

Long-Term Outcomes of Early Intervention in 6-Year-Old Children With Autism Spectrum Disorder

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Objective: We prospectively examined evidence for the sustained effects of early intervention based on a follow-up study of 39 children with ASD who began participation in a randomized clinical trial testing the effectiveness of the Early Start Denver Model (ESDM) at age 18 to 30 months. The intervention, conducted at a high level of intensity in-home for 2 years, showed evidence of efficacy immediately posttreatment.

Method: This group of children was assessed at age 6 years, 2 years after the intervention ended, across multiple domains of functioning by clinicians naive to previous intervention group status.

Results: The ESDM group, on average, maintained gains made in early intervention during the 2-year follow-up period in overall intellectual ability, adaptive behavior, symptom severity, and challenging behavior. No group differences in core autism symptoms were found immediately posttreatment; however, 2 years later, the ESDM group demonstrated improved core autism symptoms and adaptive behavior as compared

with the community-intervention-as-usual (COM) group. The 2 groups were not significantly different in terms of intellectual functioning at age 6 years. Both groups received equivalent intervention hours during the original study, but the ESDM group received fewer hours during the follow-up period.

Conclusion: These results provide evidence that gains from early intensive intervention are maintained 2 years later. Notably, core autism symptoms improved in the ESDM group over the follow-up period relative to the COM group. This improvement occurred at the same time that the ESDM group received significantly fewer services. This is the first study to examine the role of early ESDM behavioral intervention initiated at less than 30 months of age in altering the longer-term developmental course of autism.

Key Words: early, intervention, autism, long-term, outcomes

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Early intensive behavioral intervention is recognized as an efficacious approach for improving outcomes for young children with autism spectrum disorders (ASD). Intellectual ability, communication and language functioning, adaptive behavior, and educational placement and support have all been demonstrated to improve with early intervention.¹⁻³ However, most studies of comprehensive, intensive intervention report only immediate outcomes at the end of intervention, and the degree to which these outcomes are sustained over time is largely unknown.⁴⁻⁶ This is an important question because it is possible that developmental gains achieved with early intervention could diminish after intensive services end. The one long-term outcome study of comprehensive intensive early intervention of which we are aware was published over 20 years ago, and followed 19 children from age 7 to age 11.5 years, all of whom participated in a seminal study of intensive behavioral intervention.¹ Results showed that the intervention group maintained gains in IQ and adaptive behavior, suggesting that intervention effects may be long lasting.⁷

The Early Start Denver Model (ESDM)⁸ is a naturalistic behavioral intervention that integrates applied behavior analysis (ABA) methods with developmental approaches and parent coaching designed to promote learning, social reciprocity, and affective engagement. It is designed for children with ASD as young as 12 months of age, can be used in a variety of settings,^{9,10} and intervention goals are set within the context of a specified curriculum.¹¹ In the first randomized clinical trial of the ESDM, children were directly assessed and diagnosed with an autism spectrum disorder at age 18 to 30 months and randomly assigned to either ESDM intervention or to treatment-as-usual in the greater Seattle-area community (Community [COM]). The groups were stratified on sex and developmental quotient. The ESDM group was offered 2-hour intervention sessions twice per day, 5 days per week, for 2 years by trained therapists. The number of hours of therapist-delivered intervention (sum of both individual one-on-one hours and group intervention hours) did not significantly differ between the ESDM and COM groups. Results indicated a positive impact of ESDM on child development across a number of domains, including intellectual ability, particularly in the expressive and receptive language domains, adaptive behavior, and less severe autism diagnosis at the end of intervention.³ Significant group differences in social behavior at outcome were also found.¹² However, no significant group



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differences in autism symptom levels were found based on direct observation by examiners blinded to intervention group at the end of the study period.

The present study examined whether early intensive behavioral intervention with the ESDM had sustained effects 2 years later in this same cohort of children. This will be the first study, to our knowledge, to examine the role of early intensive behavioral intervention initiated at less than age 30 months in altering the long-term clinical course of ASD. We hypothesized, first, that children who received 2 years of ESDM in the previous RCT would maintain outcomes for 2 years after the end of the intervention study across all key developmental domains including IQ, adaptive behavior, autism symptom levels, challenging behavior, and diagnosis by demonstrating the same or better average levels of age-adjusted performance than at the end of study treatment; and, second, that at age 6, the ESDM group would continue to show greater intellectual ability, adaptive behavior, and social functioning and less severe ASD diagnoses and challenging behavior levels as compared to children receiving treatment as usual, and that the groups would not differ in terms of core autism symptoms and repetitive behavior, consistent with results reported previously immediately after intervention. We further hypothesized that the gains demonstrated immediately after intervention would generalize to peer relationships, a new domain of functioning that is developmentally relevant at age 6 years but was not assessed as part of the original study.

METHOD

Participants

A total of 39 children who participated in an RCT of early intensive intervention at the University of Washington were assessed at age 6 years. The original RCT study sample consisted of 48 children diagnosed with an ASD at age 18 to 30 months and randomized into 2 groups (ESDM, $n = 24$; COM, $n = 24$) stratified by developmental quotient and sex. Research diagnosis of ASD at baseline was based on direct assessment by expert clinicians with the Autism Diagnostic Interview-Revised (ADI-R),¹³ Autism Diagnostic Observation Schedule-WPS (ADOS-WPS),¹⁴ and clinical judgment using all available information. The ADI-R, a parent interview, and the ADOS-WPS, a semi-structured play observation, are both standardized measures used to diagnose ASD. In addition, information from family history, medical records, cognitive test scores, and clinical observation made during the course of the research assessments were considered when assigning the *DSM-IV-TR* diagnosis (detailed in Dawson *et al.*).³ The 2 groups did not differ at baseline in severity of autism symptoms, chronological age, IQ, sex, or adaptive behaviors in the original RCT, nor were there baseline group differences for the subgroup of children who completed the 2-year follow-up assessment (all $p > .05$). All children who, at baseline, had a history of issues such as significant sensory or motor impairment, serious traumatic brain injury, major physical anomalies, genetic disorders associated with ASD (e.g., Fragile X syndrome), seizure disorder, or prenatal drug exposure were excluded from this study.³ This sample was assessed in the previous study at baseline and at 1 and 2 years after randomization, coinciding with the end of ESDM intervention, and long-term follow-up was conducted at age 6 years (hereafter

referred to as baseline, 1-year, 2-year, and age-6 assessments, respectively). Attrition rates were equal across groups over the follow-up period, with 3 participants lost in each group. In the original RCT, from baseline to the end of the intervention period, the ESDM group lost no children, but the COM group lost 3 (ESDM, 1-year $n = 24$, 2-year $n = 24$, age-6 $n = 21$; COM 1-year $n = 23$, 2-year $n = 21$, age-6 $n = 18$). The age-6 follow-up sample was evaluated with the same diagnostic procedures used at the baseline and 2-year assessments.

Data reported for the current study were obtained when participating children were on average 6 years of age (mean = 72.9 months, standard deviation [SD] = 2.6, $N = 39$). In the age-6 sample, 72% were of white ethnicity, with 9 girls and 30 boys (COM = 4 girls, ESDM = 5 girls). Mothers were on average highly educated, with only 13% reporting no college, 23% reporting some college, and 64% reporting college completion. The treatment groups did not differ with regard to maternal education (ESDM: 62% college grad, 28% some college, 10% no college; COM: 70% college grad, 18% some college, 12% no college; $\chi^2 = 0.63$, $p > .50$). Median annual household incomes between the groups also did not differ (ESDM \$90,000, COM \$85,000; Wilcoxon rank sum test, $W = 152.5$, $p > .50$).

Parents were interviewed about their children's service use every 6 months from the end of the intervention study (2-year) to follow-up (age-6). At each interview, parents were asked to characterize the child's use of behavioral health treatments and therapy provided by allied health professionals that had occurred since the last interview. During the follow-up period, the average amount of ABA-based therapy and other therapies (e.g., speech/language, occupational therapy, physical therapy) received were calculated. Roughly 41% of the children (5 of 18 COM and 11 of 21 ESDM children) received no ABA-based therapy during this period. Given the skewed distributions of treatment hours received, group differences were examined with a nonparametric Wilcoxon rank sum test. The ESDM group received fewer ABA-based therapy hours per week (mean = 2.40, SD = 2.97, range 0–8.4) than the COM group (mean = 4.36, SD = 3.56, range 0–11.0); however, this was not significant ($W = 244.5$, $p = .108$). The ESDM group received significantly fewer hours/week of other therapy services (mean = 1.64, SD = 1.73, range 0–6.3) than the COM group (mean = 3.14, SD = 2.33, range 0.6–7.8; $W = 2.68.0$, $p = .027$). Interestingly, for the ESDM group, 41.5% of these therapy hours were in a group setting, whereas only 21.7% of these therapy hours in the COM group occurred in a group setting.

Procedures

Intellectual ability and autism symptom level were measured at all time points by a licensed clinical psychologist or doctoral students in clinical psychology under the supervision of a licensed clinical psychologist at the University of Washington. The assessors were naive to the intervention status of the children at all assessments. Repetitive behavior, challenging behavior, and adaptive behavior were measured by parent-reported questionnaire at all time points. Peer relationships were measured by parent-reported interview at age 6 years. All study procedures were approved by the University of Washington Institutional Review Board and were conducted with written consent of primary caregivers.

Measures

Intellectual Ability. The Differential Ability Scales (DAS)¹⁵ School Age Level were used to measure intellectual ability at the age-6 assessment. This battery is designed and normed for use with children from ages 2 years 6 months to 17 years 11 months. We report a

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