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A Scoping Review on Strategies that Enhance Medication Adherence in Children and Adolescents with Attention Deficit Hyperactivity Disorder and Associated Outcomes

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Abstract

Purpose of Review The goal of this review was to summarize interventions aimed at improving medication adherence in pediatric ADHD. Specifically, we sought to address questions regarding the prevalence of non-adherence, available interventions, assessment methods, intervention effects on adherence and outcomes, and barriers to adherence.

Recent Findings We identified 13 studies evaluating eight types of interventions: education-based programs, behavioral treatment, combined psychoeducation and behavioral treatment, digital health approaches, adjunctive therapy, near-infrared spectroscopy, nursing support, and written informed consent. All interventions demonstrated significant improvements in medication adherence compared to controls or pre-intervention baselines. The reported prevalence of non-adherence varied widely (4.8%-77%), likely influenced by diverse measurement tools. Major barriers included parental beliefs, side effects, perceived inefficacy, socioeconomic factors, and healthcare system issues.

Summary Non-adherence to ADHD medication in children can have detrimental consequences. While interventions have shown promise in enhancing adherence, multidimensional, theory-based approaches combining education, behavioral strategies, and digital techniques are needed. Digital health adoption presents opportunities but requires further research on long-term effectiveness. Interdisciplinary teams, including pharmacists, psychologists and psychiatrists can play a key role. Addressing parental beliefs, side effect concerns, socioeconomic factors, and healthcare barriers is crucial. Tailoring interventions to individual needs and barriers may optimize adherence and improve outcomes.

Keywords Medication Adherence · ADHD · Children · Adolescents · Scoping review

Introduction

Attention deficit hyperactivity disorder (ADHD) is a prevalent neurodevelopmental disorder affecting children and adolescents worldwide, with a global prevalence exceeding 5% [1, 2]. This disorder is characterized by three core symptoms: inattention, impulsivity, and hyperactivity, which may persist into adulthood in approximately 2.5% of cases [1, 3•]. The significant impact of ADHD on quality of life, manifested through psychiatric comorbidities, academic and occupational impairments, social disabilities, and risky behaviors, underscores the importance of effective management strategies [4, 5].

Pharmacological interventions, including stimulants and non-stimulants, are integral to ADHD treatment, as they have demonstrated efficacy in reducing symptom severity, improving overall quality of life, and mitigating functional impairments [6, 7]. However, despite the importance of medication adherence, approximately 50% of patients do not adhere to prescribed regimens, and families often discontinue treatment within a year [8, 9]. Non-adherence to medication is associated with increased hospitalizations, emergency visits, and preventable deaths, contributing to substantial medical costs [10]. While interventions can enhance medication adherence, there is a need for further research to improve their effectiveness [11••].

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The World Health Organization (WHO) has identified five dimensions influencing medication adherence: patient-related barriers, therapy-related barriers, condition-related barriers, socioeconomic factors, and health system barriers [12]. For children and adolescents with ADHD, the main reasons for non-adherence are medication side effects and perceived effectiveness [8, 13]. Additional barriers include stigma, medication costs, socioeconomic status, insurance coverage, and parental beliefs and attitudes toward ADHD [8]. Considering these factors is crucial for achieving better outcomes through interventions [3•, 11••].

ADHD affects all aspects of life, placing significant pressure on families in terms of work productivity, relationships, and costs [14, 15]. Therefore, adherence to medications is vital for controlling symptoms and ensuring better health outcomes, particularly for this young, growing population as they transition into adulthood [9, 16]. Identifying promising interventions can guide future research and potentially improve medication adherence. This review summarized interventions for improving medication adherence in children and adolescents with ADHD, addressing barriers to non-adherence, distinguishing it from previous reviews [11••].

Methods

This scoping review adhered to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses Extension for Scoping Reviews (PRISMA-ScR) model and the Arksey and O'Malley framework [17, 18].

Objectives and Study Questions

To explore effective interventions for promoting medication adherence and clinical outcomes in children and adolescents with ADHD, studies assessing the impact of interventions on parents were investigated. The following questions guided the literature search, data extraction, and synthesis:

1. What is the prevalence of non-adherence in control groups or post-intervention?
2. What interventions are available to improve adherence in pediatric ADHD?
3. How is medication adherence assessed?
4. How did interventions affect adherence and clinical outcomes?
5. What barriers to adherence were identified?

Search Strategy

Four databases (PubMed, Web of Science, Scopus, Google Scholar) were searched using terms related to "attention deficit hyperactivity disorder," "medication adherence/non-adherence," and "patient compliance/non-compliance." Original articles published between 2000-2023 were included.

Inclusion and Exclusion Criteria

Included studies involved: 1) Children/adolescents with ADHD prescribed pharmacotherapy, 2) Specific interventions to improve medication adherence, and 3) Reported adherence and relevant outcomes. Exclusions were: 1) Adult ADHD, 2) No pharmacotherapy, 3) No adherence intervention, 4) No adherence outcomes reported, 5) No control group/pre-test, 6) Unrelated to topic, 7) Reviews, 8) Non-English language.

Study Selection

Initially, 980 records were identified and deduplicated. Titles/abstracts were screened independently by two reviewers against inclusion criteria. Full texts of eligible studies were reviewed, with a third reviewer resolving conflicts. Reference lists were also searched, yielding one additional study.

Data Extraction and Charting

Using a standardized form, data on study characteristics, interventions, adherence measures, and key findings were extracted by two independent reviewers. Discrepancies were resolved through consensus meetings with the supervisor.

Data Synthesis and Analysis Process

Studies were grouped according to the type of intervention analyzed. For each group, populations, study designs, outcomes, and adherence measures were summarized. When a systematic review was identified, the number of potentially eligible studies included was noted, and any missed studies were added.

Results

Summary of the Included Studies

From the initial 980 records, 13 studies met the inclusion criteria for interventions to improve medication adherence in children and adolescents with ADHD (Figure 1). The earliest study was published in 2005, with over half (n=8) published between 2017-2021. Studies originated from the USA (n=3), China (n=3), Japan (n=3), Spain (n=2), Israel, and Canada (n=1 each). Sample sizes ranged from 10 participants in

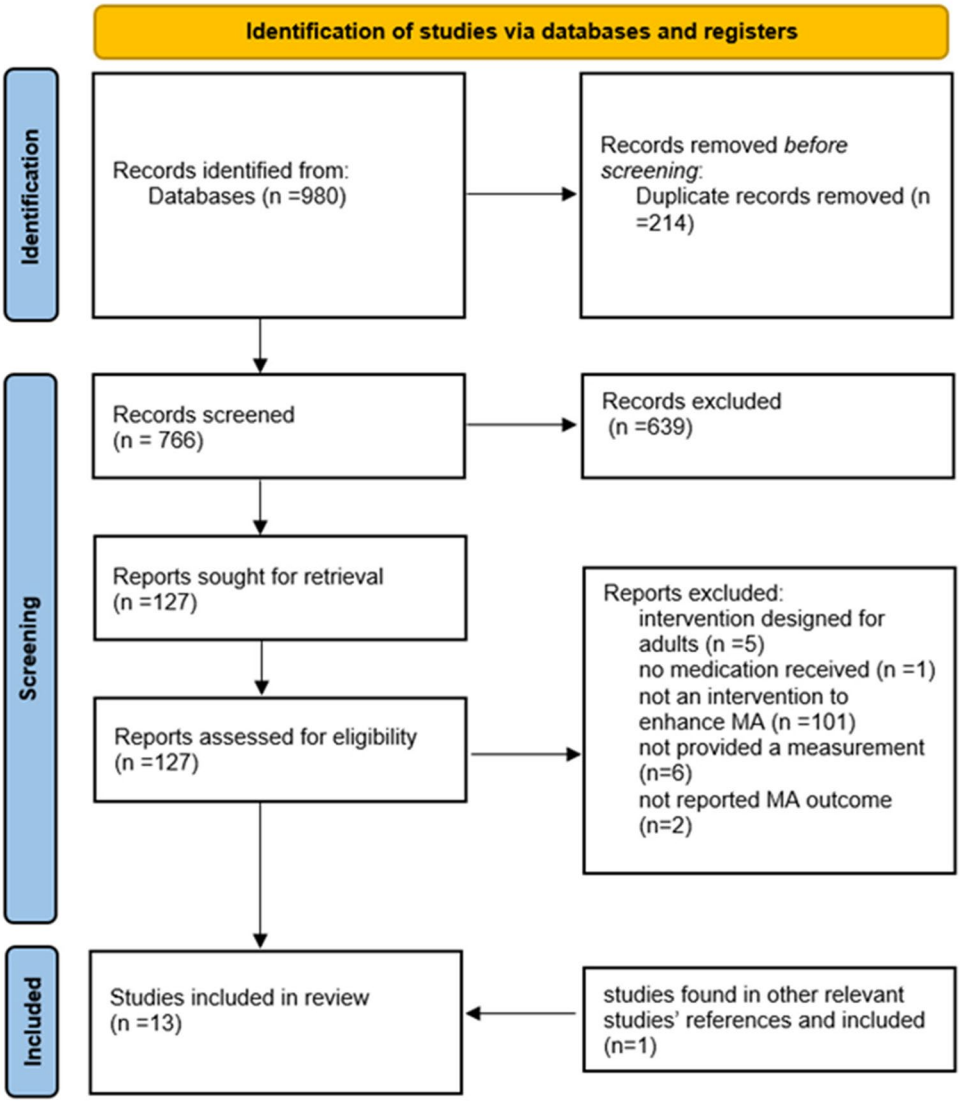

Fig. 1 PRISMA flow diagram illustrating the study section process

intervention and control arms [19] to 2369 patients [20]. See Fig. 1 for the PRISMA flow diagram outlining the study selection process

Eight types of interventions were identified: education-based programs (n=5), behavioral treatment (n=1), combined psychoeducation and behavioral treatment (n=1), digital health approaches (n=2), adjunctive therapy (n=1), near-infrared spectroscopy (n=1), nursing support (n=1), and written informed consent (n=1).

The characteristics of included studies are detailed in Table 1.

Prevalence of Non-adherence

The reported prevalence of non-adherence varied across studies, likely influenced by diverse assessment methods. In control groups or post-intervention follow-up, rates ranged from 4.8%-77%. Some studies evaluated post-intervention non-adherence, reporting 34% [21], 38% [22], and 77% [20] in controls. Others documented 4.8% [23], 63.16% [24], and 46.7% [25] non-adherence after 12, 6, and 3 months respectively. Non-persistence rates, defined as duration from treatment initiation to discontinuation, ranged from 14.3% to 39% [23, 26, 27] in pediatric ADHD.

Measurement Tools of Medication Adherence

The medication possession ratio (MPR), representing the percentage of days adhering to prescription over a period, was most common [20, 25, 28]. MPR > 0.8 generally indicated adherence, though one study used > 0.7 [25]. Pill counting by parents in medication logs reviewed by clinicians was also used [29]. Some measured adherence within specific timeframes e.g. prescriptions filled within 37 days [22], reported taking medication at week 12 irrespective of prior interruptions [27], or non-persistence as discontinuing

Table 1 Main Characteristics of Studies and Types of Interventions Included in this Review

Author, year, country	Publication type, participants	Intervention detail	Study period, control	Outcomes and results	Adherence measurement tool	Key findings
Kawai et al. [19], 2021, Japan	10 boys with ADHD (age 9.3y)	NIRS[a] probes measured prefrontal cortex oxy-Hb[b] levels during Stroop color-word test with/without methylphenidate in ADHD children	Jul 2013-Mar 2014, controls: 10 typically developing boys (age 9.5y)	The ADHD Rating Scale (RS) was used to examine methylphenidate's clinical effects. Parents and children received explanations of NIRS results and Stroop task performance simultaneously	Willingness: 0–10 numerical scale	Using NIRS to visualize prefrontal activation differences when on/off methylphenidate enhanced medication willingness in ADHD children. Off medication, they showed reduced right/left prefrontal oxygenation versus controls. On medication, oxygenation, task performance, and symptom ratings improved significantly
Enns et al. [20], 2017, Canada	485 ADHD children (5-17y) & families	Multidisciplinary 3–6-month program providing individual therapy, parent support, group therapy, education, and medication management tailored to needs	2-year cohort study, administrative database controls. Controls ($n=1884$, 5×intervention) not contacted ADHD service, matched	The primary outcomes were hospitalizations, emergency department visits (including injury-related), number of ADHD medications dispensed, and number of patients with a medication possession ratio ≥ 0.8. Socioeconomic inequities were measured via concentration curves and indices	Adequate adherence: Medication possession ratio (MPR) ≥ 0.8	The multidisciplinary intervention increased medication use, adherence, and age-appropriate schooling versus controls while reducing socioeconomic inequities in these outcomes. No between-group differences emerged for hospitalizations, emergencies, or child welfare contacts
So et al. [21], 2008, China	86 treatment-naive ADHD children & parents	Two 6-month treatment conditions: 1) Methylphenidate only 2) Methylphenidate combined with 24 weekly behavioral sessions including classroom management, skills training, and parent training	18 months later, controls received MPH[c] only	The strengths and weaknesses of ADHD symptoms and normal behaviors scale and parental attitude toward ADHD treatment options were evaluated	Adherence defined as: ≥ 80% doses taken during school year, allowing ≤ 1 month discontinuation	Low-dose methylphenidate combined with behavioral treatment led to greater reductions in ADHD/ODD[d] symptoms post-treatment and at 6 months versus medication alone. Both groups showed improved medication attitudes after 6 months

Table 1 (continued)

Author, year, country	Publication type, participants	Intervention detail	Study period, control	Outcomes and results	Adherence measurement tool	Key findings
Fried et al. [22], 2020, US	ADHD children (6-12y) & parents, matched controls	Daily customized ADHD text messages for 45 + days reminding about medication adherence, refills, and providing psychoeducation on ADHD, time management, organization	Jan 2018-Mar 2019, concurrent stimulant user controls not enrolled, age/gender matched	N/A	Stimulant adherence: Filled prescription within 37 days of intervention/enrollment	Significantly more participants receiving customized ADHD text messaging reminders refilled their stimulant prescriptions on time compared to treatment as usual controls (85% vs 62%)
Montoya et al. [23], 2014, Spain	144 parents of newly diagnosed ADHD children (6-12y)	12-month intervention with 5 manual-based 90-min sessions for parent–child psychoeducation on ADHD via manuals, slides, workbooks	12 months, medication-only controls	The primary endpoint was time for medication withdrawal/termination due to any cause. Secondary endpoints were ADHD symptom severity, functional outcome, program satisfaction, and safety	Non-adherence: ≥ 1 missed dose per parent report	While the parent psychoeducation program did not impact medication discontinuation rates compared to controls over 12 months, it significantly improved ADHD symptoms, parental treatment satisfaction, and alleviated medication safety concerns in the intervention group
Zheng et al. [24], 2020, China	Chinese ADHD children (6-11y), literate parents for medication	Four 2-h weekly sessions educating parents and teachers on ADHD, behavioral interventions, and classroom management strategies	6 months, medication-only controls	Attitudes toward treatment, the Swanson Nolan and Pelham Scale IV for ADHD severity, and the Medication Adherence Report Scale for adherence at baseline and 6-month follow-up were assessed	Medication Adherence Report Scale (MARS): 5-point scale, 4 items on intentional non-adherence, 1 item on unintentional	Following the parent/teacher training, more endorsed ADHD as a neurobiological disorder requiring medication as first-line treatment. The intervention group had higher medication adherence scores and lower ADHD symptom severity at 6 months versus controls
Bai et al. [25], 2015, China	ADHD children/adolescents (6-16y) on medication at 1st visit	Theory of Planned Behavior-based psychoeducation—expert lecture with slides/manual for parents, guided parent groups, online professional-moderated community	3 months later, controls received general counseling ($n = 45$)	Parental ADHD knowledge, TPB[e] model components, child symptoms, and medication adherence at 1 and 3 months were evaluated. Intervention group satisfaction was also measured	8-item questionnaire and MPR > 0.70 indicated adherence	Psychoeducation significantly improved parental ADHD knowledge, adherence attitudes based on the Theory of Planned Behavior, and reduced symptom rating scores versus controls at 1 and 3 months

Table 1 (continued)

Author, year, country	Publication type, participants	Intervention detail	Study period, control	Outcomes and results	Adherence measurement tool	Key findings
Naenen-Hernani et al. [26], 2017, Spain	141 methylphenidate-treated ADHD children (6-15y)	Use of written informed consent process for initiating methylphenidate treatment per clinician's discretion	6 months, usual care controls not provided written consent	The relative risk reduction and number needed to treat influenced by written informed consent were determined via bootstrapping	Non-persistence: Discontinuing methylphenidate at 2-week, 2-month, or 6-month follow-up	Using written informed consent to initiate methylphenidate increased 6-month persistence rates and reduced discontinuation risk by 67% compared to standard care without consent
Savil et al. [27], 2013, UK	346 patients (age 10.5y), historical controls	12-week atomoxetine support service with 6 calls, newsletters, texts covering medication side effects, efficacy, daily routine	6 months, historical controls	Patient treatment compliance and discontinuation rate were measured	Week 12 adherence: Patient-reported atomoxetine use, regardless of prior interruptions	The 12-week atomoxetine support program with calls/texts/newsletters suggests discontinuation rates may be lower than historically expected (9.5% vs 39% historical controls)
Meyers et al. [28], 2017, USA	165 stimulant non-adherent ADHD children (6-17y)	Assessed demographics, stimulant use, GXR[g] use, medication fills, mMPR[f], comorbidities before/after adding extended-release guanfacine	Pre-post comparison with 6-month follow-up	Medication possession ratio, adherence rate, and healthcare costs were assessed	Number of patients with a medication possession ratio of at least 0.8	Adding extended-release guanfacine to stimulants in medication-non-adherent patients significantly increased stimulant adherence and healthcare utilization costs
Weisman et al. [29], 2018, Israel	ADHD children (6-16y) & parents	iCON™ mobile app for weekly ADHD symptom/side effect reporting, medication reminders, ADHD/treatment psychoeducation	8 weeks, treatment as usual controls	Adherence rate was the primary outcome; ADHD symptom severity scales were the secondary outcomes	Pill count by parents on 4 and 8 weeks	Participants using the medication adherence app demonstrated higher overall pill counts and improved ADHD symptom scores versus controls over 8 weeks, but no benefits on other rating scales
Monastra et al. [30], 2005, US	850 families with an ADHD child per DSM-IV[h]	Assessed medical/inattention conditions, IQ. Psychoeducation on ADHD and test findings over 3×90-min sessions. Neuropsych testing	2 years, pre-post data comparison	Mean/SD of Attention Index, percentages with ADDES[i]/TOVA[j] impairments, and percentage reporting medication side effects over 2 years were reported	Two-year treatment continuation as adherence indicator	Nearly 70% of parents initiated pharmacotherapy after the neuroeducational intervention, with 95% continuing at 2 years. Stimulant-treated children with cortical slowing experienced more side effects

Table 1 (continued)

Author, year, country	Publication type, participants	Intervention detail	Study period, control	Outcomes and results	Adherence measurement tool	Key findings
Nagae et al. [31], 2018, Japan	Methylphenidate/atomoxetine-treated ADHD children/adolescents (8-15y) & parents	Education with 5 × 90-min sessions covering lectures, group discussions, recreation activities, homework assignments	Dec 2013-Dec 2014, controls: 18 families (18 children)	The SAMBA[k] measured medication attitudes/behaviors. ADHD-RS-IV assessed symptom severity. Family APGAR evaluated family satisfaction. The Japanese Client Satisfaction Questionnaire was used	Child Adherence Questionnaire (CAQ) based on a 10-item Drug Attitude Inventory assessed pediatric psychotropic adherence	The psychoeducation program improved children's medication attitudes and parents' perceived benefits while reducing child resistance. High satisfaction was reported despite no direct ADHD symptom improvements

[a]Near Infrared Spectroscopy

[b]Oxygenated hemoglobin

[c]Methylphenidate

[d]Oppositional Defiant Disorder

[e]Theory of Planned Behavior

[f]modified Medication Possession Ratio

[g]Guanfacine Extended-release

[h]Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition

[i]Attention Deficit Disorders Evaluation Scale

[j]Test of Variables of Attention

[k]South-ampton ADHD Medication Behavior and Attitude Scale

at 2-week/2-month/6-month follow-ups [26]. Assessing ≥ 80% prescription intake without > 1 month's discontinuation during school was another method [21].

Self-reports included questionnaires on medication continuity, missed doses, overall adherence during follow-up [25]; the Medication Adherence Report Scale (MARS) evaluating unintentional and intentional non-adherence behaviors [24]; parents directly questioned about pharmacological adherence [23]; and the Child Adherence Questionnaire on medication attitudes/awareness [31]. Parent-reported child's willingness to take medication on a 0–10 scale was also used [19].

Interventions Improving Adherence in Pediatric ADHD

Adjunctive Therapy

Meyers et al. [28] examined the impact of adding extended-release guanfacine (GXR) as an adjuvant to stimulant therapy in children and adolescents aged 6–17 years who were non-adherent to stimulants (MPR < 0.8). The study found that GXR augmentation significantly increased medication adherence, with an adjusted mean change in MPR of 0.20 for long-acting stimulants and 0.18 for short-acting stimulants ($p = 0.34$).

Near-infrared Spectroscopy (NIRS)

Kawai et al. [19] used NIRS to measure prefrontal cortex oxygenated-hemoglobin (ox-Hb) levels in 10 ADHD boys (mean age 9.3 years) during the Stroop Color and Word Test on and off methylphenidate. Children completed the 60-s control and stimulant tasks five times each in both medication conditions at least one month apart. NIRS data showed lower right and left prefrontal ox-Hb elevations off medication versus typical development. However, taking methylphenidate resulted in significantly increased prefrontal ox-Hb levels, better task performance, and improved symptom ratings. By visualizing these differences, parents reported enhanced willingness for their children to take methylphenidate.

Digital Health Interventions

Weisman et al. [29] utilized the iCON™ mobile app, allowing parents to weekly report their child's ADHD symptoms and medication side effects to the treating clinician, who reviewed responses at weeks 4 and 8. The app also provided medication reminders and psychoeducational material. Over 8 weeks, participants using the app demonstrated significantly higher overall pill counts ($F = 4.33$, $p < 0.05$) and greater improvement in Clinical Rating Scale (CRS) scores versus controls ($F = 4.74$, $p < 0$).

Fried et al. [22] used a customized ADHD text messaging system sending daily reminders about the prescribed regimen, refills, and psychoeducation on ADHD management. A significantly greater percentage of subjects receiving texts were adherent to stimulant treatment compared to usual care (85% vs 62%; OR = 3.46, 95% CI: 1.82–6.58).

Educational Programs

Psychoeducation for Parents Bai et al. [25] conducted a cluster randomized study of a psychoeducational program for parents of children with ADHD based on the Theory of Planned Behavior. The program included expert-guided lectures with slides and a manual covering five components: building patient-physician relationships, ADHD symptoms/impacts, medication information, adherence barriers, and parenting skills. It also involved group sessions for parents to discuss medication side effects and an online community. Compared to controls, the intervention group had significantly higher 1- and 3-month medication adherence rates (97.7% vs 75.6%).

Montoya et al. [23] evaluated a 12-month manual-based psychoeducational program for parents of newly diagnosed children (6–12 years) with ADHD. Small groups of 5–6 parents attended weekly 90-min sessions for the first 4 weeks and the 9th week. The program covered general ADHD information, behavioral management strategies, and social skills using manuals, slides, workbooks, and reading materials for leaders, parents, and children. After 12 months, there was no significant difference between psychoeducation and control groups in pharmacological treatment discontinuation rates (13.2% vs. 14.3%).

Monastra et al. [30] conducted a "neuroeducation" program for 685 parents of children with ADHD. Over three 90-min sessions, a psychologist explained clinical symptoms using test results like EEG epochs showing "cortical slowing" and illustrations of neurotransmitter systems. The sessions visualized inattention, discussed stimulant/non-stimulant mechanisms based on cortical slowing, and provided education on nutrition, sleep, exercise, and attention. Parents received lesson manuals and had 6-week, 6-month, 1-year, and 2-year follow-ups to monitor progress. Approximately 70% initiated pharmacotherapy post-intervention, with 95% continuing at 2 years.

Psychoeducation for Children and Parents Nagae et al. [31] designed a 5-day group psychoeducation program (g-pam) led by an occupational therapist and nurse to enhance children's medication knowledge and treatment collaboration with parents. Each session involved lectures on medications, group discussions, recreational games for interpersonal

skills, and homework discussing treatment with parents. The intervention significantly decreased the SAMBA-C resistance score and improved Child CAQ attitude scores compared to baseline, while control group scores did not significantly change.

Parent and Teacher Psychoeducation Zheng et al. [24] provided concurrent 4-session training programs for parents and teachers of primary school children with ADHD. Parent training covered ADHD knowledge, medication, coping with side effects/conduct issues, and behavioral management. Teacher training included ADHD information, classroom behavior strategies, scaffolding self-regulation skills, and creating a positive environment. At 6 months, the intervention group had significantly higher MARS scores (22.8 ± 0.75 vs 16.5 ± 1.63 controls) and medication usage rates (70.69% vs 36.84% controls).

Combined Psychoeducation and Behavioral Treatment

Enns et al. [20] evaluated a 3–6 month multidisciplinary intervention combining pharmacological treatment with group therapy, parent support, individual therapy, and education for 485 children and adolescents with ADHD. Specific program details like therapy types and session durations were not provided. The intervention was associated with a significantly increased medication use rate (adjusted rate ratio 1.42, 95% CI 1.03–1.96) versus controls. Children receiving the intervention were also more likely to enroll in their age-appropriate school grade, an indirect ADHD measure. However, selection bias may have influenced findings if intervention cases were more engaged in ADHD treatment.

Behavioral Treatment

So et al. [21] conducted a 6-month weekly group behavioral intervention involving 24 sessions for children, each around 100 min with 2–3 assistants per group of 8–9 children. Sessions incorporated parent training, skill training, and classroom contingency management delivered by a multidisciplinary team including teachers, nurses, psychologists, and occupational therapists. Children and parents received detailed feedback with a token economy system. After treatment, medication adherence was higher in the intervention group according to blinded assessors (93% vs 60% controls), sustained at 6 months (88% vs 59%) but not 12 months.

Nursing Support Program

Savil et al. [27] described a 12-week nursing support program for 364 parents of children (mean age 10.5 years) taking atomoxetine. It involved six 15-min calls, two motivational texts weekly, six newsletters, and appointment reminders with content themed around the first 12 weeks of atomoxetine, including daily routine, side effects, and efficacy. Basic program information suggested discontinuation rates could be lower than historically expected, with 9.5% discontinuing by week 12. Continuation rates were similar across gender and age.

Written Informed Consent

Naenen-Hernani et al. [26] examined the effect of written informed consent on methylphenidate adherence, where children's parents and those aged 12–15 years provided signed consent before initiation. At 6-month follow-up, the non-persistence rate was 92.5% in the written consent group versus 78% in controls receiving standard care without written consent. Informing and involving parents through this process may promote adherence and improve the patient-doctor relationship.

Impact of Interventions on Associated Outcomes

Adjunctive GXR with stimulants in non-adherent patients increased healthcare costs due to additional pharmacy, physician visits, and outpatient expenditures [28]. The NIRS study revealed lower prefrontal cortex oxygenated-hemoglobin levels in medication-naïve ADHD children versus controls. However, methylphenidate administration significantly increased prefrontal activation, improved task performance, and reduced symptoms [19]. Psychoeducational interventions for parents [23, 25], combined psychoeducation/behavioral treatment [21], and parent/teacher training [24] consistently demonstrated substantial ADHD symptom severity improvements assessed by standardized rating scales. While Nagae et al.'s [31] psychoeducation did not impact symptoms, it significantly reduced child resistance to medication. Monastra et al. [30] found stimulant-treated children with cortical slowing experienced more side effects versus non-stimulant treatment in those without cortical slowing. Contrastingly, a smartphone app did not significantly affect symptom severity [29].

Barriers to Medication Adherence in ADHD Youth

Major barriers included parental beliefs about medication benefits, side effects, and perceived inefficacy [22, 24, 30]. Inadequate ADHD knowledge, lack of emotional support, and parental isolation hindered treatment initiation/continuation [25]. Unawareness of ADHD severity and the consequences of non-adherence exacerbated symptoms and relapse risk [3, 25]. Side effects and insufficient disorder/treatment information reduced compliance [24]. Learning challenges tripled discontinuation risk [23]. In addition,

healthcare provider distrust, financial constraints, insurance coverage issues, and medication costs were additional barriers [20, 23, 24].

Discussion

This scoping review summarized interventions for improving medication adherence in pediatric ADHD, categorizing them into eight groups: educational programs (predominantly psychoeducation), digital health approaches, combined psychoeducation and behavioral treatment, behavioral treatment, adjunctive therapy, near-infrared spectroscopy (NIRS), nursing support, and written informed consent. All interventions demonstrated statistically significant adherence improvements compared to controls or pre-intervention baselines, indicating their potential effectiveness.

The reported non-adherence prevalence ranged from 4.8% to 77%, likely influenced by diverse adherence measurement tools employed across studies. The MPR was most commonly used, with MPR < 0.8 generally indicating non-adherence, although one study used < 0.7 as the cut-off [25]. However, the limitation of MPR is that MPR recognizes that adherence measured with claims data can provide evidence of medicine receipt but no evidence of use [32]. Although different strategies have used diverse methods, there is no gold standard for measuring medication adherence in adolescents and children with ADHD. Other methods included pill counts, prescription refill records, self-reported questionnaires, and defining non-persistence as treatment discontinuation within specific timeframes.

Notably, only one study [25] utilized a theoretical framework (Theory of Planned Behavior) to design the psychoeducational intervention, emphasizing the value of theory-driven approaches in adherence research [33, 34]. The longest follow-up duration was 2 years [30], while the shortest was 37 days for an SMS-based intervention [22], highlighting the need for longer-term evaluations considering ADHD's potential lifelong impacts [35, 36].

Interdisciplinary teams, including psychologists, nurses, occupational therapists, and teachers, played crucial roles in delivering interventions. However, the pharmacist's involvement in promoting adherence remains unexplored. Given their close patient relationships, pharmacists could significantly contribute to enhancing adherence behaviors [37, 38].

Barriers to adherence were primarily related to parental beliefs, medication side effects, perceived treatment inefficacy, socioeconomic factors, and healthcare system issues, which is consistent with previous studies introducing parental knowledge and beliefs about ADHD and perceived risks and benefits of treatment as some of the frequent reasons for non-adherence [13, 39•]. Addressing these barriers through multidimensional, theory-based interventions is crucial for improving outcomes in this population [40]. While patient education is paramount, excessive information can paradoxically reduce adherence in some cases [41].

This review had limitations, including the lack of quality assessment for included studies, restriction to four databases and English-language publications, and potential publication bias. Nevertheless, a transparent and rigorous methodology was employed to identify relevant literature.

Conclusion

Non-adherence to ADHD medication in children can have detrimental consequences. considering the prevalence and low rates of medication adherence in ADHD population, it is necessary to consider measures to solve this problem [42]. Despite efforts, there remains a need for multidimensional, theory-based interventions combining education, behavioral strategies, and digital approaches to enhance adherence in this population. Widespread digital health adoption presents opportunities, but long-term effectiveness requires further research. Interdisciplinary healthcare teams, including pharmacists, can play a key role. Addressing parental beliefs, side effect concerns, socioeconomic factors, and healthcare barriers is crucial. While patient education is important, excessive information may paradoxically reduce adherence. Tailoring interventions to individual needs and specific barriers may optimize adherence and improve outcomes for children and adolescents with ADHD.

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Declarations

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Papers of particular interest, published recently, have been highlighted as:
- • Of importance
- •• Of major importance

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