

A FOLLOW-UP STUDY OF PARENT MANAGEMENT TRAINING AND PHARMACOTHERAPY IN CHILDREN WITH ATTENTION DEFICIT HYPERACTIVITY DISORDER

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ABSTRACT

Background: Attention-Deficit/Hyperactivity Disorder (ADHD) is a prevalent neurodevelopmental condition in childhood, characterised by enduring patterns of inattention, hyperactivity, and impulsivity that are inconsistent with developmental expectations. Although pharmacotherapy and Parent Management Training (PMT) are well-established therapeutic modalities, their relative and combined effectiveness in the Indian paediatric population has not been sufficiently characterised in longitudinal studies. The aim is to evaluate and compare the effectiveness of PMT alone versus combined treatment (PMT with pharmacotherapy) on ADHD symptom severity over a six-month follow-up period, and to assess the impact of pharmacotherapy on somatic growth parameters in paediatric patients diagnosed with ADHD. **Materials and Methods:** A prospective, longitudinal observational follow-up study was conducted at multiple clinical sites in Visakhapatnam, India, from February 2023 to January 2024. A total of 144 children below 12 years of age, diagnosed with ADHD per DSM-5 criteria, were enrolled via convenience sampling. Participants received either PMT alone or combined treatment (PMT plus pharmacotherapy). ADHD symptom severity was assessed at baseline, one month, and six months using the ADHD Rating Scale-5 (ADHD-RS-5) and Clinical Global Impression-Severity (CGI-S). Somatic parameters (height, weight, BMI) were concurrently monitored. Statistical analyses included chi-square tests, one-way ANOVA, and repeated-measures MANOVA. **Result:** Of 144 enrolled children, 120 (83.3%) completed the six-month follow-up. Both intervention groups demonstrated statistically significant reductions in ADHD-RS-5 and CGI-S scores over time ($p < 0.001$). The combined treatment group, which had substantially higher baseline severity, exhibited a sharper early decline in both the hyperactivity/impulsivity and inattention domains. By six months, scores between the groups had converged. Progressive weight reduction was observed in children receiving methylphenidate, while clonidine was associated with sedation in approximately 38% of users. **Conclusion:** Combined treatment (PMT with pharmacotherapy) produces faster and more pronounced early symptom reduction, particularly in children presenting with severe baseline impairment. PMT alone remains a robust, evidence-based first-line option for children with mild-to-moderate ADHD. Regular somatic monitoring is essential when pharmacotherapy is employed. These findings endorse a severity-stratified, multimodal approach to paediatric ADHD management in diverse Indian clinical settings.

INTRODUCTION

Attention-Deficit/Hyperactivity Disorder (ADHD) is a persistent neurodevelopmental disorder identified

in current clinical literature as exerting broad effects across the lifespan. It is characterised by enduring patterns of inattention, hyperactivity, and impulsivity that are inconsistent with developmental

expectations.^[1] Epidemiological studies consistently estimate the global prevalence of ADHD at approximately 5% among children and 2.5% among adults. However, regional data, particularly from the Indian subcontinent, reveal a more nuanced and heterogeneous distribution of the disorder. Recent meta-analyses of nineteen studies conducted in India report a combined prevalence of ADHD at 7.1% among children and adolescents, with certain school-based surveys documenting rates reaching as high as 9.57%. The considerable health burden imposed by ADHD underscores the necessity of comprehensive diagnostic and therapeutic systems. When left untreated, the disorder is closely associated with negative life outcomes, including diminished academic performance, heightened risk of substance use disorders, involvement in criminal behaviour, and elevated mortality rates.^[2-12]

Modern approaches to ADHD management emphasise a multimodal therapeutic framework. Although pharmacotherapy continues to serve as a primary modality for alleviating core symptoms, it is insufficient on its own to address the complex psychosocial and family-related factors that perpetuate behavioural difficulties.^[5] Clinical guidelines from both the American Academy of Paediatrics (AAP) and the Indian Psychiatric Society advocate for individualised, tiered treatment strategies. They recommend behavioural interventions, particularly Parent Management Training (PMT)^[4] as the primary therapeutic option for preschool-aged children, and as a critical and indispensable complement to pharmacological care in school-aged populations.^[1,2] Although there is broad agreement on these treatment guidelines, the comparative long-term effectiveness of behavioural training alone versus its integration with pharmacological therapy continues to be rigorously examined in diverse clinical and socioeconomic settings.

ADHD is associated with well-characterised structural and functional alterations in brain regions involved in attention and behavioural control, particularly the frontostriatal circuitry, basal ganglia, cerebellum, and temporoparietal areas. Studies consistently report reduced brain volume and delayed cortical maturation in these regions. At the neurochemical level, the disorder involves disruptions in dopaminergic and noradrenergic signalling. Stimulant medications act primarily by blocking the dopamine transporter, thereby preventing dopamine reuptake and enhancing attentional regulation and impulse control. Oxidative stress is also considered a contributing mechanism to neuronal vulnerability, especially in the prefrontal cortex.^[5-8] Additionally, family dynamics exert a measurable influence on symptom severity; inconsistent or coercive parenting and child impulsivity may mutually reinforce one another, thereby underscoring the psychosocial rationale for parent management training.

PMT is a structured, manualised psychosocial intervention designed to equip parents and caregivers with evidence-based strategies for modifying maladaptive parent-child interaction cycles. By enhancing parental self-efficacy, establishing consistency in limit-setting, and reducing maternal psychological stress, which is frequently significantly elevated in families managing a child with ADHD^[4]. The PMT addresses the psychosocial substrate of the disorder with outcomes that are both clinically meaningful and potentially durable. Within the Indian context, cultural attitudes toward psychiatric pharmacotherapy, socioeconomic constraints, and limited access to specialist mental health services add further complexity to treatment decision-making, making it imperative to generate locally applicable evidence.^[13-17]

The present study was therefore designed to evaluate the comparative effectiveness of PMT alone versus combined treatment (PMT with pharmacotherapy) in reducing ADHD symptom severity in a paediatric cohort drawn from government tertiary care facilities in Visakhapatnam, Andhra Pradesh, India, over a six-month longitudinal follow-up period. Somatic growth parameters were concurrently monitored to assess the safety profile of pharmacotherapy in this population.^[18-25]

Objectives

- To determine the effect of Parent Management Training on symptom severity in children with ADHD.
- To evaluate the comparative effect of combined treatment (PMT with pharmacotherapy) on ADHD symptom severity across baseline, one-month, and six-month assessments.
- To assess the impact of pharmacotherapy on somatic growth parameters, specifically height, weight, and body mass index (BMI), in children with ADHD.

MATERIALS AND METHODS

Study Design: This was a prospective, observational, longitudinal follow-up study conducted to assess the long-term impact of integrated care modalities on paediatric ADHD. The study was conducted over a one-year recruitment period from February 2023 to January 2024. Ethical approval was obtained from the Institutional Ethics Committee before commencement, and written informed consent was secured from all parents or legal guardians. Written assent was additionally obtained from participating children before enrolment, in accordance with institutional ethical guidelines.

Study Setting and Participants: The study was situated across multiple clinical sites in Visakhapatnam, India, including the Government Hospital for Mental Care, the District Early Intervention Centre (DEIC), and the Paediatric Outpatient Department at King George Hospital (KGH). A total of 144 children below 12 years of age,

diagnosed with ADHD according to DSM-5 criteria, were enrolled using a convenient sampling technique over the specified recruitment period.

Inclusion Criteria

- Children below 12 years of age with a confirmed DSM-5 diagnosis of ADHD.
- Children attending the outpatient departments or admitted as inpatients at the Government Hospital for Mental Care, the District Early Intervention Centre (DEIC), or the King George Hospital Child OPD, Visakhapatnam.
- Children of either gender.
- Children whose parents or caregivers were willing and able to provide written informed consent.

Exclusion Criteria

- Children aged 12 years and above.
- Children with comorbid epilepsy or a confirmed diagnosis of an organic brain disorder.

Interventions

Parent Management Training (PMT)

The behavioural intervention was based on the NIMHANS Oppositional Defiant Disorder (ODD) Manual and the Nicholas Long Hyperactivity Guide^[11] implemented through five structured sessions of 30 minutes each, delivered on alternate days. The protocol was designed to foster a positive parent-child relationship while establishing firm, consistent, and predictable behavioural boundaries.^[10,12] The overarching goal of the multi-session training was not merely the modification of the child's behaviour, but the enhancement of parental self-efficacy and the reduction of maternal stress—frequently significantly elevated in families coping with a child with ADHD.^[4] The five core sessions were structured as follows:

- **Session 1 – Structuring and Quality Time:** Parents were trained to construct hourly schedules to provide children with predictable routines. Emphasis was placed on "quality time," a period of non-contingent positive interaction in which parents reinforce appropriate behaviour through praise, without simultaneously placing demands on the child.
- **Session 2 – Positive Reinforcement:** This session introduced the principle of differential reinforcement, whereby desired behaviours are immediately rewarded with social or tangible reinforcers (e.g., verbal praise, star charts, or preferred items), while problematic or maladaptive behaviours are consistently withheld reinforcement.
- **Session 3 – Attention Enhancement and Planned Ignoring:** Parents were instructed in the technique of systematically ignoring minor disruptive behaviours and directing attention exclusively to instances of appropriate conduct. Structured attention-enhancement tasks, including building blocks, puzzles, and mazes, were introduced to promote sustained attentional capacity.

- **Session 4 – Clear Commands:** The session addressed the critical importance of delivering specific, concise, and single-step instructions to children. This addressed the processing limitation characteristic of ADHD, wherein complex or "chained" directions are poorly encoded and frequently result in non-compliance.

- **Session 5 – Time-Out Procedures:** Parents were trained in the consistent and immediate application of time-out for dangerous or highly non-compliant behaviours, with emphasis on procedural fidelity to maximise therapeutic efficacy.

Pharmacotherapy: In the combined treatment (COMBO) group, pharmacotherapy was initiated by the treating physician based on clinical severity assessment and cardiovascular fitness evaluation. Mandatory pre-treatment cardiovascular screening, including baseline liver function tests and electrocardiography (ECG), was performed to exclude underlying cardiac disorders prior to the initiation of stimulants or alpha-2 adrenergic agonists—a mandatory safety protocol. Methylphenidate was prescribed as the first-line pharmacological agent, with clonidine employed as a second-line or third-line option in cases of stimulant intolerance, co-occurring tic disorders, or significant sleep disturbances.^[17] The evaluation focused on two distinct cohorts: those receiving PMT as a standalone intervention, and those receiving combined treatment (PMT plus pharmacotherapy). Approximately 48.6% of the overall cohort received pharmacotherapy, with methylphenidate being the most commonly prescribed agent (25.7%), followed by clonidine (22.9%).

Assessment Tools

ADHD symptom severity was assessed at three time points—baseline, one month, and six months—using the following standardised instruments:

- **ADHD Rating Scale-5 (ADHD-RS-5):** A validated, 18-item clinician- and parent-rated scale assessing the frequency and severity of inattention (IA) and hyperactivity/impulsivity (HI) symptoms based on DSM-5 criteria.^[13]
- **Clinical Global Impression-Severity (CGI-S):** A clinician-rated, seven-point global severity scale assessing overall illness severity from not ill to extremely ill.^[14]

Somatic monitoring comprised serial measurements of height, weight, and body mass index (BMI) at each assessment time point for all children receiving pharmacotherapy.

Statistical Analysis: Categorical variables were summarised as frequencies and percentages; continuous variables were expressed as means with standard deviations (SD). Between-group comparisons of continuous variables at individual time points were performed using independent samples t-tests and one-way analysis of variance (ANOVA). Within-group changes over time and between-group interaction effects (group × time) were examined using repeated-measures multivariate

analysis of variance (MANOVA), with statistical significance set at $p < 0.05$. All analyses were performed using SPSS version 23.0.

RESULTS

Participant Flow and Baseline Characteristics: Of the 144 children initially enrolled, 120 (83.3%)

completed the full six-month follow-up; 24 participants (16.7%) were lost to follow-up. The mean age of the study population was 7.68 ± 2.62 years. The majority of children had experienced ADHD-related symptoms prior to 4.5 years of age, with a mean age of symptom onset of 3.01 ± 1.42 years. The mean baseline ADHD-RS-5 total score across the full cohort was 41.01 ± 4.76 .

Demographic and Socioeconomic Profile

Table 1: Demographic Characteristics of the Study Population (N = 144)

Variable	Category	Frequency (N)	Percentage (%)
Gender	Male	117	81.3
	Female	27	18.8
Domicile	Rural	76	52.8
	Urban	68	47.2
Family Type	Nuclear	92	63.9
	Joint	52	36.1
Religion	Hindu	112	77.8
	Christian	23	16.0
	Muslim	9	6.3

The cohort was predominantly male (81.3%) and included participants from both rural and urban catchment areas. The majority of families were nuclear in structure.

Table 2: Socioeconomic Status Distribution of the Study Population (N = 144)

Socioeconomic Status	Frequency (N)	Percentage (%)
Upper	4	2.8
Upper Middle	20	13.9
Lower Middle	47	32.6
Upper Lower	45	31.3
Lower	28	19.4

A significant proportion of the cohort (63.9%) belonged to the lower-middle and upper-lower socioeconomic strata, consistent with the clinical catchment of government healthcare facilities.

Table 3: Pharmacotherapy Profile of Study Participants (N = 144)

Medication	Frequency (N)	Percentage (%)
Methylphenidate	37	25.7
Clonidine	33	22.9
No Medication (PMT Only)	74	51.4
Total	144	100.0

Approximately 48.6% of the cohort received pharmacotherapy. Methylphenidate was the most commonly prescribed agent (25.7%), followed by clonidine (22.9%).

Comparative Efficacy: ADHD-RS-5 and CGI-S Scores

A repeated-measures MANOVA was conducted to assess the effects of intervention type (PMT vs. COMBO) and time (baseline, one month, six months) on total ADHD-RS-5 scores. There was a significant main effect of intervention type ($F = 514.34$, $p < 0.001$), with the COMBO group demonstrating substantially higher baseline total scores than the PMT group. The interaction between intervention type and time was also statistically significant ($F = 151.37$, $p < 0.001$), confirming that improvement trajectories differed significantly between the two groups. Descriptive statistics revealed that although

both groups improved significantly over time, the COMBO group demonstrated a sharper decline from baseline, while the PMT group consistently maintained lower overall absolute scores throughout, reflecting its lower baseline severity.

A significant observation was also noted in CGI-S scores: symptoms were significantly lower at six months compared to baseline for both groups ($p < 0.001$). The COMBO group demonstrated a particularly pronounced reduction in global severity between the baseline and one-month assessments, with continued albeit more gradual improvement through six months.

Table 4: Comparison of ADHD-RS-5 Total Scores and CGI-S Ratings by Intervention Group Across Three Time Points

Outcome Measure	Group	Baseline Mean \pm SD	1-Month Mean \pm SD	6-Month Mean \pm SD	F Value	p Value
Total ADHD-RS-5	PMT	31.76 \pm 3.78	26.47 \pm 3.35	25.20 \pm 3.23	514.34	< 0.001
	COMBO	50.26 \pm 5.74	34.39 \pm 5.54	28.77 \pm 5.95		
CGI-S	PMT	3.79 \pm 0.62	3.24 \pm 0.795	2.69 \pm 0.623	510.09	< 0.001
	COMBO	3.99 \pm 0.53	2.31 \pm 0.78	1.80 \pm 0.628		

ADHD-RS-5 = ADHD Rating Scale-5; CGI-S = Clinical Global Impression-Severity; PMT = Parent Management Training; COMBO = Combined Treatment (PMT + Pharmacotherapy); SD = Standard Deviation.

Domain-Specific Analysis: Hyperactivity/Impulsivity (HI) Subscale

The ADHD-RS-5 hyperactivity/impulsivity (HI) subscale scores demonstrated statistically significant reductions over time in both groups ($p < 0.001$). A

two-way ANOVA revealed a significant interaction between intervention type and time ($F = 63.82, p < 0.001$), confirming that the improvement trajectory differed significantly between the two intervention arms.

Table 5: Hyperactivity/Impulsivity (HI) Domain Scores by Intervention Group Across Three Time Points

HI Domain Scores	Baseline Mean (SD)	1-Month Mean (SD)	6-Month Mean (SD)
PMT Group	15.71 (1.78)	13.03 (1.81)	12.43 (1.87)
COMBO Group	24.22 (3.76)	16.60 (3.18)	12.98 (3.25)

Despite markedly higher baseline HI severity, the COMBO group achieved scores comparable to the PMT group by the end of six months, reflecting the rapid neurobiological stabilisation afforded by pharmacotherapy that subsequently permits consolidation of behavioural gains.

Domain-Specific Analysis: Inattention (IA)

Subscale: Inattention subscale scores demonstrated a consistent and statistically significant decline across both groups over the six-month follow-up period ($F = 57.43, p < 0.001$). The PMT group maintained consistently lower absolute IA scores throughout, a

reflection of lower baseline severity. Conversely, the COMBO group exhibited a substantially larger magnitude of absolute improvement from baseline, highlighting the synergistic benefit of pharmacotherapy in the inattentive domain for more severely impaired children.

Table 6: Inattention (IA) Domain Scores by Intervention Group Across Three Time Points

IA Domain Scores	Baseline Mean (SD)	1-Month Mean (SD)	6-Month Mean (SD)
PMT Group	16.10 (2.12)	13.46 (1.58)	12.81 (1.50)
COMBO Group	26.00 (2.21)	17.85 (2.79)	15.92 (3.34)

For children with moderate baseline inattention, PMT alone achieved clinically significant functional improvement. For those with severe inattention at baseline, combined treatment provided a synergistic therapeutic gain not fully attainable by behavioural intervention alone within the same timeframe.

Somatic Growth Parameters and Adverse Effect Profile:

Serial monitoring of somatic parameters revealed modest but progressive decrements in weight and height across the six-month follow-up in both the methylphenidate and clonidine subgroups. The overall cohort BMI showed only marginal

change. The adverse effect profile of pharmacotherapy included appetite suppression in 14.3% of methylphenidate users, anxiety-related symptoms in 14.1%, and insomnia in 9.2%. Clonidine was associated with sedation in up to 38% of users.

Table 7: Somatic Growth Parameters by Medication Type Across Three Time Points

Growth Parameter	Baseline Mean (SD)	1-Month Mean (SD)	6-Month Mean (SD)
BMI – Total Cohort	16.14 (0.79)	16.03 (0.70)	16.00 (0.71)
Weight – Clonidine (kg)	30.43 (4.38)	29.26 (4.23)	29.18 (4.12)
Weight – Methylphenidate (kg)	29.55 (3.13)	28.56 (3.07)	27.81 (3.55)
Height – Clonidine (cm)	135.04 (5.45)	132.83 (5.60)	132.64 (6.38)
Height – Methylphenidate (cm)	132.88 (8.77)	130.46 (8.95)	130.15 (8.81)

BMI = Body Mass Index. Both methylphenidate and clonidine were associated with progressive decremental trends in weight and height across the six-month observation period, consistent with published meta-analytic data on stimulant-associated growth suppression.

DISCUSSION

The present longitudinal study provides a clinically relevant characterisation of the comparative effectiveness of Parent Management Training (PMT) alone and combined treatment (PMT with pharmacotherapy) in paediatric ADHD within a diverse, multi-site, government tertiary care setting in India. The findings are broadly consistent with contemporary international evidence while offering several contextually nuanced insights that are specifically pertinent to the Indian clinical environment.^[26-28]

Demographic and Epidemiological Profile: The demographic profile of the cohort—predominantly male (81.3%), drawn from both rural (52.8%) and urban (47.2%) catchment areas, and predominantly belonging to lower-middle and upper-lower socioeconomic strata is broadly consistent with established epidemiological patterns for ADHD in India. The observed male preponderance aligns closely with the pooled findings of Chauhan et al,^[15] who, in a systematic review and meta-analysis of Indian ADHD studies, documented a pooled male prevalence of 9.40% compared to 5.20% in female children. This sex-differential expression is neurobiologically grounded: boys more frequently

present with overt hyperactive-impulsive symptomatology that prompts clinical referral and formal diagnosis, while girls with predominantly inattentive presentations are systematically underdiagnosed in community and school-based settings.^[29-32]

Similarly, Prasad et al,^[16] in a school-based epidemiological survey of 700 children aged 5–12 years conducted in Hyderabad, reported a male-to-female ratio of 3:1 and an overall ADHD prevalence of 9.57% in the cohort. The findings of the present study are thus consistent with this well-replicated demographic pattern across Indian paediatric samples, suggesting that the neurobiological determinants of sex-differential ADHD expression are not markedly modified by geographic or socioeconomic factors within the country.

The significant representation of rural participants (52.8%) in the present cohort reflects the natural catchment area of government health facilities in Visakhapatnam, which serve a predominantly semi-urban and rural population. The cohort's socioeconomic composition heavily weighted toward the lower-middle and upper-lower strata, is consistent with the observations of Gore and Morgan,^[3] who, in a review of ADHD in India, documented the clustering of presentations in resource-limited settings in South India. This association between lower socioeconomic status and ADHD clinical presentation is multifactorial, encompassing environmental stressors, perinatal risk factors, reduced access to early diagnostic services, and greater reliance on government healthcare infrastructure.^[31]

Pharmacological Integration and Medication

Profile: Approximately 48.6% of the cohort received pharmacotherapy, with methylphenidate being the most commonly prescribed agent (25.7%), followed by clonidine (22.9%). This distribution reflects current prescribing best practices. Methylphenidate, a central nervous system stimulant, remains the recommended first-line pharmacological treatment for school-aged children and adolescents with ADHD due to its rapid onset of action and well-documented, high effect size in reducing core symptoms of both inattention and hyperactivity/impulsivity^[17]. Clonidine, a non-stimulant alpha-2 adrenergic agonist, was employed as a second-line or third-line option in children with stimulant intolerance, or in cases where tic disorders and sleep disturbances coexisted with ADHD uses that are consistent with established clinical guidelines.^[17]

An Indian hospital-based study by Srinath et al^[18] reported a similar predominance of stimulant use in tertiary care settings, with increasing incorporation of clonidine in children presenting with prominent hyperactivity and sleep disturbances. Likewise, the network meta-analysis by Cortese et al^[19] demonstrated methylphenidate as the most widely utilised and evidentially supported pharmacological agent across ADHD severity scales, including the ADHD-RS and CGI. The medication profile of the

present cohort is therefore well-aligned with both Indian clinical practice patterns and internationally validated treatment algorithms.

The relatively lower proportion of children on medication (48.6%) in this cohort, compared with Western studies where pharmacotherapy rates often exceed 60–70%, warrants specific commentary. This difference may reflect cultural attitudes toward psychiatric pharmacotherapy in the Indian context, as well as a relatively higher parental preference for behavioural interventions. A cross-sectional study by Jurczakowski and Murawiec,^[20] examining parental attitudes toward ADHD pharmacotherapy noted that parental experience of treatment complexity, fears regarding long-term medication effects, and stigma associated with psychotropic use in children are significant determinants of treatment acceptance. These factors are likely amplified in lower-socioeconomic and rural Indian families, where psychiatric medications may be less familiar and access to follow-up monitoring more constrained.

Longitudinal Outcomes: Symptom Reduction and Treatment Trajectories

The primary finding of this study, that both PMT alone and combined treatment produced statistically significant reductions in ADHD-RS-5 total scores and CGI-S ratings over the six-month follow-up, affirms the clinical efficacy of each modality while critically illuminating their differential kinetics of improvement.

The robust efficacy of PMT as a standalone intervention in the PMT cohort is consistent with recent interventional literature. A randomised controlled trial evaluating behavioural parent training by Daley et al.^[21] reported significant reductions in ADHD-RS and Conners scores over 3–6 months of structured behavioural intervention. Similarly, a longitudinal cohort study by Evans et al,^[22] demonstrated sustained improvement in CGI-S scores with behavioural interventions alone in children aged 5–12 years, in the absence of pharmacotherapy. These findings collectively support the role of PMT as an effective foundational intervention, particularly in supervised, structured settings with adequate parental engagement and follow-through.

The combined treatment group, which entered the study with substantially higher baseline symptom burden, mean total ADHD-RS-5 score of 50.26 ± 5.74 versus 31.76 ± 3.78 in the PMT group, and demonstrated a markedly steeper early decline, particularly between baseline and the one-month assessment. This early advantage is mechanistically attributable to the pharmacological stabilisation of dopaminergic and noradrenergic dysregulation, which reduces the neurobiological substrate of inattention and impulsivity, thereby creating a more receptive neurological state for the consolidation of newly acquired behavioural strategies imparted through PMT.^[4] This conceptualisation of pharmacotherapy as a neurobiological scaffold for behavioural learning is a central tenet of multimodal

ADHD treatment theory, and the present data provide supporting longitudinal evidence from a real-world, resource-limited Indian setting.

A particularly noteworthy observation is the convergence of total ADHD-RS-5 scores between the PMT and COMBO groups by the six-month assessment, despite the substantially higher baseline severity of the COMBO cohort. This convergence suggests that medication-facilitated early stabilisation enables children with severe ADHD to progress along a therapeutic trajectory that eventually achieves functional parity with children whose lower baseline severity allows PMT alone to be sufficient. This sharp early decline, followed by progressive consolidation, is a hallmark of pharmacological efficacy integrated with behavioural stabilisation.^[4]

Hyperactivity/Impulsivity and Inattention Domain Analyses: Analysis of the hyperactivity/impulsivity (HI) domain revealed a significant group-by-time interaction ($F = 63.82$, $p < 0.001$), confirming that the two groups followed distinctly different improvement trajectories. The COMBO group's rapid HI score decline from 24.22 (3.76) at baseline to 16.60 (3.18) at one month, and further to 12.98 (3.25) at six months, reflects the well-documented, fast-acting efficacy of stimulant and non-stimulant pharmacotherapy in reducing overt behavioural dysregulation. The PMT group, beginning from a lower baseline of 15.71 (1.78), achieved comparable HI scores by six months through the sustained application of behavioural management strategies, demonstrating that structured parental intervention is sufficient to produce clinically meaningful HI reduction in children with moderate hyperactivity.

For the inattention subscale, both groups demonstrated statistically significant declines ($F = 57.43$, $p < 0.001$); however, the PMT group maintained consistently lower absolute IA scores throughout the study period, reflective of its lower baseline impairment. The COMBO group's larger magnitude of absolute change in the IA domain is consistent with findings reported by Nadermohammadi Moghadam et al,^[23] who, in a comparative study of Attention Process Training and Parent Management Training in children with ADHD, found that subtype-specific treatment allocation prioritising combined neurobiological and behavioural intervention in children with more severe inattentive profiles yielded superior outcomes compared to either modality alone. The present findings extend this principle longitudinally, suggesting that for children with severe baseline inattention, the synergistic effect of pharmacotherapy allows for a more substantial and temporally accelerated therapeutic gain that behavioural training alone might not achieve within the same timeframe.^[3]

Total ADHD Severity and CGI-S Ratings: The total ADHD-RS-5 scores and clinician-rated global severity (CGI-S) mirrored the domain-specific findings. Both measures showed highly significant improvement over time ($p < 0.001$), with the

COMBO group demonstrating a more pronounced and sustained improvement by the sixth month. A notable observation was the attenuation of improvement rate between months one and six in both groups—CGI-S scores at six months, while significantly lower than at baseline, showed a more modest increment of change compared to the first month. This temporal pattern highlights the chronic and relapsing nature of ADHD, and suggests that the therapeutic benefits of PMT, in particular, are not static achievements but rather dynamic processes that require continued environmental consistency, parental reinforcement, and potentially intensified or prolonged behavioural support to sustain early gains. These findings are consistent with those of a multicountry, multi-site controlled clinical trial of mobile-based PMT conducted by Tandon et al.,²⁴ involving children aged 4–11 years, which demonstrated that structured parent training delivered via mHealth platforms was associated with favourable CGI-based improvement, supporting both the efficacy and durability of the PMT effect. The present study corroborates these findings in a face-to-face, government clinical context, suggesting that the core mechanisms of PMT efficacy are generalisable across diverse delivery formats.

Somatic Safety and Growth Parameters: The somatic monitoring data revealed a progressive but modest decremental trend in both weight and height across the six-month follow-up in children receiving both methylphenidate and clonidine. The concern regarding appetite suppression as a common side effect of stimulants with consequent implications for growth is well-documented in the paediatric pharmacotherapy literature. A systematic review and meta-analysis by Carucci et al,^[26] demonstrated that prolonged methylphenidate exposure was associated with a height deficit of approximately 1 cm per year during the first three years of treatment; the somatic trends observed in the present cohort are consistent with this quantification. Similarly, Zhang et al.²⁵ in a recent systematic review, confirmed that ADHD itself independent of medication may be associated with altered growth trajectories, complicating the attribution of observed growth changes solely to pharmacotherapy.

Adverse effects documented in the methylphenidate group included appetite suppression, anxiety-related symptoms, and insomnia. These rates are in accord with published safety reviews, including a systematic review by Storebø et al,^[29] which characterised the adverse event profile of methylphenidate in children as generally mild to moderate in severity and amenable to management through dose adjustment, medication holidays, or adjunctive behavioural and nutritional strategies. The relatively high rate of sedation with clonidine (38%) in this cohort, while consistent with the known pharmacodynamic profile of alpha-2 adrenergic agonists, represents a clinically meaningful consideration in treatment selection, particularly for children in whom daytime alertness and academic functioning are priority outcomes.

A recent narrative review by Silczuk et al.^[36] examining current insights into the safety and adverse effects of methylphenidate across age groups further contextualises these findings, affirming that while short-term adverse effects are common and typically manageable, the importance of individualised risk–benefit assessment and systematic somatic monitoring cannot be overstated. The present study's protocol of serial growth measurements and cardiovascular screening prior to initiation embodies this principle of monitored clinical stewardship.

The Synergy of Multimodal Treatment: Clinical and Mechanistic Implications

The aggregate findings of this longitudinal study are consistent with international meta-analytic evidence from the period 2020–2025, confirming that combined treatment produces superior outcomes compared to behavioural training alone for children with higher severity ADHD.^[36] The widely endorsed "behaviour-first" approach remains the ideal initial strategy for preschoolers and children with milder symptom profiles; however, for children with severe impairment at baseline, a "medication-augmented" model appears essential for achieving the neurobiological stabilisation necessary to render behavioural interventions optimally effective.^[1]

One particularly clinically informative insight arising from the present data is the convergence of symptom scores between the two groups at six months, despite the COMBO group's significantly higher baseline severity. This convergence strongly suggests that medication provides the necessary stabilisation of neurobiological arousal, which then enables the parent-led behavioural strategies introduced through PMT to take root, generalise, and ultimately achieve functional parity with outcomes observed in children who had lower initial symptoms and were managed with PMT alone.^[4] However, the observed partial plateauing of global severity improvement (CGI-S) between month one and month six in the COMBO group underscores that the therapeutic benefits of PMT are not "fixed" or permanent upon acquisition, but rather require ongoing environmental consistency and potentially continued behavioural coaching to maintain early gains across the chronic course of the disorder.

These considerations carry practical implications for clinical resource allocation in India, where access to specialist child and adolescent psychiatry services is frequently limited by workforce shortages and geographic distribution. Structured PMT, delivered via standardised protocols based on validated manuals such as the NIMHANS ODD Manual³⁰ and the Nicholas Long Guide,^[11] has the potential to be disseminated through task-sharing models involving trained community health workers, primary care physicians, and teachers thereby extending the reach of evidence-based ADHD intervention beyond the tertiary care sector.

Future Directions: Future research in the Indian context should prioritise several domains. First, the integration of Artificial Intelligence and machine

learning in ADHD classification and phenotyping may enhance diagnostic precision and facilitate personalised treatment stratification, particularly for complex or comorbid presentations.^[4] Second, the development and validation of online and mobile-based PMT platforms adapted to regional languages and socioeconomic contexts in the spirit of the approach demonstrated by Tandon et al.^[24] would substantially extend the reach of evidence-based behavioural intervention to underserved rural populations. Third, while childhood management is relatively well-studied, there remains a significant evidence gap regarding how childhood ADHD interventions in the Indian context translate to adult socio-occupational functioning, interpersonal relationships, and mental health outcomes an area requiring dedicated longitudinal study extending into adulthood.^[35-37] Fourth, the development of India-specific clinical guidelines for complex ADHD presentations, encompassing comorbid conditions, cultural considerations in diagnosis, and resource-sensitive treatment pathways, represents an urgent institutional and academic priority.

CONCLUSION

The management of paediatric ADHD requires a sustained, multidisciplinary effort that balances neurobiological stabilisation with psychosocial training. This longitudinal follow-up confirms that a combined treatment model of Parent Management Training and pharmacotherapy provides the most effective pathway for rapid symptom reduction and clinically meaningful improvement, particularly for children presenting with severe baseline impairment.^{30,31} Parent Management Training alone remains a robust, evidence-based intervention that demonstrably improves both the parent–child relationship and parental psychological well-being, offering a viable and culturally acceptable first-line option for a substantial proportion of Indian families. The study further demonstrates that somatic safety specifically with regard to physical growth can be maintained through systematic clinical monitoring and the judicious use of pharmacological management strategies, including structured drug holidays where clinically appropriate. Ultimately, the success of ADHD treatment in diverse settings such as India depends on recognising the disorder as a chronic condition necessitating long-term adherence, consistent environmental modification, and the active mitigation of socioeconomic barriers to care. By empowering parents through structured training and utilising pharmacological adjuncts with an appropriately monitored risk–benefit approach, clinicians can significantly enhance the functional trajectories of children with ADHD, fostering their social, academic, and personal development.

Limitations

Several limitations of this study merit acknowledgement. First, the follow-up duration of

six months, while sufficient to demonstrate early and mid-term treatment effects, precludes conclusions regarding the long-term durability of gains or the sustained somatic impact of pharmacotherapy. Second, the use of convenient sampling may limit the generalisability of findings to broader ADHD populations, particularly those from non-government or private healthcare settings. Third, the absence of randomisation introduces the possibility of selection bias; children allocated to combined treatment may have had inherently more severe presentations at baseline, potentially confounding group comparisons despite statistical adjustment. Fourth, attrition of 24 participants (16.7%) over the six-month period may have introduced attrition bias, though the overall completion rate of 83.3% is acceptable for a longitudinal observational study conducted within a government clinical infrastructure. Fifth, the measurement of treatment fidelity, specifically the extent to which parents implemented PMT strategies consistently at home, was not formally assessed, which may have introduced variability in behavioural intervention outcomes.

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