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# Clinical Predictors of Discontinuation of Adapted Intensive Applied Behavior Analysis in Children with Autism: A 10 Year Retrospective Study

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**Abstract**

**Objective:** Applied Behavior Analysis (ABA) is an evidence-based intervention for autism spectrum disorder (ASD), but treatment discontinuation remains common. Adapted Intensive Applied Behavior Analysis (AIABA) is a culturally modified version of ABA developed for Iranian families, that integrates cultural and family values into daily routines. This study examined clinical and contextual predictors of AIABA discontinuation.
**Method:** We reviewed clinical files of 529 children with ASD (mean age = 41.7 months, SD = 13.8) who received AIABA at the Tehran Autism Center (2011 2021). Predictors included parental engagement, programming mode (in person vs. semi online), medication use, age at diagnosis, comorbidity, motor development, additional therapies, and symptom severity. Logistic regression identified predictors of discontinuation.
**Results:** Discontinuation occurred in 66.7% of children. Mean treatment duration was shorter in the discontinuation group (11.4 months) than the planned termination group (19.1 months). Significant predictors included lower parental engagement (OR = 0.03, 95% CI [0.01 0.07]), concurrent medication use (OR = 3.22, 95% CI [1.89 5.49]), semi online supervision (OR = 3.01, 95% CI [1.61 5.63]), higher pre cessation symptom severity (OR = 1.04, 95% CI [1.01 1.06]), and younger age at diagnosis (OR = 0.97, 95% CI [0.95 0.98]). The model explained 38.8% 53.9% of variance and correctly classified 83.4% of cases.
**Conclusion:** Lower parental engagement, concurrent medication use, semi online supervision, higher pre cessation symptom severity, and younger age at diagnosis significantly predicted AIABA discontinuation. Targeting parental engagement, monitoring intensity, and coordinated care may reduce dropout risk. Given the retrospective, single center design and reliance on record-based measures, results require cautious interpretation. Prospective multi-site studies are needed to translate these predictors into retention focused planning.

**Key words:** *Autism Spectrum Disorder (ASD); Applied Behavior Analysis; Family; Iran; Patient Non-Compliance; Retrospective Studies*

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Autism spectrum disorder (ASD) is a neurodevelopmental condition characterized by restricted and repetitive behaviors (RRBs) and persistent deficits in social communication and interaction (1). Recent global estimates suggest that ASD affects approximately 1 in 100 children worldwide, with identification rates rising in many countries. Beyond core symptoms, ASD places substantial emotional, financial, and caregiving burdens on families and is associated with long-term psychosocial challenges (2).

A growing body of evidence emphasizes the importance of initiating interventions during early childhood to take advantage of heightened neural plasticity (3, 4). Early intervention can substantially improve developmental trajectories and enhance communication, learning, and social functioning (5). Behavioral interventions are considered first-line treatments for ASD, while medications may be used to address specific co-occurring psychiatric or behavioral conditions such as aggression or severe irritability (6).

Applied Behavior Analysis (ABA), developed in the 1960s by Baer, Wolf, and Risley and later expanded by Lovaas, aims to reduce challenging behaviors and promote adaptive, communicative, and learning skills in children with ASD (7, 8). Comprehensive ABA programs are typically intensive and long-term, often delivered for 20 to 40 hours per week over several years. They begin with one-to-one structured interventions and gradually transition toward more naturalistic and group-based formats as skills improve (8-12). ABA is widely recognized as an evidence-based practice (EBP) for ASD (12-15). EBPs integrate the best available scientific evidence, practitioner expertise, and client values with contextual factors (16).

Multiple meta-analyses have demonstrated that comprehensive ABA-based interventions produce moderate to large improvements in intellectual functioning, language, adaptive behavior, and social skills compared with standard or minimal care (17-25). Research has also identified several predictors of optimal ABA outcomes, including higher baseline cognitive functioning, younger age at treatment entry, higher treatment intensity, lower autism severity, and longer intervention duration (26-31).

Despite its established effectiveness, delivering ABA services presents practical challenges across different settings. These challenges include high resource and cost demands, variability in study quality and implementation standards, limited availability of providers who adhere to standard protocols, cultural and regional differences in the acceptance and use of ABA programs, substantial time and participation requirements for families, and heterogeneity in intervention intensity and outcomes. This heterogeneity complicates consistent real-world application (20). Such factors may affect treatment engagement and continuity, particularly in low resource or culturally distinct contexts.

In Iran, family structure and values play a key role in shaping treatment delivery and expectations. Iranian families tend to place strong emphasis on child development and educational achievement. A key expectation, particularly among parents of younger children, is that their child will be able to attend mainstream schools. Often driven by the hope that their child will reach a typical developmental level, many parents are unwilling to register with governmental (e.g., the State Welfare Organization) or non-governmental institutions for financial or support services, as they do not want their child to have an official record of autism. Mothers are usually highly involved in daily caregiving, while long term social support systems for individuals with disabilities remain limited. Consequently, parents may have high expectations for treatment outcomes, yet they also face considerable pressure and responsibility. These cultural and contextual factors can both encourage intensive family involvement and heighten stress related to treatment demands. Within this context, an Iranian adaptation of ABA called Adapted Intensive Applied Behavior Analysis (AIABA) was developed in 2001 following a nationally funded research initiative (17).

AIABA operationalizes the Early, Comprehensive, Consistent, and Contextual (ECCC) model within the framework of Iranian culture and family values. This model emphasizes structured one to one intervention combined with systematic caregiver training to promote consistent behavior management. Importantly, therapeutic strategies are delivered throughout all waking hours within the family setting, integrated naturally into the child's daily routines. Caregiver involvement is considered essential for maintaining treatment intensity and ensuring the generalization of skills (8, 32). Although this model has evolved over the past 25 years, services remain individualized and family centered.

Treatment attrition is a well-recognized challenge across mental health services. Dropout rates in child and adolescent psychiatric care have been reported to range from 28% to 68%, and discontinuation rates in ASD interventions are also considered high (33-38). However, despite extensive research on the effectiveness of ABA, there is limited empirical evidence regarding predictors of discontinuation of ABA based services, particularly within culturally specific service models.

The present study aims to identify clinical and contextual predictors of AIABA service discontinuation among children with ASD within the Iranian cultural and healthcare context. Understanding these predictors may help improve service planning, family support strategies and long-term treatment engagement.

## Materials and Methods

### *Study Design and Setting*

This retrospective record-based study was conducted using the clinical files of children with ASD who received AIABA services at the Tehran Autism Center (formerly

known as the Center for the Treatment of Autistic Disorders) between 2011 and 2021.

***Participants and Sample Selection***

Of approximately 3,500 records initially reviewed, 529 children with complete data on all primary predictors and outcome status met the inclusion criteria and were included in the final analysis. Consecutive sampling was used to reduce selection bias.

Inclusion criteria were: (a) confirmed ASD diagnosis based on the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition, Text Revision (DSM IV TR; 39) or the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM 5; 40) criteria, with the diagnosis established independently by at least two qualified specialists (child psychologist, child psychiatrist, and/or child neurologist) who were blinded to each other's diagnostic judgments; (b) enrollment in the AIABA program; and (c) availability of baseline assessment data and follow up treatment status (planned termination versus discontinuation).

Exclusion criteria were: (a) incomplete core diagnostic records; (b) absence of follow up information regarding treatment continuation status; and (c) major missing data on primary predictor variables.

Importantly, all children included in this study were diagnosed at the Tehran Autism Center as part of the intake and diagnostic assessment process immediately prior to AIABA initiation. Therefore, age at diagnosis and age at treatment entry were considered to be the same.

***Measures***

***Demographic Checklist***

A structured intake checklist was used to record demographic and background variables, including child age and sex, parents' ages and education levels, sibling status, and medical and developmental history. These data were collected during the initial diagnostic assessment.

***Structured Diagnostic Interview for Autism (SDIA)***

The SDIA is a structured clinical interview administered to parents or caregivers, covering reciprocal social interaction, communication and language, and restricted and repetitive behaviors (41). Diagnostic thresholds were aligned with the DSM-IV-TR (42) and the International Classification of Diseases, 10th Revision (ICD 10; 43) criteria. The SDIA was developed (44) within prior national research and was modeled on established structured autism interviews. At the study center, SDIA results are used as part of a multidisciplinary diagnostic consensus process rather than as a standalone diagnostic tool.

***Gilliam Autism Rating Scale – Persian Edition (GARS-P)***

Similar to the original version (45), the GARS P is a 56-item standardized rating scale that assesses autism symptom severity across four domains: social interaction, communication, stereotyped behaviors, and developmental disturbance. Prior validation studies in Iran have demonstrated strong psychometric properties, including high internal consistency (Cronbach's alpha = 0.89; 46), strong construct validity (correlation with the Childhood Autism Rating Scale [CARS] = 0.80), and high diagnostic sensitivity and specificity at the recommended cutoff.

GARS P scores obtained at baseline and at final evaluation were used as standardized indicators of symptom severity.

***Procedure and Data Sources***

A comprehensive chart review was conducted. Data were extracted from multiple structured documentation sources routinely used in the AIABA program:

1. Initial diagnostic assessment files
2. Parent training course records prior to AIABA initiation
3. Standardized session reports completed after each AIABA session
4. Bi-weekly clinical progress assessments
5. Monthly program review reports
6. Bi-monthly GARS-P ratings completed by parents
7. Six-month multidisciplinary progress reports

Treatment planning and monitoring were conducted by a multidisciplinary team including psychologists, supervisors, a speech therapist, an occupation therapist, instructors and parents.

Operational definitions of all key predictors (AIABA monitoring mode, comorbidity, motor development, intervention mode, parental engagement, age at diagnosis, duration of AIABA, mode of termination, and autism symptom severity) are presented in Table 1.

**Table 1. Operational Definitions and Data Sources for Clinical and Contextual Predictors of AIABA Discontinuation**

| Predictor variable | Definition |
|---|---|
| AIABA Monitoring Mode | Fully in-person supervision (Greater Tehran residents) versus semi-online supervision (outside Greater Tehran), based on program delivery records |
| Comorbidity | Presence of documented psychiatric or medical comorbidity at intake based on clinical evaluation and parent report (cross-checked with medical documentation when available); coded dichotomously (present/absent) |
| Motor Development | Classified as typical versus delayed based on developmental history recorded by clinicians at intake assessment |
| Intervention Mode | Categorized into three groups: AIABA only; AIABA plus other habilitative therapies; AIABA plus pharmacotherapy (medication use derived from parent report and prescription records when available) |
| Parental Engagement | Rated by supervisors using a structured program adherence checklist (attendance, home implementation, daily practice time); categorized as low, moderate, or high using predefined operational criteria |
| Age at Diagnosis | Child age in months at time of confirmed multidisciplinary ASD diagnosis |
| Duration of AIABA | Number of months from AIABA initiation to planned termination or discontinuation |
| Mode of Termination | Coded as planned termination versus parent-initiated discontinuation |
| Autism Symptom Severity | Measured using GARS-P total score at baseline and prior to termination |

AIABA = Adapted Intensive Applied Behavior Analysis

***Data Quality and Missing Data***

Parent reported data (e.g., medication use, comorbidity) were cross checked with clinical or prescription records. Any remaining parent reported variables are interpreted cautiously and are discussed as potential sources of measurement bias.

Regarding missing data, there were some incomplete responses in the parent completed GARS P forms, primarily due to the completion of multiple evaluation forms during routine clinical assessments. As noted earlier, cases with missing GARS P scores either at treatment start or at treatment end were excluded from the analyses using listwise deletion. No imputation procedures were applied, as the study relied on retrospective clinical records collected during routine service delivery.

***Statistical Analysis***

Descriptive statistics were computed first. Binary logistic regression was then conducted to identify predictors of AIABA discontinuation. All nine predictor variables were entered simultaneously based on prior literature and clinical relevance. Multicollinearity was assessed using tolerance and variance inflation factor (VIF) statistics. All tolerance values exceeded 0.30 (ranging from 0.457 to 0.990), and VIF values ranged from 1.010 to 2.186, indicating that multicollinearity was not a concern. Thus, diagnostics of multicollinearity did not reveal any problematic collinearity among the predictors.

As detailed above, cases with missing outcome data or missing primary predictor variables had already been excluded based on the predefined exclusion criteria. Remaining missing values in secondary variables were handled using listwise deletion in the regression analyses. All analyses were conducted using SPSS version 27.0.0.

***Ethical Considerations***

This study was conducted in accordance with the 1964 Helsinki Declaration ethical standards. The procedures were reviewed and approved by the Ethics Committee of the Shahid Beheshti University, Tehran, Iran (ethical code: SBU.ICBS 96/1020). All parents were asked to verify that they had read the consent to participate form carefully and signed it to ensure informed consent was obtained.

## Results

Of the 529 included children, 437 were male (82.6%) and 92 were female (17.4%). The mean age at treatment entry was 41.7 months (SD = 13.8). The demographic characteristics of the study sample are summarized in Table 2, and parental education levels are illustrated in Figure 1. The overall sample consisted predominantly of male children. Most parents held at least a bachelor's degree. In the majority of cases, children had no siblings; but, when siblings were present, their mental health status was also examined.

Children's mean age, as well as fathers' and mothers' ages, are presented in Table 2 separately for the discontinuation group, the planned termination group as well as the total sample. Gender distribution and sibling characteristics are also reported in Table 2.

**Table 2. Demographic Characteristics of Children with ASD Receiving AIABA Services**

| Variable | | Overall Sample N = 529 | Planned Termination N = 176 | Discontinuation N = 353 |
|---|---|---|---|---|
| Child age, mean months ± SD [range] | | 41.73 ± 13.79 [17 - 92] | 41.53 ± 14.94 [18 - 80] | 41.83 ± 13.20 [17 - 92] |
| Paternal age, mean years ± SD [range] | | 39.28 ± 5.47 [28 - 55] | 39.59 ± 5.38 [31 - 55] | 39.12 ± 5.52 [28 - 55] |
| Maternal age, mean years ± SD [range] | | 35.17 ± 4.70 [23 - 48] | 35.78 ± 4.71 [26 - 48] | 34.86 ± 4.68 [23 - 47] |
| Child gender | Male, n (%) | 437 (82.6) | 145 (33.2) | 292 (66.8) |
| | Female, n (%) | 92 (17.4) | 31 (33.7) | 61 (66.3) |
| Existence of other siblings | No, n (%) | 302 (57) | 101 (33.4) | 201 (66.6) |
| | Yes, n (%) | 227 (43) | 75 (33) | 152 (67) |
| Mental health of siblings | Typical development, n (%) | 192 (84.6) | 61 (31.8) | 131 (68.2) |
| | With psychiatric disorders, n (%) | 30 (13.2) | 12 (40) | 18 (60) |
| | Without psychiatric disorders, n (%) | 5 (2.2) | 2 (40) | 3 (60) |

ASD = Autism Spectrum Disorder
AIABA = Adapted Intensive Applied Behavior Analysis

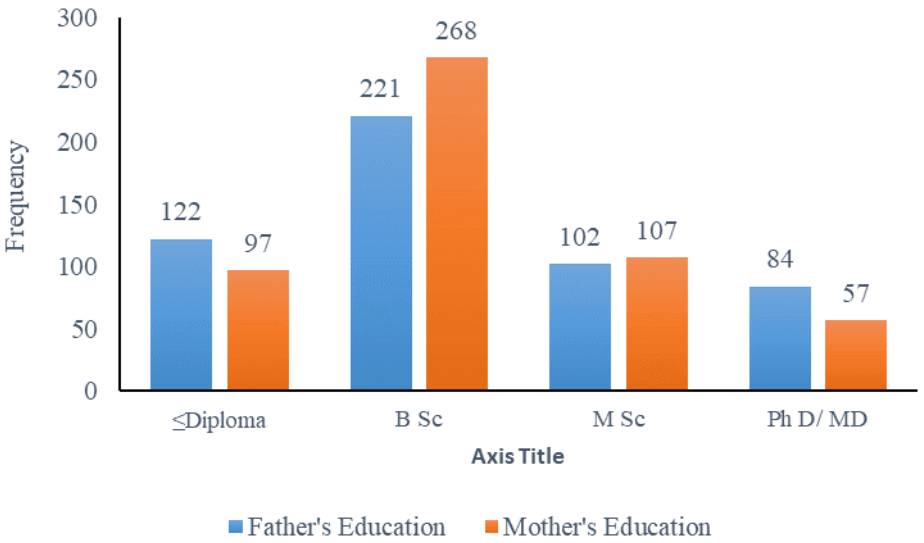



**Figure 1. Parental Education Levels in Families of Children with ASD Receiving Adapted Intensive Applied Behavior Analysis Services**

***Descriptive Statistics of Clinical Variables***

Clinical characteristics of the participants are presented in Table 3. Overall, 66.7% of the sample had discontinued AIABA services. Approximately 70% of participants received AIABA in an in-person attendance format, while the remainder received services through a semi online format. Approximately 70% of participants received additional habilitative interventions alongside AIABA, including speech therapy, occupational therapy, play therapy, parent management training, and art therapy. Medication therapy was used in 45% of cases. Most children (79.2%) demonstrated normal motor development, and 71.5% had no documented comorbid disorder.

Parental engagement in treatment was generally at a moderate level in the total sample; however, parental engagement was notably lower in the discontinuation group compared with the planned termination group (Table 3).

**Table 3. Clinical Characteristics of Children with ASD Receiving AIABA Services**

| Variable | | Overall Sample N = 529 | Planned Termination N = 176 | Discontinuation N = 353 |
|---|---|---|---|---|
| Programing and monitoring modes | In-person | 397 (75.0) | 150 (85.2) | 247 (70.0) |
| | Semi-online | 132 (25.0) | 26 (14.8) | 106 (30.0) |
| Comorbidity | No | 378 (71.5) | 131 (74.4) | 247 (70.0) |
| | Yes | 151 (28.5) | 45 (25.6) | 106 (30.0) |
| Motor development | Normal | 419 (79.2) | 152 (86.4) | 267 (75.6) |
| | Delayed | 110 (20.8) | 24 (13.6) | 86 (24.4) |
| Intervention modes* | AIABA only | 175 (33.1) | 61 (34.8) | 114 (65.2) |
| | AIABA plus other habilitative interventions | 354 (66.9) | 115 (32.5) | 239 (67.5) |
| | AIABA plus medication | 238 (45.0) | 56 (23.5) | 182 (76.5) |
| Parent engagement | Low | 192 (36.3) | 13 (6.7) | 179 (93.3) |
| | Moderate | 207 (39.1) | 84 (40.6) | 123 (59.4) |
| | High | 110 (20.8) | 79 (71.8) | 31 (28.2) |
| | Not reported | 20 (3.8) | 0 (0.0) | 20 (100) |
| ASD diagnosis age (month) | | 41.73 ±13.61 | 41.2 ±15.1 | 41.9 ±12.7 |
| AIABA duration (month) | | 14.02 ±9.75 | 19.1±9.1 | 11.4 ±9.0 |
| GARS-P** score at initiation of treatment | | 81.45 ±10.89 | 80.6 ±11.5 | 81.8 ±10.5 |
| GARS-P score at termination of treatment | | 75.58 ±12.46 | 69.9 ±12.3 | 78.3 ±11.5 |

*Percentages do not equal 100% due to overlapping categories — Mean ± standard deviation
** GARS-P: Gilliam Autism Rating Scale-Persian edition — N (%)

ASD = Autism Spectrum Disorder
AIABA = Adapted Intensive Applied Behavior Analysis

The distribution of concurrent non AIABA interventions is presented in Figure 2. Because some children received multiple concurrent services, the percentages exceed 100%. The mean age at ASD diagnosis was similar across groups: 41.9 months (SD = 12.7) in the discontinuation group, 41.2 months (SD = 15.1) in the planned termination group, and 41.7 months (SD = 13.6) in the overall sample. In contrast, the mean duration of AIABA differed markedly between groups. Children in the discontinuation group received AIABA for an average of 11.4 months (SD = 9.0), compared with 19.1 months (SD = 9.1) in the planned termination group.

Autism symptom severity, measured by the GARS-P, showed interesting patterns. Mean baseline scores were comparable between the discontinuation group (81.8, SD = 10.5) and the planned termination group (80.6, SD = 11.5). However, at the time of treatment termination, the discontinuation group had notably higher GARS-P scores (78.3, SD = 11.5) compared with the planned termination group (69.9, SD = 12.3), suggesting that those who continued treatment showed greater symptom reduction.

***Clinical Predictors of AIABA Discontinuation***

A binomial logistic regression model was conducted to examine the predictive role of clinical variables in distinguishing AIABA discontinuation from planned termination. Model statistics and regression coefficients for individual predictors are presented in Table 4. The variables entered into the model included: programming and monitoring mode (in person versus semi online), presence of comorbidity, motor development status, receipt of additional habilitative services, medication use, parental engagement in treatment, age at ASD diagnosis, GARS P score at AIABA initiation, and GARS P score prior to planned termination or discontinuation. As shown in Table 4, the logistic regression model was statistically significant ($\chi^2$ (12, N = 529) = 259.534, $p < 0.01$). The included variables explained between 38.8% (Cox & Snell $R^2$) and 53.9% (Nagelkerke $R^2$) of the variance in treatment discontinuation and correctly classified 83.4% of cases.

**Table 4. Logistic Regression Model Fit for AIABA Discontinuation**

| | Cox & Snell R Square | Nagelkerke R Square | Chi-square | Overall percentage | df | P |
|---|---|---|---|---|---|---|
| Model | 0.388 | 0.539 | 259.534 | 83.4% | 10 | **0.001** |

AIABA = Adapted Intensive Applied Behavior Analysis

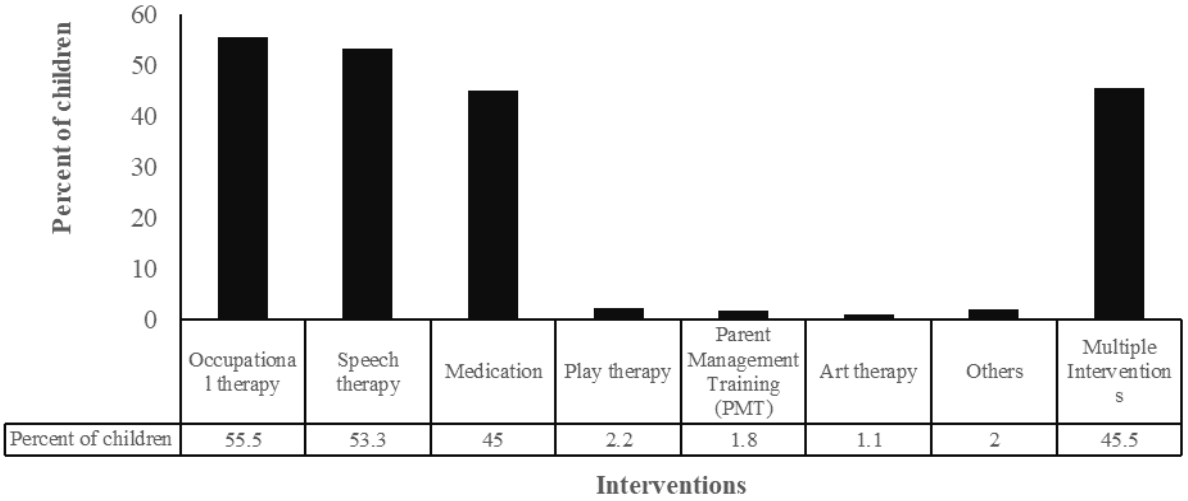



**Figure 2. Percentage of Children Receiving Concurrent Non- Adapted Intensive Applied Behavior Analysis Interventions During Treatment**

(Note: Percentages do not equal 100% due to overlapping categories)

According to Table 5, the following variables significantly predicted AIABA discontinuation, listed in order of statistical strength: parental engagement in treatment, medication use, programming and monitoring mode, GARS P score prior to planned termination or discontinuation, and age at ASD diagnosis. The presence of comorbidity, motor development status, receipt of additional therapeutic services, and GARS P score at treatment initiation were not significant predictors.

Higher parental engagement was associated with a substantially lower likelihood of discontinuation. Compared with low engagement, children with high parental engagement had a markedly reduced probability of discontinuing AIABA (OR = 0.03, 95% CI [0.01, 0.07]), and moderate engagement was also associated with reduced discontinuation risk (OR = 0.13, 95% CI [0.06, 0.27]). Medication use alongside AIABA was associated with an increased likelihood of discontinuation (OR = 3.22, 95% CI [1.89, 5.49]). Semi online programming and monitoring was likewise associated with an increased discontinuation probability compared with in person services (OR = 3.01, 95% CI [1.61, 5.63]). The baseline GARS P score at AIABA initiation did not significantly predict discontinuation. In contrast, higher GARS P scores measured immediately prior to discontinuation or planned termination significantly predicted discontinuation (OR = 1.04, 95% CI [1.01, 1.06]). Older age at ASD diagnosis was associated with a lower likelihood of discontinuation (OR = 0.97, 95% CI [0.95, 0.98]).

**Table 5. Logistic Regression Coefficients for Clinical Predictors of AIABA Discontinuation**

| Variable | B | S.E. | Wald | P | OR | 95% CI |
|---|---|---|---|---|---|---|
| Parental engagement | -3.33 | 0.40 | 69.19 | 0.001 | 0.03 | [0.01, 0.07] |
| AIABA plus medication | 1.17 | 0.27 | 18.64 | 0.001 | 3.22 | [1.89, 5.49] |
| Modes of programing and monitoring | 1.10 | 0.31 | 11.99 | 0.001 | 3.01 | [1.61, 5.63] |
| GARS-P score at discontinuation or planned termination | 0.04 | 0.01 | 11.09 | 0.001 | 1.04 | [1.01, 1.06] |
| Diagnosis age (month) | -0.031 | 0.01 | 10.05 | 0.002 | 0.97 | [0.95, 0.98] |
| Existence of comorbidity | 0.12 | 0.29 | 0.18 | 0.66 | 1.13 | [0.63, 2.03] |
| Motor development | 0.38 | 0.35 | 1.17 | 0.27 | 1.46 | [0.73, 2.91] |
| AIABA plus other therapeutic services | 0.26 | 0.27 | 0.97 | 0.32 | 1.30 | [0.76, 2.22] |
| GARS-P score at beginning of AIABA | -0.007 | 0.01 | 0.29 | 0.58 | 0.99 | [0.96, 1.01] |
| Constant | 1.47 | 1.07 | 1.89 | 0.16 | 4.36 | |

***Notes**:* Intervention items were coded as follows: Programing and monitoring modes: 0 = In-person, 1 = Semi-online; Existence of comorbidity: 0 = No, 1 = Yes; Motor development: 0 = Normal, 1 = Delay; AIABA plus other therapeutic interventions: 0 = No, 1 = Yes; Receiving medication: 0 = No, 1 = Yes; Parent engagement: 0 = Low, 1 = Moderate, 2 = High. Thus, the odds ratio (OR) can be interpreted as the odds for cases coded as 1 (AIABA discontinued) compared to cases coded as 0 (AIABA planned termination).
***Abbreviations***: B = Unstandardized beta; SE = Standard Error; OR = Odds Ratio; CI = Confidence Interval.
AIABA = Adapted Intensive Applied Behavior Analysis

## Discussion

This study examined nine predictor variables related to child, family characteristics, and therapy mode to better understand early discontinuation of AIABA in children with ASD in Iran. The findings indicate that low parental engagement, concurrent medication use, semi online programming and monitoring, higher ASD symptom severity immediately before treatment cessation, and younger age at diagnosis were significantly associated with a higher likelihood of discontinuing AIABA. Overall, these findings are broadly consistent with prior research on engagement and retention in ASD interventions, while also extending the literature by identifying specific service delivery and family level factors associated with treatment discontinuation.

### *Parental Engagement in Treatment*

Low parental engagement emerged as the strongest predictor of AIABA discontinuation. This result aligns with a substantial body of literature demonstrating that parent involvement is a central component of effective ASD intervention and is associated with better child outcomes and greater treatment continuity (47-54). A previous work has shown that parental engagement, treatment intensity, and duration jointly predict intervention outcomes (55). Parent mediated and family based intervention models emphasize that when caregivers actively participate in intervention planning and implementation, skill generalization and maintenance are more likely to occur across settings (48-52, 60-64). Neurodevelopmental research further suggests that consistent, enriched behavioral input may be associated with measurable neural and functional changes (56, 57). In this context, parental engagement may function not only as a practical support factor but also as a mechanism that sustains treatment exposure over time. Compared with prior studies, the present findings highlight that insufficient engagement is not only related to weaker outcomes but is also directly associated with premature treatment termination. From a clinical perspective, this finding supports structured parent training, empowerment, and continuous coaching models as retention enhancing strategies (54, 60–64).

### *Concurrent Medication Use and AIABA*

Concurrent pharmacotherapy was the second strongest predictor of treatment discontinuation. The proportion of children receiving medication in this sample is consistent with previous reports indicating that 30% 50% of children with ASD receive psychotropic medication (65, 66). However, medication in our sample was often initiated at a relatively young age compared with regulatory approval ranges for commonly prescribed agents (67, 68). The early initiation and relatively high frequency of pharmacotherapy in this sample may reflect a strong parental desire for optimal treatment outcomes, while also highlighting prevailing attitudes, values, and policy directions within the Iranian healthcare system.

Prior literature indicates that medication is frequently used to manage associated symptoms such as irritability, hyperactivity, and behavioral dysregulation rather than core ASD features. Therefore, medication use may act as a proxy indicator of greater behavioral complexity or family distress rather than a causal factor in discontinuation. Notably, in the present study, baseline ASD severity and comorbidity were not independent predictors of dropout, whereas parental engagement was. This suggests caution in interpretation: medication use may be associated with discontinuation through indirect pathways, such as parental expectations, perceived burden of behavioral intervention, or preference for faster symptom control.

### *AIABA Programming and Monitoring Modes*

Families receiving semi-online programming and monitoring were more likely to discontinue treatment than those receiving in-person programming and supervision. Tele-intervention and hybrid delivery models have been shown to be feasible and often effective in ASD services (63, 69, 70), particularly for parent training and coaching. However, prior reviews have highlighted considerable variability in outcomes depending on factors such as program structure, intervention intensity, caregiver readiness, and the quality of monitoring (69, 70). The present findings suggest that less intensive supervision, typically associated with semi-online service delivery, may reduce opportunities for direct therapist–family interaction, ongoing monitoring, and procedural support, which in turn may affect treatment continuation. Thus, rather than contradicting the telehealth literature, these results indicate that semi-online formats may require additional supports and structured monitoring protocols to achieve retention levels comparable to those of in-person models (63, 69, 70). This has important implications for program design, particularly as remote and hybrid services continue to expand.

The observed association between service format and treatment discontinuation should be interpreted with caution. In the present study, families residing outside Greater Tehran were more likely to receive semi-online services, whereas in-person services were primarily available to families living within the metropolitan area. A previous Iranian study (71) reported that apparent location-based differences in ASD detection age were largely explained by family-level socioeconomic factors, including parental employment and insurance status, associated with residential location. Although that study examined diagnostic timing rather than treatment retention, its findings suggest that family and socioeconomic characteristics may underlie some observed geographic differences reflected in the mode of services. Therefore, the higher discontinuation rate observed among families receiving semi-online services may partly reflect underlying family and socioeconomic factors associated with place of residence, rather than the mode of service delivery alone. Taken together, the observed association between semi-online service delivery and treatment discontinuation is likely shaped by

both service-related factors and broader family and socioeconomic influences.

***Age at ASD Diagnosis***

Younger age at diagnosis was associated with higher discontinuation rates. Prior findings on age and service engagement have been mixed. Some studies report that earlier referral is associated with greater engagement (72), whereas broader reviews conclude that the relationship between age and service participation remains inconclusive (73). Differences in outcome definitions (engagement versus discontinuation), service types, and sample age ranges likely contribute to these inconsistencies. In contrast to samples with older children, our cohort involved very young children, which may introduce distinct family pressures, uncertainty following diagnosis, and greater variability in early treatment pathways. Early diagnosis can increase service options but may also expose families to competing or non-standard interventions, potentially fragmenting commitment to a single intensive model. Framed cautiously, these findings suggest that early diagnosis alone does not guarantee sustained engagement and that structured guidance at the point of diagnosis may be important for maintaining continuity in evidence based programs.

***Severity of ASD Symptoms at AIABA Cessation***

Higher ASD severity scores immediately prior to treatment cessation were associated with discontinuation, whereas baseline severity was not. Greater post treatment severity and smaller symptom reduction were linked with dropout, while those who continued treatment showed the largest score reductions. This pattern is consistent with outcome literature indicating that symptom severity and adaptive functioning influence responsiveness and required treatment duration (74). Rather than implying that severe cases inevitably discontinue, these results suggest that when expected gains are not observed, families may be more likely to terminate services. This interpretation is consistent with prior ABA outcome studies showing heterogeneity in response trajectories and the need for individualized treatment adjustment (75). The association between medication use and higher final severity scores in our additional analysis further supports the interpretation that clinical complexity and perceived limited progress may jointly contribute to discontinuation decisions, though causal direction cannot be inferred.

Overall, these findings synthesize prior evidence on parent involvement, and service delivery with new data on discontinuation risk. Compared with earlier studies that focused primarily on treatment outcomes, this study emphasizes retention and continuity as critical components of effective ASD intervention. The predictors identified here suggest that discontinuation risk is multifactorial, involving family engagement, service format, clinical severity trajectory, contextual and family background and treatment expectations. Long term implications include the potential for interrupted intervention exposure to limit cumulative developmental gains documented in intensive behavioral programs. From a practical standpoint, these results call for early identification of low parental engagement, mandate structured parent support protocols, require careful coordination when medication is introduced, and necessitate strengthened monitoring in remote or hybrid service models. These strategies may contribute to improved retention and more stable treatment pathways.

## Limitation

Several limitations should be considered when interpreting the findings of this study.

First, the sample was drawn from a single clinical center using a specific AIABA service model, which increases the risk of selection bias and limits generalizability of the results to other intervention settings, service structures, and cultural contexts. Families entering and remaining in this program may differ systematically from those receiving other types of services. Second, some key variables were based on parental report, including medication use. Although these reports were cross-checked, they remain susceptible to recall error and reporting bias. In addition, parental engagement, identified as a major predictor of discontinuation, was not measured using a fully standardized and psychometrically validated instrument, which may introduce measurement subjectivity and reduce precision. Regarding education level, most parents were educated and showed low variance, making it unlikely to reveal an effect on AIABA discontinuation. This finding suggests that future research should investigate parental education in a broader population to assess its potential impact. Third, although multiple child and family characteristics were examined, several potentially important confounding variables known to influence treatment adherence were not directly measured or controlled. These include socioeconomic status, parental mental health, family stress, logistical barriers to service access, therapeutic alliance, and detailed cognitive and language profiles of the child. Residual confounding therefore cannot be excluded. Furthermore, this study did not examine the potential influence of social and cultural factors or the psychological and social consequences of treatment discontinuation. These factors should be investigated in future research to provide a more comprehensive understanding of AIABA discontinuation and its underlying mechanisms. Future studies should investigate these potential confounding factors to clarify their impact on treatment adherence and to strengthen causal inferences. Fourth, symptom severity and change over time were assessed using a screening-oriented rating scale with limited sensitivity to subtle longitudinal changes. As a result, smaller but clinically meaningful symptom improvements or fluctuations may not have been fully captured. Fifth, the study did not include long term follow up after treatment discontinuation. Therefore, longer term developmental, functional, and quality of life outcomes associated with early termination could not be evaluated.

Psychological and social consequences of discontinuation for both children and caregivers were also not directly measured. Sixth, although standard statistical modeling procedures were applied, detailed reporting of missing data handling methods and full regression diagnostic indices was limited, which constrains the evaluation of model robustness.

Future research should prioritize multi center, prospective designs with broader and more diverse samples, validated measures of parental engagement, more sensitive outcome instruments, and extended follow up periods. Given the central role of caregivers in sustaining AIABA participation, future studies should also test structured strategies to strengthen parental engagement and commitment. In addition, parents' attitudes toward medication and how these attitudes relate to their expectations and preferences regarding behavioral interventions should be examined, as these factors may influence treatment continuation decisions.

## Conclusion

This study aimed to identify clinical factors associated with discontinuation of AIABA treatment in children with ASD. The findings suggest that lower parental engagement, concurrent medication use, Remote and hybrid programming and monitoring methods, ASD symptom severity at the last follow up, and younger age at diagnosis are associated with a higher likelihood of treatment discontinuation. Given the retrospective design, these associations should be interpreted cautiously. The results highlight the practical importance of ongoing follow up, targeted parental education, and early supportive interventions to reduce the risk of dropout. Autism treatment centers may use these findings to identify families who may require additional guidance and monitoring. Future research with prospective designs and broader measures is recommended to refine treatment protocols and develop more effective strategies to prevent discontinuation.

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## Conflict of Interest

None.

## Author's Contributions

HP and SaSa: conceptualization, software, formal analysis, investigation, methodology, project administration, resources, visualization, writing – original draft, writing – review & editing. SiSa and KK: conceptualization, writing – original draft, writing – review & editing. SiSa, EV, and FF: data curation, software, formal analysis, writing – original draft, writing – review & editing. All authors reviewed and interpreted the results and approved the final version.

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