The Effectiveness of Neurocognitive Training (NCT) in Enhancing Attention and Executive Function in Children with ADHD: A Pilot Study

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Abstract

Our study examined the effectiveness of computer-based Neurocognitive Training (NCT) in improving core symptoms of Attention-Deficit/Hyperactivity Disorder (ADHD) in children, including attentiveness, timeliness, impulsiveness, hyperactivity, emotional lability, and executive functioning. Method: Twenty-four children in grades 3–6 diagnosed with ADHD completed 40 sessions of NCT. Pre- and post-intervention changes were measured using the MOXO d-CPT (student assessment) and the Conners 3-Parent (Conners 3-P) rating scales. A two-way repeated measures ANOVA was conducted to analyse outcomes and evaluate differences based on medication status and gender. Results: Following NCT, participants showed significant improvements in attentiveness, timeliness, impulsiveness, hyperactivity, emotional lability, and executive functioning. Parent reports indicated notable reductions in behavioural symptoms, including inattention, executive function deficits, hyperactivity, impulsivity, emotional lability, and the global index total. While no statistically significant differences emerged between medicated and non-medicated groups, non-medicated participants demonstrated greater improvement in attentiveness and hyperactivity, whereas medicated children performed better in timeliness and impulsiveness. Gender differences were observed, with girls exhibiting fewer behaviours related to hyperactivity, impulsivity, emotional lability, and lower global index scores. Conclusion: Computer-based NCT produced significant improvements in ADHD symptomatology in children, as evidenced by both objective measures and parent reports. Findings suggest NCT is a promising intervention for managing ADHD symptoms in educational and clinical contexts. Future research should further examine the roles of gender and medication status in NCT outcomes to better understand neurocognitive functioning and optimize interventions for children with ADHD.

1. Introduction

Attention-deficit/hyperactivity disorder (ADHD) prevalence varies nationally and internationally, with a global prevalence of 8% [1], and it is one of the most common neurodevelopmental disorders among school-age children in the US [2]. The prevalence of ADHD in school-age children is 3% to 7% in the US [3]. The prevalence rate is 6.26% in China [4] and 7.2% in Europe [5]. According to open data from the Hong Kong government (https://data.gov.hk/en/, retrieved on 22 January 2026), students with ADHD are the second-largest population among the nine special educational needs (SEN) categories studying in Hong Kong public-sector ordinary primary and secondary schools. The core symptoms of ADHD that primarily emerge during the school-age period include inattention, hyperactivity, and impulsivity [6]. These symptoms have harmful effects on the quality of life and functioning, including self-esteem, academic achievement, social performance, and relationship management [7].

Neurocognitive Training (NCT) is a brainwave technology that can serve as an attention and executive function enhancement program for students with ADHD. Unlike neurofeedback systems based on operant conditioning, NCT translates real-time brainwave data into readable visual presentations that accurately provide feedback on students' attention levels at any given time. NCT training is based upon the scientific basis of neuroplasticity. Taking advantage of the visualized attention level, students can improve their attentive state through a series of specially designed games and programs. While computer-based neurocognitive training (NCT) has been investigated as an effective intervention for students with ADHD at schools in the US for a long time [8][9] and similar effective results were also obtained in China [10][11], the practice and studies on this intervention haven't yet been conducted in Hong Kong to test its effectiveness.

2. The current study

This study evaluates the effectiveness of a 20-week Neurocognitive Training (NCT) intervention (40 lessons) for primary school students with ADHD in Hong Kong. While medication and traditional cognitive training are common approaches for ADHD management, this study investigates NCT as a potential alternative or complementary intervention for improving core ADHD symptoms and executive functions.

The primary objective is to assess the NCT program's efficacy in addressing key behavioral and

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cognitive domains, including attention, timeliness, impulsivity, hyperactivity, and executive functions.

To capture a comprehensive assessment of intervention effects, data were collected from both students and their parents, providing multi-informant perspectives on behavioral and cognitive changes. By analyzing outcomes from multiple informants, this study aims to provide preliminary evidence on the NCT program's viability as a validated intervention for children with ADHD in Hong Kong, offering parents and educators an evidence-based alternative or supplementary approach.

3. Methodology

Participants

The study was approved by Human Research Ethics Committee (HREC) of The Education University of Hong Kong (Refer No: 2022-2023-0226). The participants were recruited based on the following inclusion criteria:

- Clinical diagnosis of attention-deficit/hyperactivity disorder (ADHD) per the Diagnostic and Statistical Manual of Mental Disorders (DSM-V) made by the child's clinician (e.g., primary care medical doctor, clinical psychologist, or educational psychologist), and

- The child was in third to sixth grade. To increase the external validity of the intervention, children were included regardless of whether they were taking medication. All participants were instructed to continue with their scheduled doctor visits and standard support in school, independent of their participation in the study.

Children with coexisting diagnoses of autism spectrum disorder, dyslexia, or other serious mental illnesses such as psychosis were excluded from the study to limit potential confounding factors and extensive changes to the intervention protocol that could affect its standardized implementation. Written informed consent and child assent were obtained before the study began.

Eleven (46%) girls and thirteen (54%) boys with ADHD from mainstream primary schools were recruited in this study. Their age ranged from 8 to 11, with a mean of 9 and a standard deviation of 0.908. Their ADHD presentations included "combined presentation" (54.2%), "predominantly inattentive presentation" (37.5%), and "predominantly hyperactive/impulsive presentation" (8.3%). Twelve out of 24 children were taking medication during the training period. Their education grade levels were third grade (29.2%), fourth grade (33.3%), fifth grade (20.8%), and sixth grade (16.7%). Please refer to Table 1 for more demographic information.

Table 1. Demographic of Study Participants

Characteristics		Total
N		24
Gender	Male	13
	Female	11
Age	8 yo	8
	9 yo	8
	10 yo	7
	11 yo	1
Grade	Third	7
	Fourth	8
	Fifth	5
	Sixth	4
ADHD medication	Yes	12
	No	12
Family income	<30000	5
	30001-50000	7
	50001-70000	3
	70001-90000	1
	>90000	3
Schools	Subsidy	20
	Private	4

Interventions

NCT is a range of cognitive games designed to improve attention, executive functioning, behavior, and cognitive function in individuals with ADHD. The system used the Body-Wave armband EEG sensors to detect two frequency ranges: one in the low-frequency theta brainwave range (4–8 Hz) and another in the high-frequency beta brainwave range (12–15 Hz), which tracked the player's attention signature through the body and sent it wirelessly to the computer.

With practice, participants acquired skills to control the characters displayed on the screen, which led to the suppression of theta waves and an increase in beta activity (attentive state). As the ratio of theta to beta waves changed, an algorithm was applied to enable participants to score points on the computer program and enhance their attention through the completion of six different exercises (Attention Stamina, Visual Tracking, Time on Task, Short-Term Memory, Discriminatory Processing, and Auditory Processing Home). For example, in one specific exercise, a dolphin character swam down to the ocean floor to collect coins from a treasure chest. However, if the child became distracted, the dolphin swam back up to the surface of the ocean. As the participant progressed through the exercise and the theta-to-beta ratio decreased, reflecting effective focusing in the training exercises.

Research assistants (RAs) received standardized training to administer the NCT training. Each session lasted two 60-minute sessions per week for a total of 40 sessions, conducted at a 2:1 to 5:1 student-to-RA ratio depending on logistics. The sessions occurred after school or on weekends. The students completed a standardized session checklist at each session to track their progress, and they were rewarded with small, tangible prizes if they achieved their goals.

3.1. Measures

Outcome measures were completed by both students and parents, which included pre-post intervention on student assessment (MOXO d-CPT) and parent reports (Conners 3-Parent [Conners 3-P]),

3.1.1. MOXO-CPT (https://moxo.neurotech-solutions.com/) The MOXO d-CPT is an objective diagnostic supportive tool for ADHD. This online test involves executing predetermined reactions to target and non-target stimuli. The test incorporates distractors (auditory, visual, and combined) in the CPT to enhance sensitivity and specificity as compared to conventional CPTs. It measures four domains of attention: attentiveness, timeliness, hyperactivity, and impulsivity; and requires about 30 minutes (with practice and the entire protocol) to complete.

3.1.2. The Conners 3-Parent Assessment [12] is a validated and standardized online instrument designed to assess ADHD symptomatology based on parents' observations of their children's behavior. It comprises multiple subscales, of which we focused on four in the current study: inattention, hyperactivity/impulsivity, executive functioning, learning problems, and two DSM-IV ADHD symptoms scales (inattention and hyperactivity-impulsivity). Additionally, we extracted two composite indices—emotional lability and the total global index—which are automatically calculated by the assessment system to evaluate participants' emotional regulation and overall symptomatology. Participants with elevated emotional lability scores were more prone to frequent crying, temper outbursts, or frustration. A high total global index score indicated significant emotional dysregulation, coupled with heightened restlessness, impulsivity, and inattention.

3.2. Data collection procedure

Data collection and intervention for this study were conducted at the BrainX Center, the sole authorized provider of the NCT program in Hong Kong. Prior to the intervention, participants completed the MOXO d-CPT, and parents completed the Conners 3-P. All participants completed the full 40-session training program without dropout, after which the same assessments were re-administered.

3.3. Statistical analysis

Our study employed a two-way repeated measures ANOVA design to evaluate the effects of Neurocognitive Training (NCT) on attentional and behavioral outcomes in children, with time (pre-test vs. post-test) as the within-subjects factor and gender and medication status (medicated vs. unmedicated) as between-subjects factors. Participants completed the MOXO (MOXO-CPT), assessing attentiveness, timeliness, impulsiveness, and hyperactivity, while parents provided additional behavioral data via the Conners 3-P rating scale, measuring inattention, executive functioning, hyperactivity/impulsivity, emotional lability, and a Total Global Index. Statistical analyses examined time effects, group differences (gender, medication), and interaction effects, with partial eta-squared (η^2_p) indicating effect sizes. All analyses were conducted at a significance threshold of $p < .05$, and pairwise comparisons with estimated marginal means were applied where significant differences were detected. The Bonferroni method was used to adjust for multiple comparisons. All the analyses were conducted with IBM SPSS version 29.

4. Results

Our results are based on participants' MOXO-CPT data. Table 2 shows the main effects of time (pre-test vs post-test) of the four ADHD symptoms of participants based on the repeated measure ANOVA. The following sections elaborate on those changes in detail.

4.1. Attentiveness

A two-way repeated measures ANOVA revealed a significant main effect of time on attentiveness, $F(1, 20) = 13.945$, $p < .001$, $\eta^2_p = .411$, indicating a significant improvement from pretest (Mean = -2.15, SE = 0.639) to post-test (Mean = 0.22, SE = 0.211). No significant main effects were observed for gender ($p > .05$) or medication status ($p > .05$). Additionally, no significant interactions were found between time and medication ($F(1, 20) = 1.013$, $p > .05$), time and gender ($F(1, 20) = 0.117$, $p > .05$), or among time, gender, and medication ($F(1, 20) = 1.594$, $p > .05$).

4. 2. Timeliness

A significant main effect of time was observed for timeliness, $F(1, 20) = 15.978$, $p < .001$, MSE = 2.581, $\eta^2 p = .444$, indicating a significant

Table 2. **MOXO test - The difference between pre- and post-intervention results based on students' data**

	pre			post			*F*	*p*
	N	Mean	SE	N	Mean	SE		
Attentiveness	24	-2.15	0.639	24	0.22	0.211	*13.945*	***.001******
Timeliness	24	-1.86	0.463	24	0.01	0.356	*15.978*	***.001******
Impulsiveness	24	-1.25	0.426	24	0.04	0.339	*7.320*	***.014****
Hyperactivity	24	-6.47	2.471	24	-1.27	1.540	*6.217*	***.005****

Note: *** p<.001, ** p<.01, * p<.05

Table 3. **Conners 3-Parent - The difference between pre- and post-intervention based on parents' data**

	pre			post			*F*	*p*
	N	Mean	SE	N	Mean	SE		
Inattention	24	81.90	1.372	24	70.43	2.233	*21.397*	***.001******
DSM-IV ADHD Inattention	24	80.43	1.987	24	68.34	2.231	*27.851*	***.001******
Executive Functioning	24	77.92	2.217	24	66.64	2.181	*20.624*	***.001******
Hyperactivity and Impulsivity	24	76.49	2.555	24	68.40	2.940	*11.786*	***.01*****
DSM-IV Hyperactivity andimpulsivity	24	76.09	2.593	24	68.67	2.827	*9.915*	***.005*****
Learning Problem	24	71.89	1.777	24	62.65	2.022	*19.696*	***.01*****
Emotional Lability	24	69.88	2.990	24	61.84	2.046	*15.413*	***.001******
Global Index (Total)	24	76.28	2.073	24	66.86	2.028	*20.360*	***.001******

Note: *** p<.001, ** p<.01, * p<.05

improvement in scores from pre-test (Mean = -1.86, SE = 0.463) to post-test (Mean = 0.01, SE = 0.356, $p < .01$). A marginally significant interaction between time and gender was found, F(1, 20) = 4.062, $p = .057$, MSE = 2.581, η^2_p = 0.169. Post-hoc analyses revealed that girls exhibited a significant improvement in timeliness from pre-test (Mean = 2.04, SE = 0.682) to post-test (Mean = 0.77, SE = 0.525), whereas boys showed no significant change (pre-test: Mean = -1.68, SE = 0.627; post-test: Mean = -0.75, SE = 0.48).
Between-group comparisons indicated no significant difference in timeliness between boys and girls at pre-test. However, following the NCT intervention, girls (Mean = 0.77) performed significantly better than boys (Mean = -0.75) (Figure 1).

No significant interactions were observed between time and medication status (F(1, 20) = 0.022, $p = .883$) or for the three-way interaction of time, gender, and medication (F(1, 20) = 0.008, $p = .929$). Additionally, no significant main effects were found for gender ($p = .406$) or medication ($p = .522$).

4.3. Impulsiveness

The analysis demonstrated a significant main effect of time on impulsiveness, F(1, 20) = 7.320, $p = .014$, MSE = 2.653, η^2_p = .268, with improvements from pretest (Mean = -1.25, SE = 0.462) to post-test (Mean = 0.04, SE = 0.339, $p<.05$). A significant main effect of medication was also observed, F(1,20) = 4.413, $p<.05$, η^2_p = .181.

Figure 1. Participants' performance on timeliness between boys and girls

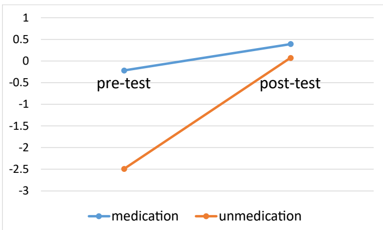

Figure 2. Participants' performance on impulsiveness under different medication statuses

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Participants with medication had better performance on impulsiveness than unmedicated participants.

Although no significant interaction between time and medication was found (F(1, 20) = 2.019, p = .171), participants without medication showed larger improvements than those on medication (Figure 2). No significant interaction between time and gender (F(1, 20) = 0.155, *p* = *.698*), or the three-way interaction (F(1,20) = 1.541, *p* = *.229*). Gender differences were non-significant (*p* = *.913*).

4.4. Hyperactivity

A significant main effect of time was found for hyperactivity, F(1, 20) = 6.217, *p* <*.05*, MSE = 51.537, η^2_p = .237, with scores improving from pretest (Mean = -6.47, SE = 2.471) to post-test (Mean = -1.27, SE = 1.540). No significant interactions were observed between time and medication (F(1, 20) = 1.185, *p* =*.289*), time and gender (F(1, 20) = 0.083, *p* = *.776*), or the three-way interaction (F(1, 20) = 0.950, *p* = *.341*). Additionally, no significant differences were found between medicated and unmedicated participants (*p* = *.752*) or between genders (*p* = *.359*).

4.5. Results based on parents' Conners 3 data

Table 3 shows the main effects of time based on the results of repeated-measure ANOVA of parents' data.

4.5.1. Inattention. A significant main effect of time was observed for inattention, F(1, 20) = 21.397, *p* < *.001,* MSE = 72.717, η^2_p = .517, with scores decreasing from pretest (Mean = 81.90, SE = 1.372) to post-test (Mean = 70.43, SE = 2.233, *p* < *.001*). No significant interactions were found between time and medication (F(1, 20) = 0.847, *p* > *.05*), time and gender (F(1, 20) = 0.898, *p* > *.05*), or the three-way interaction (F(1, 20) = 0.489, *p* > *.05*). Medication (*p* = *.080*) and gender (*p* = *.621*) effects were non-significant.

4.5.2. DSM-IV ADHD Inattention. Significant main effect of time was detected for the DSM-IV based Inattention behaviors, F(1,20)=27.851, *p* = <*.001,* MSE = 62.060, η^2_p = .582, with scores dropping from pre-test (Mean = 80.43, SE = 1.987) to post-test (Mean = 68.34, SE = 2.231). No significant interactions were observed for time × medication (F(1, 20) = 0.638, *p* = *.434*), time × gender (F(1, 20) = 2.535, p = .112), or the three-way interaction (F(1, 20) = 0.002, *p* = *.964*). Medication (*p* = *.334*) and gender (*p* = *.767*) effects were non-significant.

4.5.3. Executive Functioning. A significant main effect of time was found for executive functioning, F(1, 20) = 20.624, *p* < *.001*, MSE = 73.063, η^2_p = .508, with improvements from pretest (Mean = 77.92, SE = 2.217) to post-test (Mean = 66.64, SE = 2.181, *p* < *.001*). No significant interactions were observed for time × medication (F(1, 20) = 0.476, *p* = *.498*), time × gender (F(1, 20) = 1.587, p = .222), or the three-way interaction (F(1, 20) = 0.08, *p* = *.780*). Medication (*p* = *.153*) and gender (*p* = *.857*) effects were non-significant.

4.5.4. Hyperactivity and Impulsivity. A significant main effect of time was observed, F(1, 20) = 11.786, *p* <*.01*, MSE = 65.706, η^2_p = .371, with scores decreasing from pretest (Mean = 76.49, SE = 2.555) to post-test (Mean = 68.40, SE = 2.940). No significant interactions were found for time × gender (F(1, 20) = 3.994, *p* = *.059*), time × medication (F(1, 20) = 2.992, *p* = *.099*), or the three-way interaction (F(1, 20) = 0.003, *p* = *.959*). Medication (*p* = *.483*) and gender (*p* = *.778*) effects were non-significant.

4.5.5. DSM_IV Hyperactivity and Impulsivity. A significant main effect of time was observed, F(1, 20) = 9.915, *p* <*.01*, MSE = 65.633, η^2_p = .331, with scores decreasing from pretest (Mean = 76.09, SE = 2.593) to post-test (Mean = 68.67, SE = 2.827). Significant interactions were found for time × gender (F(1, 20) = 4.658, *p* = *.043,* η^2_p = .189). Pairwise comparisons with marginal means revealed that girls exhibited a significant decrease in Hyperactivity and Impulsivity behaviors from pretest (Mean = 78.88, SE = 3.819) to post-test (Mean = 66.38, SE = 4.164, *p* < .05), whereas boys showed no significant change between pretest (Mean = 73.30, SE = 3.509) and post-test (Mean = 70.96, SE = 3.826, *p* = .473) (Figure 3). No other significant interactions were detected, including time × medication (F(1, 20) = 2.765, p = .112) or the three-way interaction of time × gender × medication (F(1, 20) = 0.452, p = .509). Additionally, neither the main effect of medication (*p* = *.578*) nor gender (*p* = *.919*) reached statistical significance.

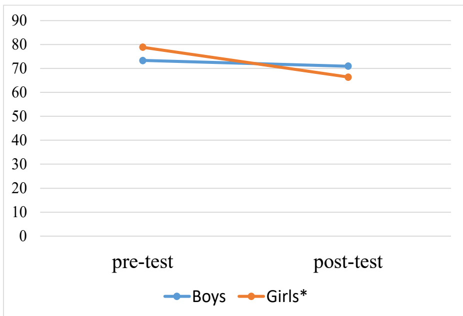

Figure 3. DSM_IV Hyperactivity and Impulsivity performance between boys and girls

4.5.6. Learning Problems. A significant main effect of time was observed, F(1, 20) = 19.696, *p* <*.01*, MSE = 51.197, η^2_p = .496, with scores decreasing from pretest (Mean = 71.89, SE = 1.777) to post-test (Mean = 62.65, SE = 2.022). No significant interactions were found for time × gender (F(1, 20) = 2.222, $p = .152$), time × medication (F(1, 20) = 0.054, $p = .819$), or the three-way interaction (F(1, 20) = 0.008, $p = .930$). Medication ($p = .481$) and gender ($p = .240$) effects were non-significant.

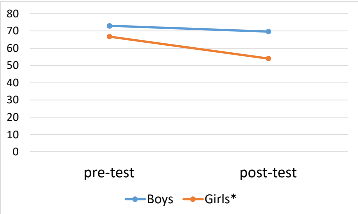

Figure 4. Comparison between boys and girls on their emotional liability

4.5.7. Emotional Lability. A significant main effect of time was observed, F(1, 20) = 15.413, MSE = 49.537, $p < .001$, $\eta^2_p = .435$, indicating a reduction in emotional lability from pretest (Mean = 69.88, SE = 2.990) to post-test (Mean = 61.84, SE = 2.046, $p < .01$). Additionally, a significant time × gender interaction emerged, F(1, 20) = 5.276, $p < .05$, $\eta^2_p = .209$. Pairwise comparison analyses revealed that while no significant difference existed between girls and boys at pretest ($p > .05$), girls exhibited a significantly greater improvement in emotional lability at post-test (Mean = 54.03, SE = 3.013) compared to boys (Mean = 69.66, SE = 2.768, $p < .01$). Further within-group comparisons demonstrated that boys did not show a significant change in emotional lability following the intervention (pretest: Mean = 72.99, SE = 4.05; post-test: Mean = 69.66, SE = 2.77; p = .243). In contrast, girls experienced a significant decrease in emotional lability, with scores dropping from Mean = 66.77 (SE = 4.40) at pretest to Mean = 54.03 (SE = 3.01) at post-test ($p < .001$) (see Figure 4). A significant main effect of gender was also found, F(1, 29) = 5.407, $p < .05$, with girls (Mean = 60.40, SE = 3.458) displaying lower emotional lability overall compared to boys (Mean = 71.32, SE = 3.178). No other interactions reached statistical significance ($p > .05$).

4.5.8. Total Global Index. A significant main effect of time was found, F(1, 20) = 20.360, $p < .001$, MSE = 51.474, $\eta^2_p = .504$, with improvements from pretest (Mean = 76.28, SE = 2.073) to post-test (Mean = 66.86, SE = 2.028, $p < .001$). No significant interactions were observed ($p > .05$). A significant gender effect emerged, F(1, 21) = 5.467, $p < .05$, with boys (Mean = 75.696, SE = 2.389) scoring higher than girls (Mean = 67.442, SE = 2.600).

5. Discussion

To our knowledge, this is the first study to assess the effectiveness of neurocognitive training on the attention behaviour and executive functioning of children with ADHD in Hong Kong. Consistent with our hypothesis, both student assessments and parent reports demonstrated significant improvements in ADHD symptoms, executive function, and emotion regulation among children aged 8-11 after receiving NCT training, which targets modifying brainwave activity by teaching students to regulate their cortical activity. These findings underscore the potential of NCT as an effective intervention for children with ADHD. Notably, parent-reported improvements in their children's learning problems suggested that acquired skills may generalize to academic settings. Furthermore, our results indicate that stimulant medication did not interfere with the efficacy of NCT, supporting its use as either a standalone or adjunctive treatment.

An intriguing finding was the observed gender differences in treatment response. Girls outperformed boys on post-test measures of timeliness (MOXO report), DSM-IV Hyperactivity and Impulsivity, and emotional lability (Conners 3-P report). These findings suggest that NCT treatment may respond differently across genders. This finding aligns with prior research indicating that girls with ADHD typically present with greater intellectual impairment but lower hyperactivity and antisocial behaviors compared to boys [13]. While neurocognitive training has been shown to benefit children with ADHD in both Western [14] and Chinese [15] populations, gender-specific patterns remain underexplored, particularly in Asian contexts. Some studies in China have even excluded female participants entirely [11], highlighting a critical gap in the literature. Our study, which included both boys and girls from Hong Kong, found that girls exhibited superior post-intervention performance in certain domains, suggesting that gender may be an important moderating factor in treatment efficacy. Future research should further investigate the interplay between gender and medication in the context of NCT to better understand neurocognitive functioning in children with ADHD.

Hormonal influences may contribute to these sex differences. Although prepubertal hormonal variations are subtle, adolescence marks a period of significant neuroendocrine changes that can modulate ADHD symptomatology [16]. For instance, hormonal fluctuations in boys have been linked to increased academic difficulties, aggression, and risk-taking behaviors, whereas girls may experience heightened emotional dysregulation, including sadness and anxiety [16]. These biological differences could partially explain the observed disparities in NCT outcomes and warrant further investigation in future studies.

Methodologically, this study is notable for its successful implementation of NCT in a real-world

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setting. As the first Hong Kong-based study to administer NCT after school hours, we demonstrated the feasibility of training research assistants to deliver group-based NCT (2–5 children per session) in a controlled after-school environment. This approach not only ensured high participant retention but also highlighted the practicality of integrating NCT into school-based intervention programs.

6. Limitations and future direction

While this pilot study provides promising evidence for NCT as a viable intervention, its small sample size limits the generalizability of the findings. Nevertheless, the observed functional improvements in primary school-aged children support the need for larger, randomized controlled trials in school settings, incorporating more diverse populations and controlling for potential confounders. Long-term follow-up studies are also necessary to assess the durability of NCT's benefits.

7. Conclusion

Despite these limitations, our findings contribute valuable preliminary evidence on the feasibility and efficacy of NCT for children with ADHD in Hong Kong. The study lays the groundwork for future research to optimize neurocognitive interventions, particularly in addressing gender-specific treatment responses and facilitating broader implementation in educational environments.

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