



The Efficacy of Visual Activity Schedule Intervention in Reducing Problem Behaviors in Children With Attention-Deficit/Hyperactivity Disorder Between the Age of 5 and 12 Years: A Systematic Review

Naveena Thomas and Sudhin Karuppali

Department of Audiology and Speech Language Pathology, Kasturba Medical College, Mangalore, Manipal Academy of Higher Education, Manipal, Karnataka, India

Objectives: Children with attention-deficit/hyperactivity disorder (ADHD) tend to be noisy and violate rules with their disruptive behaviors, resulting in greater difficulties with off-task behaviors and being at risk for social refusal. The visual activity schedule (VAS) intervention program is a frequently used method to teach multiple skills involving on-task, use of schedules, transition behaviors, social initiation, independent play skills, classroom skills, and academic skills. The current systematic review aimed to examine the efficacy of using VAS intervention in reducing problem behaviors in children with ADHD between 5 and 12 years of age.

Methods: Systematic searches were conducted using two electronic databases (PubMed and Scopus) to identify relevant studies published in English between 2010 and 2020. Four studies met the inclusion criteria: two studies examined the effect of schedule-based tasks and the use of an iPad on classroom skills, while the other two examined randomized clinical trials (RCTs) of psychosocial treatment for ADHD inattentive type and a cross-sectional study examined the impact of the group size on task behavior and work productivity in children with ADHD.

Results: The findings indicate that the interventions used in all four studies could lead to increased satisfaction among participants and parents, as well as a reduction in problem behavior. In terms of the research indicators, the RCT had low quality, while the others were of high quality.

Conclusion: A larger number of studies and the ADHD clinical population would help to increase the generalizability of future reviews of treatments in this context.

Keywords: Attention deficit hyperactivity disorder; Schedule; Social; Problem; Behaviors.

Received: July 21, 2021 / Revision: September 22, 2021 / Accepted: September 30, 2021

Address for correspondence: Sudhin Karuppali, Department of Audiology and Speech Language Pathology, Kasturba Medical College, Mangalore, Manipal Academy of Higher Education, Manipal, Karnataka, India

Tel: +91-9844807634, Fax: +91-8242428183, E-mail: sudhin.karuppali@manipal.edu

INTRODUCTION

Attention-deficit/hyperactivity disorder (ADHD) is a condition that occurs in children during the developmental period with symptoms being manifested at home and school with characteristics such as impulsivity, inattention, and hyperactivity [1]. ADHD syndrome has been categorized into three types, namely: the combination type, the predominantly inattentive type, and the predominantly hyperactive/impulsive type. The severity of the symptoms ranges from mild, moderate, and severe (American Psychiatric Association, 2013) [2]. The Diagnostic and Statistical Manual of Mental

Disorders, 5th edition (DSM-5) mentions that people with ADHD have a history of inattention and/or hyperactivity-impulsivity, which makes it difficult for them to work and develop skills [2]. According to the DSM-5, individuals with ADHD under the age of 16 should exhibit six or more symptoms of inattention and hyperactivity-impulsivity, while adolescents and adults aged 17 and above should exhibit five or more of the symptoms, with the symptoms having been present for at least six months, which becomes inadequate for their developmental stage. Although some of the above-mentioned behaviors are sometimes considered as characteristic features of typically developing children as well, when exhibited inappropriately in varied settings, it is reflected as a psychiatric disorder [1].

Children with ADHD tend to be noisy and violate rules with

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their disruptive behaviors, resulting in greater difficulties with off-task behaviors, thereby bringing them at risk for social refusal [3]. They tend to exhibit signs of hyperactivity and inattention, coexisting with a reduced level of communication skills [4]. Pronounced deficits in phonological and syntactic structures have been noted in children with ADHD [5], which is crucial for literacy development [6]. Apart from these linguistic components, studies have reported language problems in ADHD characterized by pragmatic deficits [7]. These pragmatic impairments associated with ADHD may include children having: 1) reduced verbal output and further disfluencies when faced with activities that include preparation and coordination of verbal responses, such as storytelling or giving directions; 2) timing issues when it comes to starting a discussion, taking turns and keeping or changing topics during a conversation; and 3) excessive verbal output during spontaneous interactions, task changes, and play conditions [8].

Different interventional approaches have been suggested for the treatment of individuals with ADHD, which may include behavioral, pharmacological, psychotherapeutic, physical exercise, and education-based approaches [9]. Pelham et al. [10] emphasized the role of behavioral interventions for ADHD, which included parents and teachers administered, combined, and direct intervention programs with the affected individuals. Parents become primary educators in their children's lives, with the power to mold their attitudes. As a result, it is important to provide parents with the support they need by addressing their child's problem habits and offering solutions for modifying or enhancing the behaviors that interfere with their daily activities. Rather than focusing on the symptoms of ADHD, a behavioral approach focuses on functional impairments [11]. Some of the key organizational skills required for children with ADHD have been noted to be in the area of strategy and skill preparation [12].

School-home note intervention is a frequently used method to enhance classroom behavior and task-relevant behavior in middle-aged and elementary school children [13]. Using methods such as these have resulted in a significant enhancement in classroom behaviors such as paying attention, performing homework, talking with the teacher's permission, maintaining seating, as well as executing quality and quantity classwork [13]. As children with ADHD face challenges in academic settings, it becomes difficult for them to perform well in classroom settings, with frequent display of symptoms of inattention, disruptive behaviors, poor sitting behaviors and an inability to control their impulses. The visual activity schedule (VAS) intervention program is a frequently used method to teach multiple skills involving on-task, use of schedules, transition behaviors, social initiation, independent play

skills, classroom skills, and academic skills [14]. An activity schedule can include pictures, drawings, photographs, or a set of images that cue a person to engage in a sequence of doing things that helps one to complete their activity or assignment without the need for assistance. A child's academic and social skills depend on their ability to remain on tasks with minimal distractions. Such skills allow children to gain the required input, complete tasks or assignments, and be active during discussions that are held in a classroom [15]. VASs have been used to reduce the latency to initiate a new activity [16], reduce temper tantrums during transitions [17], and to enhance and maintain multiple social skills [14]. The implementation of VAS intervention programs such as providing small-group directions have been used in general classrooms and/or educational settings [18], aiding in the enhancement of academic skills and the degree of interaction between peers, thereby reducing disruptive behaviors in classrooms [19]. This interventional approach is commonly used among children with autism spectrum disorder (ASD) [20] and intellectual disabilities [21]. Children diagnosed with ADHD exhibit difficulties in these skills, leading to disruptive behaviors in the classroom. The efficacy of using the VAS in children with ADHD has been studied minimally compared to that in children with ASD. Consequently, the current systematic review aimed to evaluate the efficacy of using the VAS in children with ADHD between the ages of 5 and 12 years.

METHOD

Protocol and registration

The review protocol for the current study was registered in the International Prospective Register of Systematic Review (PROSPERO). The registered protocol can be found at: https://www.crd.york.ac.uk/prospero/display_record.php?RecordID=212844.

Electronic search strategy

The databases used for the present systematic review included the PubMed and Scopus databases. A search strategy was used for each of the databases with two keywords pertaining to the population ("attention deficit hyperactivity disorder," "ADHD"); seven keywords in relation to the intervention ("VAS," "visual activity schedule," "picture prompts," "visual schedule," "visual cues," "work system," "visual reminders"); and five keywords pertaining to the outcome ("on task behavior," "on schedule behavior," "independent skills," "social skills," "problem behaviors") [14,22-26], with the Boolean operators such as "AND," "OR," and "NOT."

The initial search was performed on October 16, 2020, and the search terms were determined based on two criteria. First,

the outcomes or skills that improved with the use of VAS were identified from eight research articles [14,22-28] with outcomes being considered as the key words. Second, most of the possible alternative words were used as keywords in the search to avoid missing any relevant articles. The search was restricted to peer-reviewed English language studies published between 2010 and 2020. We also manually searched for the following journals: 1) *Journal of Emotional and Behavioral Disorders*; 2) *Journal of Behavioral Neurology*; 3) *Journal of Psychology & Psychotherapy*; 4) *Journal of Health & Medical Research*; and 5) *Journal of Special Education and Technology* to identify any potential articles that could have been missed.

Study selection

A three-phase selection process was considered for the final inclusion of the studies. It was initiated by compiling the studies obtained from the search of the two databases using the Mendeley desktop reference management system. In the second phase, the duplicates were removed, and using the COVIDENCE manager (<https://www.covidence.org/>) the two reviewers independently screened the titles and abstracts according to the inclusion and exclusion criteria set a priori. The inclusion criteria were: 1) children diagnosed with ADHD in the age range of 5 and 12 years; 2) English language peer-reviewed observational studies or randomized controlled trials (RCTs) published between 2010 and 2020; 3) either single case research studies or group design studies; 4) studies with at least one participant diagnosed with ADHD; and 5) studies from PubMed and Scopus databases. The exclusion criteria were as follows: 1) children diagnosed with other disabilities such as ASD and intellectual disabilities; 2) children with neurodevelopmental disorders; 3) thesis/dissertations from institutional repositories; 4) narrative review articles, case reports, or editorials; and 5) studies with adolescents with ADHD (over 12 years of age).

The full length review was performed only after we identified all relevant articles, including the manual search. In cases of uncertainty over whether an abstract met the inclusion criterion, the authors obtained the full-text article and independently evaluated each paper to incorporate it. In the event of a disagreement, the researchers arrived at a consensus by reevaluating the inclusion criterion and recorded the reasons for excluding these studies. Finally, we recorded our decision-making process using a Preferred Reporting Items for Systematic Review and Meta-Analyses (PRISMA) chart [29].

Data extraction and management

The two reviewers independently extracted the data from the full-length articles that met our criteria using a specifi-

cally devised data extraction form. A third reviewer checked both of the reviewers' data extractions. The following data were extracted for the current systematic review: 1) research design; 2) participant gender and age; 3) settings; 4) targeted skills; 5) dependent variables/measures; 6) schedule type and mode of presentation; 7) materials used; 8) strategies used; and 9) results/outcomes [14].

Quality assessment

The quality of the two single case studies [25,26] was assessed using relevant quality indicators [28]. The quality assessment scale, a yes/no rated system, was used to evaluate if the described criteria were met. A total of 20 indicators were used to assess the quality of the reviewed studies. Two independent reviews assessed the quality of each study using the quality indicators [28], and responses were verified by a third reviewer. One of the studies by Hart et al. [27], followed a cross-sectional case design, and the quality (selection, comparability, and outcome) of the study was assessed using the Newcastle Ottawa scale [30]. The quality of the fourth study by Pfflner et al. [31] followed a randomized clinical trial which was assessed using the validated revised Cochrane risk-of-bias tool for randomized trials (RoB 2) [32].

RESULTS

Study selection

Initially, 964 articles were identified across the two databases. Among them, 444 were found to be duplicates and were removed based on the title and abstract. The existing 525 articles were screened, and 489 were found to be irrelevant based on the prior set of the inclusion and exclusion criteria set by the researchers. A total of 57 articles met the eligibility criteria, of which 53 articles were excluded after full length review. Finally, four articles were found to be relevant to the study and met the inclusion criteria. The PRISMA chart of the systematic review is shown in Fig. 1.

Study characteristics

The study characteristics of the four included articles have been shown in Table 1.

Participants

Among the four studies, 237 children were diagnosed with ADHD, with 38.81% being female and 61.18% being male. All participants in the four studies were between 5 and 12 years of age. Two studies reported recruiting 58% [31] and 76% [27] of male participants. The 199 participants included in one of the studies [31] included children between 7 and 11 years of age, diagnosed with ADHD-Inattentive Type (AD-

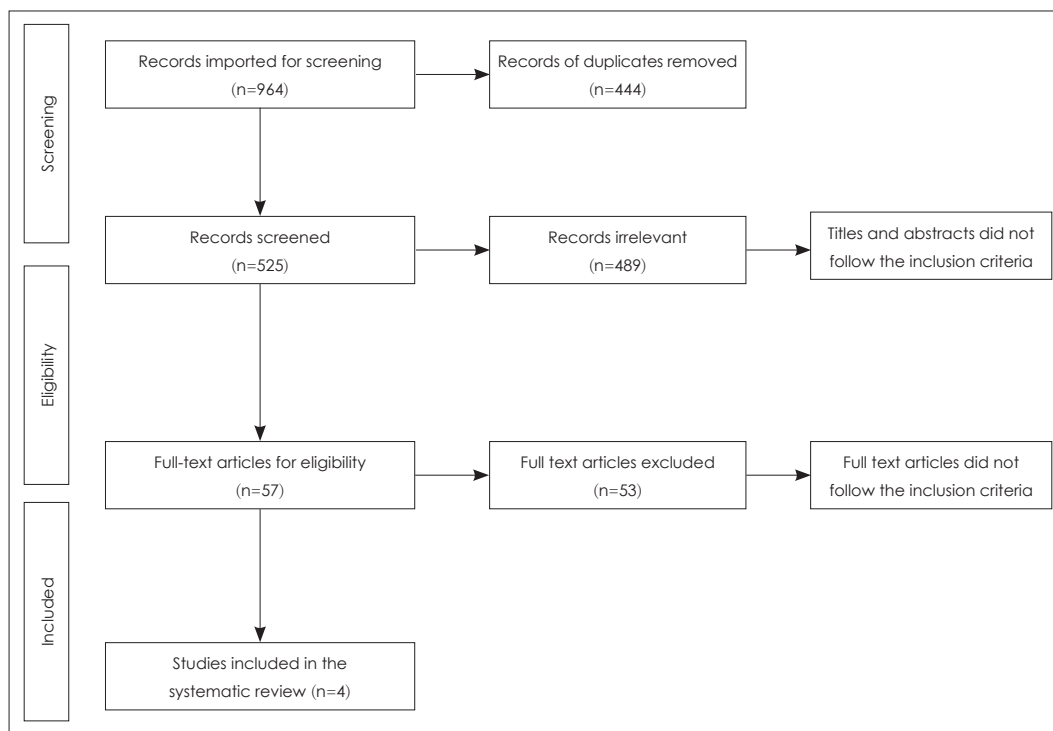


Fig. 1. The Preferred Reporting Items for Systematic Review flowchart for the current study.

HD-I); and in another study [27], the 33 participants included children between 7 and 12 years of age who were diagnosed with ADHD. Among the two single case studies, one of them [26] reported two male participants of 7 and 9 years of age, respectively, while the other [25] reported three male participants (a child with moderate intellectual disability, a child with ADHD, and a child with global delay) with the ADHD participant aged 5.8 years.

All four selected studies had at least one child with ADHD who participated in the study. In one of the single case studies [26], the risk of ADHD in the two participants was rated using Conner's Teacher Rating Scales-Revised, Short and Conner's Parent Rating Scales-Revised, Short [33]. In another study [25], there was no mention of the scale/tool used to diagnose the participant as ADHD. Since the use of a standard diagnostic system was not part of the study selection criteria for the current systematic review, this study [25] was therefore considered for the review, primarily because it met all other criteria pertaining to the use of VAS as an intervention for children with ADHD.

In a RCT study [31], the participants were diagnosed with ADHD-I using the Kiddie Schedule for Affective Disorders and Schizophrenia for School-Age Children and Wechsler Intelligence Scale for Children and for ADHD-I, all of the patients met the full DSM-IV requirements. In a study by Hart et al. [27], the researchers used parent and teacher rating scales, such as the Disruptive Behavior Rating Scale [34] and IOWA

Conners Rating Scale [35] to determine ADHD symptoms.

Settings

All four studies conducted the intervention program in different settings and/or environments [25-27,31]. Two single case studies [25,26] conducted the treatment in the participant's classroom. A RCT study [31] conducted an intervention at the University of California San Francisco and the University of California, Berkeley. The intervention included group meetings with parents and children in clinics, the school premises, and over the phone, while the teacher consultations were conducted at the school and occasionally over the phone. Hart et al. [27] conducted a study relating to a summer treatment program in an academic learning center. Cirelli et al. [26] mentioned the layout of the classroom, which included 20 desks for students, one desk for teachers and a horseshoe-shaped table. However, none of the other studies [25,27,31] reported the same.

Quality assessment

The quality of the two single case studies [25,26] was assessed using single-case study quality indicators [28]. The quality of the study was determined by taking the ratio of the total number of agreements by the total number of indicators, and then multiplying by 100. One of the single case studies [26] received a quality appraisal of 95%, while the study by Stephenson [25] met a 90% quality standard, as shown in

Table 1. Data extraction sheet of four articles included in the systematic review

Characteristics	Cirelli et al. [26]	Piffner et al. [31]	Stephenson [25]	Hart et al. [27]
Research design	Nonconcurrent multiple baseline design	Randomized controlled trial	Multiple baseline	Not reported
Participants	Participants: 2 males of 7 and 9 years; Diagnosis: attention-deficit/hyperactivity disorder (ADHD)	Participants: 199 (58% of males) of 7–11 years; Diagnosis: ADHD-Inattentive Type	Participants: 3 males 1) 6.3 years; diagnosis: autism and developmental disability with moderate intellectual disability 2) 5.8 years; diagnosis: moderate intellectual disability, ADHD, and global delay 3) 5.5 years; diagnosis: autism spectrum disorder	Participants: 33 (76% of males) of 7–12 years; Diagnosis: ADHD
Setting	Each participant's classroom	University of California San Francisco; University of California, Berkeley	Classroom	Academic learning center
Targeted skills/ depended measures	On-task behavior and on-schedule behavior	Skills: organizational, social, independent, academic, self-care, daily living	Reading, writing, numbers, special activity	On task behavior and work productivity (academic skills, reading skills, independent skills)
Type of intervention	Activity schedule and through worksheet, schedule book, written instructions on paper strips, visual organizational charts, sticker charts	Child Life and Attention Skills Treatment: - Ten 90-minute parent group meetings - Six 30-minute child group meetings - Teacher consultation Parent-focused treatment: - Parent training group - Individual family meetings - Monthly treatment booster sessions for families Treatment as usual: - Parenting workshop - Special education services - Seating modified homework - Behavioral chart - Extra time on tests	Schedule apps through iPads and pictures displayed	Summer treatment program: small-group condition - Reading comprehension activity in the instructional period - Reading comprehension testing during testing period whole-group condition - Reading comprehension activity during instructional period - Reading comprehension test during testing period Independent seatwork - Reading comprehension activity during instructional period - Reading comprehension test during testing period
Strategies used	Simplified directions, repetition of directions, incentive coupons, extended time, rephrasing questions	Problem-solving steps, self-cues, reminder list, role plays, scaffolding, routinization, using rewards, positive consequence such as praises, cue based reminders, organizational strategies, group based rewards, play activities	Verbal and visual prompts	Not reported
Results/ outcomes	Increased on task and on schedule behavior in the absence of teacher prompts	Reduction of inattention symptoms, increases in social skills, and overall improvement, increased organizational skills	Completed one step in the intervention session and improved rapidly in terms of schedule app usage through writing, reading and number based activities	Increased on-task behavior during small-group instruction, increased work productivity during small group condition

Table 2. Quality checklist for single case studies (quality indicators of single case designs)

Indicators	Cirelli et al. [26]	Stephenson [25]
Participant		
Described sufficiently	Y	Y
Selection described sufficiently	N	N
Setting described sufficiently	Y	Y
Dependent variable (DV)		
Described with replicable precision	Y	Y
Quantifiable	Y	Y
Measurement described to replicable precision	Y	Y
Measurement occurred repeatedly	Y	Y
Interobserver agreement data reported	Y	Y
Independent variable (IV)		
Described with replicable precision	Y	Y
Systematically manipulated	Y	Y
Procedural fidelity described	Y	Y
Baseline		
Phase provided evidence of pattern, prior to intervention	Y	Y
Described with replicable precision	Y	Y
Validity		
Three demonstrations of experimental effect	Y	Y
Design controlled threats to internal validity	Y	Y
Effects replicated, indicate external validity	Y	Y
DV socially important	Y	Y
Magnitude of change in DV due to intervention socially important	Y	Y
IV is cost effective/practical	Y	N
IV is implemented over time, typical contexts/typical agents	Y	Y
Indicators met/total indicators	19	18
Total percentage	19/20 × 100=95%	18/20 × 100=90%

Table 2. The ratings obtained for the cross-sectional study [27] for each section (selection, comparability, and outcome) were 4, 1, and 3, respectively, indicating good quality, as shown in Table 3. For the RCT study [31], the quality was determined by taking the ratio of the total number of “yes” (5) and the total indicators (19), then multiplying by 100. The result revealed a score of 26.3%, suggesting the study was of low quality, as shown in Table 4.

The treatment procedure of the two single case studies [25,26] is illustrated in Table 5.

The treatment procedure of the RCT [31] and cross-sectional study design [27] are illustrated in Table 6.

DISCUSSION

The current systematic review included four peer-reviewed articles (two single case studies, one cross-sectional study, and one RCT study). All four studies attempted to focus on ADHD participants, with the single case studies [25,26] having a smaller number of participants which enabled them to

provide more attention to the chosen participants. This was possible in the RCT [31] and the cross-sectional study [27] because of the large number of children who participated. One of the parameters set for the study selection criteria was to have at least one participant diagnosed with ADHD, which was met by all four studies that were finally included in this systematic review. However, in the study by Stephenson [25], although one of the participants was diagnosed with ADHD, there was no mention of the diagnostic system used for the same. However, as the use of a standard diagnostic system was not part of the study selection criteria for the current systematic review, this study [25] was considered for the review, primarily because it met all other criteria pertaining to the use of VAS as an intervention for children with ADHD. The recruitment of participants [36] and the study settings [37] largely contributed to the efficacy of the study. The recruitment process was well-documented in the RCT and the cross-sectional study, but not in the two single case studies. Similarly, the study settings in the two single case studies were mentioned clearly, since it was conducted in a school and

Table 3. Quality checklist for cross sectional study (Newcastle Ottawa Scale [30])

Domains	Hart et al. [27]
Selection	
1. Representativeness of the sample	
a) Truly representative of the average in the target population	-
b) Somewhat representative of the average in the target population	*
c) Selected group of users	-
d) No description of the sampling strategy	-
2. Sample size	
a) Justified and satisfactory	-
b) Not justified	*
3. Non-respondents	-
a) Comparability between respondents and non-respondents characteristics is established, and the response rate is satisfactory	-
b) The response rate is unsatisfactory, or the comparability between respondents and non-respondents is unsatisfactory	-
c) No description of the response rate or the characteristics of the responders and the non-responders	*
4. Ascertainment of the exposure	-
a) Validated measurement tool	*
b) Non-validated measurement tool, but the tool is available or described	-
c) No description of the measurement tool	-
Comparability	
1. The subjects in different outcome groups are comparable, based on the study design or analysis. Confounding factors are controlled	-
a) The study controls for the most important factor (select one)	*
b) The study control for any additional factor	-
Outcome	
1. Assessment of the outcome	-
a) Independent blind assessment	-
b) Record linkage	**
c) Self-report	-
d) No description	-
2. Statistical test	-
a) The statistical test used to analyze the data is clearly described and appropriate, and the measurement of the association is presented, including confidence intervals and the probability level	*
b) The statistical test is not appropriate, not described or incomplete	-

classroom setting; however, there was no such clarification in the RCT and cross-sectional study. As the single case studies [25,26] were conducted in the classroom, the examiners were able to concentrate on classroom and academic skills that the participants could easily generalize [38]. In a cross-sectional study [27], academic testing was used as part of the recruiting procedures to assess the participants' eligibility for the study, which was not addressed in other studies, however, it is generally considered as an ideal method for recruiting participants for research studies [39].

Prior to the treatment sessions, the screening protocol was discussed in terms of interviews with both parents and teachers [31]; however, the diagnostic procedures were mentioned in the cross-sectional study but not in the two single case

studies. In all four studies [25-27,31], the chosen participants were assessed on a variety of skills. Two of the single case studies centered on classroom skills, while the RCT focused on everyday living skills. Hart et al. [27] targeted task behavior, which was observed over two periods. Despite the fact that the four studies focused on a wide range of skills, all of the targeted skills were significant in improving abilities and decreasing problem behaviors. In terms of the practices and materials used, each of the four studies took a different approach towards intervention. The materials used in the three studies [25-27] differed based on the type of intervention program. Pfiffner et al. [31] did not report the materials used in the session, even though the intervention had been mentioned. A variety of strategies, including verbal, gestural, as

Table 4. Quality checklist for randomized controlled trial [31] (Revised Cochrane risk-of-bias tool for randomized trials [RoB 2] [32])

Sl. no	Signaling questions	Response options
Risk of bias arising from the randomization process		
1.	Was the allocation sequence random?	Y/PY/PN/N/NI
2.	Was the allocation sequence concealed until participants were enrolled and assigned to interventions?	Y/PY/PN/N/NI
3.	Did baseline differences between intervention groups suggest a problem with the randomization process?	Y/PY/PN/N/NI
Risk of bias due to deviations from the intended intervention/effect of assignment/adhering to intervention		
4.	Were participants aware of their assigned intervention during the trial?	Y/PY/PN/N/NI
5.	Were carers and people delivering the interventions aware of participant's assigned intervention during the trial?	Y/PY/PN/N/NI
6.	Were important non-protocol interventions balanced across intervention groups	NA/Y/PY/PN/N/NI
7.	Were there deviations from the intended intervention that arose because of the trial context	NA/Y/PY/PN/N/NI
8.	Was an appropriate analysis used to estimate the effect of assignment/adhering to intervention?	Y/PY/PN/N/NI
9.	Was there potential for a substantial impact (on the result) of the failure to analyze participants in the group to which they were randomized?	NA/Y/PY/PN/N/NI
Risk of bias due to missing outcome data		
10.	Were data for this outcome available for all, or nearly all, participants randomized?	Y/PY/PN/N/NI
11.	Is there evidence that the result was not biased by missing outcome data?	NA/Y/PY/PN/N/NI
Risk of bias in measurement of the outcome		
12.	Was the method of measuring the outcome inappropriate?	Y/PY/PN/N/NI
13.	Could measurement or ascertainment of the outcome have differed between intervention groups?	Y/PY/PN/N/NI
14.	Were outcome assessors aware of the intervention received by study participants?	NA/Y/PY/PN/N/NI
15.	Could assessment of the outcome have been influenced by knowledge of intervention received?	NA/Y/PY/PN/N/NI
16.	Is it likely that the assessment of the outcome was influenced by knowledge of intervention received?	NA/Y/PY/PN/N/NI
Risk of bias in selection of the reported result		
17.	Were the data that produced this result analyzed in accordance with a pre-specified analysis plan that was finalized before unblinded outcome data were available for analysis?	Y/PY/PN/N/NI
18.	Is the numerical result being assessed likely to have been selected, on the basis of the results, from multiple eligible outcome measurements (e.g., scales, definitions, time points) within the outcome domain?	Y/PY/PN/N/NI
19.	Is the numerical result being assessed likely to have been selected, on the basis of the results, from multiple eligible analyses of the data?	Y/PY/PN/N/NI

Y, yes; PY, probably yes; PN, probably no; N, no; NI, no information

well as gestural and verbal prompts, were used in the schedule-based intervention program in one of the single case studies, while both verbal and physical prompts were used in another study [25]. Physical prompts were discovered to have a significant impact on eliciting the responses, which was not mentioned in RCTs [31] or cross-sectional studies [27]. During any treatment program, the duration of the session played a significant role. The duration mentioned in all four studies was different, and depended on how sufficiently they had used the strategies, tasks, and materials for the participants. In the study conducted by Cirelli et al. [26], the students were required to complete worksheets and place them in a work folder, which took a longer time (25–30 minutes) than the participants in the Stephenson [25] study who were expect-

ed to complete basic activities (counting tasks, letter identification, and numbering) using an iPad, which took a shorter time (5–10 minutes). The Child Life and Attention Skills Treatment (CLAS) program used in the study by Pfiffner et al. [31] lasted longer as it focused on the training of parents, teachers, and children with ADHD. In addition, the intervention program used here included parent-focused treatment and treatment as usual. Therefore, the amount of time needed to achieve the desired level of satisfaction was longer. The details of the program duration are listed in Table 6. In the study by Hart et al. [27], the authors provided an intervention program (10 minutes each) under three different conditions (whole group, small group, and independent seat-work), which also resulted in a longer duration of VAS inter-

Table 5. Treatment procedures of two single case studies

Domains	Cirelli et al. [26]	Stephenson [25]
Materials used	High preference books, pencils, erasers, 11.4-cm × 11.4-cm spiral bound hard cover schedule book with five tabs, a piece of paper outside the schedule book's front cover, paper strips	iPad (version 1.1.6; Good Karma Applications Inc., 2012)
Pre-experimental procedure	Teacher survey and preference assessment	Nil
Targeted skills	On-task behavior and on-schedule behavior	Reading, writing, number and a special activity
Intervention procedure	<p>Step 1: Students had to go to the horseshoe table, get one worksheet, complete it, place it in a work folder, and go to the horseshoe table to get the next worksheet (and so on, until all worksheets were completed and placed in the folder).</p> <p>Step 2: Students had to bring the folder with all completed worksheets to the teacher, return to their desks, take out a self-selected book, and read quietly.</p>	<p>Step 1: Pictures shown on the iPad wherein activities for writing, reading, and number was provided in manila folders on the student's desk (writing, reading, and numbering, was labeled with text and a colored line drawing; the teacher chose the activities in the folder, which differed from session to session; tracing or writing letters and words; looking at picture books, and various counting and numeral recognition tasks were among the activities)</p> <p>Step 2: When the reading choice was selected, the student could either choose a book or choose a folder from which to complete an activity</p> <p>Step 3: The student could select the special activity from many choices represented by picture symbols which was depicted by a star graphic</p> <p>Step 4: iPad presented with an open app and a verbal cue. If no response was received after 5 seconds, least to most prompts were given by the teacher</p> <p>Step 5: If prompt did not elicit a correct response, the teacher repeated the verbal prompt and physically assisted the student to touch the correct picture</p> <p>Step 6: The teacher waited 5 seconds after the student activated the first row of the schedule and heard the verbal prompt for the student to receive the corresponding task</p> <p>Step 7: The teacher waited 5 seconds after the task was placed away for the student to hit the check mark indicating that the task was completed</p> <p>Step 8: The teacher waited for the student to touch the next activity after the check mark was hit (in this manner, the student completed the four items on the schedule)</p> <p>5–10 minutes</p> <p>Teacher</p>
Duration of session	25–30 minutes	
Personnel for data recording	Teacher	Teacher

Table 5. Treatment procedures of two single case studies (continued)

Domains	Cirelli et al. [26]	Stephenson [25]
Reliability	<p>Inter-observer agreement (IOA) & procedural integrity (PI)</p> <ul style="list-style-type: none"> - Data collected by school's child study team (an intern, a learning disabilities teacher consultant, school psychologist) - IOA data for on-task activity was collected for 32% of sessions for first participant (Student A) and 53% of sessions for second participant (Student B) - Mean IOA obtained for on-task activity was 99% (Student A) and 98% (Student B) - Mean IOA obtained for on-schedule activity was 99% (Student A) and 100% (Student B) (PI was measured during each steps of both baseline and schedule teaching sessions) - The PI scores obtained were 95% (Student A), 100% (Student B), and 100% (Student A & B) 	<p>Procedure reliability (PR) & observational reliability (OR)</p> <p>(Both measures were collected in each of the sessions)</p> <ul style="list-style-type: none"> - The author recorded 10 of the 13 baseline sessions and 41 of the 71 sessions - The obtained overall PR score was 92% (baseline) and 97.8% (intervention) - The obtained mean OR score was 100% (baseline) (for all students; Student 2 was the child with ADHD) and 95.5% (intervention) for Student 2.
Social validity	<ul style="list-style-type: none"> - Ascertained from participants, peers, and teachers using a survey - Yes/No response <ul style="list-style-type: none"> a. Participant response <ul style="list-style-type: none"> - Request for a larger schedule - Request to use the schedule at home - Claims his peer wanted one too b. Peers response <ul style="list-style-type: none"> - Exhibited interest in learning more about the schedule - Expressed desire to get one too c. Teachers response <ul style="list-style-type: none"> - Willing to keep using the schedule - Felt it was fair and reasonable - Agreed on its use to handle off-task and disruptive behaviors 	<ul style="list-style-type: none"> - Ascertained from teachers using a survey - Degree of agreeability <p>Both teachers agreed or strongly agreed that:</p> <ul style="list-style-type: none"> - Learning how to use the scheduling app was necessary - It will help improve independence - Would use the intervention again - Would recommend it to others
Results	<p>Student A:</p> <ul style="list-style-type: none"> On-task performance (baseline 1): 50% On-task performance (baseline 2): 58% On-task performance (schedule teaching session): 100% On-schedule performance (schedule teaching session): 96% and 100% On-task performance (post teaching session): 92–100% On-schedule performance (post teaching session): 100% <p>Student B:</p> <ul style="list-style-type: none"> On-task performance (baseline 1): 51.75% On-task performance (baseline 2): 52% On-task performance (schedule teaching session): 100 % On-schedule performance (schedule teaching session): 94% On-task performance (post-teaching session): 99% On-schedule performance: 100% 	<p>Student 2 completed two steps correctly in the first intervention session and then rapidly improved. Although student 2 never achieved mastery a clear intervention effect was evident with him, completing 10–12 steps correctly for over half of the intervention sessions. There were only three sessions where he completed fewer than 10 steps correctly.</p>

Table 6. Treatment procedure of randomized clinical trial and cross-sectional study design

Domains	Pfiffner et al. [31]	Hart et al. [27]
Recruitment Screening	Schools, school mental health providers, learning specialists Parent/Teacher telephone interviews and assessed for demographics, school and mental status (Children who failed the initial screening requirements were further evaluated)	Local professionals or schools, advertisements or reports in the local media Nil
Diagnostic	Parents and teachers rated the children using: - Child Symptom Inventory (CSI-4) - Impairment Rating Scale (IRS)	Parents and teachers rated the children using: - Disruptive Behavior Disorder Rating Scale - IOWA Conners Rating Scale Children who met the evidence-based diagnostic criteria got enrolled into the summer treatment program (STP)
Academic testing	Nil	- Woodcock-Johnson Tests of Academic Achievement (WJ-III) (Subtests: letter word identification, reading fluency, work attack, math calculation, and math fluency) - Peabody Vocabulary Test (PPVT-III) - On-task behavior during instructional period - On-task behavior and work productivity during testing
Targeted measures	Efficacy of child life and attention skills treatment: Parent component: planning, working memory, multitasking, prioritizing Child component: independence (academic, study and organizational skills: self-care and daily living skills) and social skills (good sportsmanship, assertion, conversational skills, dealing with teasing, friendship making, play-date skills)	
Intervention procedure	A. Child Life and Attention Skills Treatment (CLAS) CLAS attempts to maximize the efficacy of psychosocial treatment for the inattentive type of ADHD. CLAS included: - The reliance of techniques such as scaffolding, reminders and routinization. - Parent component (PA), child component (CA), and teacher component (TA) Strategies included: a. PA: rewards, praise, establishing daily routines, directions and commands, avoiding power struggles, parent stress management, organize/structure the home b. CA: problem solving steps, self-cues, reminder lists focusing on independence and social skills c. TA: evidence based classroom management strategies B. Parent-focused treatment (PFT) received the same number of parent group and individual family meetings as CLAS families C. Treatment as usual (TAU)—Booster session for PFT and CLAS Families received a written diagnostic report and a list of community treatment providers	STP offered state-of-the-art treatment to children with ADHD and related problems - Included whole group (WG) condition, small group (SG) condition, and independent seatwork (IS) condition - Both the instructional and testing periods were present in all three conditions, with the instructional period focusing on reading comprehension and the testing period on worksheet completion

Table 6. Treatment procedure of randomized clinical trial and cross-sectional study design (continued)

Pfitfner et al. [31]		Hart et al. [27]
Duration of session	Ten 90-min parent group meetings Ten 90-min child group meetings One 30-min orientation meeting	10-min each for WG, SG, and IS conditions (instructional and testing periods)
Personnel for data recording	Therapists	Teachers and research assistant
Post intervention analysis	- DSM-IV inattention symptoms rated on a 4-point scale - Organization skills were rated on a 4-point rating scale by teachers and parents - Social skills rated using Social-Skills Improvement System (SSIS) by teachers and parents - Functional Impairment was rated using the IRS - Global psychosocial functioning was rated on a 7 point rating scale using Global Impression Scale	Nil
Treatment/procedure integrity and fidelity	Intraclass reliability for the CLAS and PFT was >97%	The average observation rating: - Appropriately administered treatment components: 98.7% - Average percentage of appropriate commands: 89.2%
Social validity	Ascertained from parents and teachers using a 5-point scale pertaining to the usefulness and appropriateness of the CLAS and PFT program. Degree of satisfaction (CLAS): Parents: >95%; Teachers: 9.4% Degree of satisfaction (PFT): Parents: 94–95%	Nil
Results	Post hoc comparison between CLAS, PFT and TAU was done and the results (level of significance) are as follows: A. Inattention symptoms: Child Symptom Inventory (CSI) CLAS-PFT: parent report (PR)-0.35 & teacher report (TR)-0.21 CLAS-TAU: PR-0.68 & TR-0.17 PFT-TAU: PR-0.33 & TR-0.04 B. Organizational skills: Children's Organizational Skill Scale (COSS) CLAS-PFT: PR-0.35 & TR-0.25 CLAS-TAU: PR-0.46 & TR-0.16 PFT-TAU: PR-0.12 & TR-0.09 C. Social skills: SSIS CLAS-PFT: PR-0.12 & TR-0.26 CLAS-TAU: PR-0.34 & TR-0.02 PFT-TAU: PR-0.22 & TR-0.24 D. Overall improvement: PR: Clinical Global Impressions-Improvement (CGI-I) TR: Clinical Global Impressions-Severity (CGI-S) CLAS-PFT: PR-0.23 & TR-0.16 CLAS-TAU: PR-0.67 & TR-0.17 PFT-TAU: PR-0.45 & TR-0.01	Post hoc comparison between Independent seatwork, small group and whole group condition On-Task behavior during Instructional and testing period: Instructional Period: a) IS: $F(1, 31) = 10.44, p < 0.001$ b) SG: $F(1, 32) = 20.0, p < 0.001$ c) WG: $F(1, 32) = 6.01, p = 0.020$ Testing period: $F(2, 31) = 1.695, p = 0.200$ Post-hoc analyses were not interpreted to evaluate differences between conditions, suggests that the on-task behavior of children with ADHD does not differ between testing contexts Work productivity during testing: a) IS: $F(2, 31) = 7.501, p = 0.002$ b) SG: $F(1, 32) = 8.845, p = 0.006$ c) WG: $F(1, 32) = 14.785, p = 0.001$

vention. In each of the studies, the duration of the VAS intervention program depended on the participants involved, task complexity, and materials used in the study. This indicates that VAS intervention programs that target training of stakeholders can be longer in duration and spread over a number of sessions, whereas programs directly targeting the ADHD students may be considered to be shorter in duration.

There were more than two team members conducting the therapy session, one of them could easily record the session, while the other concentrated on taking sessions, ensuring that there were no interruptions. It was important to evaluate the treatment program's efficacy or consistency to determine whether the intervention program was appropriate for treating the patients. In one of the single case studies [26] as well as in the RCT [31], the inter-observer reliability was rated. Simultaneously, procedural integrity, treatment fidelity, observational reliability, and procedural reliability were all critical in determining the effectiveness of the treatment program [40]. To prevent bias, all of these measures were included in the study [25-27]. The parents expressed high levels of satisfaction with the CLAS program as they learned more about ADHD and how to train their children with it [31]; however, there was no mention of social validity in another study [27]. Two of the studies [25,26] assessed the acceptability of the treatment among teachers, patients, and peers, and found it to be satisfactory. The results of all four studies were measured differently depending on the type of intervention implemented. On-task and on-schedule performance were assessed on a percentage basis in one of the single case studies [26], while the progress in each step or session was examined in the other. The results of the RCT [31] were obtained by administering rating scales to the participants. The level of significance was measured in a cross-sectional study for all three conditions.

It was also crucial to conduct a post-intervention review to determine whether there were any deviations from the participant's baseline. The RCT [31] used various rating scales to perform a post-intervention review to see how far the participants had progressed or how different they were from their baseline phase. Various rating scales were used to assess the quality of the four studies [25-27,31]. The RCT [31] was of low quality, while the other three studies [25-27] were of high quality. Provided that all indicators had been similarly assessed, the efficiency of all four studies could have been ascertained uniformly.

CONCLUSION

The use of VAS in children with ADHD is a promising intervention that provides teachers and parents with adequate

guidelines to execute the intervention program in different settings. Using VAS also seeks to improve the most impacted areas such as academic, social and independent classroom skills, on-task and on-schedule behavior, and literacy skills. The use of scheduled-based activities are found to have a significant effect on ADHD children, as per the reviewed studies [25-27,31]. The results of the current study will help provide practitioners with guidelines for preparing scientifically planned interventions for children with ADHD. However, the generalizability of the findings of the current systematic review towards a wider age group is questionable. Moreover, the four studies that were evaluated in this systematic review followed three different study designs, resulting in the efficacy of the intervention program being debatable. Future research could address these issues, as well as determine the efficacy of other intervention programs in children and individuals with ADHD.

Availability of Data and Material

Data sharing not applicable to this article as no datasets were generated or analyzed during the study.

Conflicts of Interest

The authors have no potential conflicts of interest to disclose.

Author Contributions

Conceptualization: Sudhin Karuppali. Data curation: Naveena Thomas. Formal analysis: all authors. Methodology: Naveena Thomas. Supervision: Sudhin Karuppali. Writing—original draft: Naveena Thomas. Writing—review & editing: Sudhin Karuppali.

ORCID iDs

Naveena Thomas <https://orcid.org/0000-0001-6107-0895>
Sudhin Karuppali <https://orcid.org/0000-0003-2955-8107>

Funding Statement

None

Acknowledgments

The authors wish to thank Mr. Rahul K for acting as the third reviewer during the 'data extraction and management' and 'quality assessment' process.

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