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Effect of Selected Yoga Asanas and Yoga Nidra on ADHD Symptoms and Salivary Cortisol Levels in Children: A Pilot Study

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ABSTRACT

Background: Attention Deficit Hyperactivity Disorder affects approximately five to seven percent of children globally, presenting significant challenges in attention regulation, impulse control, and hyperactivity management. Conventional pharmacological interventions often carry adverse effects, prompting exploration of complementary approaches. Yoga-based practices have emerged as promising non-pharmacological strategies for managing neurobehavioral disorders.
Objectives: This pilot study investigated the effects of selected yoga asanas and yoga nidra on ADHD symptom severity across inattention and hyperactivity-impulsivity domains, and salivary cortisol concentrations in children with ADHD symptoms.
Methods: Eighteen children aged seven to twelve years with ADHD symptoms were randomly allocated to three groups using lottery method: yoga asanas (n=6), yoga nidra (n=6), and control (n=6). Intervention groups received supervised sessions four days weekly for four weeks. ADHD symptoms were assessed using the ADHD Behaviour Rating Scale. Salivary cortisol was measured at baseline and post-intervention. Non-parametric analyses including Wilcoxon signed-rank tests and Kruskal-Wallis tests were employed.
Results: All participants completed the study with 92% session attendance. Between-group analysis revealed significant differences for inattention change (χ^2=6.40, p=0.041) and total ADHD change (χ^2=9.74, p=0.008) with large effect sizes (ε^2=0.573). Hyperactivity-impulsivity showed a trend toward significance with large effect size (χ^2=4.44, p=0.108, ε^2=0.261). Cortisol levels showed no significant changes. No adverse events were reported.
Conclusion: Preliminary findings suggest that both yoga asanas and yoga nidra may effectively reduce ADHD symptoms in children compared to control. These results warrant larger randomized controlled trials to establish efficacy.

Keywords: ADHD; yoga asanas; yoga nidra; salivary cortisol; children

INTRODUCTION

Attention Deficit Hyperactivity Disorder represents one of the most prevalent neurodevelopmental conditions affecting children worldwide, with estimated prevalence rates ranging from five to seven percent across diverse populations [1,2]. The disorder manifests through persistent patterns of inattention, hyperactivity, and impulsivity that significantly impair academic performance, social relationships, and overall quality of life [3]. While stimulant medications remain the primary pharmacological treatment, concerns regarding side effects including appetite suppression, sleep disturbances, and potential cardiovascular implications have intensified interest in complementary and alternative therapeutic approaches [4,5].

Yoga, an ancient mind-body practice originating from Indian philosophical traditions, has gained substantial scientific attention as a potential intervention for various psychological and neurobehavioral conditions [6]. The practice encompasses physical postures (asanas), breathing techniques (pranayama), and relaxation methods that collectively influence the autonomic nervous system, hypothalamic-pituitary-adrenal axis functioning, and neurotransmitter regulation [7,8]. These physiological mechanisms align theoretically with the neurobiological underpinnings of ADHD, suggesting potential therapeutic relevance.

Yoga nidra, often termed yogic sleep, represents a systematic method of inducing complete physical, mental, and emotional relaxation while maintaining consciousness [9]. This practice has demonstrated efficacy in reducing anxiety, improving sleep quality, and modulating stress responses in various populations [10,11]. The technique operates through progressive relaxation stages that may influence prefrontal cortex functioning and executive control mechanisms impaired in ADHD [12].

Cortisol, the primary glucocorticoid hormone released by the adrenal cortex, serves as a reliable biomarker of hypothalamic-pituitary-adrenal axis activity and stress responsivity [13]. Research has documented altered cortisol patterns in children with ADHD, including blunted cortisol awakening responses and atypical diurnal rhythms [14]. Investigating cortisol changes following yoga interventions may provide objective physiological evidence complementing behavioral assessments.

Despite growing interest in yoga-based interventions for ADHD, empirical evidence remains limited, particularly regarding specific components such as yoga nidra [15]. Most existing studies have employed combined yoga protocols, making it difficult to identify the relative contributions of different practices [16]. Furthermore, examining ADHD symptom domains separately (inattention versus hyperactivity-impulsivity) may reveal differential intervention effects that are obscured in total score analyses [17].

This pilot study aimed to investigate the effects of selected yoga asanas and yoga nidra, delivered as separate interventions, on ADHD symptom severity across both inattention and hyperactivity-impulsivity domains, as well as salivary cortisol levels in children. The study sought to generate preliminary data regarding feasibility, effect sizes, and potential differential effects of these practices to inform design of subsequent larger trials.

METHODS

Study Design and Participants

This pilot study employed a three-arm randomized controlled design with pre-post assessments. Eighteen children aged seven to twelve years showing symptoms of ADHD were recruited from a selected school. Ethical approval was obtained from the institutional ethics committee and the study was registered with a clinical trial registry. Written informed consent was obtained from parents and written assent was obtained from children prior to participation. Participants meeting inclusion criteria were randomly allocated to three groups using lottery method: yoga asanas group (n=6; 3 males, 3 females; mean age 9.17±1.47 years), yoga nidra group (n=6; 3 males, 3 females; mean age 9.33±1.63 years), and control group (n=6; 3 males, 3 females; mean age 9.00±1.41 years). Due to the nature of the intervention, blinding of participants and yoga instructor was not possible. Parents completing the outcome measures were not blinded to group allocation.

Inclusion Criteria

Children aged seven to twelve years studying in the selected school were included in the study. Children showing symptoms of Attention Deficit Hyperactivity Disorder as identified through the ADHD Behaviour Rating Scale were considered eligible. Children who were physically fit and able to understand and follow simple instructions required for yoga asana and yoga nidra practices were included. Children whose parents or guardians provided written informed consent and who themselves gave assent to participate in the study were selected. Children willing to participate regularly throughout the intervention period were included.

Exclusion Criteria

Children suffering from any acute or chronic medical condition, neurological disorder, or physical limitation that could interfere with participation in yoga practices were excluded. Children having psychiatric or behavioural comorbidities other than Attention Deficit Hyperactivity Disorder, which could influence the outcome variables, were excluded from the study. Children receiving ongoing medical or psychological treatment that could affect ADHD symptoms or cortisol levels were not included. Children with irregular school attendance or inability to maintain regular participation throughout the intervention period were excluded.

Intervention Protocol

The yoga asanas intervention comprised supervised sessions conducted four days weekly for four weeks (total sixteen sessions). During the first two weeks, sessions were fifteen minutes in duration, which was progressively increased to twenty minutes for the remaining two weeks to allow gradual adaptation. Sessions included warming exercises followed by ten selected asanas specifically chosen for their calming and focusing properties: Tadasana (palm tree pose), Vrikshasana (tree pose), Garudasana (eagle pose), Hastapadasana (hand-to-foot pose), Gomukhasana (cow face pose), Ushtrasana (camel pose), Balasana (child's pose), Chakrasana (wheel pose), Bhujangasana (cobra pose), and Makarasana (crocodile pose). Sessions were conducted by a certified yoga instructor with pediatric experience.

The yoga nidra intervention involved guided sessions following standardized protocols adapted for children [18]. Similar to the yoga asanas group, sessions were fifteen minutes during the first two weeks and twenty minutes during the remaining two weeks. Sessions progressed through stages of initial relaxation, intention setting, body rotation awareness, breath awareness, visualization, and gradual externalization. Sessions were delivered in supine position in a quiet, dimly lit environment four days weekly for four weeks. The control group maintained regular activities without intervention and received the intervention following study completion.

Outcome Measures

ADHD symptoms were assessed using the ADHD Behaviour Rating Scale (ADHD-BRS) developed by Bhargava [19], a validated instrument based on DSM-IV-TR criteria [20] and standardized for Indian population. The scale yields subscale scores for inattention and hyperactivity-impulsivity domains, along with a total score. Parents completed the scale at baseline and within one week following intervention completion.
Salivary cortisol samples were collected between 8:00 and 9:00 AM to control for circadian variation. Participants were instructed to avoid eating, drinking, or brushing teeth for thirty minutes prior to collection. Samples were collected by a trained pathologist using passive drool method into polypropylene tubes, immediately frozen, and subsequently analyzed using enzyme-linked immunosorbent assay with established sensitivity and specificity parameters.

Statistical Analysis
Given the pilot nature and small sample size, non-parametric statistical approaches were employed. Shapiro-Wilk tests confirmed non-normal distribution for change scores. Within-group changes were analyzed using Wilcoxon signed-rank tests for inattention, hyperactivity-impulsivity, total ADHD scores, and cortisol levels separately. Between-group comparisons employed Kruskal-Wallis tests with epsilon-squared effect sizes. Effect size interpretation followed established guidelines: ε^2 values of 0.01, 0.06, and 0.14 represent small, medium, and large effects respectively [21]. Statistical significance was set at $p<0.05$. Data were analyzed using Jamovi statistical software (version 2.6.20.0).

RESULTS

Participant Flow and Attendance
All eighteen participants completed the study with no dropouts. The overall session attendance rate was 92% across both intervention groups, indicating high feasibility and acceptability of the interventions. No adverse events were reported during the study period.

Baseline Characteristics and Descriptive Statistics
Descriptive statistics for all outcome variables across inattention, hyperactivity-impulsivity, and total ADHD domains are presented in Table 1. At baseline, groups demonstrated comparable symptom severity across all domains with no significant differences. Mean inattention scores ranged from 9.67 to 10.17, hyperactivity-impulsivity scores from 11.17 to 11.67, and total ADHD scores from 20.83 to 21.83 across groups. Baseline cortisol concentrations ranged from 4.72 to 4.98 µg/L. The comparison of pre-test and post-test scores across domains is illustrated in Figure 1.

Table 1. Descriptive Statistics by Group and Domain

Variable	Yoga Asanas (n=6)	Yoga Nidra (n=6)	Control (n=6)
Inattention Pre	9.67 (1.37)	10.17 (1.47)	10.00 (1.41)
Inattention Post	9.33 (1.21)	9.50 (1.05)	10.17 (1.47)
Inattention Change	-0.33 (0.52)	-0.67 (0.52)	+0.17 (0.41)
Hyperactivity-Impulsivity Pre	11.17 (0.75)	11.67 (1.51)	11.17 (1.17)
Hyperactivity-Impulsivity Post	10.50 (0.55)	11.00 (1.10)	11.17 (0.98)
Hyperactivity-Impulsivity Change	-0.67 (0.52)	-0.67 (0.52)	0.00 (0.63)
Total ADHD Pre	20.83 (1.47)	21.83 (1.83)	21.17 (1.47)
Total ADHD Post	19.83 (1.47)	20.50 (1.05)	21.33 (1.37)
Total ADHD Change	-1.00 (0.63)	-1.33 (0.82)	+0.17 (0.41)
Cortisol Pre (µg/L)	4.72 (0.70)	4.86 (0.89)	4.98 (0.46)
Cortisol Post (µg/L)	4.71 (0.59)	4.89 (0.55)	4.90 (0.50)
Cortisol Change	-0.01 (0.29)	+0.03 (0.48)	-0.08 (0.32)

Note: Values presented as Mean (SD). Negative change scores indicate symptom reduction.

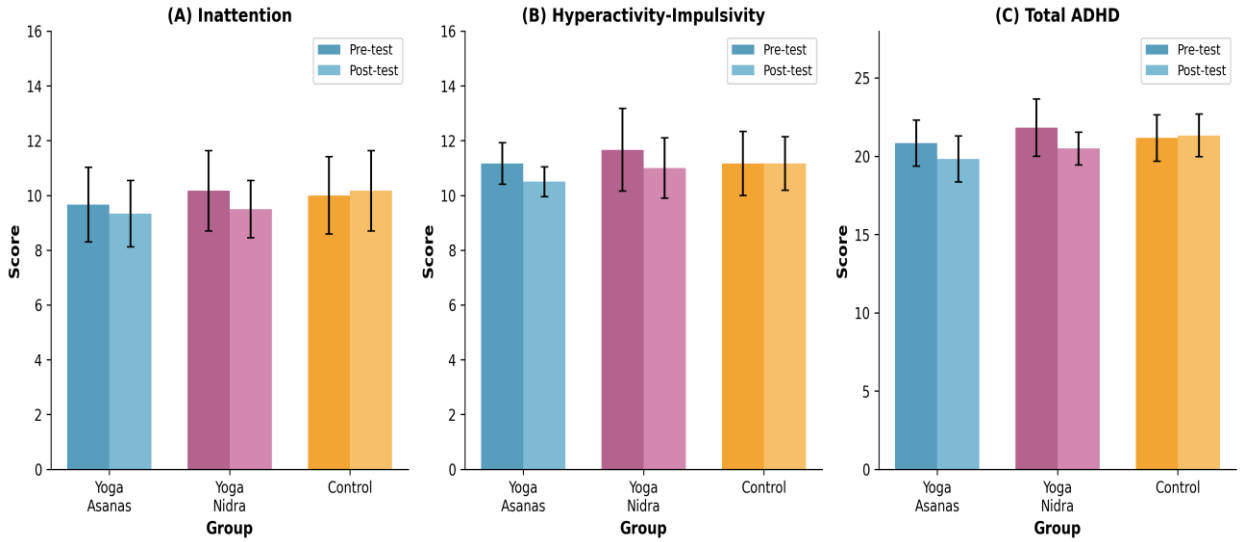

Figure 1. Comparison of pre-test and post-test ADHD scores across groups by domain: (A) Inattention, (B) Hyperactivity-Impulsivity, (C) Total ADHD. Error bars represent standard deviation.

Within-Group Changes

Wilcoxon signed-rank tests examining pre-post changes within each group revealed trends toward improvement in intervention groups (Table 2). For the inattention domain, yoga nidra showed a trend (W=0.0, p=0.125) while yoga asanas showed modest change (W=0.0, p=0.500). The hyperactivity-impulsivity domain showed consistent trends in both yoga asanas (W=0.0, p=0.125) and yoga nidra (W=0.0, p=0.125) groups. Total ADHD scores approached statistical significance in both intervention groups (yoga asanas: W=0.0, p=0.062; yoga nidra: W=0.0, p=0.062). The control group exhibited no significant changes in any domain.

Cortisol analyses revealed no statistically significant within-group changes for any condition. The yoga asanas group showed minimal change (W=10.0, p=1.000), as did the yoga nidra group (W=9.0, p=0.844) and control group (W=10.0, p=1.000).

Table 2. Within-Group Comparisons Using Wilcoxon Signed-Rank Test

Group	Variable	W	p-value
Yoga Asanas	Inattention (Pre vs Post)	0.0	0.500
	Hyperactivity-Impulsivity (Pre vs Post)	0.0	0.125
	Total ADHD (Pre vs Post)	0.0	0.062
	Cortisol (Pre vs Post)	10.0	1.000
Yoga Nidra	Inattention (Pre vs Post)	0.0	0.125
	Hyperactivity-Impulsivity (Pre vs Post)	0.0	0.125
	Total ADHD (Pre vs Post)	0.0	0.062
	Cortisol (Pre vs Post)	9.0	0.844
Control	Inattention (Pre vs Post)	0.0	1.000
	Hyperactivity-Impulsivity (Pre vs Post)	1.5	1.000
	Total ADHD (Pre vs Post)	0.0	1.000
	Cortisol (Pre vs Post)	10.0	1.000

Note: $p < 0.10$ indicates trend toward significance.

Between-Group Comparisons

Kruskal-Wallis analysis comparing change scores across the three groups revealed statistically significant differences for key outcome variables (Table 3). Inattention change scores differed significantly between groups (χ^2=6.40, df=2, p=0.041, ε^2=0.376), with intervention groups showing reductions while control showed slight increase. Hyperactivity-impulsivity change scores showed a trend toward significance with large effect size (χ^2=4.44, df=2, p=0.108, ε^2=0.261). Most notably,

total ADHD change scores demonstrated highly significant differences between groups (χ^2=9.74, df=2, p=0.008), with a large effect size (ε^2=0.573). The distribution of change scores across groups and domains is depicted in Figure 2. No statistically significant between-group differences were observed for cortisol change scores (χ^2=0.48, df=2, p=0.788, ε^2=0.028).

Table 3. Between-Group Comparisons Using Kruskal-Wallis Test

Variable	χ^2	df	p-value	ε^2
Change in Inattention	6.40	2	0.041*	0.376
Change in Hyperactivity-Impulsivity	4.44	2	0.108	0.261
Change in Total ADHD Score	9.74	2	0.008**	0.573
Change in Cortisol	0.48	2	0.788	0.028

*ε^2 = epsilon-squared effect size; *p < 0.05; **p < 0.01*

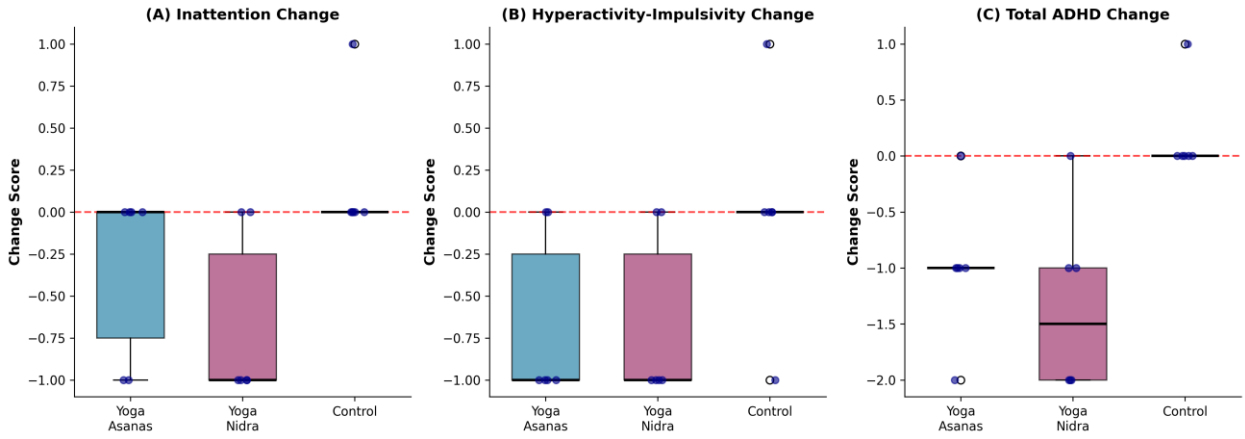

Figure 2. Distribution of ADHD score changes across groups by domain: (A) Inattention, (B) Hyperactivity-Impulsivity, (C) Total ADHD. Individual data points are displayed. The red dashed line indicates no change. Negative values indicate symptom reduction.

DISCUSSION

This pilot randomized controlled trial provides encouraging preliminary evidence supporting the potential efficacy of both yoga asanas and yoga nidra as interventions for managing ADHD symptoms in children. The between-group analyses revealed significant differences in total ADHD change scores (p=0.008) and inattention change scores (p=0.041), with large effect sizes indicating robust and clinically meaningful intervention effects. The large effect size observed for total ADHD change (ε^2=0.573) substantially exceeds conventional thresholds for large effects, demonstrating the promise of these yoga-based interventions.

The high attendance rate (92%) and absence of adverse events demonstrate excellent feasibility and safety of both yoga asanas and yoga nidra interventions in this pediatric population. These findings support the acceptability of yoga-based interventions for children with ADHD symptoms and suggest that such programs can be successfully implemented in school-based settings.

The significant between-group difference for inattention (p=0.041) and the trend observed for hyperactivity-impulsivity (p=0.108, ε^2=0.261) suggest that yoga-based interventions may beneficially influence multiple domains of ADHD symptomatology. Notably, while control group scores remained stable or slightly increased, both intervention groups showed consistent symptom reductions. The yoga asanas group demonstrated mean reductions of 0.33 points in inattention, 0.67 points in hyperactivity-impulsivity, and 1.00 point in total ADHD scores. Similarly, the yoga nidra group showed reductions of 0.67, 0.67, and 1.33 points respectively.

The comparable efficacy of yoga asanas and yoga nidra suggests that both active physical practice and guided relaxation may engage similar regulatory mechanisms relevant to ADHD symptom management. This finding has practical implications, as yoga nidra requires minimal physical exertion and space, potentially increasing accessibility for children with physical limitations or in resource-constrained settings. Both practices may enhance parasympathetic activation, improve self-regulation capacity, and strengthen attentional control through distinct but complementary pathways [7,9].

The absence of significant cortisol changes warrants consideration of several factors. First, morning cortisol measurement captures only one aspect of hypothalamic-pituitary-adrenal axis functioning; awakening responses or diurnal patterns might reveal intervention effects not apparent in single-timepoint assessments [14]. Second, the four-week intervention

duration, while sufficient to produce behavioral changes, may require extended practice periods to manifest in stable physiological adaptations. Third, behavioral improvements may precede or occur independently of stress hormone changes.

Our findings align with and extend existing literature documenting yoga benefits for pediatric ADHD populations. Previous studies examining combined yoga protocols have reported improvements in attention, hyperactivity, and behavioral regulation [6,15,16]. The present study advances this literature by demonstrating that both yoga asanas and yoga nidra, delivered as separate interventions, produce comparable effects. This specificity enables more targeted intervention recommendations based on individual preferences and practical constraints.

Several limitations warrant acknowledgment. The small sample size, while appropriate for a pilot study, limits generalizability and precluded post-hoc pairwise comparisons between specific groups. The lack of clinical ADHD diagnosis means findings apply to children with elevated ADHD symptoms rather than formally diagnosed populations. Due to the nature of the intervention, blinding of participants, yoga instructor, and parents completing outcome measures was not possible, which may introduce performance and detection biases. Reliance on parent-reported behavioral measures may introduce reporting biases. Multiple statistical comparisons were conducted without correction, which may increase Type I error risk; however, this approach is considered acceptable for pilot studies aimed at generating hypotheses. Future research should incorporate larger samples, clinical diagnosis confirmation, randomized allocation with allocation concealment, blinded assessments where possible, longer intervention durations, active control conditions, and multiple cortisol sampling timepoints.

CONCLUSION

This pilot randomized controlled trial provides promising preliminary evidence that both selected yoga asanas and yoga nidra may effectively reduce ADHD symptom severity in children aged seven to twelve years compared to control. The significant between-group differences for total ADHD scores ($p=0.008$) and inattention ($p=0.041$), along with large effect sizes and high intervention adherence (92% attendance), support the therapeutic potential and feasibility of these interventions. The comparable effectiveness of both practices offers flexibility in clinical application based on individual needs and contexts. These findings justify and inform the design of adequately powered confirmatory trials with clinically diagnosed populations. While cortisol changes were not observed, future studies should employ comprehensive stress physiology assessments to better characterize potential neurobiological mechanisms underlying the observed behavioral improvements.

DECLARATIONS

Ethics Approval and Trial Registration

This study was approved by the Institutional Ethics Committee of Lakshmibai National Institute of Physical Education, Gwalior (IEC/LNIPE/128/08) and was registered with the Clinical Trials Registry of India (CTRI/2025/02/081373). Written informed consent was obtained from parents or legal guardians of all participants, and written assent was obtained from all participating children prior to enrollment. All procedures were conducted in accordance with the ethical standards of the institutional research committee and with the 1964 Helsinki Declaration and its later amendments.

Availability of Data and Materials

The datasets used and analyzed during the current study are available from the corresponding author on reasonable request.

Conflict of Interest

The authors declare that they have no conflict of interest.

Author Contributions

VKS conceptualized and supervised the study. SK collected the data and wrote the manuscript. MS analyzed the data. All authors read and approved the final manuscript.

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