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The effectiveness of weighted blankets on sleep and everyday activities – A retrospective follow-up study of children and adults with attention deficit hyperactivity disorder and/or autism spectrum disorder

Vedrana Bolic Baric^a, Sofie Skuthälla^b, Malin Pettersson^c, Per A. Gustafsson^d and Anette Kjellberg^a

^aDepartment of Health, Medicine and Caring Sciences, Linköping University, Linköping, Sweden; ^bHabilitation Services, Region Sörmland, Nyköping, Sweden; ^cWomens Health, Vrinnevi Hospital, Region Östergötland, Sweden; ^dChild and Adolescent Psychiatry, Center for Social and Affective Neuroscience, Department of Biomedical and Clinical Sciences, Linköping University, Linköping, Sweden

ABSTRACT

Background: Attention deficit hyperactivity disorder (ADHD) and Autism Spectrum Disorder (ASD) are often accompanied by sleep problems influencing social, emotional and cognitive functioning in everyday activities.

Aim: The aim of this study was to investigate whether the use of a weighted blanket has a positive impact on sleep and everyday activities in individuals with ADHD and/or ASD.

Material and methods: The study included 85 individuals diagnosed with ADHD and/or ASD, 48 children aged ≤ 17 (57%) and 37 adults ≥ 18 years (44%), who were prescribed with a weighted blanket. The participants responded via a telephone interview.

Results: Findings demonstrated that a weighted blanket improved abilities related to falling asleep, sleeping the whole night, and relaxing during the day. Using a weighted blanket improved morning/evening daily routine, including preparing/going to sleep and waking up in the morning.

Conclusions: Weighted blankets showed positive impact on falling asleep, sleeping the whole night, and relaxing during the day, and they were used frequently by children and adults with ADHD and/or ASD. Findings indicate that a weighted blanket improved morning/evening routine, however this research area needs further investigation using both subjective and objective parameters.

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Introduction

Attention-deficit hyperactivity disorder (ADHD) and Autism Spectrum Disorder (ASD) are among the most prevalent ‘neurodevelopmental’ disorders and share an early onset, often coexist and are associated with overlapping symptoms including difficulties with executive function, social relationships, communication and comorbid conditions [1–4]. In addition, both diagnoses are frequently associated with a variety of sleep problems. Sleep problems are prevalent in around 25–55% of children and adolescents [5], 43–80% of adults with ADHD [6] and tend to be even higher among individuals with ASD, occurring in up to 45–86% [7,8].

The broad term ‘sleep problems’ in this study was defined as incorporating both behavioural difficulties,

such as bedtime resistance, as well as diagnosable sleep disorders (e.g. insomnia), diagnosed by e.g. the Diagnostic and Statistical Manual of Mental Disorders (DSM-5) [9]; and the International Classification of Sleep Disorders (ICSD) [10]. Earlier studies reporting on sleep problems for both children, adolescents and adults with ADHD or ASD include a wide range of sleep problems including, longer sleep onset latency, night awakenings, poorer sleep efficiency, lower sleep quality, decreased total sleep time, bedtime resistance, night awakenings and significantly higher daytime sleepiness compared with their peers [11–15]. Studies have also reported on diagnosable sleep disorders common in children, adolescents and adults with ADHD or ASD classified into insomnias, parasomnias, sleep-related breathing disorders and sleep related movement disorders [11], including,

CONTACT Vedrana Bolic Baric  vedrana.baric@liu.se  Department of Health, Medicine and Caring Sciences, Linköping University, Linköping, Sweden

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obstructive sleep apnoea, restless legs syndrome, periodic limb movement disorder and sleep-disordered breathing [6,16–18]. Sleep problems have been consistently related to a variety of social, emotional and cognitive functioning, including cognitive difficulties (e.g. increased problems with attention, short-term and working memory) [19–22], emotional and behavioural problems [21,23–27] and quality of life (QoL) [28–30].

Among individuals with neurodevelopmental disorders, however, there is little knowledge of how sleep problems influence everyday activities in education, home, and work. To date, research focusing on sleep and everyday activities among individuals with ADHD or ASD have mostly focused on school aged children aged 5–14 years [31], relying either on parents' or teachers' reports of the relationship between sleep problems or daytime sleepiness and school/academic functioning. Together these findings show that sleep problems negatively impact multiple aspects of school/academic functioning among children with ADHD, including school grades, social and emotional functioning in the classroom, classwork completion in school and homework [23,32,33]. Less focus has been given to the academic performance of adolescents/young adults with ADHD or ASD (up to the age of 17–30 years) and adults [31]. Studies focusing on sleep and everyday activities in adolescents with ADHD or ASD report excessive daytime sleepiness which predicted the number of D and F grades (i.e. poor and failing) that students received [34,35]. Challenging behaviours in daytime functioning have been reported and include negative mood, irritability, self-injury, and aggression [36–38].

The occupational therapy literature has primarily focused on sleep in typically developing children [39,40], military veterans [41,42], adults with acquired brain injury [43], older adults [44–47] and children and adults with mental health disorders and neurological impairments [48,49]. Furthermore, although it is widely acknowledged within occupational therapy that sleep is essential to the performance of everyday activities and health, little attention has been paid to sleep and restorative activities within the literature, with current categories of activities and/or occupation excluding sleep [48–50]. Earlier studies on interventions targeting sleep problems among children and adults with neurodevelopmental disorders and individuals without disabilities show that a variety of non-pharmacological and behavioural interventions promote sleep quality. These include sensory integration-based measures such as music therapy, massage,

tactile stimulation exercises, and weighted blankets [51,52]. Also, interventions aimed at modifying the sleep environment through selection of pillows that slow physiological and cognitive processes might improve sleep quality [53]. Furthermore, supporting individuals to create and maintain healthy sleep hygiene routines and nutrition routines might influence sleep positively [54,55].

Sensory-integration based interventions, such as the application of deep pressure simulation (DPS) using weighted blankets or vests, are commonly used interventions targeting sleep among individuals with neurodevelopmental disorders [51,52]. The underlying theory behind sensory-integration based interventions such as the use of weighted blankets is that deep pressure and consistent sensory input provided by weighted items reduces the body's physiologic level of arousal and stress, which might improve sleep [56,57]. The evidence to support the efficacy of using weighted items is scarce. Studies on the effectiveness on using weighted vests report limited evidence of improvement in school participation among children with ADHD or ASD [58] including on-task behaviour [59,60], attention [61] and a variety of behaviours such as in-seat behaviour [62], repetitive/stereotypic behaviour and aggression [63]. Most of the earlier studies on the effects of weighted blankets have focussed on measuring the overall quality of sleep among children with ADHD or ASD [51,52,64]. Weighted blankets have been reported to produce a calming and relaxing effect when lying down for children with ADHD or ASD [56,65]. These studies show limited evidence for the use of weighted blankets to improve sleep quality (sleeping for a longer period of time, falling asleep faster, and/or waking up less) [51,52,66]. Nevertheless, this intervention is favoured by children and parents with ASD [67], as well as adults [68], and is a safe intervention to use [64].

There are several weighted blankets available adding extra weight through the use of chain links built into the interior of the blanket together with padding for comfort [69]. Other weighted blankets use plastic balls to add weight [70]. There are also different weights available, ranging from 4 to 14 kilograms of excess weight. Despite the importance of sleep being highlighted in occupational therapy as a prerequisite for activity, participation, wellbeing and health [49], most of the above-mentioned studies focus on investigating the daytime functioning symptoms relating to behaviour and cognition, with very few studies investigating the effect of using weighed blankets on everyday activities at home, in school or work among

individuals with ADHD and/or ASD. Hence, the aim of the present study was to investigate whether the use of a weighted blanket may have a positive impact on sleep and everyday activities in children, adolescents, and adults with ADHD and/or ASD.

Method

Study design

A retrospective study was performed of 48 children ≤ 17 years of age and 37 adults ≥ 18 of age who were prescribed a weighted blanket *via* three child and adult Habilitation Centres (HCs) in Central Sweden between January 2012 and December 2015.

Participants

All participants were retrieved from the records of the local 'Hjälpmedelscentral' (i.e. the assistive technology centre). The list included personal security numbers and addresses of all individuals who were prescribed a weighted blanket between January 2012 and December 2015 by an occupational therapist. In Sweden, habilitation centres offer counselling, support and treatment to children, young people, and adults with disabilities throughout the country. Medical equipment and assistive technologies for people with disabilities are prescribed by publicly financed services and administered by local 'Hjälpmedelscentral'. Individuals were eligible for inclusion in this study if they were prescribed a weighted blanket due to sleep problems and diagnosed as having ADHD (ICD-10) and/or ASD (ICD-10). The participants were diagnosed in accordance with the ICD-10 by physicians [71].

Procedure

A total of 227 individuals were identified by the local 'Hjälpmedelscentral'. All 227 potential participants and their guardian(s) (if participant was younger than 18 years), received a cover letter explaining the purpose of the study, and which stated that data collection meant that they would be phoned and asked to take part in a semi-structured interview on their use of their weighted blanket, sleep and everyday activities. Potential participants and/or guardians were phoned and asked to participate. Of the potential participants, 89 individuals (39%) did not answer the phone, 38 individuals (17%) declined to participate in the study, nine individuals stated that they did not use a weighted blanket. Participants were contacted

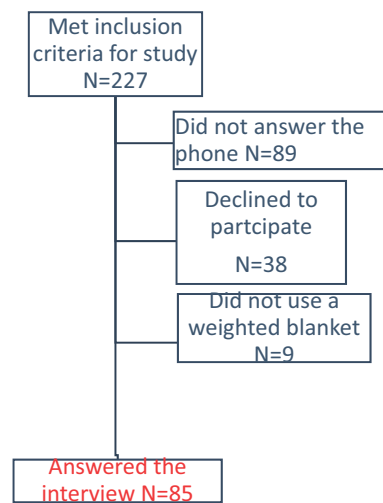


Figure 1. Study flow chart.

three times, on different days during the week, both during the day and evening before they were excluded from the study. Furthermore, six participants were excluded due to having Mild intellectual disabilities ($n=2$), Major depressive disorder ($n=3$) and Mixed receptive-expressive language disorder ($n=1$) based on ICD-10 (71). Therefore, the final sample consisted of 85 individuals who responded to the telephone interview (see Figure 1), giving a response rate of 37%. Ethical approval for this study was granted by the regional ethics committee (Dnr 2014/197-37) and verbal consent of the participants and guardian (if participant was younger than 18 years) was obtained over the phone before starting the interview.

Semi-structured interview

A regional evaluation initiative with the aim of evaluating prescribed weighted blankets for children and adolescents up to 18 years [72] was further developed for the aim of the present study investigating effectiveness of weighted blankets, sleep and everyday activities in children and adults. The interview comprised of 15 questions of which eight were based on the structure and categories of the International Classification of Functioning, Disability and Health (ICF) domains [73]: body functions and activities and participation (Table 1). The questions were mostly Yes/No questions where participants were asked to explain their choice by using follow-up questions and probing questions. The first question asked for the name and age of the person being interviewed. The second question focused on body functions, especially (b134) sleep functions, with three sub-questions covering reason for use of the weighted blanket including prolonged onset of sleep (b1341), short amount of

Table 1. An overview of the questions in the semi-structured interview based on the ICF.

ICF domain	ICF category	ICF code	Example of sub questions
Question 2	Body functions Sleep functions (b134)	Onset of sleep (b1341) Amount of sleep (b1340) Maintenance of sleep (b1342)	<i>'Why did you start using the weighted blanket?'</i> a) <i>Due to difficulties falling asleep/ prolonged onset of sleep</i> b) <i>Difficulties sleeping through the night</i> c) <i>Difficulties relaxing during the day</i>
Question 3 & 4	Activities and participation General tasks and demands (d2)	Carrying out daily routines (d230)	<i>'Do you perceive that using the weighted blanket has influenced your morning/evening routines?' If yes, please give examples on how.</i>
Question 5	Activities and participation Self-Care (d5)	Toileting (d530) Dressing (d540) Eating (d550)	<i>'How has the weighted blanket influenced your evening routines?' Please give examples.</i> a) <i>Preparing/eating dinner</i> b) <i>Going to sleep</i> c) <i>Sleeping through the night</i>
Question 6 & 7	Body functions Activities and participation Sleep functions (b124) Self-Care (d5)	Quality of sleep (b1343) Dressing (d540) Eating (d550) Education (d810–d830) Work and employment (d840–d850)	<i>'How has the weighted blanket influenced your morning routines?' Please give examples.</i> a) <i>Wakening/going up</i> b) <i>Eating breakfast</i> c) <i>Going to school/work</i>
Question 8	Activities and participation Mobility (d4) Domestic life (d6) Community, Social and Civic life (d9)	Walking and moving (d450–d469) Moving around using transportation (d470) Household tasks (d630–d640) Recreation and leisure (d920)	<i>'How has the weighted blanket influenced your afternoon routines?' Please give examples.</i> a) <i>Going home from school/work</i> b) <i>Doing household chores (cooking, dishes, laundry)</i> c) <i>Engaging in leisure activities</i>

sleep (b1340), and difficulties in maintaining sleep (b1342). The third and fourth questions focused on activities and participation in the ICF [73], specifically how the use of the weighted blanket influenced carrying out daily routines (d230) in the morning and evening. The fifth question focused on self-care (d5) activities during evening activities and asked how the use of the weighted blanket influenced evening routines including preparing/eating dinner (d550) and activities related to preparing for going to sleep (b530–d550) as well sleeping through the night (b1343). The sixth and seventh questions focused on self-care activities during the morning including how the use of the weighted blanket influenced morning routines including eating breakfast (d550), dressing (d540) and getting to school (d810–830) or work and employment (d840–d850). The eighth question focused on activities after school/work and included four sub-questions covering how the use of the weighted blanket influenced getting from school or work (d810–d850) by either walking (d450) and/or using transportation (d470), such as driving (d475). Furthermore, the eight-question focused on how the use of the weighted blanket influenced domestic life (d6) such as performing household chores (cooking, dishes, laundry; d630–d640) and engaging in recreation and leisure activities (d920). The ninth to eleventh questions focused on frequency of use (every night/several times a week/once a week/once a

month/never), as well as activities performed using the weighted blanket including watching tv, reading books, listening to music or relaxing. The 12th and 13th question focused on pharmacological treatment and if the use of the weighted blanket had influenced the amount of medicine taken or if medication had been stopped. Questions 14–15 focused on satisfaction with the prescription process including information received in connection to prescription as well as the follow up on use. Data from the questions 12–15 are not reported in the current study.

The interview was administered over the phone (ranging between 5 and 15 min). For adults some sub-questions were altered to cover work and employment (second and third authors) on printed score sheets. Information that appeared in addition to the questions asked was noted as comments.

Statistical methods

Differences between the participants were analysed using a chi-squared test with statistical significance set at $p < 0.05$. Where cell size was below five, Fisher's exact test was used [74]. Statistical analyses were carried out using IBM SPSS Statistics 25.

Table 2. Description of the participants' diagnosis at time of prescription of a weighted blanket, *n* (%).

	ASD	ASD + ADHD	ASD + behavioural/ Mental disorders ^a	ADHD	ADHD + behavioural/ Mental disorders ^a
Children (≤ 17 years of age) 48 (56.5)	2 (12.5)	11 (50.0)	1 (12.5)	29 (90.6)	5 (71.4)
Adults (≥ 18 years of age) 37 (43.5)	14 (37.8)	11 (50.0)	7 (87.5)	3 (9.4)	2 (28.6)
TOTAL 85 (100)	16 (87.5)	22 (25.9)	8 (9.4)	32 (37.6)	7 (8.3)

^aIncludes comorbid disorders such as Tics disorder, Obsessive-compulsive disorder, specific developmental disorders of speech and language, Phobic anxiety disorders, Mood affective disorders.

Results

Characteristics of the participants

The total sample consisted of 85 individuals, 43 males (50.6%) and 42 females (49.4%), aged 7–17 ($n = 48$, 56.5%), 18–30 ($n = 23$, 27.1%) and 31–59 years ($n = 14$, 15.4%). Significantly more children aged 7–17 years were male (66.7%) compared with adults (29.7%) aged 18–59 years, while more females were adults (70.3% vs. 33.3%; $p < 0.05$). Participants diagnosed at time of prescription of weighted blanket are displayed in Table 2. When comparing children with adults aged > 18 years, findings show that significantly more children were diagnosed with ADHD (90.6% vs. 9.4%), while more adults were diagnosed with ASD (37.8% vs. 12.5%; $p < 0.05$).

Analysis of response bias between participants in the present study and non-respondents regarding age, sex, type of blanket, weights used and number of years using the weighted blanket revealed that 42.4% of non-respondents were 18–30 years and 30.2% were 31–59 years of age, which is a significant difference between respondents ($p < 0.00$). No differences between gender, type of weighted blanket used or number of years using the blanket were evident between participants and non-respondents.

Type of blanket and reasons for use

The participants in this study either used a chain-weighted blanket (85.9%) or a ball-weighted blanket (12.9%). Participants used a 5–6 kg chain-weighted blanket (43.5%), or an 8 kg chain-weighted blanket (34.1%), or a 7 kg ball-weighted blanket (12.9%). Eighty percent of the participants had used the weighted blanket between 1 and 3 years and 20% between 4 and 6 years. No differences between children (≤ 17 years) and adults (> 18 years) were evident concerning type of weighted blanket, weight used or number of years using the weighted blanket.

Participants started using their weighted blanket due to difficulties falling asleep (81.2%), difficulties sleeping the whole night (65.9%), and difficulties relaxing during the day (10.6%). Significantly more adults (18.9% vs. 4.2% of the children) used a

weighted blanket due to difficulties relaxing during the day ($p < 0.05$). Eighty-nine percent of the total sample reported that using a weighted blanket improved the three stated reasons for starting to use a weighted blanket (difficulties falling asleep/sleeping the whole night /relaxing during the day). Significantly more children (68.8% vs. 45.7%) stated that using a weighted blanket improved their ability to fall asleep ($p < 0.05$).

Frequency of use

Seventy-eight percent of the total sample used the weighted blanket every night, and 24% used the weighted blanket during the day for activities such as watching TV (11.8%), reading/listening to music/books (3.6%), and relaxing during the day (12.9%).

Significantly more adults (37.8%) stated that they used the weighted blanket during the day compared with 12.5% of the children ($p < 0.05$). Of those participants that used a weighted blanket for watching TV, significantly more were children ($p < 0.05$), while significantly more adults (71.4% vs. 16.7%) used weighted blankets for relaxing during the day ($p < 0.05$).

Weighted blanket and daily activities

Almost half of the participants (45.8%) in the total sample said that using a weighted blanket improved their daily routines, especially during the evening and in the morning (see Table 3). Of the total sample 59% stated that using a weighted blanket improved preparing/going to sleep, with a significant difference between children and adults (68.8% vs. 45.7%; $p < 0.05$). Of the total sample 81% stated improvements in sleeping through the night when using a weighted blanket. A quarter of the total sample (26.5%) said that using a weighted blanket improved waking up in the morning, and 16.5% stated that using a weighted blanket improved performance of activities at work or in school/education.

Table 3. Weighted blanket use and daily activities.

	Total sample (n = 85) N (%)	Children (≤ 17 ; n = 48) N (%)	Adults (≥ 18 ; n = 37) N (%)	P (children vs adults)
Overall improvement in daily routines	38 (45.8)	18 (37.5)	20 (57.1)	ns
<i>Evening routines</i>				
Preparing/eating dinner	1 (1.2)	1 (2.1)	0 (0)	ns
Preparing/Going to sleep	49 (59.0)	33 (68.8)	16 (45.7)	<0.05
Sleeping through the night	67 (80.7)	36 (75.0)	31 (88.6)	ns
<i>Morning routines</i>				
Wakening/going up	22 (25.9)	15 (31.3)	7 (20.0)	ns
Eating breakfast	6 (7.2)	5 (10.4)	1 (2.9)	ns
Going to school/work	6 (7.2)	4 (8.3)	2 (5.7)	ns
Going home from school/work	3 (3.6)	2 (4.2)	1 (2.9)	ns
Activities in school/work	14 (16.9)	5 (10.4)	9 (25.7)	ns
Doing homework/work related tasks at home	6 (7.1)	3 (6.3)	3 (8.6)	ns
Leisure activities	5 (6.0)	2 (4.2)	3 (8.1)	ns

Discussion

The overall findings demonstrated that 59% of children and adults with ADHD and/or ASD stated that using a weighted blanket improved their ability to fall asleep, confirming the results of other studies, which showed positive trends towards an increase in total amount of sleep per night, as well as a slight decrease in time to fall asleep [66]. This is particularly important as insufficient sleep has a crucial impact on performance in daily activities such as education, activities of daily living, work, play, leisure, and social participation [51,52]. However, it is possible that these findings are related to a perception of improved sleep brought about by improved sleep hygiene consisting of a set of behavioural, environmental, or cognitive modifications to improve sleep (i.e. modification of bedtime and bedtime routines, restriction of electronic media use, restriction of caffeine use, modifications to bedroom or sleeping environment), which are often the first-line treatment recommendations [75,76]. Nevertheless, it is reasonable to assume that the weighted blanket had a positive impact on participants' sleep in the current study as 80% of them had chosen to use the blanket for one to three years, and 81% of the participants described improvements in sleeping better throughout the night. Future research should compare weighted blanket interventions with other sleep hygiene interventions, to describe the inter-relatedness among these interventions. It is also of importance to investigate further the positive trend towards improved sleeping during the night and going to bed described by the participants in the current study, using objective measures of sleep (e.g. polysomnography, actigraphy), as the results in this study were based on subjective measures.

In the present study, the weighted blankets were frequently used by 78% of the participants every night

for several years, indicating that weighted blankets were favoured by participants, in line with earlier studies reporting overall satisfaction with using weighted blankets [66–68]. Gringras et al. [67] reported that children with ASD really liked using the weighted blanket compared with a regular blanket, and Lindstedt and Umb-Carlsson [68] described that weighted blankets were highly valued by adults with ADHD. Despite being a frequent intervention to address sleep problems for individuals with ADHD or ASD favoured by the participants in this study as well as within earlier research [66–68], and the frequency of occupational therapists' recommendation for this intervention [57,66], there is a lack of evidence documenting the effectiveness of this intervention on daily activities among children, adolescents, and adults with ADHD and/or ASD. The current study adds to the body of knowledge on weighted blanket use related to the daily activities of children and adults with ADHD and/or ASD. Although subjective support for weighted blanket use exists from parents, caregivers, and children and adults with ADHD or ASD, it would be beneficial for occupational therapy research to strive to apply robust research designs to evaluate the effectiveness of this intervention on everyday activities, as highlighted by Green [48] and Tester and Foss [49], using more objective, and validated measures of sleep. This is especially important as current systematic reviews [52,57,75] report on narrow sampling methodology, small sample sizes, and low-level designs in the small number of studies on the effectiveness of weighted blankets. In addition, scrutinizing the routines concerning the process of prescribing weighted blankets among adults is urgent, as this study indicated that more children are prescribed weighted blankets compared with adults.

The current study shows that only 17% of the participants described improved performance of activities

at work or in school/education with the use of a weighted blanket. These results are in part similar and in part contrary to the results of Gringras et al. [67] and Gee et al. [66] which examined daytime behaviours of children with ASD. Gringras et al. [67] reported that parents of children with ASD described an improvement in next-day behaviours, especially that their child's behaviour was calmer when using the weighted blanket: a finding that the authors hypothesize might be due to improved bedtime behaviours or improved parent/child interactions. In contrast, Gee et al. [66] reported that the morning mood of children with ASD does not appear to improve with use of a weighted blanket. The inability to report on improved everyday behaviour was partly explained by the authors as being due to three factors: persistent patterns that represent learned behaviour for which sleep might be only a partial determinant, the need to examine behaviour throughout the day in school or work in order to find subsequent changes in functional behaviour, and the need to include objective measures of everyday behaviour. A possible explanation for our result showing a small improvement in performance of activities at work or in school/education among participants brought about by weighted blanket use might be related to the lack of use of reliable and validated measures of activities of daily living in relation to weighted blankets. Furthermore, using research designs incorporating observation in everyday settings such as school and/or home might provide relevant insights into daily morning/evening routines, as well as potential influence on school and work-related activities. Further studies need to explore the interrelation between weighted blanket use and aspects of improvement at work and/or school/education (e.g. on-task behaviour, attention-to-task, social, emotional, and communication skills and task completion) using reliable and validated measures of everyday activities. A quarter of the total sample, significantly more adults, used the weighted blanket during the day due to difficulties relaxing. This finding is supported by earlier studies on weighted vest use during school/education tasks, showing that weighted vests improve in-seat behaviour, attention-to-task, and task completion in children with ADHD in a classroom environment [57–63,77]. Further studies need to examine the use of weighted blankets during the day for relaxation, especially among adolescents and adults to establish their effectiveness in improving performance in work and/or school/education.

The findings indicate that morning and evening routines, such as preparing/going to sleep reported by 59% of the participants and waking up in the morning reported by 26% of the participants, may be improved with the use of a weighted blanket. These findings are in line with the results of Gee et al. [66] suggesting that children with ASD slept between 1 and 3 extra hours a night as a result of using a weighted blanket, as well as decreased duration needed to fall asleep, indicating that weighted blankets can assist in improving overall sleep quality for children with autism spectrum disorder. Furthermore, a recent review article on the use and effectiveness of weighted blankets suggests that weighted blankets can be effective in reducing or relieving anxiety and improving evening routines [57]. Improvements in preparing/going to sleep and waking up in the morning with the use of a weighted blanket reported in the current study are particularly significant considering the findings of van der Heijden et al. [25] which show that adults with ADHD more often have an extreme evening chronotype with 70% of adults reporting difficulties with getting to bed at night and getting up in the morning Boonstra et al. [78], suggesting a delayed phase in the circadian organization of sleep and wakefulness [25]. In addition, individuals with ADHD and ASD had later sleep onset during weekdays (around 30–45 min later in ADHD and ASD than in controls), and young people with ASD woke up earlier than controls despite a later sleep onset time [25]. Earlier studies on children with ADHD have also studied the importance of establishing morning and evening routines independently within set time, indicating a need for interventions targeting morning and evening routines [79]. Whether the improved evening and morning routine findings in the current study are due to differences in sleep patterns, reduced anxiety and/or improved sleep hygiene (e.g. behavioural, environmental, or cognitive modifications to improve sleep) remains unknown. Future studies using different measurements including subjective experiences, validated report scales, sleep logs, and objective measures (actigraphy or polysomnography) should shed further light on which evening and morning routines (e.g. anxiety, sleep onset latency, total amount of sleep time or bedtime routines) are improved in participants with ADHD and/or ASD.

There are methodological strengths of this study. Given the importance of sleep in daily activities, the consequence of disrupted sleep in individuals with ASD or ADHD is potentially serious for health and

wellbeing. To date, however, the knowledge about the relationship between sleep problems and everyday activities in individuals with ASD or ADHD is limited. This current study adds to the body of research on weighted blankets and children and adults with ADHD and/or ASD in three distinct ways. First, this study included a more heterogeneous sample, by including adults with ADHD and/or ASD, than early research which has largely focussed on examining sleep in children with ASD [75,80]. Second, the inclusion of adults with ADHD and/or ASD adds to the modest body of research on adults and weighted blanket interventions. As our data demonstrated, use of a weighted blanket varied between children and adults, with children using the weighted blanket consequently every night and adults using the weighted blanket during the day. Finally, only two earlier studies [64,66] have focussed on weighted blankets to improve daily activities or target everyday behaviour as an outcome measure. The current study sheds further light on the morning/evening routines (such as 'preparing for sleep' or 'getting up in the morning', as well as everyday functioning of children and adults with ADHD and/or ASD using weighted blankets, aspects of everyday routines which have not usually been measured [49,81].

However, this study also has limitations. First, assessments were based on subjective reports on the use of a weighted blanket and influence on sleep. Although the study derives from an interview based on the ICF [73] and is tested in an earlier study [72], using validated and reliable questionnaires of daily activities, such as the Weiss Functional Impairment Rating Scale (WFIRS-S-SWE) [82], would have strengthened our findings. The assessment of children's everyday activities took place through parents' reports, however it is not possible to establish if parents were fully aware of bedtime routines of their children once in their bedroom, such as evening media use, which could influence sleep. Second, this study used subjective reports of sleep difficulties, as opposed to an objective measure of sleep, such as actigraphy, which would allow for measurement of day-to-day variations in sleep problems, in contrast to a retrospective account of weighted blanket use, which introduces the possibility of fallible memories on the part of the participants. It is also possible that the findings are related to parents' desire to see improvement in their children's sleep or a desire to please the study team by reinforcing widely held beliefs about weighted blankets, as suggested by Gringras et al. [67]. Third, there was a drop-out rate in the study: a

total of 136 individuals, dropped out partly due to 38 possible participants declining to participate, and partly because 89 individuals did not answer the phone. Therefore, caution should be employed in generalizing the results. Further studies are urged with preferably a randomized control study design. Analysis of response bias revealed that 40% of the non-respondents were adults (18–30 years and 31–59 years), which might indicate that adults stopped using the weighted blanket and were less satisfied with weighted blanket use. Although low response rates of 50% or lower might be considerable as acceptable [74], the 40% in the present study presents a considerable risk for biases. Efforts to achieve a higher response rate including establishing contact to set a time for the interview prior to conducting the telephone interviews, and sending or emailing the questions in advance, would have been beneficial in line with recommendations [74]. Face-to face interviews in which visual cues and flexible strategies, such as the participants' vocabulary could be used, represents an alternative to telephone interviews. However, this study is one of the few studies on the use of weight blankets among adults with ADHD and/or ASD who have sleep problems, adding to the documented need for further research in the field [76,80].

Disclosure statement

No potential conflict of interest was reported by the author(s).

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