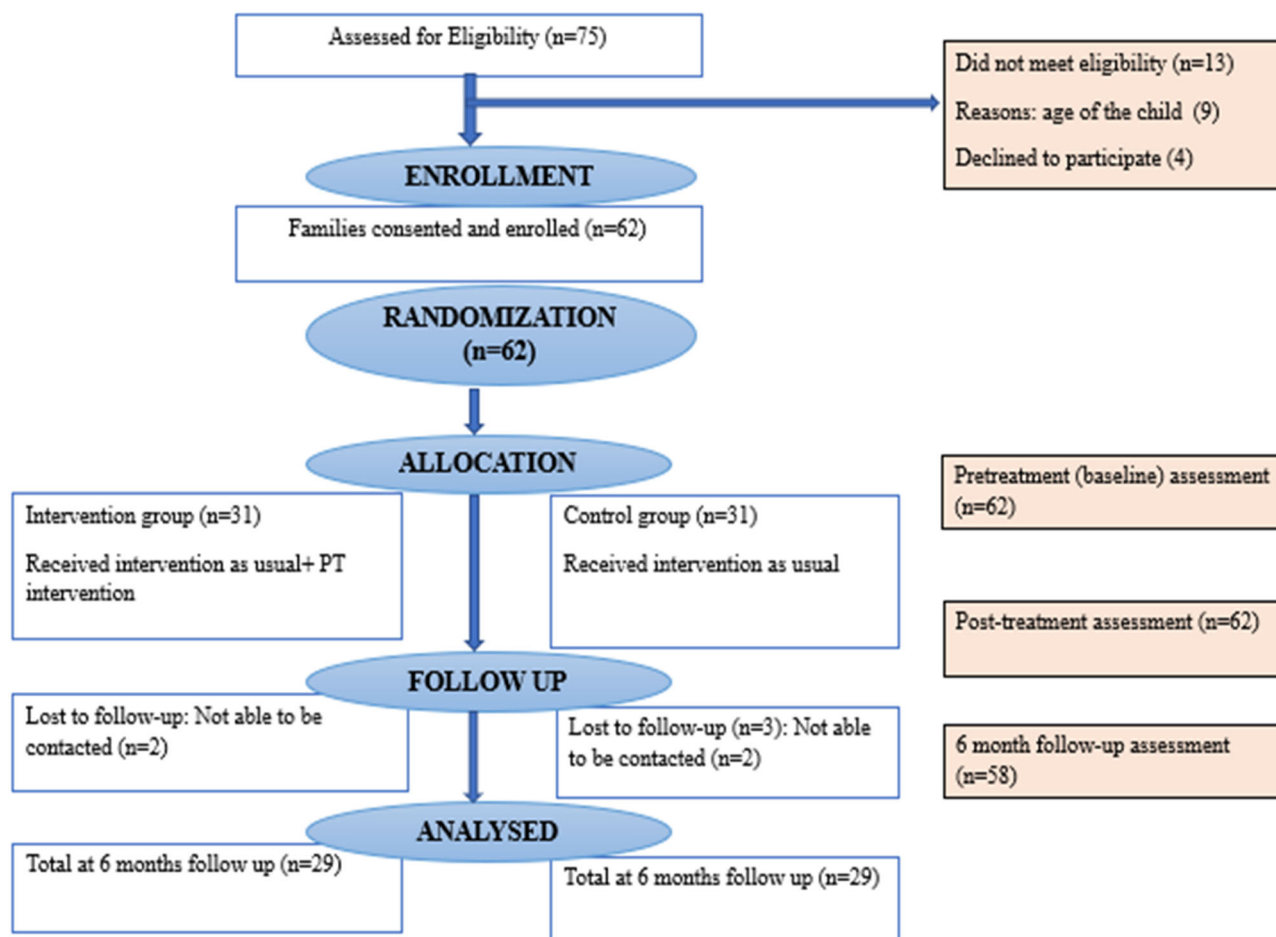


Fig. 1 Flow diagram of participants' recruitment.

delivered using a range of modalities, including interactive training activities, group discussion, video examples, role-play with therapists, handouts, and regular homework assignments (Dawson-Squibb et al., 2020).

It consisted in eight 120 min core group sessions, focused on: educating parents to better understanding of ASD and its characteristics (communication, socialization and behavioral difficulties), supporting them to discuss their reactions that can help to empower them and encourage a positive perception of their child's ASD, and assisting them in managing parental grief and mental health problems.

Furthermore, the program aimed at guiding parents and training them on behavioral principles for reducing child impairments behavior, through identifying the purpose of behavior and applying anticipatory or consequence strategies to manage disruptive behavior (Table 1).

Moreover, two online individual optional booster sessions were skills based and action-oriented, homework tasks and feedback proposed for families. The parents agreed to do, daily, at least 30 min of planned practice activities with the child.

The structured PT sessions were administered using direct instruction, video examples, role-play with therapists, handouts, and regular homework assignments. Sessions were delivered by special educators or psychologists who had experience working with children with autism and their parents and the researcher (Ph.D. candidate), over a 20-week period. The sessions were conducted in dialectal Arabic, the mother tongue of the Tunisian population.

Parents completed efficacy self-report measures at pre- and post-treatment assessment and at 6-month follow-up.

Non-intervention control group. This group consisted of parents and their children with autism who received local early childhood services but no interventions. Parents were informed that they were to be part of a follow-up study on ASD and receive initial and 6-month follow-up assessments.

Statistical analyses. Statistical analyses were conducted using the IBM SPSS statistics version 22 and statistical significance was set at 0.05. Categorical variables were expressed as frequencies. Continuous variables were expressed as means \pm Standard Deviations (SD) if normally distributed, or median and inter-quartile range if not normally distributed. The normality of distribution of data was first made with Kolmogorov-Smirnov test.

The present study adopts several statistical procedures to answer the research questions. For the comparison of proportions, we used Pearson's Chi square (χ^2) test. Means were compared using Student's *t* test and Mann-Whitney *U* test.

Results

Sociodemographic and clinical data at baseline. Twenty-eight dyads completed the study. There was no statistically significant difference between the intervention and the control group before the intervention (Table 2).

Measures of anxiety and depression (HADS) and Quality of life (WHOQOL). The findings demonstrated that anxiety and depression scores (all $p = 10^{-3}$), as well as total score ($p = 0.04$)

Table 1 The educational components used in parent training “parents in action: blue hope”.

Group sessions of 120 min	Goals	References
Session 1: Outline and program goals	Training program: contains the PT steps and aim, the content, duration, and goals of every session.	
Session 2: What is autism?	Review of diagnostic labels to understand ASD: Causes and characteristics (how it affects the lives of people with ASD), sensory problems Tools: Posters, ppts, questions and answers, group discussion, videos.	(American Psychiatric Association (APA), 2013; Hodges et al., 2020)
Session 3: Parent reaction to the diagnosis How to cope	Group Discussion: <ul style="list-style-type: none"> • Discuss impact of diagnosis on family members: • Identify coping strategies • Managing parental stress, grief • Supporting parents to discuss their reactions • Empowering and encouraging the positive perception of their child with ASD. Tools: Videos, Goal setting, Problem-solving, Storytelling.	(Treacy et al., 2005)
Sessions 4: Verbal communication Session 5: Non-verbal communication	<ul style="list-style-type: none"> • Identifying communication impairments • Improving social interaction and communication to help parents establish good practice • How to give clear instructions to their children Role-play with therapists, Goal setting, Problem-solving, and regular homework assignments.	(Gal et al., 2009; Hart Barnett, 2018)
Session 6: Understanding and managing difficult behavior. Principles of positive behavior support Session 7: Positive behavior support: changing behavior by manipulating consequences Encouraging new behaviors (prompting, shaping and chaining)	<ul style="list-style-type: none"> • Guide parents and to teach them on behavioral principles for reducing child impairments behavior, through identifying the purpose of behavior and applying anticipatory or consequence strategies to manage disruptive behavior. • How to focus on good behaviors Videos, group discussion, encourage asking questions, raise awareness, discuss feedback, Goal setting, Problem-solving, and regular homework assignments.	(Ivy and Schreck, 2016; Jang et al., 2012)
Session 8: How to work and play with your child At home Out, in natural environment	<ul style="list-style-type: none"> • Discuss how to choose appropriate toys/activities • Symbolic play • Educative activities Review how to encourage appropriate play Videos, group discussion, encourage asking questions, raise awareness, role-play with therapists, and regular homework assignments.	(Hart Barnett, 2018; Mercer, 2017)

in the intervention group at baseline and follow-up, were significantly and positively different (Table 3).

As for quality of life, significant improvements were noted for psychological domain, non significant improvements for social and environmental domains and no difference for physical domain (Table 3).

Measure of the severity of autism (SCQ) and behavioral problems (ABC). No significant difference was found between the two groups at baseline ($p = 0.41$). and at post-treatment. However, a significant positive difference was noted at the 6 months follow-up (Table 4)

On the contrary, significant immediate and at 6 month follow-up positive differences were obtained for irritability, hyperactivity, social withdrawal, inappropriate speech, and stereotyped behavior scores (Table 4).

Discussion

The main aim of this study was to examine the impact of PT on multiple parent mental health outcomes, including parental anxiety, depression, and quality of life. Also, the impact of intervention on child outcome for instance on communication, disruptive behavior and autism severity were assessed. The challenges parents face in raising a child with ASD and the deep impact of their attitudes on the prognosis of ASD are a strong

argument for the need for parenting training. Our study is one of the few to use an RCT with Arab parents of children with ASD to show the effectiveness of parental outcomes(Alanazi et al., 2022; Alqatarnah et al., 2022; Hemdi and Daley, 2017).

This study found that training parents was beneficial in reducing their mental health burden, it significantly decreased anxiety level in the intervention group compared to the control group, not only in the short term but also in the long term as shown at the 6 months follow up which is consistent with the studies of Mirza et al., 2020 and Rios et al. (2021) (Mirza et al., 2020; Rios et al., 2021).

Indeed, parent training serves as a valuable tool in aiding parents to, effectively, manage their child’s disorder, concurrently alleviating the burden of negative emotional states. Furthermore, through education and active involvement in their child’s development, parents not only gain valuable insights but also witness incremental progress, fostering a sense of optimism and hope for the future (Tabatabaei et al., 2022).

Some comparable studies found no significant reduction in parent stress as presented in the review of (Oono et al., 2013). This could be due to the fact that the content of most of the interventions was primarily aimed at improving child outcomes rather than reducing parent stress.

Taking into account the well-documented impact on the quality of life (QoL) of parents, existing literature consistently

Table 2 Baseline demographic and clinical characteristics.

Characteristics	Intervention group (N = 31)	Control group (N = 31)	p
Parents			
Age (Years), M (SD)	36.94 (5.59)	37.19 (3.34)	0.82
Gender M/F (%)	10/90	32/68	0.059
Education Primary/Secondary and higher (%)	3/97	1/99	0.73
Working (%)	71	68	0.89
Public Health Insurance (%)	100	100	1
Children			
Gender M/F (%)	68/32	75/25	0.39
Current Age (Years), M(SD)	5.61 (0.91)	5.94 (1.03)	0.19
Age at diagnosis (Months), M (SD)	33.48 (7.39)	32.71 (7.72)	0.68
Aberrant Behavior Checklist, M (SD)			
Irritability	16.09 (4.94)	15.80 (2.37)	0.87
Social Withdrawal	11.38 (2.66)	10.67 (2.37)	0.27
Stereotyped behavior	6.16 (1.73)	6.06 (1.59)	0.82
Hyperactivity	16.64 (4.92)	15.12 (2.77)	0.13
Inappropriate Speech	6.80 (1.51)	6.09 (1.46)	0.06
SCQ, M (SD)	20.32 (2.92)	19.68 (3.31)	0.41
HADS			
Anxiety M (SD)	13.10 (2.83)	11.94 (3.37)	0.14
Depression, M (SD)	12.35 (2.28)	11.29 (2.58)	0.09
QOL			
Physical domain	11.88 (2.03)	11.75 (1.72)	0.78
Psychological domain	10.52 (2.24)	10.84 (2.06)	0.56
Environmental domain	9.88 (2.34)	10.77 (2.12)	0.12
Social domain	10.90 (2.89)	11.44 (3.14)	0.48

Table 3 Comparisons of anxiety, depression and quality of life (QoL) scores at baseline (T0), immediate post-treatment (T1) and after 6 months (T2).

Outcomes	Time	Intervention group M (SD)	Control group M (SD)	p-value
Anxiety	T0	13.10 (2.83)	11.94 (3.37)	0.14
	T1	8.45 (2.52)	12.48 (3.49)	<10 ⁻³
	T2	6.97 (2.12)	12.58 (3.78)	<10 ⁻³
Depression	T0	12.35 (2.28)	11.29 (2.58)	0.09
	T1	6.74 (1.94)	11.16 (3.05)	<10 ⁻³
	T2	5.39 (1.76)	11.87 (3.51)	<10 ⁻³
Physical QoL	T0	11.88 (2.03)	11.75 (1.72)	0.78
	T1	12.06 (1.94)	11.35 (1.88)	0.14
	T2	11.55 (1.71)	11.11 (1.58)	0.29
Psychological QoL	T0	10.52 (2.24)	11.75 (1.72)	0.56
	T1	12.71 (1.72)	10.92 (1.87)	<10 ⁻³
	T2	12.55 (1.37)	9.89 (1.68)	<10 ⁻³
Social QoL	T0	10.90 (2.89)	11.44 (3.14)	0.48
	T1	12.56 (2.65)	11.17 (2.87)	0.53
	T2	11.90 (2.73)	11.08 (2.52)	0.22
Environmental QoL	T0	9.88 (2.34)	10.77 (2.12)	0.12
	T1	11.39 (2.37)	10.81 (2.14)	0.31
	T2	11.73 (2.65)	10.54 (2.01)	0.51

highlights that parents raising children with Autism Spectrum Disorder (ASD) often experience a lower QoL and an elevated susceptibility to psychological disorders (McKechanie et al., 2017; Musetti et al., 2021). This pattern transcends geographical and cultural boundaries, as parents of children with ASD consistently report lower QoL compared to parents of typically developing children (Vasilopoulou and Nisbet, 2016).

Hence, increasing parental involvement in the intervention for children or adolescents with ASD may be one way to promote their QoL: in this sense, our study demonstrated that parents of children with ASD showed significant improvement in QoL after they participated in parent training. These results are consistent with previous studies (Leadbitter et al., 2020; Lichtlé et al., 2019). Moreover, the systematic review of Musetti et al, highlighted that a constructive collaboration between professionals and parents in planning and executing interventions may promote more ecological results and better satisfaction among parents (Musetti et al., 2021).

In the other hand, PT demonstrates a positive impact on child outcomes, equipping parents with specific techniques to manage behavioral challenges in children with ASD. This study underscores a notable enhancement in behavior impairments, with a significantly greater difference observed in the PT intervention group when compared to the control group. Specifically, scores related to irritability, hyperactivity, social withdrawal, inappropriate speech, and stereotypy showed significant and positive differences (all $p < 0.001$) between the intervention group at baseline and after treatment, as opposed to the control group.

This body of research contributes to a growing body of evidence regarding the beneficial effects of PT on child outcomes. In fact, recent studies have demonstrated that

interventions grounded in the principles of Applied Behavior Analysis (ABA) can effectively mitigate behavior problems. (Makrygianni et al., 2018; Oono et al., 2013; Su Maw and Haga, 2018 Aman et al., 2009).

Indeed, a large RCT in 180 children (mean age 8 years) with ASD of (Bearss et al., 2015) showed that a structured PT intervention based on ABA principles, as used by (Aman et al., 2009) helped reducing disruptive and noncompliant behavior in young children with ASD ($p < 0.001$).

When examining the language skills of the children, our study revealed a significant and noteworthy improvement. Importantly, these positive effects of the intervention appeared to accumulate on the long term, rather than manifesting in the short term. This consistency in results aligns with previous research findings and underscores the enduring impact of the intervention on children’s language development (Dawson et al., 2010).

The observed beneficial effects of parent training were consistent with some prior meta-analyses and systematic reviews (Deb et al., 2020; Ratliff-Black and Therrien, 2021), but more favorable than data reported in others (Nevill et al., 2018; Oono et al., 2013; Tachibana et al., 2017).

The important improvement can be attributed to the effective intervention methods employed in parent training, including the use of videos, role-playing exercises, and workshops. In an ideal scenario, when parents’ training incorporates practical elements such as video clips and interactive workshops, it enhances the training experience and leads to more significant improvements in their skills and outcomes. These hands-on approaches facilitate a deeper understanding and application of the strategies taught, ultimately contributing to the positive results observed in this study (Tabatabaei et al., 2022).

Furthermore, this study showed a significant improvement of in autism severity in the intervention group. Our findings are in line with others studies: (Zhou et al., 2018) declared that PT was positively associated with greater improvement in frequency of children’s spontaneous functional verbal utterances and imitative behaviors during the treatment and subsequent follow-up periods.

Table 4 Comparisons of SCQ And ABC scores at baseline (T0), immediate post-treatment (T1) and after 6 months (T2).

Outcomes	Time	Intervention group M (SD)	Control group M (SD)	p-value
SCQ	T0	20.32 (2.92)	19.68 (3.31)	0.41
	T1	18.13 (2.60)	19.77 (3.43)	0.38
	T2	15.77 (2.09)	18.71 (3.35)	<10 ⁻³
ABC Irritability	T0	16.09 (4.94)	16.25 (2.67)	0.87
	T1	14.51 (4.11)	15.54 (2.97)	0.26
	T2	12.64 (4.04)	15.77 (2.57)	0.001
ABC Hyperactivity	T0	16.64 (4.92)	15.12 (2.48)	0.13
	T1	13.87 (4.60)	14.74 (2.85)	0.37
	T2	11.70 (3.84)	13.96 (2.50)	0.008
ABC Social Withdrawal	T0	11.38 (2.66)	10.67 (2.37)	0.27
	T1	9.19 (2.71)	10.51 (2.06)	0.035
	T2	8.06 (2.64)	10.58 (2.30)	<10 ⁻³
ABC Inappropriate Speech	T0	6.80 (1.51)	6.09 (1.46)	0.06
	T1	5.58 (1.25)	5.90 (1.64)	0.38
	T2	4.87 (1.25)	6.22 (1.87)	0.002
ABC Stereotyped Behavior	T0	6.16 (1.73)	6.06 (1.59)	0.82
	T1	5.22 (1.82)	5.58 (1.52)	0.40
	T2	4.67 (1.51)	5.77 (1.74)	0.01

In addition, the study of Solomon (Solomon et al., 2014) with 128 children with ASD and their parents showed significant improvements in functional emotion development beside the improvements of the symptoms of ASD, contrasting with the meta-analysis of Nevill (Nevill et al., 2018), on efficacy of 19 randomized-control trials of parent-mediated interventions for children with ASD age 1–6 years, with only small improvements on measures of ASD symptom severity, socialization, and cognition and not on emotions.

Our study shows that parent training programs can be implemented in developing countries like Tunisia with a positive impact on children with ASD and their parents. This not only has the potential to improve the well-being and outcomes for these children, but it can also reduce the burden on already limited healthcare systems and offer a solution to overcome barriers posed by limited resources and cultural beliefs (Oshodi et al., 2019).

Parent training programs can provide a cost-effective and sustainable solution for families with children with autism in low-resource settings. The community-based approach reduces the reliance on specialized personnel, making the programs more affordable and accessible. This approach also helps building a supportive network within the community, reducing stigma and increasing awareness and acceptance of autism. The active involvement of governments and healthcare systems in providing necessary resources and infrastructure is crucial to ensure the successful implementation of parent training programs (Kakooza-Mwesige et al., 2022; Oshodi et al., 2019).

Limitations of the study. This study makes a significant contribution to improving the psychological health and well-being of both families and children by enhancing parenting practices and behaviors. Additionally, this intervention may offer a viable solution for middle- or low-income families caring for children with autism spectrum disorder (ASD).

However, it's important to acknowledge several limitations in the methodology of the study. First, the sample size was relatively small and consisted of preschool children with mild to moderate ASD, potentially limiting the generalizability of the results.

Second, due to resource constraints, double-blinding was not feasible, possibly introducing bias into the study. Furthermore, as is common in long-term prospective studies, there were dropouts in this study.

It's worth noting that parental involvement in an intervention can positively influence their perceptions of their children's behaviors. In future studies, it would be advantageous to incorporate rating scales and observation instruments completed by teachers or professionals not directly involved in the child's intervention. This would allow for a more objective evaluation and comparison of changes in children's behaviors.

Finally, to gain a more comprehensive understanding of the intervention's impact on both the child and the parent, future studies should consider including measures based on physiological markers of parental stress and behavioral observations.

Conclusion

Parent training provided more guiding from therapists to parents. Training would improve parent's mastery of techniques; hence, they could guide and support their children, experience the behavioral changes in them, and, therefore, find positive meaning in raising them. Thing that may impact favorably parent mental health, enhance communication skills, and reduce disruptive behavior among children with ASD, including in developing and under-resourced settings, with some adjustment to be less resource consuming and acceptable for the communities and available facilities.

Authors recommend using this study and similar ones as a source of inspiration for policy makers in Tunisia and LMICs to propose culturally relevant, economically possible and socially acceptable and feasible services. Management of ASD should be more based on a good education and strengthening of parents and families rather than of creation of imported technical services that will never meet the requirements of LMICs.

Data availability

The data generated in the course of this study is currently part of an ongoing academic research project for a Ph.D. thesis. Due to the nature of the project and academic considerations, the primary data cannot be made publicly available at this time. However, we are committed to sharing the data and findings from this research with the scientific community. The main data, along with a detailed description and analysis, will be published in a forthcoming scientific paper.

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Author contributions

NA: Identified the research topic—developed the research protocol—was responsible for data collection and data analysis—designed the data analysis plan—elaborated the summary of the results and interpreted the results—wrote the manuscript. SH and NG: provided a critical review of the report and manuscript. All the authors have read and agreed to the final manuscript.

Competing interests

The authors declare no competing interests.

Ethical approval

This RCT study was approved by by the research ethics committee of the faculty of medicine of Sousse under the reference number CEFMS 58/2020. It was retrospectively registered in the Pan African Clinical Trial Registry under the identification number PACTR202212752100115. The procedures used in this study adhere to the tenets of the Declaration of Helsinki.

Informed consent

Before their involvement in the study, informed consent (including the study's purpose, procedures, potential risks, and benefits), and voluntary participation were guaranteed for all participants. Participants were also made aware of their right to withdraw from the study at any time. They were informed that their confidentiality and privacy would be protected throughout the study, and their data would be analyzed anonymously. All participants in the study, one parent from each family, provided their written informed consent to be enrolled in the research.

Additional information

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