The Effectiveness of Parent Training Interventions in Autism Spectrum Disorder: A Systematic Review

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Research

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Abstract

Background: The role of parents in taking care of children with Autism Spectrum Disorder (ASD) is critical. This systematic review study aimed to investigate the effect of parents-based training interventions on taking care of children with ASD.

Method: All relevant studies were searched through some electronic databases such as PubMed, Scopus, Google Scholar, Cochrane Library, Science Direct, Web of knowledge, and also via hand searching in relevant journals, checking the reference list of articles, expert contact, and grey literature from 1 January 2000 to 30 February 2020.

Result: Eventually, 53 articles were considered. In total, 1758 parents of children with ASD participated in these studies that 49 studies were conducted in high-income countries, 19 studies in the home, 25 studies in the training centers. 14 studies carried out only in training way, 39 studies in training along with practices and assignments, 30 individual interventions, 21 interventions in the group. Most studies had a range of 10 to 30 sessions in a 60 to 120-minute period. Also, the effectiveness of interventions was studied in both parents and children groups.

Conclusion: According to the included studies, parents-based training interventions have significant impacts on parents and their children's behavior.

Introduction

The autism spectrum disorder (ASD), introduced first by Leo Connor (1894-1981), has always been regarded as one of the most challenging psychiatric disorders in various scientific communities since 1943; the American Psychiatric Association has identified two main characteristics in diagnosing this disorder according to the [Diagnostic and Statistical Manual of Mental Disorders \(DSM-5\)](#); 1. Difficulty with social communication and interaction that have been demonstrated as defects and delays in language, speaking with an abnormal tone or rhythm and using a singsong voice or robot-like speech, failing to understand and respond to someone conservation, not expressing emotions or feelings and appearing unaware of others' feelings, making little, lack or inconsistent eye contact, facial expression, and body language; and 2. Restrictive and repetitive behaviors which include performing repetitive movements (e.g., spinning, rocking, or hand flapping, and spinning wheels of a toy car), unusually sensitive to some light and sound, prefer some specific food, performing abnormal activities that may cause self-harm (e.g., head-banging orbiting), resistance to specific environmental changes and becoming upset. DSM-5 emphasizes that these symptoms generally appear in the first years of life and limit daily functionality [1]. Epidemiological studies show that the number of families globally suffering from this disorder is increasing dramatically. According to the United States Centers for Disease Control and Prevention (CDC) statistics in 2008, about 1 in 88 children aged 8-10 has been diagnosed with ASD [2]; America Psychiatric Association in 2013 has estimated the prevalence of ASD in 1% globally [3];

However, the previous edition of the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV) estimated the incidence of this disorder in 2 to 5 cases per 10,000 people [4].

In addition to the high prevalence rate of ASD, the diagnosis, training, and maintenance of children with ASD cause the damage and consequences which may affect almost all aspects of a family; naturally, for parents, knowing that their child is diagnosed with autism disorder is a bitter, painful and unexpected moment. Some parents may have denied this for a long time and will try to find ways to prove the absence of ASD in their child [5]. Studies have shown that parents with autistic children experience higher anxiety levels and lower quality of life than those with mentally retarded children without ASD, cerebral palsy, and normal children. It can be expected that the presence of a child with ASD in the family will increase the amount of stress within the family and affect the whole family aspects; the parents of these children often experience many marital and familial tensions [6]. Gau and colleagues (2012) in their research indicated that parents of children with ASD showed lower levels of positive emotions compared with normal children's parents, the former have lower satisfaction in a marital relationship [7]. Also, Kelly and colleagues (2008) showed that not only ASD can affect family mental health, but also family conflicts predict the incidence of autism symptoms [8]. Khanna and colleagues (2011) also found that the family's adaptation to their child's disorder affected the children's behavioral problems. Hence, the relationship between children with ASD and family functioning can be considered as a mutual relationship [9]. These findings implicitly point to the importance of parents' role in ASD understanding, the principle encounter, and the management of maladaptive behaviors in children with this disorder, which is less attention.

Despite the scientific advances, the main causes of ASDs have not been identified clearly; although several factors have been suggested in ASD etiology but not definitely; therefore, researchers in this area believe that ASD is a multifactorial disorder and should be caused by several common factors [10]; As a result of the multi-facility of ASD, the available therapies and training methods are also very diverse; Kalyva [11] in his book titled "Autism: Educational and Therapeutic Approaches" describes more than 20 available training methods. However, the remarkable point in the interventions is that most of them are less accessible, costly, and time-consuming and today there is a need to introduce less costly parents-based interventions [12]. Also, most of the interventions are child-based, and at different centers, the child is intervention's target; however, before and after these meetings, parents have the most interaction with their children. Therefore, the short-term and less reliable interventions will not have much impact on their lifestyle and future. Fortunately, current studies have shown that systematic and proper parents-based trainings have positive effects and are remarkable in two perspectives: first, they help parents to cope with their child's disorder and slightly reduce their inner negative feelings; second, by educating and assisting their child and seeing some of their minor improvements and progress, they will be enlightened at least with hope for the future [13, 14]. In this regard, the literature review of the studies about training interventions on parents with ASD children suggests that these interventions can be considered as complementary and even suitable alternative for other interventions. In this regard, the present study intends to systematically review the parents-based training interventions in autism spectrum disorder.

Method

This systematic review was designed and conducted in 2020 and has been prepared according to the systematic reviews guidelines in "Systematic reviews to support evidence-based medicine" book [15].

Search strategy

The required studies were collected from some databases such as PubMed, Scopus, Google Scholar, Cochrane Library, Science Direct, and Web of knowledge from 1 January 2000 to 30 February 2020. To identify and cover most of the published articles, after searching databases, several valid journals were also searched manually. After excluding the irrelevant articles with the study objectives and inclusion criteria, the reference lists of selected articles were searched to enhance the reliability of the identification of the paper and find additional articles. Gray literature also has done through the European Association for Gray Literature Exploitation (EAGLE) and the Healthcare Management Information Consortium (HMIC) databases.

Inclusion and exclusion criteria

The inclusion and exclusion criteria applied for all articles based on the PICO model are presented in the following table 1:

Quality assessment

The reporting quality of all articles after the extraction of articles was evaluated by two evaluators using the Consolidated Standards of Reporting Trials (CONSORT) checklist. This checklist was selected due to its specificity in evaluating interventional studies in particular in clinical trials and its translation and validation in Persian to evaluate the articles [16]. The CONSORT assessment tool is one of the most important and applicable tools in evaluating the clinical trials studies, which was introduced as an international and standard methodology in clinical trials reporting by a group of clinical trials, statisticians and epidemiologists in the mid-1990s. Based on the latest version of the CONSORT Checklist, it contains 37 items to evaluate 6 main points in clinical trials. These six sections include title, abstract, introduction, materials and methods, results, discussion and other information; each of which also includes different sections [17]. Any disagreements between investigators were resolved by discussion and in consultation with the more expert person.

Data extraction

First, three data extraction forms were designed manually in the Word software (one form for inserting the general specifications of articles, one form for information and results of interventions, and one form for the description of implemented interventions). In the next step, the data of 3 articles were extracted experimentally using these forms and possible deficiencies in the initial forms were resolved. Data extraction was done by two reviewers independently. Extracted information in Form 1 (Appendix 1: articles specifications) includes: the author's name and the publication year, the country where the study

was conducted, the study location (home and training centers), the type of study, participant's demographics. Form 2 (Appendix 2: intervention specifications) includes: the author's name and the publication year, brief title of the intervention (Appendix 3: full details of interventions are given in), type of intervention, using the electronic/technology methods for intervention (e-mail, internet, designed programs, games, software), duration of intervention and follow-up, intervention methods (group or individually), evaluation tools, results, statistical significance in results (Yes/No) and overall effectiveness of the intervention (quite effective, somewhat effective and ineffective, the ambiguous cases in this regard were identified in consultation with the research team members). The extracted information in Form 3 (details of the intervention) also include the author's name, publication year of the article and the details of interventions.

Data Analysis

Content analysis was used to analyze the data, which is a method for identifying, analyzing and reporting the themes within the text. It is also widely used in text data analysis [18, 19].

Data coding was performed by two of the researchers. The steps of data analysis and coding were as follows: Familiarity with the text of data extracted from articles (data immersion), identification and extraction of primary codes (identification and extraction of data related more with primary codes), themes identification (placement of primary extracted codes in related themes), reviewing and completing identified themes, naming and defining themes, ensuring the reliability of the extracted codes and themes (reaching an agreement between the two coders by discussing and resolving issues). Descriptive data were analyzed and reported manually with descriptive statistics (percentage, frequency, mean, etc.).

Results

Of the 1830 articles found from mentioned databases and other resources, 730 were deleted due to duplication, then 987 articles were deleted after reviewing the title and abstracts of the articles. After full text reading, 60 articles were deleted because of the inconsistency with the inclusion criteria, finally 53 articles were remained (The characteristics and details of the studies are provided in Appendix 1-3). The figure 1 shows the process of screening the articles:

The country where study was conducted: This research's findings showed that out of the 53 papers, only 7 articles were conducted in low income countries (e.g., Bangladesh) and medium income countries (e.g., Turkey, China, Thailand and Jordan) and 46 other articles in high income countries (e.g., United States, Canada, the United Kingdom, the Netherlands and Australia), 37 of which were conducted in the United States. It should be noted that the division of countries was based on the 2018 World Bank statistics.

The study location: The studies according to interventions location were divided into two main types of study (interventions at home and interventions in training centers). 19 studies were conducted in home, 25 studies in training centers, and 9 studies in both home and training centers.

The participants' number: A total of 1758 parents participated in these studies, of which 1420 were in the experimental group and 338 were in the control group.

Training protocols: 53 protocols were extracted. These protocols include various trainings such as social skills training (13 studies), comprehensive training of ASD (12 studies), behavioral training and management of incompatible behaviors (11 studies), cognitive training (9 studies), sleep health-related training (4 studies), nutrition-related training (2 studies) and toilet-using-related training (2 studies). In addition to these training protocols, in 11 studies, some routine and conventional trainings, due to the ethical considerations, also were provided for control groups in the centers. However, in other studies, according to the conditions in each study, the control group did not receive any special training.

Using technology: In this research, using and not using training technologies such as the internet, tablets, laptops, smartphones, etc. were also evaluated. The results indicated that in 38 studies, some kinds of training technologies were used, but in 15 studies no technology was used. The electronic devices used in these studies according to the needs and structure of the interventions were devices such as voice recorders, camcorders, training clips, cameras, etc.

Type of interventions: The extracted results showed that the type of interventions can be divided into two types of only training and mixed training (training along with practice). Among the studies only 14 studies were devoted to training alone through the holding of the workshop and sessions, and 39 studies also implemented their interventions in the form of training along with practice.

Duration of interventions: Among the included studies, 43 studies referred to the duration of their interventions, which included a period time ranging from 1 to 100 weeks. In general, the studies that lasted less than 10 weeks were studies with only training intervention and studies with practice-based interventions had duration time between 10 and 30 weeks.

Follow-up period: The evaluation of existence or absence of the follow-up period and its duration showed that 17 studies had a follow-up period, and in 36 remaining studies, there wasn't follow-up period. The follow-up period in these 17 studies varied from 2 weeks to 18 months. However, most follow-up courses were conducted between 1 and 6 months.

Duration of intervention sessions: In 42 studies, the duration of each intervention session was indicated, which had a range of 10 minutes to 5 hours' duration. The length of the sessions in most interventions ranged from 60 to 120 minutes.

Intervention method: The results showed that the method of conducting interventions in the studies can be divided into two general types of individual and groups training. Accordingly, 30 interventions were performed individually, 21 interventions in groups and 2 interventions in both individually or in group.

Evaluation instruments: The evaluation instruments in this research were tests and questionnaires that were used before, during and after the implementation of the interventions in the studies. The results indicated that most studies using valid tools, otherwise other similar tools such as researcher-based tools

were used. Two tools for assessing the level of stress in parents and the Vineland scale were used more than other tools in studies.

The studies' results: The results of the studies are different and diverse according to the type of intervention and the target behaviors of each study. Regarding the main objective of this study, which was examining the effectiveness of parent-based training interventions, two general groups (parents and children) could be influenced by the trainings. Therefore, the following conclusions from study results can be presented:

A) Results on parents: The results for parents are the favorable impacts of interventions on parents directly or indirectly (Fig2).

B) Results on children: The results for the children are directly or indirectly favorable effects of the parents-based interventions on the child and the symptoms of his disorder. The results of interventions for the child can be categorized into two general areas according to the ASD syndromes in DSM-5:

1- Disturbance in social interactions: The results of the 21 studies demonstrated some improvement in the social relationships and interactions ability in children. However, the results of 2 studies showed that the provided trainings had no significant effect on the improvement of social skills of these children. There were also contradictory results in the language and communication skill development in children; six studies reported positive results in improving the language skills, but the results of three studies did not show the positive effects of training in improvement of language skills in children.

2- Restrictive and repetitive behaviors and activities: Results from 17 studies indicated that parent-based training interventions had positive effect on the restrictive and repetitive behaviors of children. These behaviors and activities included a range of behaviors related to sleep patterns, nutrition-related behaviors, stereotypical movements, small and large movements, stimulation and hyperactivity, and so on. However, the results of 3 studies also showed that the training did not have a significant effect on these behaviors.

Training protocols: The extracted training protocols comprise a total of 7 different sections as presented in Fig3.

Effectiveness of interventions based on the variables studied in the study (high-income and low- and middle-income countries, location / field of study, type of intervention (educational or combined), method of implementing intervention (individual, group, combined) using or not using the technology, intervention time, follow-up time and protocols) are shown in Table 2.

Interventions in high-income countries were more effective than low and middle-income countries. The effectiveness of the interventions did not differ much regarding the location. The interventions in which the technologies were used were more effective. The effectiveness of educational interventions was less than the combined interventions. Nutrition, sleep and toilet training protocols were more effective than other protocols.

Discussion

Out of 1830 extracted articles, 53 articles remained and the relevant data were extracted from them. The reviewing studies showed that most studies have been carried out in high-income countries; among 53 articles, the 46 articles had been conducted in high-income countries and only 7 studies in low and middle-income countries. Also, the efficacy of studies in high-income countries was estimated to be 26.68%, which is higher than those of low and middle-income countries (42.85%). The findings of this study are considerable in two perspectives: first, despite the scientific and medical progress of advanced countries, parent-based trainings continue to be as one of the most important training and interventions methods, and second, in using the extracted therapeutic protocols, the cultural, social and economic considerations of these countries should be taken into account, and these methods should be adapted to the context and considerations of the countries. In this regard, one sort of the extracted data from these studies was the interventions location; the results showed that almost half of the interventions were carried out in child's home. In the low and middle-income countries, especially among lower socio-economic level ones, the presence of a stranger at home (even in the therapist role) is not accepted; In this regard, most studies in low and middle-income countries have been conducted in training centers [18-21].

Another finding in this study is that, in most studies (37 articles) a variety of technologies were used; most of these technologies were also used in interventions and training protocols. For example, in most studies where parents were asked to practice assignments, clips and educational pictures were provided as templates; or in cases where communication between the educator and the parent was essential, it was calling through virtual networks such as Skype. In some cases, in order to assess the parent's performance and feedback and provide the corrective feedback and appropriate solutions, they were asked to take a picture of their interaction and behaviors with the child at certain times of the day. The effectiveness percentage of studies that used technology was 86.48%, which was higher than other studies (81.25%). This finding of research is also important in two perspectives: first, considering the increasing use of technology and virtual spaces, family access to the internet, smartphone, camcorder and video, etc., can be possible; Second, as mentioned above, considering the context and culture of families in less developed countries, it is likely that the acceptance of a stranger at home may be accompanied by problems; therefore, by using these technologies we can benefit in some cases, such as protocols training, observation of home milieu and even assessment of the interventions results [22].

The other finding of the present study was that among 53 papers, only 14 articles were held in workshops and training forms; participants in this short term training model do not perform a specific practice and they listen to the teacher only. However, this training model also have some benefits for example, if the teaching protocols goal is increasing the theoretical knowledge and parents' awareness, this model can be used [23]. Ideally, it is expected that when the parents training is provided in a practical way along with using facilities such as video clips, their trainings and outcomes could be having more significant improvement [24]; however, in this study, the effectiveness percentage of mixed education (84.61) was higher than the only training method (78.57%). In addition, following the combination of these two

training models we can benefit from both models' advantages. For example, due to the importance of parents' knowledge about ASD, some parts of the protocol can be formulating in form of training only and other parts in form of assignments and practical strategies.

Another result of this study was the evaluation of the trainings duration, duration of each session, and the existence or absence of follow-up courses; the results showed that the duration of interventions had a wide range of 1 to 100 weeks. The duration of the sessions also was not constant, and it fluctuated from 10 minutes to 5 hours; in general, most of the studies carried out ranged from 10 to 30 sessions and had the highest percentage of efficacy (86.95%). The follow-up courses in these studies varied from 2 weeks to 18 months, with most studies ranging from 6 to 15 weeks. In summary, we can determine the child situation in terms of the ASD severity based on DSM-5 and provided interventions (individual and group) according to the target behaviors, and the level of parent's knowledge and awareness; for example, the findings showed that studies that focused on providing parenting practical training had ranged from 10 to 30 weeks. The duration of each session was also between 60 and 120 minutes in these studies. The existence or absence of a follow-up period and its duration can also be influenced by the importance of the study results as well as the amount of access to the research. Therefore, if there are no restrictive constraints in various studies, a follow-up period of 3-6 months will increase the number of studies with reliable and stable results [25].

In the context of the interventions form (individual and group), the results showed that 30 studies were estimated with 90% effectiveness in individual form, 21 studies with 76.19 effectiveness in group form, and in mixed form the effectiveness was significant. Given the widespread symptoms and different categories of ASD, it seems that the homogeneity of the training members can be considered as an important criterion in this regard; According to DSM-5, the severity of ASD, based on the severity of communication and social interaction, and restrictive and repetitive behaviors, is divided into 3 levels; the need for more considerable monitoring and supporting, the need for significant monitoring and supporting and the need for monitoring and supporting [3]. Therefore, we can use as an important criterion in the formation of training groups. In addition, the nature and subject of training protocols are important in this regard; for example, several studies in this study focused on the use of toilet or behavioral problems during sleep in children with ASD; If needed to present these trainings as a group, they should be grouped by parental screening and according to their needs. In general, given the benefits of group-based education, including cost and time-saving factor, as well as the strong theory in this field, such as the social learning theory of Albert Bandura [26], it can be said that group-based training, if well-organized, would be more productive and effective.

Another finding of the present study is the extracted results from included articles; as noted, these results can be categorized into two sections; the results for parents and results for child. The most frequent result for parents was that parental skills had improved in the implementation of various interventions (in 25 studies). This finding is important because most interventions in ASD focused on the child and are usually provided directly by a trainer or expert person [27]; in fact, that each child with ASD has its own unique characteristics and lives in a unique environment where the family as a whole and parents have

the highest levels of interaction and cognition in this environment. Therefore, it seems desirable to emphasize the role of parents in teaching and directing their children.

Other findings were the reduction of stress and psychological problems in parents. The results of 9 studies indicated that the interventions reduced parental stress and psychological problems such as depression and anxiety. Studies have shown that diagnosis of ASD impose extra pressures on parents and other family members [28, 29]; therefore, these results can be helpful.

Increasing the parental satisfaction from interventions and their outcomes on their child was one of the most frequent results in this research; this finding was also cited in 7 studies. In fact, it seems that the contribution of parents in resolving child's problems, especially when they see their efforts result, they experience more positive emotions and get optimistic about the future. The results of the study [30] showed that parents with autistic children are more likely to cooperate with teachers and participate in counseling sessions. Thus, by involving parents in the training courses, they can help to avoid negative emotions such as feelings of guilt, anxiety and disappointment towards the future. In this regard, another significant results were decrease in the parental stress which has been mentioned in other studies [31].

Other important and frequent results for parents are the increasing of their knowledge and awareness about ASD and affected children that were mentioned in 5 studies. In fact, it can be said that ASD identification is the first step in helping children with this disorder; however, in most extracted educational protocols, at least one full session was provided in order to introduce ASD and its features. As mentioned in the type of interventions, only education is necessary due to advantages such as time and cost-saving factors, but it is insufficient; however, in the present study, the effectiveness rate of this type of intervention was less than mixed interventions. Nevertheless, by combining these two educational models, it is possible to use the advantages of both models in parallel. In addition to the mentioned results, some studies have found that quality of life, general conditions of the family milieu, interaction with other family members and friends, social acceptance, self-confidence and parental sleep patterns have improved, as well as the reduction of physical punishment, negative emotional feedback, and feeling of loneliness, body complaints and social deprivation.

In addition to parents, the results also included children, which according to the DSM-5 criteria; these results were summarized in two general aspects: social relationships and behaviors and restrictive and repetitive activities. In sum, the results for children also indicate the desirable effectiveness of parents training, especially in social and behavioral skills; but in the context of more complex cognitive skills such as language teaching, the results were contradictory and are less effective. It should be noted that these results were reported while parents were educating their children as educators, however, the effectiveness of the training by parents compared with other trainings provided by specialists in different centers was equal [32, 33].

The latest finding of the present study is training protocols; these protocols were comprised of seven aspects: social skills, general education, teaching and management of incompatible behaviors, cognitive training, sleep-related training, nutrition-related training and toilet-using-related training. Among the

mentioned protocols, social skills with the 13 studies were the most frequent protocol and their effectiveness was estimated to be 30.29. General education protocols were among the most developed protocols (12 studies) with an effective percentage of 89.5; the general education term was used to facilitate the partitioning of extracted protocols; this aspect included a number of protocols that provided the public and general training courses such as daily caring and general introduction of ASD. Another incongruous protocol was behavioral training and management of incompatible behaviors. The frequency of these protocols was 11, with an effective percentage of 90.9. The protocols related to cognitive education (language skills and community attention) with the relatively high frequency (9 protocols) had the lowest level of effectiveness (55.5%); as noted, the results of these studies were controversial. For example, the results of the study [34] indicated a significant effect of Pivotal Response Treatment (PRT) training on improving the language skills of children with ASD, while one of the study results [35], had no significant effect on the provided parents training in the field of language skills. Oosterling et al. [35] indicated that using different evaluation tools, the characteristics of children with ASD and different levels of verbal intelligence of these children are the possible causes of these results. In one study on autistic children with high levels of verbal intelligence showed that language-related teaching is effective [36]. In addition to the mentioned protocols, sleep-related (4 studies), nutrition-related (2 studies) and toilet-using-related trainings (2 studies) also included protocols in which their effectiveness was fully estimated in this research.

The present study has two main limitations: First, the frequencies obtained in different domains did not fit; this was effective in determining the effectiveness of these domains. For example, the frequency of the intervention method was 30 in individual studies, of which 27 were completely effective, while the frequency of mixed interventions was only 2, of which both were completely effective and their effectiveness was estimated to be 100%. The second limitation was that the meta-analysis of the studies was not possible due to the type of reports and their nature.

Conclusion

Based on the results of this study, the importance of designing and implementing interventions based on parents' training in ASD is becoming more evident; on the one hand, studies have reported significant results for both parents and children, on the other hand, the various aspects examined in this study could be used to create an appropriate protocol for parent training. One of the important dimensions was the interventions location that according to the results of this study, the mixed interventions (both at home and in the centers) had the highest percentage of effectiveness; therefore, it is suggested that this point will be considered in the development of training protocols. Regarding the type of intervention, considering the higher effectiveness of the mixed intervention, the choice of this intervention model seems preferable. Considering the best results of mixed interventions (both individual and group), using this mixed model is preferable. Interventions that used any of the existing technologies had higher percentage of effectiveness, therefore the use of technology in providing training protocols for parents seems to be desirable. Regarding the interventions duration, the results showed that interventions performed within the range of 11 to 30 weeks had the highest percentage of effectiveness; therefore, the

setting of new protocols would be more preferable. Evaluation the extracted protocols from the studies showed that protocols with defined target variable in training have more effect, for example, the effectiveness percentage of sleep, nutrition and toilet-using-related protocols have been estimated completely.

Abbreviations

ASD: Autism Spectrum Disorder

Declaration

Ethics approval and consent to participate

Not applicable in this section.

Consent for publication

Not applicable in this section.

Availability of data and materials

All data generated or analyzed during this study are included in this published article.

Competing Interests

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper

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Authors' contributions

T SH and A S were mainly responsible for the design and supervision of the study. R R and G K were involved in the screening and extracting of data. SH H T and I SH performed a quality appraisal. SH H and A S analyzed data(Meta-analysis). R R, T SH and RR prepared the article and all the authors revised and approved it.

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Tables

TABLE 1:
inclusion and exclusion criteria according to PICO

PICO	Inclusion criteria	Exclusion criteria
Population	Parents with ASD children	Interventions with targets other than parents such as children, teachers and
Intervention	Studies with parent training based interventions	Unconventional and common interventions for parents (without regular protocols) in different centers.
Comparative group	Parents without ASD child and any interventions	Parents with ASD and other disorders child such as ADHD
Outcome	Reduction the parents and their children ASD-related problems	Irrelevant outcomes such as parents comments about presented trainings
Other	Studies in the English language	Observational or non-interventional studies Survey studies Studies using assessment tools

Table 2:
Effectiveness of parent training-based interventions on the studied variables

Variables	Variable level	Interventions NO.	Effective interventions	Effectiveness (%)
Country	High-income countries	46	36	78/26
	Low and middle-income countries	7	3	42/85
Intervention location	Training centers	25	21	84
	Home	19	16	84/21
	Mixed	8	7	87/5
	Not identified	1	1	100
Intervention type	Education	14	11	78/57
	Mixed (training and education)	39	33	84/61
Intervention method	Individual	30	27	90
	Groups	21	16	76/19
	Mixed	2	2	100
Using technology	Yes	37	32	86/48
	No	16	13	81/25
Interventions duration	week $\leq$ 10	17	14	82/35
	11 $\leq$ week $\leq$ 30	23	20	86/95
	31 $\leq$ week $\leq$ 50	2	1	50
	week $\geq$ 51	1	0	0
	Unknown	10	9	90
Follow-up duration	week $\leq$ 5	3	2	66/6
	6 $\leq$ week $\leq$ 15	9	6	66/6
	16 $\leq$ week $\leq$ 30	3	2	66/6
	week $\geq$ 31	5	4	80
	Unknown	33	28	84/8
Protocols	Social skills	13	12	92/3
	Comprehensive training	12	10	87/5

Management of incompatible behaviors	11	10	90/9
Cognitive training	9	5	55/5
Sleep-related training	4	4	100
Nutrition-related training	2	2	100
Toilet-using-related training	2	2	100

Figures

Figure 1

Figure 2

Training interventions results for parents

Figure 3

Training protocols