

The Effectiveness of Applied Behavior Analysis based Intervention in Modification of Stereotype Behaviours and Behavioural Issues of Children with Autism Spectrum Disorder - A Systemic Literature Review using PRISMA

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Abstract

The aim of the study was to systemically review the effectiveness of interventions in the use of the ABA Method (Applied Behavior Analysis) to manage and improve stereotype behaviours and behavioural issues in children with Autism Spectrum Disorder (ASD). A total of 14 studies were selected and reviewed following strict procedures. The study included studies published from different regions of the world since 2002 that provide an assessment of the efficacy of ABA treatment by comparing the participants' performance before and after the application of treatment. This systemic review is also included a study that belongs to different field (Dentistry), where it showed the effectiveness of the ABA method on the improvement of oral hygiene of children with ASD. This systematic literature review employed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA), which helps to identify reliable, valid literature and critically appraise the published systematic reviews. It is anticipated that the study will contribute to the body of the knowledge thorough a comprehensive and up-to-date assessment of the effectiveness of ABA intervention.

Keywords: Applied Behavior Analysis, Children, Autism Spectrum Disorder

Introduction

Disability is not only a medical disease; it is a complicated reality that considers the interaction of a person's physical characteristics and the features of the society in which he or she lives' (World Health Organization, 2016). Autism or Autism Spectrum Disorder (ASD) is a

neurological and developmental disability or disorder with a complicated condition that includes problems with social interaction, communication and by restricted and repetitive behaviour (Lam et al., 2006). Apart from that, autism also means lifelong mental disability caused by failure of brain function, which affects a child's ability to communicate, build relationships with people and unable to respond to the outside world appropriately.

ASD is a relatively severe condition of disability whose signs are often noticed by parents during the first three years of a child's life (Landa, 2008). It can involve a wide range of symptoms and skills (motor, language, learning skills) or a minor problem or a disability that needs full-time care in a special facility. Symptoms include two areas identified with core deficiencies: social communication/interaction and restrictive, repetitive patterns of behaviour (American Psychiatric Association, 2013). Additionally, it encompasses a variety of co-occurring conditions that frequently affect individuals with ASD, such as emotional and behavioural difficulties (e.g., anxiety, compulsions, aggressive behavior destruction, and uncooperative behaviour), sleep difficulties (e.g., difficulty falling asleep, superficial sleep, early awakening, and low sleep efficiency), feeding and eating difficulties, gastrointestinal difficulties, sensory sensitivities, learning and intellectual disabilities, as well as co-morbid conditions (Maskey, 2013). On the other hand, motor impairments are widely reported in most children with ASD, especially poor behavioural and speech skills (Srinivasan & Bhat 2016), and they significantly impact their social communication development, adaptive functioning, and quality of life (MacDonald et al., 2017).

The development of motor skills depends a lot on the development of the child's brain, body balance, and improved eye and hand coordination. Ironically this is a deficiency in autistic children, and these characteristics can make life very challenging to children and youth with ASD and have service needs in behavioural, educational, health, leisure, family support, and other areas. Previous studies have shown that in case of physical disabilities, therapeutic support and assistance of the coaches may improve or correct, in the same way, the implementation of the Applied Behavior Analysis (ABA) Method including other methods such as picture exchange communication system (PECS), drug therapy and music therapy can modify and change behavioural speech issues (Rafiee & Khanjani, 2020). This ABA method is well recognized in medical discipline as it is well developed, research-based, scientific that focuses on analysing, designing, implementing, and evaluating social and other environmental modifications to produce meaningful changes in human behavior (Dillenburger & Keenan, 2009). It also includes direct observation, measurement, and functional analysis of the relations between environment and behaviour. The applied behaviour analysis is the basis for intervention used to cure individuals suffering from developmental disabilities, especially for the autism spectrum (Cooper et al., 1987).

ABA is a branch of behavioural science that is concerned with the experimental investigation of socially important behaviour in relation to environmental factors. Throughout the last four decades, applied behaviour analysts have developed several procedures aimed at enhancing, reducing, and maintaining significant human behaviours (Lovaas, 1987). This research will significantly impact severe problem behaviour, developmental disabilities, organisational behaviour, behavioural pharmacology, behavioural economics, and others. As seen by the growing number of service providers and certified specialists in this sector, the field of applied behaviour analysis has seen more substantial growth in behavioural intervention for children with autism and autism spectrum disorders (Cooper et al., 1987).

In psychosocial terms, basic skills influence positive self-concept in peer relationships, necessary for an active lifestyle and success in games and sports. Children with ASD have

difficulty mastering basic motor skills and cannot learn to interact positively with their peers, and experience deficits in motor skills. The association between poor motor coordination indicates an increase in weak or damaged nerves, whereas these nerves are responsible for integrating information from the motor senses. Thus, it is common knowledge that children with ASD are often associated with uncontrollable behaviour problems; poor speech skills and solitary attitudes limit the process of behaviour in daily life.

Understanding these obstacles and recognising the behavioural issues facilitators, the ABA method will help establish and design in the enhancement of the motor skills by ensuring their appropriate therapy. This method assists in finding out and understanding the reasons for specific behaviour. ABA method is a science of behaviour management to train individuals in mastering various types of abilities comparable to the abilities of other individuals. This methodology effectively teaches essential communication, games, sports, social interaction, daily living, and self-help skills. The implementation of the ABA Method is limited to autistic children and implemented in various fields such as sports, education, and vocational skills. It is also a field of psychology specialised in the analysis and modification of behaviour through applying theories. This modification aims to identify functional relationships between specific environments and behaviours.

The research on the ABA approach for children with ASD has been steadily developing over the last decade, and its effectiveness has already been the topic of several meta-analyses published in peer-reviewed publications. Although the inclusion criteria for each of these studies varied, they all confirmed the efficacy of ABA intervention in treating ASD, regardless of whether pre- and post-intervention techniques or various group designs were employed to assess effectiveness. The current systematic study sought to determine the efficacy of ABA intervention in enhancing stereotyped and adaptive behaviour.

Previous systemic reviews on children with ASD were conducted in the context of Western and European countries (Elsabbagh et al., 2012). However, to the best of the authors' knowledge and literature searching, almost no systemic review paper was included studies on the ABA method for children with ASD from Asian countries, especially Southeast Asia (Elsabbagh et al., 2012; Sun & Allison 2010). Precise quantification of ABA intervention effectiveness, including different world regions, is not currently available. Thus, this systemic review aims to analyse the effect of the ABA method on the modification of behaviours in children with ASD. This study also pursued a comprehensive account of comprehensive, intensive and long-term ABA intervention effects on subjects' functioning in motor skills domains. Therefore, studies targeting behaviours will be discarded.

Method

Registration and PRISMA guidelines

The procedures for this systemic review have been registered in the PROSPERO International prospective register of systematic reviews, which published protocols from systematic reviews prior to the initiation of data extraction to reduce reporting bias (Schiavo, 2019). This study was designed following the PRISMA guidelines (Tong et al., 2012).

Eligibility Criteria

This review included all types of published English language research that assessed the effectiveness of the ABA Method for managing and improvement of behavioural issues in children with ASD, except 'grey literature' such as non-peer-reviewed articles, conference

papers, working papers, evolutions, textbooks, reports and theses. Two authors of the current review formulated the following PICOS parameters to include studies.

Population: Any child with ASD from schools, care homes, rehabilitation centres or organisations involved in the ABA method delivery to the children between the ages of 3 and 18 years old was included. Additionally, participants were diagnosed with ASD included only.

Intervention: Any intervention with or without a control group was needed for the studies.

Control: Monitor none (studies did not need a control group or comparator because this analysis was not a comparative efficacy study).

Outcomes: The ABA method's effectiveness for managing and improving behavioural issues in children with ASD were noted.

Setting: Any normal setting where the ABA method was applied on children with ASD (e.g. school, care homes, rehabilitation centres and nursing home care) were provided.

Table 1

Inclusion and Exclusion Criteria

Inclusion Criteria	Exclusion Criteria
i) This study limited the search to empirical studies and systemic reviews.	i. Book Chapters, textbooks, working papers, or other types of non-peer-reviewed publications were excluded from the study.
ii) This study focused only on children with ASD.	ii. Children or people who were affected by other disorders were not included.
iii) Papers written in the English language from January 2002 to January 2022 have been included.	iii. Articles that are not written by using the English Language.
	iv. Studies published before January
	v. 2002 were excluded as well.
	vi. Articles that represent review or survey regarding previous work.
	vii. Hospital-based studies were excluded.

Information Sources and Search Strategy

Two separate scientists determined papers using electronic database searches and manual searches for relevant published studies and systematic reviews. PubMed and the Cochrane Library were searched. It was limited to the title, abstract, or topic, depending on the database's search capabilities. The search was restricted to English-language journals and by selected date. Thus, both databases were searched from January 2002 to January 2022 as it was good to use sources published in the past 20 years to identify research that is more current and reflective of very recent information.

Keywords Search Strategy

Two authors experienced in database searching developed the search strategy. The search terms were merged using a search technique based on the Boolean operators "AND" and "OR" in conjunction with different Medical subject terms. Each search record was documented as to the date of search, database, keywords, the number of studies included and the number of eligible studies. The main keywords utilised in the article search included autism spectrum disorder OR autism OR autistic disorder OR ASD AND applied behaviour analysis OR ABA. The following strategy was developed for PubMed: (((((autism spectrum disorder) OR autism) OR autistic disorder) OR ASD) OR autistic children)))) AND applied

behaviour analysis) OR ABA) OR behavioural therapy))) AND behaviour) OR behaviour skill) AND stereotype behaviour) AND children)))).

During Cochrane database searching, trials matched ((((((autism spectrum disorder) OR autism) OR autistic disorder) OR ASD) OR autistic children)))) AND applied behaviour analysis) OR ABA))))) in Title Abstract Keyword - with a Cochrane Library publication date between January 2002 and January 2022, in Cochrane Protocols, Trials, Clinical Answers, Special Collections with 'Developmental, psychosocial and learning problem and public health' in Cochrane Groups (Word variations have been searched).

Results

Search results and quality appraisal of the studies

A total of 324 publications (294 from PubMed via MEDLINE, from Cochrane 28 and manual search 2) were identified (Figure 1) through advanced searches (additional filter and search limit) with different titles. After screening titles and removal of duplicate studies, 75 papers were selected from PubMed and 14 articles from the Cochrane database. Two reviewers independently screened the titles and abstracts of all selected studies for inclusion and decided which articles needed to be excluded and full-text screening. From these, 35 studies from PubMed and eight studies from Cochrane were selected by the reviewers after independently assessing the methodological quality and results of the studies (to minimise the risk of bias). The reviewers then compared the lists of studies, and disagreements were sorted out through detailed discussion for each study. Ultimately, this led to 15 articles – 11 from PubMed (8 from the initial search and 2 from the revised search), 2 from Cochrane and 2 by manual search as shown in Figure 1.

One author carried out the systematic search, while another author checked the inclusion/exclusion of studies from a subset. The two writers individually examined the selected papers and reached consensus on which research to include in the review. The first and second writers extracted data and assessed the possibility of bias separately. In the case of a dispute, resolutions were made through discussion with the third referees, if required, after the complete manuscript was inspected. The instrument addressed the following domains: sequence creation, concealment of allocation, blinding of participants and personnel, blinding of result assessment, comprehensive outcome data collection, selective outcome reporting, and other sources of bias.

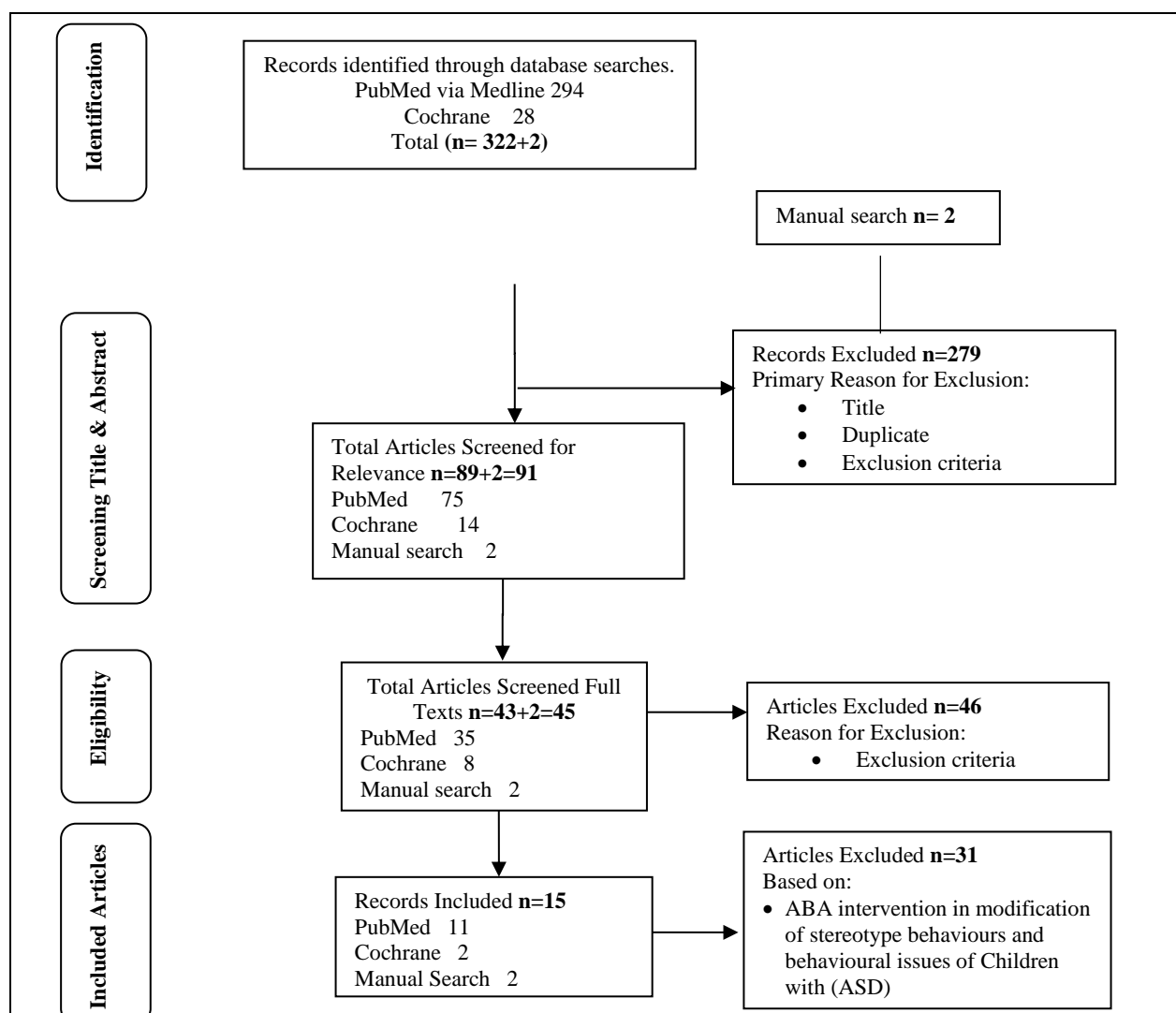


Figure 1: PRISMA Flow Chart on Literature searching

Table 2

Studies Published from Various Regions of The World 2005-2022

Author	Study Region	Study Design Sample size,	Intervention	Result
Kristen et al (2022) (17)	Southern California	A Retrospective, observational study, sample size 334	Over 24 months	Of those referred for ABA, 66% initiated ABA and remained in services for 12 months, whereas less than half (46%) remained in services for 24 months. Having a history of special education was associated with longer time spent in ABA, whereas having a single parent was associated with discontinuation of ABA. A minority of children received a full ABA dose (28%), but the lowest functioning children still

Eldevik et al (2006) (18)	Norway	Retrospective study, sample size 28	Two years	experienced clinically significant adaptive behaviour gains after 24 months of ABA ($p = 0.02$). Low-intensive behavioural treatment may be more effective than low-intensive eclectic special education treatment. Gains in IQ and language skills made in the behavioural treatment group were more modest than those reported in previous studies employing intensive behavioural treatment.
Eikeseth et al (2012) (19)	Norway	A clinical study, sample size 35	Two years	Children who received Intensive behavioural Intervention (EIBI) scored significantly higher on all scales of adaptive behaviour than the children receiving as usual treatment. Moreover, children in the EIBI group showed significant improvements in adaptive behaviours, maladaptive behaviors, and autism symptoms after one year of treatment, and this change continued into the second year of treatment.
Fernell et al (2011) (20)	Stockholm, Sweden	A longitudinal prospective naturalistic study. Sample size 208	Two years	Study data did not support that children with ASD generally benefit more from the most intensive ABA intervention programs than from less intensive interventions or targeted interventions based on ABA.
Fageeh et al (2021) (21)	Jazan, Saudi Arabia	In a cross-sectional study, 15 un-cooperative children between the ages of 6-12 years.	Four weeks	The application of the ABA method using avatars and delivered through videos can significantly improve knowledge on oral hygiene among cooperative autistic children.
Fava et al (2011) (22)	Italy	In a comparative study, sample size 22	Six months	Cross-setting staff- and parent-mediated EIBI produces substantial gains on diagnostic, developmental, language,

Rafiee & Khanjani (2020) (23)		A semi-experimental study including pre-tests and post-tests. Sample size 40	2015-2016	adaptive and behavioural measures in children with ASD. Applied behaviour analysis therapy was essentially effective in enhancing eye contact and social interaction and reducing stereotypical and masochistic behaviours.
Jaffe (2010) (24)		A case study, sample size	Ten weeks	ABA method seems to have significantly improved social behaviours and reduced stereotyped behaviours in autistic people. Most of the behavioural problems decrease gradually through over learning.
Zachor et al (2007) (25)	Israel	A comparative study, Sample size 39		The ABA group showed significantly more significant improvements than the Electric Development group post-intervention. Pre-post-intervention differences in language and communication domain were significant only for the ABA group. Both groups showed significant improvement in the reciprocal social interaction domain. However, the effect size was greater for the ABA group.
Peters-Scheffer et al (2011) (26)	Netherlands	Controlled studies with a pre-test/post-test design		comprehensive early intervention behavioural intervention was effective in children with autism spectrum disorders compared with other treatments or usual practice in terms of IQ and adaptive behaviours
Magia et al (2007) (27)	UK	The perspective study, sample size 44	Two years	Home-based EIBI, as implemented in the community, and autism-specific nursery provision produced comparable outcomes after two years of intervention.
Remington et al (2007) (28)	UK	The perspective	Two years	Robust differences favouring intensive behavioural intervention were observed on

		study, sample size 44		measures of intelligence, language, daily living skills, positive social behaviour, and a statistical measure of the best outcome for individual children.
Peters-Scheffer et al (2013) (29)	Netherlands	Randomised controlled trial, Sample size 40	Two years	The treatment group outperformed the control group on IQ, developmental age, adaptive behaviour, interpersonal relations, play and receptive language, and fewer autistic symptoms were seen in the treatment group. Following the intervention, no differences between groups were found on expressive language, behavioural flexibility and maternal stress. Progress in developmental age, adaptive behaviour, interpersonal relations, play and receptive and expressive language was clinically and reliably significant for the majority of the Low-Intensity Behavioral Treatment group.
Howard et al (2005) (30)	USA	A comparative study, sample size 45	14 th months	The differences were statistically significant for all domains except motor skills. Learning rates at follow-up were also substantially higher for children in the Intensive Behavior Treatment group than for the other two groups. These findings are consistent with other research showing that IBT is considerably more efficacious than "eclectic" intervention
Dawson et al (2012) (31)		A Randomised controlled trial, Sample size 48	2 years	This was the first trial to demonstrate that early behavioural intervention is associated with normalised patterns of brain activity, which is associated with improvements in social behaviour in young children with an autism spectrum disorder.

The table above shows studies that have been done from various countries. There were 15 studies conducted from 2005 until 2022. The diversity of these studies included retrospective studies, clinical studies, naturalistic studies, four cross-sectional studies, comparative studies, case studies, controlled studies and prospective studies. Most of studies show significant findings with a P value is less than 0.05, which is 0.02. Most studies also prove a positive improvement in ASD children in terms of speech, behaviour and social interaction. Although all ABA intervention studies evaluated behavioural changes in children with ASD, overall, they differed in terms of study design, parameters, sample size, participant characteristics, intervention and intervention characteristics, making it a challenge to determine which parameters are most likely to contribute to the effectiveness, and level of effectiveness of ABA interventions.

Discussion

Behavioural treatment methods guide the treatment of children with autism. However, they must be adapted to each child's specific circumstances. While several studies have been undertaken to determine the efficacy of ABA intervention in children with ASD, the collective analysis of this material has been impeded by various factors: (1) studies employ inconsistent methodological features in terms of research design, sampling methods, and quality standards; (2) intervention characteristics are highly variable, including treatment duration, intervention model, and mode of delivery (e.g. clinic-based vs parent-managed); (3) participants' pre-intervention functioning and age are highly variable; and (4) studies report outcomes using a variety of different metrics (Morris, 2000).

This review identifies that the majority of the literature in this area has been less-subjective (sample size less than 25), designed in two distinct types of research (Fageeh et al., 2021; Fava et al., 2011), making comparisons extremely difficult, and that studies are frequently procedure-specific (in terms of treatment approaches), preventing results from being widely disseminated through standard methods of clinical science. Interventions are shown to be effective when all these are carefully planned, engineered, monitored, and designed in such a way to target and facilitate the specific skill domains and can communicate outside the treatment environment of the hospital for children with ASD and the speech and language issues. The families of these children and school personnel should cooperate and support these children's treatments by presenting family-centred and school-centred interventions. Also needs to be trained in evidence-based teaching and behavioural management practices.

Positive results have been reported in all the studies for behavioural modification, speech and language problems, daily living skills, academic performance and communication skills. However, these findings have had some effects on the social and health policies of different countries (World Health Organization, 2016; Elsabbagh et al., 2012; Fernell et al., 2018). Studies suggest that children have a greater chance of integrating into school with ABA intervention without additional specialist support whilst maintaining gains over long-time follow-ups (Peters-Scheffer et al., 2011). However, the dissemination of research findings may still be considered limited. For example, recent reviews on autism do not even acknowledge the very existence of ABA intervention Srinivasan & Bhat (2016); Sun & Allison (2010) or misrepresent its application and effects. Despite the questions that arise from the studies mentioned above, we may reach safe conclusions about treatment efficacy using systematic qualitative and quantitative analysis of the findings of at least some of the intervention studies.

Although there are several models of ABA intervention in autism and developmental disabilities, all bonafide programs should share a standard set of core features: a) treatment may begin as early as 3 to 4 years of age, b) intervention is intensive (20–40 weekly hours) and in addition, incidental teaching and practice goals may be operating during most waking hours, c) intervention is individualised and comprehensive targeting a wide range of skills, d) multiple behaviour analytic procedures are used to develop adaptive repertoires, e) treatment is delivered in one-to-one format with a gradual transition to group activities and natural contexts, f) normal developmental sequences guide and treatment goals, and g) parents are, to different extents, trained and become active co-therapists. A study where the author's study data did not support Fernell et al (2011) and another study where limitations of the study include lack of independent assessments of children receiving EIBI and lack of random assignment of participants to treatment groups Eikeseth et al (2012) were found.

Limitations and Future Study Directions

Several methodological flaws were identified in the other two investigations (Eldevik et al., 2006; Peters-Scheffer et al., 2013). The study was a retrospective analysis rather than a planned inquiry, with no randomization of participants, a small sample size, no direct quality control measures for therapy, and assessments made in part by the study's authors. Additionally, the authors assert that the curriculum for behavioural programmes is more structured and manualized, and they did not gather data on these aspects (Eldevik, 2006). There was no fully randomised controlled trial design used, and treatment groups were assigned based on the child's availability to visit the school, two groups that were very similar on key dependent measures prior to treatment beginning, and no data were collected on maintenance recommendations and overall treatment outcome for their child (Peters-Scheffer et al., 2013). Inadequate documentation of the review process necessitates care when assessing the review results' trustworthiness (Peters-Scheffer et al., 2011). Future studies should address this issue in the recruiting and retention of participants. Another limitation of the present study is the small number of studies, and it was not possible to formally assess publication bias. Further study could conduct a meta-analysis with the inclusion of more literature.

Contributions

Autism spectrum disorders are a group of complex neurodevelopmental disorders, and the world is concerned about them. However, the prevalence of ASD in many Asian countries is still unknown, especially in Southeast Asian countries. Moreover, no studies were found in this region that reported the ABA method's application on children with ASD. This review noted about two studies conducted in middle-east countries (Fageeh et al., 2021; Rafiee & Khanjani, 2020). Findings from this review suggest that continuous efforts are needed to raise awareness of autism and improve the quality of life of affected families in Asian countries. This study will also contribute to the evidence base needed to design further research and make policy decisions on addressing this issue in this region for allocation of resources and services.

Conclusions

Based on the opinions expressed, the researchers found that a study on the effectiveness of a combination of the ABA Method and Behavior Modification Method on children with ASD for speech and behavioural problems can be conducted as a reference for teachers' parents.

Additional research is needed to refine current behavioural treatment approaches. Finally, the authors hope that this review paper will help promote the future application of the ABA method on children with ASD-related research in Asia as this region continues to raise its standard of living in all aspects.

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