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Teensleep

Pilot report and executive summary

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Independent evaluators:

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Durham
University



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This project was funded as part of the Education and Neuroscience scheme, which was jointly funded by the Wellcome Trust and the Education Endowment Foundation and launched in January 2014. The aim of the scheme was to provide funding for collaborative projects between educators and neuroscientists to develop evidence-based interventions for use in the classroom, or to rigorously test existing tools and practices.



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Executive summary

The project

Teensleep aims to improve students' sleep, with the long-term aim of improving educational attainment. The project involves teachers delivering a series of 10, half hour lessons highlighting the importance of sleep for effective learning as well as providing practical guidance, such as avoiding caffeine in the evening, that students can use to improve their sleep. Teachers receive detailed resources to support this and a half day training for a lead teacher to help them use the resources who then cascades the training to other teachers in their school. All teachers were invited to attend the training if they had time. The project targets teenagers as their biological clocks put them at risk of sleep problems.

The aim of the evaluation was to establish whether the intervention: showed evidence of promise by improving students' sleep; was feasible to deliver; and was ready for an impact evaluation. All children in Year 10 (aged 14-15) were included in this project, but students with a history of sleep problems were excluded from the detailed sleep monitoring. Ten secondary schools (1,504 pupils) took part. The trial took place between September and December 2016.

The University of Oxford's Sleep and Circadian Neuroscience Institute developed Teensleep as part of a round focused on Neuroscience co-funded by The Wellcome Trust and the EEF.

Key conclusions

1. There was no evidence that Teensleep improved students' sleep as measured using a wrist-worn activity monitor before and after the intervention. The absence of a comparison group, and high dropout amongst pupils, reduces the security of this finding.
2. Students' self-reported sleep-related behaviours improved, in particular, daytime napping reduced, and students' knowledge of sleep hygiene increased.
3. All schools reported delivering the full programme. The time available for cascading training was limited, but teachers reported that the well-structured resources meant this was not a major issue.
4. Teachers and students were enthusiastic about Teensleep and felt it could be incorporated into their school's curriculum, following refinements to reduce some repetitive content and make the lessons more interactive.
5. The collection and analysis of sleep data was challenging. There was variation in how students used the wrist worn activity monitors and in how researchers interpreted the data. In both cases further piloting might help to ensure consistency before an impact evaluation.

What are the findings?

There was no evidence that Teensleep improved students' sleep measured using a wrist-worn activity monitor before and after the intervention. However, some students who participated in focus groups reported that they made behavioural changes as a result of the programme. Napping frequency reduced post-intervention with 47% of students reporting taking a nap pre-intervention in comparison to 31% post-intervention. Small improvements were observed in students' self-reported sleep quality, daytime sleepiness and alertness, but the mean score on the post-test sleep hygiene behaviours questionnaire was stable. Students' self-reported sleep knowledge improved pre- to post-intervention.

Teachers responded very positively to the training, both initial training by the project delivery team, and cascade training within their school. Some teachers thought the training led by the project delivery team could have been condensed with a reduced emphasis on sleep science. Not all schools managed to provide time to dedicate to cascading the training and preparing staff for delivering the programme,

however staff noted that this was offset by the programme's high-quality resources. All schools reported delivering all Teensleep lessons within the autumn term, although due to timetabling challenges some schools opted for different delivery models to the proposed weekly 30-minute lesson. Some schools provided shorter and more frequent sessions, while others opted for a more condensed delivery. Despite these structural changes the replicability of the information within Teensleep lessons appeared to be high.

Further work is needed before Teensleep is ready for an impact evaluation due to the challenges of measuring and analysing sleep. The sleep data collection tools used were time consuming and burdensome for students. Those taking part in data collection found it challenging and there was variable compliance with the data collection protocol, particularly actigraphy. Further, some schools did not comply with the protocol for recruiting students to the subgroup. In particular, there were suggestions of teacher selection of students. Issues were also identified relating to the coding and entry of actigraphy data, which is important to consider for any future evaluations.

How was the pilot conducted?

The evaluation of the programme adopted a mixed method approach. Sleep data, to assess the evidence of promise, was collected by the developers through actigraphy, sleep diaries, sleep surveys and a quiz of students' knowledge about sleep.

An independent process evaluation was simultaneously conducted to assess the programme's feasibility and readiness for trial. This involved observing teacher training and lesson delivery, as well as teacher interviews, teacher surveys and student focus groups. Participating schools volunteered and were not randomly sampled. All Year 10 students took part in Teensleep lessons and a sub-group participated in sleep monitoring through the use of actigraphs and sleep diaries.

Summary of pilot findings

Question	Finding	Comment
<i>Is there evidence to support the theory of change?</i>	No	There was no evidence that Teensleep improved students' sleep. However the student questionnaires only collected limited data on very poor sleep, so future research could focus on the sub-group of poor sleepers.
<i>Was the approach feasible?</i>	Yes	All schools reported delivering all lessons within the programme with fidelity.
<i>Is the approach ready to be evaluated in a trial?</i>	Mixed	Acceptability and fidelity of Teensleep was high. Further development and refinement of sleep data collection tools and methods are required due to high attrition among other issues.

Introduction

Intervention

Oxford Teensleep is a sleep education programme (OTS programme) developed by the University of Oxford's Sleep and Circadian Neuroscience Institute (SCNi). The programme was designed to provide sleep education to 14–16-year-olds (Years 10 and 11) in state secondary schools in England through an interactive lesson package delivered by teachers. The content aimed to educate students on sleep science, sleep hygiene, and stress management and how these factors can influence academic performance and general wellbeing.

The OTS programme consisted of ten lesson plans which could either be delivered as ten half-hour lessons or five hour-long lessons during form time or Personal, Social, Health and Economic education (PSHE) lessons. Schools could choose the delivery schedule of the programme and whether to teach the lessons during form or PSHE time. The lessons, as detailed in Table 1, were designed to:

- be interactive, discursive and self-reflective;
- introduce the scientific theory and facilitate discussion of the impact at an individual level; and
- end with a focus on the students and their own sleep.

The material focused on the importance of sleep for learning and memory but also covered how sleep impacts on emotion, health, creativity, and sports performance. Although there were 'do and do nots' in the sections on sleep hygiene, lessons reverted to the theory and asked students to focus on what impact poor sleep hygiene (for example, using your phone in bed) might have on their sleep and how that would make them feel in terms of the theory (for example, broken sleep resulting in reduced reaction times and poorer sports performance).

Table 1: OTS lessons and aims

Title		Aims
<i>At the end of each lesson, students will be able to...</i>		
1	What is sleep?	Describe what sleep is; recognise the difference between good and poor sleep.
2	Why is sleep important?	Summarise the important role sleep plays in their lives; identify the effects of poor sleep.
3	The body clock and sleep drive	Talk about what controls when we sleep and how it changes in teenagers; say whether they are an 'early bird', a 'night owl', or someone in-between; discuss how the timing of their alertness has changed from aged ten to now.
4	Sleep scheduling	Work out their own sleep schedule; use sleep scheduling to improve their sleep; list things that can change how they sleep.
5	Lifestyle and sleep	Recognise lifestyle factors which can influence sleep.
6	Light and sleep	Understand the impact of light and sleep; tell someone how electronic devices can disrupt sleep.
7	Creating a sleep haven	Assess the sleep-friendliness of their bedroom; create a link between their bed and sleep.
8	Thoughts and emotions at bedtime	Identify thoughts and emotions which might interfere with sleep; practise breathing exercises to relax.
9	Managing the racing mind	Recognise and work on restructuring unhelpful thoughts; practise progressive muscle relaxation.

10	The sleep-friendly routine	Practise thought-blocking to deal with repetitive thoughts; practise a visualisation tool to reduce mental alertness at night; plan a bedtime routine to help sleep.
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In order to deliver the OTS programme, teachers received a number of resources and a comprehensive half-day training session, all developed and led by the project delivery team. The half-day training session was held on-site within each school and led by two researchers from the project delivery team. Each school was required to release a minimum of two teachers to attend the training. It was expected that teachers who attended this training would subsequently cascade it to other staff members who would be delivering the programme (depending on whether all staff who would deliver the programme had attended the initial training); this was without facilitation from the project delivery team but supported by relevant training resources such as PowerPoint slides. In addition to the training, teachers received a resource booklet (hard copy) to guide the structure and delivery of each lesson alongside PowerPoint slides. Students also received a handbook (hard copy) which included information and activities to be completed during each lesson. The aim of the student handbook was to encourage students to reflect on their behaviours. In addition to these materials, the project delivery team developed and provided parents with a short pamphlet to encourage their child's engagement with the programme and support any behaviour change the students might choose to implement as a result. The project delivery team also offered staff access to an online sleep improvement programme designed for adults (Sleepio) that was previously developed by the project team's Principal Investigator. This appears to have been intended to encourage teachers in developing a personal interest in the topic, but this was not a formal part of the programme.

The programme was delivered to Year 10 pupils during the autumn term of 2016.

Background evidence

In adolescence, biological rhythms change in such a way that it is difficult for adolescents to go to sleep and get up early. Therefore, a teenager waking up at 7am to start school at 9am is akin to asking a 55-year-old to get up at 5am: this leads to a significant amount of sleep deprivation. This sleep deprivation interacts with biological rhythms, creating a period of low energy and tiredness which lasts into mid-morning (Crowley *et al.*, 2007). The biological predisposition for delayed sleep in adolescence is exacerbated by a more relaxed societal attitude to bedtimes, 24/7 access to social media, and abnormal light exposure from a range of electrical devices. Many adolescents now have devices in their bedrooms (tablets, phones) that emit a low-level light in the blue wavelength which has been shown to have a direct, alerting effect on the biological clock which may interfere with the process of going to sleep (for example, Cajochen *et al.*, 2006). Studies have shown that using technology, such as e-readers, in the hour prior to sleep can delay the expression of the 'sleep hormone' melatonin (Chellappa *et al.*, 2013). Pupils are also dealing with the stress of exams and are unaware of the importance of sleep and the effects of sleep deprivation (Curcio *et al.*, 2006).

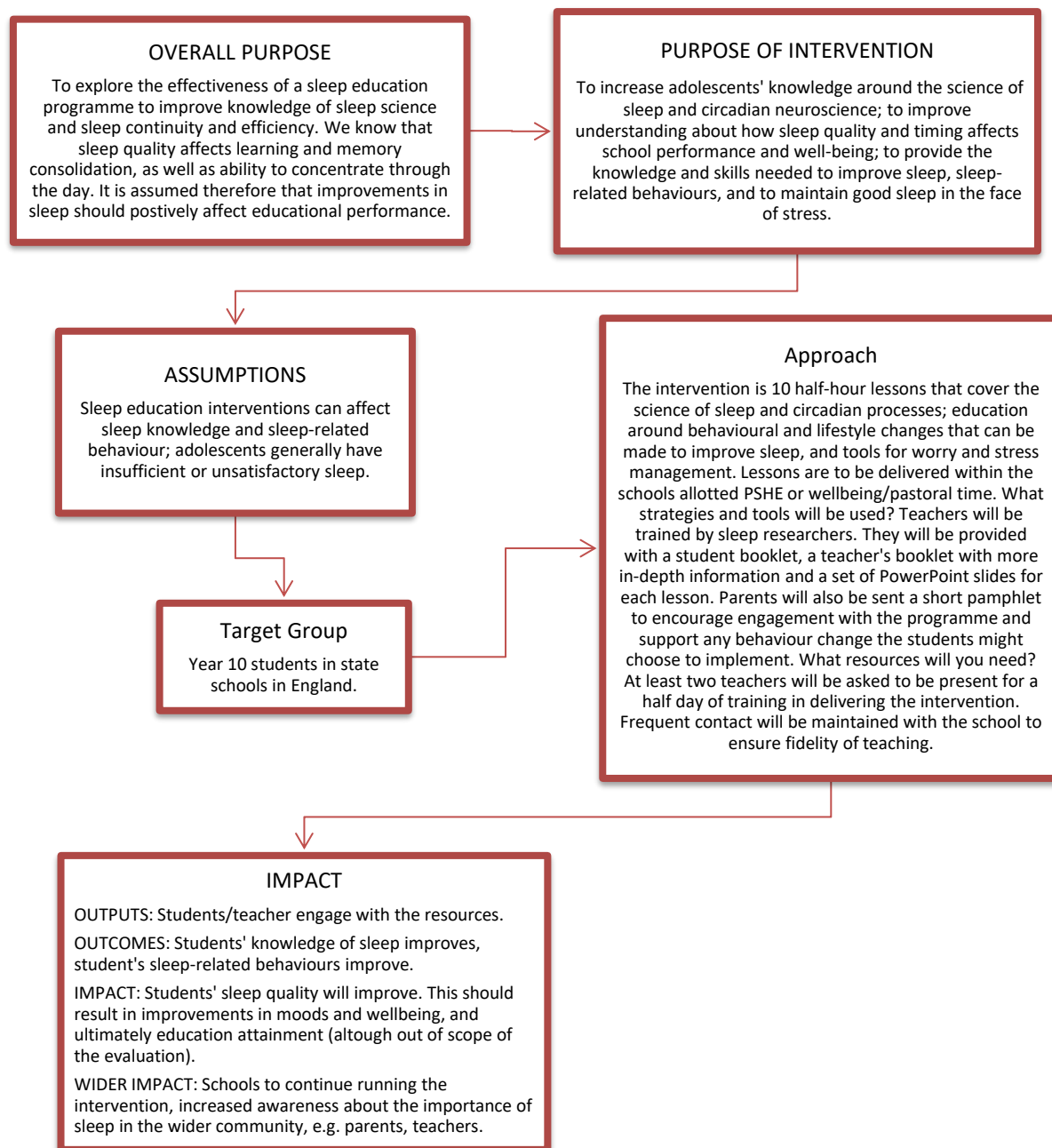
There is growing evidence that teenagers' academic attainment is hampered by a lack of sleep (see Dewald *et al.*, 2010). Poor sleep, frequent and early awakenings, and late bedtimes have been found to negatively affect learning capacity and school performance among adolescents (Curcio *et al.*, 2006; Fallone *et al.*, 2002; Wolfson and Carskadon, 2003), with one of the most common consequences being daytime sleepiness (Moore and Meltzer, 2008). Empirical evidence demonstrates an association between a lack of sleep and the consolidation of cognitive performance, which is required for executive functioning including abstract reasoning, goal directed behaviour, and creative processing (Curcio *et al.*, 2006; Walker *et al.*, 2002).

Therefore, an intervention that increases teenagers' awareness of the importance of sleep and can positively alter their sleep behaviour would be of great benefit to the adolescent population.

Research questions

Figure 1 presents the OTS programme Theory of Change model developed by the project development and evaluation team; below are the research questions.

Figure 1: OTS programme Theory of Change



Evidence of promise: Is there evidence to support the theory of change? This question will be investigated using the following outcome measures:

- a) changes to sleep as reported by actigraphy data and sleep diaries including night-time sleep continuity variables (sleep/wake times) and changes in sleep efficiency (the percentage of time spent in bed asleep over time spent in bed);
- b) changes in night-time sleep length measured using actigraphy at the two time points (pre- and post-intervention);
- c) changes to frequency and duration of napping pre- and post-intervention measured using sleep diaries;
- d) changes to knowledge of sleep, measured using the sleep quiz; and
- e) pre and post self-report data on students' sleep patterns, sleep hygiene, and daytime sleepiness/alertness collected through students' completed questionnaires.

Feasibility: Is the approach feasible to deliver?

- a) To what extent are the participating schools engaged with and delivering the intervention?
- b) What are the different stakeholder viewpoints towards, and acceptability of, the intervention?
 - i. teachers who attended the training, using follow-up surveys and interviews;
 - ii. other teachers within the school, ascertained during case study visits;
 - iii. parents (through completed returned consent forms); and
 - iv. pupils through focus groups in case study schools.
- c) How is the intervention disseminated within the schools to other staff?
- d) How effective is the level of support and training?
 - i. What are the barriers to successful delivery of the intervention?

Readiness for Evaluation: Is the intervention ready to be evaluated in a trial?

- a) Is fidelity to the intervention being maintained?
 - i. Are nominated staff accessing the available training and utilising the relevant materials?
 - ii. Are the different aspects of the intervention being completed?
- b) What is the efficacy and acceptability to pupils of the data collection tools? Are pupils able to maintain fidelity in implementing the data collection methods?
- c) What is the cost of the programme and is it affordable to schools?

Ethical review

The project delivery team obtained favourable ethical approval on 22 April 2016 from the University of Oxford Central University Research Ethics Committee to deliver the Oxford Teensleep Education Programme and associated data collection materials. Ethical approval was granted on 7 September 2016 by the Durham University School of Education Ethics Committee for the evaluation elements.

At the start of the project, school headteachers signed a Memorandum of Understanding (MoU) agreeing to the delivery of the programme and associated data collection methods (Appendix 1). Headteachers subsequently received an additional information sheet and MoU developed by the evaluation team which detailed the evaluation (Appendix 2).

Schools involved were asked to send out an information sheet and opt-out consent form (Appendix 3) to all parents of children in Year 10, which outlined the purpose of the study and allowed them to opt-out of their child's data being used in the research. Parents were required to return opt-out consent forms to the school which was advised to return these to the project delivery team who would subsequently inform the evaluation team. This did not affect whether the child would receive the intervention. For the collection of detailed sleep data and the pupil focus groups, opt-in parental consent was obtained (Appendix 4 and 5).

Opt-in consent was sought from relevant school staff for observations, interviews, and surveys as part of the process evaluation.

Project team

The evaluation team

This was a collaborative evaluation between researchers at Durham University's Centre for Evaluation and Monitoring (CEM) and Durham University's Sleep Lab. The project team was responsible for the design, conduct, analysis, and reporting of the evaluation.

Durham University, CEM

Dr Lyn Robinson – Principal Investigator

Dr Helen Wareham – Data Analyst

Ms Jessica Hugill – Data Analyst

Dr Laura da Costa – Project Researcher

Mrs Kirsty Younger – Project Researcher

Mrs Dawn Mee – Research Administrator

Dr Susan Stothard – Co-Investigator

Durham University, Sleep Lab

Professor Helen Ball – Principal Investigator

The Project Delivery Team

The project delivery team was responsible for the conduct of the research including school recruitment and ongoing relationships with schools, informing parents and pupils, intervention development (including writing detailed description of intervention to allow others, if necessary, to be able to replicate the intervention), intervention training and delivery, and data collection. The delivery team from SCNi included Professor Russell Foster, Professor Colin Espie, Dr Chris Harvey, Dr Gaby Illingworth and Dr Rachel Sharman.

Methods

Design

This project was initially co-funded by the Education Endowment Foundation (EEF) and the Wellcome Trust as part of the Education and Neuroscience round. It was designed to evaluate two different interventions:

- a sleep education programme, which aimed to teach pupils about the importance of sleep and techniques to improve their sleep; and
- later start times—testing the impact of moving schools' start times to 10am.

The evaluation was initially intended to last three years using a different evaluation team. The first year would see the development and piloting of the sleep education programme with a randomised controlled trial (RCT) of both programmes across 100 schools to follow in the second year. Recruitment targets to the pilot and the main trial were not achieved. Feedback from schools suggested that the later start times intervention was the main barrier to recruitment. Schools were concerned that it was not a feasible intervention, and it was too risky to undertake in Year 11—at the same time as high stakes testing was taking place.

The EEF, Wellcome Trust, and the project delivery team decided to restructure the project. The later start times element was discontinued, and the project changed to just focus on sleep education which was easier for schools to accommodate. The first stage of the pilot study (March–June 2016) saw the project delivery team develop the OTS programme. The programme was refined through feedback from six schools that had tried to implement all or part of the programme. At the end of this stage, the OTS programme was manualised and was ready to move to the second stage of piloting.

The second stage of the pilot was to run in 12 schools in autumn term 2016. The aims of the pilot were two-fold.

(1) The first aim was to look for evidence of promise by using sleep data collected by the project delivery team through the use of:

- a sleep quiz to gauge pupils' knowledge of sleep science and good sleep hygiene;
- a sleep survey to document sleep quality, circadian preference, daytime sleepiness/alertness, sleep hygiene, and information on health-related quality of life;
- a sleep diary to document subjective self-reported sleep duration and quality; and
- sleep monitoring devices known as actigraphs to provide a measure of sleep duration and quality; actigraphs are telemetric devices designed to be worn on the non-dominant wrist, which provide a continuous measure of the motor component of activity measured through a tri-axial accelerometer thus allowing researchers to derive data which indicates whether the wearer was asleep or awake and their quality of sleep at any time of wearing.

(2) The second aim was to assess the feasibility of taking the programme to a main trial that would assess the impact of the programme on attainment.

The evaluation of the programme adopted a mixed method (qualitative and quantitative) approach which utilised the sleep data collected by the project delivery team for inferences of evidence of promise (through the intervention's impact on students' sleep) and a comprehensive, independent process evaluation to assess the programme's feasibility and readiness to trial. The pilot did not adopt a RCT design for several reasons. First, the project delivery team needed to collect data to ascertain whether the data collection tools are useful, reliable and valid for a main trial. Second, the appointment of the Durham evaluation team occurred after the project delivery team had recruited half of the schools to

the pilot at which point a RCT design had not been presented. Consequently, this study employed a pre-post design with no control group. For this reason, it was not possible, nor part of the planned design, to estimate the counterfactual. Thirdly, this was a feasibility study, not intended to assess the effectiveness of the intervention at this stage.

Recruitment

Schools

Schools were eligible to participate if they were a state secondary school in England. Schools also had to agree to all of the study requirements outlined in the developer's MoU, which described their commitment to the delivery of the programme. Their continued participation was also dependent on agreement to the additional MoU which outlined the process evaluation. At the time the Durham evaluation team was appointed, the project delivery team had already recruited several schools to the project, some of which were outside the usual EEF eligibility criteria. For the original trial, a recruitment company was employed to find willing schools which met the usual EEF FSM eligibility criteria and could implement the intervention in the specified timescale. Two selective schools remained in the sample, but this was approved by the EEF. The EEF also approved the provision of gift vouchers for the prize draw.

Students

All students who were in Year 10 at the start of the academic school year 2016/2017 received the intervention as delivered by their teachers and completed a sleep quiz and sleep survey pre- and post-intervention. Parents and students were informed about the pilot study via parent/student information sheets. Parents could opt-out of schools sharing students' data with the research team, but not out of student participation in the intervention.

Opt-in parental consent was required for students' participation in detailed sleep data collection using actigraphy and sleep diaries. This data was to be collected from a subgroup of 15 students within each school who met the eligibility criteria. However, after reduced recruitment in one school, and following a discussion with the evaluation team, this was increased to 15/20 students. Students were excluded from participating in the detailed sleep data collection if they had a current sleep disorder (for example, insomnia or sleep walking), a psychological disorder (such as ADHD, anxiety, or depression), a physiological disorder which may interfere with sleep (such as asthma, diabetes, epilepsy, or metabolic disorders), heart-rhythm abnormalities, or who were taking medications that may impact on sleep (for example, antihistamines, antidepressants, or corticosteroids). Individuals who had suffered a concussion where they were unconscious for more than five minutes, or those who had been to a country that was three or more time zones away from the U.K. (for example the U.S.A. or Asia) within the previous six months were also excluded from participating in detailed sleep data collection. These eligibility criteria were determined by the project delivery team.

The project delivery team assessed student eligibility through a semi-structured face-to-face sleep screening interview (Appendix 6) taking place within each participating school, lasting approximately ten minutes per student. Students were only to undergo sleep screening on presentation of their parental consent form, which schools had provided to students in advance of the project delivery team's visit. If more than 15 students returned a completed parental consent form, the project delivery team would number the completed forms from one to *n*. They would then call the evaluation team (principally, the project administrator) for a randomised selection of students (plus five numbered reserves). Students were then asked to participate in a sleep screening interview in the selected order. Any student that did not meet the eligibility criteria would be replaced by a student from the reserves list who also underwent the same face-to-face process of eligibility screening. In the case of more than five exclusions, the project delivery team were to call the evaluation team to receive additional randomised students. Within the interview, students were asked to report sleep disturbances (lasting more than six

months), sleep problems, sleep/wake disorders, health, psychological problems, family history of insomnia, and general demographics. Some issues emerged, which are discussed further under 'Limitations'.

The project delivery team agreed to keep detailed recruitment and attrition records for all sleep-related data collection methods and provide these to the evaluation team for reporting.

Data collection

The project delivery team was responsible for collecting and inputting sleep data using the methods below; this was subject to rigorous quality assurance (QA) processes (described in detail in the three sections that follow) conducted independently by the evaluation team. All the analyses presented within this report were conducted independently by the evaluation team.

Sleep quiz

A sleep quiz (Appendix 7) was used to measure changes in pupils' knowledge of sleep as a result of being a recipient of the OTS programme. This was devised by the project delivery team with the purpose of measuring improvement in sleep knowledge (that is, the ability to correctly recall aspects of the sleep material that had been delivered in teacher-led sessions). Pupils were requested to complete this pre- and post-intervention quiz during school time. The quiz was delivered as a 'surprise' and pupils were therefore not asked to revise for it. Schools returned completed quizzes to the project delivery team for data entry. The evaluation team conducted QA of 10% of the sleep quizzes to ensure entry consistency; no significant discrepancies were identified.

Sleep survey (students)

A sleep survey was used to measure changes to students' self-reported sleep patterns, sleep hygiene, and sleepiness/alertness. Students completed a survey pre- and post-intervention. This survey, created by the project delivery team, requested students to document sleep quality, circadian preference, daytime sleepiness/alertness, sleep hygiene, and information on health-related quality of life. Teachers were asked to distribute the paper questionnaires to students for completion in school, under exam conditions. The sleep surveys took approximately 30–40 minutes to complete at each data collection point. Schools returned completed quizzes to the project delivery team for data entry. The evaluation team conducted QA of 10% of the sleep surveys to ensure entry consistency; no significant discrepancies were identified. Within each school, students who completed the sleep survey at either time-point were entered into a prize draw to win one of two £25 Amazon gift vouchers, organised and provided by the project delivery team.

Actigraphy and sleep diary

Across all schools, actigraphy¹ and sleep diaries (see Appendix 8) were used continuously for a 14-day period pre- and post-intervention with a sub-sample of 15 students who met the eligibility criteria as determined during the sleep screening interviews.

The project delivery team trained students face-to-face, in each school on how to wear the actigraphs prior to pre-intervention data collection. Students were asked to press the marker button on their device when they were in bed, had switched the lights off, and were attempting to sleep. As actigraphy uses movement to determine sleep onset/offset, this method is the most accurate way to determine sleep intention as distinct from lying in bed, awake, engaging in other activities. Students were also instructed to press the same marker when they woke from sleep in the morning and had no intention of returning

¹ Actigraphy is widely used in sleep research as an objective measure of sleep parameters and has been validated using polysomnography. The actigraphs used in this study were MotionWatch 8 (MW8) devices by CamNtech (formerly Cambridge Neurotechnology, Papworth Everidge, Cambridge).

to sleep. The project delivery team had delivered the actiwatchers to each pupil on the same day as the first night of wearing the device and they were able to check that the pupils understood the procedure in person. The project delivery team also spoke with each school when the pupils were given the actiwatchers for the post-intervention data collection to remind them what to do.

At the same time as wearing the actiwatchers, students were requested to complete a sleep diary to document subjective self-reported sleep duration and quality (see Appendix 8). The sleep diaries were developed by the project delivery team for the purpose of this pilot study and are based on the Consensus Sleep Diary (Carney *et al.*, 2012). Each page represented a day and students were instructed to start completing them just before going to sleep about the day past and finish when they woke each morning about the previous night's sleep. The diary consisted of sleep quantity and quality questions, pre-sleep behaviours, and nap frequency and timing. Students were instructed that the sleep diary was to be filled out as a 'best guess' for their sleep. From focus group feedback in the first stage of piloting, the project delivery team noted that students were concerned about entering 'wrong' answers in the diary, so the subjective nature of the diary was emphasised during the instruction. The project delivery team also reported that during the first stage of piloting the students struggled with filling out questions about the day before (for example, caffeine use after 6pm) in the morning when they woke; thus they were instructed to complete the diary at two time points for this phase.

Following pre-intervention data collection, participants were to be excluded from analysis if there was less than two weekend nights and five weekday nights of actigraphy data. It is common in actigraphy research to collect seven consecutive days of data in order to ensure at least two week and two weekend nights given fluctuations in weekday and weekend sleep patterns, however it is accepted that there is no 'gold standard' for the number of days. Where insufficient pre-intervention data was provided, these students data was not included in pre-post analysis. Further, in the case of post-intervention actigraphy being less than seven days, the baseline data of that participant was removed from the analysis of change for evaluation purposes. To encourage the return of full data, all pupils were made aware that they would be entered into a prize draw to win a £25 Amazon voucher at each time point (two vouchers per school) and that all students, from all schools, who provided a complete set of actigraphy data at both time-points would be entered into a prize draw to win a 32GB iPad Pro (9.7"). The evaluation team provided the randomisation for the prize draw as the delivery team had met the students.

At the end of each 14-day data collection point, students were asked to return the actigraphs and sleep diaries to the school, where the project delivery team arranged a courier to collect the devices and paperwork. The project delivery team downloaded and coded the actigraphy data in line with a data analysis protocol that was developed (see Appendix 9). Ten percent of all returned sleep diaries underwent QA by the evaluation team and no significant issues were identified. Similarly, 10% of the actigraphy data collected underwent a QA process by the evaluation team to check consistency and inter-rater reliability. The evaluation team calculated the magnitude and direction of variation in outcome variables and Pearson's Correlation Coefficient (one approach to investigating inter-rater reliability) was computed to describe inter-rater reliability. Agreement on scored and calculated variables and correlation coefficients are found in

Table 2. Data on inter-scorer variation is shown in Table 3. Similar agreement percentages were found for pre- and post-intervention data. Calculated variables are less consistent than scored variables as variation will be cumulative. Disagreements were greater for the post-test than the pre-intervention data.

Table 2: Percentage of agreement on scored and calculated actigraphy variables including Pearson's Correlation Coefficient

Coding variable		% of cases of agreement between delivery and evaluation team	Correlation coefficient
Pre-intervention	Lights out	85%	0.98
	Fell asleep	87%	0.99
	Woke up	82%	0.96
	Got up	81%	0.95
	Time in bed	77%	0.86
Post-intervention	Time asleep	83%	0.81
	Lights out	85%	0.77
	Fell asleep	86%	0.84
	Woke up	89%	0.91
	Got up	85%	0.91
	Time in bed	76%	0.76
	Time asleep	82%	0.77

Table 3: Actigraphy inter-scorer variation

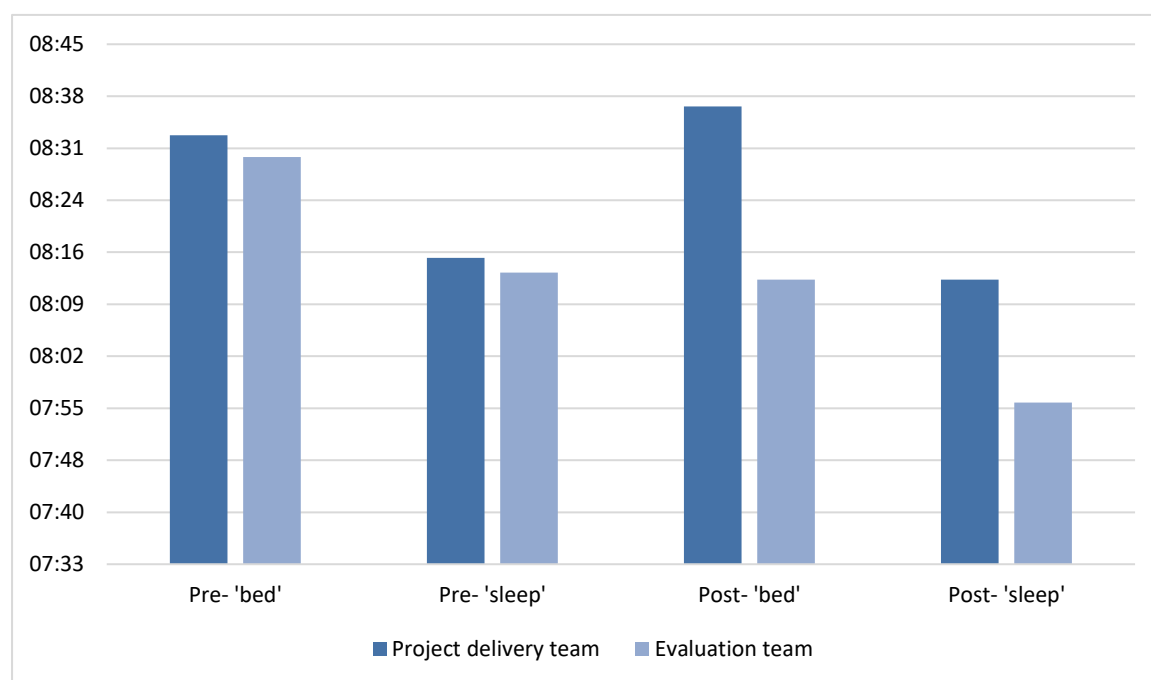
Variable	Variation	Pre-intervention n=199	Post-intervention n=144
Time in bed	Identical (within 1 min)	151	100
	Evaluation team scored longer n (sum of differences)	13 (6hrs 39mins)	9 (7hrs 14mins)
	Evaluation team scored shorter n (sum of differences)	33 (24hrs 50mins)	22 (48hrs 58mins)
	No. of cases not scored by project delivery team	2	13
	Time in bed total difference (sum of differences)	31hrs 29mins	5hrs 12mins
Total sleep period	Identical (within 1 min)	163	108
	Evaluation team scored longer	9 (4hrs 27min)	5 (5hrs 19mins)
	Evaluation team scored shorter	25 (23hrs 23min)	18 (43hrs 19mins)
	No. of cases not scored by project delivery team	2	13
	Time in bed total difference	27hrs 50mins	48hrs 38mins

Figure 2 illustrates the mean values of two outcome measures pertinent to the main research question: 'time in bed' and 'time asleep'. The figure shows means for the same data, as coded by the project delivery team and evaluation team. While the pre-intervention values are very similar, differences in post-intervention data can be observed. The agreement between the delivery and evaluation teams highlights a potential source of concern and the need for blind ratings from independent evaluation teams with a well-specified protocol for future studies. It also reflects the element of subjectivity in the ratings, which means that such data should be interpreted with caution and validated with other measures, for example the sleep diary.

It should be noted that post-intervention data indicated that some students were less engaged with the watches and weren't consistently completing the sleep diaries in the second round of data collection;

implementing the coding protocol was, thus, more challenging as it required a higher level of the coder's subjective judgement. This could go some way in explaining the observable increase in errors/variations. However, it does not explain why the variation tended to be in a consistent direction. Assessing the source of systematic variation in actigraphy data coding is vital for ensuring a Type 1 error does not occur in future trials. Moving forward, it is important that the actigraphy coding protocol is sufficiently robust to eliminate such large coding discrepancies in any future trial. Clear training for coders would also be required alongside this. The protocol and training should be further developed and used in any further trials. For an effectiveness trial in future, we suggest that two independent evaluation teams analyse the data separately and then compare results, thus validating the results in a way that is independent from the project delivery team.

Figure 2: Comparison of mean scores of actigraphy outcome variables calculated by the project delivery team and the evaluation team



Summary of data collection tools to assess evidence of promise

Table 4 describes the outcome measures relating to 'evidence of promise' to be assessed using variables from the various sleep data collection methods. The project delivery team provided the following variables from the actiwatches: time in bed, assumed sleep, actual sleep (time and %), actual awake (time and %), sleep efficiency (%), sleep onset latency, and wake bouts. The evaluation team looked to identify potential variation between the pre and post values and provide a descriptive analysis of each of these variables. The analysis was repeated comparing Free School Meals (FSM) eligibility and also looking at school-level variation. Secondary analysis repeated the above analysis with the sleep diary and survey data, providing descriptive analysis of the potential variation between pre and post data.

Table 4: Description of data collection tools and outcome measures (evidence of promise)

	Outcome measure	Data collection method	Variable
PRIMARY	Changes in sleep time during time in bed and the number of wake bouts (proxy measure of sleep continuity) between pre and post data.	Actigraph data from actiwatchers	Sleep efficiency (%); wake bouts frequency
SECONDARY	Changes in time between going to bed and falling asleep, wake time in bed, actual sleep time etc. between pre and post data.	Actigraph data from actiwatchers	Time in bed; assumed sleep; actual sleep time; actual sleep (%); actual wake time; actual wake (%)
	Changes in sleep time during time in bed between pre and post data.	Sleep diary data	Self-reported sleep efficiency (%)
	Changes in sleep knowledge scores between pre and post data.	Sleep knowledge quiz	Total score and individual question scores
	Changes in sleep behaviour scores between pre and post data.	Surveys/questionnaires	Sleep related sub-scale domains (excluding health and well-being)
	Changes and variation between different groups overall and between pre and post data.	School and pupil level demographic data	Above variables
	Changes in the frequency and duration of napping between pre and post data.	Sleep diary data	Self-reported napping frequency and duration

Student attendance

Student attendance data was collected from schools by the evaluation team in anticipation of assessing whether sleep behaviour was associated with school behaviour. However, the attendance data provided by schools was too sporadic to be used in any meaningful way for analysis.

Intervention delivery records

Schools were asked to provide a delivery schedule for the sleep education programme, including the date and time each lesson was to be taught and which teacher within each school delivered it. This was used to monitor the fidelity of the intervention. The evaluation team's research administrator contacted the schools weekly, via telephone or email, to clarify if lessons had been taught as set out in the delivery schedule provided by the school prior to starting the intervention; however, the data provided by schools was sparse.

To understand replicability of training sessions and to monitor engagement at the cascade training sessions, staff attendance data was collected, where possible, via telephone/email by the evaluation team directly from the staff member who led the training. Here, the staff member was (a) requested to provide names and roles of teachers who had received cascade training and (b) requested to describe the structure, content, and duration of the cascade training.

Teacher surveys

The evaluation team developed two surveys to understand engagement and gauge fidelity to the intervention amongst each school's staff.

- (1) *Teacher training survey*: Teachers who attended the training led by the project delivery team were asked to complete an online or paper-based survey to gauge the effectiveness of support and training.
- (2) *Teacher delivery survey*: All teachers who delivered the intervention were asked to complete an online or paper-based survey at the end of the intervention to capture resource usefulness and acceptability, intervention delivery, and perceived impact of the intervention.

For participating in the required aspects of the evaluation (providing student attendance data, delivery schedules, and completing relevant surveys) all schools received a £200 Amazon gift voucher. Provision of this gratuity was approved by the EEF due to the difficulties the project delivery team encountered with recruitment to the evaluation study. The gratuity was intended to compensate the schools for the heavy administrative burden involved in data collection for testing the feasibility of the project.

School case studies

To investigate the feasibility of implementing the intervention, the evaluation team conducted a multiple case study design with longitudinal aspects with the three schools that had the highest FSM rate within the sample. The experience of these schools with the intervention was particularly important to ascertain as such schools are the EEF's target group.

- a) One school setting was selected to participate in the longitudinal case study, where programme implementation was documented through observations of the developer-led training session, the cascade training session (if appropriate, where possible), and the delivery of two lessons. The evaluation team aimed to observe one session that was delivered by a teacher who attended the developer-led training and another session being delivered by a teacher who attended the cascade training only.

- b) Two additional settings were involved in the cross-sectional case study. These schools were visited by the evaluators twice to elicit observation data and perceptions of stakeholders at two pre-identified lessons.

Where possible, semi-structured interviews also took place during visits or by telephone with the school's 'lead contact' and teachers delivering the programme to discuss implementation, acceptability, and perceived efficacy. These interviews provided a wider perspective of the intervention within each setting and explored how the intervention was used and adapted in different school environments, including any barriers. Data on costs to the school for delivering the intervention was also collected.

The three schools who participated in the case studies received an additional £400 Amazon gift voucher.

Student focus groups

Five focus groups were conducted in the three case study schools: one in each school with pupils who had participated in the full data collection (actigraphy and sleep diaries) and an additional focus group in two of the schools with pupils who had received the intervention but were not in the actigraphy group. This allowed the evaluation team to ascertain the acceptability of the intervention and the associated data collection methods (for example, sleep survey, sleep screening interview), and identify potential sources of bias. The focus groups had five to eight participants, lasted approximately 30–40 minutes, and took place during school time. Parental consent was gained prior to the focus groups (see Appendix 5). The time between completing the intervention and the focus groups is reported in Table 6 and a gap between the two activities may have impacted upon pupils' recollections and feelings.

Project delivery team interview

The evaluation team conducted an interview with the project delivery team at the end of the programme to discuss further development of, or changes to, the programme, perceived impact, implementation fidelity including actual barriers, information on costs, and future plans.

Summary of data collection tools to assess programme feasibility/readiness to trial

Table 5 describes the outcome measures relating to feasibility and readiness to trial to be assessed from data collected through the relevant data collection tools.

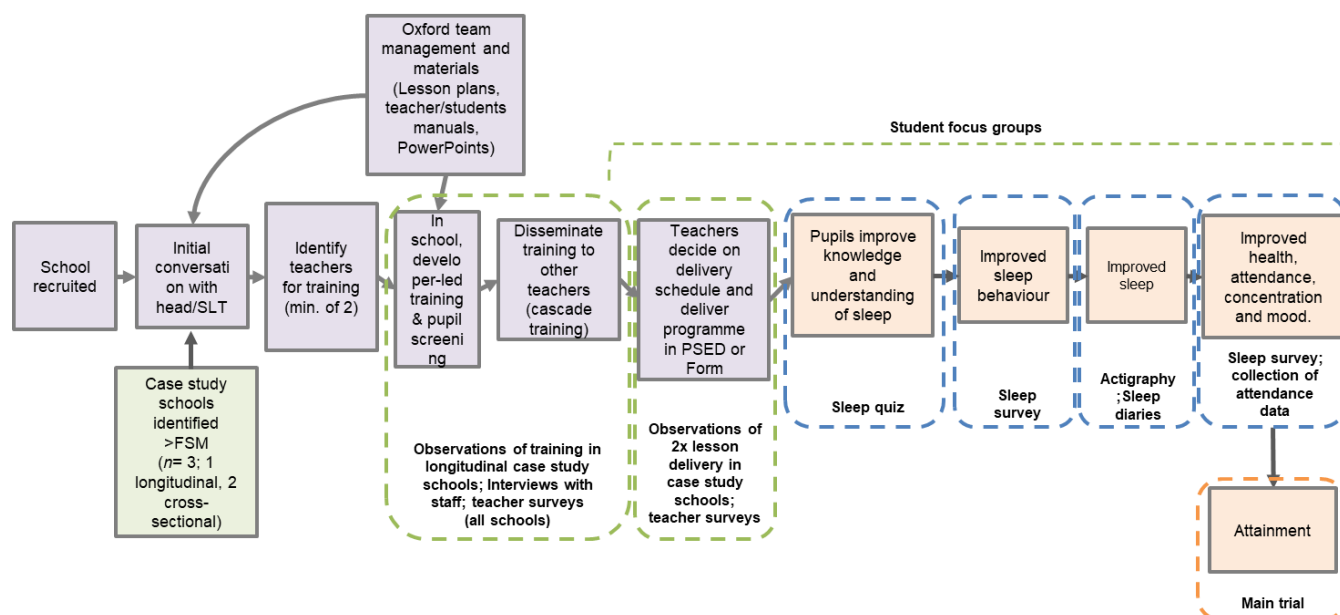
Table 5: Description of data collection tools and outcome measures (evidence of promise)

	Outcome measure	Data collection tools
FEASIBILITY	To what extent are the participating schools engaged with and delivering the intervention?	Staff interviews; staff surveys; delivery schedules; observations of lesson delivery
	What are the different stakeholder viewpoints towards, and acceptability of, the intervention?	Staff interviews/surveys; student focus groups
	How is the intervention disseminated within the schools to other staff?	Staff interviews; staff surveys; observation(s) of cascade training
	What are the barriers to successful delivery of the intervention?	Staff interviews; staff surveys; delivery schedules; observations of lesson delivery/training
READINESS	Is fidelity to the intervention being maintained?	Delivery schedules; observations of lesson delivery/training
	What is the efficacy and acceptability to pupils of the data collection tools? Is fidelity to the data collection tools being maintained by pupils?	Completion and return rates of sleep quiz, sleep survey, actigraphy and sleep diaries; project delivery team interview (end-point)
	What is the cost of the programme and is it affordable to schools?	Staff interviews; staff surveys; project delivery team interview (end-point)

Logic Model

Figure 3 illustrates the OTS programme Logic Model and details how the programme was delivered in line with data collection methods and key outcome measures. The original version of the logic model was created during the first project set-up meeting with input from the evaluation team, the project delivery team, and the EEF (see Appendix 10) and updated by the evaluation team to its current form.

Figure 3: OTS programme Logic Model (version 2)



Timeline

Table 6: Teensleep project timeline

	Date	Activity
2016	April	Ethics approval (project delivery team)
	April–June	School recruitment (project delivery team)
	May	Project set-up meetings
	June–August	Project set-up, finalising of evaluation protocol, evaluation/EEF contract signed
	September	Ethics approval (evaluation team) Schools return MoU to evaluation team Delivery of teacher training by project delivery team Observations of training by evaluation team Distribution and completion of teacher training surveys by evaluation team Completion of teacher training interviews by evaluation team Observations of cascade training by evaluation team Return of delivery schedules from schools to evaluation team Parental consent (opt-in/opt-out) Subgroup screening interviews, student randomisation (if applicable) and sleep monitoring training
	September–October	Completion of pre-intervention sleep quiz and sleep survey (all students) Subgroup screening interviews, randomisation (if applicable) and sleep monitoring training Subgroup pre-intervention sleep data collection (actigraphy/sleep diaries)
	September–December	Delivery of OTS programme within schools Case study visits
	October	Data entry of pre-intervention sleep data by project team
	October–December	Post-intervention sleep data collection
	October–January	Completion of post-intervention sleep quiz and surveys in schools
	December	Teacher delivery survey
2017	January	Return of pre-intervention sleep data from project delivery team to evaluation team
	January–March	QA process on pre-intervention sleep data
	January–February	Student focus groups
	January–March	Data entry of post-intervention sleep data by project delivery team
	February–March	Student focus groups
	March–April	QA process on post-intervention sleep data

	May	Return of all required sleep data variables from the project delivery team to the evaluation team
	June	Data analysis Project delivery team interview Readiness to trial presentation at the EEF
	July–September	Report writing

Findings

Participants

Schools

Twelve schools were recruited to the original trial by the project delivery team using the following strategies: mail-outs (led by the company 'Sprint'), emailing, cold calling schools, and recruitment events held in Oxford, London, Reading, and York. The project delivery team noted the most effective method of recruitment was the mail-outs via 'Sprint'. Whilst all 12 schools returned an implementation MoU to the project delivery team, two schools dropped out prior to signing and returning the MoU for the current evaluation citing that they were worried they could not deliver the programme as intended because of staffing issues. The total sample for the pilot included ten schools.

Table 7 describes the socio-demographic characteristics where available (see Table 7 and Table 7 legend for explanation) of the ten schools that returned both the implementation and evaluation MoUs and details the proportion of students currently in receipt of FSM (%FSM) or having been in receipt of FSM in the previous six years (%FSM Ever 6) to be used as a proxy for disadvantage. Attainment 8 represents the average achievement of each school.² The proportion of students in receipt of FSM across the schools ranged from 0.8–28.6%, with an average of 18.1%. Two schools had selective admission.

Table 7: Socio-demographic characteristics of participating schools

School ID	Location	Size #	School type	Ofsted rating	%FSM	%FSM Ever6	Attainment 8 score
1	Urban	528	Academy	Good	18.9	39.4	46.8
2	Rural	995	Community	Good	5	13.2	49
3	Urban	886	Community	Good	26.2	41.8	48.9
4	Urban	885	Academy	Good	24.6	44	46.1
5	Urban	880	Foundation	Good	28.6	50.9	48.7
6	Urban	631	Academy	Unavailable	22	40.6	48.9
7+	Urban	687	Academy	Outstanding	3.7	3.9	75.8
8	Urban	1283	Academy	Unavailable	9.1	19.3	45.1
9	Urban	803	Community	Good	11	23	45.8
10+	Urban	836	Grammar	Outstanding	0.8	8.6	64.6

* State-funded with a selective admissions policy.

'Unavailable': unavailable Ofsted report as recently converted to Academy.

Students

All students in Year 10 at the start of the academic school year 2016/2017 received the intervention as delivered by their teachers. The evaluation team asked schools to provide information on cohort size and pupil characteristics, for example, gender, FSM, and KS2 scores, for students whose parents did not opt-out of their child's data being used as part of the research. This data is detailed in Table 8. In total, 166 students across the ten schools participated in the sleep screening interview to determine eligibility for participation in the subgroup data collection, with 160 being eligible to take part. However, after screening had taken place it transpired that only 145 of 160 of those who were selected had appropriate consent to take part in the study. Students' data was excluded from the subgroup analysis if there were less than seven days of actigraphy data (including at least two weekend days) at either or both pre- or post-intervention. From 145 consented students, 137 received data collection tools (actiwatch and sleep diary) post-intervention and 85 (58%) returned sufficient actigraphy data to be

² Attainment 8 represents the average achievement of the school's pupils across eight subjects. The score is calculated by comparing the achievement of all its pupils against the Attainment 8 score of all pupils nationally with similar prior attainment.

included in the pre-post analysis. It should be noted that the data collection for some of the students ran into the school holidays, which explains some of the attrition. Of these 85 students, ten (12%) were in receipt of FSM.

Table 8: Summary of Year 10 pupil-level data for schools that received the OTS programme

School ID	Cohort size <i>N</i> *	M:F % ratio	FSM (%)	KS2 APS with ranges ³	Received data collection tools
1	77	53:47	32 (42%)	n/a	11
2	143	51:49	7 (5%)	27.6 ⁴ (15–35)	14
3	132	52:48	53 (40%)	n/a	13
4	176	47:53	41 (23%)	26.3 (15–33.9)	15
5	178	45:55	43 (24%)	26.8 (13.2–35.9)	15
6	134	48:52	25 (19%)	n/a	13
7	112	0:100	0 (0%)	35.2 (31.7–38.9)	15
8	217	58:42	12 (5.5%)	28 (15–39)	13
9	192	50:50	18 (9%)	27.6 (16.5–34.7)	12
10	143	62:38	6 (4%)	32.8 (28–38)	16

*It should be noted that the exact number of parents who opted-out of their child's data been used is not clear. The project delivery team reported that schools only returned data collected using the quiz and survey if opt-out consent forms had not been returned to the school. Data collected independently by the evaluation team indicated 40 opt-out forms were received by schools, however this figure could be higher.

Evidence to support theory of change

For this study, the protocol did not specify separate analyses of the data by weekday and weekend sleep.

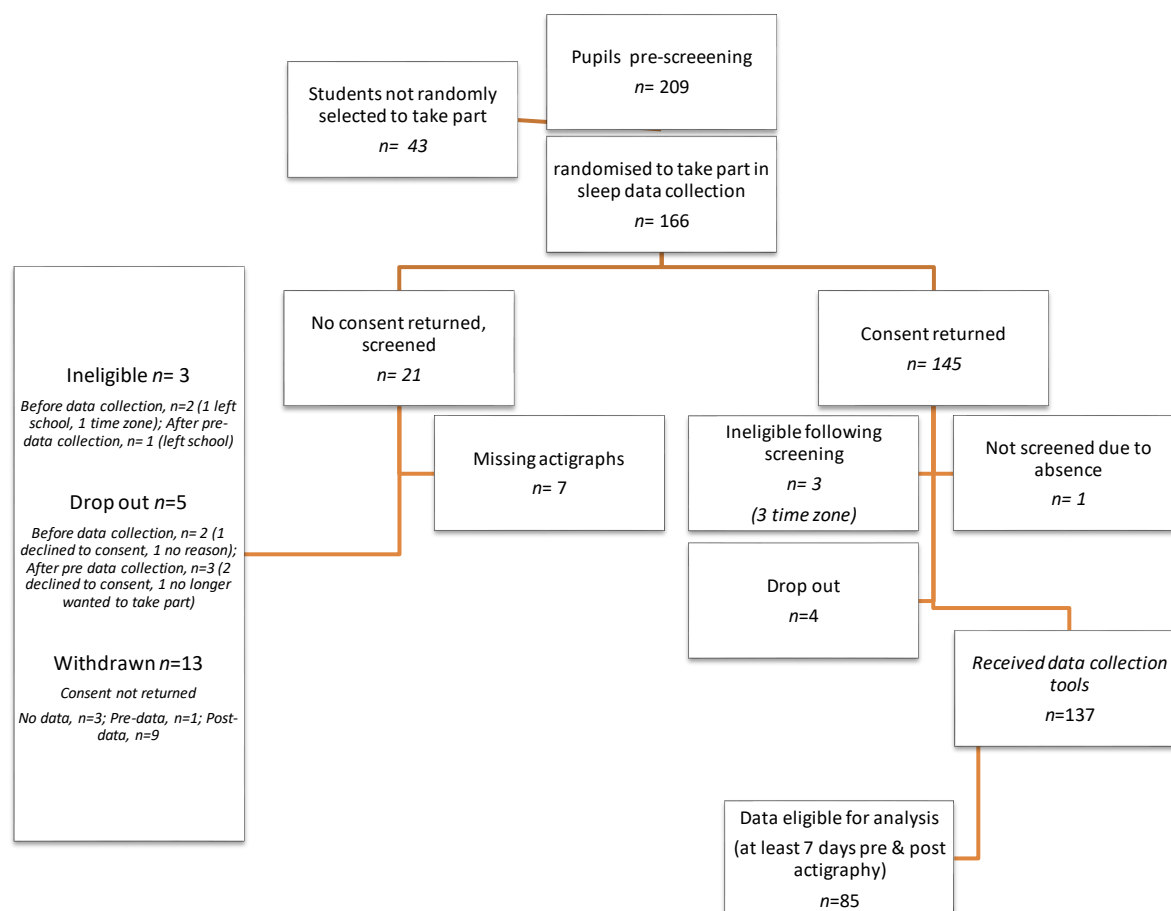
Sleep efficiency

Research question: Did the intervention produce any change in students' sleep as reported by actigraphy data and sleep diaries, including night-time sleep continuity variables (sleep/wake times) and changes in sleep efficiency (the percentage of time spent in bed asleep over time spent in bed)?

Figure 4 illustrates the flow of subgroup participants including the number of students whose data was eligible to be included into the descriptive analyses. Two schools' sleep data collection overlapped into Christmas (one by one week, one by 12 days). Some of the data from one of these schools was useable but the other school had to be excluded.

³ With KS2 data, schools were asked to return the APS but some schools returned a combination of levels and/or KS2 subscale scores which were not able to be converted into an APS.

⁴ A number of pupils had no KS2 data.

Figure 4: Flow of participants in the subgroup data collection

In total, 85 students provided actigraphy data pre- and post-intervention for inclusion into the descriptive analysis.

The mean difference between students' pre- and post-intervention sleep efficiency (%) was -0.2min (min -5.4, max 7.1, SD 2.3) indicating that sleep efficiency remained unchanged between the two time points.

Table 9: Students' mean sleep efficiency pre- and post-intervention collected from actigraphy data

	Mean %	Min %	Max %	Std. deviation
Pre-intervention	84.8	72.0	92.4	4.2
Post- intervention	84.6	73.2	93.1	4.3

Night-time sleep duration

Research question: *Did the intervention produce any change in students' night-time sleep duration measured using actigraphy at the two time points?*

Data to assess this outcome was gathered using the 85 eligible students' actigraphy data pre- and post-intervention and included changes in time between going to bed and falling asleep, wake time in bed, and actual sleep time. Table 10 provides a definition and the mean differences between pre- and post-intervention for each variable. All variables had small increases on average from pre- to post-intervention with the exception of 'actual sleep' (%) which had a marginal decrease, however substantial variations exist between participants as indicated by the minimum and maximum values. This suggests that a subgroup analysis may provide further insight in future studies. Good sleepers at pre-intervention are already sleeping well and unlikely to get better sleep as a result of the intervention. A more focused investigation of poor sleepers would be of interest.

Table 10: Students mean night-time sleep length pre- and post-intervention collected from actigraphy data

Variable and definition	Mean	Min.	Max.	Std. deviation
Time in bed (min) The total elapsed time between the 'Lights out' and 'Got up' times.	+2.9	-68.4	73.6	30.4
Assumed sleep (min) The total elapsed time between the 'Fell asleep' and 'Woke up' times.	+2.6	-64.1	67.1	26.7
Actual sleep (min) The total time spent in sleep according to the epoch-by-epoch wake/sleep categorisation.	+1.1	-55.0	49.8	22.5
Actual sleep (%) Actual sleep time expressed as a percentage of the assumed sleep time.	-0.2	-3.9	4.7	1.6
Actual wake (min) The total time spent in wake according to the epoch-by-epoch wake/sleep categorisation.	+1.5	-22.3	25.6	9.8
Actual wake (%) Actual wake time expressed as a percentage of the assumed sleep time.	+0.2	-4.7	3.9	1.6
Sleep latency (min) The time between 'Lights out' and 'Fell asleep'.	+0.6	-36.6	53.3	10.1

Napping frequency

Research Question: *Did the intervention produce any change in students' frequency and duration of napping pre- and post-intervention as measured by sleep diaries?*

Sleep diaries required students to report their daytime napping frequency pre- and post-intervention. Sleep diary data for the 85 students whose data was eligible for use indicated that reported napping frequency reduced post-intervention with 47% of students reporting taking a nap pre-intervention in comparison to 31% post-intervention.

Knowledge of sleep

Research Question: Did the intervention produce any changes in students' *knowledge of sleep, measured using the sleep quiz?*

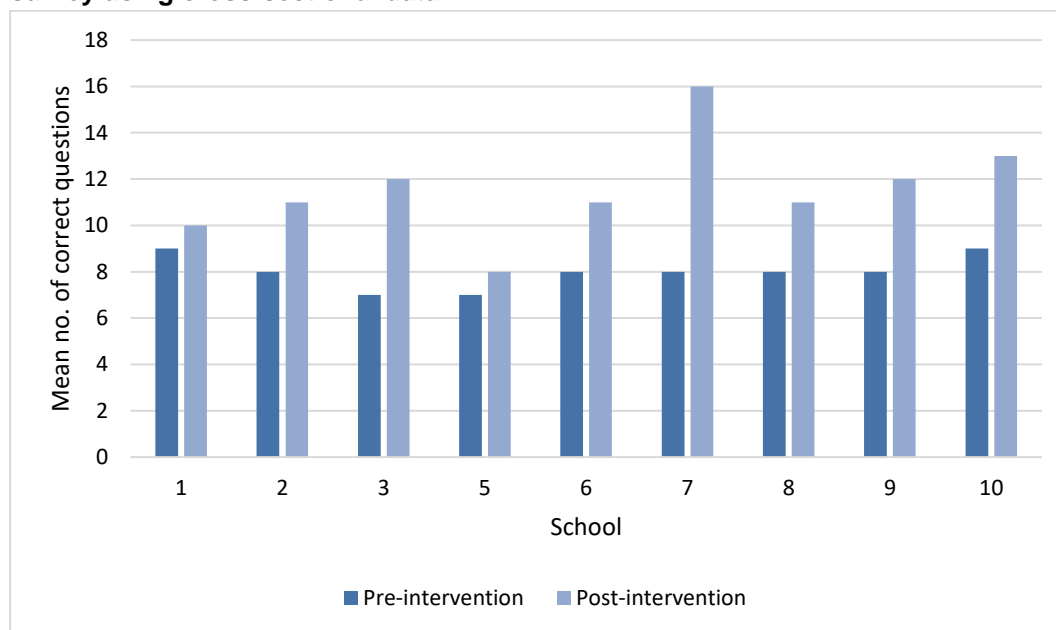
Table 11 details the number of returned completed or partially completed sleep quizzes by school. The project delivery team reported that School 4 lost all but three of their completed sleep quizzes at the post-intervention stage. This resulted in an overall drop in participation of 12% ($n=131$), although if School 4 is excluded, the fall in participation is 1.6% ($n=16$).

Table 11: Sleep quiz return numbers by school

School ID		No. of returned sleep quizzes	
		Pre-intervention	Post-intervention
1	55		43
2	93		72
3	126		121
4	118		3
5	60		82
6	94		117
7	111		105
8	162		167
9	143		159
10	132		101
TOTAL	1094		970

Figure 5 illustrates the mean number of correct responses by students (overall) when completing the sleep quiz pre- and post-intervention, by school. These are for all pupils completing the quiz prior to the intervention and all pupils completing the quiz post-intervention. Results for pupils who completed all of the pre- and post-intervention quizzes are reported in Appendix 11 with partial scores included. Pupils from School 4 have been excluded due to their lack of post-intervention response. From the cross-sectional data, there is a trend for scores to increase between pre- and post-intervention with mean scores increasing from 9.7 pre-intervention to 11.7 post-intervention. It is important to acknowledge that the sleep quiz is not a validated measure, however it provides a useful measure of sleep knowledge for the purposes of this study.

Figure 5: Changes to students' knowledge of sleep from pre- and post-intervention sleep quiz survey using cross-sectional data



Self-reported sleep

Research question: Was student sleep patterning, sleep hygiene, and daytime sleepiness affected by the intervention according to the completed sleep surveys?

Table 12 details the number of returned sleep surveys pre- and post-intervention by school. Some surveys were returned partially incomplete. Where available, including partial responses, data was included in descriptive analyses presented below.

Table 12: Number of sleep surveys analysed pre- and post-intervention by school

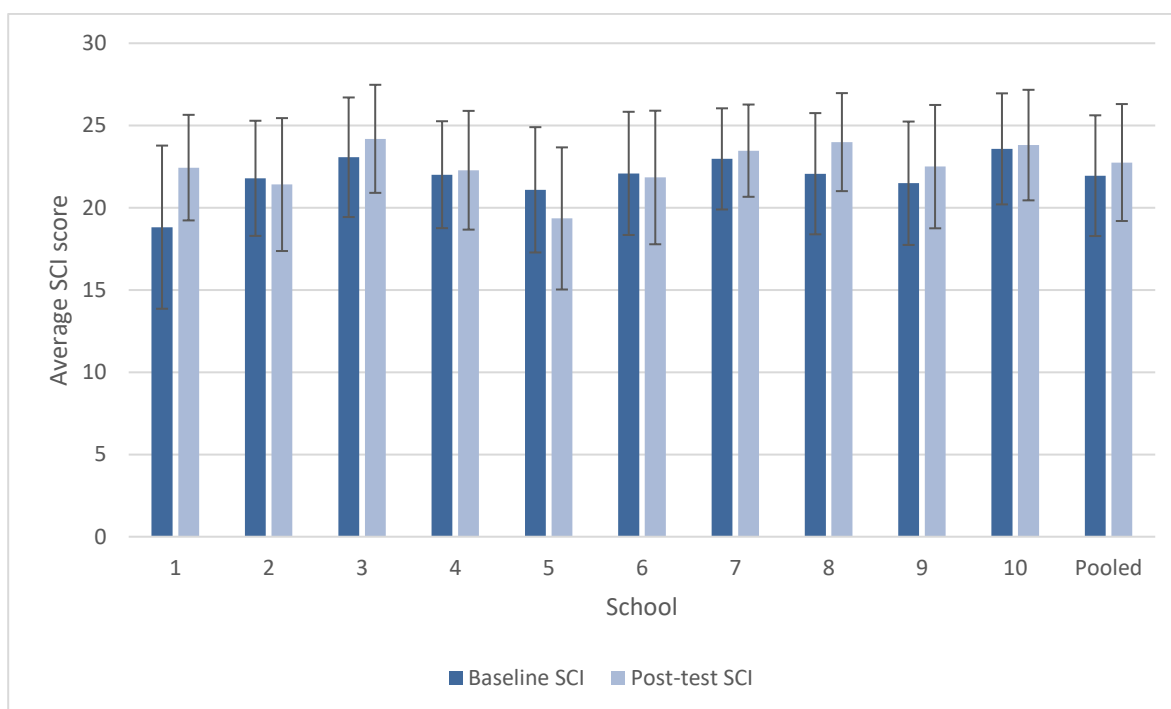
School ID	Cohort size	Pre-intervention	Post-intervention
1	77	74% (57)	35% (27)
2	143	85% (122)	51% (73)
3	132	89% (118)	75% (99)
4	176	70% (123)	58% (103)
5	178	62% (110)	23% (40)
6	134	87% (117)	71% (96)
7	112	96% (107)	92% (103)
8	217	76% (165)	62% (135)
9	192	88% (169)	65% (125)
10	143	35% (50)	15% (21)
Total	1504	76% (1138)	55% (823)

It should be noted that one respondent was not assigned to a school so was included in total figures but not in school-level analyses.

The sleep survey included the validated 'Sleep Condition Indicator' (SCI) developed by Espie *et al.* (2014) which gives an indication of: students' sleep, concerns about getting to sleep, remaining asleep, sleep quality, daytime personal functioning, daytime performance, duration of sleep problem, nights per week having a sleep problem, and extent troubled by poor sleep. Each item was scored on a five-point scale (0–4) with a possible total score range from 0 to 32, with higher values indicative of better sleep. Students with no responses whatsoever were excluded from the analyses. Partial responses were included (105 partial responses at baseline and 77 at post-test). The approach to include partial

responses was a pragmatic decision. Individual student scores were totalled, and an average was calculated for each school for pre- and post-intervention, along with pooled averages for the total dataset. Pooled averages for SCI score were 23.58 (SD 3.4) for baseline and 23.81 (SD 3.4) for post-test. Cronbach's alpha for internal consistency was 0.854 for baseline and 0.833 for post-test.

We have also analysed the data from full responses for the full sample by way of comparison. At baseline, the mean score was 21.95 (SD = 7.3) and 22.75 at post-test (SD = 7.1). The results from both analyses should be viewed with caution due to the analysis of both partial and full responses. Figure 6: Average pre- and post-intervention SCI scores with 95% confidence intervals by school, for all participants



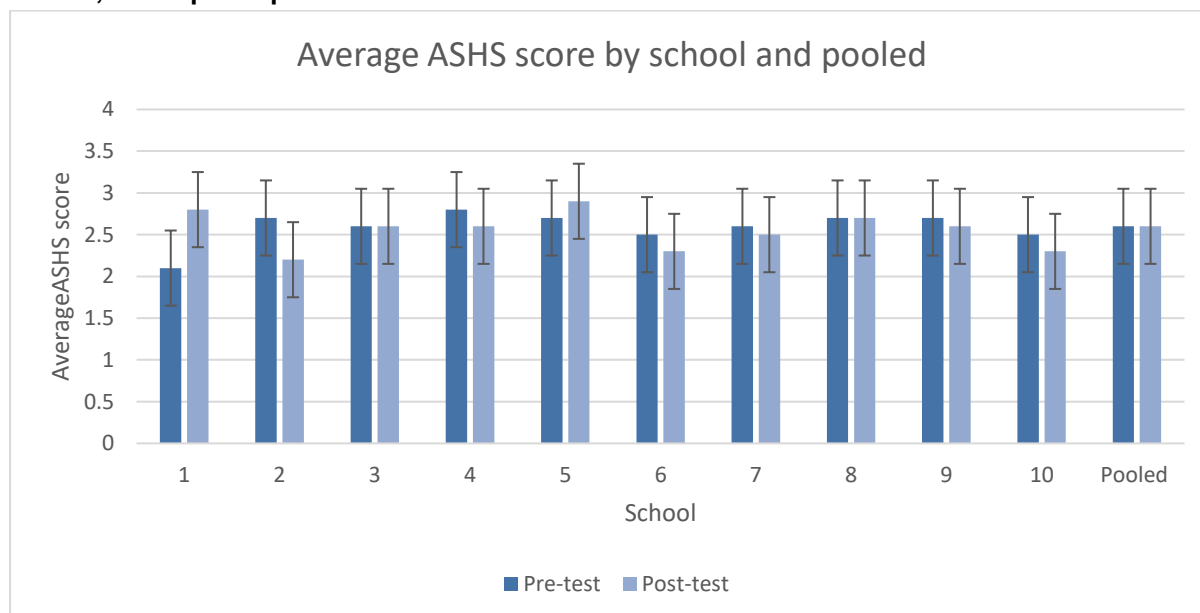
This descriptive analysis was repeated for the sub-set of participants in each school that completed the survey at both pre- and post-intervention. This included partial responses. A table of averages for students with both pre- and post-intervention measures can be found in Appendix 11 and shows a total increase of 0.36 between pre- and post-intervention for this group.

Questions within the sleep survey, which originated from the Adolescent Sleep Hygiene Scale (ASHS), were used to understand potential differences in students' sleep hygiene pre- and post-intervention. The ASHS is a 32-item self-report measure designed specifically to assess theoretically-based sleep hygiene domains thought to influence sleep quality and quantity among youths aged 12 years and older (Storfer-Isser *et al.*, 2013). In previous research higher total sleep hygiene scores from the ASHS have been associated with better sleep (Storfer-Isser *et al.* 2013). Storfer-Isser *et al.* found that 24 items formed a valid set of subscales and these were used in the analyses which follow. The survey responses were scored using a six-point ordinal rating scale ranging from 1 (never) to 6 (always); adolescents indicated how often each item occurred during the past fortnight. Higher scores indicate better sleep hygiene. Each subscale score is calculated by taking the average of the items comprising that subscale, and the mean of the subscale scores is used to create the total sleep hygiene score, presented in Figure 7 as the average by school for all participants. This average score was 2.6 (SD = 0.9) at pre-intervention and 2.6 (SD = 0.9) at post-intervention. Partial responses were included (255 students with partial responses at baseline and 1,87 at post-test). The approach to include partial responses was a pragmatic decision.

Cronbach's alpha to assess internal consistency for the 24 items in the ASHS-r was 0.83 for baseline ASHS-r and 0.85 for post-test.

We have also analysed the data from full responses for the full sample by way of comparison. At baseline, the mean score was 2.6 (SD = 0.9) and 2.6 at post-test (SD = 0.9). The results from both analyses should be viewed with caution due to the analysis of partial and full responses

Figure 7: Average pre- and post-intervention ASHS scores with 95% confidence intervals by school, for all participants



Appendix 11 shows a table of averages showing matched data for participants completing both pre- and post-test sleep surveys, where we see a similar pattern to the analyses presented here with all participant data included.

Questions within the sleep survey relating to daytime alertness/sleepiness originated from the Cleveland Adolescent Sleepiness Questionnaire (CASQ). All 16 questions relating to these subscales required students to respond to a five-point Likert scale, the ranges of which included:

- never (0 times per month);
- rarely (less than three times per month);
- sometimes (1–2 times per week);
- often (3–4 times per week); and
- almost every day (5 or more times per week).

For the purposes of these descriptive analyses, the Likert responses were coded from 1–5 with a higher score indicating a higher level of daytime sleepiness or a lower level of daytime alertness. Scores were totalled for each student and averaged by school. Partial responses were included. Pooled averages for daytime sleepiness from CASQ were 19.7 (SD = 3.4) for baseline and 20.2 (SD = 3.5) for post-test. As illustrated in Figure 7, self-reported daytime sleepiness increased slightly in five schools from pre- to post-intervention. Self-reported daytime alertness increased slightly in four schools from pre- to post-intervention as illustrated in Figure 8. Pooled averages for alertness from CASQ were 13.9 (SD = 2.6) for baseline and 13.9 (SD = 2.3) for post-test. Cronbach's alpha was calculated for the alertness and sleepiness subscales separately. For baseline, alertness $\alpha = 0.79$, sleepiness $\alpha = 0.83$; whilst post-test alertness $\alpha = 0.83$, sleepiness $\alpha = 0.84$.

Cronbach's alpha for the full scale (with the alertness items reverse-scaled) was $\alpha = 0.84$ for baseline and $\alpha = 0.85$ for post-test.

At baseline, the mean total score for the full scale, including partial responses, was 35.4 (SD = 10) and for post-test was 35.8 (SD = 9.6). For pupils with full responses, the mean total score at baseline was 35.9 (SD = 9.8) and for post-test was 36.3 (SD = 9.3).

Figure 7: Average pre- and post-intervention daytime sleepiness scores (CASQ) with 95% confidence intervals by school

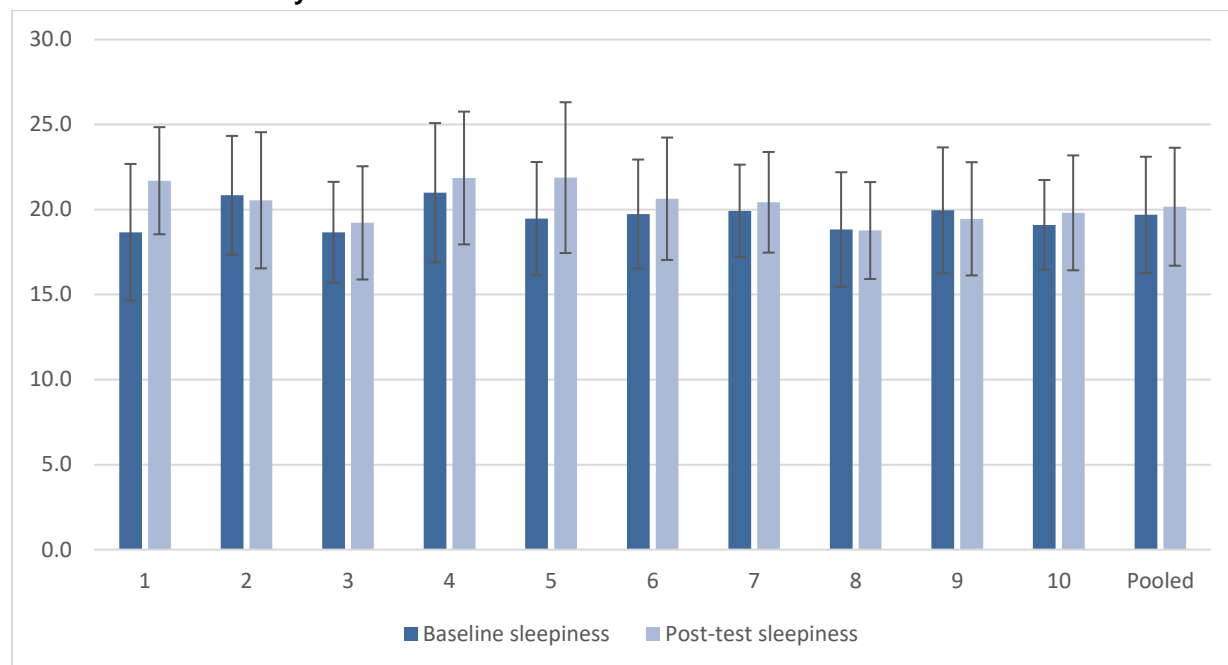
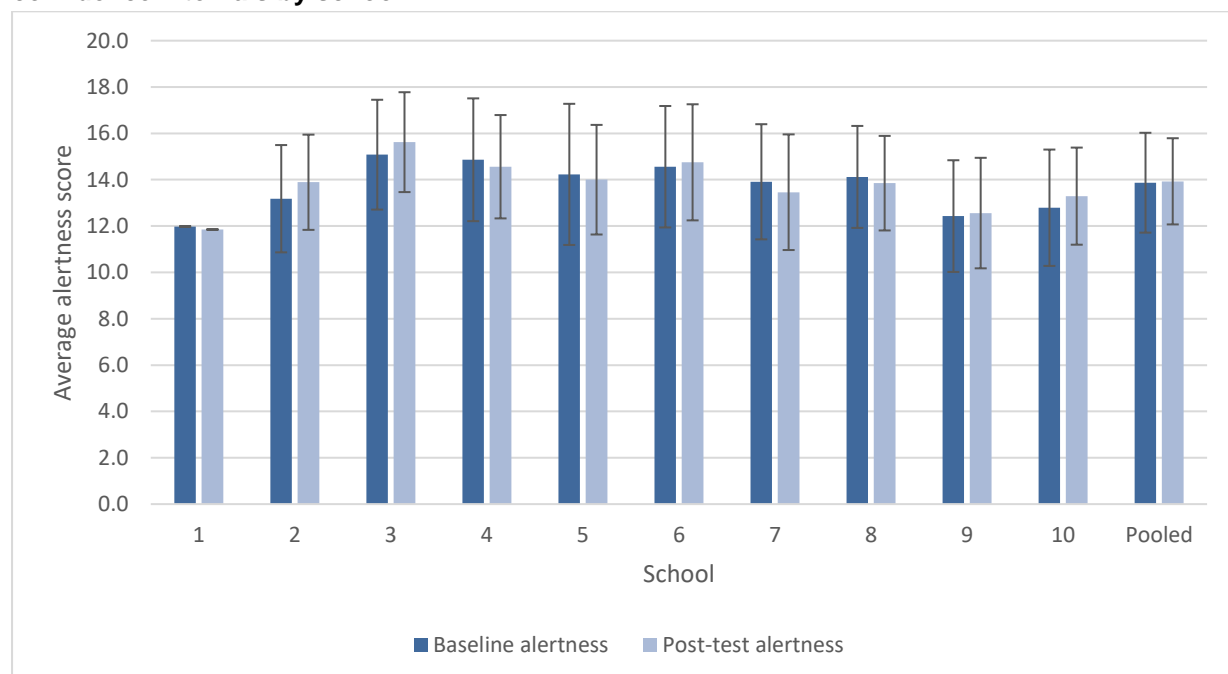


Figure 8: Average pre- and post-intervention daytime alertness scores (CASQ) with 95% confidence intervals by school



Feasibility

The data included in the next two sections of the report (Feasibility and Readiness for Trial) was collected independently by the evaluation team.

The lead contact in each school provided a delivery timetable to the evaluation team so that they could monitor whether the schools delivered the programme as they had planned. The evaluation team's administrator contacted the teachers from each school on a weekly basis to establish whether the lessons went ahead as planned. Seven of the ten schools provided some responses over the ten weeks confirming that the sessions had been delivered as planned. No school provided a full set of responses for all ten sessions taught.

In total, 29 responses were received to the teacher training survey and 28 to the teacher delivery survey.

Three schools participated in the case study visits. These included observations of teacher training and lesson delivery as detailed in Table 13. Semi-structured interviews were conducted with the lead contacts from each of the case study schools and, where possible, with a teacher that delivered the lessons to students (either in person after the observations, or by telephone at a later date). A recording of each interview was transcribed and analysed to elicit key themes discussed by staff. In one school the lead contact was interviewed twice; in another school one interview was conducted with the main lead contact who led the cascade training and a teacher who attended the cascade training (a second lead contact sat in on the interview); and in the longitudinal case study school, the lead contact was interviewed once. Of the remaining seven non-case-study schools, only two conducted cascade training. Whether cascade training was conducted depended on whether all staff who would be delivering the intervention had attended the initial training. Where cascade training was needed, its delivery was variable. Some schools held full training sessions as per the original training by the project team. Other schools could not provide timetable space for cascade training and so this was delivered ad hoc, sometimes in a quick ten-minute briefing, and sometimes via email. Lack of time for proper staff training has implications for the feasibility of wider project roll-out. A teacher from each of these schools was invited to participate in a telephone interview; both teachers agreed, however due to illness, one teacher was unable to be interviewed.

Table 13: Case study observations

School ID	Lesson observation	Training observation
3	Lesson 3	Project delivery team led training and cascade
	Lesson 9	
4	Lesson 4	Project delivery team led training and cascade
	Lesson 6-7	
	Lesson 10	
5	Lesson 4	None
	Lesson 10	

Student focus groups were conducted in the three case study schools to capture student views of both the Teensleep intervention and to assess whether students had difficulties with the data collection procedures. In each of the three schools, a focus group was conducted with pupils who participated in the actigraph or sleep diary data collection ($n = 17$; consisting of three, eight, and six students). Group sizes fluctuated due to the number of pupils who returned parental consent who were willing and available to participate. In two schools, a focus group was also conducted with pupils who received the intervention but did not participate in the actigraph or sleep diary data collection ($n = 15$, six students in one group, nine in the other). Whilst all attempts were made to gather consent, response rates were low. In one school no students returned consent to take part in the non-actigraphy focus group.

Evaluation of teacher training

Observations were made of the project delivery team's teacher training sessions; these were structured around the student and staff workbooks with the help of supporting PowerPoint slides. Training covered basic sleep science, circadian biology, sleep hygiene, external influences on sleep, stress management, and behaviour change. A large amount of time was spent explaining the science behind the OTS programme (lessons 1–3), while training on the content of lessons 8–10 at the end of the session felt rushed due to timing constraints. However, given the level of detail in the workbooks and accompanying information, teachers received sufficient information to deliver the lessons. Session discussions focused on potential difficulties that may be encountered when delivering the lessons and strategies to mitigate these. Staff appeared engaged, but would have benefitted from a comfort break mid-session. In addition to delivering programme content, staff were encouraged to promote the OTS programme using in-school plasma screens and parental information leaflets. Staff were also offered codes to gain free access to 'Sleepio', a Cognitive Behavioural Therapy-based (CBT) website designed by the PI for use by adults (subsequent teacher surveys indicated that four teachers accessed this, 22 did not, and two did not know what it was).

Training evaluation also included responses to a training survey. Using a five-point Likert scale from 'strongly disagree' to 'strongly agree', teachers reported the training was informative, engaging, and easy to understand. Approximately half (17 of 29) of the teachers felt the training was too long. Suggestions for improvement included spending less time on the 'science' of the programme, that details for each lesson were unnecessary and a summary would suffice, that training could be more interactive, and to circulate slides prior to training. One participant wished the training was held on a staff development day. In five out of ten schools, teachers who attended the training were required to cascade information to other staff members; all 11 respondents felt confident about this and that the materials provided would help them to do so.

Cascade training was delivered at the school's discretion, depending on time restrictions and staff availability. One school delivered it as a block at the beginning of the programme, one school cascaded lessons on a weekly basis, and two schools provided block sessions. Each school attempted delivery as a group but encountered difficulties getting everyone together for sessions. The total time spent on cascade training, reported ad hoc by teachers during interviews, ranged from 30 minutes to 2.5 hours. In the school that devoted the shortest time to cascade training it was described as a 'condensed session' in which the PowerPoint slides were not discussed individually, and staff were encouraged to spend their own time looking at the materials provided. Another school provided weekly sessions with email used to 'drip feed' information to tutors immediately before delivering to students. Observation at this school found that staff received a handout with some brief written notes as a guide to teaching the lessons, as well as access to the PowerPoint presentation containing the full training notes.

Interviewees considered that the training provided was sufficient for staff to deliver the lessons to the students. This was largely attributed to the quality of the teaching materials from the delivery team. Only two issues were raised about the training materials. Firstly, one school reported that the box of staff workbooks had gone missing, suggesting they were used in cascade training. Secondly, one interviewee commented that the staff workbooks were 'a bit overwhelming' and the student version was more user-friendly.

A key obstacle to cascade training was the organisation of sessions in the restricted time available. In some instances, training was arranged during staff break times and after school hours. This made it more difficult to get staff 'on board' with the programme.

Evaluation of programme implementation

The OTS programme was developed to be delivered flexibly within PSHE sessions or form time. It was a priority for all schools that the programme should not impinge on the existing curriculum. As detailed

in Table 14, schools chose to deliver the programme variably. Most delivered the OTS lessons during morning tutor time—a 30-minute slot often used for teaching PSHE—however, observations found that some of this time was taken up by pupil registration and other administration tasks leaving only 20 minutes to deliver the lesson. One school chose to deliver most of the programme in one enrichment day (occasional days when the whole school are off timetable). Regardless of delivery method, all schools reported delivering the whole programme.

Table 14: Participating schools' programme delivery schedules as reported in teacher interviews

School ID	Delivery structure	Delivery time period (all 2016)
1	1-hour session weekly	16/09–05/12
2	30-minute sessions weekly	26/09–25/11
3	30-minute sessions weekly	2/11–14/12
4	4x 30-minute session + enrichment day	11/10–20/10
5	20-minute sessions twice weekly	31/10–28/11
6	20-minute sessions twice weekly	12/10–07/12
7	30-minute sessions twice weekly	10/10–04/11
8	20-minute session twice weekly	17/10–21/11
9	10x 25-minute sessions	12/10–17/12
10	4x15-minute sessions weekly	02/10–12/12

There were 59% (17 of 29) of teachers in the teacher delivery survey who stated that they would make changes to the way in which the OTS programme was timetabled and delivered within their school, specifically mentioning time constraints, lesson length, and where the lessons fitted within the curriculum.

The advantages of delivering the programme over weekly sessions within familiar tutor groups were highlighted by one interviewee who felt this format would be a '*safer environment*' meaning that students would be more receptive and willing to discuss sleep within their acquainted tutor group as part of a non-curriculum subject. Feedback from staff that implemented the day long 'enrichment day' programme was that the format was not ideal and '*a bit of an overkill*'. It was felt that the programme would have worked better if it had been delivered as per the recommended ten-lesson structure. Observation of the day-long format also found disruptive behaviour among some pupils who had to be removed from the lessons. This was suggested to have been caused by students being taught in their PE sets (same sex groups) and not in their usual tutor groups with their familiar tutor.

In interviews, staff felt strongly that lessons and staff training should be scheduled into the timetable well in advance and lessons should afford sufficient time to cover the content for the programme to be successful. This is important for any planned future trials in schools.

Evaluation of lesson delivery

Student group size ranged from 13 to 25 and the classroom arrangements differed across the observations; some classrooms were traditionally set out whilst others took place in a computer, science, food technology, or drama room. Teachers were consistent in following the PowerPoint format and students utilised the workbooks as lessons proceeded. Most teachers complemented the slides with personal anecdotes to prompt students to think about the issues being raised and initiate discussions; this engaged students well, facilitated learning, and reduced student distraction. However, due to time restrictions, teachers often had to limit debates and the observer felt that lessons were too

fast-paced. One teacher dimmed the lights during the guided imagery exercise; in another school it was emphasised '*it's up to YOU to make the changes*'. In most cases lessons were concluded by the teacher summarising at least some of the take home messages.

Observers noted some potential delivery problems, for example, where students were asked to carry out sleep schedule calculations, some students who had poorer maths skills had made errors or required extra help that could not easily be accommodated in class time. Also, when talking about bedtimes, 'shocked noises' and 'subtle shaming' occurred between students. Potentially, these discussions could cause embarrassment and teachers may need guidance on how to approach this exercise.

Perceived impact of staff participation

Although no formal staff feedback about the programme was gathered by the schools themselves, interviewees relayed general opinions of staff about the OTS programme. The consensus was that staff had found teaching and learning about the programme interesting and useful especially as they could see that most students were enthused and had 'embraced' the programme.

Staff also expressed that it was important to receive information and feedback on the impact of the trial (individual school results as well as overall) and many looked forward to hearing the results of future studies. This evidence (particularly in relation to the individual school results) was considered important for schools to have available when deciding whether or not to adopt the programme.

Perceptions of student focus groups

The majority of student focus group participants seemed to have clear recollection of the programme and various aspects of the lessons although it is important to acknowledge that there was a time span between the intervention and the focus group. Several participants found the information they had learned was previously unknown to them or had elaborated on their existing knowledge base. A minority of focus group participants spoke less favourably about the programme or had a poor recollection of the format and content of the lessons, including a lack of understanding of the information taught and the feeling that the lessons were 'boring'.

In the focus groups, participants recalled the PowerPoint presentations, completing the workbooks, group discussions, and keeping sleep diaries. One mentioned watching a video. Some felt that parts of the programme, particularly towards the final lessons, were unnecessarily repetitive.

Some of the focus group participants (17 of 22) discussed whether the programme had resulted in behavioural changes. They reported making at least one change as a result of the lessons, such as alterations to sleep schedules, changes in use of electronic devices, and use of guided imagery/breathing techniques. Only three participants commented that they had not wanted or needed to implement any changes, although it was clear that they had gained new information from the lessons.

Participants reporting that the changes were effective described feeling more rested, feeling fresher on waking, not as tired in lessons/more productive, being more aware/in control of sleeping patterns, feeling less stressed before sleep, experiencing better quality and longer sleep, improved mood, and better concentration. However, some participants continued to struggle to get out of bed in the morning and felt sleepy during lessons. Furthermore, it was evident that not all the changes were applied consistently. For example, some participants only implemented changes such as sleep schedules during weekday evenings and behaved differently on weekends and school holidays.

Approximately half of the focus group participants (17 of 32) discussed reasons why it could be difficult for them to implement what they had learned during the programme. Commonly cited reasons were disruptions from siblings, distraction of mobile phone when in bed, stress or worry about school work,

and staying up later on non-school nights. When families weren't on board, participants felt they had little power to make changes.

Readiness for trial

Replicability, scalability, and affordability

The evaluation team surveyed teachers about how closely they followed the content of the OTS lessons as detailed in the teachers' workbook and the lesson PowerPoint slide; 13 of 28 responded 'completely', 14 of 28 'somewhat' and one teacher responded, 'not at all'. Some teachers indicated what they changed to suit their class/school including: allowing more time for discussion, adjusting length of the lessons, skipping over slow paced content, providing context, and talking about their own experiences.

The cost of delivering the programme varied between schools.

Affordability of the programme was mentioned during staff interviews. The initial in-school training visit included the staff time of two researchers to deliver the half-day training plus appropriate travel and subsistence (car hire: £1,261.01; petrol (and parking): £303.21; and accommodation totalling £851.88 covering all participating schools in the evaluation). The project delivery team provided all printed materials (teacher/student handbooks) to schools in the pilot study. Training and resources could be delivered online as a means of reducing the 'start-up' costs to schools.

In relation to staff time, it was a requirement for two staff members to attend the training for three hours. Additionally, schools reported spending an average of 1.5 hours cascading the training to other staff members. Of the 28 teachers who completed the survey, 27 reported how much time they spent planning/preparing to deliver each lesson beyond the training they received. Six responded 'no time', 19 responded 'up to 30 minutes', and two responded '30–60 minutes'. Some schools suggested using actigraphy as part of the programme, but this is not necessarily advocated and would significantly increase the cost of the programme to the school with each actigraph costing an estimated £500. Given the high cost per unit this would seem prohibitive.

To summarise, the costs were as follows:

One-off teacher training session per school

Three hours of programme developer time to deliver training plus travel expenses between Oxford and the school location (car hire: £1,261.01; petrol (and parking): £303.21; and accommodation totalling £851.88 covering all participating schools)

Three hours per teacher

Printing and delivery of materials

Student workbooks	£2.29 per pupil
Teacher workbook	£0.07 per pupil
Sleep diary	£0.03 per pupil
Parent leaflet	£0.10 per pupil
Delivery of materials	£0.38 per pupil
Total printing and delivery	£2.87 per pupil

Staff time

30 minutes preparation before each lesson, 5 hours in total (based upon modal response from teachers' survey)

10 x 30-minute lessons (or 5 x 60-minutes) of lesson time to deliver the intervention.

Replicating at different times of year could usefully inform the timing of a full trial. Another consideration for future projects would be to focus on the sleep survey as the outcome, which would be more feasible than actiwatch to employ on a large scale. Ultimately, the primary outcome would be student attainment so the sleep survey results would be a secondary outcome.

Lessons learnt from sleep data collection

As detailed in **Error! Reference source not found.** (above), the number of 'eligible' actiwatch and sleep diary data points captured suggests a two-week collection period is burdensome for the target population. Student focus group data indicated that missing data in the actigraph and sleep diary exercises were mainly due to forgetfulness. This may explain the high number of unreturned 'missing' actigraphs ($n = 12$). The lost actigraphs also suggests a need for better processes to be in place for the return of the devices, considering the vast expense per unit.

Around half of the focus group participants in the actigraph group (9 out of 17) reported either forgetting to press the button on the actigraph or forgetting to complete the sleep diary, with some reporting that they filled the diary in at a later time. Participants forgot to put the watch back on after showering, and commented that in the post-test period the actiwatch was no longer a novelty and therefore they found it harder to remember to collect the data.

Three students stated that the actigraph was itchy and irritated their skin and one said it would dig into their arm when sleeping, another adding that it increased their anxiety when they could see that they had not had enough sleep.

One participant admitted to changing their behaviour (going to bed earlier) during the data collection period so it looked like they were 'sleeping properly' and another admitted to wearing a friend's actigraph as well as her own for a two-day period.

'I ended up wearing two... my friend she went swimming, and I was on the side, 'cos I couldn't go swimming so I took hold of her watch and I completely forgot, so I was like pressing two buttons at night and pressing two buttons in the morning and remembering two times... I was messaging her in the morning, with like, 'you went to sleep at this time.' (Focus group C, actiwatch wearing female)

This suggests that a Hawthorne effect (actiwatch or sleep diary group participants adjusting their behaviour because they are being studied) may have influenced the data captured during this project. It is likely, however, that a Hawthorne effect would have been stronger in the pre-test data collection phase (due to the novelty of the data capture procedures) than in the post-test phase. Therefore, it is unlikely to have produced spurious improvements in sleep following implementation of the programme. In fact, there is some evidence from student comments that it had the opposite effect, with students forgetting to capture data in the post-test phase of the pilot study. As there was no 'control group' in this study there is no opportunity for a John Henry effect here, but this might be a concern if this project were to be studied in a RCT.

The above information suggests that actigraphy is not a suitable method of data collection for use with teenagers as missing data and experimental effects would drastically compromise a trial. At present, however, there are no other ambulatory methods for capturing validated sleep data. Teenagers are probably the most difficult group to work with in this kind of study.

Data collection using questionnaires

A proportion of students did not complete all questions within each questionnaire; there were several partial responses. Consideration should be given to methods to encourage students to complete as many items as possible within each instrument.

Conclusion

Key conclusions

1. There was no evidence that Teensleep improved students' sleep as measured using a wrist-worn activity monitor before and after the intervention. The absence of a comparison group, and high attrition, reduces the security of this finding.
2. Students' self-reported sleep-related behaviours improved, namely daytime napping reduced, and students' knowledge of sleep increased.
3. All schools reported delivering the full programme, although they were constrained by limited available time for cascade training. Teachers reported that this constraint was offset by the programme's well-structured resources.
4. Teachers and students were enthusiastic about the project and were receptive to the future incorporation of Teensleep into their school's curriculum following refinements to reduce some repetitive content and make the lessons more interactive.
5. The collection and analysis of sleep data was challenging. There was variation in how different students used the wrist-worn activity monitors and in how different researchers interpreted the data. Both of these issues would likely benefit from further piloting to ensure consistency before an impact evaluation.

Formative findings

The pilot study, in particular the feedback received from teachers and students, has highlighted a number of ways in which the intervention could be improved. To summarise, **participants recommended:**

- Reducing the amount of time required for teacher training would be appreciated by staff. Some participants favoured the option of online training, however as this was not tested in the pilot study it is unclear whether it would reduce the efficacy of the training.
- Requiring schools to adopt a formal cascade training method and time slot could be beneficial in order to ensure teachers have adequate preparation time. To facilitate this, the lead-in time for schools delivering the programme needs to be substantially enhanced to allow schools to schedule the programme into their timetables/curriculums appropriately.
- Providing information on an optimal delivery schedule and time allowance for each lesson. Whilst a flexible delivery schedule is appealing to schools, the quality of delivery within certain timeframes and within certain classes needs to be taken into consideration. Frequent, scheduled sessions over a longer timescale appeared to be the most favoured by teachers. There was also feedback to suggest that form time was not suitable due to required daily commitments and that content would be better placed within dedicated PSHE lessons.
- Reducing the amount of 'science' content in staff training and lesson content as this is less likely to drive behavioural change, unlike practical interactive lesson strategies/activities.
- Including actigraphs (or a similar, lower cost device) to encourage students to focus on their sleep patterns as part of a sleep programme package may enhance student engagement.
- Conducting a thorough review of materials to exclude repetition and the inclusion of more interactive activities.

The pilot study data examined by the evaluation team reveals several difficulties that would be encountered in moving to a main trial:

- poor engagement of some schools in obtaining and returning consent forms and data;
- large amount of attrition from pre-test to post-test phase of data collection;

- loss of data due to 'forgetfulness' of pupils in wearing actiwatch, recording sleep diary data, and in losing/failing to return actiwatch;
- experimental effects in data collection when recording sleep diary data;
- some inconsistencies in scoring actigraphic sleep data (we have worked with the project delivery team to develop an improved protocol); and
- selection of pupil participants based on self-reports of sleep problems and related health issues.

Interpretation

As detailed in the Theory of Change (page 8), the purpose of the OTS programme was to increase adolescents' knowledge of the science of sleep including how sleep quality and timing affects school performance and wellbeing. By equipping students with knowledge and appropriate skills, positive changes to sleep and sleep-related behaviours should be observed. Despite knowledge of these subjects increasing, the OTS programme did not directly improve students' sleep as measured with instruments; the descriptive analysis of students' pre- and post-intervention actigraphy data indicated that students' sleep efficiency (defined as the proportion of time in bed that participants are actually asleep) and night-time sleep duration did not change as a result of the OTS programme. The actigraphy data did highlight substantial underlying variations in students' sleep. Whilst sleep efficiency or length did not increase pre- to post-intervention, self-reported sleep diary data indicated that sleep-related behaviours, namely daytime napping, reduced, and the sleep quiz indicated that students' knowledge of sleep increased. Also, small improvements were observed in students' perceived sleep quality, daytime sleepiness and alertness, but no changes in sleep hygiene behaviours from pre- to post-intervention were identified. These findings provide weak support for some of the assumptions of the Theory of Change.

In general, the OTS programme was well-received by both students and staff at the participating schools. Following training delivered by the project delivery team, teachers reported feeling prepared to deliver cascade training and the lessons, although feedback suggested the training could be condensed. Many staff expressed excitement and optimism and felt that the programme could help to combat a recognised problem amongst students and consequently improve student performance, health, and wellbeing.

Cascade training varied between the schools in frequency, duration, and depth of content covered. However, any shortfall in the cascade training appears to have been ameliorated by the quality of the materials supplied to staff—the PowerPoint presentations and workbooks. This, on the whole, enabled the lessons to be delivered to students in a consistent manner. Barriers and challenges to delivering the cascade training were largely related to difficulties organising mutually convenient meeting arrangements and the restricted amount of time available to staff.

The delivery of lessons to students was also constrained by the limited timetable availability. One school opted to deliver the majority of the programme over one day whilst the rest provided weekly lessons to pupils. Feedback from the interviewees indicated that the suggested format of ten half-hour lessons was the most favourable option. There was some suggestion that students may benefit from each lesson being made longer to allow time for more group discussions, playing of video clips, and to cover the programme content in more depth.

Student focus groups demonstrated that students had a clear recollection of the OTS programme and were able to recall different aspects of the lessons with several stating that they had found the information interesting and useful. Only a small number of participants found some of the lesson content to be unnecessarily repetitive or uninteresting.

Overall, it appears that both staff and students would be receptive to the future incorporation of the OTS programme into their school's curriculum. Constructive criticism and comments from staff and lesson observers have indicated that few changes would be required to the actual programme content but

attention would need to be given to ensuring that staff training and lesson delivery was organised correctly to ensure both staff and students fully benefitted from the programme. That two schools dropped out, and some struggled with delivering cascade training and fitting class delivery into the timetable, suggests some difficulties with feasibility.

Some focus group participants acknowledged making behavioural changes as a result of the programme with the most common changes being to sleep schedules, use of electronic devices, and the employment of guided imagery/breathing exercises. The majority reported that they had recognised the beneficial effects of the changes on sleep quality and duration as well as having a wider positive impact on everyday life, such as improved mood, better concentration and feeling more rested. The overall theme emerging from the focus group discussions was that most participants had gained a better understanding and appreciation of the ways in which sleep affects, and can be affected by, lifestyle, health, and wellbeing.

Focus groups also highlighted issues that were apparent barriers to implementing the knowledge gained by students from the programme; these included disruption from siblings, distraction from mobile phones, worries over school work, and changes to routines on non-school nights. For those that participated in the actigraph and sleep diary data collection, the main barrier was forgetting to complete the activities. There were also some issues that came to light that may have affected the accuracy of the data collected (such as students wearing another's actigraph and falsifying data records).

Limitations

Generally, there was low representation from EEF target schools (those with more than 30% FSM pupils). The inclusion of two selective schools may mean that the findings are not generalizable to EEF target schools.

The opt-in consent process developed by the project delivery team was challenging to implement in practice. The project delivery team provided schools with the relevant information sheets and consent forms to distribute to students for them to gain opt-in parental or guardian consent from those willing to take part in the actigraphy and sleep diary data collection. Completed consent forms were to be returned to relevant teachers prior to the project delivery team's scheduled visit to the school, when consent would be checked for completeness and the eligibility screening interviews and actigraphy training would take place. In some schools, teachers selected students to attend the sleep screening interview without knowing whether a complete consent form had been returned. In some cases, the project delivery team conducted sleep screening interviews with students and collected some or all sleep data without the opt-in parental consent being in place. Due to a lack of consent, some of the collected data could not be returned to the evaluation team for inclusion in the descriptive analysis presented in this report. Where the relevant consent was present, student-selection by teachers may have influenced engagement and introduced bias to the findings presented here. Moving forward, the process for obtaining consent for such data collection tools requires re-development and piloting prior to any future data collection.

The condensed timeline for the delivery of the programme within schools (during autumn term) impacted on pre- and post-intervention data collection periods. In schools that chose to deliver the programme intensely, over a short period, pre- and post-intervention data collection points were very close together. This was less of an issue in schools that chose to spread the delivery of the programme over the full term; however, in one school post-intervention sleep data collection overlapped into the Christmas vacation meaning that this data had to be excluded from the analysis as it did not represent a normal 'school week', Monday to Friday.

The actigraphy scoring protocol requires further development for use within a main trial where a large amount of data would require entry and coding by multiple research staff. The development of a replicable protocol, based on Appendix 9, should be thoroughly piloted prior to the entry and coding of

further actigraphy data in a bigger trial. In a randomised trial there is the potential for invalidation via Hawthorne and John Henry effects, and for potentially large attrition that would also result in a biased sample.

Practical constraints meant that it was not possible to adopt a randomised controlled design for this study (see Design section for further details). As a result, there was no control group for a chronological comparison of the outcomes. It should be noted that the sleep quiz implemented to determine changes to students' knowledge of sleep was not a validated measure.

Future research and publications

Suggestions for future trial methodology, design, and outcome measures have been noted throughout the report. To summarise, these include:

- The process for obtaining consent for data collection requires redevelopment and piloting prior to any future data collection.
- The development of a replicable protocol, based on Appendix 9, should be thoroughly piloted prior to the entry and coding of further actigraphy data at main trial to ensure results do not over- or under-estimate the impact of the intervention.
- As the sleep quiz implemented in this pilot study was not a validated measure, the implementation of a validated measure to capture changes in sleep knowledge pre- and post-intervention should be considered.
- Independent scoring of actigraphy data should be conducted for all outcome measures given the problems noted with replication and consistency.

During the project delivery interview, questions for further research were discussed. These included:

- Is an improvement in actual sleep or perceived sleep associated with improved educational outcomes?
- Does the OTS intervention impact differently on students depending on their demographics and academic ability—that is, do advantaged, higher ability students benefit disproportionately from the intervention because they have a greater understanding of the material and are therefore more able to implement it and are generally more motivated? Could the intervention increase inequalities in educational outcomes if the lowest achieving students do not have the capacity to be able to modify their sleep environments or sleep disruptions?

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Appendix 1: Project delivery team information sheet and memorandum of understanding

School Agreement to participate in the Teensleep Pilot Study

Please sign two copies, retaining one and returning the second copy to Claire Beauchamp at the Sleep and Circadian Neuroscience Institute, Nuffield Department of Clinical Neurosciences, University of Oxford, Oxford Molecular Pathology Institute, Sir William Dunn School of Pathology, South Parks Road, Oxford, OX1 3RE.

School Name: _____

Aims of the Evaluation

The aim of this pilot project is to evaluate the impact of the Teensleep education programme, the largest study ever to assess the effects of sleep education on academic, health and sleep outcomes. The results of the research will contribute to our understanding of whether sleep can be improved via education, and the effect this has on health and wellbeing. Ultimately we hope that the evaluation will equip school staff with knowledge to better support young people in improving their sleep habits and ultimately with achieving GCSEs.

Rationale

Sleep is of great importance for our health and wellbeing. It replenishes and prepares us to function at our best during the daytime, and without adequate sleep we are more vulnerable to physical and mental illnesses. Of course, such long-term effects are of concern, but also important are the next day effects of poor sleep, which include fatigue, problems with concentration and learning, irritability and other interpersonal difficulties. Scientists have taken great interest in what sleep is and how it works. We now know that there are two processes that work in harmony to control our sleep-wake pattern. The first of these is sleep-wake homeostasis. This system tells us that the need for sleep is accumulating as we progress throughout the day, and helps us to maintain sleep throughout the night to make sure that the sleep we get compensates for hours of wakefulness. If this system existed alone then we would all start the day feeling fresh and progressively get drowsier as the day went on. This is not the case: we have peaks and troughs in our tiredness/alertness throughout the day. The second process, our circadian biology or biological clock, drives this pattern.

Changes in circadian biology during adolescence have a profound effect on the adolescent sleep-wake cycle. From the age of about ten our circadian rhythms begin to delay, and continue to delay until around 21 years old. This means that as we go through adolescence and into early adulthood we are naturally more inclined to go to bed later and get up later. The biological underpinnings of this are well mapped out. The circadian rhythm is driven by the suprachiasmatic nucleus (SCN), a part of our brains, which receives light signals from the optic nerve. In the morning, when it begins to get light,

the SCN tells us it is time to be awake. The SCN then signals the onset of various processes, such as increasing body temperature and the production of certain hormones, such as cortisol, which, amongst other functions, increases blood sugar, to provide an increase in energy levels. Other hormones, such as melatonin, are suppressed. Melatonin is crucial in the onset of sleep and sleep maintenance. Melatonin levels typically remain low during the day and high during the night, increasing as we approach sleep.

In adolescence it has been shown that melatonin levels naturally rise later, making it difficult to go to sleep early, and difficult to get up early. Therefore, asking an adolescent to get up at 7am to start school at 9am is akin to asking a 55-year-old to get up at 5am; this leads to a significant amount of sleep deprivation. Adolescents generally have a natural circadian dip between 3-7am. The interaction between the circadian rhythm and sleep deprivation elongates this dip, extending it until around 10am. This means that adolescents are typically starting school at a time when they are feeling the effects of sleep deprivation and when their natural rhythms are not optimised for alertness, engagement, and therefore learning. Compounding this, it is well established that sleep has a pivotal role to play in learning and memory consolidation.

Not only do adolescents have a natural biological predisposition to staying up later, but also the devices they use to communicate and for entertainment may also impact sleep. TV screens, tablets and phones emit light at a level that may interfere with sleep onset, compounding the effects of the naturally occurring circadian delay. Pupils are also dealing with the stress of exams and the pressure to perform well. We will therefore be looking at the effect of sleep education on sleep quality and academic outcomes. This will be the largest study to look at whether sleep education can be utilised to minimise some of the effects of the delay in the adolescent biological clock and sleep deprivation resulting from poor sleep habits and behaviours.

The Pilot Study

The pilot study will be conducted to evaluate the content, delivery and efficacy of a sleep education programme. Changes in sleep behaviour and practices will be evaluated to determine the ability of the sleep education programme to improve adolescent sleep. This will be used to refine the programme in preparation for a main trial, which will assess whether sleep education improves academic performance at GCSE, and sleep quality. The content will include guidance on good bedtime routines, the science behind sleep related behaviours, stress-management techniques and how to maintain good sleep during periods of stress.

Teachers (at least two) within your school will be trained in delivering the programme which consists of five hours of content designed as tenx30 minute topics which can be delivered flexibly (for example,, fivex60 minute lessons). The training will take place in your school and last three hours by the research team at the University of Oxford. We would then like teachers who have undergone the training to cascade this to other teachers in the school who will also be delivering the programme. You will be provided with a handbook, lesson plans and PowerPoint slides to assist you in delivering each of the lessons. We will also provide you with a handbook to give to each student to use during the lessons to facilitate learning and assist with required activities. These materials should be used also in the cascade training. Teachers who are delivering the cascade training will be provided with

the slides that the researchers used in the initial training sessions. Any questions or uncertainty that arises during the cascade training should be feedback to the research team, who will respond to queries and provide extra input where needed. The programme must be provided to Year 10 students between September and the end of November 2016.

To help us evaluate the impact of the programme, we will also be surveying all Year 10 pupils involved through questionnaires at the beginning and end of the pilot study. This survey will assess sleep, sleepiness, circadian preference, general wellbeing and sleep hygiene. The questions asked in the survey are non-invasive, and it will be made clear to all pupils taking the survey that they can miss out any question that they are uncomfortable answering. We will provide the school with the surveys for teachers to distribute during class time for pupils to complete. The survey will take approximately 40 minutes to complete, and should be completed under exam conditions. Once complete, the University of Oxford team will arrange for a courier to collect the surveys. Following completion of this survey, if the researchers think that it would be good for the pupil to talk to their parents/carers or a doctor about their health or wellbeing following this conversation, they will inform the relevant teacher at the school. Pupils will also be asked to complete a sleep knowledge quiz at the beginning and end of the sleep education programme. This will allow us to evaluate if it is an improvement in sleep knowledge that drives any change in their sleep patterns/quality. Again, we will provide the school with the sleep knowledge quiz to distribute to pupils to complete during class time. We anticipate the sleep knowledge quiz will take pupils no longer than ten minutes to complete. Once complete, the University of Oxford team will arrange for a courier to collect the surveys. The survey data are gathered anonymously so, researchers cannot trace back data to an individual pupil. To allow us to do this, pupils will be asked to put their examination number on all surveys as their unique code therefore students will need to be supplied with this number if they do not know it. If information about survey responses needs to be sent back to schools then this number along with the nature of the concern will be returned to schools for them to then identify the pupil.

Schools will be required to inform all parents of pupils about the research by giving out information sheets and consent forms provided by us. Schools will need to collect Opt-Out consent forms from parents/carers of pupils who do not wish their child to take part in the sleep survey or sleep knowledge quiz. As well as the information sheets, we will also ask schools to distribute a pamphlet to parents which explains the importance of sleep and gives some information on what we are teaching the pupils.

We would also like to monitor sleep patterns and activity levels during the day, over a two week period before and after the programme is delivered, in a subgroup of 15 pupils using wrist worn devices. These are completely non-invasive devices that students wear like a watch. These devices will be used to allow us to investigate whether sleep length and quality improves as a result of the programme. During this time, these 15 pupils will also be asked to fill in a sleep diary. This will assess the individual's perception of their sleep, and also provide the researchers with information regarding sleep habits, for example caffeine consumption after 6pm. Pupils will be asked to volunteer for these aspects of the research. We will require the school to distribute and collect information sheets and consent forms to parents of pupils wishing to take part in the sleep monitoring aspect of the pilot study. Fifteen pupils will be selected at random from all the pupils who return a consent form to this sleep monitoring activity. The University of Oxford team will then arrange a time with you to visit your school to carry out screening interviews with 15 consenting pupils, these will take up to 15 minutes per pupil, and will happen in the afternoon after the teacher training session. Pupils therefore will be asked to be taken out of class for

these interviews. The screening interviews ask pupils about their general health (physical and psychological) as these factors may influence sleep. Unfortunately, we cannot include individuals who have a current sleep disorder (e.g., insomnia, sleep walking), psychological disorder (e.g., ADHD, anxiety, depression), physiological disorder which may interfere with sleep (e.g., asthma, diabetes, epilepsy, metabolic disorders), heart-rhythm abnormalities, or who take medications that may impact on sleep (e.g., antihistamines, antidepressants, corticosteroids – such as the brown inhaler). We also cannot include individuals who have suffered a concussion where they were unconscious for more than five minutes, or those who have been to a country which is three or more time zones away from the UK (e.g., USA or Asia) within the last six months. If the researchers think that it would be good for the pupil to talk to their parents/carers or a doctor about their health or wellbeing following this conversation, they will inform the relevant teacher at the school.

Once the two week monitoring period is over, we will require the school to collect in the devices and sleep diaries from participating pupils, after which the research team will arrange a courier to collect them. Asking pupils to complete the surveys, and for a sub-sample to wear the devices, will allow us to assess the feasibility of these methods in the school environment and track any improvements caused by the sleep education programme.

A prize draw is being offered to all students who complete a full 14 days of sleep monitoring on the wrist worn device (£25 Amazon voucher per school both before and after the Teensleep lessons). Students who complete both 14 day periods will also be entered into a larger prize draw across all schools for a chance to win an iPad. A prize draw is also being offered for all completed surveys at each round of data collection (2 x £25 Amazon Voucher per school both before and after the Teensleep lessons). The Oxford researchers will provide the exam candidate numbers of the students who achieve this to the evaluation team so they can conduct each of the prize draws.

Who has reviewed this project?

This project has been reviewed by, and received ethics clearance through, the University of Oxford Central University Research Ethics Committee and through Durham University's School of Education Ethics Committee.

Data protection

All pupil data collected during the research project will be stored securely, treated confidentially, shared between the research teams at the University of Oxford and Durham University and used only for research purposes. Everyone who has access to the project's data has a duty of confidentiality and is responsible for handling study data in accordance with applicable Data Protection law(s) and has undergone relevant data protection training. All research staff who enter the schools as part of this pilot study will have DBS clearance.

Who is running the project and who do I contact for further information?

The Teensleep education programme has been designed and will be delivered by researchers at the University of Oxford and is being evaluated by an evaluation team based at Durham University.

For further information on the Teensleep programme please contact the project coordinator, Adam Jowett: adam.jowett@ndcn.ox.ac.uk; 01865 618 666.

For further information on the evaluation of the Teensleep programme, please contact Dr Lyn Robinson (Lead Researcher, CEM Durham University) on 0191 334 4197 or by email Teensleepevaluation@cem.dur.ac.uk.

Responsibilities

The UNIVERSITY OF OXFORD TEAM will:

- Provide a half-day course in delivering the education intervention, making sure teachers understand the science behind the lessons and how to use the materials properly
- Provide on-going support to the school in terms of facilitating survey collection and supporting cascade training

The SCHOOL will (please tick):

- ☐ Ensure the shared understanding and support of all school staff for the project and personnel involved
- ☐ Release relevant staff so that they can attend a half-day training session
- ☐ Provide cascade training to teachers delivering the programme who did not attend the half day training session
- ☐ Deliver the sleep education programme to Year 10 students
- ☐ Inform all parents/carers about the study and collect Opt-In/Out consent forms
- ☐ Be a point of contact for parents/carers seeking more information on the project
- ☐ Facilitate the completion of the surveys and sleep quiz by all pupils before and after the programme and return to the Oxford team when requested
- ☐ Support the completion of sleep diaries and the wearing of wrist devices in the sub group of selected pupils
- ☐ Agree to participate in the evaluation of the Teensleep education programme, being led by Durham University (please read the 'Teensleep pilot study evaluation, information for schools' sheet). Please note, your participation in the Teensleep education programme is dependent upon your participation in the evaluation.

We commit to the Evaluation of Teensleep as detailed above:

Head teacher name: _____

Signature: _____

Other relevant school staff names: _____

Date: _____

Appendix 2: Evaluation team information sheet and memorandum of understanding

Evaluation of the Teensleep Education Programme

Information for Schools

The Teensleep education programme has been designed and will be delivered by researchers at the University of Oxford. The pilot study has been funded by the Education Endowment Foundation (EEF) and the Wellcome Trust who have selected researchers at the Centre for Evaluation and Monitoring at Durham University to evaluate how effective the Teensleep programme is. You have received this information sheet as you have identified that your school would like to take part in the Teensleep education programme pilot study, details of which can be found on the enclosed/attached 'School agreement to participate in the Teensleep pilot study; 4 Aug 16 v8' document. To take part in the pilot study, your school must also agree to take part in the evaluation of the Teensleep programme.

What does the evaluation involve?

All schools who sign-up to participate in the Teensleep pilot study will need to:

1. Identify a staff member to be the key point of contact for the evaluation team.
2. Provide information on all Year 10 pupils including school attendance data, their eligibility to receive Free School Meals, gender and Key Stage 2 point score, providing parental consent has been obtained.
3. Provide a delivery schedule of when all Teensleep lessons will be taught (including the lesson content, date/time of delivery and the name of the teacher delivering the session) and supply completion data to Dawn Mee, the evaluation team's research administrator, who will contact you via telephone or email weekly to see if the Teensleep programme has been delivered as originally planned alongside the pupil attendance data at each lesson.
4. Complete an online or on paper survey following training (and return to the evaluation team) which it will take no longer than 15 minutes (applicable to all staff members who completed the training).
5. Complete an online survey after all of the Teensleep lessons have been taught. All staff members who taught the programme will be emailed the link to this survey. It will take no longer than 15 minutes to complete.
6. Identify the staff member who led cascade training (if applicable) to participate in a short telephone interview lasting no longer than 30 minutes. This staff member will be requested to complete a separate consent form. This interview will take place at a time convenient to the staff member.
7. Identify all staff members who attended the cascade training so that the research team can randomly select one teacher to participate in a short telephone interview lasting no longer than 30 minutes to discuss their experience of the cascade training. This staff member will be requested to complete a separate consent form. This interview will take place at a time convenient to the staff member.

For completing these elements of the evaluation, your school will receive a £200 Amazon voucher.

Your school may also be selected to facilitate a visit from a member of the research team to:

1. Observe the training session led by the University of Oxford, and the cascade-led training session led by staff in your school.
2. Observe two Teensleep lessons being delivered within your school at two different time points.
3. Conduct a focus group with two groups of 5-8 students (one group who did not take part in the sleep monitoring aspect of the pilot study, and one group who did). These focus groups will last between 30-45 minutes, and are to take place within school time during January-February 2017. The research team will arrange with you the most convenient time for these to take place. Beforehand, we will provide you with information sheets and consent forms to distribute to parents of students wishing to take part in the focus group.

For participating in these additional observation visits and helping the research team facilitate the student focus group your school will receive an additional £400 Amazon voucher.

How will data collected from schools be used in this project?

Data collected as part of this project will be used only for research purposes and will be collected to evaluate the Teensleep programme, its impact on pupils, and how the programme is implemented. We will handle all research data confidentially and in line with the Data Protection Act. During the project, data will be shared between the universities involved (University of Oxford) but will only be accessed by the specific staff working on the project. Any researcher who visits your school will have DBS clearance.

Who has reviewed this evaluation?

This evaluation has been reviewed and approved by Durham University's School of Education Ethics Committee.

Who is running the evaluation and who do I contact for further information?

A research team at the Centre for Evaluation and Monitoring at Durham University, led by Dr Lyn Robinson, is evaluating how effective the Teensleep programme is. If you have any questions, concerns or require further information on the evaluation of the Teensleep programme, please contact Mrs Dawn Mee (research administrator) in the first instance by telephone (0191 334 4367) or by email (TeensleepEvaluation@cem.dur.ac.uk).

If you have any questions relating directly to the Teensleep education programme, please contact the Postdoctoral Research Assistants, Dr Rachel Sharman or Dr Gaby Illingworth (Teensleep@ndcn.ox.ac.uk).

Do we have to take part in the evaluation?

Participation in the Teensleep pilot study is voluntary; you should choose whether you wish your school to take part. However your school cannot implement the Teensleep programme unless you also agree to participate in the evaluation. If you do wish to be involved, we will ask the head teacher to sign a Memorandum of Understanding (attached) showing that they understand and agree to all aspects of taking part in the evaluation of the project.

Will the evaluation be published?

At the end of the Teensleep programme, a report will be made publicly available on the Education Endowment Foundation's website (<https://educationendowmentfoundation.org.uk>), for anyone who is interested in the findings of the research. Data will also be published in relevant academic journals. Individual data will not be published; therefore, no individual could be identified via these publications.

Evaluation of the Teensleep Education Programme

School Memorandum of Understanding

To be completed by the head teacher. Please tick each box, sign and provide information below:

- ☐ I confirm that I have read and understood the information sheet for the Evaluation of the Teensleep Education Programme and have had the opportunity to ask questions.
- ☐ I understand that by agreeing to take part in the delivery of the Teensleep programme, we also agree to take part in the evaluation and will receive a £200 Amazon voucher for the school.
- ☐ I agree to identify a staff member to be the key point of contact for the evaluation team.
- ☐ I agree to provide the evaluation team with my school's delivery schedule of the Teensleep programme and to provide completion and attendance data of each session.
- ☐ I agree to send the research team the pupil information required as detailed in the information sheet. I understand that the research team will only use any information gathered in this project for research purposes as described.
- ☐ I agree for staff to complete the requested surveys and participate in the telephone interviews (if applicable). I understand that separate consent will be sought from individuals involved in the interviews.
- ☐ I understand that members of the research team may request to visit the school to observe Teensleep lessons, and conduct focus groups with some students. If my school is chosen for this, I understand the school will receive an additional £400 Amazon gift voucher.
- ☐ I understand that all child and staff data will be kept confidential and that no material which would identify the school or individual children or staff will be used in any reports of this evaluation
- ☐ I consent to my school taking part in the evaluation of the Teensleep education programme.

Head Teacher name: _____ Head Teacher signature: _____

Date: _____

School Name: _____ School postcode: _____

Email address: _____

Identified key staff member: _____ Their email address: _____

Appendix 3: Parent information sheet and opt-out consent form

Teensleep Pilot Study Information for Pupils and Parents/Carers The Teensleep Education Programme: Surveys and Sleep Knowledge Quiz

1. Study title

Teensleep: Improving Sleep in Adolescence through Education

2. Background of the study

You may be aware that the pupil's school is taking part in the pilot study of the Teensleep project. The following paragraphs will explain the overall project and the pilot study, and then go on to explain what the pupil is being asked to do and why.

Background to the Teensleep project

Sleep is of great importance for our health and wellbeing. It replenishes and prepares us to function at our best during the daytime. Without good sleep, we are more likely to become unwell. These long-term effects are of concern, but so are the effects of poor sleep the following day. If you do not sleep well or get enough sleep, you are likely to feel tired, have problems with concentration, and probably feel irritable. Scientists have taken great interest in what sleep is and how it works, particularly in adolescence. We know that during the teenage years sleep patterns change. This change is driven by a change in the level of a hormone called melatonin. High levels of melatonin help us to fall asleep, and we find it difficult to sleep if there are low levels of melatonin in our bodies. During teenage years the levels of melatonin we produce begin to change. This change means that teenagers find it very difficult to fall asleep early, and difficult to wake up early. Asking a teenager to get up at 7am to start school at 9am is like asking a 55-year old to get up at 5am: this leads to a significant amount of sleep deprivation.

As well as the changes in biology which occur during the teenage years, there are other factors which contribute towards poor sleep quality such as using devices (like tablets, smartphones, and computer games) to communicate and for entertainment late into the evening. TV screens, tablets and phones emit light at a level that may interfere with how easily you can fall asleep, which may interact with the effects of the biological changes. Teenagers are also dealing with the stress of exams and the pressure to perform well.

In this project we are looking at the effect of sleep education on sleep quality, mood and wellbeing. This information will then hopefully lead to projects assessing the effects of sleep education on educational performance which we would expect to improve if sleep improves.

During the autumn of 2016 the pupil will receive the Teensleep lessons, which have been written by researchers at the University of Oxford, and that their teachers have been trained to deliver. The Teensleep lessons will teach pupils about:

- Good bedtime routines
- The science behind good sleep related behaviours
- How to deal with stress, particularly
- How to maintain good sleep during stressful times

This will be the largest study to look at the effect of sleep education on adolescent sleep, health, wellbeing, and academic performance.

3. What will happen in the pilot study?

The Teensleep pilot study is being carried out to evaluate the content and delivery of a sleep education programme in order to obtain feedback from teachers and students on its accessibility and feasibility. This feedback will be used to refine the programme in preparation for the main trial when we will assess whether sleep education improves sleep quality, general wellbeing and academic performance at GCSE. As part of the evaluation of the sleep education programme, we will find out how much pupils know about sleep through a quiz. This is a short quiz, lasting approximately ten minutes and students will be requested to complete this by their teachers during lesson time.

In order for us to track any improvements in the pupil's health, sleep, and wellbeing that may result from the Teensleep lessons, we also want to conduct a survey with all pupils taking the lessons. If you agree that the pupil can take part in this, we will be asking pupils to complete a short survey twice; once before and once after the sleep education programme is taught. The survey will take about 30–40 minutes to complete. The survey will ask questions about:

- *Sleep quality* – for example 'How long does it take you to fall asleep?'
- *Tiredness* – we will ask pupils to rate how likely it is that they will fall asleep during certain activities, such as doing schoolwork at home in the evening
- *Wellbeing* – for example 'Thinking about the last week, have you been in a good mood?' or 'Thinking about the last week, have you had fun with your friends?'
- *Whether they are more alert in the evening or the morning* – for example 'I go to bed at [insert time]' or 'I wake up with/without the use of an alarm clock'

- *Sleep hygiene* – we will ask pupils about their sleep habits, for example ‘I fall asleep while listening to loud music’ or ‘I go to bed feeling hungry’

Pupils who complete a survey, before and after the Teensleep lessons, will be entered into a prize draw at their school for a chance to win one of two £25 Amazon Vouchers. Following the survey, if the researchers think that it would be good for the pupil to speak to their parent or a doctor about their health or wellbeing following this survey, they will inform the relevant teacher at the school.

In order for us to understand how different individuals respond to the Teensleep programme, we will also request that the pupil’s school provides the research team (at Durham University) with information on the pupil’s gender, attendance, their eligibility for Free School Meals and Key Stage 2 point score.

More information on the Teensleep Pilot Study and the research team can be found here: www.Teensleep.org.uk.

4. Why has the pupil been invited to take part?

You have been contacted about this research because the pupil is in year 10 and their school has agreed to participate in the pilot study.

5. Is the pupil eligible to take part?

All pupils receiving the sleep education programme in Year 10 are eligible to take part.

6. Does the pupil have to take part?

Before you agree that the pupil can take part you should have had a chance to talk with the researchers about the study and fully understand what the pupil is being asked to do. It is also important that you have read this information sheet in full, to ensure you know exactly what the pupil is being asked to do and what their rights are as a participant. If you have any questions about any of this then please contact a member of the research team (details of how to do so are in the ‘people’ section below). Please remember that **the pupil is free to withdraw at any time without reason and without penalty. Their participation is voluntary. If you are not happy with the pupil taking part you are under no obligation at all to agree.**

7. Are there any potential risks in taking part?

There are no risks or direct benefits to taking part in this aspect of the pilot study; however, the information the pupil provides will tell us more about the accessibility and feasibility of the sleep education programme and will hopefully give us a better understanding of how sleep education may affect sleep and wellbeing in adolescence.

9. What happens to the research data provided?

All of the pupil's data collected during the research project will be stored securely, treated confidentially, shared only between the research teams at the University of Oxford and Durham University and used only for research purposes. Everyone who has access to the project's data has a duty of confidentiality and is responsible for handling study data in accordance with applicable Data Protection law(s) and has undergone relevant data protection training. None of the information we collect will affect the pupil's place at their school. All research staff who enter the school as part of this pilot study will have DBS clearance. Oxford University will store the data gathered for up to five years after the end of the trial, to allow time for it to be properly analysed, published and reviewed. After this period it will be destroyed. The University's data storing policies can be read here: <http://researchdata.ox.ac.uk/university-of-oxford-policy-on-the-management-of-research-data-and-records/>. Again data are stored anonymously and you will never be identified.

10. Will the research be published?

At the end of the Teensleep programme of research, a report will be made publicly available on the Education Endowment Foundation's website (<https://educationendowmentfoundation.org.uk>), for anyone who is interested in the findings of the research. Data will also be published in relevant academic journals. Individual data will not be published; therefore, no individual could be identified via these publications.

11. Who has reviewed this project?

This project has been reviewed by, and received ethics clearance through, the University of Oxford Central University Research Ethics Committee and through Durham University's School of Education Ethics Committee.

12. Who are the research team?

The Teensleep programme is being delivered to schools by a research team at the University of Oxford.

The Principal Investigators on this research are Professors Russell Foster (Russell.Foster@eye.ox.ac.uk) and Colin Espie (Colin.Espie@ndcn.ox.ac.uk). More information on all the staff involved can be found at www.Teensleep.org.uk.

A research team from the Centre for Evaluation and Monitoring (CEM) at Durham University, led by Dr Lyn Robinson (Email: Lyn.Robinson@cem.dur.ac.uk, Tel: 0191 334 4197), has been asked to see how effective the Teensleep programme is by the Education Endowment Foundation, an organisation that funds research into education, and the Wellcome Trust, an organisation that funds research to improve health.

13. Whom do I contact if I have a question or concern about the study or I wish to complain?

If you have a concern about the Teensleep education programme, please contact the Postdoctoral Research Assistants, Dr Rachel Sharman or Dr Gaby Illingworth (Teensleep@ndcn.ox.ac.uk) who will do their best to answer your query. The researchers at the University of Oxford should acknowledge your concern within ten working days and give you an indication of how they intend to deal with it. If you remain unhappy or wish to make a formal complaint, please contact the chair of the Research Ethics Committee at the University of Oxford who will seek to resolve the matter in a reasonably expeditious manner:

Chair, Medical Sciences Inter-Divisional Research Ethics Committee:

Email: ethics@medsci.ox.ac.uk

Address: Research Services, University of Oxford, Wellington Square, Oxford OX1 2JD

For further information about the evaluation of the Teensleep programme more generally you can contact Mrs Dawn Mee on 0191 334 4367 or by email Teensleepevaluation@cem.dur.ac.uk.

14. What should I do next?

If you are happy for the pupil's survey responses and knowledge about sleep to be used in the pilot of the Teensleep project, you do not need to do anything. Thank you for your help with this project.

If you would rather the pupil did not complete surveys or provide information about their sleep knowledge, please complete the attached form and return it to the pupil's school by **[INSERT DATE]**

Teensleep Pilot Study Evaluation: Opt-Out Form

If you **do not** want information to be provided by the pupil and shared for use in the Teensleep pilot study, please return this form to the pupil's school by **[INSERT DATE]**

☐

I **do not** want information about the pupil's sleep knowledge to be shared for use in the Teensleep pilot study

☐

I **do not** want the pupil to complete the surveys and for their responses to be shared for use in the Teensleep pilot study

☐

I **do not** want the pupil's school to share the following information on the pupil for use in the Teensleep pilot study: gender, attendance, their eligibility for Free School Meals and Key Stage 2 point score

Parent/Carer Signature _____ Date _____

Child's Name _____

Child's School _____

Appendix 4: Sleep data collection opt-in consent

Teensleep Pilot Study Information for Pupils and Parents/Carers Collecting Information about Sleep

1. Study title

Teensleep: Improving Sleep in Adolescence through Education

2. Background of the study

You may be aware that your school is taking part in the pilot study of the Teensleep project. The following paragraphs will explain the overall project and the pilot study, and then go on to explain what you (the pupil) are being asked to do and why.

Background to the Teensleep project

Sleep is of great importance for our health and wellbeing. It replenishes and prepares us to function at our best during the daytime. Without good sleep, we are more likely to become unwell. These long-term effects are of concern, but so are the effects of poor sleep the following day. If you do not sleep well or do not get enough sleep, you are likely to feel tired, have problems with concentration, and probably feel irritable. Scientists have taken great interest in what sleep is and how it works, particularly in adolescence. We know that during the teenage years sleep patterns change. This change is driven by a change in the level of a hormone called melatonin. High levels of melatonin help us to fall asleep, and we find it difficult to sleep if there are low levels of melatonin in our bodies. During teenage years the levels of melatonin we produce begin to change. This change means that teenagers find it very difficult to fall asleep early, and difficult to wake up early. Asking a teenager to get up at 7am to start school at 9am is like asking a 55-year old to get up at 5am; this leads to a significant amount of sleep deprivation.

As well as the changes in biology which occur during the teenage years, there are other factors which contribute towards poor sleep quality such as using devices (like tablets, smartphones, and computer games) to communicate and for entertainment late into the evening. TV screens, tablets and phones emit light at a level that may interfere with how easily you can fall asleep, which may interact with the effects of the biological changes. Teenagers are also dealing with the stress of exams and the pressure to perform well. In this project we are looking at the effect of sleep education on sleep quality, mood and wellbeing. This information will then hopefully lead to projects assessing the effects of sleep education on educational performance which we would expect to improve if sleep improves.

During the autumn of 2016 you will receive the Teensleep lessons, which have been written by researchers at the University of Oxford, and that your teachers have been trained to deliver. The Teensleep lessons will teach pupils about:

- Good bedtime routines
- The science behind good sleep related behaviours
- How to deal with stress, particularly

- How to maintain good sleep during stressful times

This will be the largest study to look at the effect of sleep education on adolescent sleep, health, wellbeing, and academic performance.

3. What will happen in the pilot study?

The school you are attending has agreed to take part in the pilot study of the Teensleep project. The pilot study is being carried out to evaluate the content and delivery of the Teensleep lessons in order to get feedback from teachers and students on its accessibility and use in schools alongside assessing if the lessons can improve sleep. This will be used to refine the programme in preparation for the main trial which will assess the effect of sleep education on sleep, general wellbeing and academic performance at GCSE level.

In order for us to track any improvements to sleep which may result from the Teensleep lessons, we are selecting a small group of pupils at random from each school to look at their sleep in more detail for two weeks before the lessons start and again for two weeks after they finish. If you agree to participate in this part of the research, you will be given a sleep diary and a movement device to wear like a watch around your non-dominant wrist. The device measures how active you are during the day, and will allow us to assess how well you sleep during the night. The sleep data gathered will allow us to assess how sleep changes in response to the intervention, and if changes in sleep affect general wellbeing. **The watch must be worn constantly over the two-week period, except when bathing or swimming.**

As well as the watch, you will also be provided with a sleep diary. We will be asking you to fill this diary out every day, before you go to sleep about the day you have just had and then in the morning shortly after you wake up about the sleep you have just had and how you feel. This diary will allow us to review how much sleep you believe you are getting and how this compares to the data we get from the watch. It will also ask questions about other lifestyle factors that may affect sleep, such as the amount of caffeine you consume after 6pm and your media use in the hour before bed.

A researcher from the University of Oxford will visit you at school to deliver the watch and sleep diary, and explain how to use both during class time.

Students who complete a full 14 days of sleep monitoring on the wrist worn device will be entered into a prize draw at their school for a £25 Amazon voucher. Students who complete both 14 day periods will also be entered into a larger prize draw across all schools for a chance to win an iPad. At the end of the two week period, you will need to return your watch and sleep diary to your teacher.

4. Why have I been invited to take part?

You have been contacted about this research because you are in Year 10 and your school has agreed to participate in the pilot study.

5. Can I take part?

Before you can participate in sleep monitoring, a researcher from the University of Oxford will have a short conversation with you lasting about five minutes and will write down your answers from this in

a questionnaire. We will ask about your sleep and also about your general health (physical and psychological) as these factors may influence how you sleep. Unfortunately, we cannot include individuals who have a current sleep disorder (e.g., insomnia, sleep walking), psychological disorder (e.g., ADHD, anxiety, depression), physiological disorder which may interfere with sleep (e.g., asthma, diabetes, epilepsy, metabolic disorders), heart-rhythm abnormalities, or who take medications that may impact on sleep (e.g., antihistamines, antidepressants, corticosteroids – such as the brown inhaler). We also cannot include individuals who have suffered a concussion where they were unconscious for more than five minutes, or those who have been to a country which is three or more time zones away from the UK (e.g., USA or Asia) within the last six months. If the researchers think that it would be good for you to talk to your parents/carers or a doctor about your health or wellbeing following this conversation, they will speak to a teacher at your school.

Fifteen pupils will be randomly selected to wear the movement watch and complete the sleep diary from all pupils who meet the inclusion criteria and whose parents have returned signed consent forms.

6. Do I have to take part?

Before you agree to take part you should have had a chance to talk with the researchers about the study and fully understand what you are being asked to do. It is also important that you have read this information sheet in full, to ensure you know exactly what you are being asked to do and what your rights are as a participant. If you have any questions about any of this then please contact a member of the research team (details of how to do so are in the 'people' section below). **After agreeing to participate you are free to withdraw at any time without reason and without penalty. Your participation is voluntary. If you are not happy with taking part you are under no obligation at all to agree.**

7. Are there any potential risks in taking part?

There are no risks or direct benefits to taking part in this aspect of the pilot study; however, the information you provide will tell us more about the best ways to use movement devices and sleep diaries with school students and will hopefully give us a better understanding of how sleep education may affect sleep and wellbeing in adolescence.

8. What happens to the research data provided?

All your data collected during the research project will be stored securely, treated confidentially, shared between the research teams only at the University of Oxford and Durham University and used only for research purposes. We will not use your name or the name of the school in any report arising from the research. Everyone who has access to study data has a duty of confidentiality and is responsible for handling study data in accordance with applicable Data Protection law(s) and has undergone relevant data protection training. Oxford University will store the data for up to five years after the end of the trial, to allow time for it to be properly analysed, published and reviewed. After this period it will be destroyed. The University's data storing policies can be read here: <http://researchdata.ox.ac.uk/university-of-oxford-policy-on-the-management-of-research-data-and-records/>. None of the information we collect will affect your child's place at their school. All research staff who enter the school as part of this pilot study will have DBS clearance.

9. Will the research be published?

At the end of the Teensleep programme of research, a report will be made publicly available on the Education Endowment Foundation's website (<https://educationendowmentfoundation.org.uk>), for anyone who is interested in the findings of the research. Data will also be published in relevant academic journals. Individual data will not be published; therefore, no individual could be identified via these publications.

10. Who has reviewed this project?

This project has been reviewed by, and received ethics clearance through, the University of Oxford Central University Research Ethics Committee and through Durham University's School of Education Ethics Committee.

11. People

The Teensleep programme is being delivered to schools by a research team at the University of Oxford. The Principal Investigators on this research are Professors Russell Foster (Russell.Foster@eye.ox.ac.uk) and Colin Espie (Colin.Espie@ndcn.ox.ac.uk). More information on all the staff involved can be found at www.Teensleep.org.uk. Any queries should initially be sent to Teensleep@ndcn.ox.ac.uk. Any complaints should be directed to the Principal Investigators. If you wish to change details we hold about you, you should contact one of the principle investigators.

A research team from the Centre for Evaluation and Monitoring (CEM) at Durham University, led by Dr Lyn Robinson (Email: Lyn.Robinson@cem.dur.ac.uk, Tel: 0191 334 4197), has been asked to see how effective the Teensleep programme is by the Education Endowment Foundation, an organisation that funds research into education, and the Wellcome Trust, an organisation that funds research to improve health.

12. Whom do I contact if I have a concern about the study or I wish to complain?

If you have a concern about any part of the Teensleep education programme, please contact the Postdoctoral Research Assistants, Dr Rachel Sharman or Dr Gaby Illingworth (Teensleep@ndcn.ox.ac.uk) who will do their best to answer your query. The researchers at the University of Oxford should acknowledge your concern within ten working days and give you an indication of how they intend to deal with it. If you remain unhappy or wish to make a formal complaint, please contact the chair of the Research Ethics Committee at the University of Oxford who will seek to resolve the matter in a reasonably expeditious manner:

Chair, Medical Sciences Inter-Divisional Research Ethics Committee:

Email: ethics@medsci.ox.ac.uk

Address: Research Services, University of Oxford, Wellington Square, Oxford OX1 2JD

For further information about the evaluation of the Teensleep programme more generally you can contact Mrs Dawn Mee on 0191 334 4367 or by email Teensleepevaluation@cem.dur.ac.uk.

13. I'm happy to take part, what do I do next?

Please complete the attached consent form and return it to school by **[INSERT DATE]**.

Teensleep Pilot Study

CONSENT FORM for Pupils and Parents/Carers

Collecting Information about Sleep

Names and roles of researchers:

University of Oxford:

Professor Russell Foster – Co-Principal Investigator
 Professor Colin Espie – Co-Principal Investigator
 Dr Christopher-James Harvey – Research Associate
 Mr. Adam Jowett- Project Coordinator

Dr Gaby Illingworth – Postdoctoral Research Assistant
 Dr Rachel Sharman – Postdoctoral Research Assistant

University of Durham:

Dr Lyn Robinson – Principal Investigator
 Professor Helen Ball - Co-principal Investigator
 Dr Helen Wareham - Co-principal Investigator
 Dr Sue Stothard – Co-principal Investigator
 Dr Laura da Costa – Research Assistant
 Mrs Kirsty Younger – Research Associate
 Mrs Dawn Mee – Research Administrator

Please initial box

Yes

No

1. I confirm that I have read and understand the information sheet dated 24th August 2016 for the above study, have had the opportunity to ask questions, and have had satisfactory answers to any questions.
2. I understand that my child's participation is voluntary and they are free to withdraw at any time without giving any reason, without any adverse consequences as a result of this decision.
3. I understand that by giving consent my child will be asked to wear a movement watch and complete a sleep diary for two weeks both before and after the Teensleep lessons, should they meet the criteria and be randomly selected.
4. I understand that information my child provides will be shared with The University of Oxford, and the evaluation team at Durham University. I give permission for these organisations:
 - a) to have access to the information provided, and
 - b) to store anonymised data for further analysis.
5. I understand that I will need to return all the research equipment provided to my child as soon as the study has finished.
6. I understand how to raise a complaint.

<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>

7. I give permission for my personal details to be kept after the study, so I can be contacted about future research (selecting no here does not affect eligibility to take part in the research).

☐☐

8. I agree to my child participating in this study.

☐☐

Name of Pupil

Signature

Date

Name of Parent/Carer

Signature

Date

Name of Researcher

Signature

Date

Please return this form to your child's school by **[INSERT DATE]**.

Appendix 5: Focus group opt-in consent

Teensleep Pilot Study

Information for Pupils and Parents/Carers Evaluation of the Teensleep Education Programme: Focus Groups

As you will know, [name of school] has been taking part in the Teensleep Pilot Study where last term, Year 10 pupils were taught a programme that focused on sleep education. The sleep education programme was developed by a research team based at the University of Oxford (for more information on the programme please visit www.Teensleep.org.uk). The programme is being evaluated by a research team at the Centre for Evaluation and Monitoring (CEM) at Durham University.

To learn about pupils' thoughts on this programme, the CEM research team would like to invite Year 10 pupils to take part in a 30-minute group chat (known as a focus group) which will take place at their school, during the school day, in March 2017. We would like to run two focus groups in the school, (1) one which includes pupils who were taught the sleep education programme, and (2) another which includes pupils who twice took part in the sleep monitoring (completing a sleep diary and wearing a sleep monitor). We are looking for 5-8 pupils to take part in each focus group, and will choose pupils at random from the consent forms we receive back (please see below). For taking part in the focus groups, all pupils will be entered into a prize draw to win a £25 Amazon voucher. Dr Laura da Costa, from the CEM research team, will visit the school to run the focus groups. An audio recording device will be used to ensure accuracy of our records, however once the audio content of the focus groups has been transcribed and anonymised, it will be destroyed. The information from the focus groups will help us to understand, develop and improve the sleep education programme for a future research project. To take part in the focus group, the attached consent form must be completed by a parent/carers and returned to school by **Monday 27th February 2017.**

Do pupils have to take part?

Pupils do not have to take part in the focus groups if they do not want to. If a pupil decides to take part, they can decline to answer any questions during the focus group and if they change their mind about taking part, they are free to withdraw at any time without providing a reason and without any negative consequences. Participation is voluntary. If you have any questions, please contact a member of the research team using the details provided below.

Are there any potential risks in taking part?

There are no risks or direct benefits to taking part in this aspect of the Teensleep Pilot Study; however, the information pupils provide during the focus groups will tell us more about how pupils perceive the sleep education programme and will hopefully give us a better understanding of how sleep education may affect sleep and wellbeing in adolescence.

What happens to the information provided during the focus groups?

All pupil data collected during the research project will be stored securely, treated confidentially, shared only between the research teams at the University of Oxford and Durham University, and used only for research purposes. Everyone who has access to the project data has a duty of confidentiality, is responsible for handling study data in accordance with applicable Data Protection law(s), and has undergone relevant data protection training. None of the information we collect will affect the pupil's place at their school. All research staff who

enter the school as part of this pilot study will have DBS clearance. Focus group data are stored anonymously and pupils will not be identifiable in any resulting reports.

Will the information from the focus groups be published?

At the end of the Teensleep Pilot Study, a report including information from the focus groups will be made publicly available on the Education Endowment Foundation's website

(<https://educationendowmentfoundation.org.uk>), for anyone who is interested in the research findings. The research will also be published in relevant academic journals. Individual data will not be published; therefore, no individual will be identifiable via these publications.

Who has reviewed this project?

The evaluation of the Teensleep programme has been reviewed by, and received ethics clearance through, Durham University's School of Education Ethics Committee. Any ethical concerns about this evaluation should be addressed to the School of Education Ethics Sub-Committee, Durham University via email to ed.ethics@durham.ac.uk.

Who are the research team?

The evaluation of the Teensleep programme is being delivered by a research team from the Centre for Evaluation and Monitoring (CEM) at Durham University, led by Dr Lyn Robinson-Smith (Email: Lyn.Robinson-smith@cem.dur.ac.uk, Tel: 0191 334 4197), and is funded by the Education Endowment Foundation, an organisation that funds research into education, and the Wellcome Trust, an organisation that funds research to improve health.

For further information about the evaluation of the Teensleep programme more generally you can contact Mrs Dawn Mee on 0191 334 4367 or by email

Teensleepevaluation@cem.dur.ac.uk.

What should I do next?

If you are happy for the pupil to take part in the focus groups, if randomly selected, then please complete the attached consent form and return it to school by **Monday 27th February 2017.**

Thank you for your help with this project.

Teensleep Pilot Study Evaluation: Consent Form

If you consent for the pupil to take part in a focus group and for information to be provided by the pupil and shared for use in the Teensleep Pilot Study, please read through the below, and place a tick next to each statement if you agree. Please return this form to the pupil's school by **Monday 27th February 2017.**

☐

I agree for the pupil (named below) to take part in the Teensleep focus group, should they be randomly selected.

☐

I have read and understood the information sheet regarding the focus groups for the evaluation of the Teensleep Education Programme.

☐

I understand that the focus group discussion will be recorded using an audio recording device and that the audio recording will be destroyed once it has been transcribed and anonymised.

☐

I understand that I can contact the researchers to ask questions at any time.

☐

I understand that pupils can decline to answer any questions and/or withdraw at any time during the focus group, without penalty of any kind.

☐

I understand that pupil data provided during the focus group will be kept confidential and secure, and that pupils and their school will not be identifiable in any report or other publication resulting from this evaluation.

Parent/Carer Signature _____ Date _____

Pupil's Name _____

Pupil's School _____

Appendix 6: Screening questionnaire

Screening Interview

School: _____

Pupil number: _____

1. SLEEP STATUS

Do you currently have a sleep problem?

Yes / No

Falling asleep? Y / N

How long does it take you to fall asleep? <30 min / >30 min

Waking up during the night? Y / N

How long are you awake for in total? <30 min / >30 min

What time do you usually go to sleep on a weekday? _____

What time do you usually wake up in the mornings on a weekday? _____

Is your sleep pattern similar during the weekends e.g. going to sleep/wake at the same time or difficulties falling asleep/waking during the night? Y / N

Describe the sleep pattern e.g. long lie ins indicative of social jet lag/delay

If participant reports a problem try to get a description and timeframe

How long have you had this sleep problem? _____ Months

How many night's per week are you affected by your sleep problem? _____ night's per week

Establish whether it is acute (3-6months) /chronic (6months+) insomnia (poor sleep occurring 3 or more nights per week defined as >30min SOL or >30min WASO) or stress related insomnia (e.g. during exam time only or Sunday night).

If participant has probable insomnia exclude from study.

2. RULE OUT OTHER SLEEP/WAKE DISORDERS

Have you been abroad in the last six months? Y / N

Where did you last travel? _____

When did you last return from travelling? _____

If over three time zones (WEST = Americas, EAST = East Africa), exclude from study.

Have you ever noticed one of the following in the last month?

- | | |
|--|-----|
| A. RESTLESS LEGS: Crawling or aching feelings in the legs (calf) and
Inability to keep legs still? | Y N |
| B. PERIODIC LEG MOVEMENTS: Leg twitches or jerks during the night? | Y N |
| C. APNOEA: Snoring, pauses in breathing at night, short of breath, choking
at night; morning headaches, chest pain, dry mouth? | Y N |
| D. NARCOLEPSY: Sleep attacks, sleep paralysis, hypnagogic/hypnompic hallucinations,
cataplexy? | Y N |
| E. GASTRO-ESOPHAGEAL REFLUX: Sour taste in mouth, heart burn; reflux? | Y N |
| F. PARASOMNIAS: Nightmares, night terrors, sleep walking, sleep talking? | Y N |

Describe any YES response and ask if a GP has said they have X

If on judgement, the participant has a probable sleep disorder exclude from study.

3. CONSEQUENCES

Does how you're sleeping at the moment affect your day in any way?

Yes / No / Unsure

Describe if YES e.g. do you feel tired, sleepy, and irritable or have poor concentration

4. GENERAL HEALTH

Do you consider yourself to be in good health?

Yes / No

Describe if NO

Do you suffer from an ongoing illness (e.g. Asthma, Diabetes)?

Yes / No

Describe if YES including how long

Are you currently on any medication?

Yes / No

Describe if YES including dose if possible

Exclude if there is any medical condition that effects the CNS or medication that influences sleep

5. PSYCHOLOGICAL PROBLEMS

Have you ever been diagnosed with a psychiatric disorder or mental condition?

Yes / No

Have you suffered a concussion where you were unconscious for more than 5 minutes?

Yes / No

Exclude if YES to either

6. PERSONAL AND FAMILIAL HISTORY OF INSOMNIA

Is a member of your immediate family (parents, children, brothers, sisters) currently experiencing sleep difficulties?

Yes / No / Unsure

Describe if YES including relation to participant

7. DEMOGRAPHICS

Date of birth: _____

Gender: Male / Female / Other

8. INCLUSION/EXCLUSION

Participant is:

Included / Excluded

Reasoning:

Researcher Name _____

Date _____

Conditions that affect sleep – not exhaustive

ADHD
 Autism/Asperger Syndrome
 Autoimmune disorders – Lupus, Sjogrens Syndrome, gout, rheumatoid arthritis
 Bipolar Disorder
 Chronic Fatigue Syndrome
 Chronic Headache Syndrome
 Chronic Pain Syndrome
 Currently experiencing hayfever
 Depression/Anxiety
 Diabetes
 Enucleation of Eyes
 Epilepsy
 Heart Failure
 Kidney Disease
 Musculoskeletal Disorders – Arthritis, Fibromyalgia
 Neuromuscular Disorder – Myotonic Dystrophy
 Nocturia
 Panic Disorders
 Respiratory issues – emphysema, bronchitis, COPD, Cystic fibrosis (NOTE: Mild Asthma is OK)
 Schizophrenia
 Strokes
 Thyroid Disease

Mediations that affect sleep – not exhaustive

Medication	Used to treat	Common examples	Effect on sleep
ACE inhibitors	High Blood Pressure	Benazepril, Captopril, Lisinopril	Cough
Alpha Blockers	High Blood Pressure, Raynauds Disease	Alfuzosin, Doxazosin, Prazosin, silodosin, terazosin, tamsulosin	Decreased REM
Beta Blockers	High Blood Pressure, heart rhythm disorders, angina	Metoprolol, pinadolol, propranolol	Insomnia, awakenings, nightmares
Clonidine	High Blood Pressure	clonidine	REM disruption
Corticosteroids	Inflammation, asthma, autoimmune disease	Prednisone, Fluticasone, Budesonide, Mometasone, Beclomethasone, Circlesonife, Flunisolide	Decreased REM sleep
Diuretics	High Blood Pressure	Chlorothiazide, Chlorthalidone, Hydrochlorothiazide	Night time urination, calf cramps
Medications containing alcohol	Cough, cold and flu	Many	Suppressed REM
Medications containing caffeine	Pain relievers	Many	Wakefulness

Opioids	Pain relievers	Hydrocodone, oxycodone, buprenorphine	Reduction of N3 and REM
Sedating antihistamines	Cold, allergy, motion sickness	Chlorpheniramine, diphenhydramine, dimenhydrinate	Drowsiness
SSRIs	Depression/Anxiety	Fluoxetine, paroxetine, sertraline	Decreased REM, daytime fatigue
Statins	Cholesterol	Atorvastatin, simvastatin	Difficulties falling sleep, frequent awakenings.
Sympathomimetic stimulants	ADHD	Dextroamphetamine, amphetamine, methylphenidate	Difficulty falling asleep, decreased REM and deep sleep
Tricyclics	Depression	Amitriptyline, Amoxapine, clomipramine	Restless legs, morning grogginess
Theophylline	Asthma, COPD	Theophylline	Wakefulness
Thyroid hormone	Hypothyroidism	Levothyroxine	Difficulty falling asleep, fragmented sleep, insomnia

Appendix 7: Sleep quiz



Teensleep Sleep Knowledge Quiz

Dear Student,

We want to know how much you know about sleep before you have the Teensleep lessons.

This quiz contains multiple choice questions about sleep. Please answer the best you can. Remember all your answers will remain anonymous and will not be shared with your teachers, parent(s)/carers, or other members of your class. Answer this quiz on your own, don't discuss how to answer a question with your friends.

Thanks for your time today and for taking part in our project,

The Teensleep team at the University of Oxford

Introduction

Please write the name of your school

Please enter your pupil number. If you are not sure your teacher will be able to tell you

What is your date of birth?

Please write in the format of DD/MM/YY (for example 14/10/01 is 14th October 2001)

What is your gender?

Please choose only one of the following:

☐ Female ☐ Male ☐ Other

Please put a tick in **one circle only** to indicate the answer you think is correct for each question.

1. We will spend about

- ☐ a quarter of our life asleep
- ☐ half of our life asleep
- ☒ a third of our life asleep ✓

2. Most teenagers need

- ☐ 7 – 8 hours of sleep a night
- ☒ 9 – 10 hours of sleep a night ✓
- ☐ 11 – 12 hours of sleep a night

3. REM sleep stands for

- ☒ Rapid Eye Movement Sleep ✓
- ☐ Really Early Morning Sleep
- ☐ Resting Event Monitoring Sleep

4. Which of these drinks is a source of caffeine?

- ☐ Fanta
- ☒ Lucozade ✓
- ☐ Lilt

5. Electronic devices are bad for sleep because the light they emit is

- ☐ Yellow
- ☐ White
- ☒ Blue ✓

6. Tensing and relaxing muscles in the body to help us relax is known as

- ☐ Continuous muscle relaxation
- ☐ Periodic muscle loosening
- ☒ Progressive muscle relaxation ✓

7. Thinking a lot at bedtime

- ☒ May make your sleep lighter and disturbed ✓
- ☐ Can make your sleep deeper and longer
- ☐ Will have no effect on your sleep at all

8. Which of the following would be a good bedtime routine?

- ☐ Exercising, eating dinner, and using your mobile phone
- ☐ Doing homework, watching TV, and playing video games
- ☒ Cleaning teeth, having a warm bath, and reading a printed book ✓

9. Napping during the day should be avoided, but if needed

- ☐ Can happen at any time and must last no more than 90 minutes
- ☒ Can happen before 3pm and must last less than 20 minutes ✓
- ☐ Can happen before 6pm and must last less than one hour

10. Snacking before bed should be avoided but if needed a sleep promoting snack could be

- ☒ Cereal and milk ✓
- ☐ Chicken and pasta
- ☐ Hot chocolate and a biscuit

11. Having a long lie in is OK on

- ☐ Saturday and Sunday
- ☒ Saturday only ✓
- ☐ Sunday only

12. Deep sleep occurs

- ☒ Mostly in the first half of the sleep period ✓
- ☐ Mostly in the last half of the sleep period
- ☐ Occurs equally throughout the sleep period

13. Teenagers shouldn't have more than

- ☒ 100mg of caffeine a day ✓
- ☐ 200mg of caffeine a day
- ☐ 300mg of caffeine a day

14. In REM sleep you have

- ☐ Slow wave sleep
- ☐ Slow rolling eye movements
- ☒ Vivid dreaming ✓

15. At puberty, a teenager's biological urge to sleep delays by

- ☐ 0 – 1 hours
- ☒ 1 – 3 hours ✓
- ☐ 3 – 5 hours

16. Sleep hygiene refers to

- ☒ Behaviours and habits that promote good sleep ✓
- ☐ Changing bed sheets to promote good sleep
- ☐ Exercising just before bed to promote good sleep

17. The sleep hormone is called

- ☒ Melatonin ✓
- ☐ Melanin
- ☐ Myosin

18. Whether a person is a morning or evening type is influenced by their

- ☐ Clocktype
- ☐ Phototype
- ☒ Chronotype ✓

19. If negative thoughts are stopping sleep we could try

- ☐ To keep thinking about them
- ☐ To forget them
- ☒ To restructure them ✓

20. Alcohol and nicotine can cause you to have

- ☒ Less deep sleep, less REM sleep, and more light sleep ✓
- ☐ More deep sleep, less REM sleep, and more light sleep
- ☐ Less deep sleep, more REM sleep, and more light sleep

Appendix 8: Sleep diary

[Oxford Teensleep logo]

TEENSLEEP SLEEP DIARY

Instructions:

Thank you for agreeing to have your sleep monitored as part of our Teensleep study. We hope you find it fun!

We would like you to record how you feel you have slept for 14 nights whilst wearing the activity-monitoring device. Please start filling the diary out prior to sleep about the day you have just had and then continue filling it out when you wake in the morning.

REMEMBER we want to know how you think you sleep, so don't focus on the clock too much when you're going to sleep or if you wake up during the night. Best guesses are what we want!

If you have any questions, please do not hesitate to contact us.

Pupil Number: _____

Teensleep Number: _____

School Name: _____

Date: _____

Contact Teensleep: 01865 618666 Teensleep@ndcn.ox.ac.uk

Actiwatch and Sleep Diary Cheat Sheet

Getting to know your Actiwatch



1. You need to wear it all the time during the **TWO-WEEK** period.
2. It needs to be worn on your **NON-DOMINANT WRIST** – the hand you do not write with
3. It is **WATERPROOF** but please take it off if you are going swimming for a long time (more than 30 minutes)
4. There is a light sensor on the watch, please try to keep the device outside your clothing when possible
5. The device can come loose so needs to be checked regularly
6. If you forget to put it back on after removing it then please put it on as soon as you remember, and make a note in your sleep diary of the approximate time this happened on the day that you removed it
7. Everyone at your school who wears the watch for the whole 14 nights will be entered into a prize draw to win a £25 Amazon voucher

Registering sleep and wake on the Actiwatch

An Actiwatch uses movement to work out when you are awake and asleep. It can become a bit confused if you spend a lot of time sitting on your bed doing things like reading or watching TV. To help us, there is a button on the front of the device called an event marker. When you press it, a light will appear on the front of the watch and a mark will be placed on the digital data.

We want you to use this to let us know when you are in bed trying to sleep and when you wake up in the morning.

At Night

Press the button when you have turned out the lights and are now trying to fall asleep

In the Morning

Press the button when you have woken up for the day and don't intend to sleep or doze anymore

Napping

Press the button when you start and end each nap if you have them

Don't worry if you forget to press the button, just make a note on the sleep diary so we know.

Completing your sleep diary

Please write your GCSE exam number, school name, and date on the front cover. If you do not know your pupil number (exam number) your teacher will be able to find it for you.

Each page is one day and you need to remember to complete it every day.

Please start filling it out just before you want to turn the lights out to go to sleep about the day you have just had and then continue filling it out when you wake in the morning.

REMEMBER we want to know how you think you sleep, so don't focus on the clock too much when you're going to sleep or if you wake up during the night, **best guesses** are what we want!

Make sure you write the date in the space provided each day. There is an example day on the first page that has been completed in red.

If you forget to complete the diary one day please do not try and guess, just make a note on the page that you forgot to fill it out.

Here's an explanation of what each diary question means:

1. Did you take any medication today?

Circle yes, if you have taken medication that day and write down what you have taken. In the example diary after this cheat sheet, the person used their asthma inhaler.

2. Did you drink or eat any of these items containing caffeine after 6pm?

Tick if you drank or ate any of the listed items after 6pm. In the example diary, the person had tea and chocolate after 6pm.

3. Did you use/do any of the following in the hour before bed?

Tick each thing you used or did in the hour before sleep. In the example diary, the person used their laptop, did homework, and had a snack in the hour before bed.

4. Did you nap today?

If you napped, please write the times you started and finished napping. In the example diary this person napped between 2pm and 3pm. Remember to press the Actiwatch button if you do nap!

5. At what time did you get into bed tonight?

This is the time you actually get in to bed in the evening; some people may stay in bed awake for some time (E.g. reading) before they turn off the lights to try and sleep. In the example diary, the person got into bed at 10pm.

6. Lights Out: What time are you putting the lights out to try and go to sleep?

This is the time that you turn off the lights and are trying to fall asleep. In the example diary, this person turns the lights out and tries to sleep at 11pm. This is the point you would press your Actiwatch to tell us that you are now trying to sleep!

7. What time did you wake up this morning?

This is the time you wake up and decide you aren't going to sleep anymore. In the example diary, this person woke at 7am. This is the point you would press the Actiwatch to tell us you are now awake.

8. At what time did you get out of bed this morning?

This is the time you actually get out of bed – this may be after you have been lying in bed doing other things, like watching TV or checking your phone. In the example diary, the person gets out of bed at 7:15am. They may have spent the 15 minutes in bed reading or watching TV after they woke up.

9. How long do you think it took you to fall asleep? (After Lights Out)

Once you have turned off the lights, how long do you think it took you to fall asleep? We want your best guess for this, do not try and count the minutes as you fall asleep. In the example diary, the person thinks they took about 15 minutes to fall asleep.

10. How many times do you think you woke up during the night?

How many awakenings do you remember having during the night? In the example diary, the person thinks they woke about 2 times overnight.

11. How long do you think you were awake during the night?

Add up all the time you think you were awake during all of the awakenings. This can be 0 if you don't remember waking up. Again, don't watch the clock, we just want your best guess for this. In the example diary, the person thought they had been awake for about 5 minutes overnight.

12. About how long do you think you slept in total?

How long do you think you slept altogether, subtracting the time it took for you to go to sleep and any awakenings you may have had. In the example diary, the person thought they had slept for 7 hours and 40 minutes.

13. Would you have liked to sleep longer if you could?

Circle yes if, when you woke in the morning, you would have liked to sleep longer and, if you did, write down how much longer you would like to have slept. In the example diary, the person would like to have slept 1 hour longer.

14. How rested/refreshed do you feel this morning?

Circle how refreshed/rested you felt when you woke up in the morning. In the example diary, this person circled 2 which means they felt moderately rested/refreshed when they woke.

15. How awake do you feel this morning?

Circle how awake you felt when you woke up in the morning. In the example diary, this person circled 1 which means they didn't feel very awake at all when they woke up in the morning.

16. How mentally awake were you in bed last night?

Think back to when you were falling asleep and circle how mentally awake you felt when you were trying to sleep. Mentally awake can be when thoughts are running through your head or you have an active brain and you feel you can't shut it off. In the example diary, this person circled 2 which means they felt they were moderately mentally awake whilst they were trying to go to sleep.

17. How physically tense were you in bed last night?

Think back to when you were falling asleep and circle how physically tense you felt when you were trying to sleep. Physically tense can be when your body feels stressed, tight, or jumpy, like it cannot relax. In the example diary, this person circled 4 which means they felt very physically tense when they were trying to sleep.

If at any point you get confused by a question in the sleep diary or need help with the Actiwatch device, please contact us: 01865 618666 Teensleep@ndcn.ox.ac.uk

EXAMPLE Before Sleep 1 – Date 01 / 09 / 2016

FILL OUT BEFORE SLEEP								
1a	Did you take any medication today? YES / NO (please circle)							
1b	If yes to Question 1a, please list: Asthma Inhaler							
2	Did you drink or eat any of these items containing caffeine after 6pm? (please tick):							
	Tea	<input checked="" type="checkbox"/>	Fizzy Drink	<input type="checkbox"/>				
	Coffee	<input type="checkbox"/>	Energy Drink	<input type="checkbox"/>				
	Chocolate	<input checked="" type="checkbox"/>	Other: please write					
3	Did you use/do any of the following in the hour before bed? (please tick):							
	Laptop	<input checked="" type="checkbox"/>	Mobile Phone	<input type="checkbox"/>	Watch TV	<input type="checkbox"/>	Snack	<input checked="" type="checkbox"/>
	Tablet	<input type="checkbox"/>	e-Reader	<input type="checkbox"/>	Homework	<input checked="" type="checkbox"/>	Exercise	<input type="checkbox"/>
	PC	<input type="checkbox"/>	Games Console	<input type="checkbox"/>	Listen to music	<input type="checkbox"/>	Read a paper book	<input type="checkbox"/>
4a	Did you nap today? YES / NO (please circle)							
4b	If yes to Question 4a, please list the times you napped: 14:00 to 15:00							
FILL OUT JUST BEFORE SLEEP						HOURS : MINUTES		
5	At what time did you get into bed tonight? 24hr clock						<u>2</u> : <u>2</u> : <u>0</u> : <u>0</u>	
6	Lights Out: What time are you putting the lights out to try and go to sleep? REMEMBER TO PRESS THE ACTIWATCH BUTTON NOW!						<u>2</u> : <u>3</u> : <u>0</u> : <u>0</u>	

EXAMPLE After Sleep 1 – Date 02 / 09 / 2016

FILL OUT WHEN YOU WAKE UP IN THE MORNING		HOURS : MINUTES	
7	What time did you wake up this morning? REMEMBER TO PRESS THE ACTIWATCH BUTTON NOW!	<u>0</u>	<u>7</u> : <u>0</u> : <u>0</u>
8	At what time did you get out of bed this morning? 24hr clock	<u>0</u>	<u>7</u> : <u>1</u> : <u>5</u>
9	How long do you think it took you to fall asleep? (After Lights Out)	<u>0</u>	<u>0</u> : <u>1</u> : <u>5</u>
10	How many times do you think you woke up during the night?	<u>2</u>	TIMES
11	How long do you think you were awake during the night?	<u>0</u>	<u>0</u> : <u>0</u> : <u>5</u>
12	About how long do you think you slept in total?	<u>0</u>	<u>7</u> : <u>4</u> : <u>0</u>
13a	Would you have liked to sleep longer if you could? YES / NO (please circle)		
13b	If yes to Question 13a, how much longer?	<u>0</u>	<u>1</u> : <u>0</u> : <u>0</u>
MEASURING THE QUALITY OF YOUR SLEEP LAST NIGHT (PLEASE CIRCLE)			
	not at all	moderately	very
14	How rested/refreshed do you feel this morning?		
	0	1	2 3 4
15	How awake do you feel this morning?		
	0	1 2 3 4	
16	How mentally awake were you in bed last night? E.g. thoughts running through your head		
	0	1	2 3 4

17	How physically tense were you in bed last night? E.g. your body couldn't relax	0	1	2	3	4
----	--	---	---	---	---	---

Before Sleep 1 – Date ____ / ____ / 20____

FILL OUT BEFORE SLEEP								
1a	Did you take any medication today? YES / NO (please circle)							
1b	If yes to Question 1a, please list:							
2	Did you drink or eat any of these items containing caffeine after 6pm? (please tick):							
	Tea		Fizzy Drink					
	Coffee		Energy Drink					
	Chocolate		Other: please write					
3	Did you use/do any of the following in the hour before bed? (please tick):							
	Laptop		Mobile Phone		Watch TV		Snack	
	Tablet		e-Reader		Homework		Exercise	
	PC		Games Console		Listen to music		Read a paper book	
4a	Did you nap today? YES / NO (please circle)							
4b	If yes to Question 4a, please list the times you napped:							
FILL OUT JUST BEFORE SLEEP							HOURS : MINUTES	
5	At what time did you get into bed tonight? <i>24hr clock</i>						____ : ____	
6	Lights Out: What time are you putting the lights out to try and go to sleep? REMEMBER TO PRESS THE ACTIWATCH BUTTON NOW!						____ : ____	

After Sleep 1 – Date ____ / ____ / 20____

FILL OUT WHEN YOU WAKE UP IN THE MORNING						HOURS : MINUTES
7	What time did you wake up this morning? REMEMBER TO PRESS THE ACTIWATCH BUTTON NOW!					____ : ____
8	At what time did you get out of bed this morning? <i>24hr clock</i>					____ : ____
9	How long do you think it took you to fall asleep? (After Lights Out)					____ : ____
10	How many times do you think you woke up during the night?					____ TIMES
11	How long do you think you were awake during the night?					____ : ____
12	About how long do you think you slept in total?					____ : ____
13a	Would you have liked to sleep longer if you could? YES / NO (please circle)					
13b	If yes to Question 13a, how much longer?					____ : ____
MEASURING THE QUALITY OF YOUR SLEEP LAST NIGHT (PLEASE CIRCLE)						
	not at all		moderately		very	
14	How rested/refreshed do you feel this morning?					
	0	1	2	3	4	
15	How awake do you feel this morning?					
	0	1	2	3	4	

16	How mentally awake were you in bed last night? E.g. thoughts running through your head
	0 1 2 3 4
17	How physically tense were you in bed last night? E.g. your body couldn't relax
	0 1 2 3 4

[Continues to 'Before Sleep 14' and 'After Sleep 14' in the same format. In the original sleep diary, all questions (1-17) appeared on a single A4 page and each day started on a new page]

Appendix 9: Actigraphy data analysis protocol

Original

The first analysis plan is outlined here.

Analysis of the motion record is to be completed within the MotionWare software. When a record is opened an Actogram is automatically generated. The OT will print and label these actograms and store them as a hard copy to be used if there is a discrepancy in analysis between the OT and the ET.

To analyse the data, the OT will use the “select days” option to selectively identify the 14-days of each study period for analysis. Although there is an option to remove missing data when the watch was not worn or when there were periods of abnormal high activity, this function will not be used unless the anomalous activity appears during the sleep period.

When the sleep analysis option is open, each individual sleep period over the 14-days will be evaluated. The “Lights Out” and “Got Up” markers will be manually moved to where the students have indicated using the marker button capability. The markers for “Fell Asleep” and “Woke Up” (final awakening) will be automatically adjusted according to the former markers and the activity data.

NOTE In the case of the student forgetting to use the marker the following analysis protocol will be followed:

- a) In the first instance the sleep diary “Lights Out” and “What time did you get up” questions will be used as surrogates to afford a standard measure between scoring sites.
- b) In the event there is no corresponding diary day then the markers will be placed when activity ceases and begins. If this methodology is used then the sleep latency variable will be left blank as this will be inaccurate.

In both cases a note must be made in an excel spreadsheet specific for issues relating to Actigraphy analysis. It should include the filename of the record, the day/date where the error has occurred, the time point (Lights Out/Got Up/ Both), and what the replacement method was for the missing marker.

Once the sleep region has been selected for each of the days identified, the inbuilt, validated algorithm will evaluate each epoch between “Fell Asleep” and “Wake Up” assigning each as Sleep or Wake and also as Mobile or Immobile.

When annotation of the record has been complete, it needs to be re-saved as the original filename but with the suffix _Scored.

Amended

Following discussion between the programme delivery and evaluation teams, the protocol was amended, as below.

When the sleep analysis option is open, each individual sleep period over the 14 days will be evaluated. To analyse a sleep period, you use the “select any” function in the software and highlight the sleep period to be analysed ensuring that you leave adequate buffer space (approximately one hour) either side of activity cessation/resumption. The *blue* “Lights out” and “Got up” markers *in the Motionware programme (version 1.1.25)* will automatically position to where the students have indicated their sleep intention window (by using the marker button capability). The *red* markers for “Fell asleep” and “Woke Up” (final awakening) will be automatically adjusted according to the former markers and the activity data *by the Motionware programme* using the proprietary algorithms. Following this, various sleep statistics will be calculated for that night.

NOTE

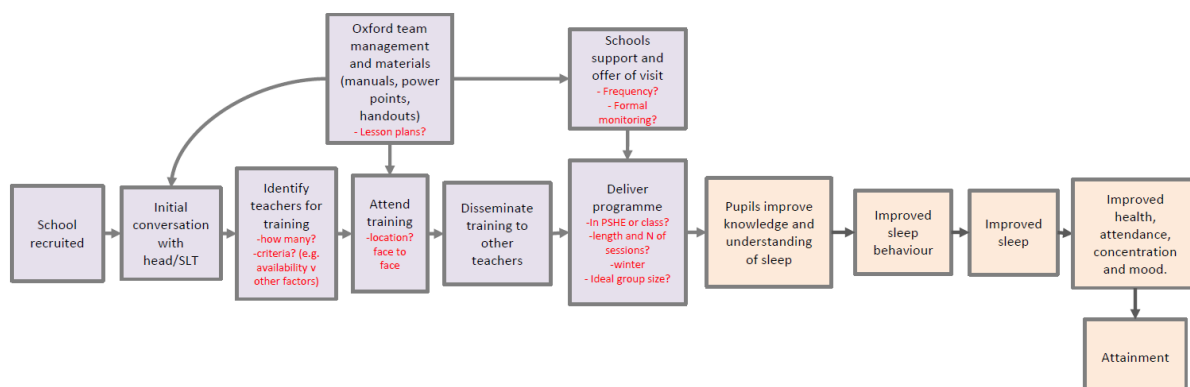
1. In the case of the student forgetting to use the marker *button capability* the following analysis protocol will be followed:
 - a) In the first instance the sleep diary “Q6: Lights Out: What time are you putting the lights out to try and go to sleep?” and “Q7: What time did you wake up this morning?” questions will be used as surrogates to afford a standard measure between scoring sites. *The answer provided by the student in the sleep diary to Q6 will be inputted into the Motionware programme in the box “Lights Out”; the answer provided by the student in the sleep diary to Q7 will be inputted into the Motionware programme in the box “Woke Up”.*
NOTE: This rule should not be followed if the diary times are significantly different to what is seen in the activity and light. In cases such as this, option 1b should be followed
 - b) In the event there is no corresponding diary day (or the diary times are considered to be inconsistent with activity and light readings) then the markers will be placed when activity ceases and resumes. If this methodology is used then the sleep latency variable will be left blank as this will be inaccurate.
 - c) *NOTE: This rule should not be followed if the diary times are significantly different to what is seen in the activity and light. In cases such as this, option 1b should be followed*
In the case of the student having used the marker button capability more than once, and consequently there are multiple blue markers in the Motionware programme from which to select one blue marker each for “Lights Out” or “Got Up”, use the marker closest to activity cessation/resumption.
2. In the case of marker buttons being pressed during the sleep period:
 - a) *disregard if there is sufficiently low activity prior to the marker during the sleep period*
 - b) *move the lights out marker to this student marker point if the student has indicated the subsequent low activity is a nap in the sleep diary i.e. low activity and first marker at 21:00, activity reminiscent of wake at 23:40 and marker indicating sleep intention at 23:50, following day diary indicates nap between 21:00 and 23:40 (students were instructed to try and press markers for naps)*
3. In the case of the student pressing the marker button capability for “Lights Out” much earlier or later than expected (i.e., 6pm and the actigraphy shows activity continues for considerably longer, i.e., till 10pm or 2am and the actigraphy shows activity ceased considerably earlier, i.e., 10pm), consult the sleep diary Q6, and input the answer as “Lights Out” in the Motionware programme.
NOTE: This rule should not be followed if the diary times are significantly different to what is seen in the activity and light. In cases such as this, option 1b should be followed
4. In the case of the student pressing the marker button capability for “Got Up” much earlier or later than expected (i.e., 4am and the actigraphy shows a lot of activity starting considerably later, i.e., 7am or 10am and the actigraphy shows a lot of activity starting considerably earlier, i.e., 7am), consult the sleep diary Q7, and input the answer as “Woke Up” in the Motionware programme.

NOTE: This rule should not be followed if the diary times are significantly different to what is seen in the activity and light. In cases such as this, option 1b should be followed

Cases for which you should not score a night's sleep:

- 1. In the case of missing actigraphy data during the sleep period (i.e., the student may have taken off the watch during sleep), do not score. NOTE: Although not ideal, the data are OK to be scored if the watch was only worn at night*
- 2. No markers and no actigraphy data, do not score.*
- 3. In the case of unlikely actigraphy for a period within the 14-day-coding period, do not score. NOTE: this can occur if the student has placed their device on their bedside table and the corresponding activity will be very low as the table gets knocked during the night.*
- 4. In the case of markers or a diary entry and no actigraphy data, do not score. NOTE: students may press the marker and complete the diary but not wear the watch.*
- 5. In the case of no markers, no sleep diary data, and no actigraphy data for a period within the 14-day-coding period, the sleep period cannot and will not be coded.*

Appendix 10: Initial version of OTS logic model



Appendix 11: Sleep survey scores for matched pre- and post-intervention respondents

Table 15: Average score for each school on Sleep Condition Indicator, for participants completing both pre- and post-intervention surveys

School	Baseline SCI	Post-test SCI
1 (n=27)	23.00 (SD = 5.24)	22.44 (SD = 6.42)
2 (n=73)	21.75 (SD = 7.32)	21.41 (SD = 8.08)
3 (n=98)	23.16 (SD = 7.08)	24.23 (SD = 6.59)
4 (n=103)	22.36 (SD = 6.31)	22.28 (SD = 7.22)
5 (n=40)	20.25 (SD = 7.75)	19.35 (SD = 8.64)
6 (n=96)	22.43 (SD = 7.28)	21.84 (SD = 8.12)
7 (n=102)	23.25 (SD = 6.04)	23.47 (SD = 5.64)
8 (n=135)	22.59 (SD = 7.30)	24.0 (SD = 5.96)
9 (n=125)	21.66 (SD = 7.73)	22.50 (SD = 7.50)
10 (n=20)	22.70 (SD = 8.15)	23.65 (SD = 6.85)
Pooled	22.38 (SD = 7.01)	22.74 (SD = 7.13)

Table 16: Average score for each school on Adolescent Sleep Hygiene Scale (ASHS) (24 items), for participants completing both pre- and post-intervention surveys

School	Baseline ASHS	Post-test ASHS
1 (n=27)	2.63 (SD = 0.62)	2.71 (SD=0.61)
2 (n=73)	2.67 (SD = 0.88)	2.20 (SD = 1.05)
3 (n=98)	2.65 (SD = 0.79))	2.58 (SD = 0.84)
4 (n=103)	2.83 (SD = 0.78	2.83 (SD = 0.78)
5 (n=40)	2.68 (SD = 0.95)	2.68 (SD = 1.21)
6 (n=96)	2.46 (SD = 0.89)	2.28 (SD = 1.06)
7 (n=102)	2.55 (SD =0.54)	2.54(SD = 0.56)
8 (n=135)	2.67 (SD = 0.82)	2.64 (SD = 0.66)
9 (n=125)	2.72 (SD = 0.90)	2.61 (SD = 0.81)
10 (n=20)	2.53 (SD = 0.54)	2.43 (SD = 0.49)
Pooled	2.64 (SD = 0.81)	2.54 (SD = 0.85)

Table 167: Average score for each school on Sleepiness Scores from CASQ for participants completing both pre- and post-intervention surveys

School	Baseline sleepiness	Post-test sleepiness
1 (n=27)	20.78 (SD = 7.32)	21.70 (SD = 6.31)
2 (n=73)	20.88 (SD = 7.08)	20.55 (SD = 8.01)
3 (n=98)	18.46 (SD = 5.98)	19.19 (as = 6.69)
4 (n=103)	21.21 (SD = 8.28)	21.86 (SD = 7.81)
5 (n=40)	19.00 (SD = 7.34)	21.88 (SD = 8.87)
6 (n=96)	19.67 (SD = 6.34)	20.64 (SD = 7.20)
7 (n=102)	19.71 (SD = 5.31)	20.52 (SD = 5.88)
8 (n=135)	18.57 (SD = 6.53)	18.77 (SD = 5.70)
9 (n=125)	20.06 (SD = 7.84)	19.46 (SD = 6.66)
10 (n=20)	19.80 (SD = 5.63)	19.90 (SD = 6.93)
Pooled	19.72 (SD = 7.0)	20.19 (SD = 6.94)

Table 18: Average score for each school on Alertness Scores from CASQ for participants completing both pre- and post-intervention surveys

School	Baseline alertness	Post-test alertness
1 (n=27)	12.11 (SD = 4.06)	11.85 (SD = 4.11)
2 (n=73)	13.81 (SD = 4.99)	13.89 (SD = 4.31)
3 (n=98)	15.27 (SD = 5.27)	15.65 (SD = 4.47)
4 (n=103)	14.96 (SD = 6.25)	14.56 (SD = 4.73)
5 (n=40)	13.65 (SD = 4.75)	14.00 (SD = 5.01)
6 (n=96)	14.80 (SD = 4.85)	14.75 (SD = 5.0)
7 (n=102)	14.03 (SD = 4.40)	13.42 (SD = 4.09)
8 (n=135)	14.27 (SD = 5.04)	13.85 (SD = 4.78)
9 (n=125)	12.76 (SD = 5.11)	12.56 (SD = 4.19)
10 (n=20)	13.50 (SD = 3.87)	13.45 (SD = 6.93)
Pooled	14.12 (SD = 5.13)	13.95 (SD = 4.6)

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