The Snug Vest’s Effects on Anxiety and Behaviour in Children with Autism Spectrum Disorder*

Abstract

Background Deep Pressure Therapy devices are widely used in the treatment of autism, yet little scientific evidence exists to support their effectiveness.

Purpose We tested the effects of an inflatable garment that applies pressure to the torso (the “Snug Vest”).

Method We conducted an ABAB withdrawal design to test the effects of the vest in 7 children (5-9 years-old) with Autism Spectrum Disorder. We compared treatment (“on-days”, wearing the vest inflated vs. “off-days”, wearing the vest deflated or not at all), and intervention time point (prior to, directly following, and after a delay).

Findings We found a significant interaction between treatment and time point for parents’ subjective ratings of attention and for salivary cortisol levels, and a significant effect of the vest on naïve coders’ ratings of problem behaviors. We found no effect on blood pressure or heart rate.

Implications These findings suggest that the garment can have beneficial effects on the functioning of some children with autism.

*Note: this study is pending publication
Purpose
The purpose of this research is to test the effects of the Snug Vest, an inflatable garment, that applies pressure to the torso on behavioural and physiological function using ABAB method.

Method
The study involved an ABAB withdrawal design to test the effects of the vest on 7 children with Autism Spectrum Disorder 5-9 years old. The study compares treatment on:

- **ON DAYS**: (wearing the vest inflated)
- **OFF DAYS**: (wearing the vest deflated or not at all)

and **intervention time points**.

Day 1    Day 2    Day 3    Day 4    Day 5
No vest   Inflated vest   Deflated vest   Inflated vest   No vest

Measures

1. **Parent questionnaires:**
   - Pre-session questionnaire
   - Pre-experiment questionnaire
   - Sensory profile
   - Vineland adaptive behaviours scale
   - Post-session phone questionnaire

2. **Physiological measures:**
   - **a. Salivary cortisol**
     Measured beginning of, end of, & 20 mins. following, each intervention period.
   - **b. Blood pressure**
     Measured beginning of, end of, & 20 mins. following, each intervention period.
   - **c. Heart rate**
     Continuous recording during intervention period.

3. **Behavioural observation:**
   - [Participants were video recorded during the intervention period.]
   - Two naive coders per child identified and coded a range of problem behaviours.

Intervention Session

The 20 minute intervention session comprised of 3 activities:

1. **Computer game**
   - Designed to challenge sustained attention (Continuous Performance Task).

2. **Card sorting game**

3. **Jigsaw puzzle**

Data Analysis
All data was entered into IBM SPSS statistics software, V.21 for analysis. Because many participants demonstrated elevated anxiety and behaviour problems on the first day, Day 1 data is excluded from analysis. Data analyzed using 2 x 3 repeated measures analysis of variance (ANOVA) with treatment (on-days, off-days) and time points.

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Results

1 Parent questionnaire

Mean parent rating of child's attention:

Parents indicated that their children were more attentive on “on” days (day 2&4) and less attentive on “off” days (day 3&5). Attention rating on a 7-point Likert scale.

We found a significant interaction between treatment and time point, such that parents indicated that their children were more attentive directly after and two hours following the intervention session on days when their children wore the vest inflated, but less attentive on days when their child wore the vest deflated or not at all.

— Kayla D. Ten Eycke

2 Physiological measures

a. Mean Participant Salivary Cortisol Levels:

Salivary cortisol levels (in nanograms per milliliter) decreased during intervention session and decreased post intervention, regardless of “on” & “off” days. There was a significant interaction between time point and treatment condition. Cortisol is a major glucocorticoid, produced in the adrenal cortex, which rises in response to stress.

b & c. Blood Pressure & Heart Rate:

No significant differences found
Naive Coders’ Ratings of Problem Behaviours:

Two naïve raters scored the frequency of participants’ problem and off-task behaviors over the intervention session. Based on a paired samples t-test with treatment (“on” & “off” days) as the independent variable, coders observed significantly more problem behaviors on “off” days (M = 5.4 SD = 3.1) compared to “on” days (M = 2.8 SD = 2.8), t(6) = 3.556, p = .012.

Discussion:

“Whereas the majority of previous studies have found no effect for deep pressure treatments, the present study provides tentative support for such treatment. ...To the best of our knowledge, this is the first study to use such a comprehensive set of assessments. Further research using extended treatment and more varied outcome measures is necessary to corroborate the current findings and ascertain their generalizability to real-life contexts.”

— Kayla D. Ten Eycke
Beta Trial Feedback
Study on Usability, Efficacy, and Performance of Snug Vest for Children with a range of disorders

Abstract

Background Prior to commercialization of Snug Vest, we gathered feedback for better understanding of product use and to make final improvements on product.

Purpose We gathered feedback on usability, efficacy, and performance of a Snug Vest - Deep Pressure vest.

Method We conducted a 28-day study in a real-life context: home or school-based setting, to collect data from 15 children (6-9 years old) with a range of disorders. An initial phone call was made with each caretaker prior to starting the trial. The children were instructed to fill out worksheet booklets and caretakers (parents, therapists, or teachers) filled in questionnaires for 4 weeks. On the 28th day, a phone interview was conducted for follow-up.

Findings The results show that most children benefited from using the Snug Vest. No major product changes were needed prior to commercialization.

Implications Feedback suggests that Snug Vest can be beneficial to reduce amount of time, and occurrences of symptoms experienced throughout the week. Due to small sample size, this beta study serves as a pilot for conducting larger clinical and efficacy testing in the future.
Purpose

To analyze if the vest was working as intended, find out the frequency of use, and extract information for how to improve the product. We wanted to test the vest in real-time environments including home with parents, classrooms with teachers, and therapy center with occupational therapists.

Method

Each participant was given a beta kit to complete the study. The beta kit consisted of:

- A beta Snug Vest & pump
- Instructions manual and CD
- Warranty sheet
- Worksheet booklet
- Stationery kit (marker, coloured pencils, post-its).

Caretakers including parents, teachers, and therapists were asked to fill out weekly questionnaires and worksheets with their children, followed by a phone interview as outlined in the 28 day schedule.

15 children participated in this study with a range of disorders. See below: 8 caretaker fully completed all 4 weekly questionnaires.

28 Day Schedule

The beta trial asked the caretaker/parent to fill out weekly questionnaires from Qualtrics. Children were asked to fill in worksheet booklets that gave us information on the efficacy and performance of Snug Vest. The booklet also included additional time logs, journals, and worksheets for reference.

<table>
<thead>
<tr>
<th>Week 1</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>A</th>
<th>4</th>
<th>B</th>
<th>5</th>
<th>6</th>
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<td>9</td>
<td>10</td>
<td>11</td>
<td>A</td>
<td>B</td>
<td>12</td>
<td>13</td>
<td>14</td>
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<tr>
<td>Week 3</td>
<td>15</td>
<td>16</td>
<td>17</td>
<td>18</td>
<td>A</td>
<td>B</td>
<td>19</td>
<td>20</td>
<td>21</td>
</tr>
<tr>
<td>Week 4</td>
<td>22</td>
<td>23</td>
<td>24</td>
<td>25</td>
<td>A</td>
<td>B</td>
<td>26</td>
<td>27</td>
<td>28</td>
</tr>
</tbody>
</table>

ASD: Autism Spectrum Disorder
SPD: Sensory Processing Disorder
ADHD: Attention Deficit Hyperactivity Disorder
FASD: Fetal Alcohol Syndrome Disorder
TS: Tourette’s Syndrome

Child with Parent
Child with Therapist
Child with Teacher

**5-13 years old**

- ASD
- SPD
- ADHD
- FASD
- TS
- NOT SPECIFIED

Purpose

Call was made to ensure beta kit was delivered and to set official start date.

Worksheet A

Worksheet A is filled out prior to, during and after inflating vest for maximum 20 mins.

Worksheet B

Worksheet B is filled out during inflation session.

Online questionnaire

Follow-up phone interview
Measures

1. **Usability**

Caretakers’ Questionnaire
Questionnaire was taken to determine if each component of the vest and pump were satisfactory.

2. **Efficacy**

a. Caretakers’ Questionnaire
Caretakers filled in questionnaire to see if child’s symptoms were better or worse each week.

b. Worksheet
Children circled how they felt prior to, during, and after 20 minute inflation session. Children also used orange pencil to colour areas of physical comfort, and used green pencil to colour areas of discomfort.

3. **Pressure performance**

a. Caretakers’ Questionnaire
Caretakers filled in questionnaire to determine how satisfied they were with pressure distribution of vest.

b. Worksheet
Child was shown a front and back view of child’s silhouette, where it sectioned off shoulders, chest, stomach, and sides. Child was asked how much pressure they felt and if it was enough pressure while wearing Snug Vest.

Results

1. **Usability**

Caretakers’ Questionnaire on 15 Snug Vest Features

On average, 12 features were “satisfactory” and 4 features including deflation tube whistle noise, pump, hood drawstrings, and hood were “not satisfactory”. On the commercialized Snug Vest 2013 version, we replaced the beta pump with a higher quality pump with faster inflation rate. We also eliminated the hood drawstrings for safety purposes and are looking for detachable hood options and alternative deflation tubes that are less noisy while retaining current fast deflation rate.

User Benefits

We asked caretakers if user benefited from wearing Snug Vest on the fourth week. **Most users benefited**, while a small portion of caretakers required more time to determine whether they will benefit from Deep Pressure.

<table>
<thead>
<tr>
<th>Very dissatisfied</th>
<th>Somewhat dissatisfied</th>
<th>Neutral</th>
<th>Somewhat Satisfied</th>
<th>Very Satisfied</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Inflation tube location</td>
<td>Dissatisfied</td>
<td>Neutral</td>
<td>Satisfied</td>
<td></td>
</tr>
<tr>
<td>2. Pump clipping mechanism</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Deflation tube location</td>
<td>Dissatisfied</td>
<td>Neutral</td>
<td>Satisfied</td>
<td></td>
</tr>
<tr>
<td>4. Deflation tube whistle noise</td>
<td>Dissatisfied</td>
<td>Neutral</td>
<td>Satisfied</td>
<td></td>
</tr>
<tr>
<td>5. Deflation tube ease of use</td>
<td>Dissatisfied</td>
<td>Neutral</td>
<td>Satisfied</td>
<td></td>
</tr>
<tr>
<td>6. Velcro shoulder adjustment</td>
<td>Dissatisfied</td>
<td>Neutral</td>
<td>Satisfied</td>
<td></td>
</tr>
<tr>
<td>7. Velcro side adjustment</td>
<td>Dissatisfied</td>
<td>Neutral</td>
<td>Satisfied</td>
<td></td>
</tr>
<tr>
<td>8. Use of Velcro</td>
<td>Dissatisfied</td>
<td>Neutral</td>
<td>Satisfied</td>
<td></td>
</tr>
<tr>
<td>9. Pump</td>
<td>Dissatisfied</td>
<td>Neutral</td>
<td>Satisfied</td>
<td></td>
</tr>
<tr>
<td>10. Hood</td>
<td>Dissatisfied</td>
<td>Neutral</td>
<td>Satisfied</td>
<td></td>
</tr>
<tr>
<td>11. Height of collar</td>
<td>Dissatisfied</td>
<td>Neutral</td>
<td>Satisfied</td>
<td></td>
</tr>
<tr>
<td>12. Hood drawstrings</td>
<td>Dissatisfied</td>
<td>Neutral</td>
<td>Satisfied</td>
<td></td>
</tr>
<tr>
<td>13. Chin guard</td>
<td>Dissatisfied</td>
<td>Neutral</td>
<td>Satisfied</td>
<td></td>
</tr>
<tr>
<td>14. Top shoulder strap</td>
<td>Dissatisfied</td>
<td>Neutral</td>
<td>Satisfied</td>
<td></td>
</tr>
<tr>
<td>15. Pockets</td>
<td>Dissatisfied</td>
<td>Neutral</td>
<td>Satisfied</td>
<td></td>
</tr>
</tbody>
</table>

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Efficacy

a. Parent Questionnaire

Symptom's Occurrences Throughout The Week

Based on parent's feedback, there were positive outcomes that show decrease in anxiety, tantrums, meltdowns, and tactile defensiveness occurrences throughout the weeks after starting the trial. There were neither positive nor negative results for imbalances and stimming.

Amount of Time Participant Experiences The Symptoms

The data shows that the amount of time children experience tantrums, and panic attacks decreased; while there were no positive nor negative changes in meltdowns, stimming, or self-injuries.
b. Child’s Emotions Prior to, During, and After Inflation Session (Worksheet A)

On Worksheet A, children were asked to circle different emoticons that corresponded to how they felt at the moment. In total, children had more positive emotions after inflating vest.

![Emotions Graph]

Positive emotions:
- Very happy, happy, comfortable/calm, excited, secure, relieved, focused.
Neutral emotions:
- Neutral, tired.
Negative emotions:
- Anxious, confused, angry, annoyed, bored, scatter-brained.

Pressure Performance

a. Parent Questionnaire on 6 Deep Pressure Benefits

On average, all 6 deep pressure benefits were “satisfactory”. Based on the questionnaires, participants were most satisfied with adjustable pressure levels. The least satisfying pressure benefit was pressure on shoulders.

<table>
<thead>
<tr>
<th>Very dissatisfied</th>
<th>Somewhat dissatisfied</th>
<th>Neutral</th>
<th>Somewhat Satisfied</th>
<th>Satisfied</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Evenly distributed pressure</td>
<td>Dissatisfied</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Adjustable pressure levels</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>3. Pressure on back</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Pressure on shoulders</td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>5. Pressure on sides</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. Minimal pressure on stomach and chest</td>
<td></td>
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</tr>
</tbody>
</table>

b. Pressure mapping (Worksheet B)

Out of the 3 children that completed this exercise, on average, all 3 mentioned that pressure was “just right” throughout sides, stomach, chest, upper and lower back regions. On average, pressure was “not enough” on the shoulders.

Shown on the right is an example of a child who filled out Worksheet B with their caretaker. Question 1 asked how much pressure the child felt and second question asked if pressure was enough.
In general, we received mostly positive feedback on usability, efficacy and performance of Snug Vest. We are happy to see that children with a range of disorders are benefiting from wearing the vest, not just limited to autism spectrum disorders. For areas where we received less satisfactory feedback, we have already improved on aspects of Snug Vest including: pump, instruction manual, and clear labelling. We hope to improve pressure on shoulders in the future. Due to the limited sample size, we believe that this study serves as a pilot for conducting larger clinical and efficacy testing in the future. With every Snug Vest we make, we truly hope that the vest will benefit all users.