Weighted Belt Use to Reduce Attention Deficit Hyperactivity Disorder Symptoms

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Abstract

Weighted belt use was examined to determine effectiveness in reducing symptoms of Attention Deficit Hyperactivity Disorder (ADHD) in school-aged children. Parents rated their child using the Conners-3 ADHD Index-Parent Form (AI-P) to establish eligibility to participate and provide a baseline measure of symptoms. Probability scores indicating ADHD diagnosis of 55 or higher were required. Ten subjects completed the study, aged 7 to 13. Parents then rated their child again using the AI-P after wearing a weighted belt 15 to 30 minutes a day for a week. A Reliable Change Index (RCI) based on a two-tailed 90% Confidence Interval around the baseline score allowed comparison with the score while wearing the weighted belt. Results indicated that while wearing the weighted belt, 8 out of 10 participants were rated with significantly fewer symptoms based on a RCI for their raw scores. Six out of 10 participants were rated with significantly fewer symptoms based on a RCI for their *T*-scores. Additionally, parents of 4 participants actually no longer rated their child's behavior in the clinical range based on their *T*-score while wearing the weighted belt after daily use for a week, a Clinically Meaningful change. Results indicated that use of a weighted belt can be an effective intervention not based on medication that does merit consideration for school-aged children with symptoms of ADHD.

Keywords: ADHD, weighted belt, Conners-3, children, attention, behavior

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Introduction

Attention deficit hyperactivity disorder, or ADHD, is a significant problem among school-age children. ADHD is characterized by developmentally inappropriate impulsivity, inattention, and hyperactivity, and the Diagnostic and Statistical Manual of Mental Disorder, (fourth edition) (American Psychiatric Association, 1994) estimates the prevalence of ADHD at 3% to 5% of school-age children. With improved guidelines on treatment and diagnosis, pediatricians have reported that approximately 9% of US children have been diagnosed with ADHD (Stein, et al., 2009). The second administration in 2007 National Survey of Children's Health (NSCH) estimated the number of children reported by their parents to have ever been diagnosed with ADHD and the percentage of children with ADHD taking ADHD medications (Blumberg, Foster, and Frasire, 2010). The first administration was in 2003. Results of this study were analyzed by The Centers for Disease Control and Prevention, (CDC, 2010). The CDC report indicated a nearly 22% increase (from 7.8% to 9.5%) in the percentage of children 4- to 17-years of age with a parent-reported diagnosis of ADHD (ever). The CDC report also revealed a 2:1 or even a 3:1 ratio of boys to girls in terms of diagnostic prevalence. Among children with current ADHD, the CDC analysis showed that 66.3% were taking medication for the disorder. In total, 4.8% of all children aged 4- to 17-years old (2.7 million) were taking medication for ADHD. ADHD has been noted to be the most commonly diagnosed neurobehavioral disorder of childhood, with increasing trends in prevalence during the past decade and increases in ADHD medication use (Pastor and Ruben, 2008; Castle, Aubert, Verbrugge, Khalid, and Epstein, 2007).

There are three subtypes of ADHD, the Combined Type, with symptoms of both inattention and hyperactivity-impulsivity, the predominantly Inattentive Type, and the predominantly Hyperactive-Impulsive Type. Symptoms of inattention include failing to give close attention to details or making careless mistakes, difficulty sustaining attention, not listening, not following through on instructions and failing to finish tasks, difficulty organizing, avoiding difficult tasks, losing things, being easily distracted, or being forgetful. Symptoms of hyperactivity include fidgeting, inappropriate running or climbing about, difficulty with quiet play, seeming to be driven, or talking excessively. Symptoms of impulsivity include blurting out, difficulty waiting, and interrupting others. All school-age children exhibit some degree of these behaviors in normal functioning. In order to be diagnosed with ADHD, symptoms are more frequent and severe than those found with typical children, and cause significant impairment in at least two settings (such as home and school). ADHD is a significant risk factor for academic performance, psychosocial adjustment, and future psychopathology (Mannuzza, Klein, Bessler, Malloy, and LaPadula, 1998). Children with ADHD often exhibit sensory processing problems such as being easily distracted by irrelevant stimuli that are ignored by others, frequently shifting from one uncompleted activity to another, having difficulty remaining seated when expected to do so, performing messy work, making noises, and grabbing objects or touching things excessively. Theoretically, these children have sensory systems that send abnormal signals to the brain cortex that interfere with organizing brain activity (Kranowitz, 1998). The brain becomes over-stimulated, making it difficult to organize behavior and to concentrate (Hatch-Rasmussen, 1995). This neural sequence often results in negative emotional responses or outbursts, so the child with ADHD is seen as a behavior problem (Hallowell and Ratey, 1994; Kranowitz, 1998).

ADHD is one of the most extensively investigated psychiatric disorders of childhood and adolescence by the medical community (Goldman, Genel, Bezman, and Slanetz, 1998). In 2007, 2.7 million children were taking medication to help manage their ADHD (Scudder, 2011). There has been an increase in rates of diagnosis in teens, and an increase in rates of medication among girls as they get older. In boys, rates of medication use increase throughout childhood, peaking at 11- to 14-year-olds. Reports indicate that medication is a frequent intervention for children with ADHD, with about two-thirds of children with ADHD receiving medication for ADHD, and that the more severe the ADHD per parent report, the more likely it was for the child to receive medication at some point during treatment (CDC, 2010). The use of stimulant medication is one of the most common medical interventions for ADHD, which may act on the reticular activating system to help dampen some of the activating stimuli that cause hyperactivity. Other medication interventions may work to increase neurotransmitters (dopamine, norepinephrine) that are suspected of being deficient (Silver, 1993; Taylor, 1994). Serotonin levels have also been found to be low in children with hyperactivity and attention deficits (Gainetdinov, et al. 1999). While these medications can be effective in reducing symptoms of ADHD, they can also have side effects, and the long term consequences of use are not well understood. Many parents seek intervention for their school-age children diagnosed with ADHD which is not medication based. Counseling and behavior management strategies to reduce symptoms of ADHD are also available and in wide use. These interventions may be employed in the school setting, at home, or in an outpatient setting.

The intervention under consideration for this study is the use of a weighted belt to reduce symptoms of ADHD. The use of weighted vests has historical grounding in the field of occupational therapy. This intervention has been employed for problems in the area of sensory integration processing dysfunction. Sensory Integration (SI) theory describes information processing as a neurobiological process requiring the detection, assimilation, organization, interpretation, and use of sensory information that allows an individual to interact adaptively within the environment in daily activities at home, at school, and in other settings (Ayers, 1972). The Sensory Integration (SI) approach may result in positive outcomes in sensorimotor skills and motor planning, socialization, attention, and behavioral regulation (May-Benson, T.A., and Koomar, J.A., 2010). Sensory processing is thought to occur in the reticular activating system, before awareness (Kidd, 2008). Use of a weight vest or belt is thought to heighten awareness and improve the effectiveness of sensory processing, by producing proprioceptive stimuli (Watling, Dietz, Kanny, and McLaughlin, 1999), which help the brain to discriminate and manage muscular movement more effectively. Ayers (1979) defined proprioception as sensations derived from muscles and joints especially from resistance to movement, so that one's brain knows where each part of the body is and how it is moving at any given time. Typical occupational therapies for proprioception problems include running and jumping, to improve the ability to feel one's body. Hyperactivity has been theorized by Kidd (2008) to be sensation seeking behavior, a person unaware of sensation being experienced, or difficulty with coordination and motor management. A weighted vest or belt provides deep pressure input, which is believed to have a calming effect on adults and children (Edelson, Edelson, Kerr and Grandin, 1999; Grandin, 1992; McClure and Holtz-Yotz, 1991). These researchers have hypothesized that deep pressure calms children by modulating their central nervous system processing of sensory information. Using weighted vests as a means of providing deep pressure is believed to decrease purposeless hyperactivity and increase functional attention to purposeful activity (Fertel-Daly, Bedell, and Hinojosa, 2001). Deep pressure may stimulate the increase of serotonin, as well as other neurotransmitters, to create a natural calming in the central nervous system in children with ADHD who may have lower levels of serotonin in their blood (Gainetdinov et al. 1999; Taylor, 1994). Deep pressure from a weighted vest may provide calming input to the central nervous system, possibly by promoting production of serotonin and dopamine (VandenBerg, 2001). Occupational therapy often incorporates the use of weighted vests to increase children's attention to school-based tasks. Sensory integration or proprioception difficulties are thought to be found in children with a variety of diagnoses, including autism, learning disabilities, ADHD, and developmental coordination disorder.

The use of weighted vests has been the subject of limited study. Their use has been largely confined to very young children with severe behavioral disorders, to help increase their ability to participate in physical therapy in highly structured programs or interventions. Children diagnosed with Autism or with a Pervasive Developmental Delay (PDD) often exhibit difficulty managing their behavior, focusing and sustaining attention, and staying on the task. Occupational therapists have employed the use of weighted vests for sensory-based approaches to treatment (Ayers, 1979), which provide specific sensory stimulation, with the basic assumption that targeted sensory input will lead to the remediation of impaired sensory processes (Polatajko and Cantin, 2010). The use of weighted vests has been reported in two direct service studies, one for PDD (Fertel-Daly, Bedell, and Hinojosa, 2001) and one for ADHD

(VandenBerg, 2001). The Fertel-Daly study objective was to examine the effects of using a weighted vest on attention to a fine motor task and self-stimulatory behaviors in preschool children with PDD. The use of a weighted vest was demonstrated to improve on task behavior, reduce distractibility and impulsiveness, and improve appropriate behavior in a classroom or treatment setting. VandenBerg found that all 4 ADHD students in her study demonstrated an increase in time on task during a fine motor activity while wearing the weighted vests.

A recent alternative to a weighted vest is a weighted belt. These weighted belts are easier to wear and are available commercially. Weighted vests are typically individually made for a child. The weight of the belt is proportional to the individual's physical weight, and generally 5% of a child's body weight is used to gain therapeutic results.

For physical therapy, the belt can be placed with the center of the weight anterior, posterior, or over the left or right hip to help the child become more aware of where he or she needs to shift their center of gravity. The ability to easily cue a child into their body has proven to be very powerful with physical therapy (Wellenberger, 2008). The manufacturer and distributor of two brands of weighted belts (the Sensory Belt and the Miracle Belt), Original Diamond Designs, suggest that their product would help with symptoms of Attention Deficit Hyperactivity Disorder. The Sensory Belt is specifically designed for children, teens and adults who weigh over 75 pounds and the Miracle Belt is specifically designed for infants and children who weigh less than 75 pounds. The manufacturer offered to provide weighted belts free of cost for this study to help determine their effectiveness in reducing symptoms of ADHD. Original Diamond Designs instructs that the weighted belts be worn for fifteen to 30 minutes per day, or until the wearer becomes uncomfortable with the belt. Once comfortable they advise that the wearer may use the belt as long as they feel necessary with breaks throughout the day.

The objective of this study was to determine the short term effectiveness of wearing a weighted belt in reducing symptoms of ADHD. The hypothesis was that a measure of symptoms of ADHD made before the use of the weighted belt, when compared to a measure of symptoms of ADHD made while wearing a weighted belt after a week of use, could be demonstrated to be statistically significantly different, and that the difference would indicate a reduction of symptoms of ADHD. The null hypothesis was that the use of the weighted belt would produce no change in the rating of symptoms of ADHD. An increase in symptoms was also not hypothesized.

The theory that use of a weighted belt might reduce symptoms of ADHD was based on the theory that increased sensory integration in the area of proprioception and deep pressure would allow better subjective awareness and therefore better control of symptom behavior due to that awareness.

Method

Participants

School-age children (8 boys, 2 girls, M_{age} = 9.1 years, age range: 7 to 13 years) were recruited with flyers posted in the waiting room of Cranberry Counseling PC, online at the practice website (http://www.children-psychology-and-mental-health.com), and at a local parent support group (Attention Deficit - Information Network or AD-IN). Local pediatricians were asked to support the study, and to place recruitment flyers in their waiting rooms. Parents of children diagnosed with ADHD who were interested in participating in the study contacted the investigator. Parents were informed about the study, and the requirements of their child's participation. Parents signed an informed consent form indicating voluntary participation, with the option to discontinue participation at any time without consequence. Parental consent also indicated consent for their minor child. No children were contacted directly by the investigator. Subjects who completed the study were largely from Massachusetts, with one each from Virginia, Michigan, and Canada. Parents requested participation for 22 children. Seven did not return the initial screening questionnaire, 3 were accepted into the study and given a weighted belt, but did not return the second or post intervention questionnaire, 1 was accepted into the study but did not pick up a weighted belt, and 1 child refused to wear the weighted belt, resulting in 12 potential participants that did not complete the study.

Materials and Procedures

The variable used to determine ADHD symptoms was a score from an index form of the Conners-3 assessment tool (Conners, 2008). The Conners-3 ADHD Index form contains 10 items that best distinguish youth with ADHD from youth in the general population. The Index form is particularly useful in screening and treatment monitoring situations, or when the same individual will be completing the form multiple times. It is a quick way to measure treatment effectiveness or response to intervention. In the development of the AI-P, the scale was examined to determine the ability to discriminate between relevant groups (ADHD and general population), a degree of congruence in ratings from different informants, and a score that correlates in a meaningful and theoretically expected way with scores from other instruments. Raw scores of 10 or higher can predict ADHD group membership with over 90% probability. Raw scores from 5 to 9 (probability values ranging from 64% to 87%) also accurately predict

ADHD group membership, while scores of 0, 1, or 2 can accurately predict general population group membership. Jacobson and Truax (1991) provide a method of calculating a Reliable Change Index (RCI) value that can be used to determine whether a change in scores between test administrations is statistically significant. These RCI values take into account the difference in test scores for two administrations, as well as the standard error of difference between them (the standard error of difference is computed with SEM_2 estimates). The RCI is provided for both raw scores and *T*-scores (probability scores). This method establishes a two-tailed 90% Confidence Interval for a baseline Conners-3 AI-P score. Subsequent scores can then be compared to the baseline score to determine if a change in scores meets or exceeds the RCI value, which can then be considered a statistically significant change. The rather liberal criterion of 90% was used for the two-tailed Confidence Interval to ensure that important changes (both increases and decreases in scores) were not missed. Clinically Meaningful change on the Conners-3 AI-P probability scores (*T*-scores) is indicated by a change in classification (i.e., from high to low probability of ADHD classification). A Clinically Meaningful change would suggest clinically meaningful improvement. Age and gender significantly affect the scores on the AI-P, so norms are broken down by age and gender. Mothers and fathers are reported to rate their children similarly on the Index forms. The reliability and internal consistency of the Index form has been demonstrated at high levels. Test-retest reliability scores for the Index form have been found to be significant.

Parents interested in volunteering their child for the study filled out the 10 item screening scale (the Conners-3 ADHD Index – Parent form) to determine their child's eligibility to participate in the study. In order to be included, parent ratings of their children's behavior needed to result in a *T*-score of 55 or greater (a probability score which indicates diagnostic likelihood of ADHD). 15 children reached criteria for inclusion. All 10 subjects who completed the study had initial *T*-scores greater than or equal to 90 (the highest on the scale). The score on the AI-P used for inclusion criteria was also considered to be the baseline measure for the study.

Procedure

The design was a single case study with a pre-intervention measure and a post-intervention measure.

The Conners-3 ADHD Index – Parent (AI-P) version was utilized for the pre-intervention and post-intervention measure. The pre-intervention measure was obtained as the screening measure for inclusion in the study. This score was considered the baseline for each subject.

The intervention consisted of wearing a weighted belt appropriate to the size and weight of the child. Instructions about use of the weighted belt were provided in writing to the parent. The weighted belt was worn for 15 to 30 minutes for a day for a week, while the child could be observed by the rating parent. The post-intervention measure was obtained when the parent rated their child’s behavior with the AI-P at the end of the week, during the time the child was wearing the weighted belt. Children were allowed to wear the weighted belt for more than the required time if they desired. Subjects were allowed to keep the weighted belt after completion of the study, free of cost, so that there would be no withdrawal effect, and so that any gains made during the study could be continued after completion of the study. Subjects wore the weighted belts at home with parental supervision, so that no stigma would be attached by use during school time, and so that use would not be observed by others the subject did not intend.

The Conners-3 AI-P was developed with a statistical Reliable Change Index (RCI) in order to demonstrate statistically meaningful change in symptom behavior over time or during interventions based on changes in raw scores or in *T*-scores. The RCI establishes a two-tailed Confidence Interval (with a liberal criterion of 90%) for the baseline score. In addition, the Conners-3 AI-P offers a possible result of Clinically Meaningful change, defined as when the *T*-score (probability score) falls below 55, where probability scores are not considered to indicate diagnostic significance.

This study was undertaken within the confines of the private practice of the investigator, Cranberry Counseling PC. No funding was obtained from any source for the study.

Children included in the study may have also been undergoing treatment of another type during this study, but initial AI-P ratings determined that their behavior continued to be symptomatic in order to participate in the study. Data about other interventions, such as medication, behavior management, or counseling, were not gathered. No change in other interventions was requested for participation. No parents reported any changes in other interventions. No change in other interventions was expected during the short one week duration of participation in the study.

Results

Each subject in the study had an initial AI-P *T*-score based on parent rating of greater than or equal to 90, the highest rating able to be obtained on the scale. Each subject was rated by their parent using the same AI-P while wearing a weighted belt, after daily use of the weighted belt for 15 to 30 minutes for a week. Initial AI-P scores were compared to AI-P scores while wearing the weighted belt after a week. An RCI (based on a two-tailed 90% Confidence

Interval) was used to determine significance of change between scores. The Conners-3 AI-P scores before and during use of the weighted belt are presented in Table 1.

Table 1

Conners-3 AI-P Scores Before [with 90% Confidence Interval] and During Weighted Belt Use

Subject	Age	Gender	Initial Score Raw / *T*-score		Score With Belt Raw / *T*-score [b]	Δ [a] Raw / *T*-score
1	8	Female	9	[6.12, 11.88]	8	1
			≥90	[83.84, 96.16]	89	1
2	13	Male	12	[9.12, 14.88]	2	10 [a]
			≥90	[83.84, 96.16]	53 [b]	37 [a]
3	10	Male	20	[17.12. 22.88]	5	15 [a]
			≥90	[83.84, 96.16]	71	19 [a]
4	9	Male	20	[17.12, 22.88]	15	5 [a]
			≥90	[83.84, 96.16]	≥90	0
5	10	Male	19	[16.12, 21.88]	0	19 [a]
			≥90	[83.84, 96.16]	45 [b]	45 [a]
6	7	Male	17	[14.12, 19.88]	0	17 [a]
			≥90	[83.84, 96.16]	14 [b]	76 [a]
7	8	Male	15	[12.12, 17.88]	12	3 [a]
			≥90	[83.84, 96.16]	≥90	0
8	7	Female	15	[12.12, 17.88]	14	1
			≥90	[83.84, 96.16]	≥90	0
9	8	Male	12	[9.12, 14.88]	0	12 [a]
			≥90	[83.84, 96.16]	43 [b]	47 [a]
10	11	Male	16	[13.12, 18.88]	5	11 [a]
			≥90	[83.84, 96.16]	68	24 [a]

[a] Statistically meaningful change as indicated by a Reliable Change Index (RCI), based on a 90% two-tailed confidence interval for baseline scores for the Conners-3 AI-P of 6.16 for *T*-Scores, and of 2.88 for Raw Scores. [b] Clinically Meaningful change is defined as when the *T*-Score (probability score) falls below 55 while wearing the weighted belt, where probability scores are not considered to indicate diagnostic significance.

Comparison of the AI-P scores before and during use of a weighted belt revealed that 8 of 10 subjects obtained Reliable Change Index (RCI) scores which indicated a significant decrease of their raw scores. This change indicated a significant reduction in symptom behavior, as rated by their parents. Also, 6 out of 10 subjects obtained Reliable Change Index (RCI) scores which indicated a significant decrease of their *T*-scores. These results indicated that wearing the weighted belt does produce a statistically significant decrease in ratings of ADHD symptoms, although not in all subjects. Four out of 10 subjects had no RCI change between *T*-scores. It would appear that if there is a benefit from wearing a weighted belt that the change is rather substantial, since the change in *T*-scores was from 3 times to 11 times the amount of change required to indicate an RCI (6.1 for *T*-scores). It would also appear that there can be no change as a result of wearing a weighted belt. In no case were symptoms rated as greater than baseline while wearing a weighted belt. Finally, 4 subjects actually obtained *T*-scores (probability scores) less than 55 as rated by their parents while wearing the belt after a week of daily use. This indicated a Clinically Meaningful change for those 4 subjects, where their probability scores were no longer considered to indicate diagnostic significance while wearing a weighted belt. This demonstrates the possibility of a dramatic reduction in symptoms of ADHD from wearing a weighted belt. Parent ratings represent real world assessments of what is acceptable in behavior from their children. The finding that four parents would change their rating of their child's behavior from the highest possible on the scale before intervention, to a rating that would not differentiate their child's behavior from the general population while their child is wearing the weighted belt after daily use for a week, is a meaningful result indeed. Weighted belt use may reduce symptoms of ADHD to a level below that of a clinical diagnosis for some children.

Discussion

This single case study was designed to measure the effectiveness of wearing a weighted belt in reducing symptoms of ADHD. The results indicate that 6 of 10 school-age children in the study had significantly reduced symptoms of ADHD as rated by their parents based on *T*-scores. Eight of 10 had significantly reduced symptoms of ADHD as rated by their parents based on raw scores. Given that all subjects had initial *T*-scores greater than or equal to 90, it would be highly likely for some downward drift to occur from these high ratings. However, in order to reach statistical significance, a Reliable Change Index (RCI) was required (based on a two-tailed 90% Confidence Interval established for the baseline score). Thus, smaller changes would not be considered significant.

The results also indicated that 4 out of those 6 school-age children in the study who experienced a significant reduction of symptoms also experienced a Clinically Meaningful change in *T*-scores, with ADHD symptoms as rated by their parents no longer considered to indicate diagnostic significance while wearing a weighted belt after a week. Given that these subjects had initial *T*-scores (probability scores) greater than or equal to 90, this is indeed a significant change from the top of the scale to a *T*-score less than 55.

Neither of the female subjects in the study demonstrated any significant change in the parental ratings of their symptom behavior as a result of wearing the weighted belt. One of these female subjects complained about poor fit of the weighted belt, which may have produced different results. Since only 2 of the 10 subjects were female, the sample size is too small to draw any justified conclusions based on sex of the subject.

It would appear from results that wearing a weighted belt can significantly reduce symptoms of ADHD, at least while wearing the belt. This was after daily use for 15 to 30 minutes for a week, a short intervention. It is unclear whether these results would be maintained over time, either with continued use of the weighted belt or after discontinuing use. It is unclear whether these results would be generalized to time when not wearing the belt. It is unclear whether continued use of the weighted belt would lead to increased gains in reductions of symptoms of ADHD, particularly for those subjects that did not demonstrate any improvement in the short one week intervention of this study. It is not clear whether the reduction of symptoms would be observed in a school setting, either with use of the weighted belt during school, or after use of the weighted belt. It is not clear from this study whether use of a weighted belt could lead to a reduction of the use of medications, or whether the use of a weighted belt would boost or supplement the effectiveness of other types of intervention. The encouraging results from this small short term study merit the consideration of other, larger, more complicated and more long term studies to examine such issues regarding the effectiveness of the use of a weighted belt in reducing ADHD symptoms. The design could be enlarged in the future to be a multiple group time series design with a continuous single treatment type. Group variables could potentially include sex of the subject, age of the subject, whether the subject is prescribed medication (and what type or amount), or whether the subject receives counseling or behavior management. ADHD Index measures could be obtained from a subject’s teacher. Data regarding subject demographics, or variable amounts of time the belt is worn could be studied. Other diagnostic methods could be included. However, the number of subjects required would be significantly increased.

The results from this study do not control for use of medication, type of medication prescribed, participation in counseling, or other behavior management intervention. Subjects were included based solely on their *T*-score (probability score of being diagnosed with ADHD) from parental rating of their symptom behavior, and information about other assessments or interventions was not obtained. All other interventions which were ongoing at time of initial rating were continued through the study, which spanned one week for each subject. It is unlikely that other interventions were responsible for the results obtained in this study. It is unclear what influence subject selection (or subject decision not to participate) had in the current study. It may be that certain individuals are open and receptive to an intervention such as wearing a weighted belt, and others are not. It is unlikely that parental ratings were influenced by expectations, as no expected change was necessarily predicted by the study. Indeed, parents and subjects were aware that the study was to determine whether there was any effect from wearing the weighted belts. Parent ratings of their children's behavior have been noted to be valid, reliable and stable. Change based on parent ratings should also be considered as valid, reliable, and meaningful. Also, while the Conners-3 AI-P is a simple 10 item questionnaire, it is not obvious how answers are translated into *T*-scores, and parents were not informed what scores their children initially obtained.

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