Efficacy of Applied Behavioral Intervention in Preschool Children with Autism for Improving Cognitive, Language, and Adaptive Behavior: A Systematic Review and Meta-analysis

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Objective To review the effectiveness of applied behavior intervention (ABI) programs for preschool children with autism spectrum disorder (ASD) in their cognitive, adaptive behavior, and language development.

Study design Systematic reviews, randomized or quasirandomized controlled trials (RCT) of ABI delivered to preschool children with ASD were reviewed. Quantitative data on cognitive, language, and behavior outcomes were extracted and pooled for meta-analysis (RevMan 4.2).

Results Thirteen studies met the inclusion criteria. Six of these were randomized comparison trials with adequate methodologic quality (PEDro ≥ 6). Meta-analysis of 4 studies concluded that, compared with standard care, ABI programs did not significantly improve the cognitive outcomes of children in the experimental group who scored a standardized mean difference (SMD) of 0.38 (95%CI −0.09 to 0.84; $P = .1$). There was no additional benefit over standard care for expressive language; SMD of 0.37 (95%CI −0.09 to 0.84; $P = .11$), for receptive language; SMD of 0.29 (95%CI −0.17 to 0.74; $P = .22$) or adaptive behavior; SMD of 0.30 (95%CI −0.16 to 0.77; $P = .20$).

Conclusions Currently there is inadequate evidence that ABI has better outcomes than standard care for children with autism. Appropriately powered clinical trials with broader outcomes are required. *(J Pediatr 2009;154:338-44)*

Recently the prevalence of autism spectrum disorder (ASD) was reported as 38.9 per 10 000 children in a population-based sample from southeast England.[1] There have been reports that the prevalence of ASD is increasing.[2] In 2002, Chakrabarti and Fombonne[2] concluded that the rate of pervasive developmental disorders (PDD) is higher than reported 15 years ago. Although this increase in ASD arguably may be due to a change in diagnostic criteria, improved screening and early detection, ASD is a concern for health and educational professionals who are providing intervention programs for these increasing numbers.

Childhood ASD is a pervasive developmental disorder that is characterized by abnormal functioning in 3 main areas of development before the age of 3 years: (1) reciprocal social interaction, (2) communication, and (3) stereotyped repetitive behavior.[3] In addition to these diagnostic features a range of nonspecific problems commonly is identified, such as anxiety, sleeping and eating disturbances, temper tantrums, self- and other-directed aggression.[3] Autism is understood to be part of a spectrum. Children with ASD present with great variability in severity and clinical picture, with some attaining functional language whereas others have no effective communication; some remaining isolated and aloof while others are affectionate to particular people.[4] Many children have a limited play repertoire that can be repetitive and perseverant about certain objects. Others develop stereotypical behaviors such as hand flapping, walking on tiptoes, or body rocking.[5] The diversity of ASD suggests that no one treatment has been effective for all children, and response to treatment may depend on the level of intelligence. Between 50% and 70% of children with ASD also present with an intellectual disability.[1] Measures of cognitive functioning are often used as an outcome after intervention. The original study of applied behavior intervention (ABI) by Lovaas et al[6] in 1987 claimed that children who received intensive behavioral treatment (IBT) made significant gains in IQ scores. Many

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ABA	Applied behavioral analysis	IBT	Intensive behavioral treatment
ABAI	Applied behavior analysis intervention	PDD	Pervasive developmental disorders
ABI	Applied behavior intervention	PEDro	Physiotherapy Evidence Database
ASD	Autism spectrum disorder	SMD	Standardized mean difference

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Supported by a National Health and Medical Research Council Career Development Fellowship (NHMRC 473849), and a Smart State Fellowship from the Department of Innovation, Queensland. The authors declare no potential conflict of interest.

Submitted for publication Mar 24, 2008; last revision received Jul 7, 2008; accepted Sep 2, 2008.

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0022-3476/$ - see front matter

10.1016/j.jpeds.2008.09.012

of the subsequent studies evaluating ABI have tried to replicate the original study by Lovaas et al[6] and have measured similar outcomes to add to the body of evidence for ABI.

ABI is based on the theory of applied behavioral analysis (ABA) and may be known as *applied behavior analysis intervention* (ABAI) or IBT.[7] It is a method developed by Lovaas et al[8] of teaching appropriate behaviors by breaking tasks down into small discrete steps and training in a systematic and precise way called *discrete trial training*. This approach is based on the concept that children with ASD have significant difficulties with learning, being unable to learn through imitation, and listening as their normal peers do. Initially ABI was administered at a high intensity, with 40 hours of direct training each week administered to the child by student therapists under supervision.[9] In the earlier studies of discrete trial learning "aversives" were used to encourage children to participate. Aversives are negative responses by the adult given to the child when noncompliant behavior occurs. In later studies, aversives tend not to be used in ABI programs.[10] The current recommended 40-hour weekly intervention in the home setting is a major burden to the family. More recently the intensity has been reduced to 30 hours in response to families' other needs.[10] This is still a problematic level of input for most families and service providers.[10] The primary aim of this systematic review was to determine the efficacy of ABI in enhancing cognition, language and adaptive behavior when provided to preschool children with ASD.

METHODS

Search Strategy

This systematic review followed the guidelines of the Cochrane Developmental, Psychosocial and Learning Problems Review group (see Cochrane Psychosocial and Learning Problem, Search Strategy for specialized register in The Cochrane Library). The following databases were comprehensively searched: the Cochrane Database of Systematic Reviews, the Cochrane Central Register of Controlled Trials (CENTRAL, The Cochrane Library), MEDLINE Advanced (1996-Nov 2007), EMBASE (1988-Nov 2007), PsychINFO (1985-Nov 2007), CINAHL (1982-Nov 2007), AMED (1985-Nov 2007).

The search strategy comprised the following MeSH headings or Key words: (1) autism *or* autistic spectrum disorder *or* Asperger syndrome *or* (PDD) *or* child development disorder; *and* (2) behavior therapy *or* early childhood intervention *or* applied behavior analysis *or* early behavioral treatment; *and* (3) cognition outcomes *or* rehabilitation *or* child health outcomes.

Studies were downloaded into Endnote, version 9 (Thomson Reuters, New York, New York), and duplicates were deleted. Studies were identified by title and abstract and screened by the authors to assess whether they met the selection criteria set out below.

Selection Criteria

To be included in the meta-analysis, studies had to meet the following selection criteria.

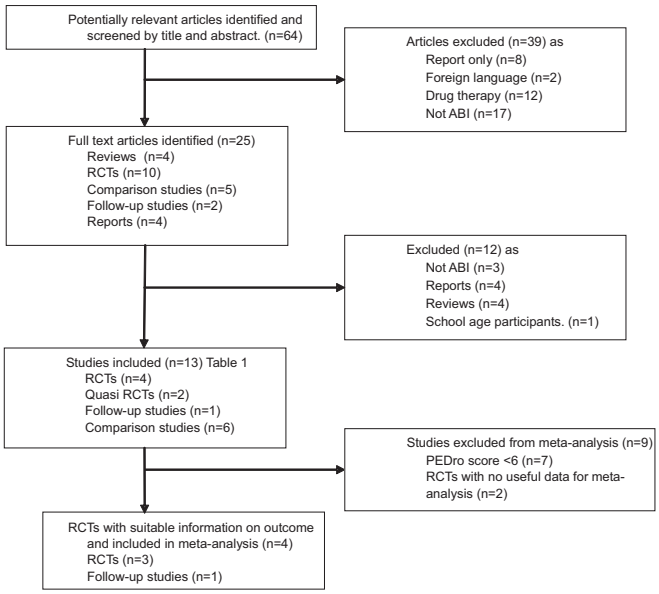

Figure 1. Study flow diagram.

1. Trials included systematic reviews, randomized controlled trials (RCT), quasirandomized controlled trials, or controlled trials.
2. Participants comprised preschool children with a diagnosis of ASD or PDD.
3. Interventions included those that focused on ABI approaches to behavioral management. These included direct behavior management for the child, parent education and training, and consultation with caregivers in the community.
4. Interventions were delivered to the parents/caregivers and/or directly to the child, by special educators, teachers, speech pathologists, psychologists, or other allied health professional students.
5. Studies occurred while the children were of preschool age between 18 months and 6 years.
6. Outcomes included cognitive, language, or adaptive behavior outcomes.

For studies that were excluded, see Study Flow Diagram (Figure 1).

Data Extraction

For qualitative analysis the Physiotherapy Evidence Database (PEDro) Scale of quality assessment was used in evaluating these articles by the 2 authors independently. The reliability of this scale has been established.[11] The PEDro scale consists of 11 qualitative measures scoring 1 or 0 for each item.[12] It was not possible to blind the subjects receiving intervention or the therapists delivering the intervention, therefore the maximum possible PEDro score was 9. Studies scoring 6 or more on the PEDro scale are considered to have adequate internal validity for quantitative meta-analysis (Table I).