Evaluation of a Womb-Like Sensory Intervention to Improve Infant Sleep

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BACKGROUND

Nearly half of parents (47%) report moderate to severe infant sleep problems during the first six months of their child's life.[1] These sleep problems can trigger a cascade of negative effects among caregivers, including marital stress, postpartum depression and anxiety, obesity, breastfeeding failure, unsafe sleeping practices, car accidents, illness, and failure at work.[2-6] Maternal depression has been shown to exacerbate infant sleep problems well into preschool age.[7] This bi-directional cycle may cause long-lasting family discord, stress, and strife.

Reducing infant sleep problems may significantly improve maternal mental health and functioning of the entire family, although interventions to improve infant sleep and settling have demonstrated limited benefit.[8-13] However, parents have often observed that baby sleep is immediately extended when the infant is rocked in a rocking chair or driven in a car. This observation has been buttressed by multiple studies showing that three womb-like stimuli – swaddling, white noise, and rhythmic motion – improve infant sleep, soothe fussing, and have an additive benefit when used in combination.[14-16]

We compared infant sleep from birth to six months of age occurring in cribs and bassinets relative to infant sleep occurring in SNOO, a responsive bassinet that provides these womb-like conditions. We measured total night sleep duration (7p-7a), longest night sleep period (7p-7a), and frequency of night waking (10p-6a) to determine whether, and to what extent, SNOO improves infant sleep.

OBJECTIVES

SNOO is a responsive bassinet intended for infants age 0-6 months (Figures 1 & 2). It provides continuous womb-like sensations, including gentle, rhythmic rocking and low-level white noise, to improve a baby's sleep and reduce fussing. The infant is placed in the SNOO sleep sack (a swaddle with wings on either side) that attaches to safety clips, securing the infant on the back for all sleep.

Figure 1. SNOO Bassinet

Figure 2. SNOO swaddle

When its sensors detect crying, SNOO's embedded computer and algorithm guide the bed through a series of 4 incrementally higher levels of motion (i.e., faster, shorter amplitude) and sound (i.e., higher volume and pitch). This is modeled on the typical calming sequence used by experienced caregivers. SNOO often calms fussing in under 1 minute. If the baby calms, SNOO gradually returns to the baseline level. However, if crying persists for more than 3 minutes, the bed automatically turns off.

SNOO is a Wi-Fi connected device and provides real-time, continuous data. This study evaluates infant sleep logs to compare the total sleep duration, longest sleep period, and number of sleep interruptions of infants (0-6 months) in SNOO relative to published studies of normative infant sleep.

METHODOLOGY

Sleep logs from 18,024 infants from August 2017 to May 2019 were filtered to eliminate subjects who: 1) started SNOO >1 week after birth; 2) used SNOO for <6 months; 3) used SNOO <6 hours/night; and/or, 4) had sleep periods >13 hours (a sign the bed may have been kept on, without a baby inside). The baby was assumed to be asleep in the bassinet if SNOO was on and remained at the baseline setting between 7p-7a.

A cohort of 7,157 babies met the filtering criteria. Their total night sleep, longest period of night sleep, and frequency of night waking were compared to a compilation of 14 peer-reviewed studies of normative infant sleep published over the past two decades. The mean and standard deviation of each study was weighted by sample size and combined to calculate sleep metrics for the reference population. Total night sleep duration was defined as the total time spent sleeping between 7p and 7a. Longest night sleep period was defined as the maximum uninterrupted sleep between 7p and 7a. Night awakenings represent the number of times SNOO increased level or stopped between 10p and 6a.

After filtering, mean and standard deviation of these three sleep metrics were calculated by age of the baby in months. Welch's T-test was used to calculate significance values by comparing the means of sleep metrics between SNOO babies and babies sleeping in traditional bassinets.

Table 1. Comparative Studies for Normative Infant Sleep

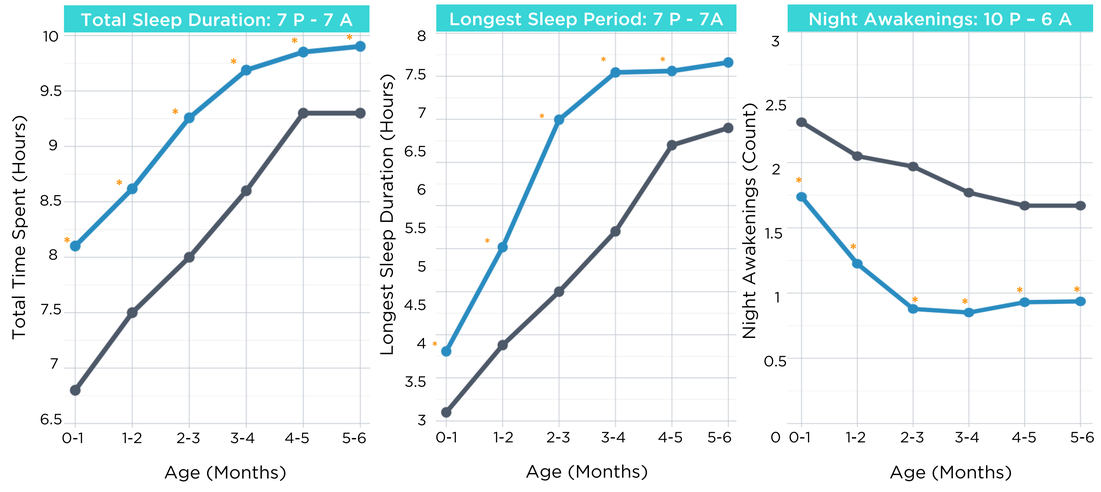
Study	Total Sleep Duration Criteria	Longest Sleep Period Criteria	Night Waking Criteria
Aarts, et. al. (1999)[17]	---	Longest interval between feedings	---
Ahn, et. al. (2016)[18]	7 PM – 7 AM	BISQ	BISQ
Burnham, et. al. (2002)[19]	Not specified	Not specified	---
Figueredo, et. al. (2017)[20]	8 PM – 8 AM	8 PM – 8 AM	8 PM – 8 AM
Kent, et. al. (2013)[21]	---	Longest interval between feedings	---
Henderson, et. al. (2011)[22]	---	Avg. across studies	---
Henderson, et. al. (2010)[23]	---	Not specified	---
Mindell, et. al. (2016)[24]	6 PM – 7 AM	---	---
Montgomery-Downs, et. al. (2006)[25]	Not specified	---	Varies; depends on bedtime of babies
Paul, et. al. (2016)[26]	7 PM – 7 AM	---	---
Perkin, et. al. (2018)[27]	7 PM – 7 AM	---	BISQ
Sadeh (2004)[28]	7 PM – 7 AM	---	BISQ
Sadeh, et. al. (2009)[29]	7 PM – 8 AM	Typical Night	BISQ
Teng, et. al. (2011)[30]	7 PM – 7 AM	BISQ	BISQ

RESULTS

For each month across the 6-month collection period, infants in SNOO experienced improved sleep: total night sleep duration increased (33 min. – 1 hour 24 min.); longest night sleep period increased (42 min. – 2 hour 0 min.); and night waking occurred one fewer time per night (1.09 ± 0.89 vs 1.89 ± 1.10).

The improvements in all three sleep metrics were statistically significant with $p<0.0005$ across all ages as compared to the reference population.

- Babies in traditional infant beds/bassinets*
- U.S. Babies in SNOO
- * $p < 0.0005$



*Average expected sleep based on literature

CONCLUSIONS

The study has several limitations. First, the consolidated metrics from published sleep studies relied on different definitions of "nighttime period" and sleep measures. Additionally, the meta-analysis did not control for the variable sample size, prematurity, and demographics of the study populations. Most importantly, the movement of the bed was used as a surrogate for the infant's sleep, which may overestimate night sleep (baby is awake in bed) or underestimate it (baby was asleep in another location with the bed off). It is recommended that future studies examine objective sleep data and control for sociodemographic differences between the control and experimental populations.

Despite these limitations, the scale of the study and high level of significance suggest that SNOO substantially improves infant sleep compared to babies sleeping in the relatively sensory-deprived environment of traditional cribs or bassinets.

We believe that – by improving infant sleep – this intervention may significantly reduce parental stress and multiple negative infant and caregiver health outcomes associated with reduced infant sleep.