Blunden et al., J Sleep Disor: Treat Care 2013, 2:3
http://dx.doi.org/10.4172/2325-9639.1000115

Journal of Sleep Disorders: Treatment & Care

Research Article A SCITECHNOL JOURNAL

Development of a Short Version of the Dysfunctional Beliefs about Sleep Questionnaire for use with Children (DBAS-C10)

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Abstract

Background: Dysfunctional beliefs about sleep (DBAS) contribute to sleep problems. There is urgent need to develop a questionnaire addressing these beliefs in children. We aimed to develop and assess the psychometric properties of a short version of the DBAS for use with children (DBAS-C10), adapted from the previous child and adult versions.

Methods: Data were collected in 134 year 6/7 students [mean (SD) age = 12.73 y (.09y)] who completed the DBAS-C10 twice, either before and after a sleep education intervention (*n*=91) or before and after curriculum as usual (*n*=43). Exploratory factor analysis and validity testing were undertaken.

Results: Three factors emerged (1) Beliefs about the immediate negative consequences of insomnia (items 1;6;7;9) (2) Beliefs about the long-term negative consequences of insomnia (items 2, 3;5;8) (3) Need to control the insomnia (items 4;10). In effect, only one difference from the adult factor structure resulted, item 2 moved from short term consequences to long term consequences of insomnia. Internal consistency of the scale was good (0.71), and the test retest reliability (when the questionnaire was completed 5-7 weeks apart) suggested consistency of responses. The questionnaire showed small sensitivity to change post intervention.

Conclusions: This scale has acceptable psychometric properties and could be used to investigate dysfunctional beliefs in children and potentially detect changes in sleep related cognitions in children in treatment interventions.

Keywords

Children; Cognitions; Sleep, Insomnia; Sleep education; Questionnaire; Measure

Introduction

Cognitive-behavioural models of insomnia describe dysfunctional beliefs about sleep as important in the aetiology and maintenance of insomnia [1,2]. An individual's belief about sleep can result in the development of unhelpful sleep behaviours. For example, the assumption that chronic poor sleep will have serious physical consequences, might lead to excessive worry about the continuous loss of sleep, resulting in efforts to stay in bed longer to recuperate lost sleep and as a consequence, extending the time spent in bed or the 'normal sleep window'. This is not necessarily beneficial, as lying in bed 'trying to sleep", is in itself an unhelpful sleep practice and can result in the opposite effect, that is, less sleep. Interactions of faulty beliefs, excessive worry and resultant sleep behaviours such as these, can result therefore in a real sleep deficit [1].

In adult poor sleepers, the Dysfunctional Beliefs and Attitudes about Sleep (DBAS) scale [3] and shorter versions [4,5] have been useful in assessing maladaptive cognitions in order to better understand how they can impact on sleep patterns. When dysfunctional cognitions about sleep are known and then challenged, this can result in improvement in sleep patterns. Indeed, changes in some dysfunctional beliefs occur in response to Cognitive Behavioural Interventions for Insomnia (CBT-I) and are also associated with other insomnia related improvements [6,7].

An extensive evidence base for these cognitions has been established in young and older adults, however it is difficult to extrapolate these results to children. Adult data may not be relevant to children [8] and this is particularly the case as certain cognitive abilities, self-assessment and self-introspection mature with time [9]. Hence extrapolating adult findings to children may not be appropriate. For example, poor physical health as a consequence of insomnia may not be as important to children and adolescents as it appears to be for adults [10]. In a series of papers [10-13], the possibility that cognitive factors may also correlate with childhood sleep disturbances has been explored. In one of these papers, the DBAS was adapted for use with children (DBAS-C) [12] – although the authors noted that further, more systematic, adaptation of this measure may improve the measure. In particular, simplifying and shortening the scale to improve understanding, maintain attention and reduce participant burden, as well as ensuring age-appropriateness of all items was deemed valuable.

A short version of the DBAS-C could be beneficial in large epidemiological and community-based research studies therefore we sought to develop a short version of this scale. Furthermore, it may be helpful to assess if a new short version of the DBAS for children might be sensitive to intervention. In children, there are no studies that have assessed if dysfunctional beliefs are amenable to change after intervention whether it is psycho-education or more involved CBT-I for children. The opportunity arose to undertake this work on a large participant group from study of sleep in children and adolescents that was already underway.

Materials and Method

First, we decided on the age group of focus in our study. We focused on children aged 9 years and above as it has been shown that children from this age are capable of self-report and introspection [9].

Adaptation of the DBAS-C into a shorter version consisted of three stages.

Stage 1: Preliminary adaptation (as reported in Gregory et al. [12])

The original adult 30-item version of the DBAS [3], which rates

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Received: December 26, 2012 **Accepted:** June 06, 2013 **Published:** August 10, 2013

each item using a 100-mm Visual Analogue Scale (strongly disagree – strongly agree) was used as a basis for the development for children of the DBAS –C24 item scale undertaken by Gregory and colleagues in 2009. Whilst keeping the scale as close to the original as possible, team members with previous experience working with children and developmentally appropriate assessment, had suggested that changes should be made with regards to 1) simplifying language (e.g. 'irritable, depressed or anxious' was replaced with 'annoyed, sad or worried') 2) defining concepts (e.g. after 'I know that I will have to pay for it on the following night' they added 'by not being able to sleep so well') and 3) excluding inappropriate items (i.e. four items addressing the use of sleeping pills, medicine, alcohol and dying during sleep).

This validation of the DBAS–C for children (24 item version), which is explained in detail elsewhere [12], was undertaken in 123 8-10 year old children (49% boys; 65% participation rate). The children were from mixed ethnic backgrounds: the largest proportion (20%) of those completing the form assessing ethnicity described themselves as African; with the second largest proportion describing themselves as White British (16%). The state-run schools recruited to participate in the study were in deprived areas of London (Gregory et al. [12] for further information about the study sample). The internal consistency of the total DBAS scale was reasonable (alpha = .76) and this scale was associated with self-report and parent-report sleep disturbances in children aged 8-10 years [12]. Furthermore, there was some degree of specificity, with sleep disturbances being predicted by certain subscales of the DBAS questionnaire (e.g. the control and predictability of sleep subscale) but not others (e.g. the sleep requirements expectations subscale).

Stage 2: Changes to ensure age-appropriateness

That initial adaptation of the DBAS into the DBAS–C measure was important for providing a starting point for assessing links between sleep difficulties and dysfunctional beliefs about sleep in children, and for generating interest in this topic. However, in their paper, the authors suggested that further revisions may be necessary. Therefore, the current revisions were proposed to improve on and maximise applicability to this age group. Accordingly, changes were made to content, length, sentence construction, semantics and response format.

This was done in three ways: teleconference focus group, feedback from research workers previously using DBAS-C and discussions within the working group (SB, MC, AG). The developed DBAS-C10 was also presented to children for comment.

Teleconference focus group discussion: Individual clinicians and researchers with experience in treating and/or researching children's sleep from the University of Glasgow Sleep Centre and Central Queensland University, (Appleton Institute of Behavioural Science) participated in a teleconference focus group, suggesting a number of revisions for an adapted scale.

Length of scale: There was concern that the 24 item scale was too long for children [14] and that developing a shorter version may, due to decreased participant burden, be more appropriate for use with young people. Espie et al. [4] have previously developed a revised ten-item short form (DBAS-10) for use with adults showing a similar robust principal component structure to the original adult version. The items for the DBAS-10 were selected because they were regarded as the most discriminatory in showing treatment effects over time and were representative of common dysfunctional beliefs – that is, misconceptions and consequences of poor sleep [4]. In that scale, there were three derived subscales, with satisfactory internal consistency and the measure showed treatment-related sensitivity.

Therefore when investigating how to develop a shorter version of the DBAS-C, it was decided to use the same ten items utilised for the Espie et al. [4] which had been successful in discriminating dysfunctional beliefs in adults [4]. Subsequently, those 10 corresponding items were identified on the children friendly DBAS-C24 item version [12] (1, 2, 5, 7, 8, 10, 11, 15, 19 and 20) for inclusion in the DBAS-C10. This strategy guarded as much as possible the psychometric integrity of both previous measures, in order to tap into the same constructs while simultaneously capitalising on wording changes from the previous adaptation for use in children [12].

Content and wording based on the DBAS-C: After this, the 10 items were extracted from the DBAS-C to be used as a basis for further adaptations attention was then turned to semantics and content of the scale. To be in concordance with what is considered age-related sleep requirements (>9hrs for adolescents and between 10-12 hours for pre adolescents [15] changes were made to the minimum sleep need item ("I need 8 hours of sleep to feel refreshed and do well during the day"). The item was changed to: "I must have at least 9 hours of sleep to function well or do well during the day". This latter phrase is not only less subjective in interpretation, but by adding "at least" also takes into account the individual variation in sleep needs in children and young people allowing therefore use in larger age groups. As it could be perceived that this statement may not be significantly dysfunctional, we added a superlative adjective –"always"- to indicate that this amount of sleep was imperative (e.g. "I must always have at least 9 hours sleep…"). Similar additions were made to other items (e.g., item 3 "I am really worried that difficulty falling or staying asleep over a long period of time…..").

Some of the other items were not deemed age-appropriate as they might not be a concern of young children and adolescents. Gregory et al. reported data on catastrophising in children that reflected they were more concerned about impact in the nearer future of sleep problems on physical appearance, rather than long-term health concerns as seen in adult samples. Therefore the item regarding serious consequences on physical health was changed to physical appearance [12].

Lastly, any phrases alluding to what could be classified as having a poor night's sleep ('chronic insomnia', 'not sleeping well', 'not getting a proper night's sleep' etc.) were all changed to 'not getting the sleep I need' to make this consistent across all items and easier for this age group to understand (Table 1).

Feedback from research assistants (Response format): A further issue considered was the use of the visual analogue scale response format. Thought was given to the age range and optimal method of eliciting responses based on two reviews of instrument design and development [14,16]. In addition we contacted six Psychology graduates who had all been involved in the original DBAS-C study [12] who had not only administered the DBAS-C to the participants but also other tasks, some of which employed numbers rather than visual analogue scales. Five of the six graduates who received this request for information responded. They were asked individually for feedback on the use of the visual analogue scale used for the DBAS-C measure. The graduates were asked: "To what extent do you think

the children were comfortable using the line response scale in order to indicate their response?" Four of the five graduates suggested that the children needed some explanation with that format (the final respondent thought that even with explanations, the children did not appear to know what they were doing).

After discussion, all five of the graduates thought that children preferred using numbers as compared to the visual analogue scale. It was decided therefore to utilize a number scale.

Child-generated changes: In order to enable usage of this questionnaire in the target age range, children themselves were asked to comment on the scale. Eight youth aged 9-14 years (mean age 12.2 years – 4 males, all of Anglo Saxon ethnicity and in public schooling) known to colleagues of the first author, were invited to participate. Evaluation followed procedures for qualitative evaluation of questionnaires with a short annotated feedback questionnaire based on DeWalt et al. guidelines [16]. The aim was not to elucidate opinion on inclusion of specific items but rather to assess potential difficulties with comprehension of the novel DBAS items and wording and to ask participants (a) if the scale was understandable (b) if there were any additional items needed or (c) if they had any further comments about the scale. According to that evaluation, the questionnaire was well understood by all age respondents (100%) with the majority 6/8 (75%) confirming the items reflected their existing beliefs with no further comments suggested. Therefore based on the findings of this evaluation, no further adaptations were made to the scale. With our inclusion of qualitative and quantitative methods, and having constructively sought input from professional and enduser groups, we believe that we have utilised more sophisticated methodologies than the previous children's version insuring the best possible age appropriate scale. The final version of the scale is presented Appendix 1.

Stage 3 -validation and reliability of the DBAS–C10

The final version was trialed as part of a larger randomised control trial of the Australian Centre for Education in Sleep (ACES) sleep education program [17],which aimed to assess and improve sleep knowledge, sleep duration and sleep patterns in pre- adolescent children. Details of the program content are published elsewhere [18]. This scale was included in the assessments for that study to assess beliefs about sleep in this age group and as a secondary aim, to evaluate if sleep education would change these beliefs. In order to capture a diverse socio–economic sample, twenty schools were randomly selected across tertiles of all high (tertile 1) middle (tertile 2) and low (tertile 3) income brackets and from public and private schools, in metropolitan Adelaide, South Australia. The first six schools agreeing to participate with their year 6/7 class were included in this study. Schools were then randomly allocated to the education program (Intervention group, n=4) or control group (*n*=2). A total of 244 questionnaires were distributed to 7 classes in six schools, with 134 agreeing to participate (return rate 55%). Sample demographics are presented in Table 1. The intervention group completed the DBAS-C10 at baseline during first class of the day (T_1) and again at the same time after the delivery of the 4 week sleep education program 5-7 weeks after baseline (T_2). At T_2, two children declined to participate in the study (and therefore did not complete the DBAS-C10). The control group completed the scale at two time points corresponding to the intervention group.

Table 1: Descriptive summary of demographic characteristics for DBAS-C10 trial.

Characteristic	Time 1	Time 2
N (Total)	131	129
% (N) Control	32% (42)	42
% (N) Intervention	67% (89)	87
Return rate	55%	55%
Mean age Range	12.80 11-14y	12.66 11-14y
% (N) Females	57% (74)	58% (75)
Number of schools in each tertile*	2 in tertile 1 3 in tertile 2 1 in tertile 3	2 in tertile 1 3 in tertile 2 1 in tertile 3

NB * tertile rankings are a measure of socio-economic status (SES) utilised by the South Australian Education Department and the Australian Bureau of Statistics with 1 being the lowest and 3 the highest (SES)

Statistical Analyses

Scores for all respondents were calculated from summing scores for each item to make a total score (the higher the score, the more dysfunctional the belief) and were subsequently utilised to assess validity at T_1. At follow up, T_2 control participant's scores (*n*=44) were used to assess test-retest reliability and intervention participant's scores; (*n*= 89) were used to assess whether scores on the DBAS-C10 changed as a result of intervention (sensitivity to change). Mixed model analyses were utilised to assess changes for each item score pre and post sleep education delivery (time), across control versus intervention (group). Internal consistency was tested with Chronbach's Alpha reliability and sensitivity to change tested with mixed model analyses. Power calculations (Cohen's *d*) suggested a need for a sample size of 20 to have 80% sufficient power at a level of significance of 0.05 to test sensitivity to change after the sleep education intervention with student t-tests. An exploratory factor analysis was undertaken. Firstly, a Kaiser – Meyer –Olkin Measure of Sampling Adequacy were used to assess the adequacy of the sample size, and the factor structure was evaluated with Rotated Factor Matrix using Principal Axis Factoring and Varimax with Kaiser Normalization coupled with observation of the Scree Plot. Statistical software IBM SPSS Version 19 for Window was utilised for statistical analyses.

Results

DBAS-C10 Reliability

Factor Analysis of the DBAS-C10: Kaiser – Meyer –Olkin Measure of Sampling Adequacy suggested an adequate sample for factor analyses (KMO =0.976; $p = 0.000$).

Based on the Component Transformation Matrix and observation of the Scree plot and the component transformation matrix, a three factor structure was explored which was slightly different from the original factor structure proposed by Espie et al. [4].

The original factor structure for the DBAS-10 (adult version) was

Factor 1: Beliefs about the immediate negative consequences of insomnia (items 1;2;6;7;9)

Factor 2: Beliefs about the long-term negative consequences of insomnia (items 3;5;8)

Factor 3: Need to control the insomnia (items 4;10).

Using Principal Axis Factoring and the Varimax rotation method with Kaiser Normalisation in 3 iterations three similar factors were extracted with Eigenvalues > 1. The only difference was that Item 2, "*When I don't get the sleep I need on a particular night, I must catch up the next day by napping or by sleeping longer the next night*" which loaded onto Factor II rather than Factor I (Table 2).

The three factor structure accounted for 53.38% of the cumulative variance with Factor accounting for 21.54%, an additional 18.71% for Factor II and Factor III a further 13.13%.

The means and distributional characteristics of DBAS-C10 scores were investigated and all were evenly distributed. Descriptor values for the total scale score were investigated by calculation of a coefficient (Cronbach's alpha) at T_1. Chronbach's alpha for the total scale was adequate at 0.71. Internal consistency for Factors I and II were 0.65 and .061 respectively. Given that Factor III only had two items and consistent with Espie et al. [4] who did not undertake this analysis on only two items, Chronbach's alpha was not calculated for Factor III.

At T_2, (5-7 weeks after baseline), scores from control participants were analysed for test–retest reliability with mixed model analyses for each individual item. Results suggested that while some group x time interactions were statistically significant, in general, responses remained relatively stable over time with differences between T_1 and T_2 of 0.5 (range 1.0-5.0). Four items showed less consistent responses [Items 2 -5] with differences ranging from 0.6 - 1.0 (Table 3). When grouped into factors, Factor 1 slightly decreased, Factor 2 slightly increased and Factor 3 was overall unchanged. The effect size (for differences of 0.5) is 0.31(CI= 0.13 to 0.48) suggesting the effect sizes for all of these differences were small.

When testing for sensitivity to change in the intervention group, there were few differences between T_1 and T_2. When grouped into factors, Factors 1 and 2 overall increased and Factor 3 remained unchanged (Table 3). Similarly the effect sizes for all of these differences were generally small.

Discussion

This paper describes the adaptation of the DBAS for use in children primarily aged 9-14 years but with the potential to be used for older paediatric age-groups and broaden its appeal. The scale was adapted and shortened from a previous children's version [12], then evaluated through a consensus approach with sleep and psychology researchers who have worked with children and was readjusted accordingly. A small group of children commented on the final version and then this final version was validated on a group of 134 youths. Results suggest that the DBAS-C10 proved to be an instrument with good content validity and a robust factor structure. Sensitivity to change after a sleep education intervention was inconsistent with some positive trends which may be clarified with further evaluation. These findings indicate that the scale may be useful in these age groups to determine cognitions around sleep.

Table 2: Rotated Factor Matrix using Principal Axis Factoring and Varimax with Kaiser Normalization showing three principal factors.

	Factor 1	Factor 2	Factor 3
Item 1	.744	-.016	-.028
Item 6	.751	.231	.089
Item 9	.631	.213	.195
Item 7	.461	.317	-.022
Item 2	.379	.581	-.050
Item 3	.195	.472	.418
Item 5	.245	.625	.020
Item 8	-.040	.784	.133
Item 4	.388	-.220	.695
Item 10	-.179	.237	.767

Factor 1: Beliefs about immediate negative consequences
Factor 2: Beliefs about long-term negative consequences
Factor 3: Need to control insomnia

Of interest, some items in the control group showed significant changes over time, although effect sizes were small. When grouped into factors, Factor I decreased, Factor II increased and Factor III showed the most decrease (Table 3). It is unclear why these responses showed inconsistencies but reasons may be a normal regression toward the mean, that the test re-test time interval was too long, that the children were randomly answering questions, or that the items themselves did not target a clear construct. Given that the items were based on a similar longer version with similar validity, this latter explanation would seem unlikely. It is worth considering that these small and subtle changes in scores, whilst statistically significant, may not be clinically meaningful, especially given the small effect sizes. Larger samples may assist with this understanding.

Similarly, responses after the sleep education intervention did not consistently decrease dysfunctional beliefs. It should be noted that the use of the DBAS-C10 was opportunistic and was utilised during an ongoing project which was not specifically aimed at decreasing dysfunctional beliefs about sleep. Therefore, as the sleep education program was aimed at improving sleep patterns and although we inadvertently expected dysfunctional beliefs to reduce, the program did not specifically target these beliefs and thus this may explain any lack of difference (e.g items 4 and 10). In fact as both Factors 1 and 2 increased (although only slightly), this may be a reflection that responses were more informed at T_2. For example in question 1 ("I must always have at least 9 hours sleep to function well or do well during the day."), participants agreed with this statement more at T_2. It could be argued that participants, who had been instructed during the sleep education program that 9 hours sleep is necessary for their age group, were actually responding 'more correctly' at T_2. Furthermore, after teaching a child that insufficient sleep is associated with negative daytime sequelae, it may not be 'dysfunctional' to worry about how much sleep an individual gets, or that they are not getting what they have been instructed is 'enough'. It must be noted that the addition of the word "always" in that item (I must always have at least 9 hours sleep to function well or do well during the day) was included to maximise perception of dysfunctionality but that this subtlety may not have been detected by these young participants. The items in this DBAS-C10 were based on both adults and children validated versions. Perhaps as suggested in the adult literature [4], future adaptations may include more extensive evaluations by paediatric sleep experts to rate the extent to which they believe the DBAS items/statements are actually dysfunctional or maladaptive in nature at these ages. Perhaps the lack of change after intervention may suggest that children are modelling beliefs about sleep on those of their parents and given that the intervention was targeted only at

Table 3: Mean (SD) results of mixed model analyses comparing DBAS-C10 scores between groups (control vs intervention) before and after intervention (time) groups. All scales range: 1= Strongly Disagree – 5 = Strongly agree – mean 2.5.

Item	Item	Control (C)		Intervention (INT)		Significance and results
Factor 1 Beliefs about immediate negative consequences		T_1	T_2	T_1	T_2	Group x Time *
1.	I must always have at least 9 hours ……..	3.6 (.16)	3.3 (.16)	3.6 (.11)	4.0 (.11)	ns
6	When I don't get the sleep I need, …… the things that I do the next day.	3.7 (.15)	3.3 (.15)	3.7 (.10)	3.9 (.10)	Group * Group x time *
7	When I feel annoyed……. it is always because I didn't get sleep I needed the night before.	3.1 (.16)	2.7 (.16)	2.9 (.11)	3.0 (.11)	Group x time *
9	When I feel tired,……, it is always because I didn't get the sleep I needed the night before.	3.4 (.17)	3.2 (.17)	3.5 (.11)	3.2 (.11)	Time *
Mean Total Factor 1		3.4 (.26)	3.0 (.31)	3.3 (.32)	3.4 (.44)	ns
Factor 2 Factor 2: Beliefs about long-term negative consequences						
2	When I don't get the sleep I need on a particular night, I must catch up the next day …….	3.3 (.17)	3.1 (.28)	3.4 (.35)	3.5 (.49)	Group x Time **
3	I am really worried that difficulty …… might affect my physical appearance.	2.5 (.17)	3.2 (.17)	2.5 (.12)	2.7 (.12)	Time **
5	When I have trouble getting to sleep, it makes me worry …..to sleep.	2.3 (.17)	3.3 (.17)	2.0 (.12)	2.1 (.12)	Group ** Time** Group x Time **
8	When I don't get the sleep I need …… disturb the way I sleep for the whole week.	2.5 (.17)	3.0 (.17)	2.2 (.11)	2.7 (.11)	Time ***
Mean Total Factor 2		2.6 (.46)	3.1 (.12)	2.5 (.61)	2.7 (.57)	Group** Time** Group x Time**
Factor 3 Factor 3: Need to control insomnia						
4	When I have trouble getting to sleep, I should stay in bed and try harder.	3.5 (.17)	2.6 (.17)	3.7 (.12)	3.7 (.12)	Group ** Time** Group x Time **
10	When I have lots of thoughts at night, I …….. cannot control all these thoughts that I am having.	3.2 (.17)	3.0 (.17)	3.1 (.11)	3.1 (.12)	ns
Mean Total Factor 3		3.3 (.21)	2.8 (.28)	3.4 (.42)	3.4 (.42)	Group* Time* Group x Time*

NB * = p=0.05 ** = p <0.01***p<0.001.

the children, beliefs did not change. This is a supposition and needs to be clarified in future studies.

A final reason for inconsistent responses over time may be that sleep education could target beliefs about consequences (Factors I and II), whereas issues with controllability of any sleep disorder (Factor III) might require more intense cognitive work. As addressing issues with controllability was not a part of this program this may explain the findings (eg. for Factor III).

Limitations of the study include the uneven sample size between intervention and control groups, the low participation/return rate and potentially the sample size of the pilot sample (n=8). Further studies with larger samples sizes are currently ongoing. A final limitation is that this measure was not validated against other measures assessing sleep problems in children and adolescents. Reliability and validity of the DBAS-C10 was not tested prior to this study given that the opportunity arose to utilise the scale during an ongoing project. Future studies are aimed at addressing this issues and clearly validating the DBAS-C10 against the DBAS-C.

Despite these limitations, this study has advanced understanding of assessing dysfunctional beliefs about sleep in children and it is expected that this information can be used to form the basis of further study. Given the published effectiveness of the DBAS measures for understanding the development/ maintenance/ treatment of sleep problems in previous studies [3,4,12], developing a shorter user friendly measure for use with children holds significant promise for taking forward the paediatric sleep field. Indeed, even prior to publication, four international teams have requested information about this measure and it has been utilised in the ongoing sleep education trial in Australia. Utilising this scale in larger samples, across cultures and in broader age groups would now be recommended to increase its usefulness in paediatric sleep research and clinical domains.

Acknowledgements

Alice M. Gregory was supported by a Leverhulme Research Fellowship during this study. The authors thank Louise Hood, members of the STEPS Team, University of Glasgow Sleep Centre; Hayley Etherton, Gabby Rigney and John Petkov. This study was in part financially supported by the Australian Research Council and SA Health Department.

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