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# Can introduction of sleep hygiene videos improve sleep and concentration in 5th and 6th graders? Interventional study

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## Abstract

**Background** Insomnia is a very common condition in childhood with a prevalence of 25–50%. It can present as difficulty with initiating and maintaining sleep with frequent disruptions throughout the night. Sleep insomnia is known to affect children's development and contribute to poor attention and memory. Establishing a good sleep routine will have a beneficial effect not just on the child's wellbeing and development but the whole family.

The objective of the study was to assess the effectiveness of sleep hygiene videos in improving sleep quality and subsequent cognitive function in children aged 10–11 years.

Two cartoon videos on sleep hygiene were designed along with a child-friendly questionnaire to be filled by grade 5 and 6 students in two different schools in the city of Leeds, England. Questionnaires were filled prior to viewing the videos and 2 to 3 weeks afterward to assess response to the video contents. The videos were viewed in April and May 2022.

**Results** In the East of Leeds School, 49 students participated. In the North of Leeds School, 45 students participated. Significance of outcomes were analysed using the Wilcoxon signed-rank test. In the first school, there was a significant improvement in sleep duration, sleep disturbance, sleep latency, daytime dysfunction due to sleepiness and sleep efficiency ( $p < 0.05$ ). In the second school, there was a significant improvement in sleep duration, sleep disturbance and sleep latency ( $p < 0.05$ ).

**Conclusion** Poor sleep function is a major issue in children. The results demonstrated that the use of sleep hygiene videos can support children with sleep difficulties and help them to modify their behaviour through self-health promotion.

**Keywords** Sleep hygiene, Sleep quality, Poor sleep function, Insomnia, Behavioural sleep intervention

## Background

Sleep is essential for health, growth, psychology, motor development and cognitive function [7]. Sleep duration is variable as it is dependent on the sleep cycle. We sleep

for 4–6 cycles each night. Each cycle lasts from 70 to 120 min. Each cycle consists of four different stages, from light sleep to deep sleep. Unable to reach stages 3 and 4 in each cycle of sleep affect memory, thinking, creativity and cognitive function.

According to the American Academy of Sleep Medicine, “insomnia involves difficulty falling asleep or staying asleep, or regularly waking up earlier than desired, despite allowing enough time in bed for sleep” [1]. Insomnia is a big problem as it affects 25–50% of children [7]. Insomnia can be due to sleep apnoea,

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nocturia, restless leg syndrome (rare in children) or environmental factors [7]. Sleep hygiene improves the routine and the sleep environment. Sleep hygiene helps to initiate sleep and maintain sleep through the night without the need for medication. A cross-sectional study conducted in the USA back in 2007 found that 81% of cases where children presenting to a medical professional for insomnia led to medical prescription [10]. Some of the medications are unlicensed for children, affect the brain and have side effects. Behavioural therapy was prescribed for only 22% of the cases. Highest occurrence of insomnia was found in children between 6 and 12 years of age [10].

A review that was published in 2006 found that behavioural therapy is effective in children below 5 years of age [5].

In this interventional study, we are analysing the effectiveness of sleep hygiene videos as a single therapy in children from 10 to 11 years of age (grades 5 and 6), with the aim to improve sleep quality and subsequently cognitive function.

## Methods

The focus of the study was to support children aged 10 and 11 years in establishing a good sleep hygiene using a behavioural model of introducing sleep hygiene principles by presenting an effective and clear message that children in this age can understand in the form of animated cartoons. The utility of this approach is assessed through a retrospective self-completing questionnaire.

### Subjects' characteristics

Two different grades in two different schools across Leeds city (England) participated. The subject of the study was 5th- and 6th-grade students. Thirty students per class and subsequently a total of sixty students per school were expected to be included in the study. There were no exclusion criteria.

### Design of the videos

The videos were made with Adobe After Effects and Character Animator. Language and animations were child friendly. Two videos were created. The first video was called "The importance of sleep", and it explained the importance of sleep, the different stages of sleep with the features of each stage, the different causes of insomnia and tips on how to initiate and maintain sleep [11]. The video ended up with an open question on what you would do to improve your sleep. The second video was called the "Big sleeping book", and it demonstrated different scenarios children could find themselves in when struggling to sleep, followed by advice on how to deal with each scenario such as having a new baby in the

house, having a noisy neighbour or stopping video games before bed. The first video was 3.27 min. The second video was 2.44 min. The videos were intentionally short to facilitate a high engagement rate.

### Design of the questionnaire

The questionnaire was a self-completing questionnaire that was adapted from the Pittsburgh Sleep Quality Index Questionnaire [2]. The questionnaire was modified to be child friendly. It consisted of 30 statements that assess sleep duration, sleep disturbance, sleep latency, daytime dysfunction due to sleepiness, sleep efficiency, subjective sleep quality and cognitive function. The children had four options to choose from: rarely, sometimes, often and almost always. Rarely was described as none or 1–3 times a month, sometimes as 1–2 times a week, often as 3–5 times a week and almost always as 6–7 times a week. Students filled the questionnaire by ticking the relevant box.

### Implementation and data collection

SENCOs (Special Educational Needs Coordinator) were contacted at seven schools across Leeds to acquire approval to conduct the research study at their school in October 2021. Four schools showed interest, but due to staff shortages during the COVID-19 pandemic and site-specific COVID-19 restrictions from October 2021 until February 2022, we were only able to conduct the research in 2 schools in April and May 2022. One school was in the north, and the other was in the East of Leeds. The latter school is in one of the low socioeconomic areas of Leeds with high deprivation. I visited the schools and interacted with SENCOs and students explaining the study design. The students filled the questionnaire before watching the two videos and repeated the questionnaire after 2–3 weeks of watching the video; this interval was to give the children the time to implement and reflect on their sleep hygiene. The session was incorporated as part of their PSHCE lesson (personal, social, health and citizenship education).

### Statistical analysis

The data from the questionnaire were answered using a Likert scale. The data was transferred to an Excel sheet for analysis. A scoring from 0 to 3 represented positive statements (0 for rarely, 1 for sometimes, 2 for often and 3 for almost always). A scoring of 0 to –3 was used to represent negative statement (0 for rarely, –1 for sometimes, –2 for often and –3 for almost always). For positive statements, 3 represented the greatest function, and 0 represented the greatest dysfunction. In contrast, when considering negative statements, 0 represented the greatest function, and –3 represented the greatest dysfunction. Data was grouped into seven domains (Tables 1 and

2) which were sleep duration, sleep disturbance, sleep latency, daytime dysfunction due to sleepiness, sleep efficiency, subjective sleep quality and cognitive function. One statement was removed from the study as multiple students did not understand its meaning, so 29 statements were analysed instead of 30 (Tables 1 and 2). The statement was “I feel unlikely to sleep after having a nap/sleep”. One statement matched two domains. The statement was “I wake up while sleeping”, and the response to it was analysed under sleep disturbance and sleep efficiency. As the statements are categorical questions, a table chart was used to represent the results. Percentage of change was calculated based on the difference in score of each domain between the first and the second questionnaire. We employed the Wilcoxon signed-rank test to determine the significance of the outcomes of each domain for each school. We employed critical values corresponding to  $p < 0.05$ . The critical values were taken from the statistical resource real-statistics.com (Real Statistics using Excel, [12]).

## Results

### Results of the first school in the East

In grade 5, 25 students filled the questionnaire. One questionnaire was not analysed as not all the statements were answered. In grade 6, 28 students filled the questionnaire. Three questionnaires were not analysed as some of the statements were not answered (Fig. 1).

Students who were not present in school in the first phase of the study were asked not to complete the questionnaire in the second phase.

In total, 49 completed questionnaires were analysed. There was a positive change in sleep duration by 13.6%, sleep disturbance by 10.9%, sleep latency by 22%, daytime dysfunction due to sleepiness by 8.7%, sleep efficiency by 10% and subjective sleep quality by 6% (Table 3). There was a negative change in cognitive function by 1.3%. We employed the Wilcoxon signed-rank test to establish the significance of these changes. The null hypothesis ( $p < 0.05$ ) was rejected for sleep duration, sleep disturbance, sleep latency, daytime dysfunction

**Table 1** The data analysis of the first school (East of Leeds) for grade 5 and grade 6

Domains	Grade 5 (24 students)			Grade 6 (25 students)		
	Before watching the videos	After 2 weeks	Ideal score	Before watching the videos	After 2 weeks	Ideal score
<b>Sleep Duration</b>						
The hours I sleep is enough	42	48	72	46	45	75
I have difficulty getting back to sleep once I woke up in the middle of the night	-35	-24	0	-29	-25	0
<b>Sleep disturbance</b>						
I wake up while sleeping	-30	-25	0	-22	-16	0
I wake up easily because of the noise	-31	-17	0	-30	-23	0
<b>Sleep latency</b>						
I fall into deep sleep	31	40	72	37	43	75
I have difficulty falling asleep	-37	-25	0	-34	--28	0
<b>Daytime dysfunction due to sleepiness</b>						
Poor sleep gives me headaches	-18	-18	0	-28	-19	0
Poor sleep makes me angry	-24	-11	0	-26	-18	0
Poor sleep makes me loss my appetite	-7	-1	0	-19	-22	0
Poor sleep makes it hard for me to think or remember what I am taught	-19	-13	0	-28	-14	0
Poor sleep makes me lose interest in school work or play	-19	-8	0	-24	-16	0
Poor sleep cause me to make mistakes in school	-18	-10	0	-19	-10	0
Poor sleep makes me to forget things in lessons	-13	-9	0	-16	-9	0
Poor sleep makes it hard for me to pay attention in school	-18	-12	0	-20	-17	0
I feel sleepy during the day and in school	-30	-19	0	-35	-32	0
Poor sleep makes me lose interest in things I like to do	-6	-1	0	-12	-11	0
Poor sleep makes me very tired in school	-31	-17	0	-25	-24	0
Poor sleep affects my life every day	-17	-11	0	-15	-12	0
<b>Sleep efficiency</b>						
I'm happy will my sleep every day	42	39	72	41	45	75
I'm very relaxed after sleep and ready to go to school	24	38	72	29	31	75
I wake up while sleeping	-30	-25	0	-22	-16	0
I toss and turn on my bed	-34	-31	0	-33	-31	0
I never go back to sleep after awakening during sleep	-15	-15	0	-22	-17	0
<b>Subjective Sleep quality</b>						
I feel refreshed after sleep	30	36	72	37	30	75
My Fatigue is relieved after sleep	33	29	72	35	31	75
I feel full of energy after sleep	26	33	72	31	27	75
I would like to sleep more after waking up in the morning	-40	-36	0	-59	-53	0
I have difficulty to get out of bed in the morning	-52	-41	0	-50	-48	0
<b>Cognitive function</b>						
I can focus during the lesson	57	61	72	56	56	75
It's easy to pay attention and remember what the teacher said	57	61	72	57	45	75

**Table 2** The data analysis of the second school (North of Leeds) for grade 5 and grade 6

Domains	Grade 5 (19 students)			Grade 6 (26 students)		
	Before watching the videos	After 3 weeks	Ideal score	Before watching the videos	After 3 weeks	Ideal score
<b>Sleep Duration</b>						
The hours I sleep is enough	36	33	57	50	48	78
I have difficulty getting back to sleep once I woke up in the middle of the night	-38	-34	0	-44	-35	0
<b>Sleep disturbance</b>						
I wake up while sleeping	-28	-18	0	-30	-27	0
I wake up easily because of the noise	-11	-11	0	-25	-20	0
<b>Sleep latency</b>						
I fall into deep sleep	28	27	57	35	40	78
I have difficulty falling asleep	-22	-23	0	-29	-27	0
<b>Daytime dysfunction due to sleepiness</b>						
Poor sleep gives me headaches	-17	-15	0	-13	-26	0
Poor sleep makes me angry	-15	-17	0	-18	-23	0
Poor sleep makes me loss my appetite	-16	-13	0	-10	-18	0
Poor sleep makes it hard for me to think or remember what I am taught	-23	-15	0	-23	-17	0
Poor sleep makes me lose interest in school work or play	-25	-18	0	-25	-22	0
Poor sleep cause me to make mistakes in school	-15	-16	0	-27	-20	0
Poor sleep makes me to forget things in lessons	-12	-14	0	-24	-16	0
Poor sleep makes it hard for me to pay attention in school	-18	-9	0	-19	-17	0
I feel sleepy during the day and in school	-14	-22	0	-30	-23	0
Poor sleep makes me lose interest in things I like to do	-18	-18	0	-11	-18	0
Poor sleep makes me very tired in school	-16	-13	0	-26	-26	0
Poor sleep affects my life every day	-17	-13	0	-12	-19	0
<b>Sleep efficiency</b>						
I'm happy will my sleep every day	31	33	57	47	44	78
I'm very relaxed after sleep and ready to go to school	28	22	57	39	37	78
I wake up while sleeping	-28	-18	0	-30	-27	0
I toss and turn on my bed	-39	-34	0	-38	-43	0
I never go back to sleep after awakening during sleep	-19	-16	0	-22	-22	0
<b>Subjective Sleep quality</b>						
I feel refreshed after sleep	27	32	57	51	46	78
My Fatigue is relieved after sleep	34	28	57	48	41	78
I feel full of energy after sleep	33	27	57	39	39	78
I would like to sleep more after waking up in the morning	-29	-29	0	-48	-49	0
I have difficulty to get out of bed in the morning	-29	-31	0	-44	-42	0
<b>Cognitive function</b>						
I can focus during the lesson	47	41	57	56	57	78
It's easy to pay attention and remember what the teacher said	42	35	57	52	58	78

due to sleepiness, sleep efficiency and cognitive function domains (Table 3). We could not reject the null hypothesis ( $p < 0.05$ ) for subjective sleep quality (Table 3). Analysing each domain, the sleep disturbance and sleep latency outcomes were furthest away from the  $W$ -critical ( $< 20\%$  of  $W$ -critical) which suggest more substantial impact.

### Results of the second school in the North

In grade 5, 25 students filled the questionnaire. Six questionnaires were not analysed as some of the statements were not answered. In grade 6, 28 students filled the questionnaire. Two questionnaires were not analysed as some of the statements were not answered.

Students who were not present in the first phase of the study and were asked not to complete the questionnaire in the second phase (Fig. 1).

In total, 45 completed questionnaires were analysed. There was a positive change in sleep duration by 5.9%, sleep disturbance by 6.7%, sleep latency by 3.7%, daytime dysfunction due to sleepiness by 1% and sleep efficiency by 0.6% (Table 4). There was a negative

change in subjective sleep quality by 4.9% and cognitive function by 2.2%. We employed the Wilcoxon signed-rank test to establish the significance of these outcomes. The null hypothesis ( $p < 0.05$ ) was rejected for sleep duration, sleep disturbance and sleep latency and cognitive function and subjective sleep quality domains. We could not reject the null hypothesis ( $p < 0.05$ ) for daytime dysfunction due to sleepiness and sleep efficiency (Table 4). Analysing each domain, the sleep disturbance was furthest away from the  $W$ -critical ( $< 30\%$  of  $W$ -critical) which suggest more substantial impact.

### Discussion

Poor sleep hygiene is a common cause of sleep difficulties; it is recognised that poor sleep hygiene affects children in various ways presenting as behavioural difficulties, poor concentration and daytime sleepiness. The focus of the study was to support children of a certain age group in establishing a good sleep hygiene using a behavioural model of introducing sleep hygiene principles. There are established psychometric parameters for

**Table 3** The total score of the main 7 domains depending on the type of the statement used in the first school with the % of change (East of Leeds)

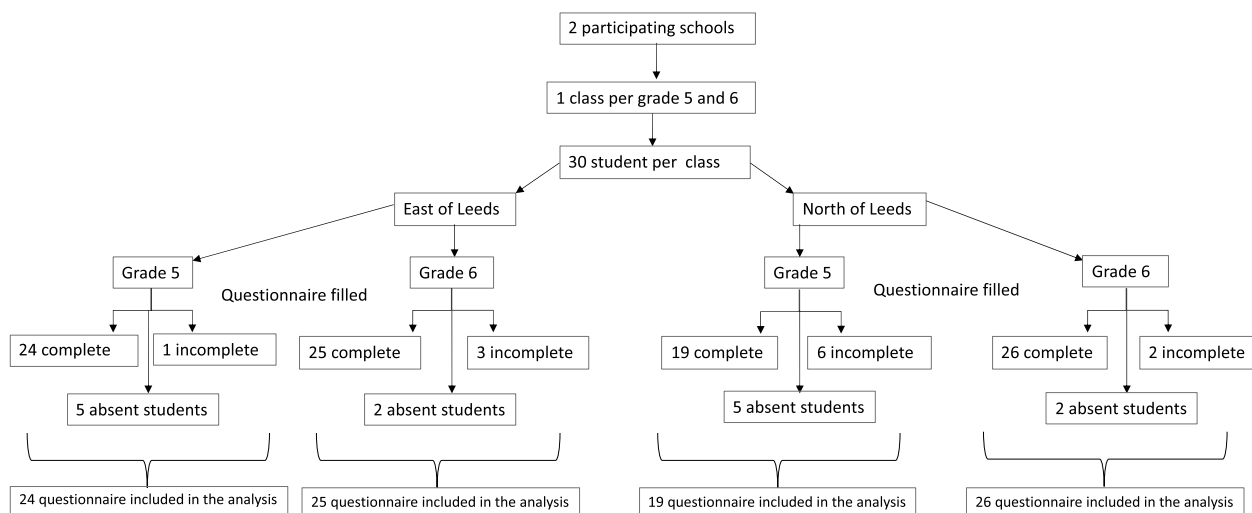
Domains (Total score)	Grade 5 (24 students)		Grade 6 (25 students)		Total (49 student)		Max score	change (%)	p-value
	Before watching the videos	After 2 weeks	Before watching the videos	After 2 weeks	Before watching the videos	After 2 weeks			
<b>Sleep Duration</b>									
Positive response statement (1 statement)	42	48	46	45	88	93	147	3.401360544	P<0.001
Negative response statement (1 statement)	-35	-24	-29	-25	-64	-49	0	10.20408163	
<b>Sleep disturbance</b>									
Negative response statement (2 statements)	-61	-42	-52	-39	-113	-81	0	10.88435374	P<0.001
<b>Sleep latency</b>									
Positive response statement (1 statement)	31	40	37	43	68	83	147	10.20408163	P<0.001
Negative response statement (1 statement)	-37	-25	-34	-28	-71	-53	0	12.24489796	
<b>Daytime dysfunction due to sleepiness</b>									
Negative response statement (12 statements)	-220	-130	-267	-204	-487	-334	0	8.673469388	p<0.001
<b>Sleep efficiency</b>									
Positive response statement (2 statements)	66	77	70	76	136	153	294	5.782312925	P<0.001
Negative response statement (3 statements)	-79	-71	-77	-64	-156	-135	0	4.761904762	
<b>Subjective Sleep quality</b>									
Positive response statement (3 statements)	89	98	103	88	192	186	441	-1.360544218	P<0.2
Negative response statement (2 statements)	-92	-77	-109	-101	-201	-178	0	7.823129252	
<b>Cognitive function</b>									
Positive response statement (2 statements)	114	122	113	101	227	223	294	-1.360544218	P<0.001

adults in order to assess sleep function, but these are absent for children. One published study assessing the use of the well-established adult self-assessment questionnaire “The Pittsburgh Sleep Quality Index (PSQI)” in healthy children found that PSQI is a very liable tool to assess sleep function in children [8]. We adapted the PSQI questionnaire and made it more child friendly in order to facilitate self-assessment in children. The PSQI questionnaire has seven domains of assessment which are sleep duration, sleep disturbance, sleep latency, daytime dysfunction due to sleepiness, sleep efficiency, subjective sleep quality and the use of sleep medication [2]. In the American Academy of Sleep Medicine (AASM), sleep duration is defined as “the regular total hours to promote optimal health”, sleep disturbance is defined as “ any situation that interferes with sleep”, sleep latency is defined as “ the amount of time requires to fall asleep once settling down for the night”, daytime dysfunction is defined as “the role of sleep in daily function”, sleep efficiency is defined as “the total amount of time that the person slept divided by the total amount spent in bed” and subjective sleep quality is defined as “the subject aspect of sleep like depth and restfulness” [3]. The domain of sleep medications, which is also part of the PSQI, was not taken into consideration in our study since we assessed sleep function in healthy

children in normal stream schools. In children with ADHD, ADHD stimulant medications such as methylphenidate can affect the sleep initiation by delaying it by 30 min [9]. Based on this, we used six of the seven domains of the PSQI [2]. We aimed to assess cognitive function in our study by involving a child psychologist. This would provide the opportunity to adapt part of the questionnaire to assess the cognitive development. Due to COVID-19 restrictions, we were not able to arrange this. However, cognitive function was the seventh domain in our study with two questions serving as indicators rather than determinants. A 2- to 3-week duration between the questionnaires was given to allow the students time to implement the changes identified and discussed. At least 2-week duration is needed to differentiate transient from permanent impact [2]. We had a total number of 94 completed questionnaires from two schools. In the East of Leeds School, there was significant improvement in five domains which were sleep duration, sleep disturbance, sleep latency, daytime dysfunction due to sleepiness and sleep efficiency. The positive change in subjective sleep quality was determined to be insignificant. In the North of Leeds School, there was significant improvement in three domains which were sleep duration, sleep disturbance and sleep latency. The change in outcomes related to daytime

**Table 4** The total score of the main 7 domains depending on the type of the statement used in the second school with the % of change (North of Leeds)

Domains (Total score)	Grade 5 (19 students)		Grade 6 (26 students)		Total (45 students)		Max score	Change (%)	p-value
	Before watching the videos	After 3 weeks	Before watching the videos	After 3 weeks	Before watching the videos	After 3 weeks			
<b>Sleep Duration</b>									
Positive response statement (1 statement)	36	33	50	48	86	81	135	-3.703703704	
Negative response statement (1 statement)	-38	-34	-44	-35	-82	-69	0	9.62962963	P<0.001
<b>Sleep disturbance</b>									
Negative response statement (2 statements)	-39	-29	-55	-47	-94	-76	0	6.666666667	P<0.001
<b>Sleep latency</b>									
Positive response statement (1 statement)	28	27	35	40	63	67	135	2.962962963	
Negative response statement (1 statement)	-22	-23	-29	-27	-51	-50	0	0.740740741	P<0.001
<b>Daytime dysfunction due to sleepiness</b>									
Negative response statement (12 statements)	-206	-183	-238	-245	-444	-428	0	0.987654321	P>0.2
<b>Sleep efficiency</b>									
Positive response statement (2 statements)	59	55	86	81	145	136	270	-3.333333333	
Negative response statement (3 statements)	-86	-68	-90	-92	-176	-160	0	3.950617284	P<0.2
<b>Subjective Sleep quality</b>									
Positive response statement (3 statements)	94	87	138	126	232	213	405	-4.691358025	
Negative response statement (2 statements)	-58	-60	-92	-91	-150	-151	0	-0.37037037	P<0.05
<b>Cognitive function</b>									
Positive response statement (2 statements)	89	76	108	115	197	191	270	-2.222222222	P<0.001



**Fig. 1** Flowchart of questionnaires included in the analysis

dysfunction due to sleepiness and sleep efficiency was small in the second school and deemed insignificant by the Wilcoxon signed-rank test. The negative change in subjective sleep quality was determined to be

significant. Subjective sleep quality is difficult to assess in adult, and it varies between individuals and its culture affected [3]. The outcomes in the second school were less desirable, and this could be related to the

students taking the second phase of this study after the spring half-term holiday, and in their assessment week (exam week), both of which can be confounding factors. There was a negative change in outcome in the cognitive domain in both schools that was deemed statistically significant. The cognitive domain was assessed via two statements about memory and concentration. This was not a full cognitive assessment. Utilising a detailed comprehensive cognitive assessment tool with the consultation of a child clinical psychologist could clarify this outcome.

Overall, there was significant improvement in multiple domains in sleep functions in both schools. A published review in paediatric sleep medicine found that there is limited awareness of childhood sleep function between health professionals [6]. There is limited research in the sleep field in children, and it is confined to children with ADHD and autism spectrum disorder. We could not elicit any published studies about the effect of behavioural sleep intervention in healthy children at school age. A published study in children with ADHD from 5 to 12 years of age with sleep difficulties found that behavioural sleep intervention was effective in improving sleep and behaviour [4].

To our knowledge, this is the first study to assess the effect of behavioural modification of sleep principles using a video resource; further studies with a larger sample size will be required to investigate the full potential of this approach. Having a tool that is easily accessible to schools, SENCO, parents and children may have a substantial impact on sleep hygiene.

We are aware that the study sample was relatively small. We would have liked a larger number of students to be included in the study, but there were difficulties in school engagement during the COVID-19 pandemic and subsequent restrictions. Parents should also be engaged as they play an instrumental part in environmental modifications; this will be considered in the second phase of the study.

## Conclusion

Behaviour sleep intervention has a significant and long-term impact on children. Introducing child-friendly sleep hygiene videos can improve a child's sleep and health. Further studies are needed with a larger sample size.

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## Authors' contributions

EH designed the study, collected and analysed data and drafted the manuscript. SR critically revised the manuscript. SP designed the videos. All authors read and approved the final manuscript.

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No grant was provided to conduct the study.

## Availability of data and materials

Data and supporting materials are available on reasonable request.

## Declarations

### Ethics approval and consent to participate

Not applicable. NHS ethics approval was not required as per NHS REC review. Documents can be provided on request.

### Consent for publication

Not applicable.

### Competing interests

The authors declare that they have no competing interests.

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