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EVALUATING EFFECTIVENESS OF GROUP INTERVENTION WORKING ON EXECUTIVE FUNCTION FOR CHILDREN WITH ATTENTION DEFICIT HYPERACTIVITY DISORDER: A PROSPECTIVE OBSERVATIONAL COHORT STUDY

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Abstract

Introduction: The objective of this study is to evaluate the effectiveness of Simon Says Program (SSP), a strategy-based group intervention program working on executive function (EF) for children with Attention Deficit Hyperactivity Disorder (ADHD). **Methods:** A prospective observational cohort study was conducted from December 2021 to July 2022 recruiting 21 SSP participants, either they were on stimulant or not on stimulants, and 12 other ADHD patients who are on stimulant medication only without prior participation in SSP, using convenience sampling method, from Child Development Clinic Hospital Sultan Ismail. NICHQ Vanderbilt Assessment Follow Up Scales (VAS) were used to measure its effectiveness and the significance of score differences before and after SSP were assessed using paired sample t-test of Statistical Package for Social Science (SPSS) version 28.0 software. **Results:** Total of 33 children participated in the study. From our study, only those participants on behavioural therapy alone showed statistically significant reduction in inattentive score, hyperactivity score and total symptoms score at the third month and sixth month after joining SSP from parents-rated VAS. There were no statistically significant differences in the average VAS performance score for both groups. **Conclusion:** SSP could be an effective behavioral intervention for children with ADHD children. Limitations included lacking clear generalizability due to the convenience sampling method and potential inter-rater variability.

Keywords: Simon Says Program, Strategy based training, ADHD, Executive function
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Introduction

Attention Deficit Hyperactivity Disorder (ADHD) is defined as a persistent pattern of inattention or hyperactivity and impulsive behaviour that is more frequent and severe than is typically seen in a child at a given developmental stage. Children and adolescents with ADHD often struggle with behavioural control, interpersonal relationships, academic performance, and personal issues [1]. These ultimately lead to worse health-related quality of life scores than the typically developing groups varying from a small to moderate degree in physical domains and a large degree in psychosocial domains [2].

In past decades, there has been evidence supporting proposed theory that symptoms of inattention, hyperactivity, and lack of impulse control in ADHD are caused by underlying deficits in the executive function (EF) [3]. Additionally, a recent systemic review showed that cognitive training can be an effective intervention for children and adolescents

with ADHD and might be considered as a complement to psychostimulant medication [4]. Most EF training can be classified into two categories: process-based training and strategy-based training. The aim of EF training is to achieve far transfer, which means the generalization of the training in children's daily life, in cognitive skill, academic performance and social adjustment. However, a significant number of previous studies on process-based EF training efficacy failed to find or examine the effect of far transfer [5]. Strategy based EF training, which is a remedial approach involving guidance and practise in compensatory technique to improve executive

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function integral to everyday task, has shown positive result [6].

An EF group intervention with proven efficacy and promising transferability, which shall also be feasible, flexible, and cost-effective to be conducted in both clinical and the more ecologically valid school settings, is urgently needed locally to improve long-term outcome for ADHD children. The objective of this study is to evaluate the effectiveness of Simon Says Programme (SSP), a strategy-based group intervention working on EF for children with ADHD. We hypothesized that compared with the control group, the intervention group would show improvement in EF deficits with reduction of ADHD symptoms and improvement in performance.

Methodology

Study design

A prospective observational cohort study was conducted from December 2021 to July 2022 at child development clinic (CDC) Sultan Ismail Hospital, a tertiary referral centre in Malaysia. This study design was selected as it is effective to assess the outcome of SSP, a group interventional programme that has been held annually every December at CDC as part of standard of care for ADHD patients.

Ethics

Approval from Medical Research and Ethics Committee of Malaysia's Ministry of Health was obtained before commencement of study: approval number: NMRR ID-21-02252-YTC. Written informed consent was obtained from all participants who agreed to participate. No ethical problems were encountered during the study.

Patient and public involvement

Although patients and their families were not involved in the design, they are intimately involved in the implementation of the intervention and the conduct of this research. In addition to attending the programme diligently, they had helped distributing NICHQ Vanderbilt Assessment Follow Up Scales (VAS) to teacher informants.

Once the study has been published, participating families and teachers will be sent details of the results in a study newsletter suitable for a non-specialist audience.

Participants and sample size

Sample size calculation was not done as there is no official registry for the number of children with ADHD in Malaysia. Participants in this study, who fulfilled following inclusion and exclusion criteria, were recruited with convenience sampling method.

Inclusion criteria:

1. Children aged seven to twelve years old with a clinical diagnosis of ADHD made based on diagnostic criteria specified in the Diagnostic and Statistical Manual of Mental Disorders, 5th edition (DSM-5) [7]. Diagnosis is made by a developmental paediatrician or clinical fellows attached to child development clinic.
2. Parents of recruited children who have completed parent psychoeducation and parent behavioural intervention programme organised by CDC.

Exclusion criteria:

1. Children with co-morbid of autism spectrum disorder (level two and above), genetic disorders, or severe medical conditions.
2. Children with psychiatric disorder, cognitive and significant language impairment.
3. Children who could not commit to attend entire ten-days course of the intervention programme.

Kaufman Brief Intelligence Test-Second Edition (KBIT-2) Non-Verbal Intelligent Quotient (NVIQ) subtest is used at CDC Hospital Sultan Ismail as a quick measure of patients' non-verbal intelligence. A recent study showed that it is a sufficient intelligence-screening tool for children with developmental disabilities [8]. All participants of this study had a KBIT-2 NVIQ composite score of average and above to ensure the SSP content could be delivered effectively.

SSP was held over two different languages (Malay and Mandarin) in December 2021 and was participated by 22 children with ADHD, of which 21 of them were recruited into the study forming two intervention groups: combination treatment group and SSP-only group. Parents of a SSP participant declined to participate in this study.

On the other hand, 12 children with ADHD, who are on stimulant treatment only and never attend SSP, were recruited from CDC during the same period forming stimulant-only group. Hence, overall sample size for this study was 33 participants.

Intervention

Simon Says Programme is a specific programme working on executive function by providing children with ADHD strategies to improve their executive function. This program is adapted from "Simon Says Pay Attention - Help for children with ADHD" by Marcie Yeager and Daniel Yeager. The programme content was translated and delivered in two languages, namely Malay and Mandarin, and example videos were reproduced in these two languages with volunteer staff members as actors to suit the local culture and setting.

The programme is divided into four sections, each focusing on a particular executive function, namely working memory, behavioral intervention, shifting focus, and goal orientation. Each session will be delivered via a series of prescribed activities with game elements using the "P.L.A.Y" formula which stands for four different steps, namely 'Play', 'Link', 'Assign', and 'Yahoo!'. SSP was conducted in 90-minute face-to-face sessions at CDC for ten consecutive days in December 2021 and the participants were further divided into two separate groups which were led by one tutor and one training assistant in each group. To ensure participants were able to understand structured lessons and group activities in SSP, only suitable CDC patients were selected by the CDC's developmental pediatric consultant to join SSP.

Outcomes

The primary outcome of this study was to determine the effectiveness of SSP as a group therapy programme to improve executive function of children with ADHD. ADHD symptoms and performance were assessed before SSP (month zero), then three months and six months after completing SSP.

The secondary outcome was to compare the effectiveness of combination treatment (stimulant and SSP), behavioural therapy (SSP) alone, and medication (stimulant) alone on ADHD children. ADHD symptoms and performance were assessed at the same interval as above.

Measures

NICHQ Vanderbilt Assessment Follow Up Scales

NICHQ Vanderbilt Assessment Follow Up Scales (VAS) was used to assess ADHD symptoms and academic

and behavioural performance. VAS has two separate scales for parents and teacher informants. As VAS is the subjective measure using questionnaires, different language versions were used in this study to avoid interpretation errors due to language barrier. While English, Malay, and Mandarin versions of VAS are available as options for parent informants, teacher informants have the option of English and Malay version [9–11].

Each scale has two components: symptoms assessment and impairment in performance. There will be 18 items under the section of symptoms assessment which each item is measured on a four-point scale ranging from zero (never) to three. Scores of two or three on a single symptom question reflect often-occurring behaviours. First nine items assess inattentive symptoms while item ninth to eighteenth rate hyperactivity and impulsivity symptoms. Score of each item will then be summed up. The second section of the scale has a set of total nine performance measures, scored one to five. Scores of four (somewhat of a problem) and five (problematic) reflect problems in performance. Average of the performance items serves as measure of improvement over time with treatment.

VAS is easy to complete and score, psychometrically sound, and useful for collecting data from multiple sources and assessing academic and behaviour performance [12,13]. It can be used to establish baseline to measure treatment effectiveness [13].

Data collection

Before the SSP began, the primary investigator approached the SSP-participating families explaining about the study. Meanwhile, twelve other families were recruited from CDC's Ritalin Clinic. Informed consent was obtained from all the children using informal assent to take part and their parents signed a consent form. Baseline information such as demographic data, medication, education, and occupational therapy was collected before the SSP.

For SSP participants recruited in this research, VAS questionnaires were filled up by parents and teachers before the SSP and repeated three and six months later. For subjects recruited for stimulant-only group, VAS questionnaires filled before commencement of stimulant therapy were retrieved from patients' existing medical record and used as the baseline VAS rating. VAS were distributed in the third month and

sixth month after SSP as the other two intervention groups.

Data Analysis

Data was analysed using the Statistical Package for Social Science (SPSS) version 28.0 software. Descriptive statistics were used to describe the demographic data of participants in this study. The ADHD symptoms and average performance score differences before and after SSP for combination treatment group and SSP-only group were assessed using paired sample t-test. Result of these continuous variables were presented using mean and standard deviation. On the other hand, ANOVA was used to compare the treatment outcome on ADHD children from combination treatment (stimulant and SSP),

behavioural therapy (SSP) alone, and medication (stimulant) alone. The significance level was set at $p < 0.05$.

Results

The demographic and clinical characteristics of the different sample groups are presented in Table 1. The response rate throughout study was 100%. Stimulant-only group (n=12) played the role as a control group to the SSP participants who were grouped into two intervention groups, namely the combination treatment group (n=13) and the SSP-only group (n=8).

Table 1. Demographic characteristics of the study population (n=33)

	Values
Gender (Male: Female, n)	32:1
Age (Mean)	9
NVIQ score (KBIT-2)	114
Comorbidity (n)	
ASD	31
Dyslexia	22
Dyscalculia	2
Speech sound disorder	2
Stimulant Medication (Yes: No; n)	25:8
Mean Dose	10mg daily
Education (n)	
Mainstream	19
Special Education	11
Private school	3
Duration of therapy per month (n)*	
<1 hour/ month	12
1-4 hour/month	15
5-8 hour/month	14
>8 hour/month	2

ADHD, attention hyperactivity disorder; ASD, autism spectrum disorder; NVIQ, Non-Verbal Intelligence Quotient; KBIT-2, Kaufman Brief Intelligence Test-Second Edition

*Therapy includes occupational therapy, speech therapy and early intervention programme that each subject attends in public and private facilities, excluding Simon Says Programme in this study.

SSP participants showed improvement from parents' and teachers' observation as evidenced by the mean reduction score in total symptoms score, hyperactivity score and inattentive score in VAS (Figures 1A and 1B). However, the teachers from the combination treatment group did not report the

sustained improvement of ADHD symptoms at 6-month after SSP (Figure 1B).

Of note, the mean reduction of inattentive symptoms, hyperactive symptoms and total symptoms score at 3-month and 6-month after SSP was only statistically significant in the SSP-only group, as reported by their parents (Table 2).

Table 2. Comparison of mean score difference of VAS total symptoms and performance scores within and between groups

Vanderbilt Assessment Scale		Treatment modalities						Score difference between group		
		Combination treatment (n=13)		SSP-only (n=8)		Stimulant-only (n=12)		F	Df	p
Parent	Score difference post SSP	M(SD)	p	M(SD)	p	M(SD)	p			
Total symptoms	0-3 months	-5.77 (4.05)	0.18	-6.23 (1.88)	0.01*	-0.08 (3.71)	0.98	0.85	2,30	0.44
	0-6 months	-6.77 (3.70)	0.09	-7.63 (1.98)	0.01*	-4.17 (2.2)	0.09	0.35	2,30	0.71
Average performance	0-3 months	-0.08 (0.15)	0.62	0.02 (0.10)	0.88	0.39 (0.26)	0.17	1.61	2,30	0.22
	0-6 months	-0.25 (0.13)	0.08	-0.20 (0.09)	0.07	0.08 (0.28)	0.77	0.84	2,30	0.44
Teacher	0-3 months	-0.15 (1.47)	0.92	-0.13 (2.62)	0.96	-6.00 (4.90)	0.25	1.01	2,30	0.38
	0-6 months	1.84 (1.96)	0.37	-2.63 (3.21)	0.44	-8.25 (4.71)	0.11	2.33	2,30	0.12
Average performance	0-3 months	-0.11 (0.16)	0.49	-0.17 (0.20)	0.43	-0.15 (0.37)	0.65	0.01	2,30	0.99
	0-6 months	0.08 (0.19)	0.69	-0.38 (0.17)	0.06	-0.42 (0.38)	0.30	1.02	2,30	0.37

Negative values of score difference indicate a better performance at post-test or follow up with respect to pre-test

*p <0.05 = significant

VAS, NICHQ Vanderbilt Assessment Follow Up Scales; SSP, Simon says program; SSP-only, Simon Says Programme-only

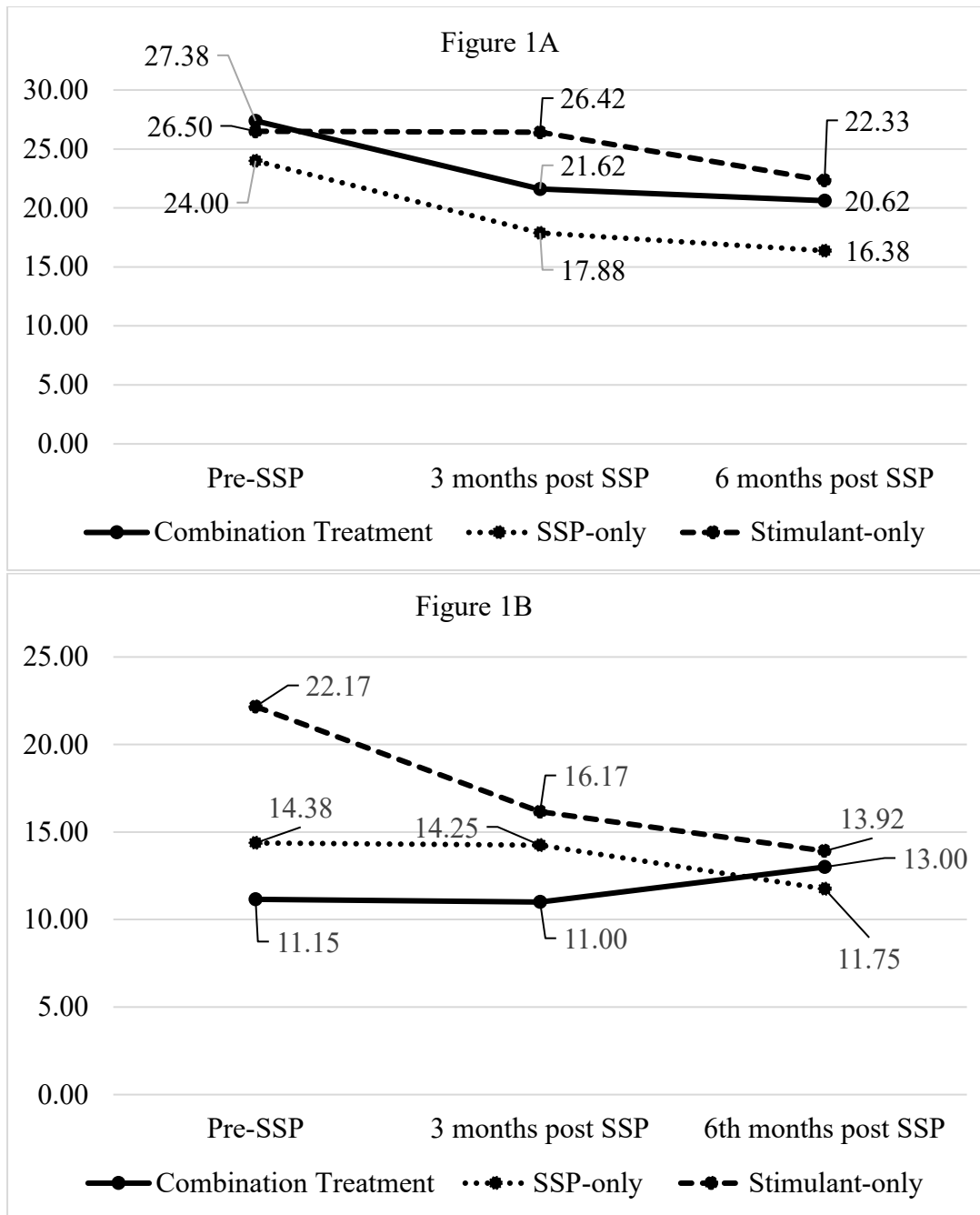


Figure 1. Comparison of total symptoms score in VAS pre-SSP, 3 months post-SSP and 6 months post SSP. 1A, total symptoms score in VAS reported by parents. 1B, total symptoms score in VAS reported by teachers.

VAS, NICHQ Vanderbilt Assessment Follow Up Scales; SSP-only, Simon Says Programme-only

Comparing parents and teachers' rating for ADHD symptoms for each group, parents reported greater reduction than teachers in both inattentive and hyperactive symptoms score (Table 2). When we studied further into teacher rating of ADHD symptoms score, the greatest reduction was observed in the stimulant-only group, followed by combination treatment group and SSP-only group at

3 months (Table 2). In fact, an increase in ADHD symptom score was observed in combination group at 6 months (Figure 1B).

There were no statistically significant differences in the average performance score from VAS reported by the parents and teachers during the study period (Figure 2 and Table 2).

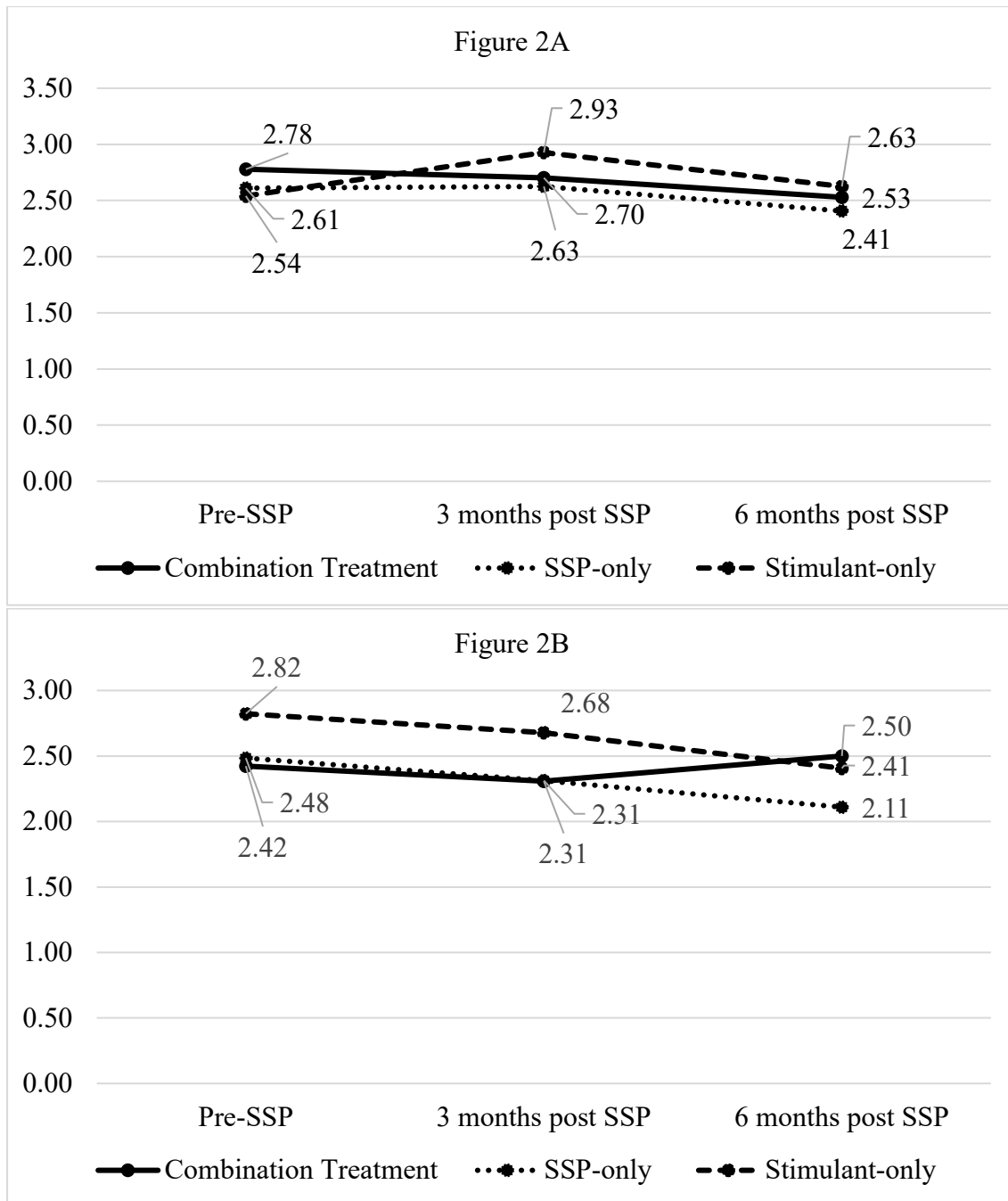


Figure 2. Comparison of average performance score in VAS pre-SSP, 3 months post-SSP and 6 months post SSP. 2A, average performance score reported by parents. 2B, average score in VAS report by teachers.

VAS, NICHQ Vanderbilt Assessment Follow Up Scales; SSP-only, Simon Says Programme

The secondary outcome was comparing the outcome of combination treatment (stimulant and SSP), behavioural therapy (SSP), and medication (stimulant) alone. There were no statistically significant differences between group comparing mean ADHD symptom scores and average performance score of parents and teachers' rating of VAS pre- and post-treatment as determined by one-way ANOVA (Table 2).

Discussion

This study demonstrated that SSP, being a strategy-based executive function training, instils important skills related to executive functions which then improve ADHD symptoms. From parental and teachers' observation, children with ADHD showed improvement as evidenced by reduction in VAS mean total symptoms, hyperactivity symptoms, and inattentive symptoms score after participating in SSP.

However, mean reduction of total symptoms score at 3 months and 6 months after SSP was only statistically significant in SSP-only group as reported by their parents. Average performance score remained plateau in each intervention group throughout the follow up period. Our study did not show that combination treatment is the best treatment modalities for ADHD in contrast to the largest RCT studies on treatment modalities for ADHD children [14].

Improvement of symptoms scores measured with VAS pre- and post- SSP in this study had shown that SSP could be an effective strategy-based executive function training and help improving ADHD symptoms. Previous study on another strategy-based group intervention, the 'Pay Attention!' further supported the role of strategy-based training to improve EF of ADHD children [15].

The effectiveness of SSP in reducing the ADHD symptoms is likely attributed to the P.L.A.Y formula used in each section of the programme. Using various playful activities to introduce executive functions in 'Play' step can reduce stress in the classroom, cultivate joy and self-confidence, and foster social bonding, which then support efforts to improve EF[16].

Giving examples in stories in the 'Link' step demonstrate how an executive function can be applied and practise under varying contextual conditions, so that those respective skills could be mastered and applied in concrete real-life situations later. Several classroom-based programmes in early childhood education with this similar approach had proven its effectiveness [17–19]. The 'Link' step also implements other important training principles including modelling of the focal skills by the teacher and informed training [20]. Assignments distributed during SSP to bring home allow children practising behaviour related to executive functions in ecologically valid context. This improves outcome of SSP, as suggested by a previous review article which highlighted repeated practise producing the benefit of improving EF[21]. Adding reward and social feedback contingent in the final step of Yahoo! will increase the participants' task engagement resulting in greater training gain [22].

High teacher-reported total symptom score in stimulant only group before receiving stimulant

medication had likely facilitated parents' decision to initiate medical treatment for ADHD due to their desire to see children improving in their school performance and behaviour as suggested by a recent qualitative study.

From our study, although parents and teachers from the behavioural-therapy-only group reported reduction of ADHD symptom score after participating in SSP, statistically significant reduction was only observed from parents' observation. Conversely, parents and teachers of SSP participants from the combination treatment group did not report statistically significant improvement despite a reduction of ADHD symptoms score. In line with this discrepancy, the possible reasons behind are subjected to debate. Although VAS is psychometrically sound and useful to assess academic and behaviour performance, (12,13) parental and teacher reports may still be subjective. A previous study also reported that interrater agreement between parents and teachers is generally low and at best moderate on the ADHD symptom level [23]. Of note, behavioural intervention will be the only treatment modalities available for families who opted not for stimulant treatment. Whether ratings from parents of the SSP-only group were subjected to rater bias effect by over-optimising the reduction of ADHD symptoms, more objective and direct psychometric measures needed to be included in future studies to investigate further on this issue.

Noticeably, parent rated ADHD symptoms showed greater reduction than teacher rated scoring, reflecting more pronounced treatment effect. This was consistent with a randomised controlled trial studying informant-related effects that concluded treatment effects were more pronounced in parent than in teacher ratings [24]. Importantly, the same study cast serious doubt on the general assumption that teacher ratings are more immune to bias, while being as sensitive as parent ratings. Hence, both parents and teachers should be regarded as relevant sources which may contribute different pieces of information to the evaluation of treatment [24].

In our study, reduction in the teacher rated ADHD symptoms score was observed the greatest in the stimulant-only group, followed by combination treatment group and behavioural therapy only group. Was it the treatment effect from the stimulant? Our study did not explore the possible explanation

for this doubt. However, a previous study proved that teachers seem particularly sensitive to detecting medication-induced short-term reductions in hyperactivity, which may lead to erroneous carry-over effects in their ratings of other symptom dimensions could probably explain this finding in our study [25]. Additionally, stimulant was served largely during school hours and most parents opted not to continue Ritalin after school. This may explain why parents observed less significant improvement in ADHD symptoms compared to teacher for those children who were taking regular stimulant in our study.

Transfer effects have been a focus of debate for years [26]. Our study did not show significant improvement of performance score in VAS to demonstrate the extent of transfer effect of SSP. Inter-rater variability in teacher-rated observation of behaviour and performance of 3 months and 6 months post SSP following changes of some teachers due to new academic year could have potential impact on transferability of SSP. Whether there was smaller treatment effect due to diminished reliability of ratings from rater changes, a previous study suggested otherwise [24].

Most of the patients included in our study has comorbid diagnoses. Previous study has shown that children with comorbid diagnoses usually have higher level of symptomatology and EF problems. They may have more room for improvement than children presenting with one single diagnosis [25]. In addition, they may respond differently to specific treatments, have differing clinical correlates, or demonstrate unique clinical outcomes that might influence results obtained across studies [4]. Hence, efficacy of SSP could be more critically being analysed by categorising ADHD children to homogenous subgroups according to their comorbid diagnoses.

Limitation

A few limitations of this study should be noted. First, convenience sampling used in this study is known of lacking clear generalisability, which leads to biased estimates of the target population and its sociodemographic subpopulation [26]. Due to convenience sampling, the sample size per arm was not similar and small. There was potential inter-rater variability in observation of behaviour as teachers filling VAS might not be the same teacher due to change in academic year.

Recommendation

Existing evidence and result in this study suggests justification to allocate resources to further evaluate the efficacy of various EF training, since it carries the promise of reducing symptomatology and improving academic, interpersonal, and occupational outcomes [4]. Further studies using randomized controlled methods and bigger sample size are needed to provide a better understanding of the efficacy, transferability, and feasibility of SSP. Other considerations should include coupling of subjective measures using parents and teacher-rated questionnaires and objective measures to evaluate the outcome of SSP and grouping ADHD children into more homogenous subgroups based on comorbid pattern. In addition, more studies are indicated to evaluate whether combination treatment is more superior than behavioural intervention alone and stimulant alone in our local population.

To go beyond a one-time boost and address real-life demands in daily life and school, it seems promising to embed the continued scaffolding of executive functions application in the instructional context. School teachers could be educated to lead children in SSP to use strategies learnt in a feasible and not too time-consuming manner as we recognize that this is a demanding task in the context of heterogeneous classrooms.

Conclusion

In summary, SSP could be an effective behavioural intervention for children with ADHD although our study did not demonstrate transfer effect. However, result in our study may suggest justification to allocate resources to further evaluate the effectiveness of implementing SSP in primary schools to provide EF training for students with ADHD.

Declaration of conflicting interests

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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