Effects of Weighted Vests on Attention, Impulse Control, and On-Task Behavior in Children With Attention Deficit Hyperactivity Disorder

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MeSH TERMS

- arousal
- attention
- attention deficit disorder with hyperactivity
- impulsive behavior
- sensation

OBJECTIVE. In this study, we examined the effectiveness of using weighted vests for improving attention, impulse control, and on-task behavior in children with attention deficit hyperactivity disorder (ADHD).

METHOD. In a randomized, two-period crossover design, 110 children with ADHD were measured using the Conners' Continuous Performance Test–II (CPT–II) task.

RESULTS. In the weighted vest condition, the participants did show significant improvement in all three attentional variables of the CPT–II task, including inattention; speed of processing and responding; consistency of executive management; and three of four on-task behaviors, including off task, out of seat, and fidgets. No significant improvements in impulse control and automatic vocalizations were found.

CONCLUSION. Although wearing a weighted vest is not a cure-all strategy, our findings support the use of the weighted vest to remedy attentional and on-task behavioral problems of children with ADHD.

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Weighted vests are frequently used by occupational therapy practitioners who work with children with attention deficit hyperactivity disorder (ADHD) as a modality to provide direct somatosensory input (Olson & Moulton, 2004a, 2004b). Adding sensory stimulation has been found to increase the attention ability (Zentall, Grskovic, Javorsky, & Hall, 2000) and reduce the excessive movement (Lee & Zentall, 2002) of students with ADHD. It is believed that the deep-touch pressure input provided by the weighted vests can decrease sensory modulation dysfunction by changing levels of arousal in the central nervous system, thereby resulting in positive functional and behavioral outcomes (Baranek, Wakeford, & David, 2008; VandenBerg, 2001).

According to neurophysiology studies, the *reticular formation* is an area of the brain that receives and processes information from most sensory systems (Zhang, Kang, & Lundy, 2011); however, Reeves (2001a) suggested that deep-touch pressure input is able to override other arousing inputs, such as auditory, visual, and light-touch stimulation, because deep-touch pressure input does not send direct projections to the reticular formation. Rather, deep-touch pressure input travels from the medulla to the thalamus and somatosensory cortex where, according to sensory stimulation theory, it is able to reduce excitability and decrease arousal by providing descending inhibitory control on the reticular formation through reciprocal pathways. Therefore, the deep-touch pressure input reaches higher order centers quickly and is able to provide a down-regulating influence on the reticular formation (Blanche & Schaaf, 2001; Reeves, 2001b).

Several studies have examined the effects of weighted vests; however, a database search of PsycINFO and Medline found only one study (VandenBerg,

2001) on the effects of wearing a weighted vest on ADHD children's on-task behavior. VandenBerg (2001) examined the relation between wearing a weighted vest and time on task for 4 children with ADHD. The results of his study showed that the on-task behavior of all 4 students was increased by 18%–25% while wearing the weighted vest. Examination of the results suggests that the weighted vest was an effective intervention for increasing time on task during typical table top activities. VandenBerg's study has been criticized for its several methodological weaknesses, including weak research design (A-B single-subject design), difficulty of replication (a 15-min teacher-led, tabletop activity), and poor interobserver agreement (IOA; Reichow, Barton, Sewell, Good, & Wolery, 2010).

Although some of the studies examining weighted vests have reported positive results (Fertel-Daly, Bedell, & Hinojosa, 2001; Joe, 1998; Myles et al., 2004; VandenBerg, 2001), some have not. Stephenson and Carter (2009) reviewed seven studies on weighted vests, all of which adopted a single-subject design to analyze few participants. They found that the authors of five of the studies concluded that weighted vests were an ineffective intervention or provided mixed results. On the basis of their review, Stephenson and Carter concluded that weighted vests could not be recommended for clinical application.

Conners' Continuous Performance Test

The Conners' Continuous Performance Test (CPT; Rosvold, Mirsky, Sarason, Bransome, & Beck, 1956) and its variants have been used for at least 50 yr to measure sustained attention or impulse control in many different populations (Reddy, Newman, Pedigo, & Scott, 2010). CPTs typically consist of "target" stimuli and "nontarget" stimuli, which are presented in random order for a length of time that is sufficient to measure attentional performance. Many studies (Epstein et al., 2003; Johnson, Robertson, et al., 2007; Seidel & Joschko, 1990), as well as a meta-analytic review of CPT research (Losier, McGrath, & Klein, 1996), confirm poorer CPT performance in children with ADHD than in children without disabilities. The validity of the CPT as a measure of both inattention and impulsivity in children with ADHD has also been supported by correlations between CPT outcome measures and parent–teacher ratings of these variables (Avila, Cuenca, Félix, Parcet, & Miranda, 2004).

Among the CPTs, the Conners' Continuous Performance Test–II (CPT–II; Conners, 2004) has become increasingly popular among clinicians because of its adequate reliability and easy administration (Reddy et al., 2010). The CPT–II yields variables that purport to measure inattention (omission errors), impulsivity (commission errors), speed of processing and responding (reaction time [RT]), and consistency of executive management (RT variability). *Commission error*—the number of times the individual responds to nontargets—is assumed to be an index of impulsivity; *omission error*—the number of times the individual does not respond to targets—is assumed to be an index of inattention. The other two variables (RT and RT variability) are also believed to provide additional information related to attentional performance (Hervey et al., 2006; Hurks et al., 2005; Johnson, Kelly, et al., 2007).

On-Task Behavior

It is evident that students with ADHD exhibit higher rates of gross motor activity and fidgeting, negative verbalizations, and various other off-task behaviors relative to students without ADHD (Zentall, Craig, & Kuester, 2011). Compared with their peers, school-aged children with ADHD have been shown to exhibit significantly longer periods of excessive motor (limb) activity while engaged in specific attention tasks (e.g., CPT; Alberts & van der Meere, 1992). These problematic on-task behavior patterns are manifested in classrooms as difficulty in attending to and following instructions, completing instructional activities, and complying with classroom rules (Barkley, 1990). Without effective intervention, these on-task behavior patterns can impede a student's educational experience by limiting the acquisition of new skills and preventing the development of adaptive teacher and peer relationships.

In summary, the research question of this study was, Do weighted vests work on improving attention, impulse control, and on-task behavior in children with ADHD? The purpose of this study was to determine whether wearing a weighted vest would improve attentional, impulse, and on-task behavioral difficulties during the CPT task for children with ADHD. Our aim was to increase the rigor of weighted-vest research by expanding the number of participants included, adopting quantitative research methods, using random assignment, and blinding for the experimental conditions. For attention, we hypothesized that the participants' attention-related information processing could be significantly improved by ignoring unrelated sensory input when they were wearing weighted vests. For impulsivity, we hypothesized that the participants' performance of impulse control could be significantly improved by decreasing arousal state when they were wearing weighted vests. For on-task behavior, we hypothesized that the frequency of the participants' problematic on-task behavior could be significantly decreased by the calming effects of weighted vests.

Method

Research Design

A randomized, two-period crossover design was used in this study to balance the order of two vest conditions (Figure 1). Recent theoretical formulations have repeatedly emphasized that ADHD should be regarded as a heterogeneous condition. This heterogeneity is evident in children with ADHD in at least three different respects: expression of different symptom domains, neuropsychological impairments, and comorbid behavior problems (Wåhlstedt, Thorell, & Bohlin, 2009). The crossover design provides statistical efficiency, because different patients may respond with wide variation to treatments, whereas variation within the same patients may be considerably less (Woods, Williams, & Tavel, 1989). Also, because all participants in this study completed the CPT–II task twice, the crossover design could decrease the impact of practice effects in this neuropsychological task. Thus, the within-subjects comparison provided by the crossover design produced a more precise estimate of the difference between wearing weighted versus unweighted vests.

Ethical approval for the study was obtained from the Research Committee at Da Chien Hospital in Taiwan. Participants were given information about the purpose of the study and assurances of confidentiality and the right to withdraw without prejudice. Written consent to participate was obtained from all participants.

Participants

Children with ADHD were recruited from several clinics in this study. Inclusion criteria for these ADHD participants were as follows: (1) full-scale intelligence quotient of the Wechsler Intelligence Scale for Children—fourth edition above 80, (2) diagnosis of ADHD by a qualified neurologist, (3) no diagnosis of neurological disorders other than ADHD, (4) normal or corrected visual problems, and (5) normal hand function. Participants who took medicine for ADHD symptoms were asked to suspend using medication during the days of testing.

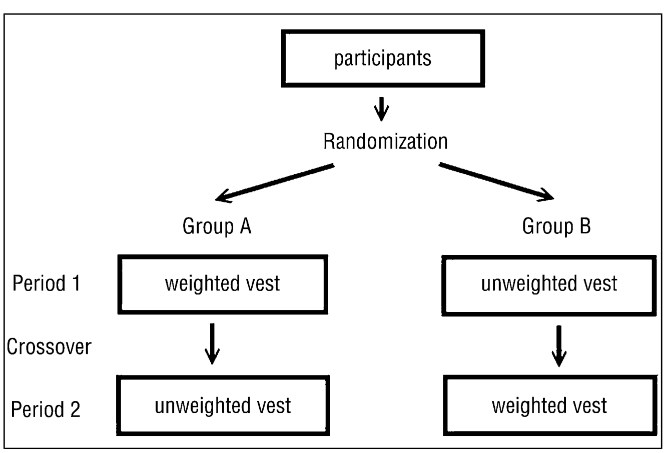

Figure 1. The randomization, two-period crossover design.

Setting

The experimental setting was located in a clinic therapy room. All participants had to visit this room twice with a 4-wk interval. In each appointment, every participant was administered the CPT–II task once individually in this therapy room, free from distractions. Only the administrator (the first author, Lin) was present during the testing.

Instruments and Equipment

Weighted Vests. A multipocketed vest (Southpaw Enterprises, Dayton, OH) was used in both vest conditions (see Figure 1). Each weighted vest contained 18 interior pockets (8 in the front, 8 in the back, and 2 on the top of the shoulders), into which could be inserted weighted fabric pouches. According to survey results from Olson and Moulton (2004b), a weighted vest typically has 10% of a person's body weight evenly distributed around the vest. For the weighted vest condition (providing deep-touch pressure), weights (1/2-lb or 1/4-lb fabric pouches) were placed into the interior pockets until the weight of vest reached 10% of the participant's body weight, evenly distributed around the vest. For the unweighted vest condition, no fabric pouches were placed in the interior pockets; the unweighted vest weighed less than 1% of each participant's body weight.

We chose to add 10% of each participant's body weight to the vest in the weighted vest condition, rather than the 5% of body weight used in previous studies (Fertel-Daly et al., 2001; VandenBerg, 2001), for two main reasons. First, we wanted a clear difference between the two vest conditions (wearing a vest of 10% vs. one of less than 1% of each participant's body weight) in this study. Second, if the behaviors were truly affected by the weighted vests, we wished to diminish the possibility that the deep-touch pressure input provided through the weighted vest would be insufficient to modulate the undesired behaviors, which was a concern of Collins and Dworkin (2011) in their study of weighted vests.

Conner's Continuous Performance Test–II. The CPT–II (Conners, 2004) was adapted to collect all participants' data in a standardized way in this study. Respondents were required to press the mouse button when any letter except the target letter "X" appeared. The CPT–II was administered using a laptop personal computer and took 14 min to complete. The CPT–II has adequate reported reliability (split-half coefficients on all measures ranging from .73–.95; Conners, 2000). In addition, different reports have shown that clinical participants with ADHD perform significantly worse than those without ADHD on CPT–II measures (Conners, 2000; Schweiger, Abramovitch, Doniger, & Simon, 2007; Teicher, Polcari, Fourligas, Vitaliano, & Navalta, 2012). These results indicate that the CPT–II is sensitive to attentional deficits present in the ADHD population, making it an appropriate choice for this study.

We used raw scores rather than *T* scores; therefore, the raw scores of omission error and commission error are presented with the number of error times. The raw scores of mean hit response time for correct responses (RT) and mean hit response time standard error (RT variability) are in milliseconds, and lower scores for errors of omission or commission indicate better performance.

Digital Video Camera. Four types of problematic on-task behaviors were collected in this study, including (1) *vocalizations,* making meaningful or meaningless utterances; (2) *off task,* looking away from computer monitor; (3) *out of seat,* leaving the seat; and (4) *fidgets,* exhibiting fidgeting or extraneous body movements during the CPT–II task. These on-task behaviors of each participant were videorecorded using a Sony Handycam hard disk drive digital video camera (Sony Corporation, Tokyo).

Procedures

All participants in this study were randomly assigned to one of two groups: Group A or Group B. The participants in Group A completed the CPT–II task under the weighted vest condition first, and then they did the same task under the unweighted vest condition 4 wk later. The participants in Group B completed the CPT–II task in the reverse order (see Figure 1). In the weighted vest condition, each participant was weighed by the first author to establish the amount of weight (10% of the participant's weight) to be placed in the pockets of the vest prior to the beginning of the CPT–II task. In the unweighted vest condition, each participant was also weighed by the same author prior to the beginning of the CPT–II task; however, no fabric pouches were inserted into the vest. All participants were informed that they were wearing the same vest in both wearing conditions.

The CPT–II task was administered using the standard protocol; that is, practice was given first, followed by the actual test administration. The testing data (omission errors, commission errors, RT, and RT variability) were collected and analyzed initially by the program itself. The entire 14-min period of on-task behaviors (vocalizations, off task, out of seat, and fidgets) was recorded for each participant; these behavior data were downloaded to an external hard drive and displayed on a personal computer. Each participant's complete 14-min videorecorded data were randomly ordered prior to coding.

Behavioral coding was conducted by two trained senior occupational therapists who were blinded to the specific study hypotheses and group assignments. The primary researcher conducted reliability coding. Coders were trained through discussion and practice videos. Before coding the study data, the two trained senior occupational therapists exceeded 95% accuracy over three consecutive observation sessions. Each 14-min period of behavioral data was coded for every 10 s. In every 10-s block, each targeted on-task behavior was coded as one (and only one) point if the targeted on-task behavior appeared during this period, no matter how many times the behavior appeared or how long the behavior persisted in the time block. The collecting and coding procedure was the same for every participant in this study.

Interobserver agreement (IOA) was calculated by dividing the number of intervals in agreement by the sum of agreements and disagreements and then multiplying by 100 (Tawney & Gast, 1984). In this study, IOA data were collected from the practice sessions of the CPT–II task during the two vest conditions. According to the standard set by Bakeman and Gottman (1987), this study's IOA values (κ coefficient) were very good (vocalizations = .96; out of seat = .98; fidgets = .95; off task = .95; see Bakeman & Gottman, 1987).

To create a blind context during the coding of each participant's on-task behavior, we used the same vests but without any weighted fabric pouches inserted into the interior pockets as a second vest condition (the unweighted vest condition). Only the first author, who set the CPT task settings and helped the participants don the vests, knew whether the vest was weighted. This procedure created the blind condition to decrease bias on the part of the coders. In the unweighted vest condition, we assumed that no effect of deep pressure was provided because the weight of the vests was less than 1% of each participant's body weight.

Statistical Analyses

Both the CPT–II testing data and observational behavior data were analyzed with the statistical software package

SPSS Version 19 (IBM Corporation, Armonk, NY). All data analyses were two-tailed, and significance was set at $p < .05$. The within-individual mean scores of the outcome measures were analyzed using the assessment with the weighted and unweighted conditions. Paired t tests were used to compare the CPT–II data and the behavior scores between the two conditions.

Results

One hundred twenty-eight Taiwanese children with ADHD were recruited in the beginning of this study, and 34 of these children took medicine regularly. Of the 34 children under regular medicine, 18 declined to suspend taking drugs on the days of testing, so these participants were removed from the roster. In the end, 110 children with ADHD were enrolled and completed the entire procedure of this study. The demographic data for the 110 children are shown in Table 1.

Performance on the CPT–II

We randomized all participants into Group A or Group B to minimize the practice effect of the CPT–II task (see Figure 1). Even though we used random assignment, equivalency was also assessed for these two groups, and no differences were found between the two groups in age, $F(108) = 0.143$, $p > .05$; IQ, $F(108) = 0.226$, $p > .05$; or gender, $F(108) = 0.274$, $p > .05$.

Paired t tests were conducted to analyze the differences between the two vest conditions. We used raw scores rather than T scores; therefore, the raw scores of omission error and commission error are presented with the number of errors in Table 2. The raw scores of mean hit response time for correct responses (RT) and mean hit response time standard error (RT variability) are in milliseconds, and lower scores for errors of omission or commission indicate better performance. The differences in the scores of the CPT–II task between the weighted and unweighted vest conditions are shown in Table 2. In the weighted vest condition, the participants showed significant improvement in t scores ($p < .05$) of inattention (omission errors), speed of processing and responding (RT), and consistency of executive management (RT variability). However, no difference was shown in impulsivity (commission errors).

Table 1. Demographic Characteristics of Participants

Variable	Children With ADHD (n = 110)
Age, *M* (*SD*)	8.6 (1.7)
IQ, *M* (*SD*)	99.3 (6.6)
Gender, *n* (%)	
Male	93 (84.5)
Female	17 (15.5)
Education (elementary school), *n* (%)	
1st–2nd yr	67 (60.9)
3rd–4th yr	28 (25.4)
5th–6th yr	15 (13.6)

Note. ADHD = attention deficit hyperactivity disorder; *M* = mean; *SD* = standard deviation.

Performance of On-Task Behavior

Participants wearing weighted vests during the CPT–II task showed significant improvements ($p < .05$) in most of the coded behaviors. These improvements included the frequency of looking away from the computer monitor (off task), leaving the seat (out of seat), and exhibiting extraneous movements (fidgets; see Table 2). However, the data showed no difference between the two vest conditions in the on-task behavior of making meaningful or meaningless utterances (vocalizations).

Discussion

The purpose of this experiment was to determine whether wearing a weighted vest, which is used to apply deep-touch pressure input, would improve attention, impulse control, and on-task behavior during the CPT–II task for children with ADHD. Most activities of daily living among school-age children need to be done with appropriate attention and on-task behavior; therefore, we adopted the CPT–II task as the experimental tool in this study. Through this 14-min computerized and standardized attentional test, we collected unbiased data on each participant's attentional and behavioral performance. The data, which were collected under different vest conditions, provided us valuable information to explore the effects of weighted vests.

This study has several advantages over previous research on weighted vests. First, we recruited more ADHD children than did previous studies, all of which adopted a single-subject design based on a few participants, to explore the effectiveness of weighted vests. Second, we used a replicated, standardized, and computerized attentional test (CPT–II) to measure all participants' performance of attention and impulse control and collect their on-task behavioral data at the same time. No previous research has tested the effects of weighted vests on attentional performance and impulse control with a standardized assessment tool. Third, a single-blind design was adopted in the coding procedure toward all collected behavioral data to minimize possible bias. On the basis of these advantages, the findings of our study should be valuable to discussions of the use of weighted vests.

Table 2. Variables and On-Task Behaviors: Weighted and Unweighted Vest Conditions

	CPT–II Score				
Variable	Unweighted Vest, *M* (*SD*)	Weighted Vest, *M* (*SD*)	*df*	*t*	*p*
CPT–II variable					
Omission errors	52.6 (52.9)	41.7 (44.9)	109	3.21*	.002
Commission errors	23.3 (8.0)	23.9 (8.6)	109	−1.1	.287
RT, ms	528 (163)	502 (156)	109	3.18*	.002
RT variability, ms	22.78 (16.52)	18.66 (12.70)	109	3.86*	.000
On-task behavior					
Vocalizations	5.49 (8.44)	4.82 (9.69)	109	0.79	.433
Off task	45.81 (27.97)	35.08 (25.59)	109	6.33*	.000
Out of seat	3.22 (10.9)	0.58 (1.59)	109	2.58*	.011
Fidgets	29.43 (26.86)	14.26 (15.57)	109	7.48*	.000

Note. We used raw scores rather than T scores for omission errors and commission errors; lower scores indicate better performance. CPT–II = Conners' Continuous Performance Test–II; *df* = degrees of freedom; *M* = mean; RT = the average of the correct response times; RT variability = the standard deviation of the mean of correct response times; *SD* = standard deviation.
*$p < .05$.

Attentional Performance

In the aspect of attentional performance, the participants in the weighted vest condition showed considerable improvements in all three attentional variables (omission errors, RT, and RT variability) during the CPT–II task compared with the unweighted vest condition. The number of omissions, which represents inattention, was significantly decreased when the participants wore weighted vests. In addition, speed of processing and responding (RT) and consistency of executive management (RT variability) were significantly improved in the weighted vest condition. The faster and more consistent RT indicates that the participants paid more attention to the task. These results support our hypothesis that the deep-touch pressure input provided by weighted vests would help the participants to perform attention-related information processing.

Impulse Control

In our study, no difference between the two vest conditions was observed in the number of errors of commission, which represents impulsivity, suggesting that weighted vests were ineffective in remedying the deficiency of impulse control. *Impulsivity* is a personality trait defined by a tendency toward acting without forethought, making quick cognitive decisions, and failing to appreciate circumstances beyond the here and now (Barratt, 1985). It has been proposed that people who are impulse tend to be physiologically underaroused at rest (Barratt, 1985; Eysenck & Eysenck, 1985), although they experience relatively greater arousal increases in response to stimulation (Eysenck & Eysenck, 1985; Houston & Stanford, 2001).

Electrodermal–EEG studies of arousal in Barry's laboratory (Barry, Clarke, Johnstone, McCarthy, & Selikowitz, 2009) have separated the concept of "activation" from that of "arousal." By separating these concepts, *arousal* is defined as "the current energetic state," and *task-related activation* is defined as "the change in arousal from baseline to the task" (Barry et al., 2009, p. 399). It has also been demonstrated that the activation mechanism—dynamic changes in neural network activities—is impaired in ADHD (Barry et al., 2009; Nazari, Wallois, Aarabi, & Berquin, 2011). In addition, the state regulation hypothesis (Sergeant, 2000, 2005) proposes that poor state regulation is characterized by problems in regulation of effort, arousal, and activation.

On the basis of these studies and related hypotheses, it appears that the complex mechanism of impulse control involves not simply control of the state of arousal but also other factors. A possible explanation for the lack of a major difference in commission errors between the two vest conditions in this study is related to the complex mechanism of impulse control. Although the deep-touch pressure provided by the weighted vests is believed to have a calming effect (Olson & Moulton, 2004a), this effect may only decrease the overarousal state in response to stimulation but not affect the regulation of other factors (e.g., activation, effort, or both) when the person executes impulse inhibition, which is required to regulate the highly dynamic changes of neural network activities.

On-Task Behavior

Three types of on-task behaviors (off task, out of seat, and fidgets) were shown to be significantly different between the two vest conditions of this study. Only the behavior of automatic vocalizations, including meaningful and meaningless utterances, was not shown to be significantly different between the two vest conditions, although the frequency of vocalizations did decrease in the weighted vest condition (see Table 2). A possible reason why automatic vocalization was not shown to be significantly improved by wearing weighted vests may be related to the experimental tool and setting of this study. We used the CPT–II task, a laboratory tool set in a quiet room, to test the participants' performance of attention. According to the data on vocalizations, most were meaningless utterances. It is possible that meaningful utterances were considerably decreased because the participant was facing an unresponsive computer monitor in a quiet room. The results could be different if these participants were observed in their natural settings. The other three types of on-task behaviors were all significantly improved when the participants wore weighted vests. This result supports the effects of wearing weighted vests in improving the problematic on-task behavior of children with ADHD.

Limitations

The main strength of this study is the considerable number of ADHD participants, which is rare in research on weighted vests. With such a large sample size, the effects of weighted vests would not easily be influenced by a single or several outliers. Despite this strength, our study does have some limitations.

First, some research and surveys have suggested that the effects of weighted vests may be both immediate and delayed (Olson & Moulton, 2004a, 2004b) or delayed rather than immediate (Fertel-Daly et al., 2001). We explored only the immediate effects on attentional and behavioral performance of wearing a weighted vest loaded with 10% of the child's body weight; therefore, the delayed effect was not detected. Practitioners who adopt protocols other than those in our study should proceed with caution.

Second, limited to the experimental tool (the CPT–II task) we adopted only one variable to measure impulsivity. The result may be changed by adopting more measures of impulse control through other experimental tools.

Third, we did not consider a no-vest condition. To create a blind context during the coding of each participant's on-task behavior, we adopted the same multipocketed vest in both experiment conditions. Although the unweighted vests adopted were less than 1% of each participant's body weight, the presence of the unweighted vest might have had an impact that was not considered.

Fourth, the subtype of ADHD was not considered. One of our main purposes was to increase the rigor of weighted vest research by recruiting as large a sample of participants with ADHD as possible. The balance of each subtype of ADHD was not considered during the period of recruitment; therefore, the participants' ADHD subtype in this study was generally not identified. Although some participants were of identified subtypes, analyzing the data was problematic because of the inadequate proportions of these subtypes among these participants. Finally, because all the children were recruited from clinical settings in this study, our findings should not be extrapolated to the general population.

Future Research

This study is an initial step in detecting the effects of weighted vests on children with ADHD; it should and, we hope, will be used as a springboard for future research on related issues of weighted vests. On the basis of the results and the limitations of our study, several important issues are in need of further research and clarification.

First, we did not explore the delayed effect of wearing a weighted vest; this issue warrants examination in future research. Second, we treated the unweighted vests as vests that provided no effect of deep-touch pressure in this study. Because the unweighted vest condition is not equal to a no-vest condition, however, wearing the unweighted vest still might have affected the participants. To clarify this issue, we recommend adding the no-vest condition in future research. Third, because most of the participants' subtypes of ADHD were not identified or distinguished, no further analysis related to this issue could be carried out. It might be helpful to run advanced analysis to determine whether the outcomes were different based on the subtypes. This is an important empirical question that future research should target. Last, further research is needed to investigate the underlying reason why the deep-touch pressure provided by weighted vests does not remedy the problem of impulsivity. On the basis of state regulation hypothesis (Sergeant, 2000, 2005), we propose that the complex ability of impulse control could be controlled by several factors (arousal, activation, or effort). Thus, the deep-touch pressure provided by weighted vests may decrease the participant's overarousal state, but it may not help with dynamic regulation of these factors. This proposition should be tested in a further study with well-designed methodology.

Implications for Occupational Therapy Practice

The results of this study have the following implications for occupational therapy practice:

- Weighted vests could be provided as a useful modality to assist with improving the attentional and behavioral performance of children with ADHD.

- Wearing weighted vests truly improves three aspects of attentional performance (inattention, speed of processing and responding, and consistency of executive management) of children with ADHD, although this method is not a cure-all strategy for their attentional deficits.
- Wearing weighted vests truly improves three aspects of behavioral performance (off task, out of seat, and fidgets) of children with ADHD, although this method is not a cure-all strategy for their behavioral deficits.
- Practitioners who adopt weighted vests to provide deep-touch pressure should apply the technique cautiously, especially if wearing protocols different from those in this study are used.

Conclusion

In conclusion, this study provides further understanding of the effects of wearing weighted vests. Our findings highlight the utility of weighted vests as a means to remedy attentional and on-task behavioral performance in children with ADHD. These findings indicate that the deep-touch pressure input provided by weighted vests indeed improves three aspects of attentional performance, including inattention (omission errors), speed of processing and responding (RT), and consistency of executive management (RT variability), and three types of on-task behaviors, including off task, out of seat, and fidgets. Thus, we recommend that weighted vests be considered as a useful modality to assist with improving the attentional and on-task behavioral performance of children with ADHD. These results also support the previous single-subject design study conducted by VandenBerg (2001), which is the only published literature related to investigations of the effect of weighted vests on the behavior of children with ADHD. ▲

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