The Impact of a Behavioral Intervention on Parent Sleep Hygiene Behaviors

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Abstract

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Objectives: A longitudinal randomized control trial (RCT) was conducted to determine whether a sleep hygiene intervention improved long-term child sleep. This study assessed whether the intervention changed child night time media usage in the intervention group relative to the control group, as well as the frequency of parents' sleep inducement strategy usage from baseline to three months. **Methods:** Linear regressions applying the Difference in Differences (DiD) model were conducted to examine whether differences between groups existed due to the intervention beyond the passing of time for child media use and parent sleep inducement strategy use. **Results:** Two sleep strategies, *adult stays out of room,* and *adult lying down with child,* showed statistical significance of differences between the intervention and control groups across time ($p < 0.05$ and $p < 0.01$). Although improvements were seen in the intervention group for other primary outcomes, no statistical significance was found at these time points. **Discussion:**

This study sought to determine whether a sleep hygiene intervention could influence positive parental behavior mediating their child's media use and the sleep inducement strategies used at bedtime. At these time points, the intervention did influence two sleep strategies, *adult stays out of room*, and *adult lying down with child*. It will be important to assess how the intervention impacts these primary outcomes further along in the parent RCT.

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Introduction

Sleep problems are common among children between 2.5 to 5 years of age. For young children, parents play an important role in their child's social and physical contexts, guiding their child's lifestyle habits (i.e. nutrition and exercise) and determining what physical environment they grow up in (i.e. neighborhood livability, school access, etc.). Common risk factors for disrupted sleep include the child's temperament and behavior, family dynamics, and the social and physical environment the child lives in. The most common behavioral sleep problems are with sleep onset and night wakings, which impact 25-40% of young children due to conditioned sleep associations or difficulties with parental limit setting. Other common sleep problems include nightmares, early waking, and insufficient duration of sleep. These risk factors can result in childhood sleep problems that include poor sleep duration, poor sleep quality, and/or poor sleep consistency. These sleep problems could result in obesity, poor academic performance, and mental health issues in the long-term. Figure 1 maps the pathways of child sleep and long-term outcomes. Ameliorating sleep problems is critical to ensuring optimal childhood development as sleep plays an important role in proper brain development, physical growth, lifelong health and wellbeing.

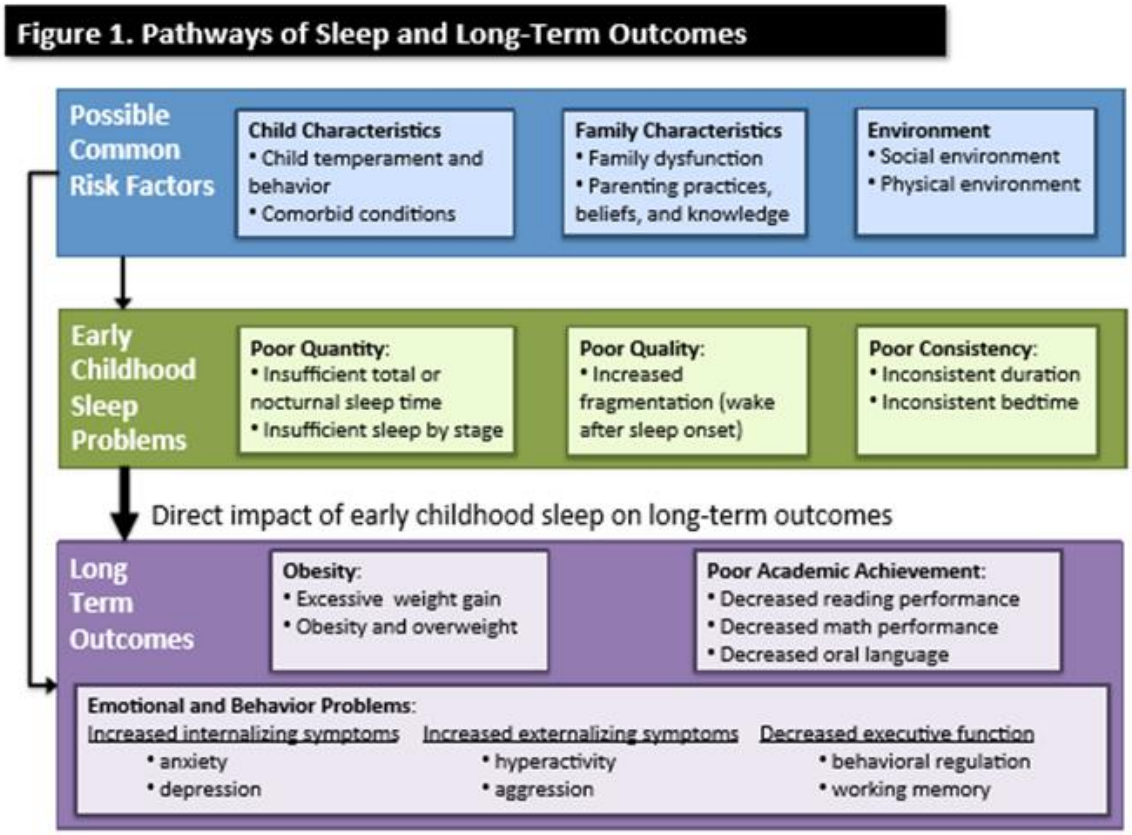

Fig. 1 Factors Impacting Sleep Hygiene and Its Associated Long-term Health Outcomes

Studies that have considered the impact of media usage on children[12,13] highlight the need to address media usage's interactions with sleep[1-4], which increases risk for long-term obesity[1,4] and poor mental health[2,4,5]. Several previous studies have been conducted to understand impacts of media usage, most of which have been short-term, cross-sectional[8], and present findings about impacts of poor sleep or long-term effects.

Few interventional studies have been conducted to target parental behavior change as a mechanism for improving media usage and ultimately sleep among children, but parental behavior change has not been described. Specifically, though researchers have conducted sleep interventions targeting parental behavior change for young children's sleep improvement in

Australia, they have reported child outcomes (e.g., sleep, mental health, obesity and academic performance) but not changes in parental behavior[14-16].

The Sleep Health in Preschoolers (SHIP) study is an ongoing randomized control trial (RCT) of an intervention to improve children's sleep for both their short- and long-term health and wellbeing. Trained case managers implemented the intervention longitudinally over three years through home visits and phone calls. After establishing consent, baseline assessments of both the parent and child were conducted. In the active phase, case managers provided parents with sleep knowledge, and coached them in goal setting and problem solving. In the maintenance phase, parents were provided with guidance and sleep skills management on a monthly basis. In the feedback portion of the intervention parents received an assessment report describing their behavioral and sleep outcomes progress. These phases should result in changes in parental beliefs towards sleep, resulting in behavior change, and improved child and parent sleep. This evaluation examined changes in behavior during the active phase.

The present study focuses on addressing a gap in the literature by examining whether and how parents' decisions to induce sleep changed as a result of the SHIP intervention during the active phase of the intervention in the first three months of its delivery. Specifically, this study aims to evaluate how the SHIP intervention changed parents' sleep promotion strategies in order to help their child fall asleep, and focused on two questions: (1) Between baseline and three months, did child night-time media use in the intervention group change compared to the control group? (2) Did the frequency of positive sleep inducement strategy use increase (and negative strategy use decrease) from baseline to three months significantly more in the intervention group parents than the control group parents?

Methods

Study Design

This assessment employed a longitudinal prospective pretest-posttest control group design, with 433 children recruited and randomized for the study.

As above, in the RCT, trained case managers implemented the intervention longitudinally over 12 months through home visits and phone calls. This analysis focuses on findings of the active phase of the intervention, which took place over the first 3 months for each family, during which time case managers provided parents with sleep education and coached them in goal setting and problem solving.

Study Sample

To be potentially eligible for the RCT, children needed to be between the ages of 30 to 60 months with behavioral sleep problems at enrollment. After being recruited via flyers and notices aimed toward parents posted at community centers, libraries, churches, schools, daycare centers, and local social media, parents were invited to complete an online survey using the Children's Sleep Habits Questionnaire to screen for eligibility. Children were eligible for inclusion if they scored greater than 50 on the questionnaire, or 41 or higher and received less than 9 hours of sleep a night by parent report as cut points for poor sleep outcomes. Children were excluded if they had significant developmental disabilities, cancer, diabetes or other comorbid conditions that impact child sleep, or receive treatment with stimulant medications. Children whose parents did not speak English were also excluded. Family structure was not restricted (i.e. divorced parents); one parent was designated as the primary study parent.

Intervention

The active phase of the intervention administered by case managers involved a home visit at baseline and weekly follow-up phone calls for three months. Home visits decreased barriers to

intervention access for families, and case managers reviewed the family's assessment results prior to the visit, allowing them to tailor goal setting and problem-solving skills appropriately to the needs of the parent and child.

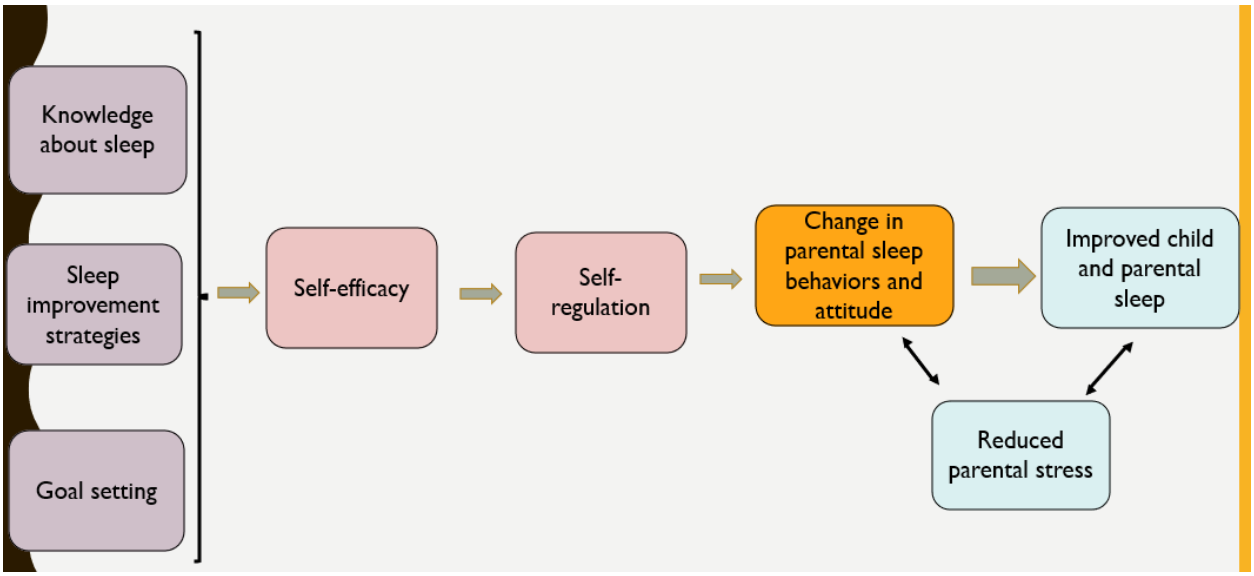

Figure 2. A model of the theory of cause and effect of parental behavior change around sleep

Figure 2 is a cause and effect model demonstrating how this intervention seeks to change parental behavior to address their child's sleep problems. The intervention was implemented to improve child sleep by fostering parental self-efficacy and by providing effective sleep-promoting strategies. By increasing parental knowledge about sleep, providing sleep improvement strategies, and encouraging goal setting around sleep habits, this intervention seeks to increase self-efficacy in the parent. By providing parents with sleep strategies (i.e. alternatives to reduce media access in the bedroom, decreasing amount of media use, and a variety of strategies to induce sleep, etc.), this intervention intends to encourage parents to believe in their ability to make a change in their habits due to the plethora of positive actions they can take. By increasing knowledge and self-efficacy, the intervention hopes to assist parents in self-regulation of negative sleep habits (and uptake of positive sleep strategies) in their children and themselves, which will result in changes in their behavior, positive impacts of reduced parental stress, and

ultimately, improved child sleep (which will additionally improve parental sleep). Social Cognitive Theory (SCT) "posits that learning occurs in a social context with a dynamic and reciprocal interaction of the person, environment, and behavior"[6]. SCT informed the measures that detect whether parents' outcome expectations changed for the improvement of their child's sleep over time, as well as informing how case managers addressed parental self-efficacy, goal setting and provided coping strategies for barriers. SCT informs this intervention by iteratively coaching parents in assessment, learning, goal-setting, and problem-solving. This study seeks to shift parental motivation, build skills and increase self-efficacy of parents to drive behavior change, along with providing parents with health education.

Measures

Assessment Instrument

A sleep and time diary was provided for one week to all parents at baseline and at three months. All data collection occurred within the parent-child dyad's home to ensure real-time responses to the diary questions. This diary contained questions for parents to answer each day, monitoring their child's, as well as their own, behaviors. Questions included asking about wake and sleep times, types of media usage, duration of night waking periods, and their child's daytime activities. Although these are self-reported responses by parents, responses are collected in real time over 7 days. The diary measure is commonly used in various sleep studies[2, 11-13] over retrospective survey measures.

Primary Predictor

The intervention assignment is defined as case manager administered sleep hygiene education and support. Having access to this sleep hygiene guidance is our primary predictor of improved parentally enacted sleep moderating behaviors.

Primary Outcomes

Aim 1 Outcome: Media use was defined as a child's subsequent time spent watching TV or viewing other device screens (iPad, smartphones etc.) as allowed and determined by their parent. Media use was measured from parent reported media use in 15-minute increments for seven nights in the sleep diary and is defined as each child's media use time averaged over seven days at baseline and T3. Screen black out time is defined as the timepoint when parents indicated their child stopped using media each night. Screen black out time determined an average of when each child stopped using media across seven nights. Duration categories delineate families based on approximated average media use over seven nights (i.e. 1-29 minutes, 30-59 minutes, etc.). Duration categories determined the percent of families with zero, 1-29 minutes, 30-59 minutes or more than 60 minutes of media use per night. Percent of nights of media use was measured from the number of nights parents marked as 'media used' and is defined as the average percentage of nights of media used for each group.

Aim 2 Outcome: A frequency variable was derived to indicate how often parents used a certain sleep strategy to help their child fall asleep. Nine possible strategy options were included in the sleep diary assigned to each dyad, with some considered positive (*special toy or blanket, listening to music, adult staying out of the room*), some considered to negatively impact sleep (*watching TV/video, adult rocking or holding child, adult laying down with child*) and others are neutral (*reading a story, singing a song, adult staying in room*). Each sleep strategy is a potential outcome. For sleep strategies used prior to a child's bedtime, the parent checked a box next to each sleep strategy option, with no limit to the number of strategies that could be marked. Parent use of individual sleep strategies was calculated as the proportion of nights the strategy was

marked as used, out of the first seven nights of diary data and excluding nights for which no strategy data was reported.

Descriptive Measures

For descriptive purposes we included measures of the child and family's characteristics at baseline (i.e. age, gender, socioeconomic status (SES), ethnicity).

Statistical Plan

All analyses were conducted in STATA version 14. Descriptive statistics were used to demonstrate equal distribution of dyads across study arms by age, gender, SES, ethnicity, family demographics, income, and night-time media use.

Difference in Differences analyses (DiD) were conducted to determine whether a meaningful difference exists between study groups for all measures of media use and sleep strategy use. These analyses were done to answer how media use changed and how frequency of sleep strategy usage changed between groups.

1) Night time media usage

Linear regressions were done using the DiD approach to determine changes in media use from T0 to T3 for the intervention group versus the control group for mean media duration, screen blackout time, percent of nights with any media use, and to determine changes in the overall distribution of media use duration categories from T0 to T3 between groups.

2) Parents' sleep inducement strategies

To examine whether the frequency of sleep strategy use differed from T0 to T3 based on being in the intervention or control group, a DiD approach was done. Because strategy usage was averaged across the week, linear regressions were done to determine changes in usage across groups.

Institutional Review Board Approval

All study procedures and analyses were approved by the Institutional Review Board (IRB) at Seattle Children's Hospital prior to initiation of this study, and the evaluator was added to the IRB team in November 2018 prior to acquiring data access and has no conflicts of interest.

Results

Diary data was available for 181 child-parent dyads in the intervention arm, and 161 child-parent dyads in the control arm (see Fig. 3).

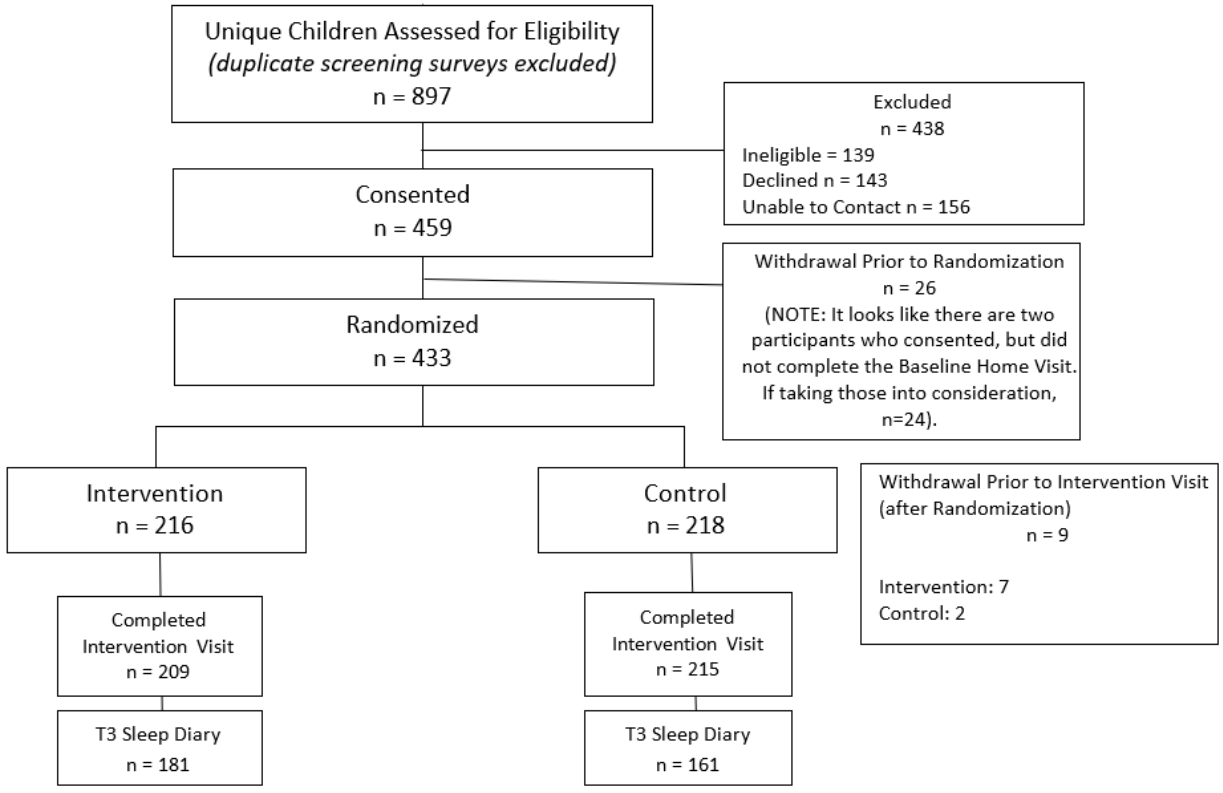

Fig. 3. SHIP CONSORT Diagram.

Demographics

Demographics were evenly distributed for this randomized-control trial, with no significant differences between study arms in all characteristics (child's gender, child's age, family, race, family composition and family income) (see Table 1). On average, participants

were under four years old (44.8 months and 45.1 months for intervention and control group respectively). The majority of the sample was white (88% of participant families indicated white as their racial identity), and 9-11% identified as Hispanic, 13-18% as Asian, 2% as Indigenous, and 2-5% as Black. Most families were married (93.4% and 95% of intervention and control families, respectively), 48.1% and 41.6% hold a graduate degree, and 63.9% and 60% have an annual income above $100,000 of intervention and control families, respectively. Most children did not have media access in the bedroom (70%) and averaged 27 and 28.1 minutes of media use before bedtime at baseline for intervention and control groups, respectively.

Primary Outcome Findings

The usage of two sleep strategies showed a significant difference between groups from baseline to three months (see Table 2). There was a change in use of the positive strategy, *adult stays out of room*, between intervention and control groups ($p<0.05$), with an increase in the intervention group (28.7% to 42.7%) and a decrease in the control group (32.9% to 29.7%). There was also a change in use of the negative strategy, *adult lying down*, between groups ($p<0.01$), with a decrease in intervention group use (40.9% to 22.9%) and an increase in the control group's use (41.4% to 43.1%). Although we see a decrease in some strategy usage from baseline to follow-up in the intervention group (*adult stays in room* from 38.8 to 27.3%, and *watching TV/video at bedtime* from 2.7% to 0.6%), the changes are not statistically significantly different from those seen in the control group over the same time period ($p = 0.13$ and 0.10). For the negative strategy, *adult holding or rocking child*, both groups decreased usage (9.3% to 8.1% for the intervention group, and 12.3% to 9.0% for the control group), but the between-group difference was insignificant across this time period ($p=0.77$).

Though all media usage was reduced in both groups over time, the intervention did not have a significant effect on any media usage outcome relative to the control at these time points (see Table 3). At baseline, intervention and control groups had similar average duration of media use at 27.0 minutes and 28.1 minutes (27.6 and 25.5 SD intervention and control respectively). At three months, the intervention families used media for less time on average at 21.4 minutes (24.7 SD), while the control families used media for 28.6 minutes (25.7 SD) (p= 0.11). For the intervention group, screen blackout time changed from 7:25pm to 7:12pm (51.6 minutes and 50.4 minutes SD for T0 and T3 respectively). For the control group, screen blackout time changed from 7:20pm to 7.27pm (51.6 minutes and 54.6 minutes SD for T0 and T3 respectively), however the DiD analysis is insignificant (p=0.06).

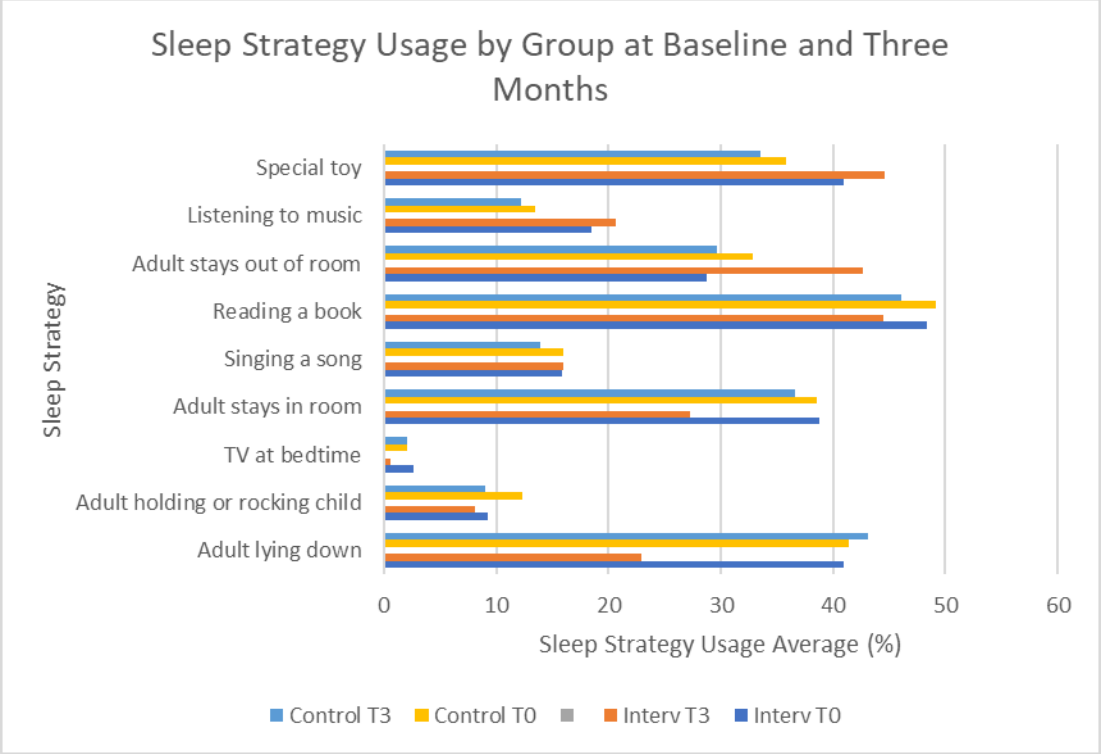

Fig 4. Percent of sleep strategy used by group at baseline and three months

Discussion

Sleep is an important part of proper childhood development, and parental skill building and involvement can facilitate that growth. This assessment seeks to bridge the gap in knowledge about these parental roles and examine the intervention's ability to encourage positive impacts on child sleep. We present findings from this assessment conducted three months into the parent RCT's intervention delivery. The overall estimates showed improvement in the intervention group's media use and sleep strategy behaviors from baseline to three months. Relative to the control group, the intervention was associated with a significant impact on two sleep strategies, the positive strategy, *adult stays out of the room*, and the negative strategy, *adult lying down*. Case managers specifically targeted these two sleep strategies as immediate goals for parents to implement suggesting the intervention's targeting of specific strategies influenced parents. The intervention was not associated with a significant impact on the other outcomes relative to the control group at these time points.

The point estimates from baseline to three months do suggest the intervention resulted in changed parental behavior in the intervention group, which is not seen in the control group across those time points. Duration of media use, screen blackout time, and percent of nights with any media use decreased for the intervention group but not relative to the control. This could be due to a regression to the mean as there could be general improvement in participants as a result of time regardless of the intervention's influence. In some instances, the control group behaviors seemed to worsen, such as mean media duration and average screen black out time. Regardless, our statistical analyses did not show significant improvement associated with the intervention for these outcomes and at these time points.

These findings could be due to being underpowered given our small sample size. Three months may also not be enough time to elicit behavior change, even given the differences seen in

the intervention group across time, or the intervention's effects may not be strong enough to be gauged in three months.

This study sought to determine whether a sleep hygiene intervention could moderate parental behavior mediating their child's media use and the sleep strategies used at their child's bedtime. We saw estimates that looked like improvement for two sleep strategies, but no significant improvement was observed for intervention participants relative to control on media use or other sleep strategies at these time points. These are not the primary outcomes for this parent study, and the other outcomes will be addressed in future papers.

It will be important to identify whether the positive impacts found within three months persist further along in the study. This is one of the first longitudinal sleep interventions examining parental behavior change. Further interventions must be implemented to examine impacts and efficacy trans-nationally and cross-culturally.

Table 1. Study Sample Characteristics

	Intervention Group	Control Group	p-value
Child Sex (%)			
Female	49.7%	44.7%	0.36
Age in months			
Mean (SD)	44.8 (10.5)	45.1 (10.4)	0.78
24-35 months (%)	22.1%	20.0%	0.95
36-47 months (%)	44.2%	43.8%	
48-59 months (%)	23.2%	24.4%	
60-71 months (%)	10.5%	11.9%	
Race/ethnicity (not mutually exclusive), %			
White	87.7	87.5	0.95
Black	2.23	5	0.17
Hispanic	11.2	9.4	0.59
Asian	13.9	18.1	0.30
Pacific Islander	0.56	3.1	1.77
Indigenous	2.23	2.5	0.87
No answer	1.12	1.25	0.91
Family demographics, %			
Married	93.4	95.0	0.52
Single	1.7	1.9	0.88
Divorced	2.8	1.9	0.59
In a relationship	1.1	1.9	0.56
Parent education, %			
High school or some university	15.5	14.9	0.39
4-year College degree	36.5	43.5	
Graduate or professional degree	48.1	41.6	
Family Income, %			
< $25K	2.8	4.4	0.67
$25-50K	4.4	6.3	
$50-75K	13.3	10.6	
$75-100K	15.6	18.8	
> $100K	63.9	60	
Child Media Use			
Child baseline evening media use (min)	27.0 (27.6)	28.1 (25.5)	0.73
Child Media Access in Bedroom, %			
No media in room	69.6	70.2	0.90
Media used in room, but not kept there	24.3	24.8	
Media kept in room	6.1	4.97	

Table 2. Mean % of nights each sleep strategy used by study arm and time

	Intervention Group		Control Group		
Sleep Strategy	T0 (%)	T3 (%)	T0 (%)	T3 (%)	I v. C p-value
Positive					
Special toy	41.0	44.6	35.8	33.5	0.35
Listening to music	18.5	20.6	13.5	12.2	0.53
Adult stays out of room	28.7	42.7	32.9	29.7	< 0.05
Neutral					
Reading a book	48.4	44.5	49.2	46.1	0.99
Singing a song	15.9	16.0	16.0	14.0	0.75
Adult stays in room	38.8	27.3	38.6	36.6	0.13
Negative					
Watching TV/Video	2.7	0.6	2.1	2.1	0.10
Adult holding or rocking child	9.3	8.1	12.3	9.0	0.77
Adult lying down	40.9	22.9	41.4	43.1	< 0.01

Table 3. Average media use results by dyad and timeframe

	Intervention		Control		
Media Time	T0	T3	T0	T3	p-value (Int v Control)
Duration (min)	27.0 (27.6)	21.4 (24.7)	28.1 (25.5)	28.6 (25.7)	0.11
Duration (%)					0.07
None	11.8	25.1	6.8	11.8	
1- 29mins	51.7	48.0	54.0	49.7	
30-59mins	27.0	17.3	27.3	24.8	
1 hr +	9.6	9.5	11.8	13.7	
Screen blackout time	7:25pm (51.6 min)	7:12pm (50.4 min)	7:20pm (51.6 min)	7:27pm (54.6 min)	0.056
Mean % of nights with any media use	53.8	44.1	56.6	53.0	0.20

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