A routine within a routine: can bedtime yoga improve sleep for the whole family?

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Abstract

Parents often point to bedtime as a source of frustration, yet early bedtimes and sufficient sleep are important for children's development, learning, and behavior. **Objectives:** The purpose of this pilot study was to evaluate the feasibility and preliminary effectiveness of a yoga-based bedtime in a sample of parent-child dyads from a rural community. **Methods**: Using a waitlist control study design, children aged 2-5 years and their parent were randomized to either intervention (yoga) or control (bedtime story) groups. Pre- and post-intervention measures were obtained using the CHAOS, CSHQ, and FNPA scales. Height, weight, and waist circumference were measured by trained research staff. Sleep and physical activity were measured by accelerometry. **Results**: Of 15 dyads who completed all assessments, 13 (81.2%) completed at least 16 yoga sessions. CSHQ score improved within both groups (Cohen's d 0.42 vs. 0.52 for intervention and control, respectively), and FNPA score improved in the intervention group (Cohen's d = 0.4). Number of sessions completed was inversely associated with change in CHAOS score ($r = -0.74$, $p = 0.003$). **Discussion**: Results show that a bedtime yoga routine is feasible for families of 2-5-year-old children, as evidenced by good adoption and adherence. Improvements in survey-based measures of sleep and household chaos suggest that a yoga-based routine may be slightly more effective than a story-based routine. These data provide preliminary support for further research designed to refine and test a yoga-based bedtime routine in a larger sample.

Introduction

The preschool years are characterized by sleep consolidation and changing sleep needs as children adapt to daily schedules that cease to include daytime naps. At this age, children should be sleeping 10-12 hours in a 24-hour period. [1] Children who get inadequate sleep experience cognitive and behavioral deficits that may ultimately conflict with the demands of daily life. [2] For younger children (aged 0-4 years) specifically, previous studies have shown an increased risk of overweight and obesity when children have shorter nighttime sleep. [3] Despite the apparent consequences of reduced sleep, achieving this nightly goal can oftentimes be difficult as sleep schedules have several contributing factors, such as caregiver temperament and family schedules.

Parents of young children often point to bedtime as a source of frustration in their homes. Yet, early bedtimes are important for achieving daily sleep recommendations and, therefore, children's development, learning, and behavior. Children need to wind down prior to bedtime because arousal can interfere with adequate sleep. [4] Previous studies have shown that children who were reported to be less calm, more restless, and more aroused during pre-sleep periods took longer to fall asleep. The less calm children were at bedtime, the later the bedtime, the later mid-sleep, and the later the wake time. [5] Contrary, routines are consistently associated with better sleep in early childhood. [6]

Household chaos, defined as general, situational factors that create excess noise, commotion (e.g., family members entering and leaving the home), and congestion within the home [7] may contribute to bedtime frustration. Examples of specific chaos vary, with common cases being noise, crowding, family instability, lack of routines, and unregulated screentime.[8] Most commonly, television noise has been reported as the greatest creator of household chaos. [9] As such, chaos has recently garnered attention as a possible mechanism explaining environmental risks related to childhood sleep and has negative consequences on nightly sleep schedule adherence. [10] Household chaos has been linked to increased cortisol levels and risk for obesity [11,12] and, therefore, may contribute to pre-bedtime arousal. By establishing a nightly routine, we may be able to reduce the effects of household chaos, restore stability within the household, and positively impact children's overall health and well-being.

Nighttime routines are valuable for reducing frustrations in the house and falling asleep. A bedtime routine may help regulate sleep time and the events leading up to it. In infants, toddlers, and preschool-aged children, those with a consistent bedtime routine report earlier bedtimes and more nighttime sleep. [13] Without a consistent routine, bedtime may be hectic for caregivers and lead to increased stress within the home. On the contrary, bedtime routines have significantly improved toddler mothers' moods, specifically tension, anger, fatigue, and confusion. [14] Previous studies have tested specific routines to increase the quality and quantity of childhood sleep. One study included a bath and massage within 30 mins of bedtime. This proposed routine did not result in a significant improvement in sleep latency throughout the intervention period. [15] Another study using a massage-only routine significantly reduced the number of nightly awakenings but did not improve any other sleep measures. [16] Despite the

efforts to establish an effective bedtime routine for children, interventions tested to date have made little progress. Perhaps the massage or bath time techniques are failing to successfully target the neurological influences of quality sleep, and a more effective method could be used. Alternatively, these techniques may be shorter than necessary or insufficient when used in isolation.

Though we know nightly routines are beneficial for reducing arousal, some routine components may be superior to others. Yoga, specifically, has been shown to reduce arousal by reducing sympathetic activation and increasing parasympathetic activation. [17] Gentle yoga reportedly decreases stress and improves psychological and physiological health in adults [18] as well as children. One study showed enhanced creativity, behavior control, and anger management after 10 weeks of a 30-minute-per-week classroom-based yoga intervention. [19] Research has also indicated that yoga is an effective modality for children with ADHD to reduce inattention and increase discrimination ability. [20] It is possible, then, that by increasing focus and limiting distractions, yoga may be helpful as a part of the bedtime routine.

Considering the recommendation for lengthy childhood sleep and the frustrations families often experience around bedtime, many groups have attempted to create a bedtime room to ease the transition from wakefulness to sleep. A yoga routine designed for bedtime use is a novel approach with the potential to help children (and parents) wind down more quickly and achieve a more restful night of sleep. Therefore, this pilot study aimed to evaluate the feasibility and preliminary effectiveness of a yoga-based bedtime intervention compared to a story-based control in a sample of parent-child dyads from a rural community.

Participants and Methods

Study Design

Participants in this study were children aged 2.0-5.9y and the parent/guardian who self-identified as the caregiver most involved in bedtime. Each dyad visited the lab on 6 occasions. Using a waitlist control design, dyads were randomized to either intervention (yoga) or control (bedtime story) groups. Parents completed a series of questionnaires at each study visit, and both children and parents underwent measurement of height, weight, and waist circumference. Sleep and physical activity were measured over one week via accelerometry. Families were enrolled between July 2019 and November 2021, with a pause from March 2020 – July 2021 due to the COVID-19 shutdown. Study flow and summarized assessments completed at each visit are shown in Figure 1. This study was approved by the [blinded for review] Institutional Review Board (IRB # 19-X-124). All parents provided written informed consent and children provided verbal assent prior to participation.

Questionnaires

Pre- and post-intervention measures were obtained using the Confusion, Hubbub, and Order Scale (CHAOS), Children's Sleep Habits Questionnaire (CSHQ), and Family Nutrition and Physical Activity tool (FNPA).

CHAOS. The Confusion, Hubbub, and Order Scale (CHAOS) [7] is a 15-question survey that assesses the participants' home environment. Using a 4-item scale ranging from strongly agree to strongly disagree, the parent rated statements regarding the temperament of the house. Statements included examples such as "We almost always seem to be rushed" and "It is a real zoo in our home." These statements aim to measure the amount of noise, confusion, clutter, hubbub, frenetic activities, and disorganization in the home. After completion, the test is scored using coding and reverse coding methods and summed. The higher the score, the more chaotic the home environment is.

Children's Sleep Habits Questionnaire (CSHQ). We used an abbreviated version of the CSHQ, originally developed for use with school-age children [21]. Parents reported their child's usual bedtime and wake time on weekdays and weekends, the amount they usually sleep each day, and the length of naps. Likert-scale questions further address child sleep characteristics, including the length of time it takes to fall asleep, frequency with which the child sleeps alone or in bed with a parent or sibling, and use of comfort strategies, including rocking, special objects, and additional bedtime supports. Child sleep quality is addressed via questions about night waking, restless sleeping, snoring, teeth grinding, daytime sleepiness, and whether the child wakes on their own. We used the total CSHQ score for this analysis; sleep time (min/night) was derived from accelerometry data.

Family Nutrition and Physical Activity Tool (FNPA). The FNPA includes 20 questions related to the family obesogenic environment; [22] questions address each of ten constructs, including family meals, family eating practices, food choices, beverage choices, restriction/reward, screen time/monitoring, healthy environment, family activity, child activity, and family schedule/sleep routine. Each construct is addressed by two questions scored on a 4-point Likert scale, and 6-items are reverse-coded. Individual question scores are summed to compute a total score where a higher score indicates a healthier family home environment. We used only the total FNPA score in this analysis.

Anthropometry. Parent and child height, weight, and waist circumference were measured by trained research staff. Height was measured to the nearest mm with the participant standing in sock feet on a portable stadiometer (Schorr Productions, Olney, MD, USA) with the head in the Frankfort plane. Weight was measured to the nearest 0.1kg on an electronic scale, ensuring pockets were empty and extra layers were removed. Waist circumference was measured to the nearest 0.1 cm at the level of the superior border of the iliac crest using a fabric measuring tape (Baseline Evaluation Instruments, White Plains, NY, USA). Parent BMI was calculated in kg/m^2, and child height, weight, and BMI percentiles and z-scores were determined using age- and sexy-specific CDC growth charts. [23] The primary investigator (EHG) trained all research assistants in anthropometric procedures and monitored measurement quality.

Assessment of Sleep and Physical Activity. Parents and children were fitted with an Actigraph GTX3+ worn on an elastic belt at the right hip. Participants were asked to wear the accelerometer 24 h/day for 7 days, removing it only for water activities and were specifically instructed to wear it during the daytime hours and overnight. Each parent received a log sheet to record bedtime, wake time, nap time, and any non-wear time for both parent and child each day. Accelerometry data was downloaded in 10-second epochs to Actilife v. 6.13.3 (Actigraph, LLC, Pensacola, FL), and wear time was evaluated for inclusion in data analysis (minimum wear time 4 days, 10 h/day). Physical activity was calculated using Evenson preschooler cut points for children or Freedson cut points for parents. Sleep was evaluated using the GGIR package in R (v 2.7-1). [24,25]

Intervention (Yoga group). Dyads randomized to the yoga (intervention) group were given the book Good Night Yoga by Miriam Gates and Sarah Jane Hinder [26] (illustrator; ISBN: 978-1-62203-466-6) and directed to incorporate it into their bedtime routine at least 4 nights per week for 4 weeks. Good Night Yoga is a bedtime story that talks children through the setting of the sun, the rising of the moon, and the night routines of other creatures while leading them through a series of yoga poses that begin standing in mountain pose and end on the floor in child's pose, calming the child as the story progresses. Parents received a bedtime diary where they could record the date, whether the child completed the yoga routine each evening, and share comments about their experience with the book. After 4 weeks, families returned to the lab for visit 3, at which they completed anthropometric assessments and questionnaires and were fitted with accelerometers to wear for the next week. Accelerometers were returned and downloaded a week later, and families were asked to continue using the yoga routine as often as they desired for the next 4 weeks (maintenance). Frequency of use was not tracked during the maintenance period. After 4 weeks of maintenance, families returned to the lab for visit 5, at which they completed assessments a third time and were fitted with an accelerometer for a final week of data collection. Accelerometers were returned and downloaded a week later at visit 6.

Waitlist Control (Story group). Dyads randomized to the control group were allowed to pick 1 of 6 picture books that they could choose to implement in their bedtime routine if desired, and study staff explained the importance of having a regular bedtime routine. They were asked to return to the lab in 4 weeks (visit 3), at which time they completed anthropometric assessments and questionnaires and were fitted with an accelerometer to wear for the following week. At visit 4, dyads returned their accelerometers and then "crossed over" to the intervention phase. Dyads in this group were given the same instructions described above and asked to return after 4 weeks for post-assessments (visits 5 and 6).

Statistical Analysis. Participant characteristics were summarized using means and standard deviations for continuous variables and frequencies for ordinal data. Questionnaires were scored according to their respective procedures and summarized using means and standard deviations. Changes in sleep, physical activity, CHAOS score, CSHQ score, and FNPA total score were calculated by subtracting visit 1 from visit 3 and visit 3 from visit 5. Paired t-tests were used to assess change between pre- and post-intervention scores for CHAOS, CSHQ, FNPA total

score, child physical activity, parent and child sleep, and baseline differences between the yoga and control groups. Pearson correlation was used to assess the relationship between change in CHAOS score and number of yoga sessions completed. As this was an exploratory analysis, significance was accepted at $p < 0.05$ for all analyses and adjustment for multiple comparisons was not performed. Finally, effect size (Cohen's d) was calculated for all pairwise comparisons. Analyses were conducted in SPSS v 29.0.

Results

As shown in Figure 2, 19 initial study visits were scheduled, and 17 dyads were enrolled. One dyad did not complete baseline assessments, and one dyad chose not to continue after baseline assessments were complete but before randomization. All 15 dyads that were randomized to a study condition completed the yoga intervention; maintenance data was not collected for one intervention family due to the timing of the COVID-19 shutdown.

Characteristics of the sample are presented in Table 1. Children were approximately 4 years of age, parents were 36.4 ± 4.8 y of age on average, and 94% identified as mothers. Most parents (53%) had education beyond a 4-year college degree. Adherence was assessed by the number of yoga sessions completed with a minimum target of 16 sessions. Thirteen (86.7%) of the dyads met or exceeded the 16-session target (mode = 20 sessions; 125.0% of target; Table 1). Child physical activity, whether expressed as moderate-to-vigorous (MVPA) or total (LMVPA), did not change significantly in either group (Table 2).

None of the child sleep variables changed significantly over the course of the intervention (Table 3), and as shown in Figure 3, considerable inter-individual variability existed in child sleep duration during both the intervention (Figure 3a) and control (Figure 3b) periods. Although there was a statistically significant change in parent sleep onset and parent WASO, effect sizes were small. Figure 4 illustrates the considerable inter-individual variability in parent sleep duration during both the intervention (Figure 4a) and control (Figure 4b) periods.

Survey results are shown in Table 4. Overall, the CSHQ total score improved with a moderately-large effect size in both groups (Cohen's d 0.42 vs. 0.52 for intervention and control, respectively; $p > 0.05$), and the FNPA score improved in the intervention group, but not control (Cohen's d = 0.4 vs. 0.04; $p > 0.05$). Although CHAOS score remained unchanged in both groups, correlation analysis showed that completing more sessions was associated with a more considerable decrease in CHAOS total score ($r = -0.76$, $p = 0.003$; Figure 5).

Parent comments collected as part of the intervention diaries indicate a broad range of child responses to the yoga routine (see Table 5). Many parents included positive comments about their child's/family's enjoyment of the nightly routine. In contrast, others commented that they were prevented from engaging in the routine by tantrums, their child's refusal to engage, or outside factors like sickness or getting home late. Some parents noted that engaging in a yoga

session calmed their child down after a long day or high arousal (i.e., tantrums), while some days, they noted that their child struggled with calming down and getting into the routine.

Discussion

Results of this pilot study suggest that implementation of a bedtime yoga routine is feasible for families of 2-5-year-old children, as evidenced by good adoption and adherence. Beyond feasibility, total CHSQ score improved in both groups, while FNPA score improved in the intervention group. Furthermore, completing more bedtime yoga sessions was associated with a larger decrease in total CHAOS score. These results support the notion that easing the transition from wakefulness to sleep can successfully improve child sleep. Engaging the family in a yoga-based bedtime routine may also positively impact the family obesogenic environment and lessen household chaos.

Contrary to our hypothesis, we did not observe a change in CHAOS score. However, correlation analysis did indicate that completing more yoga sessions was associated with a larger decrease in CHAOS total score. Chaos is thought to interfere with child sleep through several mechanisms. Disorganized, noisy environments contribute to parent stress [27–29] and child arousal and may reduce parental warmth and responsiveness. [30,31] Disorganized households may be characterized by people coming and going, talking over one another, or turbulent interactions, while households with lower levels of disorganization are more frequently described as calm, peaceful, and relaxing, and often have two parents present. [32] Given these characteristics, it may be expected that routines that help shift household dynamics from higher to lower disorganization could reduce both parent and child arousal and promote more positive, soothing interactions between parents and children.

Generally, routines help families peacefully transition between daily activities (e.g., from activity to mealtimes). [6] Bedtime may be an advantageous time to implement calming routines because it is a time of day that naturally lends itself to nurturing care. Implementation of a consistent bedtime routine is associated with improved maternal mood and maternal perception of child sleep quality. [14] Despite evidence that most families observe a consistent bedtime routine during infancy and early toddlerhood, far fewer families report following a routine nightly during the preschool years. [13] Even so, evidence suggests that following a routine some of the time is associated with better sleep outcomes, [13] suggesting that a 4-night-per-week routine should be enough to improve child sleep and parental perception of their child's sleep. This improvement in parental perception of their child's sleep is supported in our current work by the improvement in the CSHQ total score demonstrated in the intervention period.

During the early childhood years, bedtime routines featuring parental presence and parent/child contact are associated with improved child sleep quality and quantity and decreased child arousal as measured by salivary cortisol. [33] Quiet activities may also be important but are not clearly independent of the effects of parental contact and presence. Routines involving bath and massage, for instance, help improve infant and toddler sleep, [14]

though it is unclear whether improvements can be tied to those activities specifically or to the parental presence and contact more generally.

A yoga-based routine could contribute directly to reducing arousal by reducing sympathetic activation and increasing parasympathetic activation, both of which are important for a smooth transition from wakefulness to sleep. [33] Pre-sleep arousal, across cognitive and physiological domains, is clearly linked to insomnia among adults. [34,35] Cognitive arousal, characterized by worries and racing thoughts, may be directly lessened by the meditative aspects of yoga, where one focuses on the movement and the breath, allowing these thoughts to quiet. Physiological arousal, including high heart rate and muscle tension, is also likely to lessen because of gentle yoga. [17] Based on work by Hoyniak and colleagues in 2021, [5] we would expect those reductions in physiological arousal primarily to be associated with shortened sleep onset latency and, therefore, increased total sleep duration. Future evaluations of a yoga-based bedtime routine should include measures of pre-sleep arousal to confirm these hypotheses. Notably, in our study, several parent quotes referenced that the yoga routine helped children calm down (e.g., "after a temper tantrum, yoga calmed *[child]* down," and "…Everyone was wound up – it helped settle things"). However, other entries noted that "wired" and "riled up" children were distracted and struggled to engage, suggesting that the ability to engage the child in a structured yoga practice may be too difficult if the arousal is past a critical point.

Although we did not observe a change in actigraphic sleep measures amongst children or parents, survey measures of sleep quality improved in both the control and intervention periods. CHSQ total score and FNPA score each improved slightly from pre-post intervention, with a moderate effect size in both cases. One of the two questions on the FNPA that deal specifically with sleep addresses bedtime routines and, therefore, would be expected to improve if a family implemented a new routine. The questions on the CSHQ relate less specifically to a bedtime routine and more to necessary bedtime supports, consistency, ease of falling asleep, and waking or other signs of restlessness during the night. Thus, an improvement in this score would be expected to indicate an improvement in the wake-sleep transition, the quality of the child's nighttime sleep, or the child's demeanor upon waking in the morning. Taken together, these findings suggest that implementing the bedtime routine spurred some noticeable change in the child's transition to sleep and/or sleep quality, as perceived by the parents.

Strengths and Limitations

Our results are limited by the small pilot sample. Although the small sample limits our ability to draw generalizable conclusions, we maximized the usability of the data by employing a waitlist control design. We showed that families could follow the yoga-based routine, which may be influenced by our participants' relatively high education and socioeconomic status. Our findings are strengthened by data obtained from the sleep diaries, which supports excellent adoption and adherence to the prescribed routine. The open-ended comments parents included present additional, rich data that can be used to refine and strengthen the intervention going forward.

Overall, our findings support further research specifically designed to test the effectiveness of a yoga-based bedtime routine, in comparison to other routine structures, for improving both child and parent sleep. Future studies should include measurements of physiological arousal, including measures of sympathetic and parasympathetic activation, to begin elucidating the mechanism of action.

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Contributors: LMC contributed to analysis, visualization, writing the original draft, and reviewing and editing the final draft. CB contributed to project administration, data collection, data management, project administration, data quality, and review and editing of all drafts. JW contributed to conceptualization, methodology, data collection, and review and editing of the final draft. BW contributed to methodology, data collection, data quality, project administration, and review & editing of the final draft. EHG contributed to conceptualization, methodology, project administration, resources, supervision, validation, writing the original draft, and review & editing of the final draft.

Data sharing: Data are available from the corresponding author upon reasonable request.

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Table 1. Participant Characteristics. Values are mean (SD) unless otherwise indicated. Groups represent initial randomization; data are from baseline visit.

	All	Yoga	Story	p
Children	17	8	7	
Age (y)	4.0 (1.0)	3.78 (0.9)	4.1 (1.1)	0.532
Height (cm)	98.8 (12.4)	99.0 (8.9)	96.8 (17.2)	0.763
Weight (cm)	16.7 (2.3)	15.8 (2.5)	17.3 (1.9)	0.224
Waist (cm)	49.3 (3.4)	49.4 (3.6)	48.6 (3.6)	0.704
Parents				
Age (y)	36.4 (4.8)	37.5 (4.4)	35.6 (4.6)	0.426
Height (cm)	162.8 (7.6)	161.9 (8.4)	165.9 (6.2)	0.328
Weight (cm)	73.8 (14.5)	71.9 (10.2)	74.1 (19.2)	0.792
Waist (cm)	86.4 (11.6)	84.0 (9.0)	86.1 (14.0)	0.732
Sessions completed	--	18 (112.5%)	20 (125.0%)	0.324

Table 2. Children's physical activity pre- and post-yoga intervention. Values are mean (SD); effect size is represented by Cohen's d point estimate.

Children	Pre	Post	Post-Pre	p	Effect
MVPA (min/day)					
Intervention (n=17)	63.8 (28.6)	60.8 (31.3)	-2.4 (16.7)	0.620	0.147
Control (n=6)	67.9 (17.0)	70.0 (22.7)	2.15 (16.2)	0.758	-0.133
LMVPA (min/day)					
Intervention	257.1 (79.1)	240.6 (93.6)	-16.5 (94.5)	0.558	0.174
Control	288.7 (45.4)	279.8 (46.6)	-8.84 (46.2)	0.659	0.191

MVPA = moderate-to-vigorous physical activity; LMVPA = light-moderate-vigorous physical activity

Table 3. Child and parent sleep measured by accelerometer pre- and post- yoga intervention. Values are mean (SD); effect size is Cohen's d point estimate.

Children	**Pre**	**Post**	**Post-Pre**	**p**	**Effect**
Sleep onset (time)					
Intervention (n=10)	21.45 (0.74)	21.39 (1.16)	-0.06 (1.0)	0.09	0.061
Control (n=6)	21.04 (0.69)	21.03 (0.37)	-0.01 (0.54)	0.97	0.015
Sleep duration (h)					
Intervention	7.87 (0.47)	7.97 (0.87)	0.10 (1.03)	0.76	-0.092
Control	7.72 (1.09)	7.95 (0.44)	0.24 (1.16)	0.64	-0.204
WASO					
Intervention	1.24 (0.37)	1.48 (0.28)	0.24 (0.39)	0.37	-0.604
Control	1.28 (0.25)	1.32 (0.46)	0.04 (0.23)	0.70	-0.168
Parent	**Pre**	**Post**	**Post-Pre**	**p**	**Effect**
Sleep onset (time)					
Intervention (n=10)	*22.60 (1.02)*	*22.48 (0.73)*	*-0.12 (0.75)*	*0.03*	*0.160*
Control (n=5)	21.76 (0.56)	21.56 (0.83)	-0.204 (0.40)	0.49	0.509
Sleep duration (h)					
Intervention	7.52 (0.67)	7.37 (0.73)	-0.16 (0.69)	0.12	0.225
Control	7.61 (1.03)	7.22 (0.38)	-0.384 (1.14)	0.32	0.338
WASO					
Intervention	*0.68 (0.22)*	*1.13 (0.86)*	*-0.45 (0.72)*	*0.02*	*-0.633*
Control	0.64 (0.24)	0.65 (0.18)	0.654 (0.182)	0.84	-0.098

WASO = wakings after sleep onset

Table 4. Total scores for CHAOS, CSHQ, and FNPA pre- and post-yoga intervention. Values are mean (SD); effect size is Cohen's d point estimate.

	Pre	Post	Post-Pre	p	Effect
CHAOS					
Intervention	40.1 (2.5)	39.8 (2.9)	-0.4 (3.5)	0.643	0.132
Control	40.0 (3.0)	39.7 (2.6)	-0.3 (4.6)	0.874	0.062
CSHQ mean					
Intervention	3.2 (0.7)	2.9 (0.6)	-0.1 (0.3)	0.178	0.416
Control	3.4 (0.8)	3.3 (0.8)	-0.2 (0.3)	0.222	0.515
FNPA					
Intervention	63.6 (7.8)	64.0 (6.7)	0.9 (2.2)	0.211	-0.403
Control	65.3 (6.4)	65.1 (6.9)	-0.1 (3.1)	0.909	0.045

CHAOS = confusion, hubbub, and order scale, total score; CSHQ = children's sleep habits questionnaire, mean score; FNPA = family nutrition and physical activity tool, total score

Table 5. Summarized quotes from sleep diaries parents completed throughout the intervention period.

Theme	Meaning	Evidence
Positive reception	The family experienced enjoyment from the yoga routine.	- Child was excited throughout book. Only stumbled on 2 poses! Big hugs after! - We are getting the hang of our new routine! Loving the extra affection too! - Whole family participated; she wanted to do twice - Excited to show Grandma how to do yoga - Brother participated and did quite well! - Went great! We learned all the moves! - Used back of book guide. Child picked lots of fave poses and talked about each one! - *[Child]* reminded *[parent]* to do the book before bed - They want to know if they get bonus points for 5 nights.
Reluctance	The child did not want to participate for unknown reasons.	- *[Child]* lost interest halfway through - Just didn't want to - *[Child]* chose not to participate until the end - Temper tantrums all evening. Only participated in Moon and Bee pose - Child very distracted but did some deep breathing - He started, then laid straight on the floor and said he was too tired + we couldn't get him to finish. - Child just wanted to go to bed - They were bonkers- running into each other and into each other between moves.
Outside factors	Some outside factor prevented the child/family from completing the yoga routine.	- Stomachache, not feeling well - Sick, asleep before bedtime - Got home late - Fell asleep in car - Finding the cats derailed yoga - Stayed with grandparents - Struggle. She had dance class and just didn't want to do it
Effectiveness	Feedback indicated the yoga routine was effective in assisting bedtime routines.	- After a temper tantrum, yoga calmed *[child]* down - Restless at bedtime, but slept through night 8-7am - Calmed them before bed - Seems to really help when she's had a long day at school - Good wind down as she was excited for school tomorrow - Easier, but still lengthy - Did with twins. Everyone was wound up - it helped settle things
Ineffectiveness	Feedback indicated the yoga routine was ineffective in assisting bedtime routines.	- Turned into dance party - Kids were riled up and giggled through it - Very hard bedtime - took hours

		- Still pretty playful after. 45 mins to sleep - She watched me. Hard to calm down - Child pretty distracted - *[Child]* did it all! Bedtime took >1 hr. Yikes - Took a break b/c they'd been so wound up.
Yoga favorites	Miscellaneous comments.	- When we got to the "Bee", he started singing bumble bee song, didn't finish - He has certain favorites - He wants to do more than others - Child specifically requested the part where he was floating on the cloud because he loves that - *[Child]* tries so hard to do bird and tree - Child is a pro and "Bee" pose had toots today! Hehe - Child likes to crawl on mom during child pose

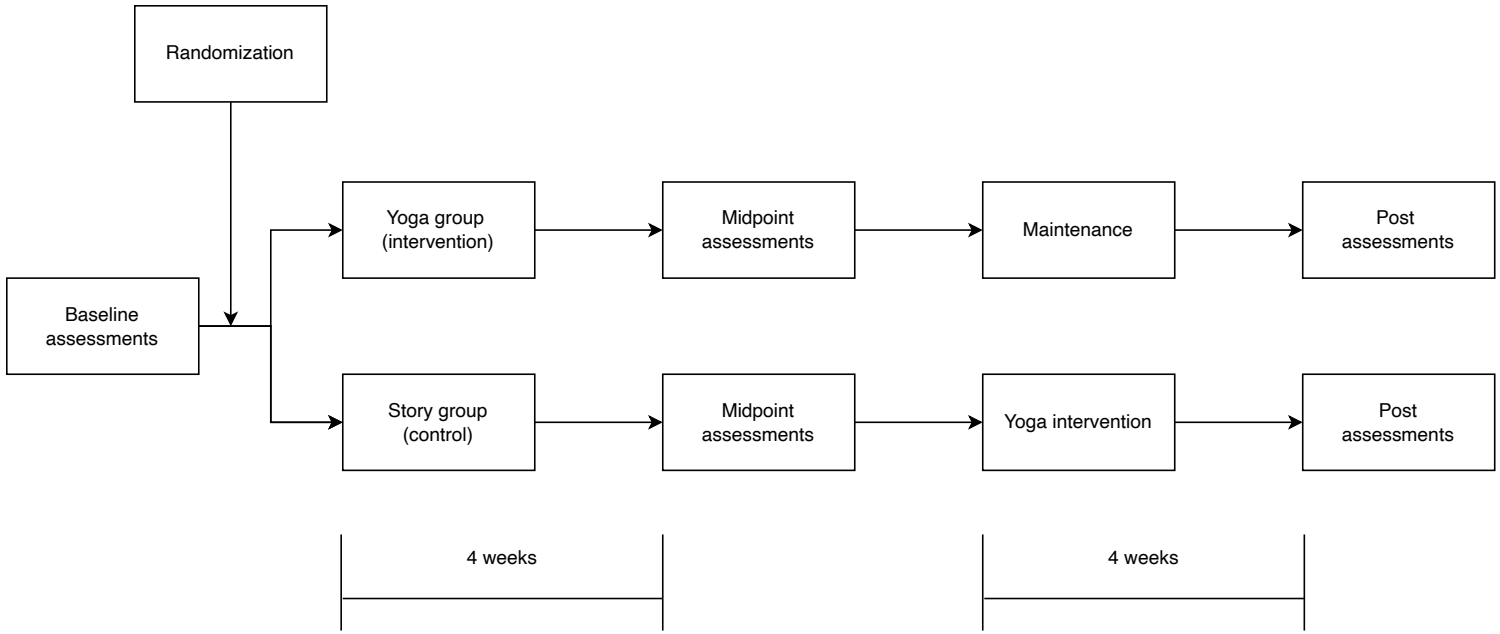

Randomization
Baseline assessments
Yoga group (intervention)
Midpoint assessments
Maintenance
Post assessments
Story group (control)
Midpoint assessments
Yoga intervention
Post assessments
4 weeks
4 weeks

Figure 1. Depiction of study flow. Assessments were completed over a one-week period at baseline, midpoint, and post. Intervention periods were 4 weeks each.

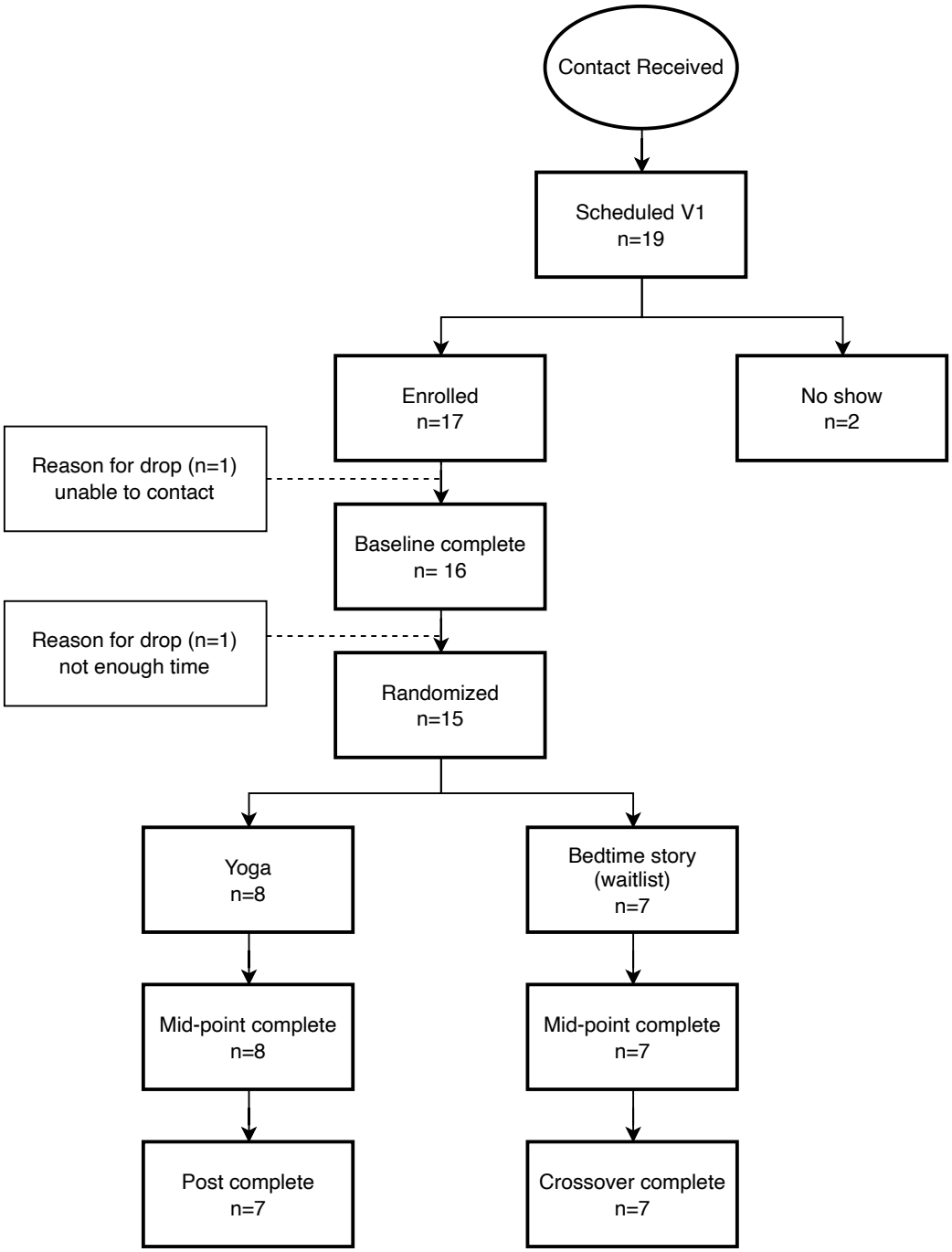
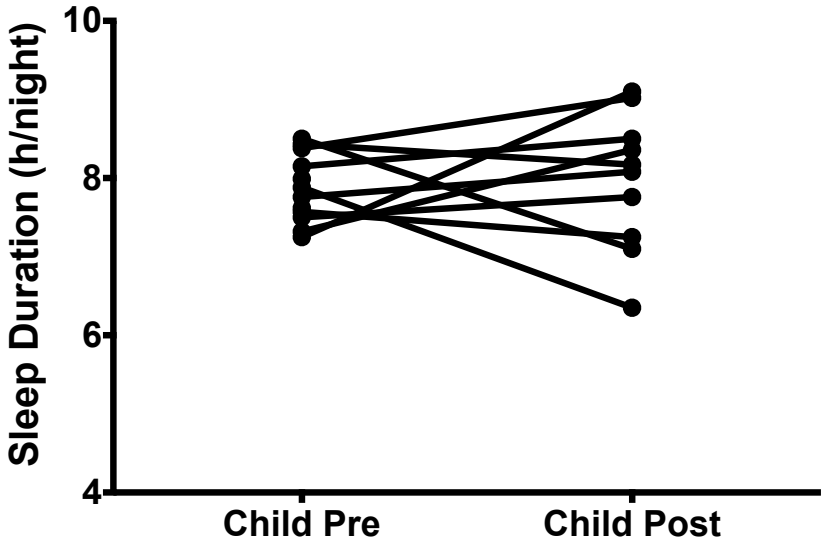

Contact Received
Scheduled V1
n=19
Enrolled
n=17
No show
n=2
Reason for drop (n=1)
unable to contact
Baseline complete
n= 16
Reason for drop (n=1)
not enough time
Randomized
n=15
Yoga
n=8
Bedtime story
(waitlist)
n=7
Mid-point complete
n=8
Mid-point complete
n=7
Post complete
n=7
Crossover complete
n=7

Figure 2. CONSORT diagram of participant flow.


Sleep Duration (h/night)
10
8
6
4
Child Pre
Child Post

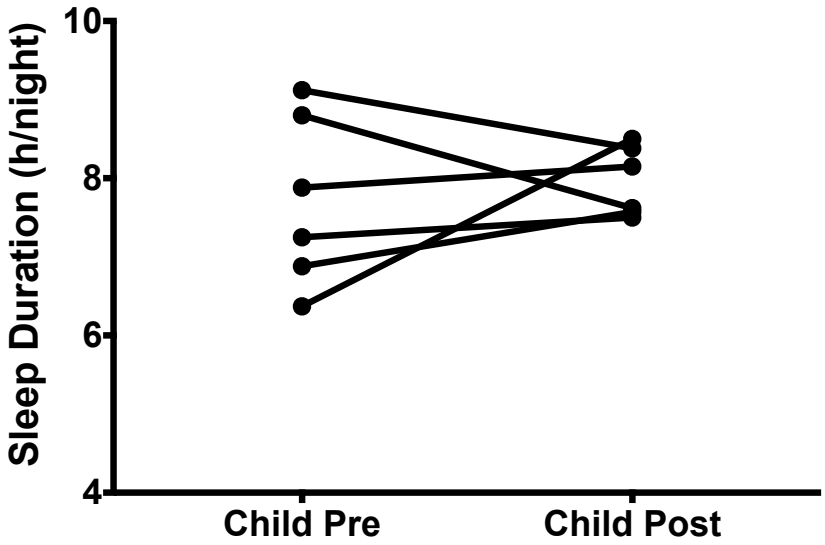
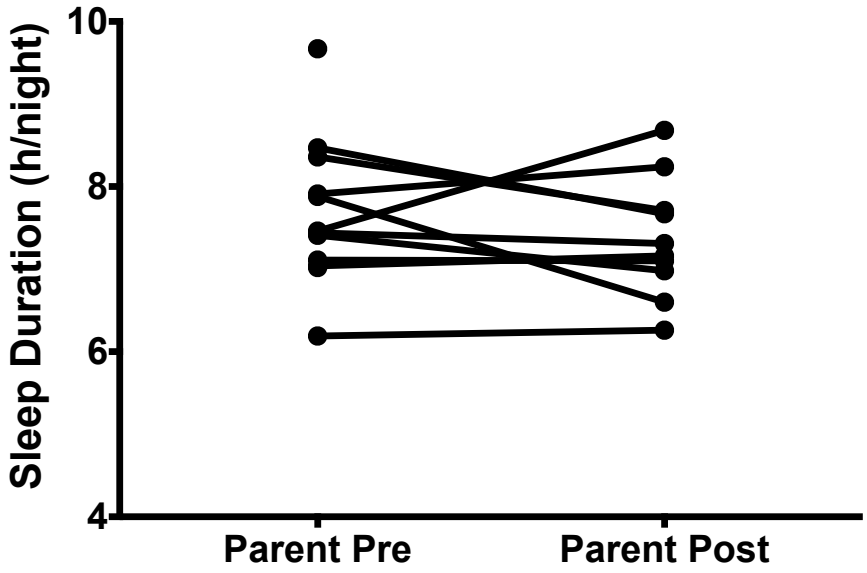

Sleep Duration (h/night)
10
8
6
4
Child Pre
Child Post

Figure 3. Sleep duration pre- and post-intervention among children in the intervention group, (a; top) vs. control (b; bottom), measured by accelerometer.


Sleep Duration (h/night)
10
8
6
4
Parent Pre
Parent Post

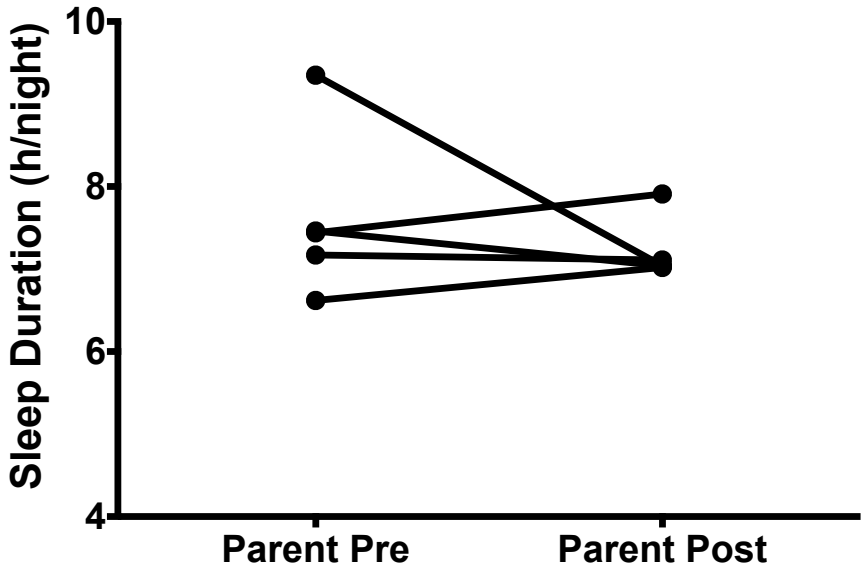

Sleep Duration (h/night)
10
8
6
4
Parent Pre
Parent Post

Figure 4. Sleep duration pre- and post-intervention among parents in the intervention group (a; top) vs. control (b; bottom), measured by accelerometer.

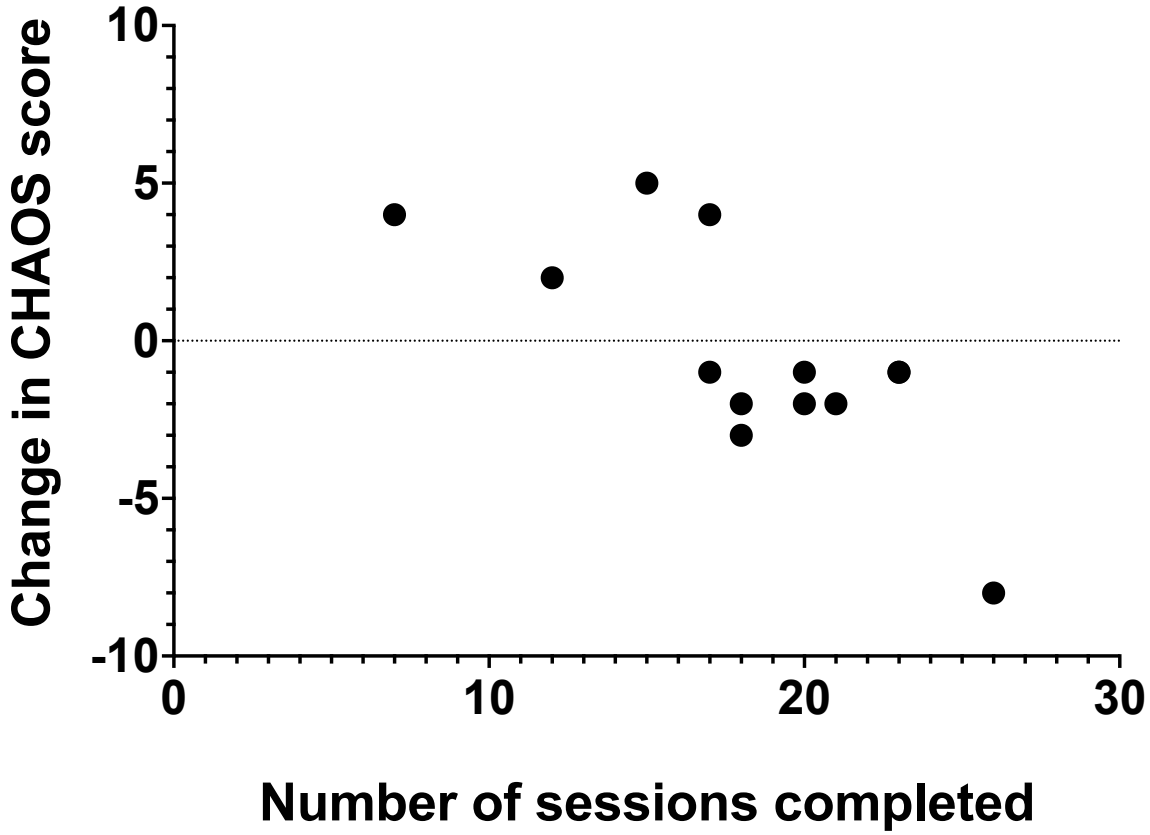

Change in CHAOS score
10
5
0
-5
-10
0
10
20
30
Number of sessions completed

Figure 5. Correlation between number of yoga sessions completed and change in CHAOS score. $r = -0.74$, $p = 0.003$